Curriculum Book

and

Assessment and Evaluation Scheme

based on

Outcome Based Education (OBE)

and

Choice-Based Credit System (CBCS)

in

Bachelor of Technology

B. Tech. (Cement Technology)

4 Year Degree Program

Revised as on 01 August 2023

Applicable w.e.f. Academic Session 2023-24

AKS University

Faculty of Engineering & Technology

Department of Cement Technology

Satna 485001, Madhya Pradesh, India

न हि ज्ञानेन सदृशं

पवित्रमिह विद्यते।

-श्रीमद्भगवद्गीता-

Forwarding

I am thrilled to observe the updated curriculum of the Cement Technology Department for B.Tech. Cement Technology Program, which seamlessly integrates the most recent technological advancements and adheres to the guidelines set forth by AICTE. The revised curriculum also thoughtfully incorporates the directives of NEP-2020 and the Sustainable Development Goals.

The alignment of course outcomes (COs), Programme Outcome (POs) and Programme specific outcomes (PSOs) has been intricately executed, aligning perfectly with the requisites of NEP-2020 and NAAC standards. I hold the belief that this revised syllabus will significantly enhance the skills and employability of our students.

With immense satisfaction, I hereby present the revised curriculum for the B. Tech. in Cement Technology program for implementation in the upcoming session.

Aksa

Er. Anant Soni
Pro Chancellor & Chairman
AKS University, Satna

From the Desk of the Vice-Chancellor

AKS University is currently embarking on a transformative journey to revamp its curriculum with an outcome-based approach, aiming to enhance the teaching and learning processes. The foundation of quality education lies in implementing a curriculum that aligns with both societal and industrial needs, focusing on relevant outcomes. This requires dedicated and inspired faculty members and impactful industry internships.

Our mission begins by crafting an outcome-based curriculum in collaboration with academia and industry experts. This curriculum design is informed by the latest technological advancements, market demands, the guidelines outlined in the National Education Policy (NEP) of 2020, and sustainable goals.

I am delighted to announce that the revised curriculum has been meticulously crafted by the Cement Technology Department, in consultation with an array of experts from the cement industry, research institutes, and academia. This curriculum effectively integrates the principles outlined in the NEP-2020 guidelines and sustainable goals, while incorporating the latest advancements in cement manufacturing technology.

The curriculum is tailored to address the specific needs of the Indian cement industry, focusing on the production of cost-effective, high-quality cement. It extends its reach to optimizing power consumption by including insights on waste heat recovery systems utilized in cement plants. This inclusion not only imparts knowledge but also encourages students' independent thinking for potential enhancements in this area.

Beyond theoretical learning, the curriculum embraces practical applications by incorporating the utilization of industrial and domestic waste in cement production. To enhance students' skills, the curriculum integrates hands-on training, industrial visits, and on-job training experiences. This well-rounded approach ensures that students receive a comprehensive education, fostering their skill development and preparing them for success in the cement industry.

I am confident that the updated curriculum for cement technology will significantly enhance students' technical skills and contribute to their employability. Throughout the revision process, the Cement Technology Department has diligently adhered to the guidelines provided by the AICTE, maintaining a total credit requirement of 169 for the B. Tech Cement Technology program.

Curriculum revision is an ongoing and dynamic process, designed to address the continuous evolution of technological advancements and both local and global concerns. This ensures that the curriculum remains responsive and attuned to the changing landscape of education and industry.

AKS University warmly invites input and suggestions from industry experts, technocrats, and alumni to enhance the curriculum and make it more student-centered. Your valuable insights will greatly contribute to shaping an education that best serves the needs and aspirations of our students.

BAChopade

Professor B. A. Chopade
Vice-Chancellor,
AKS University, Satna

Preface

As part of our commitment to ongoing enhancement, the Department of Cement Technology consistently reviews and updates its B.Tech. Cement Technology program curriculum every three years. Through this process, we ensure that the curriculum remains aligned with the latest technological advancements, as well as local and global industrial and social demands.

During this procedure, the existing curriculum for the B.Tech. Cement Technology Program undergoes evaluation by a panel of technocrats, industry specialists, and academics. Following meticulous scrutiny, the revised curriculum has been formulated and is set to be implemented starting from August 01, 2023. This implementation is contingent upon the endorsement of the curriculum by the University's Board of Studies and Governing Body.

This curriculum closely adheres to the AICTE model syllabus distributed in May 2023. It seamlessly integrates the guidelines set forth by the Ministry of Higher Education, Government of India, through NEP-2020, as well as the principles of Sustainable Development Goals. In order to foster the holistic skill development of students, a range of practical activities, including Hands-On Training, Industrial Visits, Project planning and execution, Report Writing, Seminars, and Industrial On-Job Training, have been incorporated. Furthermore, in alignment with AICTE's directives, the total credit allocation for the B. Tech Cement Technology program is capped at 169 credits.

This curriculum is enriched with course components in alignment with AICTE guidelines, encompassing various disciplines such as Fundamental Science Concepts: 24 credits, Engineering Science: 25 credits, Humanities and Social Sciences: 12 credits, Core Program Courses: 66 credits, Elective Program Courses: 9 credits, Open Electives: 9 credits, Project and Practical Training: 17 credits, Seminars: 3 credits, Indian Knowledge System: 2 credits, Sustainable Development Goals: 2 credits.

To ensure a comprehensive learning experience, detailed evaluation schemes and rubrics have also been meticulously provided.

For each course, a thorough mapping of Course Outcomes, Program Outcomes, and Programme Specific Outcomes has been undertaken. As the course syllabus is being meticulously developed, various elements such as session outcomes, laboratory instruction, classroom instruction, self-learning activities, assignments, and mini projects are meticulously outlined.

We hold the belief that this dynamic curriculum will undoubtedly enhance independent thinking, skills, and overall employability of the students.

Professor G C Mishra
Director (Cement Technology)
AKS University, Satna

01 August 2023

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum & Syllabus of B.Tech. (Cement Technology) program

(Revised as on 01 August 2023)

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Faculty of Engg. & Tech.
A.K.S. University Satna (M.P.)

Dean
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Professor B.A. Chopade
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Satna, 485001 (M.P.)

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Introduction:

AKS University proudly stands as a pioneer, being the first in the nation to introduce a comprehensive 4-year B. Tech program in Cement Technology back in 2012. This innovative curriculum has been meticulously crafted to align with the dynamic needs of the cement industry and the most current technological advancements. Currently, a vibrant community of 99 students is actively engaged in pursuing their B. Tech in Cement Technology within this department. The Cement Technology department boasts cutting-edge laboratories that serve as hubs for immersive hands-on training, enabling students to delve into practical applications of their learning. The program incorporates both in-plant training and sandwich apprenticeship training, vital components that enrich the educational journey. Distinguished by a faculty composed of cement industry experts who bring with them a wealth of industrial experience, the department combines robust classroom instruction with practical and industrial acumen. This unique blend empowers our students to confidently contribute to cement plants and make a significant impact in the field.

Vision:

To conduct its key programs and activities in a unique manner that promotes excellence and leadership in education, research, innovation in cement technology and fosters an environment that is safe, highly productive, cooperative and collegial, and dedicated to continual improvement.

Mission:

M 01 : Achieve academic excellence in Cement Technology through an innovative teaching-learning process.

M 02 : Application of sustainable cleaner technology in cement manufacture without compromising quality.

M 03: Inculcate technical competence and collective discipline in students to excel for cement manufacturing units, higher education and societal needs.

M 04 : Establish focus research groups in leading areas of cement technology for optimization of thermal and electrical energy in cement manufacture and environmental needs.

PROGRAM EDUCATIONAL OBJECTIVES (PEO)

PEO 01: To develop technical and managerial skills among the students with practical knowledge to work in cement manufacturing unit and able to handle day to day plant problems.

PEO 02: To develop R&D temperament among the students for development, innovation and sustainable technology in cement manufacturing process.

POE 03 : To develop ethical principles among the students and commitment to fulfilling international, national and local needs and social responsibilities with his/her professional excellence.

PEO 04 : Ability to understand the impact of professional engineering solutions in societal, economic and environmental contexts and demonstrate knowledge and need for sustainable development

Program Outcomes (POs)

B Tech Cement Technology Graduate will able to perform:

PO 1: .Engineering **knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO 2: **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO 3: **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO 4: **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO 5: **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO 6: **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO 7: **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO 8: **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO 9: **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO 10: **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO 11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO 12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

On completion of B. Tech. Cement Technology program, the students will achieve the following program specific outcomes: -

PSO 1: The ability to apply technical & engineering knowledge for production quality cement with the available raw material resource.

PSO 2: Ability to understand the day to plant operational problems of cement manufacture and provide economical solution to enhance the production without compromising quality of cement.

PSO 3: Ability to understand the latest cement manufacturing technology and it application in conservation of electrical and thermal energy in Portland cement manufacture.

PSO 4 : Ability to use the research based innovative knowledge for sustainable development in cement manufacture.

Consistency/Mapping of PEOs with Mission of the Department

PEO	M 1	M 2	M 3	M 4
PEO 1	3	2	3	2
PEO 2	2	2	2	3
PEO 3	2	3	2	1
PEO 4	2	2	3	3

1*: Slight (Low) 2: Moderate (Medium) 3: Substantial (High) "-": No correlation*

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GENERAL COURSE STRUCTURE & THEME

1. Definition of Credit

1 Hr. Lecture (L) per week	1 Credit
1 Hr. Tutorial (T) per week	1 Credit
2 Hours Practical (P) per week	1 Credit

2. Range of Credits:

In the light of the fact that a typical Model Four-year Under Graduate degree program in Engineering has about 160 credits, the total number of credits proposed for the four-year B. Tech. in Cement Technology is kept as 169 considering NEP-20 and NAAC guidelines.

3. Structure of UG Program in Cement Technology:

The structure of UG program in Cement Technology shall have essentially the following categories of courses with the breakup of credits as given:

Components of the Curriculum
(Program curriculum grouping based on course components)

Sl No	Course Component	% of total number of credits of the Program	Total number of Credits
1	Basic Sciences (BSC)	14.20	24
2	Engineering Sciences (ESC)	14.79	25
3	Humanities and Social Sciences (HMSC)	7.10	12
4	Program Core (PCC)	39.05	66
5	Program Electives (PEC)	5.33	9
6	Open Electives (OEC)	5.33	9
7	Project(s) (PRC)/ On job Plant Training (OJT)	10.06	17
9	Seminar (PSC)	1.78	3
10	Indian Knowledge System	1.18	2
11	Sustainable Development Goal	1.18	2
	Total	100.00	**169**

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General Couse Structure and Credit Distribution
Curriculum of B.Tech. Cement Technology

Semester -I		Semester - II	
Course Title	Credit	Course Title	Credit
1. Physics-1	3:1:2 = 5	1. Chemistry-1	3:0:2 = 4
2. Mathematics-1	3:1:0 = 4	2. Mathematics-2	3:1:0 = 4
3. Biology for Engineers	3:0:0 = 3	3. Programming for Problem Solving	3:0:4 = 5
4. Basic Electrical Engineering	2:1:2 = 4	4. Manufacturing Practice Workshop	1:0:4 = 3
5. Engineering Graphics & Design	1:0:4 = 3	5. Communication Skills (English)	3:0:0 = 3
6. Design Thinking & Idea Lab	0:0:2 = 1	6. Sports and Yoga	2:0:0 = 0
7. Introduction to Portland Cement	3:0:0 =3	7. Sustainable Development Goals	2:0:0 = 2
8. Indian Knowledge System	2:0:0 = 2		
Total Credit	**25**	**Total Credit**	**21**
Semester -III		**Semester - IV**	
Course Title	Credit	Course Title	Credit
1. Process Calculation	3:1:0 = 4	1. Heat Transfer & Mass Transfer	3:1:0 = 4
2. Mathematics-3	3:1:0 = 4	2. Thermodynamics	3:1:2 = 5
3. Environment Science (Audit)	2:0:0 = 0	3. Raw Mix Design & Cement Chemistry	3:1:0 = 4
4. Basic Electronics Engineering	3:1:2 = 5	4. Size Reduction & Commination Engineering	3:1:0 = 4
5. Engineering Mechanics	3:1:0 = 4	5. Geology and Mining of Limestone	3:1:0 = 4
6. Fluid Mechanics	3:1:2= 5		
7. Universal Human Values-2	2:1:0 = 3		
Total Credit	**25**	**Total Credit**	**21**
Semester -V		**Semester - VI**	
Course Title	Credit	Course Title	Credit
1. Total Quality Management	3:0:0 = 3	1. Instrumentation Process Control	3:1:0 = 4
2. Pyro processing & Clinker Manufacture	3:1:0 = 4	2. Maintenance Practices in Cement Plant	3:1:0 = 4
3. Pollution Control in Cement Plant	3:1:0 = 4	3. Optimization Technique	3:1:0 = 4
4. Fuel and Alternate Fuel & Raw Materials	3:1:0 = 4	4. Material Handling System, safety and Occupational Health	3:1:0 = 4
5. Cement Tech Lab-I	0:0:2 = 1	5 Cement Tech Lab-II	0:0:2 = 1

(Raw Materials and Fuel Testing)		(Testing Cement & Concrete)	
6. HSS/Management Elective -I	3:0:0 = 3	6 HSS/Management Elective-2	3:0:0 = 3
7. Open Elective -I	3:0:0 = 3	7 Engineering Project- 1(Literature Review)	1:0:2 = 2
Total Credit	**22**	**Total Credit**	**22**
Semester -VII		**Semester - VIII**	
Course Title	Credit	Course Title	Credit
1. Professional Elective-1	3:0:0 = 3	Engineering Project-3 (Prototype & Testing) / On job plant training	0:0:24 = 12
2. Professional Elective-2	3:0:0 = 3		
3. Open Elective-2	3:0:0 = 3		
4. Open Elective-3	3:0:0 = 3		
5. Engineering Project-2 (Design &Analysis)	0:0:10 = 5		
6. Seminar	0:0:2 = 1		
7. Professional Elective -3	3:0:0 = 3		
Total Credit	**21**	**Total Credit**	**12**

i. **Humanities & Social Sciences & Mgt. Electives (HSM):** Any 2 courses from the list of those offered.

ii. **Open Electives (OEL)**: Any 3 courses (from any department), based on individual interest and project.

iii. **Industry internship**: Internship in industry, start-up or R&D lab in 2nd/3rd year summer is compulsory (audit). Longer internship for 6-monthy (12 credits) can be taken in VIIIth semester, in lieu of Engineering Project. The internship must be properly evaluated.

Total Credit: 169

Course code and definition:

L = Lecture
T = Tutorial
P = Practical
C = Credit
BSC = Basic Science Courses
ESC = Engineering Science Courses
HSMC = Humanities and Social Sciences including Management courses
PCC = Professional core courses
PEC = Professional Elective courses
OEC = Open Elective courses
LC = Laboratory course
MC = Mandatory courses

IKS = Indian Knowledge System
SDGs = Sustainable Development Goals

Course level coding scheme:
Three-digit number (odd numbers are for the odd semester courses and even numbers are for even semester courses) used as suffix with the Course Code for identifying the level of the course. Digit at hundred’s place signifies the year in which course is offered. e.g.
101, 102 … etc. for first year.
201, 202 …. Etc. for second year.
301, 302 … for third year.
401. 402--- for Fourth year

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Category-wise Courses

HUMANITIES & SOCIAL SCIENCES COURSES [HS] & MANAGEMENT COURSES (2 compulsory + 2 others)

(i) Number of Humanities & Social Science Courses: 4, Credits: 12

Sl.	Code No.	Subject	Semester	Credits
1	HSMC01	Communication Skills / English (Compulsory	2	3:0:0 =3
2	HSMC- 301	Universal Human Values-2 (Compulsory course)	3	2:1:0 =3
3	HSMC- 302	Industrial Psychology	5	3:0:0 =3
4	HSMC- 303	Operations Research	5	3:0:0 =3
5	HSMC-304	Project Management	6	3:0:0 =3
6	HSMC-305	Finance & Accounting	6	3:0:0 =3
7	HSMC09	Sports and Yoga	2	2:0:0 =0
			Total Credits:	**12**

BASIC SCIENCE COURSE [BSC] (TOTAL 7)

Sl.	Code No.	Subject	Semester	Credits
1	BSC101/ BSC101-L	Physics-1 (Electromagnetism)	1	3:1:2 =5
2	BSC102	Mathematics-1 (Calculus & Linear Algebra)	1	3:1:0 =4
3	BSC103/ BSC103-L	Chemistry-1	2	3:0:2 =4
4	BSC104	Mathematics-2 (ODE, Complex variables)	2	3:1:0 =4
5	BSC201	Mathematics-3 (PDE, Prob/Stat)	3	3:1:0 =4
6	BSC105	Biology for Engineers	1	3:0:0 =3
7	BSC106-AU	Environment Science (Audit)	3	2:0:0 =0
			Total Credits:	**24**

ENGINEERING SCIENCE COURSE [ESC] (Total 7)

Sl.	Code No.	Subject	Semester	Credits
1	ESC101/ ESC101-L	Basic Electrical Engineering	1	2:1:2 =4
2	ESC102/ ESC102-L	Engineering Graphics & Design	1	1:0:4 =3
3	ESC103-L	Design Thinking + Idea Lab (Audit)	1	0:0:2 =1
4	ESC104/ ESC104-L	Programming for Problem Solving	2	3:0:4 =5
5	ESC105/ ESC105-L	Manufacturing Practice Workshop	2	1:0:4 =3
6	ESC201/	Basic Electronic Engineering	3	3:1:2 =5

	ESC201-L			
7	ESC202	Engineering Mechanics	3	3:1:0 =4
			Total Credits:	**25**

PROFESSIONAL CORE COURSES [PCC] (Total 18)

Sl.	Code No.	Subject	Semester	Credits
1.	PCC-CT101	Introduction to Portland Cement	1	3:0:0 = 3
2.	PCC-CT201	Process Calculation	3	3:1:0 =4
3.	PCC-CT202 PCC-CT202-L	Fluid Mechanics	3	3:1:2 =5
4.	PCC-CT203 PCC-CT203-L	Thermodynamics	4	3:1:2 =5
5.	PCC-CT204	Heat Transfer & Mass Transfer	4	3:1:0 =4
6.	PCC-CT205	Raw Mix Design & Cement Chemistry	4	3:1:0 =4
7.	PCC-CT206	Size Reduction & Comminution Engineering	4	3:1:0 =4
8.	PCC-CT207	Geology & Mining of Limestone Deposit	4	3:1:0 =4
9.	PCC-CT301	Pyro processing & Clinker Manufacture	5	3:1:0 =4
10.	PCC-CT302	Fuel and Alternate Fuel & Raw Materials	5	3:1:0 =4
11.	PCC-CT303	Pollution Control in Cement Plant	5	3:1:0 =4
12.	PCC-CT304	Total Quality Management	5	3:0:0 =3
13.	PCC-CT305-L	Cement Tech Lab-I ((Raw Materials and Fuel Testing)	5	0:0:2 =1
14.	PCC-CT306	Instrumentation & Process Control	6	3:1:0 =4
15.	PCC-CT307	Maintenance Practices in cement Plant	6	3:1:0 =4
16.	PCC-CT308	Optimization Technique	6	3:1:0 =4
17.	PCC-CT309	Material Handling System, Safety & Occupational Health of Cement Plant	6	3:1:0 =4
18.	PCC-CT310-L	Cement Technology lab -II (Testing Cement & Concrete)	6	0:0:2 =1
			Total Credits:	**66**

PROFESSIONAL ELECTIVE [PEC]

Total 3 to be taken, at least one from each group – Technology and Industry Sector, based on Project topic and individual interest. Illustrative courses are listed here

Sl.	Code No.	Subject	Semester	Credits
		TECHNOLOGY GROUP		
1	**PEC-CT-01**	Energy Audit in Cement plant	7	3:0:0 =3
2	**PEC-CT-02**	Transport Phenomena	7	3:0:0 =3
3	**PEC-CT-03**	Special Cements	7	3:0:0 =3
		INDUSTRY SECTOR GROUP		
1	PEC-CT-04	Design of Cement Plant	7	3:0:0=3
2	**PEC-CT-05**	Marketing of Cement	7	3:0:0 =3
3	**PEC-CT-06**	Refractory Engineering	7	3:0:0 =3
		Total Credit		**9**

OPEN ELECTIVE

(Total 3 from the Open elective subjects)

Sl.	Code No.	Subject	Semester	Credits
1	OE-CT01	Carbon Credit in Cement Manufacture	5	3:0:0=3
2	**OE-CT02**	EIA & EMP of Cement Plant	7	3:0:0=3
3	**OE-CT03**	Industrial Economics	7	3:0:0=3
4	**OE-CT04**	Concrete Technology	5	3:0:0=3
5	**OE-CT05**	Beneficiation of Low-grade limestone	7	3:0:0=3
6	**OE-CT06**	Reaction Engineering	7	3:0:0=3
Total Credit				**9**

RESEARCH PROJECT (3 Stages)

Sl.	Code No.	Subject	Semester	Credits
1	PROJ-CT01	Engineering Project-1 (Literature Review)	6	0:0:4=2
2	**PROJ-CT02**	Engineering Project-2 (Design & Analysis)	7	0:0:10=5
3	**PROJ-CT03**	Seminar	7	0:0:2=1
4	**PROJ-CT04**	Engineering Project-3 (Prototype & Testing)/ On job plant Training	8	0:0:24=12
Total Credit				**20**

OTHER COURSES

Sl.	Code No.	Subject	Semester	Credits
1	HSMC08	Sustainable Development Goals	2	2:0:0 =2
2	**HSMC07**	Indian Knowledge System	1	2:0:0= 2
Total Credit				**04**

Induction Program

Induction program for students to be offered right at the start of the first year. It is mandatory. AKS University has designed an induction program for 1st year student, details are below:

i. Physical activity
ii. Creative Arts
iii. Universal Human Values
iv. Literary
v. Proficiency Modules
vi. Lectures by Eminent People
vii. Visits to local Areas
viii. Familiarization to Dept./Branch & Innovations

Mandatory Visits/ Workshop/Expert Lectures:

i. It is mandatory to arrange one industrial visit every semester for the students.

ii. It is mandatory to conduct a One-week workshop during the winter break after fifth semester on professional/ industry/ entrepreneurial orientation.

iii. It is mandatory to organize at least one expert lecture per semester for each branch by inviting resource persons from industry.

Evaluation Scheme:

1. For Theory Courses:
i. The weightage of Internal assessment is 50% and
ii. End Semester Exam is 50%
The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

2. For Practical Courses:
i. The weightage of Internal assessment is 50% and
ii. End Semester Exam is 50%
The student has to obtain at least 40% marks individually both in internal assessment and end semester exams to pass.

3. For Summer Internship / Projects / Seminar etc.
Evaluation is based on work done, quality of report, performance in viva-voce, presentation et

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Semester wise Course Structure

Semester wise Brief of total Cerits and Teaching Hours

Semester	L	T	P	Total Hour	Total Credit
Semester -I	17	03	10	30	25
Semester -II	17	01	10	28	21
Semester -III	19	6	4	29	25
Semester - IV	15	05	02	22	21
Semester -V	18	03	02	23	22
Semester -VI	15	04	06	25	22
Semester - VII	15	0	12	27	21
Semester -VIII	0	0	24	24	12
Total	116	22	70	208	169

Details of Semester Wise Course Structure

Semester – I

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	BSC	BSC101/ BSC101-L	Physics-1	3	1	2	6	5
2	BSC	BSC102	Mathematics-1	3	1	0	4	4
3	BSC	BSC105	Biology for Engineers	3	0	0	3	3
4	**ESC**	ESC101/ ESC101-L	Basic Electrical Engineering	2	1	2	5	4
5	**ESC**	ESC102/ ESC102-L	Engineering Graphics & Design	1	0	4	5	3
6	**ESC**	ESC103-L	Design Thinking & Idea Lab	0	0	2	2	1
7	**PCC**	PCC-CT101	Introduction to Portland Cement	3	0	0	3	3
8	**IKS**	HSMC07	Indian Knowledge System	2	0	0	2	2
			Total	17	3	10	30	25

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Semester – II

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	BSC	BSC103/ BSC103-L	Chemistry-1	3	0	2	5	4
2	BSC	BSC104	Mathematics-2	3	1	0	4	4
3	ESC	ESC104/ ESC104-L	Programming for ProblemSolving	3	0	4	7	5
4	**ESC**	ESC105/ ESC105-L	Manufacturing PracticeWorkshop	1	0	4	5	3
5	HSMC	HSMC01	Communication Skills (English)	3	0	0	3	3
6	SDG	HSMC08	Sustainable Development Goal	2	0	0	2	2
7	AU	HSMC09	Sports and Yoga	2	0	0	2	0
Total				17	1	10	28	21

Semester – III

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	**PCC**	PCC-CT201	Process Calculation	3	1	0	4	4
2	**BSC**	BSC201	Mathematics-3	3	1	0	4	4
3	**ESC**	ESC201/ ESC201-L	Basic Electronics Engineering	3	1	2	6	5
4	**ESC**	ESC202	Engineering Mechanics	3	1	0	4	4
5	**PCC**	PCC-CT202 PCC-CT202-L	Fluid Mechanics	3	1	2	6	5
6	**BSC**	BSC106-AU	Environment Science (Audit)	2	0	0	2	0
7	HSMC	HSMC- 301	Universal Human Values-2	2	1	0	3	3
Total				19	6	4	29	25

Semester – IV

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	**PCC**	PCC-CT204	Heat Transfer & Mass Transfer	3	1	0	4	4
2	**PCC**	PCC-CT203 PCC-CT203-L	Thermodynamics	3	1	2	6	5
3	**PCC**	PCC-CT205	Raw Mix Design & Cement Chemistry	3	1	0	4	4
4	**PCC**	PCC-CT206	Size Reduction & Commination Engineering	3	1	0	4	4

5	**PCC**	PCC-CT207	Geology and Mining of Limestone	3	1	0	4	4
Total				15	5	2	22	21

Semester – V

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	**PCC**	PCC-CT304	Total Quality Management	3	0	0	3	3
2	**PCC**	PCC-CT301	Pyro processing & Clinker Manufacture	3	1	0	4	4
3	**PCC**	PCC-CT303	Pollution Control in Cement Plant	3	1	0	4	4
4	**PCC**	PCC-CT302	Fuel and Alternate Fuel & Raw Materials	3	1	0	4	4
5	**PCC**	PCC-CT305-L	Cement Tech Lab-I (Raw Materials and Fuel Testing)	0	0	2	2	1
6	HSMC	HSS/Management Elective -I	HSMC-302 Industrial Psychology HSMC-303 Operations Research	3	0	0	3	3
7	**OEC**	Open Elective -I	OE-CT01 Carbon Credit in Cement Manufacture OE-CT04 Concrete Technology	3	0	0	3	3
Total				18	3	2	23	22

Semester – VI

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	**PCC**	PCC-CT306	Instrumentation Process Control	3	1	0	4	4
2	**PCC**	PCC-CT307	Maintenance Practices in cement Plant	3	1	0	4	4
3	**PCC**	PCC-CT308	Optimization Technique	3	1	0	4	4
4	**PCC**	PCC-CT309	Material Handling System, Safety and Occupational Health in cement plant	3	1	0	4	4
5	**PCC**	PCC-CT310-L	Cement Technology Lab-II (Testing Cement & Concrete)	0	0	2	2	1
6	HSMC	HSS/Management Elective-2	HSMC-304 Project Management HSMC-305 Finance & Accounting	3	0	0	3	3
7	PROJ	PROJ-CT01	Engineering Project- 1 (Literature Review)	1	0	2	3	2
Total				16	4	4	24	22

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Semester VII

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
Choose any 3 PEC course for the list Given below-								
1	PEC	PEC	Professional Elective-1	3	0	0	3	3
			Professional Elective-2	3	0	0	3	3
			Professional Elective -3	3	0	0	3	3
2	OEC	Open Elective -II	OE-CT02 EIA & EMP of Cement Plant	3	0	0	3	3
			OE-CT03 Industrial Economics					
3	OEC	Open Elective -III	OE-CT05 Beneficiation of Low-grade limestone	3	0	0	3	3
			OE-CT06 Reaction Engineering					
4	PROJ	PROJ-CT02	Engineering Project-2 (Design &Analysis)	0	0	10	10	5
5	SEM	PROJ-CT03	Seminar	0	0	2	2	1
Total				15	0	12	27	21

PROFESSIONAL ELECTIVE [PEC]

Sl.	Code No.	Subject *TECHNOLOGY / INDUSTRY SECTOR* GROUP	Semester	Credits
1	**PEC-CT-01**	Energy Audit in Cement plant	7	3:0:0 =3
2	**PEC-CT-02**	Transport Phenomena	7	3:0:0 =3
3	**PEC-CT-03**	Special Cements	7	3:0:0 =3
4	PEC-CT-04	Design of Cement Plant	7	3:0:0=3
5	**PEC-CT-05**	Marketing of Cement	7	3:0:0 =3
6	**PEC-CT-06**	Refractory Engineering	7	3:0:0 =3
Total Credit				**9**

Semester VIII

SN	Category	Code	Course Title	L	T	P	Total Hour	Credit
1	PROJ/ OJT	PROJ-CT04	Engineering Project-3 (Prototype & Testing)/ On job plant Training in Cement Plant	0	0	24	24	12
Total				**0**	**0**	**24**	**24**	**12**

Total credit: 169

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Semester I

Course Code: **BSC 101/ BSC 101-L**

Course Title : **Physics-I**

Pre- requisite: Students should review the fundamentals of Electrostatics Magneto statics. Wave optics, and Modern physics.

Rationale: The program aims to develop advanced problem-solving and analytical skills and prepares students for careers in academia, research, industry, or other sectors that require advanced physics expertise.

Course Outcomes:

BSC 101.1

Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems and to relate to applications to electron optic device and CRO.

BSC 101.2

Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.

BSC 101.3

Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem.

BSC 101.4

Recall the basic concepts of crystal structure and apply them in solving numerical problems based on them in relating to applications for determination of crystal structure

BSC 101.5

Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
BSC	BSC 101	Physics-1	4	2	1	1	8	5

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
BSC	BSC 101	Physics -I	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA (VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
BSC	BSC 101-L	Physics –I Lab	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

BSC 101.1

Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	6
SW	1
SL	2
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: Understand the concept of Electric charge electric field intensities. **SO1.2:** Understand the electrostatic potential, Calculation of electric field and electrostatic potential for a charge distribution **SO1.3:** Understand the Dielectrics, Dielectric substance in an electric field **SO1.4:** Understand Biot Savart law & its application **SO1.5:** Understand the magnetic materials.	**1.** Measuring the magnetic field for a straight conductor and on circular conductor loops **2.** Measuring the magnetic field for a straight conductor and on circular conductor loops at small currents 3. Measuring the magnetic field for a straight conductor and on Straight Wire -	**Unit-1: Electrostatics & Magnetostatics** 1.1 Electric charge electric field intensities 1.2 Electrostatic potential, Calculation of electric field and electrostatic potential for a charge distribution 1.3 Introduction to. Quantization & conservation of charge 1.4 Coulomb's law, vector form of Coulomb's law 1.5 superposition principle, charge densities, electric field 1.6 Dielectrics, Dielectric substance in an electric field, 1.7 V-I phase dependence for ideal & real dielectrics 1.8 Biot Savart law & its application 1.9 current carrying conductor	**SL.1** Define Electric charge electric field intensities **SL.2** Define Quantization & conservation of charge

		moving charge in a magnetic field 1.10 comparison of electric field and magnetic field 1.11 magnetic induction and intensity, magnetization 1.12 classification of magnetic materials.	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Analyze and sketch the graph of a V-I phase dependence for ideal & real dielectrics
ii. Calculation of electric field and electrostatic potential for a charge distribution
iii. Apply Biot Savart law in different problems.

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

C. Other Activities (Specify):

Quiz, Class Test.

BSC 101.2: Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.

Approximate Hours

Item	Appx Hrs
CI	12
LI	6
SW	1
SL	2
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1: Define and understand the basic concepts of coherent sources, etc **SO2.2:** Define and understand the basic	**1.** To determine the Refractive Index of Prism by using spectrometer.. **2.** To determine the wavelength of sodium light by using Newton's	**Unit-2: Wave optics** 2.1 coherent sources, principle of superposition 2.2 Interference:-, definition and types of interference 2.3 Interference from parallel	**SL.1** Define coherent sources, principle of superposition. **SL.2** Define Fresnel

concepts of Interference of light. **SO2.3:** Understand the Michelson's Interferometer, experiments and their applications **SO2.4:** Define and understand the basic concepts of diffraction of light. **SO2.5:** Understand dispersive power of grating and,resolving power of grating.	Ring apparatus **3.** To determine the wavelength of prominent lines of mercury by plane transmission diffraction grating	thin films 2.4 wedge shaped films 2.5 Newton's rings 2.6 Michelson's Interferometer, experiments and their applications 2.7 Michelson's Interferometer, experiments and their applications 2.8 Diffraction:- Fresnel diffraction 2.9 Fraunhofer diffraction from a single slit diffraction 2.10 double slit diffraction 2.11 N-Slit Diffraction grating 2.12 dispersive power of grating and,resolving power of grating.	diffraction , Fraunhofer diffraction from a single slit diffraction.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Write the application of Interference of light in daily life.
ii. Write the application of diffraction of light in daily life.
iii. Write a short note on Newton's rings with example.
iv. Describe the method of calculation of Michelson's Interferometer with example

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

BSC 101.3: Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem

Approximate Hours

Item	Appx. Hrs
CI	12
LI	6
SW	1
SL	2

Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Define Quantum mechanics. **SO3.2** Understand the Wave particle duality **SO3.3** Explain operators in quantum mechanics. **SO3.4** Understand Uncertainty principle with elementary proof and applications **SO3.5** To Understand Time-dependent and time independent Schrodinger equation for wave function.	1. To determine Planck's Constant and work function using photo electric effect. 2. Davisson–Germer experiment - this showed the existence of electron matter waves and that they would be diffracted by a crystal 3. Compton effect - evidence for particle nature of light -	**Unit-3: Quantum mechanics** 3.1 Introduction to Quantum mechanics 3.2 Wave particle duality 3.3 de-Broglie's concept of matter waves 3.4 Free-particle wave function and wave-packets 3.5 Phase & Group velocities and their relationship 3.6 Compton Effect 3.7 Uncertainty principle with elementary proof and applications 3.8 Uncertainty principle with elementary proof and applications 3.9 operators 3.10 Time-dependent and time independent Schrodinger equation for wave function. 3.11 Time-dependent Schrodinger equation for wave function. 3.12- time independent Schrodinger equation for wave function	**SL.1** Define Wave particle duality. **SL.2** Define operators in quantum mechanics.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Write the Application of Uncertainty principle with elementary proof in real life.
ii. Explain the difference between Time-dependent and time independent Schrodinger equation for wave function.
iii. Write the properties of wave-packets.
iv. Define Phase & Group velocities.

b. Mini Project:

Oral presentation

C. Other Activities (Specify):
Quiz, Class Test.

BSC 101.4: Recall the basic concepts of crystal structure and apply them in solving numerical problems based on them in relating to applications for determination of crystal structure

Approximate Hours

Item	Appx. Hrs
CI	12
LI	6
SW	1
SL	2
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1: Understand the Free electron theory of metals **SO4.2:** Understand the Fermi level of Intrinsic and extrinsic **SO4.3:** Understand the Kronig-Penney model and origin of energy bands. **SO4.4:** Understand the intrinsic & extrinsic semiconductor **SO4.5:** Understand the tunnel diode, and it's applications	1.To draw the characteristics curve of p-n junction. 2.To draw the characteristics curve of Zener diode 3.Study the temperature dependence of resistivity of a semiconductor (Four probe method) and to determine band gap of experimental material (Ge).	**Unit-4: Introduction to solids & semiconductors** **4.1** Free electron theory of metals **4.2** Fermi level of Intrinsic and extrinsic **4.3** Kronig-Penney model (no derivation) and origin of energy bands. **4.4** Classification of conductors, semiconductors and insulators on the basis of energy band theory **4.5** Classification of conductors, semiconductors and insulators on the basis of energy band theory **4.6** Semiconductors and it's classification **4.7** Semiconductors and it's classification **4.8** Intrinsic & extrinsic semiconductor **4.9** P-N junction	**SL.1** Define Free electron theory of metals **SL.2** Define semiconductors and it's classification.

		4.10 Zener diode **4.11** Tunnel diode, and it's applications, Hall effect **4.12** Tutorial	

SW-4 Suggested Sessional Work (SW):
a. Assignments:

1. Explain Kronig-Penney model and origin of energy bands.
2. Explain free electron theory of metals.
3. Explain Hall Effect with example.

b. Mini Project:
Oral presentation,

C. Other Activities (Specify):
Quiz, Class Test.

BSC 101.5: Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	6
SW	1
SL	2
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1: Understand and state the Fundamental properties of laser beam **SO5.2:** Understand and state the Einstein's theory of matter radiation	1. To study the intensity distribution due to diffraction from single slit and to determine the slit width. 2. Study the	**Unit-5: Lasers** 5.1 Absorption 5.2 Stimulated and Spontaneous emission 5.3 coherence, pumping, population Inversion 5.4 Principle & properties of laser	**SL.1** Define Absorption, Stimulated and Spontaneous emission, coherence, pumping, population Inversion.

interaction and A and B coefficients **SO5.3:** Understand the different types of lasers **SO5.4:** Understand Solid-State laser (Ruby & Nd-YAG) **SO5.5:** Understand applications of lasers in science, engineering and medicine.	characteristics of led and laser sources. 3. Energy gap of a material of p-n junction	beam 5.5 Einstein's theory of matter radiation interaction and A and B coefficients 5.6 different types of lasers: gas laser (He-Ne), 5.7 different types of lasers: gas laser (He-Ne), 5.8 Solid-State laser (Ruby & Nd-YAG) 5.9 solid-state laser (Ruby & Nd-YAG) 5.10 applications of lasers in science, engineering and medicine. 5.11 applications of lasers in science 5.12 applications of lasers in engineering and medicine.	**SL.2** Define Principle & properties of laser beam.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Write the Principle & properties of laser beam.
ii. Write the applications of lasers in science, engineering and medicine.

b. Mini Project:

Power Point Presentation.

C. Other Activities (Specify):

Quiz, Class Test.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (SL)	Total hour (CI+SW+SL)
BSC 101.1: Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems and to relate to applications to electron optic device and CRO.	12	6	1	2	21

BSC 101.2: Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.	12	6	1	2	21
BSC 101.3: Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem.	12	6	1	2	21
BSC 101.4: Recall the basic concepts of crystal structure and apply them in solving numerical problems based on them in relating to applications for determination of crystal structure	12	6	1	2	21
BSC 101.5: Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering	12	6	1	2	21
Total Hours	60	30	5	10	105

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Electrostatics & Magnetostatics	02	04	05	11
CO-2	Wave optics	03	07	04	14
CO-3	Quantum mechanics	02	06	02	10
CO-4	Introduction to solids & semiconductors	03	03	02	08
CO-5	Lasers	03	02	02	07
Total		13	22	15	50

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming
9. Seminar
10. Workshop

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	AICTE's Prescribed Textbook: Physics (Introduction to Electromagnetic Theory) with Lab Manual	Bhattacharya & Nag, Engineering Physics	Khanna Book Publishing Company.	2nd Edition 2021
2	Introduction to Electrodynamics	David Griffiths	Tata McGraw Hill	11th Reprint, 2010.
3	Physics	Halliday and Resnick	Tata McGraw Hill	10th Edition 2018
4	Electricity, magnetism and light	W. Saslow	Academic Press	1st Edition 2002
5	Engineering Physics	Malik, Singh	Tata McGraw Hill	10th Edition 2020

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code: BSC 101 / BSC 101-L** **Course Title: Physics-I**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems and to relate to applications to electron optic device and CRO.	2	2	3	2	1	1	1	2	2	1	1	2	2	2	2	2
CO-2: Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.	3	2	1	3	1	2	1	2	2	2	2	2	2	2	2	2
CO-3: Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem.	3	3	2	1	1	2	2	2	2	1	2	3	2	2	2	2
CO-4: Recall the basic concepts of crystal structure and apply them in	2	3	1	2	1	2	1	3	2	1	2	2	2	2	3	3

solving numerical problems based on them in relating to applications for determination of crystal structure																
CO-5: Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering	**2**	**3**	**1**	**1**	**1**	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**2**	**3**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map: Physics-I

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Find how to extend the basic concepts of motion of charged particles in electric magnetic fields to solve numerical problems and to relate to applications to electron optic device and CRO.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2,1.3	**Unit-1: Electrostatics & Magnetostatics** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8, 1.9,1.10,1.11,1.12	As mentioned n above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Apply concepts in interference and diffraction to solve relevant numerical problems and to relate to relevant engineering applications.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2,2.3	**Unit-2: Wave optics** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10,2.11,2.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2,3.3	**Unit-3: Quantum mechanics** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9,3.10,3.11,3.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Recall the basic concepts of crystal structure and apply them in solving numerical problems based on them in relating to applications for determination of crystal structure	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2,4.3	**Unit-4: Introduction to solid & semiconductors** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8, 4.9,4.10,4.11,4.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Relate the basic idea of total internal reflection to the propagation of light in an optical fiber and make use of the fiber concepts to solve numerical problems and relate to applications in engineering	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2,5.3	**Unit 5: Lasers** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5 .9,5.10,5.11,5.12	

Semester I

Course Code: **BSC 102**

Course Title : **Mathematics-I**

Pre- requisite: Students should review the fundamentals of calculus and basic knowledge of differential and integration.

Rationale: The program aims to develop advanced problem-solving and analytical skills and prepares students for careers in academia, research, industry, or other sectors that require advanced mathematical expertise.

Course Outcomes:

BSC 102.1

Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions

BSC 102.2

Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.

BSC 102.3

Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.

BSC 102.4

Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena

BSC 102.5

Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.

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Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
BSC	BSC 102	Engineering Mathematics -I	4	0	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
BSC	BSC 102	Mathematics -I	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL).

As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

BSC 102.1

Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1: Understand the concept of local and global extrema. **SO1.2:** Understand the geometric interpretation of the derivative as the slope of a tangent line **SO1.3:** Apply implicit differentiation to find derivatives of implicitly defined functions **SO1.4:** Understand the hypothesis of L' Hospital's rule **SO1.5:** Understand the concept of curvature.	-	**Unit-1: Single-variable Calculus** **1.1** Rolle's Theorem, **1.2** Mean value theorems **1.3** Applications, extreme values of functions **1.4** Linear approximation, Indeterminate forms **1.5** L' Hospital's rule **1.6** Tutorial-1 **1.7** Curvature, **1.8.** Radius of curvature **1.9** Evolutes and involutes **1.10** Expansion of functions by Maclaurin's series **1.11** Expansion of functions by Taylor's series for one variable **1.12** Tutorial- 2	**SL.1** Define the derivative of a function at a point using the limit definition. **SL.2** Apply implicit differentiation to find derivatives of implicitly defined functions **SL.3** Apply derivatives to solve problems in optimization, curve sketching, and related rates.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Analyze and sketch the graph of a function using information from its derivative.
ii. Identify critical points, inflection points, and concavity.
iii. Apply L'Hôpital's Rule to find limits involving indeterminate forms

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

BSC 102.2: Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Define and understand the basic concepts of matrices, determinant, etc **SO2.2** Perform basic matrix operations, including addition, subtraction, and scalar multiplication **SO2.3** Understand the connection between matrix equations and systems of linear equations **SO2.4** Define and compute the	-	**Unit-2: Matrices** **2.1.**Rank of a Matrix **2.2.** Determinant, **2.3.** Inverse of a matrix, **2.4**-Nullity **2.5**. System of linear equations, **2.6**.Symmetric,skew-symmetric **2.7**.Orthogonal matrices **2.8**. Eigen values and Eigen vectors, orthogonal transformation, **2.9.** Diagonalization of matrices, Cayley-Hamilton Theorem,	**SL.1** Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics **SL.2** Understand numerical techniques for solving matrix problems, such as Gaussian elimination and iterative methods **SL.3** Apply matrix operations and concepts to solve

determinant of a matrix **SO2.5** Understand numerical techniques		**2.10.** Linear systems of equations, **2.11** Linear independence and linear dependence **2.12** Tutorial-1	real-world problems in various fields, such as physics, computer science, engineering, and economics

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Write the application of Matrices in Real Life.
ii. Write the properties of Eigen values.
iii. Write a short note on types of matrix with example.
iv. Describe the method of calculation of rank with example

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

BSC 102.3: Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.

Approximate Hours

Item	Appx. Hrs
CL	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1: Define and compute partial derivatives of functions of several variables **SO3.2:** Understand the directional derivative and its relation to the gradient vector **SO3.3:** Apply the chain rule to compute derivatives of	-	**Unit-3: Multivariable Calculus** **3.1.** Limit and continuity **3.2.** Total derivative, **3.3.** Euler's theorem on Homogeneous function. **3.4.** Application of Euler's theorem in approximation and errors,	**SL.1** Apply Lagrange multipliers to solve constrained optimization problems **SL.2** Apply the second derivative test to

composite functions involving multiple variables **SO3.4:** Understand mixed partial derivatives and Clairaut's theorem **SO3.5:** Identify critical points of multivariable functions		**3.5.** Application of Euler's theorem in errors **3.6.** Tangent plane and normal line. **3.7.** Maxima, minima **3.8** Saddle points, **3.9.** Method of Lagrange multipliers **3.10.** Partial derivatives **3.11** Questions of partial differential. **3.12** Tutorial-1	determine local extrema. **SL.3** Solve optimization problems involving multiple variables

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Write the Application of Euler's theorem in real life.
ii. Explain the difference between differential and partial differential
iii. Write the properties of maxima, minima.
iv. Define saddle points, point of inflection.

b. Mini Project:

Oral presentation

c. Other Activities (Specify):

Quiz, Class Test.

BSC 102.4: Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Understand the definition of a first-order ordinary differential equation **SO4.2** Solve separable differential equations using the separation of variables technique **SO4.3** Identify and use integrating factors to solve linear first-order ODEs **SO4.4** Identify autonomous differential equations and their significance **SO4.5** Recognize and solve exact differential equations	-	**Unit-4: First order ordinary differential equations** **4.1** Order and degree of equation **4.2** Exact equations. **4.3** Questions of Exact equations , **4.4** Linear equations **4.5** Tutorial-1 **4.6** Bernoulli's equations. **4.7** Equations not of first degree: **4.8** Equations solvable for p, **4.9** Equations solvable for y, **4.10** Equations solvable for x **4.11** Equations Clairaut's type **4.12** Tutorial-2	**SL.1** Apply first-order ODEs to model and analyze various phenomena, such as population growth, chemical reactions, and electrical circuits **SL.2** Apply integrating factors to convert inexact equations into exact ones **SL.3** Analyze and interpret solutions in the context of applications

SW-4 Suggested Sessional Work (SW):

a. Assignments:

Explain degree and order of differential equation with example.

b. Other Activities (Specify):

Quiz, Class Test.

BSC 102.5: Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Understand and state the Fundamental Theorem of Calculus **SO5.2** Find antiderivatives of elementary functions **SO5.3** Understand the concept of a definite integral as a limit of Riemann sums **SO5.4** Interpret definite integrals as areas under curves **SO5.5** Understand and evaluate improper integrals.		**Unit 5: Integral Calculus** **5.1.**Evaluation of definite and improper integrals, **5.2.** Beta and Gamma functions **5.3.** Properties of Beta and Gamma functions, **5.4** Relation between Beta and Gamma functions **5.5.** Double integrals (cartesian), **5.6** questions of double integrals **5.7.** Change of order of integration in double integrals, **5.8** Change of order of integration questions **5.9.** Triple integrals (cartesian), **5.10.** simple applications involving cubes and sphere **5.11** Rectangular parallelepipeds **5.12** Tutorial-1	**SL.1** Apply calculus techniques to analyze curves defined in polar form **SL.2** Use numerical methods, such as the trapezoidal rule and Simpson's rule, to approximate definite integrals **SL.3** Apply tests for convergence, such as the comparison test and the integral test

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Write the application of double and tripal integration.

ii. Write the Properties of Beta and Gamma functions.

b. Mini Project: Power Point Presentation.

c. Other Activities (Specify): Quiz, Class Test.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
BSC-102.1 Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions	12	1	1	14

BSC-102.2 Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.	12	1	1	14
BSC-102.3 Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.	12	1	1	14
BSC-102.4 Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena**.**	12	1	1	14
BSC102.5 Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.	12	1	1	14
Total Hours	60	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Single-variable Calculus	02	04	07	05
CO-2	Matrices	03	07	14	10
CO-3	Multivariable Calculus	02	06	10	15
CO-4	First order ordinary differential equations	03	03	11	15
CO-5	Integral Calculus.	03	02	08	05
Total		13	22	15	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1.	Engineering Mathematics-I ,	D.K, Jain	Shree Ram Prakashan.	7th Edition 2015-16
2.	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	36th Edition, 2010
3.	Engineering Mathematics-I	D.C. Agrawal	Shree Sai Prakashan	10th Edition 2018
4.	Higher Engineering Mathematics	B.V. Ramana	Tata McGraw Hill	11th Reprint, 2010.

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech; **Course Code: BSC 102** **Course Title: Mathematics-I**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
BSC-102.1 Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions	3	1	2	2	2	2	3	1	2	2	1	2	2	2	2	2
BSC-102.2 Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.	2	2	3	2	1	2	2	1	1	1	2	3	1	2	2	2

BSC-102.3 Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.	**2**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	**2**	**2**	**1**	**2**	**1**
BSC-102.4 Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena**.**	**3**	**2**	**2**	**2**	**3**	**1**	**3**	**1**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**2**
BSC102.5 Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.	**2**	**2**	**2**	**2**	**1**	**1**	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**3**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Mathematics-I

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Define and understand the concept of limits, Evaluate limits algebraically and graphically, Apply the basic rules of differentiation, including the power rule, product rule, quotient rule, and chain rule. Use linear approximation and differentials to estimate values of functions.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Single-variable Calculus** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11.1.12	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Define and understand the basic concepts of matrices, Differentiate between different types of matrices Perform basic matrix operations, Use matrices to represent and solve systems of linear equations. Explore more advanced topics, such as linear transformations, matrix norms, and applications in optimization and computer graphics.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Matrices** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10,2.11,2.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Define and compute partial derivatives of functions of several variables, Define and compute the gradient vector of a scalar function, Apply the chain rule to compute derivatives of composite functions involving multiple variables, Identify critical points of multivariable functions.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Multivariable Calculus** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Understand the definition of a first-order ordinary differential equation, Solve separable differential equations using the separation of variables technique, Sketch direction fields to	SO4.1 SO4.2 SO4.3 SO4.4		**Unit-4: First order ordinary differential equations** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	

	visualize the behavior of solutions, Apply first-order ODEs to model and analyze various phenomena**.**	SO4.5			
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Understand and state the Fundamental Theorem of Calculus, both parts and apply the Fundamental Theorem to evaluate definite integrals. Apply integration techniques, including substitution, integration by parts, and partial fractions.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Integral Calculus** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	

Semester I

Course Code: **BSC105**

Course Title: **Biology for Engineers**

Pre-requisite: Student should have basic knowledge of biology

Rationale: Engineering combines scientific knowledge with creative activities to move beyond current knowledge and produce original solutions to important problems. Biological systems are subject to the laws of chemistry and physics, which are also the basis of engineering, biological systems can provide excellent examples of the applications of statics, dynamics, chemical affinities, energy relations, and other concepts taught in undergraduate engineering science courses.

Course Outcomes: After completion of the course:

BSC105.1: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

BSC105.2: To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted.

BSC105.3: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" and understand the molecular basis of coding and decoding genetic information is universal

BSC105.4: To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth

BSC105.5: To convey the concept of microbes and their role in environment.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
BSC	BSC105	Biology for Engineers	3	0	1	1	5	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3)10 marks each(CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
BSC	BSC105	Biology For Engineers	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

BSC105.1: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry

Approximate Hours

Item	Appx. Hrs.
CI	9
LI	0
SW	1
SL	2
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Why we need to study biology **SO1.2** To know the differences and similarities between human eye and camera. **SO1.3** Analyze the mechanism of birds flying with Aircraft **SO1.4** Gain knowledge about the role of biology with discoveries in living world. **SO1.5** To understand the concept and amazing facts about living organisms.		**Unit1. Introduction** **1.1** Introduction to biology branches and scopes **1.2** Comparison between eye and camera **1.3** Comparison between Bird flying and aircraft. **1.4** Important discoveries of biology. **1.5** Living organisms, characteristics of living organism 1.6 classification of living organisms 1.7 Cell theory 1.8 Discuss how biological observations of 18th Century that lead to major discoveries. 1.9 Understanding Binomial system of nomenclature	**1.1** Importance of Biology in engineering **1.2** Discuss how biological observations of 18th Century that lead to major discoveries

Suggested Sessional Work (SW): *anyone*	SW1.1 Assignments SW1.2 Mini Project SW1.3 Other Activities (Specify)	1 Compare living and non living Make a model of camera and try to make a flying object and try to make a flying object

BSC105.2: To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted

Approximate Hours

Item	Appx. Hrs.
CI	9
LI	0
SW	1
SL	2
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
2.1 Hierarchy of life forms at phenomenological level. **2.2** Understand ultra structure of prokaryotic and eukaryotic organism, **2.3** Study mode of nutrition in organism. **2.4** To understand the major types of kingdoms		**Unit2. Classification** 2.1 Discuss classification based on (a) cellularity- Unicellular or multicellular 2.2 Discuss classification based on (b)Ultra structure- prokaryotes or eukaryotes. 2.3 classification based on (c) energy and Carbon utilization 2.4Autotrophs 2.5 heterotrophs, 2.6 Lithotrophs. 2.7 Molecular taxonomy- 2.8 Three major kingdoms of life. 2.9 Diversity of living organisms	**2.1** Study different examples of uni and multicellular examples **2.2** Gain knowledge about the basic structure of cell and functions of cell organelles

Suggested Sessional Work (SW): *anyone*	SW1.1 Assignments	Differentiate between prokaryotic cell and eukaryotic cell.
	SW1.2 Mini Project	Prepare the poster explaining classification of organism
	SW1.3 Other Activities (Specify)	Grow yeast or fungus and observe the growth.

BSC105.3: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences and Understand the molecular basis of coding and decoding genetic information is universal

Approximate Hours

Item	Appx. Hrs.
CI	9
LI	0
SW	1
SL	4
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
3.1 Illustrate how genetic material passes from parent to offspring? Concepts of recessiveness and dominance. **3.2** Understand the cell cycle and its importance and types of cell division. **3.3** Able to realize concept of mapping of phenotype to genes. **3.4** Discuss about the single gene disorders in humans. **3.5** Analyze the molecular basis of information transfer and study the DNA structure and compacting of genome **3.6** Gaining knowledge about the universality and degeneracy of genetic code.		**Unit3. Genetics & Information Transfer** 3.1: Mendel's laws, Concept of segregation and independent assortment. 3.2 Concept of allele. 3.3: cell cycle 3.4 Meiosis and Mitosis 3.5 Genome mapping 3.6 Gene disorders in humans 3.7 DNA as a genetic material. Hierarchy of DNA structure-from single stranded to double helix to nucleosomes. 3.8 Concept of genetic code 3.9 Universality and degeneracy of genetic code	**3.1.** Build-up the concept on the phenotype and genotype. Concepts of recessiveness and dominance **3.2.** Basic knowledge of cell and cell theory **3.3.** Concepts of physical and genetic mapping. **3.4.** Boost your knowledge on some genetic disorders in human. And mutation.

Suggested Sessional Work (SW): *anyone*	Assignments:	Differentiate between mitosis and meiosis
	Mini Project:	Explain different types of crosses of Mendelian genetics
	Other Activities (Specify):	Make a model of DNA and RNA and chart of cell cycle

BSC105.4 To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth

Approximate Hours

Item	Approx Hrs
CI	9
LI	0
SW	1
SL	3
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
4.1 In this context discuss monomeric units and polymeric structures. **4.2** To know about the structure and functions of carbohydrates. **4.3** Able to know about the building blocks of proteins. **4.4** Understand proteins-structure and function. Hierarchy in protein structure. Primary secondary, tertiary and quaternary structure. **4.5** Analyze the how does an enzyme catalyze reactions?		**Unit 4- Biochemistry and metabolism and Enzymes** 4.1 Molecules of life 4.2 Discuss about sugars, 4.3 starch 4.4 cellulose. 4.5 Amino acids 4.6 Proteins 4.7Primary, secondary, tertiary and quaternary structure of proteins. 4.8 Enzyme classification. Mechanism of enzyme action. 4.9 Nucleotides and DNA/RNA	**4.1** Study about the various disorders related to carbohydrate metabolism. **4.2** Learn names of essential and non essential amino acids. **4.3** To know about the important enzymes of human body and discuss two examples.

Suggested Sessional Work (SW): *anyone*	Assignments:	Write a detail note on Classification of Carbohydrate.
	Mini Project:	Make a chart explaining bio molecules.
	Other Activities (Specify):	List out important enzymes of human body.

BSC105.5: To convey the concept of microbes and their role in environment.

Approximate Hours

Item	Appx. Hrs.
CI	9
LI	0
SW	1
SL	2
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
5.1 Gain the knowledge of different microscopic techniques. **5.2** To gain knowledge about different bacterial species and strain. **5.3** Understand principle and types of sterilization used in microbiology. **5.4** Study the different components used in media and preparation of medium **5.5** Analyze the microbial growth curve.		**Unit 5. Microbiology** 5.1 Microscopy 5.2 staining methods 5.3 classification of microorganisms(types) 5.4 Concept of single celled organisms 5.5 Concept of species and strains 5.6 Sterilization 5.7Types of sterilization. 5.8media compositions. 5.9 Growth kinetics.	**5.1** Concept of single celled organisms **5.2** Ecological aspects of single celled organisms

Suggested Sessional Work (SW): Anyone	Assignments:	1) Draw and explain simple and compound microscope and their parts. 2) Describe Bacterial growth curve.
	Mini Project:	Make a chart showing different sterilization techniques.
	Other Activities (Specify):	Try to make a simple microscope model.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Self-Learning (SL)	Sessional work (SW)	Total hour (Cl+SW+SL)
BSC105.1: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.	9	2	1	12
BSC105.2: To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted.	9	2	1	12
BSC105.3: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" and Understand the molecular basis of coding and decoding genetic information is universal	9	4	1	14
BSC105. 4 To convey that all forms of life have the same building blocks and yet the	9	3	1	13

manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth				
BSC105.5: To convey the concept of microbes and their role in environment	9	2	1	12
Total Hours	45	13	05	63

Suggested Specification Table (For ESA)

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Group Discussion
4. Role play
5. Presentations
6. Extempore
7. Speeches
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S.no.	Title	Author	Publisher	Edition & Year
1	Biology for engineers	Arthur T johanson	Taylor & Francis CRC Press	2019
2	Biology for engineers	Dr. Tanu Allen Dr. Sohini singh	Vayu Education of India	2020
3	Biology for engineers	Tanushree Chakraborti	Prentice Hall India Pvt., Limited	2022

Curriculum Development Team

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech. Cement Tech; **Course Code: BSC105;** **Course Title: Biology for Engineers**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.	3	3	2	3	3	2	1	2	3	2	2	3	2	2	3	2
CO-2: To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted.	3	3	3	2	2	2	1	2	1	2	2	2	2	2	2	2
CO-3: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" and Understand the molecular basis of coding and decoding genetic information is universal	3	3	2	2	3	1	2	2	1	2	2	3	1	2	2	2
CO-4: To convey that all forms of life have the same building blocks and yet the																

manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth	**3**	**3**	**2**	**2**	**2**	**1**	**1**	**3**	**2**	**2**	**2**	**2**	**1**	**3**	**3**	**3**
CO-5: To convey the concept of microbes and their role in environment	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Biology for Engineers

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** To convey that Biology is as important a scientific discipline as Mathematics, Physics and Chemistry.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit1: Introduction** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned inabove page
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** To convey the classification of organism underlying criterion, such as morphological, biochemical or ecological be highlighted.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit 2**: **Classification** 2.1, 2.2, 2.3, 2.4, 2.5,2.6,2.7,2.8,2.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3**: To convey that "Genetics is to biology what Newton's laws are to Physical Sciences" and Understand the molecular basis of coding and decoding genetic information is universal	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5 SO3.6		**Unit 3: Genetics & Information Transfer** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** To convey that all forms of life have the same building blocks and yet the manifestations are as diverse as one can imagine. To convey that without catalysis life would not have existed on earth	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit 4: Biochemistry and metabolism and Enzymes** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** To convey the concept of microbes and their role in environment	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5**: **Microbiology** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

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Semester-I

Course Code: **ESC 101 / ESC 101-L**

Course Title : **Basic Electrical Engineering**

Pre-requisite: Students should have basic knowledge of Basic Circuit Elements with brief information of AC, DC, and electromagnetic concepts.

Rationale: A process of introducing formal knowledge of basic electrical elements and AC, DC, and magnetic circuit in electrical and electronic devices along with necessary knowledge about single-phase Transformer and DC machine.

Course Outcomes:

ESC 101.1: Apply network theorems to solve electrical DC circuits.
ESC 101.2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.
ESC 101.3: Analyze the three phase AC circuits and solve series and parallel magnetic circuits.
ESC 101.4: Understand the basic operating principle, types, efficiency of Transformers
ESC 101.5: Understand the basic operating principle, types of machines.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
ESC	ESC 101	Basic Electrical Engineering	3	2	1	1	7	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
ESC	ESC 101	Basic Electrical Engineering	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA (VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
ESC	ESC 101-L	Basic Electrical Engineering Lab	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

ESC 101.1: Apply network theorems to solve electrical DC circuits.

Approximate Hours

Item	Appx. Hrs
CI	07
LI	12
SW	2
SL	1
Total	22

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO1.1 Understand the Classification of electrical elements. **SO1.2** Understand the concept of voltage and current source. **SO1.3** Understand the concept of mathematical analysis based on KCL and KVL. **SO1.4** Analyze different network theorems. **SO1.5** Understand the concept of star-delta transformation.	**1.** Verification of KVL. **2.** Verification of KCL. **3.** Identification of different electrical and electronic components. **4.** Calculation of Power, Impedance and P.F. in R-L-C Circuits. **5.** Verification of Superposition Theorem. **6.** Verification of Thevenin's Theorem.	**Unit-1:DC Network** **1.1** Classification of elements – active, passive, unilateral, bilateral, linear, nonlinear, lumped and distributed **1.2** classification of voltage & current sources **1.3** mesh and nodal analysis **1.4** Superposition theorem **1.5** Star-Delta Transformations (Numerical only). **1.6** Thevenin's theorem (Only independent sources). **1.7** Numerical	1. Learn the theoretical concept of circuit element.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on mesh and nodal analysis.

b. Mini Project:

i. Derive different network theorems.

ESC 101.2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.

Approximate Hours

Item	Appx. Hrs
CI	7
LI	2
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO2.1 To Understand the concept of sinusoidal periodic waveforms. **SO2.2** To understand the concept of phase difference. **SO2.3** To understand the different triangles. **SO2.4** To understand the different connections.	**1.** Study about different types of connection in AC circuit.	**Unit-2Single-Phase AC Circuits** **2.1** Sinusoidal periodic waveforms: frequency, cycle, time period, peak value, root mean square value, average value, form factor and peak factor. **2.2** Phasor representation of alternating quantities. **2.3** Concept of phase difference, The j operator **2.4** Rectangular and polar form **2.5** Power Triangle **2.6** Impedance Triangle, Power factor **2.7** Solution of series, parallel, series-parallel network.	**1.** Remember different concept related to the Sinusoidal Periodic Waveform.

SW-2 Suggested Sessional Work (SW):

- **a. Assignments:**
  - i. Numerical Problems on Sinusoidal Network.
  - ii. Numerical Problems on Power Triangle and Impedance Triangle.
  - iii. Numerical Problems on Series and Parallel Circuit.
- **b. Mini Project:** Draw the chart of Phasor Representation.

ESC 101.3: Analyze the three phase AC circuits and solve series and parallel magnetic circuits.

Approximate Hours

Item	Appx. Hrs
CI	9
LI	4
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 To Understand the basic concept of three-phase AC circuit. **SO3.2**To understand the different types of connection of three-phase winding. **SO3.3**To Understand the three-phase power equations. **SO3.4**To Understand the concepts of magnetic circuit. **SO3.5** To understand the concept of leakage flux and fringing.	**1.** Study about the different types of three-phase AC circuits. **2.** Study different concepts related with Magnetic Circuit.	**Unit-3 :Three-Phase AC Circuit** **3.1** Introduction **3.2** phase sequence,balanced load **3.3** Connection of Three-phase Windings (delta and star connection): line and phase quantities. **3.4** phasor diagrams,Three phase power equations in balanced conditions (Elementary Numerical). **3.5** Magnetic Circuits: Introduction **3.6** magneto motive force (MMF) **3.7** magnetic field strength, magnetic flux,reluctance **3.8** Comparison of the electric and magnetic circuits. **3.9** Solution of simple magnetic circuits (only for constant permeability materials).Leakage flux and fringing.	1. Basic principle of three-phase AC Circuit.

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

   i. Numerical Problems on three-phase load.

   ii. Numerical Problems on Magnetic circuit.

ESC 101.4: Understand the basic operating principle, types, efficiency of Transformers.

Approximate Hours

Item	Appx. Hrs
CI	10
LI	8
SW	2
SL	2
Total	22

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO4.1 To Understand the constructional and operational features of Single-phase Transformer. **SO4.2** Understanding the classification of Transformer. **SO4.3**Understand the different concept related with transformer **SO4.4** Derive EMF equation of transformer. **SO4.5** Understand the Phasor Diagram at different loads. **SO4.6** Understand the different concepts related to efficiency for single-phase transformer.	**1.** Study the construction details of transformer. **2.** Perform open circuit and Short Circuit test on single-phase transformer. **3.** Study and Verification of Transformer Ratio Polarity. **4.** Perform Back to back Test on Transformer	**Unit-4 :Single-Phase Transformer** **4.1** Introduction **4.2** principles of operation **4.3** Construction **4.4** classification of transformers **4.5** Rating of transformer **4.6** EMF equation,ideal and practical transformer **4.7** phasor diagram under no load and loaded conditions **4.8** losses, efficiency calculations,Condition of Maximum Efficiency **4.9** All day efficiency **4.10** Elementary Numerical)	**i.** Remember different parts of transformer. **ii.** Calculate Losses and Efficiency of transformer.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on transformer

b. Mini Project:

i. Draw phase diagram of transformer at different loads.

ESC 101.5: Understand the basic operating principle, types of machines.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	4
SW	2
SL	1
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO5.1 Understand the constructional details of DC machines. **SO5.2**Derive EMF and Torque equations. **SO5.3** Evaluate different types of dc machine. **SO5.4** Understanding the Electrical Installation.	**1.** Study different components of DC Motor and Three Phase Starter. **2.** Study of different components of Induction Motor and Star-Delta Starter.	**Unit 5: DC Machines** **5.1** Common Construction features of DC Machines **5.2** EMF equation **5.3** types of DC machines (Separately & self-excited) **5.4** Elementary numerical **5.5** Components of LT Switchgear **5.6** Switch fuse unit(SFU) **5.7** MCB, ELCB, MCCB **5.8** Types of wires **5.9** Earthing **5.10**Cables **5.11**Torque equation **5.12**Compound DC Machine	1. Remember the Constructional features of DC Machine.

SW-5 Suggested Sessional Work(SW):

a. Assignments:

i. Numerical Problem based on EMF and Torque equation of DC machine.

b. Mini Project:

Draw the chart of different types of cable and earthing.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Laboratory Lecture (Ll)	Sessional Work (SW)	Self Learning (SL)	Total hour (CI+LI+ SW+Sl)
ESC 101.1: Apply network theorems to solve electrical DC circuits.	7	12	2	1	22
ESC 101.2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.	7	2	2	1	12
ESC 101.3: Analyze the three phase AC circuits and solve series and parallel magnetic circuits.	9	4	2	1	16
ESC 101.4: Understand the basic operating principle, types, efficiency of Transformers.	10	8	2	2	22
ESC 101.5: Understand the basic operating principle, types of machines.	12	4	2	1	19
Total Hours	45	30	10	6	91

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	DC Network	03	01	01	05
CO-2	Single-Phase AC Circuit	02	03	02	07
CO-3	Three-Phase AC Circuit	02	04	04	10
CO-4	Single-Phase Transformer	03	07	05	15

CO-5	DC Machines	01	06	06	13
Total		11	23	16	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Process calculation will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to electrical power plant
7. Demonstration
8. ICT Based Teaching Learning (VideoDemonstration/TutorialsCBT,Blog,Facebook,Twitter,Whatsapp,Mobile,Onlinesources)
9. Brainstorming

Suggested Learning Resources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition & Year
1	Basic Electrical Engineering	Fitzrald and Higgonbothom	Tata McGraw Hill	Fifth
2	Theory and Problems of Basic Electrical Engineering	D.P. Kothari and I. J. Nagrath	Prentice Hall India Learning Private Limited	2016 - Second
3	Basic Electrical Engineering	D. C. Kulshreshtha	McGraw Hill	2009
4	Fundamentals of Electrical Engineering	Ashfaq Hussain	Dhanpat Rai and Co	Third
5	Lecture note provided by Dept. of electrical engineering, AKS University, Satna.			

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech; Course Code: ESC 101 / ESC 101-LCourse Title: Basic Electrical Engineering

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Apply network theorems to solve electrical DC circuits.	2	2	3	2	2	1	1	1	2	1	1	2	1	2	2	2
CO-2: Understand the concept of sinusoidal quantities and solve single phase AC circuits.	2	2	1	3	1	2	1	1	1	1	2	2	2	2	2	2
CO-3: Analyze the three phase AC circuits and solve series and parallel magnetic circuits.	3	3	2	1	1	2	2	2	1	1	2	3	1	2	1	2
CO-4: Understand the basic operating principle, types, efficiency of Transformers.	2	3	3	2	3	2	1	3	2	1	2	2	2	3	3	3
CO-5: Understand the basic operating principle, types of machines.	2	3	3	1	2	3	2	3	1	2	2	2	2	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map: Basic Electrical Engineering

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Apply network theorems to solve electrical DC circuits.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2,1.3,1.4,1.5,1.6	**Unit-1:DC Network** 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Understand the concept of sinusoidal quantities and solve single phase AC circuits.	SO2.1 SO2.2 SO2.3 SO2.4	2.1	**Unit-2: Single-Phase AC Circuits** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Analyze the three phase AC circuits and solve series and parallel magnetic circuits.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2	**Unit-3 :Three-Phase AC Circuit** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Understand the basic operating principle, types, efficiency of Transformers.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5 SO4.6	4.1,4.2,4.3,4.4	**Unit-4: Single-Phase Transformer** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Understand the basic operating principle, types of machines.	SO5.1 SO5.2 SO5.3 SO5.4	5.1,5.2	**Unit 5: DC Machines** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	

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Semester I

Course Code: **ESC102, ESC102-L**

Course Title: **Engineering Graphics & Design**

Pre-requisite: Student should have basic knowledge of Geometry, Geometrical Shapes, basic knowledge of Computer, Mouse and keyboard use, navigating menus and dialogs, managing files and directories, etc.

Rationale: The students studying Graphics are essential in mechanical engineering, allowing engineers to visualize and communicate complex ideas clearly and concisely. Using graphics, engineers can create detailed plans for construction projects, analyses structural components, and convey design concepts to clients and stakeholders.

Course Outcomes:

ESC102.1: Get introduced with Engineering Graphics and visual aspects of design.

ESC102.2: Know and use common drafting tools with the knowledge of drafting standards.

ESC102.3: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.

ESC102.4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.

ESC102.5: To make the student understand the viewing perception of a solid object in Isometric and perspective Projection, Design modulation and simulation by Auto CAD

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
ESC	ESC102/ ESC102-L	Engineering Graphics & Design	1	4	1	1	7	3

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Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory:

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each(CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Marks (HA+CT+TSN+TCA+TA)		
ESC	ESC102	Engineering Graphics & Design	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA (VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
ESC	ESC102-L	Engineering Graphics & Design	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

ESC102.1: Get introduced with Engineering Graphics and visual aspects of design.

Approximate Hours

Item	Appx. Hrs
CI	03
LI	12
SW	2
SL	2
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO.1 Proficiency in using plain scales for measurement and drawing and understanding of representative factors in scales. **SO.2** Construction of ellipses, parabolas, and hyperbolas using various methods **SO.3** Knowledge and construction of special curves like cycloids, epicycloids, hypocycloids, involutes, and Archimedean spirals. **SO.4** Application of these curves in various engineering and mathematical contexts.	**1.1** Construction of ellipse by different methods; Normal and Tangent. **1.2.** Construction of parabola by different methods; Normal and Tangent. **1.3**Construction of involute such as polygons and circle **1.4** Construction of Cycloid, Epi-cycloid, Hypo-cycloid **1.5** Construction of Simple Scale, **1.6** Diagonal Scale & Scale of Chord	**Unit-1.0 Engineering Curve & Scale** **1.1**Introduction of Engineering Drawing, Drawing material and their uses Application of mini drafter, compass, divider, French curves, pencils grades and their uses **1.2** Construction of ellipse by different methods; Normal and Tangent .Construction of parabola by different methods; Normal and Tangent **1.3** Construction of Cycloid, Epi-cycloid, Hypo-cycloid and Construction of Simple Scale, Diagonal	**1.** Construction of Involutes **2.** Construction of Archimean Spiral

		Scale & Scale of Chord	

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Ellipes by concentric circle method, Cycloid, Involutes of Circle

b. **Mini Project:**
   i. Model of Hexagon, Pentagon, Square

ESC102.2: Know and use common drafting tools with the knowledge of drafting standards.

Approximate Hours

Item	Appx. Hrs
CL	03
LI	12
SW	1
SL	2
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO.1 Differentiate between various types of projections when and where each type of projection is commonly used in engineering and technical design. **SO.2** Be able to create orthographic projection views of objects, including front view, top view, and side views. **SO.3** Able to project points and lines onto different planes using orthographic projection. **SO.4** Learn how to find the traces of straight lines in orthographic projection and use these traces to determine the positions of lines in different planes.	**2.1** Projection of Point **2.2** Projection of Point in different co-ordinate **2.3** Projection of Straight Line **2.4** Projection of Straight Line in different Position w.t.r. H.P. & V.P. **2.5** Projection of Straight Line in different Position w.t.r. H.P. & V.P. **2.6** Projection of Straight Line in different Position w.t.r. H.P. & V.P.	**Unit-2.0 Projection of Point and Line** **2.1** Introduction of Projection **2.2** Projection of Point **2.3** Projection of Straight Line	**1.** Point Projection in different co-ordinate **2.** Projection of Straight Line in different Position w.t.r. H.P. & V.P.

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Projection of point & Projection of Straight Line

ESC102.3: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.

Approximate Hours

Item	Appx. Hrs
CI	03
LI	12
SW	2
SL	2
Total	19

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO.1 Projection of Planes like circle and polygons in different positions. **SO.2** Projection of polyhedrons like prisms, pyramids, and solids of revolutions like cylinder, cones in different positions	**3.1** Introduction ,Projection of plane **3.2** plane perpendicular to any one and parallel to other **3.3** plane perpendicular to any one and inclined to other **3.4** Introduction ,Projection of solid **3.5** Axis of solid perpendicular to any one and parallel to other **3.6** Axis of solid perpendicular to any one and inclined to other and Axis of solid inclined to both the plane HP&VP	**Unit-3.0 Projection of Plane & Solid** **3.1** Introduction of Projection Plane **3.2** Projection of Plane in different position **3.3** Introduction of projection of Solid and Projection of solid in different position	**1.** Projection of Plane in different Position w.t.r. H.P. & V.P. **2.** Projection of solid in different Position w.t.r. H.P. & V.P.

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Draw three problems of projection of plane
   ii. Draw three problems of projection of solid

b. **Mini Project:**

i. Make models of plane and solid by thermocol

ESC102.4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.

Approximate Hours

Item	Appx. Hrs
CI	03
LI	12
SW	2
SL	2
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO.1 Learn the techniques for sectioning right solids using both normal and inclined planes. **SO.2** Solves practical problems related to the section of solids and planes. **SO.3** Learn the parallel line method and radial-line method for developing surfaces in right solids including how to create accurate representations.	**4.1** Sectioning of Cone **4.2** Sectioning of pyramid **4.3** Sectioning of Cylinder & Prism **4.4** Development of cylinder and prism **4.5** Development and sectioning of pyramid **4.6** Development and sectioning of cone	**Unit-4.0 Development of Solid & Section of Solid** **4.1** Introduction of Sectioning and sectioning lines **4.2** Sectioning of Cone **4.3** Sectioning of pyramid, Sectioning of Cylinder & Prism, Development of cylinder and prism, Development and sectioning of pyramid, Development and sectioning of cone	1. Development and sectioning of cylinder 2. Development and sectioning of prism

SW-4 Suggested Sessional Work (SW):

i. Assignments:

a. Develop prism and cylinder
b. Develop pyramid and Cone

ESC102.5: To make the student understand the viewing perception of a solid object in Isometric and perspective Projection, Design modulation and simulation by Auto

Approximate Hours

Item	Appx. Hrs
CI	03
LI	12
SW	2
SL	2
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO.1 Students will learn about the scale and the specific axes used in isometric drawings. **SO.2** Students will learn the process of converting two-dimensional orthographic (multi view) drawings into isometric projections. **SO.3** Students will learn solving practical design and projection problems using CAD software and how to use CAD tools to create detailed drawings and projections of objects.	**5.1** Introduction of isometric scale and vies **5.2** Isometric view of circle, cylinder and cone **5.3** Isometric view of prism **5.4** Isometric view of pyramid **5.5** Isometric view by othographic view **5.6** Drawing of different orthographic view of planes and solid by Auto CAD commands	**Unit-5.0 Isometric projection and Auto CAD** **5.1** Introduction of Isometric Projection **5.2** Isometric view of circle, cylinder and cone **5.3** Isometric view of prism and pyramid, Isometric view by orthographic view, Introduction of Auto CAD, Description of Auto CAD commands, Drawing of different orthographic view of planes and solid by Auto CAD	**1.** Draw Isometric view of plane and solid **2.** Draw Isometric view of plane and solid by using Auto CAD command

SW-5 Suggested Sessional Work(SW):

a. Assignments:

i. Draw Isometric view of a cone resting centrally on a cube

ii. Explain five edit and draw commands

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture	Laboratory Lecture	Sessional Work	Self Learning	Total hour (CI+SW+SL)

	(CI)	**(LI)**	**(SW)**	**(SL)**	
ESC102.1: Get introduced with Engineering Graphics and visual aspects of design.	3	12	1	2	19
ESC102.2: Know and use common drafting tools with the knowledge of drafting standards.	3	12	1	2	18
ESC102.3: Apply computer aided drafting technique to represent line, surface or solid models in different Engineering viewpoints.	3	12	2	2	19
ESC102.4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	3	12	2	2	19
ESC102.5: To make the student understand the viewing perception of a solid object in Isometric and perspective Projection, Design modulation and simulation by Auto CAD	3	12	2	2	19
Total Hours	15	60	09	10	94

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Get introduced with Engineering Graphics and visual aspects of design.	03	01	01	05
CO-2	Know and use common drafting tools with the knowledge of drafting standards.	02	06	02	10

CO-3	Apply computer aided drafting technique to represent line, surface or solid models in different Engineering viewpoints.	03	07	05	15
CO-4	Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	-	10	05	15
CO-5	Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	03	02	-	05
Total		11	26	13	50

Legend: R- Remember, U- Understand, A- Apply

The end of semester assessment for Process calculation will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to electrical power plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition&Year
1	Computer Aided Engg drawing	VTU Belgaum	Visvesvaraya Tech. University	Revised edition21 edition 2020

2	Engineering Drawing	Bhatt N.D., Panchal V.M. & Ingle P.R.,	Charotar Publishing House	1999
3	Engineering Drawing	R.K. Dawan	S. Chand Publication.	1985
4	Engineering Drawing	Agrawal and Agrawal	TMH	2018
5	Training Manual			

Curriculum Development Team

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech; Course Code: ESC102, ESC102-L; Course Title: Engineering Graphics and Design

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
ESC102.1: Get introduced with Engineering Graphics and visual aspects of design.	1	1	2	2	2	2	3	1	2	2	1	2	2	2	2	2
ESC102.2: Know and use common drafting tools with the knowledge of drafting standards.	1	2	2	2	1	2	2	1	1	1	2	3	2	2	2	2
ESC102.3: Apply computer aided drafting technique to represent line, surface or solid models in different Engineering viewpoints.	2	2	1	1	2	2	2	1	1	2	1	2	2	1	2	2
ESC102.4: Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	3	2	2	1	3	1	3	1	2	1	1	2	3	3	3	3
ESC102.5: To make the student understand the viewing perception of a solid object in Isometric and perspective Projection, Design modulation and simulation by Auto CAD	1	2	2	1	1	1	3	1	1	1	2	2	3	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Engineering Graphics and Design

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**ESC102.1:** Get introduced with Engineering Graphics and visual aspects of design.	SO1.1 SO1.2 SO1.3 SO1.4	1.1,1.2,1.3,1.4,1.5,1.6	**Unit-1: Engineering Curve & Scale** 1.1,1.2,1.3	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**ESC102.2:** Know and use common drafting tools with the knowledge of drafting standards.	SO2.1 SO2.2 SO2.3 SO2.4	2.1, 2.2, 2.3, 2.4, 2.5, 2.6	**Unit-2: Projection of Point and Line** 2.1, 2.2, 2.3	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**ESC102.3:** Apply computer aided drafting technique to represent line, surface or solid models in different Engineering viewpoints.	SO3.1 SO3.2	3.1,3.2,3.3,3.4,3.5,3.6	**Unit-3: Projection of Plane & Solid** 3.1,3.2,3.3	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**ESC102.4:** Produce part models; carry out assembly operation and show working procedure of a designed project work using animation.	SO4.1 SO4.2 SO4.3	4.1,4.2,4.3,4.4,4.5,4.6	**Unit-4: Development of Solid & Section of Solid** 4.1,4.2,4.3	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**ESC102.5:** To make the student understand the viewing perception of a solid object in Isometric and perspective Projection, Design modulation and simulation by Auto CAD	SO5.1 SO5.2 SO5.3	5.1,5.2,5.3,5.4,5.5,5.6	**Unit-5: Isometric projection and Auto CAD** 5.1,5.2,5.3	

Semester-I

Course Code: **ESC103-L**

Course Title : Design Thinking & Idea Lab

Pre- requisite: There is no such pre requisite for Design Thinking and Idea. This course is intended for students from any discipline who require an understanding of design thinking for brand, product, and service development.

Rationale: Students will learn a series of design thinking concepts, methods and techniques that are used to bring about innovation in business and in the social sector. The course will be a mix of lecture, case discussions, participative and immersive learning. It will be a predominantly student driven learning to acquire the requisite skills.

Course Outcomes:

ESC103-L CO1: Identify the problems that fall under the purview of human centered design process for creative problem solving.
ESC103-L CO2: Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.
ESC103-L CO3: Build simple prototypes for problems using gathered user requirements.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
ESC	ESC103-L	Design Thinking & Idea Lab	0	2	1	1	4	1

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3)10 marks each(CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
ESC	ESC103-L	Design Thinking & Idea Lab	35	NA	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

ESC103-L.1: Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.

Approximate Hours

Item	Appx. Hrs
CI	0
LI	10
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Identifying the problem that can be solved using Design Thinking approach. **SO1.2** Obtain the insights into user's problems and make Problem statement. **SO1.3** Carry out Brain storming between the groups and generate as many as ideas possible. **SO1.4** Obtain the insights to creativity and innovation.	**Unit-1.0 Introduction To Design Thinking** **1.1** Definition of Design Thinking, **1.2** Need & Objective of Design Thinking **1.3** Stages of Design Thinking Process. **1.4** Brainstorming **1.5** Innovative Triangle		1. Develop ability to express their views.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Detail explanation of Stages of Design Thinking

b. Mini Project:

To create a prototype of users need using Design Thinking Stages

ESC103-L.2: Identify the problems that fall under the purview of human centered design process for creative problem solving.

Approximate Hours

Item	Appx. Hrs
CL	00
LI	10
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Differentiate between Design thinking and Creative thinking. **SO2.2** Learn different types of creative thinking techniques for generating creative ideas. **SO2.3** Be able to solve a problem using creativity.	**Unit-2.0 Introduction to Creativity** **2.1** Introduction of Creative Thinking. **2.2** Creative Thinking Process **2.3** Creative Problem Solving. **2.4** Creative Thinking Techniques and Tools. **2.5** Divergent and Convergent Thinking.		Different Convergent and divergent thinking tools.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

Presentation by student's team on their own creative work.

b. Mini Project:

To create a prototype of a product using their own creativity.

ESC103-L.3: Build simple prototypes for problems using gathered user requirement

Approximate Hours

Item	Appx. Hrs
CI	0
LI	10
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Understanding of Prototyping. **SO3.2** Develop understanding of various prototype testing methods. **S03.3** Understanding of Product Design	**Unit-3.0 Introduction to Prototype** **3.1** Prototyping as a mindset, prototype examples **3.2** Introduction to Rapid Prototyping. **3.3** Process of prototyping- Minimum Viable prototype **3.4** Process of Engineering Product Design **3.5** Stages of Product Design		1. Solving Practical Engineering Problem through Innovative Product Design & Creative Solution

SW-3 Suggested Sessional Work (SW):

a. Assignments: Presentation by student teams on their own developed prototype.

b. Mini Project: Make a prototype using stages of product design

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (SL)	Total hour (CI+SW+SL)
ESC103-L.1: Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.	0	10	2	1	13
ESC103-L.2: Identify the problems that fall under the purview of human centered design process for creative problem solving.	0	10	2	1	13
ESC103-L.3: Build simple prototypes for problems using gathered user requirements.	0	10	2	1	13
Total Hours	0	30	06	03	39

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
ESC103-L.1	Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.	07	05	03	15
ESC103-L.2	Identify the problems that fall under the purview of human centered design process for creative problem solving.	06	06	03	15
ESC103-L.3	Build simple prototypes for problems using gathered user requirements.	07	07	06	20
Total		20	18	12	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming
9. Seminar
10. Workshop

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Paul Harris, Basics Design-Design Thinking	Gavin Ambrose	AVA Publishing	2010
2	Prototyping for Designers: Developing the best Digital and Physical Products	Kathryn McElroy	O'Reilly,	2017
3	"Design Thinking – New Product Essentials from PDMA	Michael G. Luchs, Scott Swan, Abbie Griffin	Wiley,	2015

Curriculum Development Team

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code: ESC103-L** **Course Title: Design Thinking and Idea Lab**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1 Engineering knowledge	PO2 Problem analysis	PO3 Design/development of solutions	PO4 Conduct investigations of complex problems	PO5 Modern tool usage	PO6 The engineer and society	PO7 Environment and sustainability	PO8 Ethics	PO9 Individual and team work	PO10 Communication	PO11 Project management and finance	PO12 Life-long learning	PSO1 The ability to apply technical & engineering knowledge for production quality cement	PSO2 Ability to understand the day to plant operational problems of cement manufacture	PSO3 Ability to understand the latest cement manufacturing technology and it application	PSO4 Ability to use the research based innovative knowledge for sustainable development
CO-1: Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.	3	2	2	3	3	2	1	2	3	2	2	3	1	2	3	3
CO-2: Identify the problems that fall under the purview of human centered design process for creative problem solving.	1	3	3	2	2	2	1	2	1	2	2	2	2	2	2	3
CO-3: Build simple prototypes for problems using gathered user requirements.	2	3	2	2	3	1	2	2	1	2	2	3	1	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Design Thinking and Idea Lab

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Create empathy maps to visualize user attitudes and develop innovative products or services for a customer base using ideation techniques.	SO1.1 SO1.2 SO1.3 SO1.4	**Unit-1: Introduction To Design Thinking** 1.1,1.2,1.3,1.4,1.5	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Identify the problems that fall under the purview of human centered design process for creative problem solving.	SO2.1 SO2.2 SO2.3	**Unit-2: Introduction to Creativity** 2.1,2.2,2.3,2.4,2.5	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Build simple prototypes for problems using gathered user requirements.	SO3.1 SO3.2 SO3.3	**Unit-3: Introduction to Prototype** 3.1,3.2,3.3,3.4,3.5	

Semester I

Course Code: **PCC-CT101**

Course Title: **Introduction to Portland Cement**

Pre- requisite: Student should have basic knowledge of Rocks, Minerals, Elements and Chemical compounds.

Rationale: The students studying cement technology should possess foundational understanding about historical binding materials employed in construction. This encompasses familiarity with the invention and evolution of Portland cement. Additionally, students ought to acquire fundamental insights into various cement types, their applications, as well as the Indian regulatory authorities responsible for supervising production standards and quality of cement.

Course Outcomes:

PCC-CT101.1: Understand the character of ancient Cementitious building materials and evolution of Portland cement.

PCC-CT101.2: Acquired the knowledge of types of raw materials and fuel used in the production of Portland cement, along with its physical and chemical characteristics.

PCC-CT101.3: Understanding of the various types of cement manufactured in India and their utilization in infrastructure development.

PCC-CT101.4: Familiarize with a concise overview of the cement manufacturing process.

PCC-CT101.5: **C**omprehend the functions of different regulatory bodies in India that oversee the production and quality of cement.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
PCC	PCC-CT101	Introduction to Portland Cement	3	0	1	1	5	3

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Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+ CAT+AT)		
PCC	CT101	Introduction to Portland Cement	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT101.1: Understand the character of ancient cementitious building materials and evolution of Portland cement.

Approximate Hours

Item	Appx. Hrs
CI	8
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1: Understand ancient binding materials use in construction. **SO1.2:** Invention of Portland Cement **SO1.3:** Hydration & Strength Development in Portland cement, **SO1.4:** Type of Cement produced in India and its use. **SO1.**5: Evolution of Indian Cement Industry	.	**Unit-1.0 Historical progression and advancements in binding materials for construction** **1.1** Evolution of Binding Substances in Early construction eras. **1.2** Attributes of Natural Cement and roman cement. **1.3** Lime as construction materials and history ancient Indian construction cementing materials **1.4** Overview of the Evolution of Portland cement. **1.5** Significance of Portland in the infrastructure development. **1.6** Clinker Minerals and its properties **1.7** Concise Explanation of Cement Hydration. Strength development. **1.8** Historical Trajectory of the Indian Cement Industry.	**1.** Properties of Calcareous materials **2.** Types of rock and formation of calcareous sedimentary rock

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Ancient Binder Used for Constructions, Invention and properties of Portland, Cement strength development mechanism of Portland cement. Types of Cement produced in India.

b. Mini Project:

i. Flow diagram of Portland Cement Manufacture.

c. Other Activities (Specify):

Note on Status of Indian cement industry in world and Major cement producing companies of India

PCC-CT101.2: Acquire knowledge regarding the types of cement raw materials and fuel in Portland cement production and its physical and chemical properties.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1: To Understand the raw materials required for Portland Cement Manufacture **SO2.2:** To learn about Calcareous materials and its properties, that is prime raw materials of Portland cement. **SO2.3:** To understand the requirement of argillaceous raw materials for Clinker manufacture and its properties. **SO2.4:** To understand the types of Additives used for manufacture of Portland Cement and its properties **SO2.**5: To lean about the types of fuel used in Indian Cement Industries and its properties	.	**Unit-2 Raw Materials and Fuel used for cement manufacture** **2.1** Types of raw materials and fuel used for cement manufacture **2.2** Types, chemical and physical properties of calcareous raw materials used for cement manufacture. **2.3** Distribution of limestone deposits in India **2.4** Requirement of Argillaceous raw materials in cement Manufacture and their properties. **2.5** Types of additives used in Portland cement clinker manufacture. **2.6** Physical and chemical properties of laterite, bauxite, iron ore etc. **2.7** Physical and chemical properties of Gypsum used in cement as additives. **2.8** Physical and Chemical properties of Fly ash and GGBF Slag. **2.9** Type of fuel used by Indian cement industries for	**i.** Broad limestone deposit clusters in India **ii.** Formation of Coal deposits and its properties

		Portland cement clinker manufacture. **2.10** Properties of Coal as fuel for cement manufacture. **2.11** Properties of Petcoke	

SW-2 Suggested Sessional Work (SW):

a. Assignments:
   i. Physical, Chemical and Mineralogical properties of Cement Grade Limestone
   ii. Chemical properties of Clay, Laterite, Bauxite , Irion ore and Gypsum

b. Mini Project:
Marking of major limestone belts in India map

c. Other Activities (Specify):
Types of Coal its availability in India

PCC-CT101.3: Gain an understanding of the various types of cement manufactured in India and their utilization in infrastructure development.

Approximate Hours

Item	Appx. Hrs
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1: Types of cement Produced in India **SO3.2:** Properties and use of OPC **SO3.3:** Properties and advantages of use of PPC and PSC and its advantages in use **SO3.4:** Properties and use of SRC, SSC, OWC	.	**Unit-3: Types of cement manufactured in India and its application** **3.1** Brief characteristics and applications of different Cement Types Produced in accordance with BIS Standards **3.2** Ordinary Portland Cement (OPC), **3.3** Portland Pozzolana Cement (PPC), Portland Slag Cement (PSC), Composite cement	i. BIS specification of OPC, PPC and PSC. ii. Advantages of PPC in construction. iii. Manufacture of Granulated slag in steel plant.

and PWC **SO3.**5: Properties and Use of HESC, MC, LHC, Composite cement.		**3.4** Ordinary & Rapid Hardening Portland Cement, **3.5** Sulphate Resisting Portland Cement, **3.6** Supersulphate cement **3.7** Low – Heat Portland Cement and Oil Well Cement, **3.8** White Portland Cement, High early strength cement **3.9** Masonry Cement	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

iii. Physical, Chemical of OPC, PPC and PSC as per BIS
iv. Advantages of use of PPC in construction.
v. Properties and use of low heat cement in construction.

b. Mini Project:

Make a tale containing BIS code of various Cement produced in India and Broad Specification and its application.

c. Other Activities (Specify):

Availability, properties, generation and use of Fly Ash in India

PCC-CT101.4: **Familiarize with a concise overview of the cement manufacturing process.**

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	4
SL	2
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1: Evaluation of modern cement kiln. **SO4.2:** Understanding the process flow for manufacture of Portland cement clinker	.	**Unit-4 : Concise Explanation of the Portland Cement Production Process:** **4.1** Overview of Wet, Semidry & Dry process of Portland cement **4.2** Flow diagram for Cement Manufacturing process in dry	i. Preparation of process flow chart of Portland cement manufacture ii. Draw a typical

SO4.3: Understanding the Cement Rotary kiln and kiln components **SO4.4:** Preparation of raw meal and fuel for cement kiln. Thermo- chemical reaction of cement raw meal and formation of cement clinker **SO4.**5: Manufacture of Portland cement.		process plant for production composite and blended cement. **4.3** Brief about component of cement kiln. **4.4** Thermochemical reaction during conversion of cement raw meal to Portland cement clinker. **4.5** Brief of pyroprocessing of Portland cement clinker. **4.6** Unit Operations and Equipment used in cement plant **4.7** Raw meal preparation **4.8** Preparation of coal and petcoke for cement kiln **4.9** Clinker grinding and production of cement **4.10** Cement packing and dispatch **4.11** Typical layout of a cement plant showing various sections.	lay out of a cement plant showing various sections.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Write Thermo-Chemical Reaction occurred during clinker formation

ii. Describe briefly the dry process cement manufacture

b. Mini Project:

i. Visit to a cement a cement plant and writing a report.

c. Other Activities (Specify):

Power Point Presentation of Portland cement manufacture.

PCC-CT101.5: Comprehend the functions of different regulatory bodies in India that oversee the production and quality of cement.

Approximate Hours

Item	Appx. Hrs
CI	06
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

SO5.1: Growth of Indian cement industry in national global prospective. **SO5.2:** Over view of various regulatory bodies in India dedicated for Cement Industry **SO5.3:** Role of the regulatory bodies in Cement quality and production **SO5.4:** Overview of pollution norms for Indian cement industry and its controlling measures. **SO5.**5: Basic requirement for setting up a cement plant		**Unit 5: The Cement Sector in India and Regulatory Obligations:** **5.1** The growth of the Indian Cement Industry and its contribution to Nation Development. **5.2** Indian cement industry in global prospective **5.3** Overview of Regulatory bodies and their significance in India's Cement Industry, such as BIS, DPIIT, CPCB, SPCB, NABL, and IBM. **5.4** Essential Legal mandates for Establishing a Cement Manufacturing Unit. **5.5** A Concise Overview of Environmental Regulations **5.6** measures implemented by the Indian Cement Industry to Ensure Pollution Control.	**1.** Guideline of pollution norm by ministry of environment, Govt of India. **2.** Role of BIS in national standard development.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

List the IS codes of the Cements, Fly Ash, Granulated Slag, and Testing of cements.
Pollution Control norms by CPCB for Indian Cement Industry.

b. Mini Project:

Pollution norm of European Cement Industry vs Indian cement Industry

c. Other Activities (Specify):

List of Organization/ Institution in India for regulation of Cement Production.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (SL)	Total hour (CI+SW+SL)
PCC-CT101.1: Understand the character of ancient Cementitious building materials and evolution of Portland cement.	8	2	1	11
PCC-CT101.2: Acquired the knowledge of types of raw materials and fuel used in the production of Portland cement, along with its physical and chemical characteristics.	11	2	1	14
PCC-CT101.3: Gain an understanding of the various types of cement manufactured in India	9	2	1	12

and their utilization in infrastructure development.				
PCC-CT101.4: Familiarize with a concise overview of the cement manufacturing process.	11	4	2	17
PCC-CT101.5: Comprehend the functions of different regulatory bodies in India that oversee the production and quality of cement.	6	2	1	9
Total Hours	45	12	6	63

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Historical progression and advancements in binding materials for construction	03	01	01	05
CO-2	Portland Cement Raw Materials and Fuel	02	06	02	10
CO-3	Types of Cement Manufactured in India	03	07	05	15
CO-4	Concise Explanation of the Portland Cement Production Process	-	10	05	15
CO-5	The Cement Sector in India and Regulatory Obligations	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1	Chemistry Of Cement And Concrete	F M Le	Chemical Publishing Co Inc, US	Revised edition 21 edition 2020
2	Cement Data Book:	W. H Duda	Bauverlag	1985
3	Norms For Limestone Exploration For Cement Manufacture	National Council for Cement and Building Materials	National Council for Cement and Building Materials	1985
4	Cement Production Principle and Practice	A K Chatterjee	CRC Press. Taylor & Francis Group	2018
5	Holcim Training Manual			
6	FLS Training Manual			
7	Lecture note provided by Dept. of Cement Technology, AKS University, Satna.			

Curriculum Development Team

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8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech; Course Code: PCC-CT101; Course Title: Introduction to Portland Cement

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Understand the character of ancient Cementitious building materials and evolution of Portland cement.	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO-2: Acquired the knowledge of types of raw materials and fuel used in the production of Portland cement, along with its physical and chemical characteristics.	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1
CO-3: Gain an understanding of the various types of cement manufactured in India and their utilization in infrastructure development.	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2

CO-4: Familiarize with a concise overview of the cement manufacturing process.	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO-5: Comprehend the functions of different regulatory bodies in India that oversee the production and quality of cement.	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Introduction to Portland Cement

POs & PSOs	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Understand the character of ancient Cementitious building materials and evolution of Portland cement.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Historical progression and advancements in binding materials for construction** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8	As mentioned in above page
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Acquired the knowledge of types of raw materials and fuel used in the production of Portland cement, along with its physical and chemical characteristics.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Raw Materials and Fuel used for cement manufacture** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10,2.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Gain an understanding of the various types of cement manufactured in India and their utilization in infrastructure development.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Types of cement manufactured in India and its application** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Familiarize with a concise overview of the cement manufacturing process.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Concise Explanation of the Portland Cement Production Process** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Comprehend the functions of different regulatory bodies in India that oversee the production and quality of cement.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: The Cement Sector in India and Regulatory Obligations** 5.1,5.2,5.3,5.4,5.5,5.6	

Semester-I

Course Code: HSMC07

Course Title: Indian Knowledge System

Pre- requisite: Creating awareness among the youths about the true history and past rich culture of India.

Rationale: India has very rich and versatile knowledge system and cultural heritage since antiquity. The Indian Knowledge systems was developed on life science, medical science, literature, drama, art, music, dance, astronomy, mathematics, architecture (Strap at yaveda), chemistry, aeronautics etc, during ancient period. In this basic course, a special attention is given to the ancient and historical perspective of ideas occurrence in the ancient society, and implication to the concept of material world and religious, social and cultural beliefs. On the closer examination, religion, culture and science have appeared epistemological very rigidly connected in the Indian Knowledge System. This land of Bharat Bhumi has provided invaluable knowledge stuff to the society and the world in all sphere of life.

Course Outcomes:

HSMC07.1: To understand the ancient civilization, Indian Knowledge Systems, Concept of Panch Mahabhuta, Origin of name Bharat Varsha, Ancient Rivers, Ancient Universities and ancient agriculture.

HSMC07.2: Students will have the ability to learn about ancient books, Religious places, basic concept of Indian dance, music and arts, and fundamental aspects of Sangeeta and Natyashashtra etc.

HSMC07.3: Student will be able to gain knowledge on Vedic Science, Astronomy, Astrovastu, Vedic Mathematics, Aeronautics, Metallurgy, Nakhatras, Panchang, Concept of Zero, Pi and point etc.

HSMC07.4: Understanding on ancient Engineering, Science and Technology, Town Planning, Temple architecture, Chemistry and Metallurgy, Metal manufacturing etc.

HSMC07.5: Student will able to understand about the Life, Nature and Health through basic concept of Ayurveda and Yoga, Traditional Medicinal Systems, Ethnomedicine, Nature conservation, World Heritage Sites etc.

Scheme of Studies:

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Category of Course	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	
IKS	HSMC07	Indian Knowledge System	2	0	1	1	4	2

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Session Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Examination Scheme:

Proposed examination scheme (Marking) as per the recommendation of University Grant Commission (UGC) for Under Graduate Courses in Fundamentals of Indian Knowledge Systems 2022-23 onwards

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
HSMC	HSMC07	Indian Knowledge System	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

HSMC07.1 To understand Indian Civilization and Indian Knowledge Systems

Approximate Hours

Item	Appx. Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1. Understand Overview of Indian Knowledge Systems (IKS) **SO1.2.** Understand Classification of Ancient IKS texts **SO1.3.** Understand Introduction to Panch Mahabhutas (Earth, Water, Fire, Sky and Air) **SO1.4.** Understand Origin of the name Bharatvarsha: the Land of Natural Endowments **SO1.5.** Understand Rivers of ancient India (The Ganga, Yamuna, Godawari, Saraswati, Narmada, Sindhu and Kaveri) **SO1.6.** Understand Ancient Agriculture and ancient Universities: Takshashila and Nalanda, Gurukul system		**Unit-1. Indian Civilization and Indian Knowledge Systems** **1.1.** Overview of Indian Knowledge Systems (IKS) **1.2.** Classification of Ancient IKS texts **1.3.** Introduction to Panch Mahabhutas (Earth, Water, Fire, Sky and Air) **1.4.** Origin of the name Bharatvarsha: the Land of Natural Endowments **1.5.** Rivers of ancient India (The Ganga, Yamuna, Godawari, Saraswati, Narmada, Sindhu and Kaveri) **1.6.** Agriculture system in ancient India, Ancient Universities: Takshashila and Nalanda, Gurukul system	Golden era of ancient India

SW-1 Suggested Sessional Work (SW):

Assignments:

Concepts of Panch Mahabhuta, Classification of ancient texts, origin of ancient rivers

Mini Project:

Ancient Universities: Takshashila and Nalanda,

Other Activities (Specify):

HSMC07.2: Students will have the ability to apply the knowledge gained about Indian Art, Literature and Religious Places

Approximate Hours

Item	Appx. Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 2.1. Understand the Ancient Indian Books: Vedas, Puranas, Shastras, Upanishads, Mahakavyas (Ramayana & Mahabharata), Smrities, Samhitas **SO 2.2.** Understand the Religious places: Puries, Dhams, Jyotiralinga, Shaktipeeths, Kumbha Mela **SO 2.3.** Understand the Legendary places of Madhya Pradesh: Ujjain, Chitrakoot, Omkareshwar, Bharhut, Maihar **SO 2.4.** Understand the Basic concept of Indian Art, Music and Dance, Indian Musical Instruments **SO 2.5.** Understand the Fundamental aspects of Sangeeta and Natya shastra **SO 2.6.** Understand the different schools of music, dance and painting in different regions of India		**Unit-2. Indian Art, Literature and Religious Places** **2.1.** Ancient Indian Books: Vedas, Puranas, Shastras, Upanishads, Mahakavyas (Ramayana & Mahabharata), Smrities, Samhitas **2.2.** Religious places: Puries, Dhams, Jyotiralinga, Shaktipeeths, Kumbha Mela **2.3.** Legendary places of Madhya Pradesh: Ujjain, Chitrakoot, Omkareshwar, Bharhut, Maihar **2.4.** Basic concept of Indian Art, Music and Dance, Indian Musical Instruments **2.5.** Fundamental aspects of Sangeeta and Natya shastra **2.6.** Different schools of music, dance and painting in different regions of India	**1.** Indian Art, Music and Dance

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Visit of Chitrakoot, Maihar and Bharhuta

b. Mini Project:

ii. Kumbhmela, Story of Ramayana and Mahabharata

HSMC07. 3: Student will be able to understand Ancient Science, Astronomy and Vedic Mathematics

Approximate Hours

Item	Appx. Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 3.1. Understand Vedic Cosmology **SO 3.2.** Understand the Astronomy, Astrovastu, Vedang Jyotish, Nakshatras, Navagraha, Rashis, Vastushastra and their related plants **SO 3.3.** Understand the Time and Calendar, Panchang **SO 3.4.** Understand the Concept of Zero, Point, Pi -number system, Pythagoras **SO 3.5.** Understand the Vedic Mathematics, Vimana-Aeronautics, Basic idea of planetary model of Aryabhatta **SO 3.6.** Understand the Varanamala of Hindi language based on classification of sounds on the basis of their origin, Basic purpose of science of Vyakarana		**Unit-3. Ancient Science, Astronomy, Mathematics** **3.1.** Vedic Cosmology **3.2.** Astronomy, Astrovastu, Vedang Jyotish, Nakshatras, Navagraha, Rashis, Vastushastra and their related plants **3.3.** Time and Calendar, Panchang **3.4.** Concept of Zero, Point, Pi - number system, Pythagoras **3.5.** Vedic Mathematics, Vimana-Aeronautics, Basic idea of planetary model of Aryabhatta **3.6.** Varanamala of Hindi language based on classification of sounds on the basis of their origin, Basic purpose of science of Vyakarana.	1. Ancient Science, Astronomy and Vedic Mathematics

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Varanamala of Hindi language based on classification of sounds on the basis of their origin

b. Mini Project:

1. Nakshatras, Navagraha and their related plants

c. Other Activities (Specify):

HSMC07.4: Understand the Engineering, Technology and Architecture

Approximate Hours

Item	Appx. Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 4.1. Understand the Engineering Science and Technology in Vedic and Post Vedic Era **SO 4.2.** Understand the Town and Home planning, Sthapatyaveda **SO 4.3.** Understand the Chemistry and Metallurgy as gleaned from archeological artifacts **SO 4.4.** Understand the Chemistry of Dyes, Pigments used in Paintings, Fabrics, Potteries and Glass **SO 4.5.** Understand the Temple Architecture: Khajuraho, Sanchi Stupa, Chonsath Yogini temple **SO 4.6.** Understand the		**Unit-4. Engineering, Technology and Architecture** **4.1.** Engineering Science and Technology in Vedic and Post Vedic Era **4.2.** Town and Home planning, Sthapatyaveda **4.3.** Chemistry and Metallurgy as gleaned from archeological artifacts **4.4.** Chemistry of Dyes, Pigments used in Paintings, Fabrics, Potteries and Glass **4.5.** Temple Architecture: Khajuraho, Sanchi Stupa, Chonsath Yogini temple **4.6.** Mining and manufacture in India of Iron, Copper, Gold from ancient times	1.Ancient Science, Astronomy and Vedic Mathematics

Mining and manufacture in India of Iron, Copper, Gold from ancient times			

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Varanamala of Hindi language based on classification of sounds on the basis of their origin

b. **Mini Project:**
   i. Nakshatras, Navagraha and their related plants

c. **Other Activities (Specify):**

HSMC07.5: Understand about the Life, Nature and Health

Approximate Hours

Item	Appx. Hours
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 5.1. Understand the Fundamentals of Ayurveda (Charaka & Shushruta) and Yogic Science (Patanjali), Ritucharya and Dinacharya **SO 5.2.** Understand the Traditional system of Indian medicines (Ayurveda, Siddha, Unani and Homoeopathy) **SO 5.3.** Understand Fundamentals of Ethnobotany and Ethnomedicines of India **SO 5.4.** Understand the Nature Conservation in Indian ancient texts **SO 5.5.** Understand the Introduction to Plant Science in		**Unit-5. Life, Nature and Health** **5.1.** Fundamentals of Ayurveda (Charaka & Shushruta) and Yogic Science (Patanjali), Ritucharya and Dinacharya **5.2.** Traditional system of Indian medicines (Ayurveda, Siddha, Unani and Homoeopathy) **5.3.** Fundamentals of Ethnobotany and Ethnomedicines of India **5.4.** Nature Conservation in Indian ancient texts **5.5** Introduction to Plant Science in Vrikshayurveda **5.6.** World Heritage Sites of	1. Concept of Ayurveda and Yoga 2. Traditional system of Indian medicines 3. Ethnobotany and Ethnomedicines of India 4. World Heritage Sites

Vrikshayurveda **SO 5.6.** Understand the World Heritage Sites of Madhya Pradesh: Bhimbetka, Sanchi, Khajuraho		Madhya Pradesh: Bhimbetka, Sanchi, Khajuraho	

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Visit to world Heritage Site Khajuraho
b. **Mini Project:**
   i. Ritucharya and Din Charya, Ethnomedicinal plants
c. **Other Activities (Specify):**

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
HSMC07.1: To understand Indian Civilization and Indian Knowledge Systems	**6**	**2**	**1**	**9**
IKS. 101.2: Students will have the ability to apply the knowledge gained about Indian Art, Literature and Religious Places	**6**	**2**	**1**	**9**
HSMC07.3: Student will be able to understand the Ancient Science, Astronomy and Vedic Mathematics	**6**	**2**	**1**	**9**
IKS. 101.4: Understand the Engineering, Technology and Architecture	**6**	**2**	**1**	**9**
IKS. 5: Understand about the Life, Nature and Health	**6**	**2**	**1**	**9**
Total	**30**	**10**	**5**	**45**

Suggestion for End Semester Assessment:

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	

CO 1	Indian Civilization and Indian Knowledge Systems	**2**	**5**	**1**	**8**
CO 2	Indian Art, Literature and Religious Places	**2**	**6**	**2**	**8**
CO 3	Ancient Science, Astronomy and Vedic Mathematics	**2**	**6**	**5**	**13**
CO 4	Engineering, Technology and Architecture	**2**	**4**	**4**	**10**
CO 5	Life, Nature and Health	**2**	**5**	**2**	**9**
Total		**10**	**26**	**14**	**50**

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for **Indian Knowledge Systems** will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course teacher for above tasks. Teacher can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to Religious places, World Heritage Sites
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	An Introduction of Indian Knowledge Systems: Concept and Applications	Mahadevan, B.; Bhat V. R. and Pavana, Nagendra R. N.	Prentice Hall of India.	2022
2	Indian Knowledge Systems: Vol. I and II.	Kapoor, Kapil and Singh, A. K.	D.K. Print World Ltd	2005
3	Science of Ancient Hindus: Unlocking Nature in Pursuit of Salvation	Kumar, Alok	Create pace Independent Publishing	2014
4	A History of Agriculture in India	Randhava, M.S.	ICAR, New Delhi	1980
5	Panch Mahabhuta,	Yogcharya, Jnan Dev	Yog Satsang Ashram	2021

6	The Indian Rivers	Singh, Dhruv Sen	Springer	2018
7	The Wonder That Was India	Basam, Arthue Llewllyn	Sidgwick & Jackson	1954
8	Ancient Cities, Sacred Skies: Cosmic Geometries and City Planning in Ancient India	Malville, J. MacKim & Gujaral, Lalit M.	IGNCA & Aryan Books International, New Delhi	2000
9	The Natya Shastra of Bharat Muni	Jha, Narendra	Innovative Imprint, Delhi	2023
10	Astronomy in India: A Historical Perspective	Padmanabhan, Thanu	Indian National Science Academy, New Delhi & Springer (India).	2010
11	History of Astronomy in India 2nd Ed.	Sen, S.N. and Shukla, K.S.	INSA New Delhi	2001
12	History of Indian Astronomy A Handbook	Ramasubramanian, K.; Sule, Aniket and Vahia, Mayank	Science and Heritage Initiative, I.I.T. Mumbai and Tata Institute of Fundamental Research, Mumbai	2016
13	Indian Mathematics and Astronomy: Some Landmarks	Rao, Balachandra S.	Jnana Deep Publications, Bangalore, 3rd Edition	. 2004
14	Vedic Mathematics and Science in Vedas	Rao, Balachandra S.	Navakarnataka Publications, Bengaluru	2019
15	A History of Hindu Chemistry	Ray, Acharya Prafulla Chandra	Repbl Shaibya Prakashan Bibhag, Centenary Edition, Kolkata	1902
16	Early Indian Architecture: Cities and City Gates	Coomeraswamy, Anand	Munciram Manoharlal Publishers	2002
17	Theory and Practices of Temple Architecture in Medieval India: Bhojas samrangasutradhar and the Bhojpur Line Drawings	Hardy, Adams	Dev Publishers & Distributors.	2015
18	Indian Science and Technology in Eighteenth Century	Dharmpal	Academy of Gandhian Studies, Hyderabad.	1971
19	Science in India: A Historical Perspective	Subbarayappa, B.V.	Rupa New Delhi	2013
20	Fine Arts & Technical Sciences in Ancient India with special reference to Someswvara's Manasollasa	Mishra, Shiv Shankar	Krishnadas Academy, Varanasi	1982
21	Fundamental Principles of Ayurveda, Volume One	Lad, Vasant D.	The Ayurvedic Press, Alboquerque, New Mexico.	2002
22	Charak Samhita, Chaukhamba	Pandey, Kashinath and Chaturvedi Gorakhnath	Vidya Bhawan, Varanasi	
23	Ayurveda: The Science of Self-	Lad, Vasant D.	Lotus Press: Santa Fe	1984

	Healing			
24	Ayurveda: Life, Health and Longevit	Svoboda, Robert E	Penguin: London	1992
25	Plants in the Indian Puranas	Sensarma, P.	Naya Prokash, Calcutta	1989
26	Indian Cultural Heritage Perspective for Tourism	Singh, L. K.	Gyan Publishing House, Delhi	2008
27	Glimpses of Indian Ethnobotany	Jain, S.K.	Oxford & IBH Publishing Company Private Limited, New Delhi	1981
28	Manual of Ethnobotany	Jain, S.K.	Scientific Publishers, Jodhpur	2010

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Cos, POs and PSOs Mapping

Program Title: B. Tech Cement Tech; Course Code: HSMC07; Course Title: Indian Knowledge System

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: To understand Indian Civilization and Indian Knowledge Systems	3	3	3	3	2	1	1	2	2	3	1	2	2	3	2	3
CO-2: Students will have the ability to apply the knowledge gained about Indian Art, Literature and Religious Places	3	3	2	3	1	2	1	2	1	2	2	2	3	2	3	2

CO-3: Student will be able to understand the Ancient Science, Astronomy and Vedic Mathematics	**3**	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**1**	**3**	**2**	**3**	**3**	**2**	**3**	**2**
CO-4: Understand the Engineering, Technology and Architecture	**3**	**2**	**3**	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**2**	**2**	**3**	**3**	**3**	**3**
CO-5: Understand about the Life, Nature and Health	**3**	**2**	**3**	**1**	**2**	**1**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**	**3**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map:

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** To understand Indian Civilization and Indian Knowledge Systems	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Indian Civilization and Indian Knowledge Systems** 1.1,1.2,1.3,1.4,1.5,1.6	As mentioned in above page
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Students will have the ability to apply the knowledge gained about Indian Art, Literature and Religious Places	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Indian Art, Literature and Religious Places** 2.1, 2.2,2.3,2.4,2.5,2.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Student will be able to understand the Ancient Science, Astronomy and Vedic Mathematics	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Ancient Science, Astronomy and Vedic Mathematics** 3.1,3.2,3.3,3.4,3.5,3.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Understand the Engineering, Technology and Architecture	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Engineering, Technology and Architecture** 4.1,4.2,4.3,4.4,4.5,4.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Understand about the Life, Nature and Health	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Life, Nature and Health** 5.1,5.2,5.3,5.4,5.5,5.6	

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Semester-II

Course Code: **BSC103, BSC103-L**

Course Title : **Chemistry-I**

Pre- requisite: Students must have fundamental knowledge of mathematics, nature of molecule, valence shell electron pair repulsion theory, and different concentration terms to understand the concept of engineering chemistry.

Rationale: The students studying engineering chemistry should possess foundational understanding about basic mathematics, different concentration terms and valence shell electron pair repulsion theory to understand the basic principle of chromatography and spectroscopic analysis.

Course Outcomes:

BSC103.1 Apply VSEPR theory to predict the three-dimensional shapes of molecules.

BSC103.2: Describe the concept of symmetry, chirality and optical activity and synthesize chiral drug molecule.

BSC103.3: Explain and apply the concept of Intermolecular forces, Hydrogen bond, and transition metal complexes.

BSC103.4 Predict the concept of thermodynamics, free energy & entropy and apply Nernst equation, water chemistry as well as explain concept of acid-base, metallurgy, Emf cell and corrosion.

BSC103.5: Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopictechniques.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
BSC	BSC103	Chemistry-I	3	2	2	1	8	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) SW**:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
BSC	BSC103	Chemistry-I	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA(VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
BSC	BSC103-L	Chemistry-I	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL).

As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

BSC103.1: Apply VSEPR theory to predict the three-dimensional shapes of molecules.

Approximate Hours

Item	Appx Hrs
CI	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1. Describe the classification of different types of orbit orbitals **SO1.2** Discuss the fundamental concept of wave function and probability of distribution curve **SO1.3** Explain and apply Atomic Spectroscopy: Energies of atomic orbital's **SO1.4** Apply concept of VSEPR in the determination of geometry of different molecules. **SO1.5** Restate molecular energy level diagram of N2, F2 and O2 molecules.	**LI.1.1.** Determination of specific density of given liquid **LI.1.2.** Determination of viscosity of given liquid **LI.1.3** Paper chromatography, Thin layer Chromatography.	**Unit-1: Atomic and Molecular Structure & Periodic Properties** **1.1** Introduction of orbit, orbitals andelectronic configuration **1.2** Schrodinger wave equation and its derivation. **1.3** Hybridization and types, Intermixing of orbital **1.4** VSEPR theory,bond pair and lone pair repulsion, **1.5** Determination of geometry of themolecules **1.6** Molecular orbital theory, **1.7** Molecular energy level diagram and bond order for homo and hetero atomic molecules **1.8** Periodicity of atomic size and ionization energy **1.9** Electron gainenthalpy and types of electron gain enthalpy	1. History of development of of development of periodic table 2. Electronegativity and its application

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   Applications of molecular orbital theory for the determination of bond order and magnetic behavior.

b. **Mini Project:**
   Hybridization and its application.

c. **Other Activities (Specify):**
   Write an essay on different type of chemical bond.

BSC103.2: Describe the concept of symmetry, chirality and optical activity and synthesize chiral drugmolecule.

Approximate Hours

Item	Appx Hrs
CI	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 understand the concept of representations of 3 dimensional structures **SO2.2** explain structural isomers and stereoisomers **SO2.3** describe symmetry, chirality andoptical activity **SO2.4** explain and identify different types of reactions with mechanisms **SO2.5** apply the concept of mechanisms to synthesize drug molecules	**LI.2.1.** To synthesize drug molecules and determine its percentageyield **LI.2.2.** To determine the acid value or saponification value of oil/fat L**I2.3.** To determine partition coefficient of a organic substance between two immiscible liquids.	**UNIT 2: Stereochemistry, Organic reactions and synthesis of a drug molecule** **2.1** Representations of 3 dimensional structures **2.2** Structural isomers and stereoisomers **2.3** Symmetry and chirality, optical activity and absolute configurations **2.4** Enantiomers, diastereomers **2.5** Isomerism in transitional metalcompounds **2.6** Introduction to reactions involving substitution reaction **2.7** Addition, elimination,	1. Plane of Polarized light 2. Types of symmetry

		oxidation, reduction reaction **2.8** cyclization and ring openings **2.9** Synthesis of a commonly useddrug molecule	

SW-2 Suggested Sessional Work (SW):

Assignments: Conformational Isomerism and conformational analysis

BSC103.3: Understand the concept of Intermolecular forces, Hydrogen bond, Transition metal complexes by applying this concept.

Approximate Hours

Item	Appx Hrs
CI	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Describe Ionic, dipolar, London dispersion force, vander Waals interaction **SO3.2** Explain Hydrogen bond and types of hydrogen bond **SO3.3** Coordination compounds **SO3.4** Describe Metal ligand bonding by VBT **SO3.5** Explain Metal ligand bonding by CFT	**LI3.1.** Synthesis a inorganic metal complex **LI3.2.** Determine the two acid and two basics radical **LI.2.3.** Determination of chloride content of water	**Unit-3: Intermolecular forces and Transition metal complexes** **3.1.** Ionic, dipolar, London dispersion force **3.2.** Vander Waals interactions **3.3.** Hydrogen bond, types of hydrogen bond. **3.4.** Coordination compounds **3.5.** Metal ligand bonding by VBT **3.6.** Metal ligand bonding by CFT **3.7.** The energy level diagrams for transition metal ions and their magnetic properties. **3.8.** The energy level diagrams for transition metal ions and their magnetic properties	**1.** Coordination compounds IUPAC name and Werner theory **2.** The energy level diagrams for transition metal ions and their magnetic properties

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

VBT theory, CFT theory, The energy level diagrams for transition metal ions and their magnetic properties

b. **Mini Project:** applications of transition metal complexes

BSC103.4 Predict the concept of thermodynamics, free energy & entropy and apply Nernst equation, water chemistry as well as explain concept of acid-base, metallurgy, Emf cell and corrosion.

Approximate Hours

Item	Appx. Hrs
CI	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction(LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Restate concept of free energy, Free energy, Enthalpy Entropy and types of different thermodynamic system **SO4.2**Discuss the fundamental concept of cell representation standard EMF of cell **SO4.3** Explain and apply different types ofconcepts used in softening of water and purification of water **SO4.4** Understand and apply concept of corrosion for the development of green corrosion inhibitors **SO4.5** Understand different acid-base concepts, ionic and solubility product of salts	**LI.4.1.** Determination of hardness ofwater **LI.4.2.** Determination of alkalinityof water **LI.4.3.** Chemical analysis of a salt.	**Unit 4: Use of free energy in chemical equilibrium** **4.1**Introductionenergy, Enthalpy Entropy, system andsurroundings **4.2** Cell notation of cell, Nernst equation and its application **4.3** Water chemistry, Hardness of water, Temporary and permanent hardness **4.4** Water softening methods **4.5** Introduction of Corrosion, Mechanism of corrosion **4.6** Factors affecting rate ofcorrosion **4.7** Various acid-base concepts, Arrhenius concept, **4.8** Lewis acid-base concept,Bronsted Lowry concept **4.9** Brief idea about ionic and solubility equilibria	**1**-derivation of Nernst equation.

SW-4 **Suggested Sessional Work (SW):**

a. **Assignments:**
   Applications of green corrosion inhibitors

b. **Mini Project:**
   Analysis of water quality parameters.

c. **Other Activities (Specify):**
   Write an essay on acid-base concepts, ionic and solubility product of salts.

BSC103.5: Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopic techniques.

Approximate Hours

Item	Appx Hrs
CI	9
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Understand Identification and classification of different types of EMR and vibrational modes inmolecules. **SO5.2** Understand the fundamental principles of vibrational and rotational spectroscopy, including the interaction of light with molecular vibrations, the concept of infrared (IR) **SO5.3** Explain and apply Atomic Spectroscopy: - Energies of atomic orbital's	**LI.5.1.** Verification ofBeer-Lambertlaw **LI5.2.** Determination of absorption maximum of agiven organic compound. **LI.5.3.** Determination of cell constant and conductance of solutions.	**Unit 5: Spectroscopic techniques and applications** **5.1** Introduction of spectroscopy, discovery, properties and types of electromagnetic radiation. **5.2** Classification of different types of vibrational modes in molecules (stretching, bending, torsional, etc.).IR activity. **5.3** Energies of atomic orbitals and electronic transition, frankCondon principle. **5.4** Introduction of NMR,	**1.** Applications Nuclear magnetic resonance and magnetic resonance imaging

SO5.4 Understand and apply concept of NMR, Nuclear spin, nuclear resonance. **SO5.5** Understand introduction of X-ray Diffraction determination crystallographic structure of materials.		**5.5.** Nuclear spin, nuclear resonance **5.6** Principle and instrumentation of NMR **5.7.** Shielding and de shielding ofmagnetic nuclei. **5.8.** surface characterization techniques **5.9.** Diffraction and scattering	

SW-5 Suggested Sessional Work (SW):

a. Assignments:

Applications Nuclear magnetic resonance and magnetic resonance imaging

b. Mini Project:

Fluorescence and its applications in medicine

c. Other Activities (Specify):

Write an essay on surface characterization techniques. Diffraction and scattering.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+LI+SW+Sl)
BSC103.1: Apply VSEPR theory to predict the three-dimensional shapes of molecules.	9	6	2	1	18
BSC103.2: Describe the concept of symmetry, chirality and optical activity and synthesize chiral drug molecule	9	6	2	1	18
BSC103.3: Explain and apply the concept of Intermolecular forces, Hydrogen bond, and transition metal complexes	9	6	2	1	18
BSC103.4: Predict the concept of thermodynamics, free energy & entropy and apply Nernst equation, water chemistry as well	9	6	2	1	18

as explain concept of acid-base, metallurgy, Emf cell and corrosion.					
BSC103.5: Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopic techniques.	9	6	2	1	18
Total Hours	45	30	10	5	90

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Atomic and Molecular Structure & Periodic properties	03	01	01	05
CO-2	Stereochemistry, Organic reactions and synthesis of a drug molecule	02	06	02	10
CO-3	Intermolecular forces and Transition metal complexes	03	07	05	15
CO-4	Use of free energy in chemicalequilibrium	-	10	05	15
CO-5	Spectroscopic techniques and applications	03	02	-	05
Total		11	26	13	50

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	A textbook of engineeringchemistry	Shyamala Sundara	S. Chand	Edition 2008
2	A Textbook of Engineering Chemistry	Shashi Chawla |	Dhanpat Rai Prakashan	Edition 2020
3	A Textbook of Engineering Chemistry	PC Jain and Monika Jain	Dhanpat Rai Prakashan	Edition 2018

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Cos, POs and PSOs Mapping

Ptogram Title: B. Tech Cement Tech **Course Code: BSC103 / BSC103-L** **Course Title: Chemistry-I**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Apply VSEPR theory to predict the three-dimensional shapes of molecules.	3	1	2	2	3	2	3	2	2	1	3	2	2	3	2	2
CO-2: Describe the concept of symmetry, chirality and optical activity and synthesize chiral drug molecule	2	1	2	2	1	2	3	2	1	1	2	2	2	2	2	2
CO-3: Explain and apply the concept of Intermolecular forces, Hydrogen bond, and transition metal complexes	2	2	1	1	1	2	2	2	1	2	1	2	1	2	2	2

CO-4: Predict the concept of thermodynamics, free energy &entropy and apply Nernst equation, water chemistry as well as explain concept of acid-base, metallurgy, Emf cell and corrosion.	**2**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**2**	**3**	**2**
CO-5: Collectively aim to equip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopic techniques.	**2**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**2**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Chemistry-I

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Apply VSEPR theory to predict the three-dimensional shapes of molecules.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2,1.3	**Unit-1: Atomic and Molecular Structure & Periodic properties** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in above page
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Describe the concept of symmetry, chirality and optical activity and synthesize chiral drug molecule	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	2.1,2.2,2.3	**Unit-2: Stereochemistry, Organic reaction andsynthesis of a drug molecule** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Explain and apply the concept of Intermolecular forces, Hydrogen bond, and transition metal complexes	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1,3.2,3.3	**Unit-3: Intermolecular forces and Transition metal complexes** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Predict the concept of thermodynamics, free energy & entropy and apply Nernst equation, water chemistry as well as explain concept of acid-base, metallurgy, Emf cell and corrosion.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1,4.2,4.3	**Unit-4: Use of free energy in chemical equilibrium** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Collectively aim toequip students with a comprehensive understanding of the theoretical principles, practical methodologies, and diverse applications of various spectroscopic techniques.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	5.1,5.2,5.3	**Unit-5: Spectroscopic techniques and applications** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

Semester-II

Course Code: **BSC104**

Course Title : **Mathematics-II**

Pre- requisite: Objective of this course is to familiarize the prospective engineers with techniques in Ordinary and partial differential equations and Laplace transform. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines.

Rationale: The program aims to develop the tool of power series and Fourier series for learning advanced engineering mathematics

Course Outcomes:

BSC104.1: Understand the importance of Laplace transform and elementary properties of Laplace transform

BSC104.2: To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions

BSC104.3: Demonstrate an understanding of the Vector Calculus

BSC104.4: Define and recognize the method to solve Sequences and series

BSC104.5: Students will create the concept of a Partial Differential Equations

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
BSC	BSC104	Mathematics -II	4	0	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
BSC	BSC104	Mathematics -II	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

BSC104.1: Understand the importances of Laplace transform and elementary properties of Laplace transform

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Understand the concept of Laplace transform of elementary functions **SO1.2** Understand the Laplace transform of derivatives **SO1.3** Understand the Inverse Laplace transform **SO1.4** Understand the Application of Laplace transform		**Unit-1.0 Laplace Transform** **1.1** Introduction of Laplace transform **1.2** Laplace transform of elementary functions **1.3** Linearity property **1.4** Properties of Laplace transform, **1.5** Laplace transform of derivatives **1.6** Laplace transform of Integral **1.7** Multiplication by t^n **1.8** Division by t **1.9** Inverse Laplace transform **1.10** First shifting theorem **1.11** Second shifting Property **1.12** Convolution theorem **1.13** Application of Laplace transform	**1.** Change of scale property

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Example on Properties of Laplace transform
2. Example on Laplace transform of derivatives
3. Example on Laplace transform of Integral
4. Example on Multiplication by t^n
5. Example on First shifting theorem

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

BSC104.2: To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	1
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Understand the concept Solving Second order linear differential, **SO2.2** Understand the Solution by variation of parameters **SO2.3** Understand the Power series solutions: **SO2.4** Understand the Legendre's equations and Legendre polynomials		**Unit 2: Ordinary differential Equations** **2.1** Linear differential Equation with constant coefficients **2.2** Complimentary Function and Particular integral **2.3** Solution by Inspection Method **2.4** Solution by change of dependent variable **2.5** Solution by change of Independent variable **2.6** Solution by variation of parameters **2.7** Power series solutions (Frobenius method): **2.8** Series for Ordinary Point **2.9** Legendre's equations and **2.10** Bessel's equation and **2.11** Tutorial	**1.** Examples of Frobenius method

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Example on Solution by variation of parameters
2. Example on Power series solutions:
3. Example on Legendre's equations and
4. Example on Legendre polynomials
5. Example on Frobenius method

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify):

Quiz, Class Test.

BSC104.3: Demonstrate an understanding of the Vector Calculus

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Understand the scalar and vector point function **SO3.2** Understand the Line integrals, Surface integrals Volume integrals **SO3.3** Understand the Gradient, Curl, divergence **SO3.4** Understand the Gauss Divergence theorems, Stoke's theorems		**Unit 3: Vector Calculus** **3.1** Differentiation of vector **3.2** scalar and vector point function **3.3** Directional derivatives **3.4** Gradient **3.5** Curl **3.6** Divergence **3.7** Line integrals, **3.8** Surface integrals **3.9** Volume integrals **3.10** Green's theorems **3.11** Gauss Divergence theorems **3.12** Stoke's theorems	**1.** Examples on Stoke's theorems

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Example on Directional derivatives
2. Example on Gradient
3. Example on Divergence
4. Example on Surface integrals
5. Stoke's theorems

b. Mini Project:

Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify): Quiz, Class Test.

BSC104.4: Define and recognize the method to solve Sequences and series

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Understand Convergence and Divergence of sequence **SO4.2** Understand the Tests for convergence **SO4.3** Understand Fourier series **SO4.4** Understand and Calculation of limits		**Unit4: Sequences and Series** **4.1** Limits of sequence of numbers **4.2** Convergence and Divergence of sequence **4.3** Cauchy sequence **4.4** Calculation of limits **4.5** Infinite series **4.6** Tests for convergence **4.7** Rabbe test and logarithmic test **4.8** Comparison test **4.9** Fourier series **4.10** Even and odd function **4.11** Half range sine and cosine series **4.12** Half range cosine series **4.13** Parseval’s theorem.	**1.** Some theorem on sequence

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Example on Cauchy sequence
2. Example on Tests for convergence
3. Example on Comparison test
4. Example on Fourier series
5. Example on Even and odd function

b. Mini Project: Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify): Quiz, Class Test.

BSC104.5: Students will create the concept of Partial Differential Equations

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	1
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Understand the Solutions of first order linear PDE **SO5.2** Understand the Solution to homogenous and Non-homogenous linear PDE **SO5.3** Understand the First order PDE **SO5.4** Understand PDE of Second order by particular integral method		**Unit 5: Partial Differential Equations** **5.1** Definition of Partial Differential Equations **5.2** First order PDE **5.3** Solutions of first order linear PDE **5.4** Solution to homogenous PDE **5.5** Non-homogenous linear PDE **5.6** PDE of Second order by complimentary function and **5.7** PDE of Second order by particular integral method. **5.8** Lagrange's Linear equation, **5.9** Charpit's method **5.10** Separation of variable method for the solution of heat equations **5.11** wave equations	**SL.1** Problems on PDE

SW-5 Suggested Sessional Work (SW):

a. Assignments:

1. Example on linear PDE
2. Example on Solution to homogenous PDE
3. Example on Lagrange's Linear equation,
4. Example on PDE of Second order by complimentary function and
5. Example on Charpit's method

b. Mini Project: Oral presentation, Poster presentation, Power Point Presentation.

c. Other Activities (Specify): Quiz, Class Test.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
BSC104.1: Understand the importance of Laplace transform and elementary properties of Laplace transform	13	1	1	15
BSC104.2: To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions	11	1	1	13
BSC104.3: Demonstrate an understanding of the Vector Calculus	12	1	1	14
BSC104.4: Define and recognize the method to solve Sequences and series	13	1	1	15
BSC104.5: Students will create the concept of a Partial Differential Equations	11	1	1	13
Total Hours	60	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Laplace transforms	03	01	01	05
CO-2	Ordinary differential equations	02	06	02	10
CO-3	Vector Calculus	03	07	05	15
CO-4	Sequences and series	-	10	05	15
CO-5	Partial Differential Equations	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1.	Engineering Mathematics-I ,	D.K, Jain	Shree Ram Prakashan.	7th Edition 2015-16
2.	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	36th Edition, 2010
3.	Engineering Mathematics-I	D.C.Agrawal	Shree Sai Prakashan	10th Edition 2018
4.	Higher Engineering Mathematics	B.V. Ramana	Tata McGraw Hill	11th Reprint, 2010.

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Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech | Course Code: BSC104 | Course Title: Mathematics-II

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Understand the importance of Laplace transform and elementary properties of Laplace transform	3	3	2	2	2	1	1	2	2	1	2	2	1	2	2	2
CO-2: To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions	3	3	3	3	2	2	1	3	2	2	2	3	1	2	3	2
CO-3: Demonstrate an understanding of the Vector Calculus	3	2	3	2	2	1	2	2	2	2	2	3	1	2	3	2

CO-4: Define and recognize the method to solve Sequences and series	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**3**
CO-5: Students will create the concept of a Partial Differential Equations	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Mathematics-II

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Understand the importance of Laplace transform and elementary properties of Laplace transform	SO1.1 SO1.2 SO1.3 SO1.4		**Unit-1: Laplace transforms** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12, 1.13	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** To introduce effective mathematical tools for the solutions of ordinary differential equations and solutions with Bessel functions and Legendre functions	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: Ordinary differential equations** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10,2.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Demonstrate an understanding of the Vector Calculus	SO3.1 SO3.2 SO3.3 SO3.4		**Unit-3: Vector Calculus** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Define and recognize the method to solve Sequences and series	SO4.1 SO4.2 SO4.3 SO4.4		**Unit-4: Sequences and series** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12, 4.13	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Students will create the concept of a Partial Differential Equations	SO5.1 SO5.2 SO5.3 SO5.4		**Unit 5: Partial Differential Equations** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11	

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Semester-II

Course Code: **ESC104, ESC104-L**

Course Title : **Programming for Problem Solving**

Pre-requisite: Student should have basic knowledge programming.

Rationale: Problem solving skills can help people develop more skills and build a promising career.

Course Outcomes:

ESC104.1: Understand the basic concept of Programming languages, software, algorithm and flowchart.

ESC104.2: Acquire knowledge regarding the building blocks of programming language.

ESC104.3: Apply python for solving basic programming solutions.

ESC104.4: Create algorithms using learnt programming skills.

ESC104.5: Understand real world problems and developing computer solutions for those.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
ESC	ESC104	Programming for Problem Solving	3	4	2	1	10	5

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e., Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini projected.),

SL: Self-Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback teachers ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
ESC	ESC 104	Problem Solving and Programming	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA(VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
ESC	ESC104-L	Problem Solving and Programming-Lab	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

ESC104.1: Understand the basic concept of Programming languages, software, algorithm and flowchart.

Approximate Hours

Item	Appx. Hrs.
CI	7
LI	12
SW	2
SL	1
Total	22

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO1.1. Understand types of programming languages. **SO1.2.** Utilize Operating System **SO1.3.** Compare compiler, linker, loader **SO1.4.** Create algorithm and flow charts for problem	LI.1.1. Running instructions in Interactive interpreter and a Python Script. LI.1.2. Write a program to purposefully raise Indentation Error and Correct it. LI.1.3. Create Flow chart for an organisation LI.1.4. Create Flow chart for an education system LI.1.5. Compare various operating systems LI.1.6. Write five features of Notepad	**Unit-1 Introduction to Programming** **1.1** Evolution of languages: Machine languages, Assembly languages, High-level languages construction eras. **1.2** Software requirements for programming **1.3** System software like operating system **1.4** compiler, linker, loader **1.5** Application programs like editor. **1.6** Algorithm specification of algorithm **1.7** Flowcharts	**1.** Different types of programming languages examples. **2.** Learn about various operating systems.

SW-1 Suggested Sessional Work (SW):

a. Assignments:
1. Create algorithms for some real-life problems.
2. Create flowcharts for problems.

b. Mini Project:

i. Flow diagram of working of a university.

c. Other Activities (Specify):

NA

ESC104.2: Acquire knowledge regarding the building blocks of programming language.

Approximate Hours

Item	Appx. Hrs.
Cl	12
LI	12
SW	2
SL	1
Total	27

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1. To Understand the datatypes **SO2.2.** Identify Expressions **SO2.3.** Apply operators **SO2.4.** Use list, string tuples	**LI.2.1.** Write a program to demonstrate basic data type in python. **LI.2.2.** Write a program to compute distance between two points taking input from the user **LI.2.3.** Write a program add.py that takes 2 numbers as command line arguments and prints its sum. **LI.2.4.** Using a for loop, write a program that prints out the decimal equivalents of 1/2, 1/3, 1/4, . 1/10. **LI.2.5.** Write a program using a for loop that loops over a sequence. What is sequence? **LI.2.6.** Write a program using a while loop that asks the user for a number, and prints a countdown from that number to zero.	**Unit-2 Datatypes and Operators, Variables, Sequences and Iteration** **2.1.** Data Types **2.2.** Different types of Data types **2.3.** Expressions, Precedence Rules **2.4.** Operators **2.5.** Types of Operators **2.6.** Local Variables **2.7.** Global Variables **2.8.** List **2.9.** String **2.10.** Tuples **2.11.** Sequence Mutations **2.12.** Accumulation Patterns.	1. Operator precedence 2. Scope of variables

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Compare List and Tuples.
2. String functions with example.

b. Mini Project:

Create a Calculator.

c. Other Activities(Specify):

NA

ESC104.3: Gain an understanding of the various types of Conditional Statements, Loops, Arrays and Strings.

Approximate Hours

Item	Appx. Hrs.
Cl	10
LI	12
SW	2
SL	1
Total	25

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1. To Understand the loop types **SO2.2.** Identify the looping Expressions **SO2.3.** Apply arrays **SO2.4.** Use of user defined data type	**LI.3.1.** Write a Program for checking whether the given number is an even number or not. Using a for loop. **LI.3.2.** Write a program using a while loop that asks the user for a number, and **LI.3.3.** prints a countdown from that number to zero. **LI.3.4.** Write function to compute gcd, lcm of two numbers. **LI.3.5.** Write a program to implement Merge sort. **LI.3.6.** Write a program to implement Selection sort, Insertion sort	**Unit-3 : Conditional Statements, Loops, Arrays and Strings, User Defined Data Types** **3.1** If-else statement, **3.2** For loop, **3.3** While Loop, **3.4** Nested Iteration, **3.5** Concept and use of arrays **3.6** Declaration and usage of arrays, **3.7** 2-dimensionalarrays, **3.8** Different types of user defined datatypes **3.9** Structure **3.10** Union	**i.** Loops to access array elements **ii.** Member access in user defined data type.

SW-3 Suggested Sessional Work (SW):

a. Assignments:
1. Compare the looping statements
2. Use of user defined data type with example.

b. Mini Project:
Create a stopwatch.

c. Other Activities(Specify):
NA

ESC104.4: Familiarize with a concise overview of the Dictionaries and methods.

Approximate Hours

Item	Appx. Hrs.
Cl	10
LI	12
SW	2
SL	1
Total	25

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1. Understand the concepts of Dictionaries and Dictionary Accumulation **SO2.2.** Identify the Functions/Methods **SO2.3.** Apply functions **SO2.4.** Use of Functions/ Methods	**LI.4.1.** Write a program to count the numbersof characters in the string and **LI.4.2.**store them in a dictionary data structure. **LI.4.3.**Write a program to use split and join methods in the string and **LI.4.4.** trace a birthday of a person with a dictionary data structure. **LI.4.5** Write a program for user define function. **LI.4.6.** Write a program to demonstrate the use of Array.	**Unit-4 : Dictionaries and Dictionary Accumulation, Functions/Methods** **4.1** Dictionary Basics **4.2** Operations **4.3** Methods, accumulation. **4.4** Advantage of modularizing program into functions. **4.5** Function definition. **4.6** Function invocation. **4.7** Positional Parameter Passing **4.8** Passing arrays to functions **4.9** Recursion **4.10** Library Functions	**i.** Preparation of process Dictionary **ii.** A typical Positional Parameter Passing.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Write a program that reads a string from keyboard and prints the unique words
2. Use of user defined function with example.

b. Mini Project:

Map Two Lists into A Dictionary.

c. Other Activities(Specify):
NA.

ESC104.5: **Comprehend the functions of different File Handling and Memory Management.**

Approximate Hours

Item	Appx. Hrs.
Cl	6
LI	12
SW	2
SL	1
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO2.1 Understanding the file handling task **SO2.2** know the functions of file handling **SO2.3** Importance of csv file **SO2.4** Use of Memory Management	**LI.5.1.** Write a programto countfrequency of characters in a given file. **LI.5.2.**Can you use character frequency to tell whether the given file is a Python program file, C program file or a text file? **LI.5.3**Write a program to read data from a file. **LI.5.4.** Write a program to write data into a file. **LI.5.5.**Write a program to copy data from one file to another. **LI.5.6.**Write a program for memory management	**Unit 5: File Handling and Memory Management** 5.1 File Handling 5.2 Memory Management 5.3 Concepts of files and basic file operations. 5.4 Writing Data to a .csv File. 5.5 Reading Data to from a .csv File. 5.6 Memory Management Operations.	1. Role of file handling. 2.Working of .csv file

SW-5 Suggested Sessional Work (SW):

a. Assignments:
List the different file handling functions .

b. Mini Project:
Data base management of any fields by using file handling.

c. Other Activities(Specify):
NA.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CL)	Laboratory Instruction (LI)	Sessional Work (SW)	Self-Learning (SL)	Total hour (CL+SW+SL)
ESC104.1: At the end of this chapter the student will know the basic concept of programming.	7	12	2	1	22
ESC104.2: At the end of this chapter the student will use Operators in programs.	12	12	2	1	27
ESC104.3: At the end of this chapter the student will describe the control flow statements.	10	12	2	1	25
ESC104.4: At the end of this chapter the student will make function and dictionary	10	12	2	1	25
ESC104.5: Comprehend the functions of .csv and file handling functions.	6	12	2	1	21
Total Hours	45	60	10	5	120

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
ESC104.1	Understand the basic concept of Programming languages, software, algorithm and flowchart.	02	05	01	08
ESC104.2	Acquire knowledge regarding the building blocks of programming language.	02	03	05	10
ESC104.3	Apply python for solving basic programming solutions.	02	03	07	12
ESC104.4	Create algorithm using learnt programming skills.	1	3	7	10
ESC104.5	Understand real world problems and developing computer solutions for those.	1	05	05	10
Total		13	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Problem Solving and Programming will be held with written examination of 50 marks.

Suggested Learning Resources:

a. Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Programming for Problem Solving	R.S. Salaria, Khanna	Khanna Publishing House	2021, 4th Edition
2	Taming Python by Programming	Jeeva Jose	Khanna Publishing House	2019, 3rd Edition
3	Learning Python	Mark Lutz	O'Reilly Media	2013, 5th Edition

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech. Cement Tech. Course Code: ESC104, ESC104-L Course Title: Programming for Problem Solving

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct studies of difficult problems	Utilization of modern tools	Engineers and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-longlearning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO 1: Understand the basic concept of Programming languages, software, algorithm and flowchart.	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
CO 2: Acquire knowledge regarding the building blocks of programming language	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1
CO 3: Apply python for solving basic programming	2	2	1	1	1	2	2	2	1	2	1	2	1	1	2	2

solutions.																
CO 4: Create algorithms using learnt programming skills	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
CO 5: Understand real world problems and developing computer solutions for those.	**-**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Programming for Problem Solving

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 1: Understand the basic concept of Programming languages, software, algorithm and flowchart.	SO1.1 SO1.2 SO1.3 SO1.4	LI.1.1,LI1.2	Unit-1 Introduction to Programming 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned in Above pages
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 2 : Acquire knowledge regarding the building blocks of programming language.	SO2.1 SO2.2 SO2.3 SO2.4	LI.2.1,LI2.2,LI2.3,LI.2.4,LI.2.5	Unit-2 Datatypes and Operators, Variables, Sequences and Iteration 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7,2.8,2.9,2.10,2.11,2.12	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 3: Apply python for solving basic programming solutions. .	SO3.1 SO3.2 SO3.3 SO3.4	LI3.1, LI3.2,LI3.3,LI.3.4	Unit-3 Conditional Statements, Loops, Arrays and Strings, User Defined Data Types 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 4: Create algorithms using learnt programming skills.	SO4.1 SO4.2 SO4.3 SO4.4	LI4.1,LI.4.2	Unit-4 Dictionaries and Dictionary Accumulation, Functions/Methods: 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 5: Understand real world problems and developing computer solutions for those.	SO5.1 SO5.2 SO5.3 SO5.4	LI.5.1, LI5.2	Unit-5 File Handling and Memory Management: 5.1,5.2,5.3,5.4,5.5,5.6	

Semester II

Course Code: **ESC105, ESC105-L**

Course Title : **Manufacturing Practice Workshop**

Pre- requisite: Basic knowledge of mathematical skill with some scientific temperament.

Rationale: It is a place of work for preparing variety of jobs/products by using different kinds of Instruments, hand tools and Machines. In order to prepare the products in workshop, the workshop is divided into many branches according to nature of work. Ex: 1.Fitting shop 2. Welding shop 3. Sheet metal shop 4. M/c Shop 5. Foundry & Forging shop etc

Course Outcomes:

ESC105.1: Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.

ESC105.2: Acquired proficiency in using hand tools, understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques

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ESC105.3: Develop fundamental skills such as measuring, cutting and joining wood. Gain expertise in handling various carpentry tools and machinery.

ESC105.4: Appreciate and access the use of casting processes in manufacturing and understand the working of various casting processes.

ESC105.5: Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
ESC	ESC105	Manufacturing Practice Workshop	1	4	1	1	7	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others, **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment: Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
ESC	ESC105	Manufacturing Practice Workshop	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA(VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
ESC	ESC105	Manufacturing Practice Workshop	35	10	5	50	50	100

ESC105.1: Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.

Approximate Hours

Item	Appx. Hrs
Cl	03
LI	12
SW	1
SL	1
Total	17

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Understand various manufacturing processes, materials and technologies. **SO1.2** Acquire knowledge in cost estimation resource management and sustainable manufacturing practices.	**1.1** Safety aspects pertaining to common manufacturing practices. **1.2** Introduction of tools and machines used in each processes. **1.3** Basic instructions and procedures for using lathe and drilling machine. **1.4** Drawing of a simple workpiece for carrying out various lathe /drilling operations **1.5** Demonstration of different operations during actual performance of work. **1.6** Fire Safety Instructions during the work.	**Unit-1.0** **Manufacturing Methods casting, forming, machining, joining, advanced manufacturing methods, CNC machining, Additive manufacturing.** 1.1 Define manufacturing and various methods. 1.2 Introduction to casting, forming, machining, joining and advanced manufacturing methods. 1.3 Introduction to CNC machine.	1. Introduction to additive manufacturing.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Mechanical properties of engineering materials. Explain advanced manufacturing methods

ESC105.2: Acquired proficiency in using hand tools, understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques.

Approximate Hours

Item	AppX Hrs
Cl	03
LI	12
SW	1
SL	1
Total	17

Session Outcomes (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Understand different cutting tools like hacksaw, chisels etc. **SO2.2** Acquire knowledge of various fitting and assembly techniques.	**2.1** Safety instructions for using various fitting hand tools. **2.2** Tools Introduction **2.3** Instructions for using proper tools in the correct way **2.4** Drawing of a simple work piece for carrying out different fitting operations. **2.5** Demonstration of different inspection, checking and measuring methods used for proper fitting work. **2.6** Actual performance of a small simple job.	**Unit-2 Fitting operations & power tools** **2.1** Tools used in fitting shop **2.2** types of clamping tools, marking tools, cutting tools, striking tools. **2.3** Various operations performed on fitting shop	**i.** Types of drilling tools and threading tools.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Explain different striking tools with neat sketch

ii. Explain different types of vices used in fitting shop.

ESC105.3:.Develop fundamental skills such as measuring, cutting and joining wood. Gain expertise in handling various carpentry tools and machinery

Approximate Hours

Item	Appx. Hrs
CI	03
LI	12
SW	1
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Proficiency in measuring cutting and assembling wood. **SO3.2** Acquire knowledge in using various tools like saws, drills and planes **SO3.3** Understand joinery techniques, wood finishing and safety practices	**3.1** Safety instructions for using various carpentry tools. **3.2** Carpentry tools introduction. **3.3** Instructions for using proper tools in the correct way **3.4** Drawing of a simple work piece for preparation of common carpentry joinery work. **3.5** Demonstration of different inspection, checking and measuring methods used for proper carpentry work. **3.6** Production of any one type of joints listed below- i. Dovetail Joint/Corner ii. Joint/Mortise and Tenon Joint etc.	**Unit-3 : Carpentry shop** **3.1** Introduction to carpentry shop **3.2** Different methods of seasoning of timber **3.3** Carpentry tools	i. Defects in timber ii. Conversion of wood

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the different operation performed in wood working

ii. Sketch and describe the different joints made in carpentry shop.

iii. Explain the different types of wood working machines used in modern wood work.

b. Mini Project:

i. Production of a simple utility item using different carpentry tools and methods

ESC105.4: Appreciate and access the use of casting processes in manufacturing and understand the working of various casting processes.

Approximate Hours

Item	Appx. Hrs
CI	03
LI	12
SW	1
SL	1
Total	17

Session Outcome (SOs)	LaboratoryInstruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 The production of cast metal component, quality control measures and adherence to manufacturing standards	**4.1** Safety instructions for foundry shop, pattern making, mould preparation. **4.2** Foundry tools introduction. **4.3** Instructions for using proper tools in the correct way **4.4** Drawing of a simple work piece for preparation of a pattern. **4.5** Instructions for sand preparation, mould preparation, melting and casting properly in the safe manner. **4.6** Production of a simple casting.	**Unit-4 : Metal casting** **4.1** Introduction to foundry shop. **4.2** Pattern, Mould, Casting, pattern allowances, moulding sand. **4.3** Casting procedure, core, gating system.	i. Types of moulding sand. ii. Types of pattern

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Explain different defects in casting.

ii. Explain different casting terms like runner, riser, mould etc.

ESC105.5: : Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.

Approximate Hours

Item	Appx. Hrs
CI	03
LI	12
SW	1
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Performing set up, adjustment of flame and gas pressure, and shutdown procedure for oxyacetylene	**5.1** Safety instructions for welding shop. **5.2** Welding tools introduction for Electric Arc Welding process. **5.3** Instructions for using proper tools in the correct way. **5.4** Drawing of a simple welded joint viz. Square butt joint, T joint, Lap joint	**Unit 5: welding shop** **5.1** Introduction to welding shop, classification of welding process **5.2** Gas welding and its equipments and techniques	**1.** study of TIG and MIG welding process **2.** study of thermit welding process

welding and cutting equipment.	etc. **5.5** Demonstration of producing a square butt joint using MMAW process. **5.6** Actual production of a welded joint as described above.	**5.3** Electric arc welding and brazing process	

SW-5 Suggested Sessional Work (SW):

Assignments:

What are different types of joints in welding shop?

What is the function of flux in gas welding Preparing lap joint using arc welding process?

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Laboratory Instruction (LI)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
ESC105.1: Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.	3	1	12	1	17
ESC105.2: Acquired proficiency in using hand tools, understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques.	3	1	12	1	17
ESC105.3: Develop fundamental skills such as measuring, cutting and joining wood. Gain expertise in handling various carpentry tools and machinery.	3	1	12	1	17
ESC105.4: Appreciate and access the use of casting processes in manufacturing and understand the working of various casting processes.	3	1	12	1	17
ESC105.5: Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.	3	1	12	1	17
Total Hours	15	5	60	5	85

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods, CNC machining, Additive manufacturing	04	05	01	10
CO-2	Fitting operations & power tools	05	04	01	10
CO-3	Carpentry shop	-	05	05	10
CO-4	Metal casting	04	04	02	10
CO-5	Welding shop	05	03	02	10
Total		18	21	11	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Manufacturing Practice Workshop will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition & Year
1	Elements of Workshop Technology	Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K.	Media promoters and publishers private limited, Mumbai	Vol. I 2008 and Vol. II 2010
2	Manufacturing Engineering and Technology	Kalpakjian S. And Steven S. Schmid	Pearson Education India	Edition, 2002
3	Manufacturing Technology	Rao P.N	Tata McGraw Hill House	Vol. I and Vol. II 2007
4	Processes and Materials of Manufacture	Roy A. Lindberg	Prentice Hall India,	4th edition, 1998
5	Lecture note provided by Dept. of Mechanical Engineering, AKS University, Satna.			

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** ESC105 / ESC105-L **Course Title:** Manufacturing Practice Workshop

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.	2	1	2	2	3	2	2	2	2	1	3	2	2	2	1	2
CO-2: Acquired proficiency in using hand tools, understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques.	1	1	1	1	3	2	2	2	2	1	2	2	1	2	1	2
CO-3: Develop fundamental skills such as measuring, cutting and joining wood. Gain expertise in handling various carpentry tools and machinery.	2	2	1	1	3	1	2	2	2	1	1	2	1	2	1	1

CO-4: Appreciate and access the use of casting processes in manufacturing and understand the working of various casting processes.	**2**	**2**	**2**	**1**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**2**
CO-5: Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.	**2**	**1**	**1**	**1**	**1**	**3**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**1**	**1**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Manufacturing Practice Workshop

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Understand various production processes, selecting appropriate methods for different material, optimizing manufacturing efficiency and ensuring product quality.	SO1.1 SO1.2	1.1 1.2 1.3 1.4 1.5 1.6	**Unit-1: Manufacturing Methods-casting, forming, machining, joining, advanced manufacturing methods, CNC machining, Additive manufacturing** 1.1,1.2,1.3	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Acquired proficiency in using hand tools, understanding different types of fits and tolerances, interpreting engineering drawing and precision measurement techniques.	SO2.1 SO2.2	2.1 2.2 2.3 2.4 2.5 2.6	**Unit-2: Fitting operations & power tools** 2.1, 2.2, 2.3	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Develop fundamental skills such as measuring, cutting and joining wood. Gain expertise in handling various carpentry tools and machinery.	SO3.1 SO3.2 SO3.3	3.1 3.2 3.3 3.4 3.5 3.6	**Unit-3: Carpentry shop** 3.1, 3.2,3.3	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Appreciate and access the use of casting processes in manufacturing and understand the working of various casting processes.	SO4.1	4.1 4.2 4.3 4.4 4.5 4.6	**Unit-4: Metal casting** 4.1, 4.2,4.3	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Analyze and access the importance of welding processes in manufacturing and apply knowledge to select appropriate welding process based on the type of industrial application.	SO5.1	5.1 5.2 5.3 5.4 5.5 5.6	**Unit 5: Welding Shop** 5.1,5.2,5.3	

Semester-II

Course Code: **HSMC01**

Course Title : **Communication Skills (English)**

Pre- requisite: Students must have basic knowledge of English language.

Rationale: In order to compete in this fast growing world, LSWR skills of the students should be well developed and enhanced. Besides, they must have effective communication skills as it plays a vital role in shaping individual's personality and career. It also boosts the confidence and prepares them to face the audience fearlessly.

Course Outcomes:

HSMC01.1: Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.

HSMC01.2: Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.

HSMC01.3: Students will be able to communicate effectively in Hindi and English languages without hindrances.

HSMC01.4: Students will be able to convey their messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.

HSMC01.5: The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers.

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Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of Studies(Hours/Week)					Total Credits(C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
HSMC	HSMC01	Communication Skills (English)	3	0	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
HSMC	HSMC01	Communication Skills (English)	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including

Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL).

As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

HSMC01.1: Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.

Approximate Hours

Item	Appx. Hrs
CI	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Students will be able to introduce themselves **SO1.2** Understand the concept of Oral Presentation **SO1.3** Students will be able to dress and present effectively **SO1.4** Understand the importance of Body Language **SO1.5** Students will be able to influence mass through skit and dramas.		**Self-grooming, Basic Etiquettes and Presentation Skill** **1.1** Self-introduction **1.2** Practice Sessions **1.3** Oral Presentation **1.4** Characteristics of presentation. **1.5** Presentation topics (The importance of Education, The importance of English in Today's World and Necessity of uniforms in a college) **1.6** Professional dressing and grooming etiquettes. **1.7** Body Language tips and techniques. **1.8** Role play sessions on following topics: Classroom interaction, Hospital Scene and Scene at Railway station **1.9** Performance by Students	**1.** Prepare a presentation on the given topics. **2.** Prepare a play on the given topics.

HSMC01.2: **Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.**

Approximate Hours

Item	Appx. Hrs
CI	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Understand the techniques of Group Discussion **SO2.2**Understand the concept of Debate **SO2.3** Students will be able to design a professional resume and crack interview **SO2.4** Explain the concept of how to ace in an interview.	.	**UNIT 2:** Confidence building skills, Interview Skills and Resume Writing **2.1** Group Discussion **2.2** Do's and Donts of GD **2.3** Group Discussion sessions on impact of Covid 19 on mental health, impact of social media on lives, pros and cons of technology **2.4** Difference between GD and Debate. **2.5** Do's and Don'ts of Debate. **2.6** Debate topics on Should the Use of Plastic Be Banned? Should Parents Decide Which Career Their Children Will Pursue?, Is Artificial Intelligence Useful or Dangerous? **2.7** Interviews and their Kinds **2.8** Mock Interview Session **2.9** Resume Writing.	**1.** Prepare debate on given topics **2.** Prepare a Resume

HSMC01.3: Students will be able to communicate effectively in Hindi and English languages without hindrances

Approximate Hours

Item	Appx. Hrs
Cl	10
LI	0
SW	1
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Students will be able to organize and prepare speeches. **SO3.2** Students will be able to think and speak	.	**Unit-3 :Public Speaking Skills& Conversational Skills** **3.1** Speech **3.2** Types of Speech **3.3** Speech /Anchoring on (National Science Day, Valedictory Speech,	1. Prepare a speech on the following topics. 2. Prepare on the following

instantaneously. **SO3.3** To make them understand the inquiry procedure at public places. **SO3.4** To enable them to communicate effectively through phones.		Patriotic speech). **3.4** Performance in the class. **3.5** Extempore **3.6** Extempore Topics on (Pros and Cons of Online teaching, Environment Conservation and Education of a Girl Child) **3.7** Practice Session **3.8** Conversational Topics (Inquiry at bank, Airport, Station and Hospitals). **3.9** Telephonic Conversation (Describing about Your College Day to Your Parents from Hostel, **3.10** Talking with Customer Care Executive of Any E-Commerce Company). Revision	conversational topics.

HSMC01.4: Students will be able to convey their messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.

Approximate Hours

Item	Appx. Hrs
Cl	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Understanding about the use of Prepositions. **SO4.2** Students will be able to understand the usage of Tenses **SO4.3** Understand the concept of Active and Passive Voice **SO4.4** To understand the usage of Modals		**Unit-4: Functional Grammar and Vocabulary Building** **4.1** Prepositions (Place, Time and Direction) **4.2** MCQ based Questions on Prepositions. **4.3** Gap filling using prepositions. **4.4** Tenses **4.5** Present Tense **4.6** Past Tense **4.7** Future Tense	1. Prepare the structure of Tenses and Active Passive. **2.** Prepare 250 vocabularies.

		4.8 Voice (Active and Passive) **4.9** Modals.	

HSMC01.5: The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers.

Approximate Hours

Item	Appx. Hrs
CI	8
LI	0
SW	1
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Students will be able to understand the value of Indian Literature (R.K. Narayan) **SO5.2** Students will be able to understand the value of Indian Literature (Nissim Ezekiel) **SO5.3** Students will be able to understand the value of Indian Literature (Khushwant Singh) **SO5.4** Students will be able to understand the value of Indian Literature (Mulk Raj Anand) **SO5.5** Students will be able to understand the value of Indian Literature (Premchand)		**Unit 5-Indian Writing in English & Hindi** **5.1** The Axe- R.K. Narayan **5.2** About the Author - R.K. Narayan **5.3** The Night of the Scorpion- Nissim Ezekiel **5.4** About the Poet - Nissim Ezekiel **5.5** The Portrait of a Lady – Khushwant Singh **5.6** About the author- Khushwant Singh **5.7** The Lost Child- Mulk Raj Anand **5.8** The Shroud- Premchand	Prepare the summary of all the topics (The Axe, The Night of the Scorpion, The Portrait of a Lady, The Lost Child he Shroud).

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (CI+SW+Sl)
CO101.1: Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.	9	1	1	11
CO101.2: Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.	9	1	1	11
CO101.3: Students will be able to communicate effectively in Hindi and English languages without hindrances.	10	1	1	12
CO101.4: Students will be able to convey their messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.	9	1	1	11
CO101.5: The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers.	8	1	1	10
Total Hours	45	5	5	55

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Self Grooming, Basic Etiquettes and Presentation.	03	01	01	05
CO-2	Confidence Building and Interview Skills.	02	06	02	10
CO-3	Public Speaking Skills and Conversational Skills	03	07	05	15

CO-4	Functional Grammar and Vocabulary Building	-	10	05	15
CO-5	Indian Writings in English and Hindi	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Communication Skills	Dr. Meenu Pandey	Nirali Praksahan.	February 2019
2	A Practical Guide to English Grammar	K.P. Thakur	Bharti Bhawan Publishers & Distributors.	9th Edition, 2017
3	Living English Structure	W. Stannard Allen	Dorling Kindersley India Pvt. Ltd.	Fifth Edition,

4	Communication Skills for Engineers	Muralikrishna C., Sunita Mishra	Pearson, New Delhi.	Second edition(2010)
5.	Advanced Language Practice,	Michael Vince	Macmillan Education, Oxford	2003.
6.	English Conversation Practise	Grant Taylor	Tata McGraw Hill Education Private Limited.	2007
7.	Six Weeks to Words of Power	Wilfred Funk	W.R. Goyal Publishers and Distributors.	2005

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech   Course Code: HSMC01   Course Title: Communication Skills (English)

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.	1	1	2	2	3	3	2	2	1	1	1	1	1	1	1	1
CO-2: Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.	1	1	1	1	3	3	2	2	2	2	1	1	1	1	1	2

CO-3: Students will be able to communicate effectively in Hindi and English languages without hindrances.	1	1	2	1	2	3	1	2	1	1	1	1	1	1	1	1
CO-4: Students will be able to convey their messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.	1	1	1	1	1	3	1	2	1	1	1	1	1	1	1	1
CO-5: The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers.	1	1	2	1	1	3	1	2	1	1	1	1	1	1	1	1

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Communication Skills (English)

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Students will be able to speak confidently in public as all the topics chosen emphasis on improving speaking skills and developing self confidence amongst them.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Self Grooming, Basic Etiquettes and Presentation** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Students will be able to interact properly with improved Leadership Skills, Problem Solving Skills, Social skills and Communication Skills. Students will also be able to understand the Importance of Team Work.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: Confidence Building and Intervie Skills** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Students will be able to communicate effectively in Hindi and English languages without hindrances.	SO3.1 SO3.2 SO3.3 SO3.4		**Unit-3: Public Speaking Skills and Conversational Skills** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Students will be able to convey their messages accurately by understanding the significance of grammar as it plays a vital role in improving speaking and writing skills.	SO4.1 SO4.2 SO4.3 SO4.4		**Unit-4: Functional Grammar an Vocabulary Building** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** The Understanding of Indian Culture and English Language will be developed through the study of Dramas and Poems written by Indian Writers.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Indian Writings in English and Hindi** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8	

Semester-II

Course Code: **HSMC08**

Course Title: **Sustainable Development Goals**

Pre-requisite: Student should have basic knowledge of Environment, Natural resources, Climate change and sustainability.

Rationale: To inculcate the knowledge base on sustainable development with a view to balance our economic, environmental and social needs, allowing prosperity for now and future generations. To train students to undertake major initiatives in the efficient management of natural resources and the prevention of environmental pollution with focus on Sustainable Development.

To use environmental management tools that help to improve the quality of environment, to assess local vulnerabilities with respect to climate, natural disasters and to achieve sustainable developmental needs.

Course Outcomes:

HSMC08.1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.

HSMC08.2: Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.

HSMC08.3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.

HSMC08.4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.

HSMC08.5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programmers and processes.

Scheme of Studies:

Category of Course	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
SDGs	SDGs101	Sustainable Development Goal	2	0	1	1	4	2

Legend:
CI: Class room Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT +AT)		
HSMC	HSMC08	Sustainable Development Goal	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

HSMC08.1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.

Approximate Hours

Item	Appx. Hrs
Cl	06
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Understand about Sustainable Development **SO1.2** Understand the Need and Importance of SDGs **SO1.3** Understand the historical evolution of SDGs **SO1.4** Gain knowledge of SDGs Different goals and their importance **SO1.5** Explain the Challenges & strategies of attaining SDGs in countries..		**Unit-1.0 Introduction to Sustainable Development** **1.1** Need and Importance of Sustainable Development **1.2** Historical & Policy perspectives of Sustainable Development **1.3** Sustainable Development: World and India Perspective **1.4** Introduction to 17 SDGs **1.5** Specific learning objectives for different SDGs **1.6** Challenges & strategies of attaining SDGs in developed and developing nations	Different SDG goals details and its importance

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Overview of SDGs, Sustainable Consumption and Production, Details of 17 SDGs

b. Other Activities (Specify):

Note down the different challenges in our state and district to achieve SDG

HSMC08.2: Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability and measuring.

Approximat Hours

Item	Appx. Hrs
Cl	06
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 Explain Sustainable Development **SO2.2** Understand the NEP-2020 and SDG **SO2.3** Discuss higher Education role to achieve SDGs **SO2.4** Explain how education for Sustainable Development **SO2.**5 Explain the measuring techniques for Sustainability		**Unit-2.0 Special focus on SDG 4-Quality Education and Lifelong Learning:** **2.1** Focus of NEP-2020 on SDG **2.2** Education for Sustainable Development (ESD): **2.3** Berlin Declaration 2021 on ESD **2.4** Integration of ESD in curriculum and textbooks **2.5** Tools, Systems, and Innovation for Sustainability **2.6** Measuring Sustainability: How do we measure sustainability	1 NEP 2020 objectives and concept for SDGs 2 Concept, Tools and techniques for measuring sustainability

SW-2 Suggested Sessional Work (SW):

a. Assignments:

Education role to achieve SDGs, The role of education in Sustainable Development, Measuring techniques of sustainability, Sustainability Indicators

b. Other Activities (Specify): Seminar and group discussion on ESD and measuring sustainability Millennium Development Goals (MDGs)

HSMC08.3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.

Approximate Hours

Item	Appx. Hrs
Cl	06
LI	0
SW	1
SL	1
Total	**8**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Understand current economic issues in the context of the global sustainable development debate. **SO3.2** Outline of health, hygiene and water sanitation issues. **SO3.3** Discuss the renewable energy resources and its importance in present scenario **SO3.4** Explain the importance of sustainable production and consumption **SO3.5** Explain the problems and solution in rural and urban areas.		**Unit-3.0 Understanding the SDGs** **3.1** Circular economy (basic model of reuse, recycle, and reduce) **3.2** Rural & urban Problems & Challenges **3.3** Sustainable production and consumption **3.4** Renewable energy **3.5** Health & Hygiene, water , sanitation & water management **3.6** Waste Management	**1.** Water treatment and management practices. **2.** Nonrenewable energy resources.

SW-3 Suggested Sessional Work (SW):

Smart cities Assignments:

Eco-friendly energy resources importance, types of waste and its management, Urban Problems & Challenges

Other Activities (Specify):

Visit of waste water treatment plant, Visit of water treatment process.

HSMC08.4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.

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Approximate Hours

Item	Appx. Hrs
Cl	06
LI	0
SW	1
SL	1
Total	**8**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 Understand environmental sustainability is crucial in reducing the impacts of climate change **SO4.2** Discuss causes of emission of GHGs and its consequences **SO4.3** Explain how climate change and sustainable development both play a role in shaping the human and environmental factors of the world. **SO4.4** Explain the importance of sustainable production and consumption **SO4.5** Climate change is disrupting national economies and affecting lives and livelihoods, especially for the most vulnerable and its mitigation.		**Unit-4.0 Climate Change, Energy and Sustainable Development** **4.1** The greenhouse effect: Causes and Consequences **4.2** Climate Change: A Threat to Sustainable Development **4.3** Adaptation to Current and Future Climate Regimes **4.4** The consequences: crop failure **4.5** Solutions technology and lifestyle changes **4.6** Mitigating Climate Change	**1.** Agreement on Climate Change, Trade, and Sustainability Carbon Credit, carbon trading. **2.** Kyoto Protocol

SW-4 Suggested Sessional Work (SW):

a. Assignments:

Urban Sustainability and Climate Change, Sustainable Development Policies, Agreement on Climate Change, Trade and Sustainability, Resilient cities – What makes a city sustainable, green, and resilient

b. Other Activities (Specify):

HSMC08.5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programmes and processes.

Approximate Hours

Item	Appx. Hrs
Cl	06
LI	0
SW	1
SL	1
Total	**8**

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Understand the relevance and the concept of sustainability and the global initiatives in this direction **SO5.2** Understand role of Corporations and Ecological Sustainability. **SO5.3** Explain role of CSR in Sustainability. **SO5.4** Understand the SD challenge for companies, their responsibility and their potentials for action **SO5.5** Discuss the role of world government for world justice and peace		**Unit-5.0 Sustainable Business Practices:** **5.1** Corporate Social Responsibility **5.2** Sustainable products and services **5.3** Business and Environment **5.4** Corporations and Ecological Sustainability **5.5** Life Cycle Assessment: -LCA Overview and Application **5.6** World peace and justice: -United nations goals for peace and justice -World Government for peace	Local to the Global: Can Sustainable Development Work

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Consumption Patterns and Lifestyles, Company Perspectives for Environmental Sustainability, An Introduction to Economic Growth

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Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
HSMC08.1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.	6	1	1	8
HSMC08.2: Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.	6	1	1	8
HSMC08.3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.	6	1	1	8
HSMC08.4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.	6	1	1	8
HSMC08.5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programmes and processes.	6	1	1	8
Total Hours	30	5	5	40

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction to Sustainable Development	03	01	01	05
CO-2	Special focus on SDG 4-Quality Education and Lifelong Learning:	02	06	02	10
CO-3	Understanding the SDGs	03	07	05	15
CO-4	Climate Change, Energy and Sustainable Development	-	10	05	15
CO-5	Sustainable Business Practices	03	02	-	05

Total	11	26	13	50

Legend: R: Remember, U: Understand, A: Apply A: Analyse E:Evaluate C:Create

The end of semester assessment for Sustainable Development Goals will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to industry, water treatment plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration /Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	The Economics of Sustainable Development: The Case of India (Natural Resource Management and Policy)"	Surender Kumar and Shunsuke Managi	Springer Switzerland	2009
2	Corporate Social Responsibility in Developing and Emerging Markets	Onyeka Osuji	Cambridge	New Edition June 2022
3	Smart Cities for Sustainable Development	Ram Kumar Mishra, Ch Lakshmi Kumari, Sandeep Chachra, P.S. Janaki Krishna	Springer Switzerland	March 2022
4	Sustainable Development: Linking Economy, Society, Environment	Tracey Strange and Anne Bayley		

5	Management Of Resources For Sustainable Devpt	Sushma Goyal	The Orient Blackswan	2016
6	Energy, Environment and Sustainable Development: Issues and Policies	S. Ramaswamy Sathis G. Kumar	Regal Publications	2009
7	The New Map: Energy, Climate, and the Clash of Nations	Daniel Yergin	Penguin Press	September 2015
8	Contributions of Education for Sustainable Development (ESD) to Quality Education:	Laurie, R., Nonoyama-Tarumi, Y., Mckeown, R., & Hopkins, C.	A Synthesis of Research. Journal of Education for Sustainable Development, 10(2), 226–242.	2016
9	Sustainable Results in Development: Using the SDGs for Shared Results and Impact	OECD	OECD Publishing, Paris	2019
10	Development Discourse and Global History from colonialism to the sustainable development goals	Ziai, Aram	Routledge, London & New York	2016
11	Sustainable Development Goals An Indian Perspective,	Hazra, Somnath., Bhukta, Anindya	Springer Switzerland	2020
12	Environmental Ecology, Biodiversity and Climate Change	HM Saxena	Rawat Publication	January 2021
13	https://www.un.org/sustainabledevelopment/			
14	https://www.aiu.ac.in/documents/AIU_Publications/UN-SDG goals			
15	https://www.unesco.org/en/education-sustainable-development			
16	https://onlinecourses.nptel.ac.in/noc23_hs57/preview			
17	ttps://www.iau-hesd.net/news/5180-berlin-declaration-education-sustainable development-adopted-unesco-esd-conference-17-19			

Curriculum Development Team

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Cos, POs and PSOs Mapping

Program Title: B. Tech Cement Tech | Course Code: HSMC08 | Course Title: Sustainable Development Goals

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO 5	PO 6	PO7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	Ability to understand technical & engineering knowledge for production quality	the day to plant operational problems	the latest cement manufacturing technology and it	research based innovative knowledge for sustainable
CO-1: Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.	1	1	1	2	3	2	3	2	2	1	3	3	1	2	2	3
CO-2: Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.	1	1	2	2	1	2	3	2	1	1	2	3	2	2	2	2
CO-3: Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.	2	2	1	1	1	2	2	2	1	2	1	2	1	1	1	1
CO-4: Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of	3	2	2	2	3	2	3	2	2	1	2	2	2	2	3	3

an argument for solution.																
CO-5: Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programmes and processes.	**1**	**1**	**1**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**1**	**2**	**3**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Sustainable Development Goals

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Examine critically the 17 newly minted UN Sustainable Development Goals and understand the historical evolution, key theories, and concepts of sustainable development.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Introduction to Sustainable Development** 1.1,1.2,1.3,1.4,1.5,1.6	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Identify and apply methods for assessing the achievement of sustainable development and discover the science, technology, economics, and politics underlying the concepts of sustainability.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Special focus on SDG 4- Quality Education and Lifelong Learning:** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Understand the implications of overuse of resources, population growth and economic growth and sustainability and explore the challenges the society faces in making transition to renewable resource use.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Understanding the SDGs** 3.1,3.2,3.3,3.4,3.5,3.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Develop skills to understand attitudes on individuals, society and their role regarding causes and solutions in the field of sustainable development and apply critical thinking skills to evaluate the quality, credibility and limitations of an argument for solution.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Climate Change, Energy and Sustainable Development** 4.1,4.2,4.3,4.4,4.5,4.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Describe the steps of the design thinking methodology and how design thinking can accelerate effective SDG implementation. Deepen knowledge and pedagogical tools to incorporate values-based education for sustainable development in educational programmers and processes.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Sustainable Business Practices:** 5.1,5.2,5.3,5.4,5.5,5.6	

Semester II

Course Code: **HSMC09**

Course Title : **Sports and Yoga**

Pre- requisite: Student should have basic knowledge of Sports and Yoga concepts

Rationale: Students of Yoga should have a legal understanding of Yoga and its original text Yoga. At the same time, they should also have adequate knowledge Yoga practices in which they should have knowledge of its basic principles and elements.

Course Outcomes:

HSMC09.1: A makes the students understand the importance of Introduction of Yog.
HSMC09.2: To make the students understand the importance of Fundamentals of Yog.
HSMC09.3: To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.
HSMC09.4: To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury and Yoga & Lifestyle
HSMC09.5: To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health

Course Category	Course Code	Course Title	Scheme of Studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
HSMC	HSMC09	Sports and Yoga	2	0	0	0	2	0

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others, **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits. 2

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
HSMC	HSMC09	Sports and Yoga	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

HSMC09.1: To make the students understand the importance of Introduction of Yoga.

Approximate Hours

Item	Appx. Hrs
CI	06
LI	0
SW	0
SL	0
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Student will able to Understand the Meaning & Importance of Yoga **SO1.2** Student will able to Describe the Elements of Yoga,astang yoga **SO1.3** Student will able to Describe Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas **SO1.4** Student will able to Understand the Concept of Yoga for concentration & related Asanas **SO1.5** Student will able to Understand the Concept of Relaxation Techniques for improving concentration - Yog-nidra	.	**Unit-1. Introduction of Yoga** **1.1.** Meaning & Importance of Yoga **1.2.** Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas **1.3.** Yoga for concentration & related Asanas (Sukhasana; Tadasana; Padmasana & Shashankasana) **1.4.** Relaxation Techniques for improving concentration - Yog-nidra **1.5.** Relaxation Techniques for improving concentration - Yog-nidra **1.6.** Relaxation Techniques for improving concentration - Yog-nidra	**1.** Meaning & Importance of Yoga **2.** Introduction - Asanas, Pranayama, Meditation & Yogic Kriyas **3.** Relaxation Techniques for improving concentration - Yog-nidra

HSMC09.2: To make the students understand the importance of Fundamentals of Yoga

Approximate Hours

Item	Appx. Hrs
CI	06
LI	0
SW	0
SL	0
Total	06

Session Outcomes (SOs)	Laboratory Instructi (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1. Student will able to Understand Fundamentals of Yoga **SO2.2.** Student will able to Understand the Effect of Yoga on the functioning of Various Body Systems	.	**Unit-2. Fundamentals of Yoga** **2.1** Purpose yoga, definition of yoga, need and use of Yoga for students. **2.2** Effect of Yoga on the functioning of Various Body Systems. **2.3** Effect of Yoga on the functioning of Various Body Systems **2.4** Circulatory System, **2.5** Respiratory System, **2.6** Neuro- System , Muscular System etc.	**1.** Effect of Yoga on the functioning of Various Body Systems **2.** Fundamentals of Yoga

HSMC09.3: To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.

Approximate Hours

Item	Appx. Hrs
CI	6
LI	0
SW	0
SL	0
Total	6

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Student will able to Understand Meaning & Importance Physical Fitness, Wellness & Lifestyle **SO3.2**Student will able to Understand the Components of Physical fitness **SO3.3** Student will able to Describe **SO3.4** Student will able to Understand of Health related fitness **SO3.5** Student will able to	.	**Unit-3. Physical Fitness, Wellness & Lifestyle** **3.1** Meaning & Importance of Physical Fitness & Wellness **3.2** Components of Physical fitness **3.3** Components of Health related fitness **3.4** Components of wellness **3.5** Preventing Health Threats through Lifestyle Change **3.6** Concept of Positive	**1.** Physical Fitness **2.** Wellness & Lifestyle

Understand of Preventing Health **SO3.6** Student will able to Describe Concept of Positive Life		Lifestyle	

HSMC09.4: To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury and Yoga & Lifestyle

Approximate Hours

Item	Appx. Hrs
CI	6
LI	0
SW	0
SL	0
Total	6

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Student will able to Understand Asanas as preventive measures **SO4.2** Student will able to Understand the Hypertension, Obesity, Back Pain, Diabetes, Asthema	.	**Unit-4. Yoga & Lifestyle** **4.1** Asanas as preventive measures. **4.2** Hypertension: Tadasana, Vajrasana, Pavan Muktasana, ArdhaChakrasana,Bhujangasana, Sharasana. **4.3** Back Pain: Tadasana, Ardh Matsyendrasana, Vakrasana, Shalabhasana, Bhujangasana **4.4** Diabetes: Procedure, Benefits & contraindications for Bhujangasana, Paschimottasana, Pavan Muktasana, Ardh Matsyendrasana **4.5** Asthema: Procedure, Benefits & contraindications for Sukhasana, Chakrasana, **4.6** Gomukhasana, Parvatasana, Bhujangasana, Paschimottasana, Matsyasana. And Obesity: Procedure, Benefits & contraindications for Vajrasana, Hastasana, Trikonasana, Ardh Matsyendrasana.	1. Asanas as preventive measures

HSMC09.5: To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health &Postures.

Approximate Hours

Item	Appx. Hrs
CI	6
LI	0
SW	0
SL	0
Total	6

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Student will able to Understand the Meaning and Concept of Postures **SO5.2:** Student will able to Understand the Causes of Bad Posture **SO5.3** Student will able to describe Concept & advantages of Correct Posture	.	**Unit-5. Postures** 5.1 Meaning and Concept of Postures. 5.2 Causes of Bad Posture 5.3 Advantages & disadvantages of weight training 5.4 Concept & advantages of Correct Posture. 5.5 Common Postural Deformities – Knock Knee; Flat Foot; Round Shoulders 5.6 Lordosis, Kyphosis, Bow Legs and Scoliosis.	**1.** Meaning and Concept of Postures

SW-4 Suggested Sessional Work (SW):

a. Assignments:
i. Yoga & Lifestyle
ii. Physical Fitness, Wellness & Lifestyle

Brief of Hours suggested for the Course Outcome

Course Outcomes	**Class Lecture (CI)**	**Sessional Work (SW)**	**Self-Learning (Sl)**	**Total hour (CI+SW+Sl)**
HSMC09.1: To make the students understand the importance of Introduction of Yoga	6	0	0	6
HSMC09.2: To make the students understand the importance of Fundamentals of Yoga	6	0	0	6
HSMC09.3: To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.	6	0	0	6
HSMC09.4: To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury and Yoga & Lifestyle	6	0	0	6
HSMC09.5 To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health &Postures	6	0	0	6
Total Hours	30	0	0	30

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction of Yoga	10	10	00	20
CO-2	Fundamentals of Yoga	10	10	00	20
CO-3	Physical Fitness, Wellness & Lifestyle	05	05	00	20
CO-4	Yoga & Lifestyle	05	05	00	20
CO-5	Postures	05	05	00	20
Total		25	25	00	100

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Yoga will be held with writtenexamination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT,Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books

TEXT BOOKS

Text Books/References:

S.No.	Title	Author	Publisher	Edition & Year
1	Modern Trends and Physical Education	Prof. Ajmer Singh	New publication house Delhi	1st edition/2019
2	Asan pranayama mudra bandh	Swami satyanand sarswati	Shivanand publication Munger Bihar	1st edition 2003

3	Light On Yoga	B.K.S. Iyengar.	Iyengar publication	1st edition 2001
4	Health and Physical Education	NCERT	NCERT	1st edition 2003

Curriculum Development Team

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech. Cement Tech. **Course Code:** HSMC09 **Course Title:** Sports and Yoga

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
HSMC09.1: To make the students understand the importance of Introduction of Yoga	1	2	1	1	1	1	1	1	2	1	1	1	1	1	1	2
HSMC09.2: To make the students understand the importance of Fundamentals of Yoga	1	2	1	1	1	1	1	1	2	1	1	1	1	1	1	2
HSMC09.3: To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.	1	2	1	1	2	1	2	1	2	2	1	2	1	1	1	2

HSMC09.4: To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury and Yoga & Lifestyle	1	2	1	1	1	1	1	1	2	1	1	1	1	1	1	1
HSMC09.5 To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health &Postures	1	2	1	1	2	1	3	1	2	1	2	2	1	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Sports and Yoga

POs & PSOs No.	COs No.& Titles	SOs No.	LI	Classroom Instruction (CI)	Self- Learning (SL)
PO 1,2,3,4,5,6,7,8,9 PSO 1,2, 3, 4, 5	**HSMC09.1:** To make the students understand the importance of Introduction of Yoga	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Introduction of Yoga 1.1,1.2,1.3,1.4,1.5,1.6	As mentioned in above pages
PO 1,2,3,4,5,6, 7,8,9 PSO 1,2, 3, 4, 5	**HSMC09.2:** To make the students understand the importance of Fundamentals of Yoga	SO2.1 SO2.2		Unit-2 Fundamentals of Yoga 2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO 1,2,3,4,5,6, 7,8,9 PSO 1,2, 3, 4, 5	**HSMC09.3:** To expose the students to a variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5 SO3.6		Unit-3 : Physical Fitness, Wellness & Lifestyle 3.1, 3.2,3.3,3.4,3.5,3.6	
PO 1,2,3,4,5,6, 7,8,9 PSO 1,2, 3, 4, 5	**HSMC09.4:** To create a safe, progressive, methodical and efficient activity based plan to enhance improvement and minimize risk of injury and Yoga & Lifestyle	SO4.1 SO4.2		Unit-4 Yoga & Lifestyle 4.1, 4.2,4.3,4.4,4.5,4.6	
PO 1,2,3,4,5,6,7,8,9, PSO 1,2,3,4,5,	**HSMC09.5** To develop among students an appreciation of physical activity as a lifetime pursuit and a means to better health &Postures	SO5.1 SO5.2 SO5.3		Unit 5- Postures 5.1,5.2,5.3,5.4,5.5,5.6	

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Semester-III

Course Code: **PCC-CT201**

Course Title : **Process Calculation**

Pre-requisite: Student should have basic knowledge of Chemistry, Physics and Mathematics.

Rationale: A process calculation introduces the basic calculation techniques for analyzing and designing chemical processing equipment. Data sources containing relevant physical and chemical properties are introduced. In addition, training in group and collaborative working and communication skills is undertaken as part of this course. To enables the students to acquire knowledge on laws of chemistry and its application to solution of mass and energy balance equations.

Course Outcomes:

PCC-CT201.1: Understand the concepts of dimensional consistency and effective application of units and dimensions.

PCC-CT201.2: Apply mole concept and ideal gas equation to express the composition of mixtures.

PCC-CT201.3: Carry out material balance calculations of distillation, evaporator, crystallization and drying processes. Analyze the behavior of recycle processes, performing approximate material balances, Solve material balance problems with chemical reactions.

PCC-CT201.4: Understand the concept of humidity and usage of psychometric chart.

PCC-CT201.5: Understand general energy balance, simplify and apply to open and closed systems. Write material and energy balance for unsteady state how material and energy balances are formulated for equation.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT201	Process Calculation	4	0	1	1	6	4

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others,

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini-project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT201	Process Calculation	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT201.1: Understand the concepts of dimensional consistency and effective application of units and dimensions.

Approximate Hours

Item	Appx. Hrs
CI	08
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the concept of Base units **SO1.2** Understand the concept of Derived units **SO1.3** Understand the concept of System of units **SO1.4** Solving the Conversion of units		**Unit-1:Units and Dimensions** **1.1** Base units **1.2** Derived units **1.3** Derived quantity: Force, Pressure, Work and Heat **1.4** System of units **1.5** Conversion of units **1.6** Dimensional Consistency **1.7** Numerical Problems on Derived units **1.8** Numerical Problems on Conversion of units	**1.** Conversion factor to SI units

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Numerical Problems on Derived units and Conversion of units

b. Mini Project:

Draw the table of System of units and dimensions.

PCC-CT201.2: Apply mole concept and ideal gas equation to express the composition of mixtures.

Approximate Hours

Item	Appx. Hrs
CI	14
LI	0
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 To Understand the basic chemical calculation. **SO2.2** To apply the methods of expressing the compositions of mixture and solutions. **SO2.3** To understands the different law for chemical calculation.		**Unit-2: Basic chemical calculation** **2.1** Gram mole **2.2** Normality **2.3** Molarity **2.4** Molality **2.5** Methods of expressing the compositions of mixture and solutions: Weight percent **2.6** Methods of expressing the compositions of mixture and solutions: Mole percent **2.7** Methods of expressing the compositions of mixture and solutions: Volume percent **2.8** Ideal gas law **2.9** Dalton law and Amagat's law **2.10** Raoult's law and Henry law **2.11** Relationship between partial pressure & mole fraction of component gas to total pressure **2.12** Numerical Problems on Normality, Molarity and Molality **2.13** Numerical Problems on Methods of expressing the compositions of mixture and solutions **2.14** Numerical Problems on Ideal gas law	**1**. Remember the Periodic Table including the atomic number and atomic weight

SW-2 Suggested Sessional Work (SW):

a. Assignments:
   i. Numerical Problems on Normality, Molarity and Molality
   ii. Numerical Problems on Methods of expressing the compositions of mixture and solutions
   iii. Numerical Problems on Ideal gas law

b. MiniProject:
   a. Draw the chart of Periodic Table

c. Other Activities (Specify):
Calculation of Molecular weight and Valence

PCC-CT201.3: Carry out material balance calculations of distillation, evaporator, crystallization and drying processes. Analyze the behavior of recycle processes, performing approximate material balances, Solve material balance problems with chemical reactions.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 To Understand the basic Stoichiometric principles. **SO3.2** To apply the Application of material balance to unit operation **SO3.3** To Understand the Material balance with		**Unit-3 :Stoichiometric and Materials Balance to Unit Operation** **3.1** Stoichiometric principles **3.2** Application of material balance to unit operation: Distillation **3.3** Application of material balance to unit operation: Evaporation **3.4** Application of material balance to unit operation: Drying **3.5** Material balance with chemical reaction **3.6** Limiting reactants and Excess	1. Basic principle of Chemical reaction balance

chemical reaction **SO3.4** To Understand the Recycle, Bypass and Purging operation		reactants **3.7** Recycle operation **3.8** Bypass operation **3.9** Purging operation **3.10** Numerical Problems on material balance to unit operation: Distillation **3.11** Numerical Problems on material balance to unit operation: Evaporation **3.12** Numerical Problems on material balance to unit operation: Drying **3.13** Numerical Problems on Material balance with chemical reaction	

SW-3 Suggested Sessional Work(SW):

a. Assignments:

- **i.** Numerical Problems on material balance to unit operation
- **ii.** Numerical Problems on Material balance with chemical reaction

PCC-CT201.4: Understand the concept of humidity and usage of psychometric chart.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	4
SL	2
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Evaluation of Humidity **SO4.2** Understanding the Flow Calculations in cement plant	.	**Unit-4 :Humidity & Flow Calculation** **4.1** Molal humidity **4.2** Absolute humidity **4.3** Relative Humidity **4.4** Percent Humidity **4.5** Dry-bulb temperature, Wet-bulb temperature	i. Preparation of psychometric chart of normal temperature ii. Preparation of psychometric chart of high

SO4.3 Calculations of Flow Conversion		**4.6** Dew point, Humidity chart **4.7** Humid Volume and Humid heat **4.8** Flow Calculations **4.9** Flow Conversion **4.10** Numerical Problems on Molal humidity **4.11** Numerical Problems on Absolute humidity **4.12** Numerical Problems on Relative Humidity and Percent Humidity **4.13** Numerical Problems on Humid Volume and Humid heat	temperature

SW-4 Suggested Sessional Work(SW):

a. **Assignments:**
   i. Numerical Problems on humidity

b. **MiniProject:**
   i. Draw a chart of Flow Calculations and Flow Conversion formula

PCC-CT201.5: Understand general energy balance, simplify and apply to open and closed systems. Write material and energy balance for unsteady state how material and energy balances are formulated for equation.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 Understand general energy balance, simplify and apply to open and closed systems.		**Unit 5: Heat Capacity and Energy Balance** **5.1** Heat Capacity **5.2** Heat Capacities of Solids and Liquids	1. Remember the Enthalpy changes accompanying chemical reactions such as heat of

SO5.2 Write material and energy balance for unsteady state how material and energy balances are formulated for equation. **SO5.3** Evaluation of Heat Capacity and mean heat capacity data **SO5.4** Understanding the Heat of Reaction at Constant Pressure and Constant Volume		**5.3** Relationship between specific heat at constant pressure and constant volume **5.4** Mean heat capacity **5.5** Heat capacity of mixtures of gases **5.6** Hess's Law of Constant Heat Summation **5.7** Heat of Reaction at Constant Pressure **5.8** Heat of Reaction at Constant Volume **5.9** Effect of Temperature on Heat of Reaction **5.10** Energy balance in cyclic and non-flow processes **5.11** Numerical Problem based on heat capacity **5.12** Numerical Problem based on mean heat capacity	reaction, heat of formation and heat of combustion.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problem based on heat capacity.

ii. Numerical Problem based on mean heat capacity

b. Mini Project:

Draw the chart of basis formula using in energy balance calculation

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self-Learning (Sl)	Total Hour (CI+SW+Sl)
PCC-CT201.1: Understand the concepts of dimensional consistency and effective application of units and dimensions.	8	2	1	11
PCC-CT201.2: Apply mole concept and ideal gas equation to express the composition of mixtures.	14	2	1	17
PCC-CT201.3: Carry out material balance calculations of distillation, evaporator, crystallization and drying processes. Analyze the behavior of recycle processes, performing approximate material balances, Solve material balance problems with chemical reactions.	13	2	1	16
PCC-CT201.4: Understand the concept of humidity and usage of psychometric chart.	13	4	2	19
PCC-CT201.5: Understand general energy balance, simplify and apply to open and closed systems. Write material and energy balance for unsteady state how material and energy balances are formulated for equation.	12	2	1	15
Total Hours	60	12	6	78

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Units and Dimensions	03	01	01	05
CO-2	Basic chemical calculation	02	06	02	10
CO-3	Stoichiometric and Materials Balance to Unit Operation	02	07	06	15
CO-4	Humidity & Flow Calculation	03	07	05	15
CO-5	Heat Capacity and Energy Balance	01	02	02	05
Total		11	23	16	50

Legend: R: Remember, U: Understand, A:Apply

The end of semester as assessment for Process calculation will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. RolePlay
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition &Year
1	Stoichiomentry	Bhatt, B.L., VORA, S.M	Tata McGraw-Hill	1976
2	Chemical Process Principles Part-I	Hougen, O.A., Watson, K.M and Ragatz, R.A	John Wiley and Asia Publishing	1970
3	Basic Principles and Calculations in Chemical Engineering	Himmelblau, D.M	Prentice Hall Inc	Fourth Edition, 1982
4	Conservation of Mass and Energy	Whitwell, J.C., Tone, R.K.	McGraw-Hill	1973
5	Introduction to Process calculations (Stoichiomentry)	Gavhane, K A	NiraliPrakashan	Twenty Seven Edition, 2012
5	Holcim Training Manual			
6	FLS Training Manual			
7	Lecture note provided by Dept. of Cement Technology, AKS University, Satna.			

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Cos, POs and PSOs Mapping

Program Title: B. Tech Cement Tech   Course Code: PCC-CT201   Course Title: Process Calculation

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO1: Understand the concepts of dimensional consistency and effective application of units and dimensions.	3	3	2	2	3	2	1	1	2	1	3	2	2	3	2	**3**
CO 2: Apply mole concept and ideal gas equation to express the composition of mixtures.	3	3	2	2	2	2	1	1	1	1	2	2	2	2	3	**2**
CO3: Carry out material balance calculations of distillation, evaporator, crystallization and drying processes. Analyze the behavior of recycle processes, performing approximate material balances, Solve material balance problems with chemical reactions.	2	3	2	2	2	2	1	1	2	2	2	3	3	2	2	**3**
CO 4: Understand the concept of humidity and usage of psychometric chart.	3	2	3	2	3	2	2	1	2	1	2	3	3	3	3	**3**

CO 5: Understand general energy balance, simplify and apply to open and closed systems. Write material and energy balance for unsteady state how material and energy balances are formulated for equation.	3	2	3	1	1	3	2	2	1	1	2	3	3	3	1	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map: Process Calculation

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1: Understand the concepts of dimensional consistency and effective application of units and dimensions.	SO1.1 SO1.2 SO1.3 SO1.4		**Unit-1: Units and Dimensions** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-2: Apply mole concept and ideal gas equation to express the composition of mixtures.	SO2.1 SO2.2 SO2.3		**Unit-2 Basic chemical calculation** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10,2.11,2.12,2.13,2.14	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-3: Carry out material balance calculations of distillation, evaporator, crystallization and drying processes. Analyze the behavior of recycle processes, performing approximate material balances, Solve material balance problems with chemical reactions.	SO3.1 SO3.2 SO3.3 SO3.4		**Unit-3 : Stoichiometric and Materials Balance to Unit Operation** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11 ,3.12,3.13	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-4: Understand the concept of humidity and usage of psychometric chart.	SO4.1 SO4.2 SO4.3		**Unit-4 : Humidity & Flow Calculation** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11,4.12,4.13	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-5: Understand general energy balance, simplify and apply to open and closed systems. Write material and energy balance for unsteady state how material and energy balances are formulated for equation.	SO5.1 SO5.2 SO5.3 SO5.4		**Unit 5: Heat Capacity and Energy Balance** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11, 5.12	

Semester-III

Course Code: **BSC201**

Course Title: **Mathematics -3**

Pre- requisite: Students should review the fundamentals of calculus, linear algebra, and differential equations, and matrix operations

Rationale: The program aims to develop advanced problem-solving and analytical skills and prepares students for careers in academia, research, industry, or other sectors that require advanced mathematical expertise.

Course Outcome :

BSC201.1 By the end of the course students are expected to have deep understanding in complex analysis with a focus on Cauchy-Riemann equations, analytic functions, harmonic functions, and conformal mappings.
BSC201.2 By the end of the course students are expected to understand the concept of a contour integral in the complex plane, concept of zeros of analytic functions and behavior of functions near essential singularities.
BSC201.3 The course provides a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables.
BSC201.4 The course provides a comprehensive overview of the skills and understanding that students are expected to gain from a course covering measures of central tendency and measures of dispersion**.**
BSC201.5- The course provides a comprehensive overview of the skills and understanding that students are expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance.
Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
BSC	BSC201	Mathematics-3	4	0	1	1	6	4

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Legend:

CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI**:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), SW**:** Sessional Work (includes assignment, seminar, mini project etc.), SL**:** Self Learning, C**:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
BSC	BSC201	Mathematics - 3	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

BSC201.1 By the end of the course students are expected to have deep understanding in complex analysis with a focus on Cauchy-Riemann equations, analytic functions, harmonic functions, and conformal mappings.

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Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Understand and state the Cauchy-Riemann equations for a complex-valued function **SO1.2** Determine the real and imaginary parts of a complex function and check for analyticity using the Cauchy-Riemann equations **SO1.3** Identify and define analytic functions in the complex plane **SO1.4** Understand the concept of Represent functions as Taylor and Laurent series; classify singularities and poles; find residues and evaluate complex integrals using the residue theorem.		**Unit-1.0** **Complex Variable** : **1.1** Definition of Analytic function **1.2** Cauchy-Riemann equations in Cartesian form and polar form **1.3** Questions of Analytic function based on Cartesian form **1.4** Questions of Analytic function based on polar form **1.5** Harmonic function and orthogonal functions **1.6** Conjugate Method for construction of an analytic function **1.7** Milne’s method for construction of an analytic function **1.8** Totorial- 1 **1.9** Conformal mappings, **1.10** questions of Conformal mappings **1.11** Mobius transformations **1.12** properties of Mobius transformations	**SL.1** Apply the Cauchy-Riemann equations to verify the analyticity of a given function. **SL.2** Explore the properties of trigonometric functions in the context of complex analysis **SL.3** Define logarithmic functions and explore their behavior in the complex plane

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. write the application of complex function.

ii. Properties of Complex Variables.

iii. Write all formula of complete unit.

b. Other Activities (Specify):

Quiz, Class Test.

BSC201.2 By the end of the course students are expected to understand the concept of a contour integral in the complex plane, concept of zeros of analytic functions and behavior of functions near essential singularities.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Understand the concept of a contour integral in the complex plane. **SO2.2** Evaluate contour integrals using parametrization and integration techniques. **SO2.3** Apply contour integrals to evaluate complex integrals. **SO2.4** State and understand the Cauchy Integral formula for analytic functions **SO2.5** Apply the Cauchy Integral formula to calculate values of analytic functions		**Unit-2.0: Complex Variable (Integration)**. **2.1** Cauchy's integral formula for analytic function **2.2** Questions of Cauchy's integral formula for simple poles. **2.3** Questions of Cauchy's integral formula for order poles. **2.4** Residues of an analytic function **2.5** Questions of Residues for simple poles **2.6** Questions of Residues for order poles **2.7** Residue theorem and based questions **2.8** Poles and singularities of analytic function **2.9** Zeros of analytic function **2.10** questions of Singularity. **2.11** tutorial 1 **2.12** tutorial 2	**SL.1** Apply contour integrals to evaluate complex integrals. **SL.2** Compute Taylor series expansions for given functions **SL.3** Define residues of complex functions and understand their significance

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**

i. write a short notes on singularities.
ii. Define poles and zeros with example.

b. Mini Project:
Oral presentation, Power Point Presentation.

c. Other Activities (Specify):
Quiz, Class Test.

BSC201.3 The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Understand the fundamental concepts of probability theory **SO3.2** Develop an appreciation for the role of probability in modeling uncertainty and randomness **SO3.3** Define probability using a mathematical framework **SO3.4** Understand probability axioms and laws governing probability measures **SO3.5** Classify events as mutually exclusive, exhaustive, dependent, or independent		**Unit-3.0: Probability and Random Variable** **3.1** definition of probability **3.2** Mathematical definition of probability **3.3** Various types of events **3.4** Additive law of probability **3.5** Multiplicative law of probability **3.6** Compound probability **3.7** Conditional probability **3.8** Bays rule of probability **3.9** Discrete random variable **3.10** Continuous random variable **3.11** Binomial distribution **3.12** Poisson distribution	**SL.1** Analyze compound probability involving multiple events **SL.2** Define and understand conditional probability **SL.3** Define and understand the concept of a random variable

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i) Define probability using a mathematical framework.

ii) Write the application of probability in daily life.

b. Mini Project:

Oral presentation, Power Point Presentation.

BSC201.4 Students will compute the expression of permutation groups by using permutation multiplication.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO4.1 Define arithmetic mean and understand its significance **SO4.2** Compute the arithmetic mean for both grouped and ungrouped data **SO4.3** Apply different methods (direct method, assumed mean method) for calculating the arithmetic mean. **SO4.4** Understand the properties of the arithmetic mean, including its sensitivity to extreme values **SO4.5** Define the median and understand its interpretation		**Unit-4.0 Measures of Central Tendency** **4.1** Methods of calculating Arithmetic mean **4.2** Methods of calculating median **4.3** Properties of mean and median **4.4** Numericals of mean for different data **4.5** Numericals of median for different data **4.6** Methods of calculating mode **4.8** Relation based question of mean median and mode **4.9** Measures of dispersion **4.10** Range **4.11** Quartile deviation **4.12** Standard deviation and its properties	**SL.1** Define mode and recognize its applications **SL.2** Understand the concept of unimodal, bimodal, and multimodal distributions **SL.3** Explore the relationships and patterns among the mean, median, and mode

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. write the application of mean median and mode .

ii. Explain mean with real life example.

b. Other Activities (Specify): Quiz, Class Test.

BSC201.5 The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 Define correlation and understand its significance in statistical analysis. **SO5.2** Recognize the types of relationships between variables (positive, negative, or none) based on correlation **SO5.3** Calculate and interpret Pearson's correlation coefficient. **SO5.4** Define and calculate rank correlation coefficients **SO5.5** Understand the use of rank correlation in cases where variables may not have a linear relationship		**Unit-5.0 Statistics** **5.1** Defination of Correlation **5.2** Formula of correlation coefficient **5.3** Questions of correlation coefficient **5.4** Defination of regrattion **5.5** Question of line of regrattion **5.6** Rank correlation **5.7** Fitting of a straight line **5.7** Fitting of a second degree parabola **5.8** Fitting of different curves **5.9** Tutorial-1 **5.10** Test of significance for large sample **5.11** Test of significance for small sample **5.12** Tutorial-2	**SL.1** Define regression analysis and understand its purpose in modeling relationships between variables **SL.2** Apply the method of least squares to fit straight lines, second-degree parabolas, and more general curves to datasets **SL.3** Test the difference between two proportions

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (CI+SW+Sl)
BSC201.1: By the end of the course students are expected to have deep understanding in complex analysis with a focus on Cauchy-Riemann equations, analytic functions, harmonic functions, and conformal mappings.	12	1	1	14
BSC201.2: By the end of the course students are expected to understand the concept of a contour integral in the complex plane, concept of zeros of analytic functions and behavior of functions near essential singularities	12	1	1	14
BSC201.3: The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables.	12	1	1	14
BSC201.4: The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering measures of central tendency and measures of dispersion	12	1	1	14
BSC201.5: The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance.	12	1	1	14
Total Hours	60	5	5	70

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Complex Variable Differentiation	03	01	01	05
CO-2	Complex Variable Integration	02	05	01	08
CO-3	Probability and Random Variable	03	05	05	13
CO-4	Measures of Central Tendency and Measures of Dispersion	02	08	05	15
CO-5	Statistics	03	04	02	05
Total		13	23	14	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies

1. Improved Lecture
2. Tutorial
3. Presentation
4. Group Discussion
5. Online sources
6. Seminar
7. Workshop

Suggested Learning Resources:

a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Engineering Mathematics-III	D. K. Jain. Engineering	Shree Ram Prakashan.	1st edition, 2018
2	Engineering Mathematics-III	D.C. Agrawal	Shree Sai Prakashan	2022
3	Introduction to Engineering	H.K.Dass Sonendra Gupta	S Chand Prakashan. Dhanpat Rai Publishing	2nd edition, 2014
4	Engineering Mathematics-III			

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Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Cos, POs and PSOs Mapping

Program Title: B. Tech Cement Tech   Course Code: BSC201   Course Title: Mathematics-3

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: By the end of the course students are expected to have deep understanding in complex analysis with a focus on Cauchy-Riemann equations, analytic functions, harmonic functions, and conformal mappings.	3	3	2	2	2	1	1	2	2	1	2	2	2	3	2	2
CO-2: By the end of the course students are expected to understand the concept of a contour integral in the complex plane, concept of zeros of analytic functions	3	3	3	3	1	2	1	3	2	2	2	3	3	2	3	2

and behavior of functions near essential singularities																
CO-3: The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables.	3	2	3	2	2	1	2	2	2	2	2	3	3	2	3	2
CO-4: The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering measures of central tendency and measures of dispersion	3	3	2	2	2	2	2	3	2	2	2	2	2	3	3	2
CO-5: The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance.	3	3	3	3	2	3	2	3	2	2	2	2	3	3	3	2

Legend: 1 – Low, 2 – Medium, 3 – High

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Course Curriculum Map: Mathematics-3

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** By the end of the course students are expected to have deep understanding in complex analysis with a focus on Cauchy-Riemann equations, analytic functions, harmonic functions, and conformal mappings.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1 Complex Variable (Differentiation)** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	SL1.1 SL1.2 SL1.3
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** By the end of the course students are expected to understand the concept of a contour integral in the complex plane, concept of zeros of analytic functions and behavior of functions near essential singularities	SO2.1 SO2.2 SO3.3 SO4.4 SO4.5		Unit-2 **Complex Variable – (Integration)** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10 2.11,2.12	SL2.1 SL2.2 SL2.3
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course in elementary probability theory and random variables.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3 Probability and Random** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	SL3.1 SL3.2 SL3.3
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering measures of central tendency and measures of dispersion	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4 Measures of Central Tendency and Measures of Dispersion** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	SL4.1 SL4.2 SL4.3
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** The course provide a comprehensive overview of the skills and understanding that students are expected to gain from a course covering correlation and regression, rank correlation, curve fitting, and various tests of significance.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit-5 Statistics** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	SL5.1 SL5.2 SL5.3

Semester-III

Course Code: **ESC201, ESC201-L**

Course Title: **Basic Electronics Engineering**

Pre-requisite: Student should have knowledge of fundamental principles of analog electronics.

Rationale: In current scenario the diode, transistors, op-amp is extensively used in various electronic circuits. Such systems are required to design and maintain by engineer. Therefore, the goal of this course is for students to become competent to understand design and maintenance of such type of systems.

Course Outcomes:

ESC201.1: Understanding of the concept of semiconductor materials, pn junction junction diodes and BJT and its types.

ESC201.2: Understanding of Operational amplifier its construction working and its different types.

ESC201.3: Explain the principle, construction and working of different timing circuits and oscillator with its types.

ESC206.4: Explain the basic concepts of digital electronics, Boolean algebra, logic gates and different logic circuits

ESC201.5: Explain the principle of Electronics Communication System its types and different modulation techniques

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
ESC	ESC201/ ESC201-L	Basic Electronics Engineering	4	2	1	1	8	5

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:**

Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total, Mark (HA+CT+TSN+TCA+TA)		
ESC	ESC201	Basic Electronics Engineering	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA(VV)	Class Attendance (TA)	Total, Marks (LA+VV+ TA)		
ESC	ESC201-L	Basic Electronics Engineering	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

ESC201.1: Understanding of the concept of semiconductor materials, pn junction junction diodes and BJT and its types

Approximate Hours

Item	Appx. Hrs.
Cl	10
LI	6
SW	1
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understand the concept of semiconductor material **SO1.2**Understand the concept of PN junction diode and its characteristics **SO1.3**Understand the concept of BJT and its working **SO1.4 understand** the different type of BJT and characteristics	1. Study of PN junction diode. 2. Study of half wave and full wave rectifier. 3. study of CB CE CC of BJT.	**Devices and Applications** 1.1 Introduction to semiconductor 1.2 Introduction to P-N Junction Diode and V-I characteristics, 1.3 Half wave and Full-wave rectifiers, capacitor filter. 1.4 Tutorial-1 1.5 Zener diode and its characteristics, Zener diode as voltage regulator. 1.6 Regulated power supply IC based on 78XX and 79XX series, 1.7 Introduction to BJT, its input-output and transfer characteristics, 1.8 Tutorial-2 1.9 BJT as a single stage CE amplifier, frequency response and bandwidth. 1.10 Tutorial-3	1. Semiconductor and its types 2. Concept of PN junction

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Explain forward biasing and reverse biasing of PN junction.
ii. Describe the application of rectifier.

ESC201. 2: Understanding of Operational amplifier its construction working and its different types.

Approximate Hours

Item	Approx Hrs
CI	11
LI	6
SW	1
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
SO2.1 Understanding of operational amplifier **SO2.2**Learn the working of OP-AMP as open loop and feedback circuit **SO2.3**Understandthe construction and working of OP-AMP as inverting non inverting amplifier **SO2.4** Understand the different application of OP-AMP	1. study of operational amplifier as summing and differential 2. study of OP-AMP as integrator and differentiator 3. Study of OP-AMP as inverting and non-inverting amplifier.	**Unit-2: Operational amplifier and its applications** 2.1 Introduction to operational amplifiers, 2.2 Op-amp input modes and parameters, 2.3 Op-amp in open loop configuration, op-amp with negative feedback, 2.4 Tutorial-1 2.5 study of practical op-amp IC 741, 2.6 inverting and noninverting amplifier 2.7 applications: summing and difference amplifier, 2.8 unity gain buffer, comparator, 2.9 Tutorial-2 2.10 integrator and differentiator. 2.11 Tutorial-3	1. Concept of BJT as an amplifier 2. Concept of feedback circuit 3. Operation Of integrators and differentiators

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Theoretical Assignment related to different types of OP-AMP

ii. Explain the working principle of OP-AMP as inverting and Non inverting OP-AMP

b. Mini Project:

i. Draw a Poster of different operations of OP-AMP

EE202.3: Explain the principle, construction and working of different timing circuits and oscillator with its types.

Approximate Hours

Item	Approx Hrs
CI	11
LI	6
SW	1
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
SO3.1 To study of timing circuits and their types **SO3.2** To understand the Design and Characteristic of Timing circuit **SO3.3** To learn about the Oscillator **SO3.4** To understand the Design and Characteristic of oscillator and its types.	1. study of A stable multi vibrator 2.study of R-C phase shift oscillator 3. study of Wein bridge oscillator	**Unit-3 Timing Circuits and Oscillators** 3.1 RC-timing circuits, 3.2 Introduction to IC 555 3.3 IC 555 and its applications 3.4 IC 555 astable, IC 555 mono-stable 3.5 Tutorial-1 3.6 multi-vibrators, 3.7 Introduction of oscillators and positive Feedback oscillators 3.8 Tutorial-2 3.9 Barkhuizen's criteria for oscillation, 3.10 R-C phase shift and Wein bridge oscillator. 3.11 Tutorial-3	1. Significance of timing circuits 2. Uses of oscillator

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Make a poster of IC 555 timer
ii. Explain different types of oscillators

ESC201.4: Explain the basic concepts of digital electronics, Boolean algebra, logic gates and different logic circuits

Approximate Hours

Item	Approx Hrs
CI	15
LI	6
SW	1
SL	1
Total	23

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
SO4.1 Understand the building Blocks of digital electronics **SO4.2** Understand the building Blocks of Boolean algebra **SO4.3**Understand the concepts of logic gates and circuits **SO4.4**Understand the applications of logic gates and circuits	4.1. study of Microprocessor. 4.2. Study of Microcontroller 4.3. Identification of different logic gates.	**Unit-4 : Digital Electronics Fundamentals** 4.1 Difference between analog and digital signals, 4.2 Boolean algebra, 4.3 examples of Boolean algebra 4.4 Tutorial-1 4.5 Basic and Universal Gates, Symbols, Truth tables, logic expressions, 4.6 Logic simplification using K- map, 4.7 Logic ICs, 4.8 half and full adder, half and full subtractor 4.9, Tutorial-2 4.10 multiplexers, de-multiplexers, 4.11 flip-flops and its types 4.12 shift registers, counters, 4.13 Tutorial-3 4.14 Block diagram of microprocessor and their applications. 4.15 microcontroller and their applications.	1. Difference between analog electronics and digital electronics 2. Difference between logic gates and logic circuits

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Theoretical Assignments Based on Different types logic gates and circuits
ii. Numerical Problems Based on Boolean algebra

ESC201.5: Explain the principle of Electronics communication System its types and different modulation techniques

Approximate Hours

Item	Approx Hrs
CI	13
LI	6
SW	1
SL	1
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
SO5.1 Discussion about the communication system and its types **SO5.2**Understand the concept of modulation techniques **SO5.3**Understand the building blocks of communication system **SO5.4**Study of different types of modulation techniques, .	5.1. Study of Amplitude Modulation. 5.2. study of Frequency modulation 5.3. Study of AM and FM modulators	**Unit 5: Electronic Communication Systems** **5**.1intoduction of communication system 5.2 block diagram of communication system 5.3 The elements of communication systemise frequency spectrum 5.4 Tutorial-1 5.5 Transmission media: wired and wireless, 5.6 Introduction of Modulation 5.7 need of modulation, types of modulation 5.8 Tutorial-2 5.9 Introduction to AM 5.10 Introduction FM modulation schemes, 5.11 Mobile communication systems, cellular concepts 5.12 Tutorial-3 5.13 block diagram of GSM system.	1. Basic Structure and operation of communication system 2. Types of communication system

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Theoretical Assignment based on Different types of communication system

ii. Explain different types of modulation techniques.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Lab Instruction (LI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (CI+SW+ Sl)
ESC201.1: Understanding of the concept of semiconductor materials, pn junction diodes and BJT and its types	10	6	1	1	18
ESC201.2: : Understanding of Operational amplifier its construction working and its different types.	11	6	1	1	19
ESC201.3: Explain the principle, construction and working of different timing circuits and oscillator with its types.	11	6	1	1	19
ESC206.4: Explain the basic concepts of digital electronics, Boolean algebra, logic gates and different logic circuits	15	6	1	1	23
ESC201.5: Explain the principle of Electronics communication System its types and different modulation techniques	13	6	1	1	21
Total Hours	60	30	5	5	100

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Semiconductor Devices and Applications	04	03	01	8
CO-2	Operational amplifier and its applications	06	03	02	11
CO-3	Timing Circuits and Oscillators	04	03	01	8
CO-4	Digital Electronics Fundamentals	05	04	02	11
CO-5	Electronic Communication Systems	04	04	04	12
Total		23	17	10	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Process calculation will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional / Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Group Discussion
4. Practical Design Demonstration
5. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
6. Brainstorming

Suggested Learning Resources: (a)

Books:

S.No.	Title	Author	Publisher	Edition & Year
1	Integrated Electronics	Millman and Halkias	McGraw Hill	2017
2	Electronics Devices and Circuits	R. Boylestedand L. Nashelsky	Prentice Hall India	2009
3	Electronics Devices and Circuits	Millman and Halkias	TMH Edition	2017
4	Analog Electronics	Malcolm Goodge	TMH Edition	1990
5	Communication Electronics: Principles	Frenzel,	Tata Mc Graw Hill,	2001
6	Lecture note provided by Deptt. of Electrical Engineering, AKS University, Satna.			

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech Course Code: ESC201 / ESC201-L Course Title: Basic Electronics Engineering

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Understanding of the concept of semiconductor materials, pn junction diodes and BJT and its types	3	3	2	2	3	2	1	1	2	1	1	2	2	2	2	3
CO-2: Understanding of Operational amplifier its construction working and its	2	3	3	2	1	2	1	1	1	1	2	2	2	2	2	2

different types.																
CO-3 Explain the principle, construction and working of different timing circuits and oscillator with its types.	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**3**
CO-4: Explain the basic concepts of digital electronics, Boolean algebra, logic gates and different logic circuits	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**1**
CO-5: Explain the principle of Electronics Communication System its types and different modulation techniques	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Basic Electronics Engineering

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Understanding of the concept of semiconductor materials, pn junction diodes and BJT and its types	SO1.1 SO1.2 SO1.3 SO1.4	1.1,1.2,1.3	**UNIT-1: Semiconductor Devices and Applications** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Understanding of Operational amplifier its construction working and its	SO2.1 SO2.2 SO2.3 SO2.4	2.1,2.2,2.3	**UNIT-2**: **Operational amplifier and its applications** 2.1,2.2,2.3,2.4, 2.5,2.6,2.7,2.8,2.9,2.10,2.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Explain the principle, construction and working of different timing circuits and oscillator with its types.	SO3.1 SO3.2 SO3.3 SO3.4	3.1,3.2,3.3	**Unit-3: Timing Circuits and Oscillators** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11	

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Explain the basic concepts of digital electronics, Boolean algebra, logic gates and different logic circuits.	SO4.1 SO4.2 SO4.3 SO4.4	4.1,4.2,4.3	**UNIT-4: Digital Electronics Fundamentals** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,4.13,4.14,4.15	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Explain the principle of Electronics Communication System its types and different modulation techniques	SO5.1 SO5.2 SO5.3 SO5.4	5.1,5.2,5.3	**UNIT-5: Electronic Communication Systems** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12,5.13	

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## Semester-III

**Course Code:** **ESC202**

**Course Title:** **Engineering Mechanics**

**Pre- requisite:** Student should have basic knowledge of mathematics and Physics up to higher secondary level.

**Rationale:** As a bridge between theory and application, engineering mechanics is used to formulate new ideas and theories, discover and interpret phenomena and develop experimental and computational tools.

**Course Outcomes:**

**ESC202.1:** Understanding of term Mechanics and its classification.
**ESC202.2:** Understanding Resolution and composition of force acting on the rigid body.
**ESC202.3:** Compute the resultant of force for different system of force and study of different laws related to different force system.
**ESC202.4:** Compute the different types of load acting on different types of beam.
**ESC202.5:** Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia.

**Scheme of Studies:**

| Course Category | Course Code | Course Title | Scheme of studies(Hours/Week) | | | | | Total Credits (C) |
|---|---|---|---|---|---|---|---|---|
| | | | CI | LI | SW | SL | Total Hours (CI+LI+SW+SL) | |
| ESC | ESC202 | Engineering Mechanics | 4 | 0 | 1 | 1 | 6 | 4 |

**Legend:**
**CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

**Note:** SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.
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(Revised as on 01 August 2023)

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**Scheme of Assessment:**

**Theory**

| Course Category | Course Code | Course Title | Scheme of Assessment ( Marks ) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Progressive Assessment ( PRA ) | | | | | | End Semester Assessment (ESA) | Total Marks (PRA+ESA) |
| | | | Class/Home Assignment 5 number 3 marks each (HA) | Class Test 2 (2 best out of 3)10 marks each (CT) | Seminar one ( TSN) | Class Activity any one (TCA) | Class Attendance (TA) | Total Mark (HA+CT+TSN+TCA+TA) | | |
| ESC | ESC202 | Engineering Mechanics | 15 | 20 | 5 | 5 | 5 | 50 | 50 | 100 |

**Course-Curriculum Detailing:**

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminatingin the overall achievement of Course Outcomes (COs) upon the course's conclusion.

**ESC202.1: Understanding of term Mechanics and its classification.**

**Approximate Hours**

| Item | Appx. Hrs |
|---|---|
| CI | 9 |
| LI | 0 |
| SW | 2 |
| SL | 2 |
| **Total** | **13** |
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| Session Outcomes (SOs) | Laboratory Instruction (LI) | Class room Instruction (CI) | Self-Learning(SL) |
|---|---|---|---|
| **SO1.1** Understanding of basic knowledge of term Mechanics.<br>**SO1.2** Understanding how objects move when forces are applied to them. Newton's laws lay the foundation for comprehending how forces interact with objects to cause motion.<br>**SO1.3** Describing motion without considering its causes. This includes concepts like velocity, acceleration, displacement, and time.<br>**SO1.4** Understanding the causes of motion, mainly through the study of forces. This involves concepts like friction, tension, gravitational forces, and how they affect objects. | | **Unit-1.0 Introduction to Mechanics**<br><br>**1.1** Introduction of term mechanics<br>**1.2** classification of mechanics<br>**1.3** static and dynamics<br><br>**1.4** classification of dynamics<br>**1.5** Kinetic and kinematic<br><br>**1.6** Fundamental laws of mechanics<br>**1.7** Gravitational law<br><br>**1.8** Newton Laws<br><br>**1.9** Numerical | **1.** Numerical problem related to classification of mechanics<br>**2.** Numerical problem related to basic laws |

**SW-1 Suggested Sessional Work (SW):**

**a. Assignments:**

1. Explain Newton 2nd law of motion and its application
2. Write the definition of basic term related to static and dynamic

**ESC202.2: Resolution and composition of force acting on the rigid body.**

**Approximate Hours**

| Item | AppX Hrs |
|---|---|
| CI | 13 |
| LI | 0 |
| SW | 2 |
| SL | 2 |
| Total | 17 |
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| Session Outcomes (SOs) | Laboratory Instruction (LI) | Class room Instruction (CI) | Self Learning (SL) |
|---|---|---|---|
| **SO2.1** Ability to break down a single force into its horizontal and vertical components. This involves understanding trigonometric concepts like sine and cosine functions to determine the components of a force along different axes.<br>**SO2.2** Ability to determine the resultant of multiple forces acting on an object. This includes finding the net force and direction when multiple forces are applied simultaneously.<br>**SO2.3** Applying these concepts to real-world scenarios, such as analyzing the forces acting on structures, machines, or systems. This could involve calculating the forces involved in bridges, buildings, or mechanical devices<br>**SO2.4** Understanding how to add multiple vectors together using the Polygon Law. This involves arranging vectors head-to-tail to form a closed polygon, where the resultant vector is the vector closing the polygon from the starting point to the end point. | | **Unit-2.0 Resolution and Composition of Forces**<br><br>**2.1** Forces and its type<br>**2.2** Pressure and Stress<br>**2.3** Concept of free body diagram<br>**2.4** Characteristics and Effects of a Force<br>**2.5** System of Forces<br>**2.6** Resolution of a Force<br>**2.7** Composition of Forces, Resultant / Equilibrant Force,<br>**2.8** Law of Parallelogram of Forces,<br>**2.9** Law of Triangle of Forces, Polygon Law of Forces.<br>**2.10** Lami's Theorem<br>**2.11** Equilibrium of a Body Under Two / Three/More Than Three Forces<br>**2.12** Law of Superposition of Forces.<br>**2.13** Practice class | **1.** Numerical of resolution of forces<br>**2.** Numerical problem of Law of Parallelogram of Forces |

**SW-2 Suggested Sessional Work (SW):**

a. **Assignments:**
   1. Derivation of lamis theorem and its numerical problem
   2. Derivation of Parallelogram and its numerical
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**ESC202.3: Apply computer aided drafting techniques to represent line, surface or solid models in different Engineering viewpoints.**

**Approximate Hours**

| Item | Appx. Hrs |
|---|---|
| CI | 11 |
| LI | 0 |
| SW | 2 |
| SL | 2 |
| Total | 15 |

| Session Outcomes (SOs) | Laboratory Instruction (LI) | Class room Instruction (CI) | Self Learning (SL) |
|---|---|---|---|
| **SO3.1** Calculating the resultant force by summing up all the individual forces acting on an object. The resultant force represents the net effect of all forces combined.<br><br>**SO3.2** Identifying the point where the resultant force is applied on the object or structure. This may involve finding the moment or torque caused by the forces and locating the resultant force's line of action.<br>**SO3.3** Checking whether the system of forces is in equilibrium. If the resultant force is zero, the system is in equilibrium; otherwise, the object or structure will experience acceleration or movement in the direction of the resultant force. | | **Unit-3.0 System of forces**<br><br>**3.1** Introduction of system of forces<br>**3.2** Moment of a force<br>**3.3** Varignon's Theorem<br>**3.4** Resultant of Parallel Forces<br>**3.5** Moment of a Couple<br>**3.6** Resolution of Force into a Couple<br>**3.7** Resultant of Coplanar, Non Con-Current Forces<br>**3.8** Numerical on Moment<br>**3.9** Numerical on Couple<br>**3.10** Numerical on system of forces<br>**3.11** Practice class | 1. Explanation of nature of moment and its types<br><br>2. Numerical on resultant force |

**SW-3 Suggested Sessional Work (SW):**

**a. Assignments:**

1. Classify system of forces
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````

2. Explain the concept of couple

**ESC202.4: Compute the different types of load acting on different types of beam.**

**Approximate Hours**

| Item | Appx. Hrs |
|---|---|
| CI | 13 |
| LI | 0 |
| SW | 2 |
| SL | 2 |
| Total | 17 |

| **Session Outcomes (SO)** | **Laboratory Instruction (LI)** | **Class room Instruction (CI)** | **Self Learning (SL)** |
|---|---|---|---|
| **SO4.1** Calculating the forces and moments at support points. This includes determining the vertical and horizontal reactions, as well as any moments generated at these locations due to applied loads.<br><br>**SO4.2** Supported at both ends and can carry loads between the supports. They experience maximum bending moment at the center and zero shear at the ends.<br><br>**SO4.3** Fixed at one end and free at the other. They carry loads at the free end and experience maximum shear at the fixed end.<br><br>**SO4.4** Assemblies of beams connected by joints, commonly used in bridges and roofs. They rely on the framework of triangles to distribute loads efficiently. | | **Unit-4.0 Beams and Trusses**<br><br>**4.1** define beam and its type<br>**4.2** Simply Supported Beam, Overhanging Beam, Cantilever Beam<br>**4.3** Simply Supported Beam, Overhanging Beam, Cantilever Beam<br>**4.4** concept of load<br>**4.5** Load on the Beam or Frame<br>**4.6** Load on the Beam or Frame<br>**4.7** Calculation of support reaction and its type<br>**4.8** Support reaction calculation in cantilever beam<br>**4.9** Support reaction calculation in simple supported beam<br>**4.10** Concept of truss<br>**4.11** Analysis of truss by analytical method | 1. Numerical problem of support reaction calculation in cantilever beam and simply supported beam.<br><br>2. Numerical problem of truss analysis by joint method. |
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|---|---|---|---|
| | | (Joint method)<br>**4.12** Analysis of truss by analytical method (Section method)<br>**4.13** Practice class | |

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**
   1. Classify Beams and Load acting on it.
   2. Explain types of truss.

**ESC 102.5:** Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia.

**Approximate Hours**

| Item | Appx. Hrs |
|---|---|
| CI | 14 |
| LI | 0 |
| SW | 3 |
| SL | 2 |
| Total | 19 |

| Session Outcomes (SOs) | Laboratory Instruction (LI) | Class room Instruction (CI) | Self Learning (SL) |
|---|---|---|---|
| **SO5.1** Determining the point where the entire weight of an object or system appears to act.<br><br>**SO5.2** Quantifying an object's resistance to rotational motion around a specific axis. | | **Unit-5.0 Center of gravity and moment of inertia**<br>**5.1** Concept of Centroid, Centre of Gravity.<br>**5.2** Difference between Centroid, Centre of Gravity<br>**5.3** Centroid of Trianle<br>**5.4** Centroid of I section<br>**5.5** Centroid of angle section, Centroid of channel section<br>**5.7** Theorems of Moment of Inertia<br>**5.8** Radius of Gyration<br>**5.9** Polar Moment of Inertia of Standard Sections<br>**5.10** Moment of Inertia of Composite Section<br>**5.11** Principal Moment of Inertia | 1. Numerical problem related to center of gravity<br>2. Numerical of MI of T section<br>3. Numerical of I section. |
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| | | | |
|---|---|---|---|
| | | **5.12** Concept of mass moment of inertia<br>**5.13** Mass moment of inertia of basic solid figures.<br>**5.14** Practice class | |

**SW-5 Suggested Sessional Work (SW):**

**a. Assignments:**

1. Find the CG and MI of Circle, semi circle, and Rectangle and Triangle.

**Brief of Hours suggested for the Course Outcome**

| Course Outcomes | Class Lecture (Cl) | Lab Lecture (LI) | Sessional Work (SW) | Self Learning (Sl) | Total hour (CI+LI+SW+SI) |
|---|---|---|---|---|---|
| **ESC202.1:** Understanding of term Mechanics and its classification | 9 | 0 | 2 | 2 | 13 |
| **ESC202.2:** Understanding Resolution and composition of force acting on the rigid body. | 13 | 0 | 2 | 2 | 17 |
| **ESC202.3:** Compute the resultant of force or different system of force and study of different laws related to different force System. | 11 | 0 | 2 | 2 | 15 |
| **ESC202.4:** compute the different types of load acting on different types of beam. | 13 | 0 | 2 | 2 | 17 |
| **ESC202.5:** Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia. | 14 | 0 | 3 | 2 | 19 |
| Total Hours | 60 | 0 | 11 | 10 | 81 |
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**Suggestion for End Semester Assessment**

**Suggested Specification Table (For ESA)**

| CO | Unit Titles | Marks Distribution | | | |
|---|---|---|---|---|---|
| | | R | U | A | Total Marks |
| CO-1 | Introduction to Mechanics | 03 | 01 | 01 | 05 |
| CO-2 | Resolution and Composition of Forces | 02 | 06 | 02 | 10 |
| CO-3 | System of forces | 03 | 07 | 05 | 15 |
| CO-4 | Beams and Trusses | - | 10 | 05 | 15 |
| CO-5 | Center of gravity and moment of inertia | 03 | 02 | - | 05 |
| Total | | 11 | 26 | 13 | 50 |

**Legend: R: Remember, U: Understand, A: Apply**

The end of semester assessment for Engineering Graphics & Design will be held with writtenexamination of 50 marks

**Note**. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

**Suggested Instructional/Implementation Strategies:**

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT,Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming
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**Suggested Learning Resources:**

**(a) Books** :

| S.No. | Title | Author | Publisher | Edition & Year |
|---|---|---|---|---|
| 1 | Engineering Mechanics | Dr.R.K bansal | Laxmi Publication(p) ltd. | 4rth and 2016 |
| 2 | Engineering Mechanics | R.K Rajpoot | Laxmi Publication(p) ltd. | 3rd and 2016 |
| 3 | Engineering Mechanics: Static & Dynamics | Russell C. Hibbeler | Pearson | 14th Edition, 2015 |
| 4 | Engineering Mechanics | Timoshenko, and Young | TMH | 5th 2017 |
| 5 | Training Manual | | | |
| 6 | Lecture note provided by Dept. of Mechanical Engineering, AKS University, Satna . | | | |

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

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COs, PSo, and PSOs Mapping

Program Title: B. Tech Cement Tech Course Code: ESC202 Course Title: Engineering Mechanics

| Course Outcomes | Program Outcomes | | | | | | | | | | | | Program Specific Outcome | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 | PSO4 |
| | Engineering knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual and team work | Communication | Project management and finance | Life-long learning | The ability to apply technical & engineering knowledge for production quality cement | Ability to understand the day to plant operational problems of cement manufacture | Ability to understand the latest cement manufacturing technology and it application | Ability to use the research based innovative knowledge for sustainable development |
| **CO-1:** Understanding of term Mechanics and its classification | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 1 | 2 | 2 | 1 | 2 | 2 | 2 | 1 | - |
| **CO-2:** Understanding Resolution and composition of force acting on the rigid body. | 1 | 2 | 2 | 2 | 1 | 2 | 2 | 1 | 1 | 1 | 2 | 3 | 2 | 2 | 2 | 1 |
| **CO-3:** Compute the resultant of force or different system of force and study of different laws related to different force System. | 2 | 2 | 1 | 1 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 2 | 2 | 1 | 2 | 2 |
| **CO-4:** compute the different types of load acting on different types of beam. | 3 | 2 | 2 | - | 3 | 1 | 3 | 1 | 2 | 1 | - | 2 | 3 | 3 | 3 | 2 |
| **CO-5:** Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia. | 1 | 2 | 2 | - | 1 | 1 | 3 | 1 | 1 | 1 | 2 | 2 | 3 | 3 | 1 | 3 |

**Legend: 1 – Low, 2 – Medium, 3 – High**
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## Course Curriculum Map: Engineering Mechanics

| POs & PSOs No. | COs No.& Titles | SOs No. | Laboratory Instruction (LI) | Classroom Instruction (CI) | Self Learning(SL) |
|---|---|---|---|---|---|
| PO 1,2,3,4,5,6<br>7,8,9,10,11,12<br>PSO 1,2, 3, 4, 5 | **CO-1:** Understanding of term Mechanics and its classification | SO1.1<br>SO1.2<br>SO1.3<br>SO1.4<br>SO1.5 | | Unit-1.0 Introduction to Mechanics<br>1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9 | As mentioned in above pages |
| PO 1,2,3,4,5,6<br>7,8,9,10,11,12<br>PSO 1,2, 3, 4, 5 | **CO-2:** Understanding Resolution and composition of force acting on the rigid body. | SO2.1<br>SO2.2<br>SO2.3<br>SO2.4<br>SO2.5 | | Unit-2 Resolution and Composition of Forces<br>2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7,<br>2.8,2.9,2.10,2.11,2.12,2.13 | |
| PO 1,2,3,4,5,6<br>7,8,9,10,11,12<br>PSO 1,2, 3, 4, 5 | **CO-3:** Compute the resultant of force or different system of force and study of different laws related to different force System. | SO3.1<br>SO3.2<br>SO3.3<br>SO3.4<br>SO3.5 | | Unit-3: System of forces<br>3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11 | |
| PO 1,2,3,4,5,6<br>7,8,9,10,11,12<br>PSO 1,2, 3, 4, 5 | CO-4: compute the different types of load acting on different types of beam. | SO4.1<br>SO4.2<br>SO4.3<br>SO4.4<br>SO4.5 | | Unit-4: Beams and Trusses<br>4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12,4.13 | |
| PO 1,2,3,4,5,6<br>7,8,9,10,11,12<br>PSO 1,2, 3, 4, 5 | **CO-5:** Compute the centroid, second moment of area, center of gravity, moment of inertia and mass moment of inertia. | SO5.1<br>SO5.2<br>SO5.3<br>SO5.4<br>SO5.5 | | Unit 5: Center of gravity and moment of inertia<br>5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,<br>5..9,5.10,5.11,5.12,5.13,5.14 | |
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Semester-III

Course Code: **PCC-CT202, PCC-CT202-L**

Course Title: **Fluid Mechanics**

Pre-requisite: Student should have basic knowledge of mathematics, physics related terms such as, pressure, temperature and velocity.

Rationale: The students studying cement technology should possess fluid properties about pressure and its measurement employed in construction.

Course Outcomes:

PCC-CT202.1: The student will understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems.

PCC-CT202.2: Understanding about kinematics, dynamics and application of mass, momentum and energy equation in fluid flow**.**

PCC-CT202.3: Students will be able to apply dimensional analysis of physical quantities and methods of dimensional analysis.

PCC-CT202.4: Students will compute loss of energy in pipes, frictional loss in pipe flow**.**

PCC-CT202.5: Students will be able to describe function of flow metering devices and apply Bernoulli equation to determine the performance of flow-metering devices.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT202	Fluid & Fluid Particle Mechanics	4	2	1	1	8	5

Legend:
CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), SW**:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT202	Fluid & Fluid Particle Mechanics	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA(VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
PCC	PCC-CT202	Fluid & Fluid Particle Mechanics	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT202.1: The student will understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems.

Approximate Hours

Item	Appx Hrs
CI	12
LI	6
SW	2
SL	1
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO1.1 Understand properties of fluid like density, specific weight. **SO1.2** Viscosity, kinematic viscosity, Newton's law of viscosity. **SO1.3** Thermodynamic properties, isothermal process, adiabatic process. **SO1.4** Compressibility, surface tension. **SO1.5** Capillarity, surface tension on hollow bubble. .	**1.** Determination of discharge through a Venturimeter. **2.** Determination of discharge through a given Orifice meter. **3.** Determination of Flow through Rotamater.	**Unit-1.0 Properties of Fluids** **1.1** Fluid introduction. **1.2** Properties of Fluids. **1.3** Thermodynamic Properties of Fluids. **1.4** Viscosity, Types of Fluid. **1.5** Compressibility and Bulk Modulus. **1.6** Surface Tension and Capillarity. **1.7** Vapor Pressure and Cavitations. **1.8** Types of Flow, Rigid Body Motion. **1.9** Buoyancy and Floatation, Fluid Pressure at a Point. **1.10** Pascal's Law, Forces on Submerged Bodies. **1.11** Absolute Gauge, Atmospheric, Vacuum Pressure. **1.12** Manometers- Simple and Differential.	1. Properties of fluid, vapor pressure and compressibility. 2. Types of flow, rigid and bulk modulus.

SW-1 Suggested Sessional Work (SW):

a. **Assignments:** Fluid properties for Constructions, different properties of fluid, Cement strength depends on fluid and their properties.
b. **Mini Project:** Chart prepared for different thermodynamic properties of fluids.
c. **Other Activities (Specify):** Note on fluid properties related to Indian cement industry in world and Major cement producing companies of India.

PCC-CT202.2: Understanding about kinematics, dynamics and application of mass, momentum and energy equation in fluid flow.

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Approximate Hours

Item	AppX Hrs
CI	17
LI	6
SW	2
SL	1
Total	26

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 To Understand the types of fluid flow such as steady and unsteady flows, uniform and non- uniform flows, laminar and turbulent. **SO2.2** To learn about rate of flow or discharge. **SO2.3** To understand the continuity equation. **SO2.4** To understand the types of motion such as linear translation, linear deformation and angular deformation.	**1.** Determination of discharge through Pitot tube. **2.** Determination of Cc, Cv, and Cd for different type of orifices. **3.** Determination of Cc, Cv, and Cd for different type of mouth pieces.	**Unit-2 Fluid Kinematics, Fluid Dynamics, Fluid Flow Measurement.** **2.1** Introduction to fluid kinematics. **2.2** Method of Describing Fluid Motion. **2.3** One/Two/Three Dimensional Flows. **2.4** Rate of Flow or Discharge **2.5** Continuity Equation. **2.6** Description Of Velocity Field and Acceleration. **2.7** Velocity Potential and Stream Functions **2.8** Fluids in Circulation. **2.9** Irrotational Flow. **2.11** Types of Motion. **2.12** Vortex Flow. **2.13** Introduction to fluid dynamics. **2.14** Equation of Motion, Bernoulli's Equation. **2.15** Bernoulli's Equation from Euler's Equation. **2.16** Pressure Drop in Pipes. **2.17** Pipe Fittings and Pipe Network.	**1.** Problems on kinematics and continuity equation. **2.** Study on equation of motion and dynamics of flow.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Explanation about different types of fluid flow.
ii. Continuity equation and velocity and acceleration.

b. Mini Project:
Differentiate between Venturimeter, orifice meter and Pitot tube.

c. Other Activities (Specify):
Types of merurement devices used in different cement plant.

PCC-CT202.3: Students will be able to apply Dimensional Analysis of physical quantities and methods of dimensional analysis.

Approximate Hours

Item	Appx. Hrs
CI	09
LI	6
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Introduction to secondary or derived quantities. **SO3.2** Methods of dimensional analysis. **SO3.3** Methods of selecting repeating variables. **SO3.4** Types of forces acting in moving fluids. **SO3.5** Model laws or similarity.	**1.** To find out Reynolds Number. **2.** To verify Bernoulli's Theorem. **3.** Comparison between Reynolds number and Bernoulli's theorem.	**Unit-3**: Dimensional Analysis **3.1** Introduction to dimensional analysis. **3.2** Dimensions of Physical Quantities. **3.3** Dimensional Homogeneity. **3.4** Methods of Dimensional Analysis- Rayleigh's Method. **3.5** Numerical on Rayleigh's method. **3.6** Buckingham's π-Theorem. **3.7** Numerical on Buckingham's π-Theorem. **3.8** Types of Forces Acting On Moving Fluid. **3.9** Dimensionless Numbers and Their Derivation.	i. Dimensions of units used in fluid mechanics. ii. Dimensionless numbers, such as Reynolds number, Weber numbers. .

SW-3 Suggested Sessional Work (SW):

a. Assignments:
(i) Solving problems on Rayleigh's numbers.
(ii) Model laws of different units like Reynolds model law, Froude model law etc.

b. Mini Project:
Make a table of different properties of fluids like viscosity, acceleration, velocity etc.

PCC-CT202.4: Students will compute loss of energy in pipes, frictional loss in pipe flow.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	6
SW	2
SL	2
Total	23

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO4.1 Introduction to loss of energy in pipes. **SO4.2** Minor energy (head) losses. **SO4.3** loss of head due to sudden enlargement, sudden contraction, due to entrance of a pipe, loss of head at the exit of pipe. **SO4.4** Flow through pipes in a series, or flow through compound pipes. **SO4.**5 Flow through branched pipes.	**1.** Determination of loss of head due to friction in pipe. **2.** Determination of loss of head due to sudden enlargement in pipe. **3.** Determination of loss of head due to sudden contraction in pipe	**Unit-4 Flow Through Pipes** **4.1** Overview of flow through pipes. **4.2** Loss Of Energy In Pipes. **4.3** Frictional Loss In Pipe Flow. **4.4** Loss Of Head Due To Friction In Pipe (Friction Factor),. **4.5** Viscous Flow. **4.6** Boundary Layer Flow. **4.7** Separation Of Boundary Layer. **4.8** Drag And Lift, **4.9** Flow In Open Channels. **4.10** Laminar And Turbulent Flow Explanation. **4.11** Reynolds Experiment, **4.12** Motion of Particles Through Fluid. **4.13** Packed And Fluidized Bed.	**1.** Preparation of different head losses in the comparison form **2.** Draw a typical lay out of a fluid flow in series connected pipe or parallel connected pipe.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Explanation about different energy (Head) losses.

ii. Describe briefly power transmission through pipes.

b. Mini Project:

Visit to a cement plant and writing a report on fluid flow in how many types.

PCC-CT202.5: Comprehend the functions of different regulatory bodies in India that oversee the production and quality of cement.

Approximate Hours

Item	Appx. Hrs
CI	09
LI	6
SW	3
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Introduction the main parts of a reciprocating pump. **SO5.2** Over view of Discharge through a Reciprocating pump. **SO5.3** Role of the work done in terms of Reciprocating pump. **SO5.4** Slip of Reciprocating pump and priming of centrifugal pump.	**1.** Study of reciprocating pump. **2.** Study of Centrifugal pump. **3.** Check and compare performance of Reciprocating pump and centrifugal pump.	**Unit 5 Pumping and Compressing of Chemicals and Gases:** **5.1** Reciprocating Pumps. **5.2** Slip Of Reciprocating Pumps **5.3** Rotary Pumps, Centrifugal Pumps **5.4** Blowers.Priming Of Centrifugal Pumps, **5.5** Cavitations, Suction Lift. **5.6** NPSH,Calibrations **5.7** Mixing And Agitation **5.8** Types Of Mixers And Their Selection. **5.9** Power Requirement, Compressible Fluid Flow.	1. Learning about main parts and working of Reciprocating pump. 2. Minimum speed for starting a centrifugal pump.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

List the Main parts of a Centrifugal pump and reciprocating pump.

Definitions related to Reciprocating pump as well as Centrifugal pump.

b. Mini Project:

Making a chart for different types of casing of centrifugal pump.

c. Other Activities(Specify):

List of Organization/cement plant in India what types of reciprocating pump and centrifugal pump used.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+LI+SW+Sl)
PCC-CT202.1: The student will understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems.	12	6	2	1	21
PCC-CT202.2: Acquired the knowledge of types of raw materials and fuel used in the production of Portland cement, along with its physical and chemical characteristics.	17	6	2	1	26
PCC-CT202.3 Students will be able to apply Dimensional Analysis of physical quantities and methods of dimensional analysis.	9	6	2	1	18
PCC-CT202.4: Students will compute loss of energy in pipes, frictional loss in pipe flow..	13	6	2	2	23
PCC-CT202.5 Students will be able to describe function of flow metering devices and apply Bernoulli equation to determine the performance of flow-metering devices	9	6	3	1	19
Total Hours	60	30	11	6	107

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Properties of Fluids.	04	03	03	10
CO-2	Fluid Kinematics, Fluid Dynamics, Fluid Flow Measurement.	05	03	02	10
CO-3	Dimensional Analysis.	03	04	03	10

CO-4	Flow Through Pipes.	07	02	01	10
CO-5	Pumping And Compressing Of Chemicals And Gases	03	02	05	10
Total		22	14	14	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	A Textbook of Fluid Mechanics	R. K. Bansal	Laxmi Publications Pvt Limited	2005
2	Fluid Mechanics Part-1	R K Rajput	S Chand Publication	1999
3	Engineering Fluid Mechanics	K. L. Kumar	S. Chand Limited	2008
4	Fluid Mechanics	H.Joseph Spurk , Nuri Aksel	Springer	2008
5	Fluid Mechanics Lab Manual			

7	Lecture note provided by Dept. of Cement Technology, AKS University, Satna .

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. in Cement Technology

(Revised as on 01 August 2023)

<u>COs, POs and PSOs Mapping</u>

Program Title: B. Tech Cement Tech; Course Code: PCC-CT202 / PCC-CT202-L; Course Title: Fluid Mechanics

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: The student will understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems.	3	3	2	2	3	2	2	1	2	2	1	2	1	2	1	3
CO-2: Acquired the knowledge of types of raw materials and fuel used in the production of Portland cement, along with its physical and chemical characteristics.	3	3	2	2	1	2	1	1	2	1	2	2	3	2	2	2
CO-3 Students will be able to apply	3	3	2	2	1	3	2	2	1	1	2	3	2	2	2	3

Dimensional Analysis of physical quantities and methods of dimensional analysis.																
CO-4: Students will compute loss of energy in pipes, frictional loss in pipe flow**.**	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**1**	**2**	**2**	**3**	**3**	**2**	**2**
CO-5 Students will be able to describe function of flow metering devices and apply Bernoulli equation to determine the performance of flow-metering devices	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**3**	**1**	**2**	**2**	**3**	**3**	**3**	**3**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Fluid Mechanics

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO-1:** The student will understand stress-strain relationship in fluids, classify their behavior and also establish force balance in static systems.	SO1.1. SO1.2 SO1.3 SO1.4 SO1.5	1.1,1. 2,1. 3	**Unit-1: Properties of Fluids** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8, 1.9,1.10,1.11,1.12	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO-2:** Acquired the knowledge of types of raw materials and fuel used in the production of Portland cement, along with its physical and chemical characteristics.	SO2.1 SO2.2 SO2.3 SO2.4	2.1, 2.2, 2.3	**Unit-2**: **Fluid Kinematics, Fluid Dynamics, Fluid Flow Measurement** 2.1,2.2,2.3,2.4,2.5,2.6, 2.7, 2.8,2.9, 2.10,2.11,2.12,2.13, 2.14,2.15,2.16,2.17	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO-3** Students will be able to apply Dimensional Analysis of physical quantities and methods of dimensional analysis.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	3.1, 3.2, 3.3	**Unit-3 : Dimensional Analysis** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO-4:** Students will compute loss of energy in pipes, frictional loss in pipe flow..	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	4.1, 4.2, 4.3	**Unit-4 : Flow Through Pipes** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11, 4.12,4.13	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**CO-5** Students will be able to describe function of flow metering devices and apply Bernoulli equation to determine the performance of flow-metering devices	SO5.1 SO5.2 SO5.3 SO5.4	5.1, 5.2, 5.3	**Unit 5: Pumping And Compressing Of Chemicals And Gases** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

Semester-III

Course Code: **BSC106-AU**

Course Title : **Environmental Science (Audit)**

Pre-requisite: To study this course, the student must have a knowledge about the environmental components, pollution, biodiversity and ecosystem at senior secondary, Class 12th level.

Rationale: Environmental awareness is today's need as pollution impact is highly increasing. Environmental legislation and Audit is the mechanism to enforce environment friendly techniques/methods to business and industries. And hence knowledge of environmental legislation and audit is an essential requirement for environment engineers. This course therefore aims to develop in students, knowledge of the legal concepts, procedures and techniques which have evolved. The course also provides knowledge of tools about the environmental audit. The course will also help students to understand and carry out the environmental auditing and life cycle assessment.

Course Outcomes:

BSC106-AU.1: Gain an understanding of the fundamental principles and components of environmental auditing.

BSC106-AU.2: Train in conducting an environmental audit in any organization/ institution

BSC106-AU.3: Implement critical thinking toward environmental problems and formulate local solutions for their Mitigation.

BSC106-AU.4: Develop, Implement, maintain and Audit Environmental Management systems for Organizations.

BSC106-AU.5: For environmental protection, social equity and sustainable development

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
BSC	BSC106-AU	Environmental Science (Audit)	2	0	1	1	4	0

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), SW: Sessional Work (includes assignment, seminar, mini project etc.), SL: Self Learning, C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
BSC	BSC106-AU	Environmental Science (Audit)	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

BSC106-AU.1: Gain an understanding of the fundamental principles and components of environmental auditing.

Approximate Hours

Item	Appx.Hrs
CI	07
LI	0
SW	1
SL	2
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	SelfLearning (SL)
SO1.1 Understand air pollution and its sources. **SO1.2** Know about gaseous and particulate pollutants. **SO1.3** Observe the sources of water pollution. **SO1.4** Learn about water quality parameter. **SO1.5** Evaluate the effects of noise pollution.		**Unit-1 Industrial pollution and its mitigation** **1.1** Air Pollution: Sources, classification of air pollutants **1.2** Mitigation and control measures of Particulate matters and gaseous pollutants **1.3** Water Pollution: sources, classification **1.4** Water quality parameters, **1.5** Control measures of water pollution **1.6** Soil pollution and impacts, soil conservation, **1.7** Noise pollution: sources, effects and control measures.	1. Difference between pollution and pollutants. 2. Water quality standards.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Classify the air pollutants on different basis.

ii. Describe control measures of noise pollution.

b. Mini Project:

i. Enlist the PPEs which used to minimize the effects of noise pollution.

c. Other Activities (Specify):

ii. Measure the air quality of different places by using Sammer App.

BSC106-AU.2: Train in conducting an environmental audit in any organization/ institution

Approximate Hours

Item	Appx.Hrs
CI	6
LI	0
SW	1
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	SelfLearning (SL)
SO2.1 Know about the environmental acts. **SO2.2** To learn about Water Pollution act. **SO2.3** To understand the air Pollution Act. **SO2.4** To discuss about Environmental protection act **SO2.5** To learn about the waste management act.		**Unit-2Environmental Law and Policy** **2.1** Highlights of the Environmental Acts, **2.2** Institutional arrangements for The water (Prevention & Control of pollution) Act 1974, **2.3** The Air (Prevention & Control of pollution) Act 1981 **2.4** The Environmental Protection Act 1986, **2.5** The waste management Act 1996 **2.6** The National Green Tribunal Act 2010.	i. What is the difference between law and policies?

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Mention the measure provisions of air pollution control act.

ii. Describe waste management act.

BSC106-AU.3: Implement critical thinking toward environmental problems and formulate local solutions for their Mitigation

Approximate Hours

Item	Appx,Hrs
CI	06
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	SelfLearning (SL)
SO3.1 Know about ISO 14000 & 14001 **SO3.2** Learn applications of EMS **SO3.3**		**Unit-3: Environmental Management System** **3.1** ISO 14000 - EMS as per ISO 14001– benefits and barriers of EMS **3.2** Concept of continual improvement and	ISO Certification

Know the methods of EIA **SO3.4** Apply the methods of EIA **SO3.5** Discuss about sustainable development.		pollution prevention, **3.3** Applications of EMS, Environmental Management plan. **3.4** Introduction and Principle – purpose of EIA **3.5** Sustainable development and EIA **3.6** The EIA Process – methodologies and practice.	

SW-3 Suggested Sessional Work(SW):

a. **Assignments:**
   i. Methods of EIA
   ii. Applications of EMS
   iii. Environmental Management Plan

b. **Mini Project:** Study the EIA reports of different developmental Projects and create a EIA report for cement plant.

BSC106-AU.4: Develop, Implement, maintain and Audit Environmental Management systems for Organizations.

Approximate Hours

Item	Appx,Hrs
CI	5
LI	0
SW	1
SL	1
Total	7

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Define environmental auditing. **SO4.2** Know the Scopes of Environmental auditing. **SO4.3** Learn the objectives of environmental auditing.		**Unit-4: Environmental Audit- Scope and Requisites** **4.1** Introduction to Environmental Auditing, **4.2** Objectives and scope, Types, Basic structure of Environmental Auditing, General Audit Methodology **4.3** Elements of Audit Process: coverage- GOI notification on environmental audit- benefits to industry. **4.4** Reporting environmental audit findings-	i. Basic introduction of environmental auditing.

SO4.4 Apply the methods of Auditing. **SO4.**5 Create the auditing reports.		**4.5** Importance of environmental audit report to industry, public and the government.	

SW-4 **Suggested Sessional work (SW):**

a. **Assignments:**
   i. Objectives, scope& Typesof environmental auditing.

b. **Other Activities (Specify):** Create an environmental audit report for cement plant.

BSC106-AU.5: **For environmental protection, social equity and sustainable development**

Approximate Hours

Item	Appx,Hrs
CI	6
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Know about Environmental performance indicators **SO5.2** Understanding sustainability in the context of environmental auditing **SO5.3** Learn about Risk Assessment and Management **SO5.4** Understanding Life Cycle Assessment		**Unit 5: Tools and Techniques for Environmental Auditing** **5.1** Environmental performance indicators **5.2** Understanding sustainability in the context of environmental auditing **5.3** Introductory Risk Assessment and Management **5.4** Introductory Life Cycle Assessment (LCA) **5.5** Brief about Water audit **5.6** Brief about Energy audit	1. How to prepare audit report of Energy, water and Waste

(LCA) **SO5.**5 Create report of Energy audit.			

SW-5 Suggested Sessional Work(SW):

a. Assignments:

Prepare an interpretive electricity consumption report of the organization/ institution over a five-year period (either actual or arbitrary data can be used).

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Laboratory Instruction (LI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (CI+SW+Sl)
BSC106-AU.1:Gain an understanding of the fundamental principles and components of environmental auditing	7	-	1	2	10
BSC106-AU.2: Train in conducting an environmental audit in any organization/ institution	6	-	1	1	8
BSC106-AU.3:Implement critical thinking toward environmental problems and formulate local solutions for their Mitigation	6	-	1	1	8
BSC106-AU.4:Develop, Implement, maintain and Audit Environmental Management systems for Organizations	5	-	1	1	7
BSC106-AU.5: For environmental protection, social equity and sustainable development	6	-	1	1	8
Total Hours	30	0	5	6	41

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Gain an understanding of the fundamental principles and components of environmental auditing.	03	01	01	05
CO-2	Train in conducting an environmental audit in any organization/ institution	02	06	02	10
CO-3	Implement critical thinking toward environmental problems and formulate local solutions for their Mitigation	03	07	05	15
CO-4	Develop, Implement, maintain and Audit Environmental	-	10	05	15

	Management systems for Organizations.				
CO-5	For environmental protection, social equity and sustainable development	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition&Year
1	Environmental Health and Safety Audits: A Compendium of Thoughts and Trends	Cahill, L.B	Bernan Press.	2017
2	Handbook of Energy Audits	Thuman, A., Niehus, T., Younger, W.J.	River Publishers	2012
3	Environmental Audits. Mercury Learning & Information.	Taylor and Francis Van Guilder, C.V.,	Mercury Learning and Information	2014
4	A Guide to Local Environmental Auditing	Barton, H., and Bruder N.,	Routledge	1993
5	Lecture note provided by Dept. of Environmental Science, AKS University, Satna .			

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Cos. Pos and PSOs Mapping

ProgramTitle:B.Tech Cement Tech **Course Code:BSC106-AU** **CourseTitle:Environmental Science (Audit)**

CourseOutcomes	ProgramOutcomes												ProgramSpecificOutcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Gain an understanding of the fundamental principles and components of environmental auditing	1	3	2	2	2	3	3	2	2	2	2	3	2	3	2	3
CO-2: Train in conducting an environmental audit in any organization/ institution	3	3	3	3	1	2	3	3	2	2	2	3	3	2	3	3
CO-3: Implement critical thinking toward environmental problems and formulate local solutions for their Mitigation	3	2	3	2	2	1	3	2	2	2	2	3	3	2	3	3
CO-4: Develop, Implement, maintain and Audit Environmental Management systems for Organizations	3	3	2	2	2	2	3	3	2	2	2	2	2	3	3	3
CO-5: For environmental protection, social equity and sustainable development	3	3	3	3	2	3	3	3	2	2	2	2	3	3	3	3

Legend:1–Low,2–Medium,3–High

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

CourseCurriculumMap:Environmental Science (Audit)

POs&PSOsNo.	COsNo.&Titles	SOsNo.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**CO-1**: Gain an understanding of the fundamental principles and components of environmental auditing	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0Gain an understanding of the fundamental principles and components of environmental auditing. 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned, in above pages
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**CO-2**: Train in conducting an environmental audit in any organization/ institution	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2Train in conducting an environmental audit in any organization/ institution 2.1,2.2,2.3,2.4,2.5,2.6,	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**CO-3**:Implement critical thinking toward environmental problems and formulate local solutions for their Mitigation	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3:Implement critical thinking toward environmental problems and formulate local solutions for their Mitigation 3.1,3.2,3.3,3.4,3.5,3.6	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**CO-4**:Develop, Implement, maintain and Audit Environmental Management systems for Organizations	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: Develop, Implement, maintain and Audit Environmental Management systems for Organizations. 4.1,4.2,4.3,4.4,4.5	
PO1,2,3,4,5,6 7,8,9,10,11,12 PSO1,2,3,4,5	**CO-5**: For environmental protection, social equity and sustainable development	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit5:For environmental protection, social equity and sustainable development 5.1,5.2,5.3,5.4,5.5,5.6	

Semester III

Course Code: **HSMC-301**

Course Title: **Universal Human Values-2**

Pre- requisite: Creating awareness among the students on a holistic perspective about life.

Rationale: The purpose is to help develop a holistic perspective about life. A self-reflective methodology of teaching is adopted. It opens the space for the student to explore his/her role (value) in all aspects of living – as an individual, as a member of a family, as a part of the society and as an unit in nature. Through this process of self-exploration, students are able to discover the values intrinsic in them.

Course Outcomes:

HSMC301.1

To understanding Value Education

HSMC301.2

Students will have the ability to learn about Harmony in the Human Being.

HSMC301.3

Student will be able to gain knowledge on Harmony in the Family and Society.

HSMC301.4

Understanding Harmony in the Nature/Existence.

HSMC301.5

Student will able to understand about Implications of Holistic Understanding- A Look at Professional Ethics.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
HSMC	HSMC-301	Universal Human Values-2	3	0	0	1	4	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: Proposed examination scheme (Marking) as per the recommendation of University Grant Commission (UGC) for Under Graduate Courses in Fundamentals of Universal Human Values 2022-23 onwards SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
HSMC	HSMC-301	Universal Human Value-2	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

HSMC301.1: To understanding Value Education

Approximate Hours

Item	Appx. Hrs
CI	9
LI	0
SW	0
SL	2
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1. Understand Self-exploration as the Process for Value Education **SO 1.2**. Understand Continuous Happiness and Prosperity – the Basic Human Aspirations **SO 1.3.** Understand Right Understanding **SO1.4.** Understand Relationship and Physical Facility **SO 1.5.** Understand Happiness and Prosperity – Current Scenario		**Unit -1 Understanding Value Education** 1.1 Self-exploration as the Process for Value Education 1.2 Continuous Happiness and Prosperity – the Basic Human Aspirations 1.3 Recognizing and articulating fundamental human values 1.4 Right Understanding 1.5 Relationship and Physical Facility 1.6 Happiness and Prosperity – Current Scenario 1.7 Method to Fulfill the Basic Human Aspirations 1.8 Connect values education to community service 1.9 Understanding of values through various assessment methods	**SL.1** Human values to become a good man SL2. Identify Core Human Values

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Continuous Happiness and Prosperity – the Basic Human Aspirations

b. **Mini Project:**
   i. Relationship and Physical Facility

c. **Other Activities (Specify):**
   i. Quiz, Class Test.

HSMC301.2: Students will have the ability to apply the gained knowledge on Harmony in the Human Being

Approximate Hours

Item	Appx Hrs
CI	9
LI	0
SW	0
SL	2
Total	11

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO2.1. Understanding Human being as the Co-existence of the Self and the Body **SO2.2.** Understand the Distinguishing between the Needs of the Self and Body **SO 2.3.** Understand the Body as an Instrument of the Self **SO 2.4.** Understanding Harmony in the Self **SO 2.5**. Understanding Harmony of the Self with the Body		**Unit-2: Harmony in the Human Being** 2.1 Module-II Harmony in the Human Being 2.2 Human being as the Co-existence of the Self and the Body 2.3 Distinguishing between the Needs of the Self and Body 2.4 Body as an Instrument of the Self 2.5 Harmony in the Self 2.6 Harmony of the Self with the Body 2.7 Programme to ensure self- regulation and Health 2.8 Explore techniques for improving concentration and mental clarity 2.9 Discuss the impact of positive emotions and strategies	**SL.1** Harmony in and among human being **SL.2** Mindfulness and Self-Awareness

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   Harmony in the self
b. **Mini Project:**
   Body an instrument
c. **Other Activities (Specify):**
   Quiz, Class Test.

HSMC301.3: Learn the basic concepts of dual nature of matter and wave packet and apply them to analyze various relevant phenomenon and to solve related numerical problem

Approximate Hours

Item	Appx. Hrs
CI	09
LI	0
SW	0
SL	2
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1. Understand Harmony in the Family – the Basic Unit of Human Interaction **SO3.2.** Understand the Values in Human-to-Human Relationship **SO3.3.** Understand the 'Trust' – the Foundational Value in Relationship **SO3.4.** Understand the 'Respect' – as the Right Evaluation **SO3.5.** Understanding Harmony in the Society	-	**Unit-3: Harmony in the Family and Society** 3.1 Harmony in the Family – the Basic Unit of Human Interaction 3.2 Values in Human-to- Human Relationship 3.3 'Trust' – the 3.4 Foundational Value in Relationship 3.5 'Respect' – as the Right Evaluation 3.6 Understanding Harmony in the Society 3.7 Vision for the Universal Human Order 3.8 Role of Empathy and Understanding 3.9 Conflict Resolution Skills	**SL.1** Harmony in the society **SL.2** Reflect on Social Responsibilities

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Respect the right evaluation

b. Mini Project:

1. Trust is the fundamental value of relationships

c. Other Activities (Specify):

Quiz, Class Test.

HSMC301.4: Student will be able to understand Harmony in the Nature/Existence

Approximate Hours

Item	Appx. Hrs
CI	9
LI	0
SW	0
SL	2
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1. Understanding Harmony in the Nature, Interconnectedness **SO4.2.** Understand self-regulation and Mutual Fulfillment among 4 orders of Nature **SO 4.3**. Understand the Exploring Four Orders of Nature **SO 4.4**. Understand the Realizing Existence as Co-existence at All Levels		**Unit-4: Harmony in the Nature/Existence** 4.1 Harmony in the Nature, Interconnectedness 4.2 Self-regulation and Mutual Fulfillment among 4 orders of Nature 4.3 Exploring Four Orders of Nature 4.4 Realizing Existence as Co-existence at All Levels 4.5 The holistic Perceptions of Harmony in Existence 4.6 The Exploring Co-Existence in Existence 4.7 Introduce environmental ethics principles 4.8 Study different ecosystems	**SL.1** Harmony in the nature **SL.2** Study Ecological Principles.

SO 4.5. Understand the holistic Perceptions of Harmony in Existence		4.9 Address the challenges posed by climate change and human activities on natural harmony	

SW-4 SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Harmony in nature
b. **Mini Project:**
   i. Exploring 4 orders of nature
c. **Other Activities (Specify):**
   Quiz, Class Test.

HSMC301.5: Students will have the ability to apply the gained knowledge in Implications of Holistic Understanding- A Look at Professional Ethics.

Approximate Hours

Item	Appx. Hrs
CI	9
LI	0
SW	0
SL	2
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1. Understand Natural acceptance of Human Values **SO5.2** Understand Definitiveness of (Ethical) Human Conduct **SO5.3.** Understand A Basis for Humanistic Education **SO5.4.** Understand the		**Unit 5 Implications of Holistic Understanding- A Look at Professional Ethics** 5.1 Introduce the concept of professional ethics 5.2 Natural acceptance of Human Values 5.3 Definitiveness of (Ethical) Human Conduct 5.4 A Basis for Humanistic Education 5.5 Humanistic Constitution and Universal Human Order	**SL.1** Holistic understanding of human values **SL.2** Read case studies and real-life examples from various profession

Humanistic Constitution and Universal Human Order **SO 5.5.** Understand Competence in Professional Ethics		5.6 Competence in Professional Ethics 5.7 Strategies for Transition towards value based Life and Profession 5.8 Explore major ethical theories 5.9 Analyze case studies to illustrate ethical decision-making using different frameworks	

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Human conduct

b. Mini Project:

i. Humanistic constitution

c. Other Activities (Specify):

Quiz, Class Test.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self-Learning (SL)	Total hour (CI+SW+SL)
HSMC301.1 To understanding Value Education	09	0	0	2	11
HSMC301.2 Students will have the ability to learn about Harmony in the Human Being.	09	0	0	2	11
HSMC301.3 Student will be able to gain knowledge on Harmony in the Family and Society.	09	0	0	2	11
HSMC301.4 Understanding Harmony in the Nature/Existence.	09	0	0	2	11

HSMC301.5 Student will able to understand about Implications of Holistic Understanding- A Look at Professional Ethics.	09	0	0	2	11
Total Hours	45	0	0	10	55

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Understanding Value Education	02	04	05	11
CO-2	Harmony in the Human Being	03	07	04	14
CO-3	Harmony in the Family and Society	02	06	02	10
CO-4	Harmony in the Nature/Existence	03	03	02	08
CO-5	Implications of Holistic Understanding- A Look at Professional Ethics	03	02	02	07
Total		13	22	15	50

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration

7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
8. Brainstorming
9. Seminar
10. Workshop

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	JeevanVidya: EkParichaya	A Nagaraj	JeevanVidyaPrakashan, Amarkantak	1998
2	Human Values	A.N. Tripath	New Age Intl. Publishers, New Delhi,	2004
3	Universal Human Values	-	AICTE	2021
4	Human Values and Professional Ethics	R.R. Gaur, R Sangal and G P Bagaria	Excel Book Publisher	2009
5	Vyavaharvadï. Samajshastra	A Nagaraj	Jeevan Vidya Prakashan, Amar kantak	1999
6	Manava Vyavahara Darsana	A Nagaraj	Jeevan VidyaP rakashan, Amarkantak	2003
7	Foundations of Ethics and Management,	B P Banerjee	Excel Book	2005
8	Fundamentals of Ethics for Scientists & Engineers	E G Seebauer & Robert L. Berry	Oxford University Press.	2000
9	Engineering Ethichs (including Human Values)	M Govindrajran, S Natrajan and V.S. Senthil Kumar	Eastern Economy Edition, Prentice Hall of India Ltd.	-

Curriculum Development Team

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code: HSMC301** **Course Title: Universal Human Values-2**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to day plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
HSMC301.1 To understanding Value Education	2	2	3	2	1	1	1	3	2	1	1	2	2	2	2	2
HSMC301.2 Students will have the ability to learn about Harmony in the Human Being	2	2	1	3	1	2	1	3	2	2	2	2	2	2	2	2
HSMC301.3 Student will be able to gain knowledge on Harmony in the Family and Society.	2	1	2	1	1	2	2	3	2	1	2	3	2	2	2	2
HSMC301.4 Understanding Harmony in the Nature/Existence.	1	1	1	2	1	2	1	3	2	1	2	2	2	2	3	3
HSMC101.5: Student will able to understand about Implications of Holistic Understanding- A Look at Professional Ethics.	1	1	1	1	1	2	2	3	1	2	2	2	3	2	3	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Universal Human Values-2

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC301.1** To understanding Value Education	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Understanding Value Education** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8, 1.9	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC301.2** Students will have the ability to learn about Harmony in the Human Being	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Harmony in th Human Being** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC301.3** Student will be able to gain knowledge on Harmony in the Family and Society.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Harmony in the Family and Society** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC301.4** Understanding Harmony in the Nature/Existence.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Harmony in th Nature/Existence Implications of Holistic** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8, 4.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC101.5** Student will able to understand about Implications of Holistic Understanding- A Look at Professional Ethics.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Understanding- A Look at Professional Ethics** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8, 5.9	

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Semester-IV

Course Code: **PCC-CT204**

Course Title : **Heat Transfer & Mass Transfer**

Pre-requisite: Student should have basic knowledge of Physics and Mathematics.

Rationale: This course follows a unified approach to introduce the physical origins and rate equations of heat and mass transfer. The principal topics covered include identification of the driving forces for heat and mass transfer. The students will learn how to identify the fundamental heat and mass transfer mechanisms.

Course Outcomes:

PCC-CT204.1: Explain different modes of heat transfer and Calculate heat transfer for one-dimensional steady state conduction in solids.

PCC-CT204.2: Explain and solve heat transfer by forced and natural convection.

PCC-CT204.3: Discuss and solve heat transfer by radiation. Analyze the performance of heat exchange equipment.

PCC-CT204.4: Find the mass transfer coefficient and solve problems related to inter phase mass transfer.

PCC-CT204.5: To find time required for drying and to understand the operation of various types of drying equipment.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT204	Heat Transfer & Mass Transfer	4	0	1	1	6	4

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT204	Heat Transfer & Mass Transfer	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT204.1: Explain different modes of heat transfer and Calculate heat transfer for one-dimensional steady state conduction in solids.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Ability to understand the concept of heat and mas transfer, explain the different mode of heat transfer and their applications **SO1.2** Understand and Solve heat transfer by conduction in solids for steady state conditions. **SO1.3** The students will be able to perform economic analysis for process to calculate equipment cost, and profitability for process.	.	**Unit-1: Heat Transfer By Conduction** **1.1** Introduction to heat transfer **1.2** General concepts of heat transfer by conduction, convection and radiation **1.3** Steady state temperature fields (Fourier's Law) **1.4** One dimensional conduction without heat generation: through plain walls **1.5** One dimensional conduction without heat generation: cylindrical surfaces **1.6** One dimensional conduction without heat generation: spherical surfaces **1.7** One dimensional conduction without heat generation: composite layers **1.8** Insulation materials **1.9** Critical and optimum insulation thickness **1.10** Extended surfaces, fins and their applications **1.11** Problems based on Fourier's Law **1.12** Problems based on one dimensional conduction without heat generation	1. Application of general concepts of heat transfer by conduction, convection and radiation 2. Remember the Fourier's Law

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on Fourier's Law

ii. Numerical Problems on one dimensional conduction without heat generation

b. Mini Project:

Derivation of one dimensional conduction without heat generation for through plain walls, composite layers, cylindrical surfaces and spherical surfaces

PCC-CT204.2: Explain and solve heat transfer by forced and natural convection.

Approximate Hours

Item	Appx. Hrs
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Explain and solve heat transfer by forced and natural convection. **SO2.2**The students will be able to understanding the empirical equation for calculation of heat transfer coefficient. **SO2.3**The students will be able to perform determination of individual and overall heat transfer coefficients. **SO2.4** The students will be able to perform Log mean temperature difference.	.	**Unit-2**: **Heat Transfer By Convection** **2.1** Fundamentals of convection: Basic concepts and definitions **2.2** Natural and Forced convection **2.3** Application of dimensional analysis to heat transfer by convection **2.4** Empirical equation for calculation of heat transfer coefficient in Laminar, turbulent and transition region in forced convection **2.5** Determination of individual and overall heat transfer coefficients **2.6** Derivation of Determination of individual and overall heat transfer coefficients **2.7** Flow arrangement in heat exchanger **2.8** Log mean temperature difference **2.9** Derivation of Log mean temperature difference	**1.** Application of Natural and Forced convection **2.** Remember the Empirical equation for calculation of heat transfer coefficient

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Derivation of Determination of individual and overall heat transfer coefficients
ii. Derivation of Log mean temperature difference

b. Mini Project:

a. Draw the chart of Empirical equation for calculation of heat transfer coefficient

PCC-CT204.3: Discuss and solve heat transfer by radiation. Analyze the performance of heat exchange equipment.

Approximate Hours

Item	Appx. Hrs
CI	14
LI	0
SW	4
SL	2
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1: Discuss and solve heat transfer by radiation. **SO3.2**Analyze the performance of heat exchange equipment. **SO3.3**The students will be able to design of shell & tube heat exchanger.	.	**Unit-3 :Heat Transfer By Radiation and Heat Exchange Equipment** **3.1** Heat transfer by radiation **3.2** Absorptivity, Reflectivity, Transmissivity **3.3** Black body concept **3.4** Gray body concept **3.5** Kirchhoff's law **3.6** Steafan Boltzmann law **3.7** Planck's law **3.8** Wiens displacement law **3.9** Heat Transfer by radiation **3.10** Problem based on heat transfer coefficients by radiation **3.11** Problem based on combined heat transfer coefficients by convection	1. Remember the Basic principle of Absorptivity, Reflectivity, Transmissivity 2. Remember the Basic law of Heat transfer by radiation

		and radiation **3.12** Shell and tube heat exchangers: Basic Definitions **3.13** Shell and tube heat exchangers: Shell side and tube side passes **3.14** Classification of Shell and tube heat exchanger	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on heat transfer coefficients by radiation

ii. Numerical Problems on combined heat transfer coefficients by convection and radiation

b. Mini Project:

b. Draw the chart of classification of Shell and tube heat exchanger

PCC-CT204.4: Find the mass transfer coefficient and solve problems related to interphase mass transfer.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1: To understand the knowledge of mass transfer by applying principles of diffusion and mass transfer coefficients.	.	**Unit-4 :Molecular diffusion** **4.1** Molecular Diffusion: Definition **4.2** Fick's Law of Diffusion **4.3** Flux equation **4.4** Molecular diffusion in	Remember the Fick's Law of Diffusion Application the concept of inter-phase mass transfer

SO4.2: Explain the principles of molecular diffusion and basic laws of mass transfer. **SO4.3:** Understand the theories of mass transfer and the concept of inter-phase mass transfer **SO4.4:** Analyze the Similarity of mass, heat and momentum transfer – Analogy		gases **4.5** Steady state diffusion of A through non diffusing B **4.6** Steady state eqimolar counter diffusion **4.7** Problems based on diffusion **4.8** Analogy between mass transfer and heat transfer **4.9** Film theory **4.10** Surface renewal theory **4.11** Penetration theory **4.12** Equilibrium	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on diffusion
ii. Derivation of Steady state diffusion of A through non diffusing B
iii. Derivation of Steady state eqimolar counter diffusion

b. Mini Project:

i. Draw a chart of Analogy between mass transfer and heat transfer

PCC-CT204.5: To find time required for drying and to understand the operation of various types of drying equipment.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1: To find time required for drying and to understand the operation of various types of drying equipment's. **SO5.2:** Perform calculations on humidification and dehumidification processes using psychometric chart. **SO5.3:** Design staged and continuous contactors for gas absorption system.		**Unit 5: Drying and mass transfer operations** **5.1** Drying: Concepts **5.2** Drying: General principles **5.3** Equilibrium rate of drying curve **5.4** Time of drying **5.5** Problems based on drying **5.6** Drying equipment: Tray drier **5.7** Drying equipment: Rotary drier **5.8** Drying equipment: Drum drier **5.9** Drying equipment: Fluidized bed drier **5.10** Drying equipment: Pneumatic drier **5.11** Important mass transfer operations: Absorption **5.12** Important mass transfer operations: Adsorption **5.13** Important mass transfer operations: Humidification	i. Application the concept of Drying operation ii. Remember the Basic formula of Time of drying.

SW-5 Suggested SessionalWork(SW):

a. Assignments:

i. Numerical Problem based on drying.

b. Mini Project:

Draw the chart of drying equipment's

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (CI+SW+Sl)
PCC-CT204.1: Explain different modes of heat transfer and Calculate heat transfer for one-dimensional steady state conduction in solids.	12	2	1	15
PCC-CT204.2: Explain and solve heat transfer by forced and natural convection.	9	2	1	12
PCC-CT204.3: Discuss and solve heat transfer by radiation. Analyze the performance of heat exchange equipment.	14	4	2	20
PCC-CT204.4: Find the mass transfer coefficient and solve problems related to interphase mass transfer.	12	2	1	15
PCC-CT204.5: To find time required for drying and to understand the operation of various types of drying equipment.	13	2	1	16
Total Hours	60	12	6	78

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Heat Transfer By Conduction	03	01	01	05
CO-2	Heat Transfer By Convection	02	06	02	10
CO-3	Heat Transfer By Radiation and Heat Exchange Equipment	02	07	06	15
CO-4	Molecular diffusion	02	07	06	15
CO-5	Drying and mass transfer operations	01	02	02	05
Total		10	23	17	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Process calculation will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, WhatsApp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition&Year
1	Heat Transfer	Holman, J. P.	McGraw Hill	9th Edition, 2004
2	Process Heat Transfer	Kern, D.Q.	McGraw-Hill	1999
3	Heat Transfer - A Practical Approach	Cengel, Y.A.	McGraw-Hill	1998
4	Fundamentals of Heat and Mass Transfer	Incropera, F.P. and Dewitt, D.P.	John Wiley	5th Edition, 2002
5	Unit Operations in Chemical Engineering	McCabe, W.L., Smith, J.C., and Harriot, P.	McGraw-Hill	6thEdition,2001
6	Chemical Engineering- Vol. I	Coulson, J.M. and Richardson, J.F.	Asian Books Pvt. Ltd., India,	4th Edition, 1998
7	Mass Transfer Operations	Treybal, R.E.	McGraw Hill	1981
8	Holcim Training Manual			

9	FLS Training Manual
10	Lecture note provided by Dept. of Cement Technology, AKS University, Satna.

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COs, POs and PSOs Mapping

Course Title: B. Tech Cement Tech **Course Code: PCC-CT204** **Course Title: Heat Transfer & Mass Transfer**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PCC-CT204.1: Explain different modes of heat transfer and Calculate heat transfer for one-dimensional steady state conduction in solids.	3	3	2	2	3	2	1	1	2	1	1	2	2	2	2	3
PCC-CT204.2: Explain and solve heat transfer by forced and natural convection.	2	3	3	2	1	2	1	1	1	1	2	2	2	2	2	2

PCC-CT204.3: Discuss and solve heat transfer by radiation.Analyze the performance of heat exchange equipment.	**3**	**3**	**2**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**3**
PCC-CT204.4: Find the mass transfer coefficient and solve problems related to interphase mass transfer.	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**1**
PCC-CT204.5: To find time required for drying and to understand the operation of various types of drying equipment.	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Heat Transfer & Mass Transfer

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning(SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT204.1:** Explain different modes of heat transfer and Calculate heat transfer for one-dimensional steady state conduction in solids.	SO1.1 SO1.2 SO1.3		**Unit-1: Heat Transfer By Conduction** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8, 1.9,1.10,1.11,1.12	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT204.2:** Explain and solve heat transfer by forced and natural convection.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: Heat Transfer By Convection** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT204.3:** Discuss and solve heat transfer by radiation. Analyze the performance of heat exchange equipment.	SO3.1 SO3.2 SO3.3		**Unit-3 : Heat Transfer By Radiation and Heat Exchange Equipment** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10 ,3.11,3.12,3.13,3.14	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT204.4:** Find the mass transfer coefficient and solve problems related to interphase mass transfer.	SO4.1 SO4.2 SO4.3 SO4.4		**Unit-4 : Molecular diffusion** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11,4.12	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT204.5:** To find time required for drying and to understand the operation of various types of drying equipment.	SO5.1 SO5.2 SO5.3		**Unit 5: Drying and mass transfer operations** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10 ,5.11,5.12,5.13	

Semester-IV

Course Code: **PCC-CT203, PCC-CT203-L**

Course Title: **Thermodynamics**

Pre-requisite: Student should have basic knowledge of physics and basic laws. Understanding concepts such as energy, heat and basic principles of chemical reactions is crucial.

Rationale: In cement technology, thermodynamics plays a crucial role in understanding the energy-related processes involved in the production of cement. It helps analyze the heat transfer, reactions, and overall energy efficiency within the system. Thermodynamics enables engineers to optimize the production process, ensuring cost-effectiveness and environmental sustainability by minimizing energy consumption and emissions. Additionally, a thorough understanding of thermodynamics aids in designing and controlling the various stages of cement production, ultimately influencing the quality and properties of the final product.

Course Outcomes:

PCC-CT203.1: To understand the thermodynamic fundamentals before studying their application in applied thermodynamics.

PCC-CT203.2: To determine the thermodynamic efficiency of different energy related processes.

PCC-CT203.3: To learn the device a technically feasible refrigerator for wide applications.

PCC-CT203.4: To understand fundamental concepts related to vapor-liquid equilibrium including vapor pressure, boiling points and phase diagrams.

PCC-CT203.5: To apply concepts related to thermodynamic properties of solutions such as entropy, enthalpy, and Gibbs free energy.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT203	Thermodynamics	4	2	1	1	8	5

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Legend:
CI: Classroom Instruction (Includes different in structional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT203	Thermodynamics	15	20	5	5	5	50	50	100

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA (VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
PCC	PCC-CT203-L	Thermodynamics	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT203.1: To understand the thermodynamic fundamentals before studying their application in applied thermodynamics.

Approximate Hours

Item	AppX Hrs
CI	14
LI	6
SW	2
SL	1
Total	23

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1: To understand the basic terms of thermodynamics. **SO1.2:** To employ application of zero and first law of thermodynamics. **SO1.3:** To recognize different types of thermodynamic equilibrium. **SO1.4:** To solve the problems for specific heat at constant pressure and constant volume. **SO1.**5: To employ application of unsteady flow processes.	**1.** To verify the Boyle's law. **2.** To determine Joule Thomson coefficient of Carbon dioxide **3.** To determine the specific heat capacity of water	**Unit-1: Fundamental concepts in thermodynamics** **1.1** Heat and Work **1.2** Thermodynamic System and Processes **1.3** Zeroth law of Thermodynamics **1.4** First law of Thermodynamics **1.5** Joule's Experiment **1.6** Internal Energy, State Functions, Enthalpy **1.7** Steady-state Steady-flow Processes **1.8** Thermodynamic Equilibrium **1.9** Phase rule, Reversible Processes **1.10** Processes at Constant Volume and Constant Pressure **1.11** Heat Capacity **1.12** Thermodynamics analysis of Control Volume **1.13** Unsteady Flow Processes **1.14** Charging and Discharging of Vessel	i. Different conditions of equilibrium ii. Degree of Freedom for different processes used in cement plant

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Thermodynamics analysis of control volume.
   ii. Real life application for unsteady flow processes in cement plant.

b. **Mini Project:**
   Specific applications for different steady-state steady-flow processes in cement plant.

c. **Other Activities (Specify):**
   Difference between state function and path function.

PCC-CT203.2: To determine the thermodynamic efficiency of different energy related processes.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	6
SW	2
SL	1
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1: To understand Pressure-volume (P-V), Temperature-Volume (T-V) and Pressure-Temperature (P-T) diagram for water. **SO2.2:** To differentiate between sensible heat and latent heat. **SO2.3:** To determine the heat of reaction, heat of formation and heat of combustion. **SO2.4:** To solve the problems for	1. Experimental Measurement of P-V-T data Experiment. 2. Determination of partial molar enthalpies by adiabatic Calorimetry. 3. To measure the specific latent heat of vaporization using electric method.	**Unit-2:Volumetric properties of pure fluids and Thermal Effects** **2.1** P-T diagram **2.2** P-V and T-V diagrams **2.3** Ideal Gas, Virial Equation and its applications **2.4** Cubic Equations of State **2.5** Generalized Correlations for Gases and Liquids **2.6** Sensible heat and Latent heat **2.7** Standard Heat of Formation, Heat of Reaction and Heat of Combustion **2.8** Effect of the Temperature on Heat of Reaction **2.9** Second law of Thermodynamics, Statement of the second law	i. Ideal gas and Van der Waals equation ii. Correlations between gases and liquids

determining the power output and efficiency of heat engine. **SO2.5:** To analyze the entropy change for the system and surroundings.		**2.10** Heat Engines **2.11** Carnot cycle **2.12** Thermodynamic Scale of Temperatures **2.13** Entropy, Third law of Thermodynamics	

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Study the effect of temperature on heat of reaction.
ii. Different processes for Carnot Heat Engine cycle and their P-V and T-S diagram.

b. Mini Project:

Discuss the application of Second law of thermodynamics for different processes used in cement plant.

c. Other Activities (Specify):

Describe the isotherms for cubic equation of state.

PCC-CT203.3: To learn the device a technically feasible refrigerator for wide applications.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	6
SW	3
SL	2
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
SO3.1: To derive Maxwell's equations from fundamental property relations of thermodynamic properties. **SO3.2:** To understand the working of Otto cycle and Diesel cycle for	**1.** To study refrigeration test ring and to study the vapour compression refrigeration cycle. **2.** To study the vapour compression air conditioning cycle **3.** To calculate the	**Unit-3: Thermodynamic properties of pure fluids** **3.1** Property relations for homogeneous phases **3.2** Maxwell's Equations **3.3** Helmholtz Energy **3.4** Gibbs Energy as the	**i.** Fundamental relations for thermodynamic properties **ii.** Properties of substances at non-ideal gas

conversion of heat into power. **SO3.3:** To calculate the values of thermodynamic properties using steam table. **SO3.4:** To determine the power requirement of compressor for vapor-compression refrigeration system. **SO3.**5: To analyze other thermodynamic properties using Gibbs energy as a generating function.	Coefficient of Performance (COP) of water to water Heat Pump	generating function **3.5** Residual properties **3.6** Two-phase systems **3.7** Tables and Diagrams of Thermodynamic properties of Gases and Liquids **3.8** Otto cycle and its P-V, T-S diagram **3.9** Diesel cycle and its P-V, T-S diagram **3.10** Refrigeration and Liquefaction **3.11** Thermodynamic analysis of Processes	states. **iii.** P-H and T-S diagram for ideal vapor-compression refrigeration cycle

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Derive the Clausius-Clapeyron equation for two-phase systems.
ii. Short notes on thermodynamic analysis of separation systems.
iii. Application of Residual properties.

b. Mini Project:

Describe the different methods for liquefaction of gases. Explain in detail about Linde process for gas liquefaction.

c. Other Activities (Specify):

Prove that decrease in the work function accompanying a process at constant temperature is equal to the reversible work done by the system during the process.

PCC-CT203.4: To understand fundamental concepts related to vapor-liquid equilibrium including vapor pressure, boiling points and phase diagrams.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	6
SW	2
SL	1
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1: To understand the qualitative behaviour of vapour-liquid equilibrium. **SO4.2:** To recall Raoult's law and Henry's law for their application. **SO4.3:** To understand Bubble point and Dew point for different processes. **SO4.4:** To calculate the problems for bubble temperature, dew temperature, bubble pressure and dew pressure. **SO4**.5: To understand K-value correlations and Flash calculations.	**1.** Measurement of Vapor-Liquid Equilibrium Data. **2.** Ebulliometric determination of vapour pressure **3.** To determine the Vapor-Liquid Equilibrium (VLE) curve for the CCl_4 - toluene mixture	**Unit-4 :Introduction of Vapour-Liquid Equilibrium** **4.1** Qualitative Behaviour of Vapour-Liquid Equilibrium (VLE) **4.2** Simple Models for Vapour-Liquid Equilibria: Raoult's and Henry´s Law **4.3** Bubble Point calculations with Raoult's Law **4.4** Dew point calculations with Raoult's Law **4.5** Steps for calculating bubble pressure, dew pressure, bubble temperature and dew temperature **4.6** Numerical problem for Bubble pressure and Dew pressure calculation **4.7** Numerical Problem for Bubble temperature and Dew temperature calculation **4.8** VLE by Modified Raoult´s law **4.9** K-Value Correlations **4.10** Flash Calculations **4.11** Numerical Problem Based on K-Value Correlations and Flash Calculations	**i.** T-x-y and P-x-y diagrams. **ii.** Minimum and maximum boiling azeotrope.

SW-4 **Suggested Sessional Work (SW):**

a. Assignments:

i. Find out the expression of pressure for binary systems for dew point and bubble point calculation with Raoult's law.

ii. Write down the steps required for calculating flash calculation.

b. Mini Project:

Visit the cement plant, collect the data required for calculating the bubble and dew temperature for binary system of benzene and toluene.

c. Other Activities (Specify): Power Point Presentation to describe the qualitative behaviour of Vapor-liquid Equilibrium.

PCC-CT203.5: To apply concepts related to thermodynamic properties of solutions such as entropy, enthalpy, and Gibbs free energy.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	6
SW	2
SL	1
Total	20

Session Outcomes (SO)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1: To derive fundamental property relation for Gibbs Free Energy **SO5.2:** To understand equations relating partial and molar properties **SO5.3:** To determine the fugacity of pure components **SO5.4:** To understand the heat effect of mixing processes **SO5.**5: To analyze the properties of ideal liquid solution using Lewis-Randall rule	**1.** Measurement of activity coefficient at infinite dilution by using gas chromatograph. **2.** Ebulliometric determination of infinite dilution activity coefficient. **3.** To calculate the partial molar volume of sodium chloride solution.	**Unit 5: Solution Thermodynamics** **5.1** Fundamental Property Relation **5.2** Chemical Potential and Phase Equilibria **5.3** Partial properties **5.4** Equations relating partial and molar properties **5.5** Partial Properties in Binary Solutions **5.6** Fugacity, Fugacity of pure gases, Fugacity coefficient **5.7** Determination of fugacity of pure component **5.8** Lewis-Randall Rule **5.9** Activity and Activity coefficient **5.10** Property change of mixing **5.11** Excess properties	1.Difference between fugacity and pressure 2. Use of Chemical Potential

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Describe the Lewis-Randall equation for ideal liquid solution.
   ii. Define fugacity coefficient for a pure component and a component in solution mixture.

b. **Mini Project:** Visit the cement plant and analyze the excess properties related to cement production process.

c. **Other Activities (Specify):** Power Point Presentation to describe the heat effect of mixing processes.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (SL)	Total hour (CI+SW+SL)
PCC-CT203.1: To understand the thermodynamic fundamentals before studying their application in applied thermodynamics	14	6	2	1	23
PCC-CT203.2: To determine the thermodynamic efficiency of different energy related processes	13	6	2	1	22
PCC-CT203.3: To learn the device a technically feasible refrigerator for wide applications.	11	6	3	2	22
PCC-CT203.4: To understand fundamental concepts related to vapor-liquid equilibrium including vapor pressure, boiling points and phase diagrams.	11	6	2	1	20
PCC-CT203.5: To apply concepts related to thermodynamic properties of solutions such as entropy, enthalpy, and Gibbs free energy.	11	6	2	1	20
Total Hours	60	30	11	6	107

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	To understand the thermodynamic fundamentals before studying their application in applied thermodynamics	03	05	02	10
CO-2	To determine the thermodynamic efficiency of different energy related processes	02	06	02	10
CO-3	To learn the device a technically feasible refrigerator for wide applications.	02	07	01	10
CO-4	To understand fundamental concepts related to vapor-liquid equilibrium including vapor pressure, boiling points and phase diagrams.	02	04	04	10
CO-5	To apply concepts related to thermodynamic properties of solutions such as entropy, enthalpy, and Gibbs free energy.	02	05	03	10
Total		11	27	12	50

Legend: R: Remember, U: Understand, A:Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration /Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition&Year
1	Introduction to Chemical Engineering Thermodynamics	J. M. Smith, H. C. Van Ness and M. M. Abbott	McGraw Hill Education	8th Edition, 2019
2	Thermodynamics an engineering approach	Yunus A. Cengel and Michael A. Boles	McGraw Hill Education	5th Edition, 2006
3	Chemical Engineering Thermodynamics	D. C. Sikdar	Khanna Publishers	1st Edition, 2015
4	Chemical Engineering Thermodynamics-I	K. A. Gavhane	NiraliPrakashan	1st Edition, 2016
5	Practical Thermodynamics: A Treatise on the Theory and Refrigeration Machinery, and Other Power-Plant Apparatus	Forrest E. Cardullo	Legare Street Press	2022

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COs, POs and PSOs Mapping

Course Title: B. Tech Cement Tech **Course Code: PCC-CT203** **Course Title: Thermodynamics**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PCC-CT203.1: To understand the thermodynamic fundamentals before studying their application in applied thermodynamics	3	3	2	2	3	2	1	1	2	1	1	2	2	2	2	3
PCC-CT203.2: To determine the thermodynamic efficiency of different energy related processes	2	3	3	2	1	2	1	1	1	1	2	2	2	2	2	2
PCC-CT203.3: To learn the device a technically feasible refrigerator for wide applications.	3	3	2	1	1	2	2	2	1	1	2	3	1	2	2	3
PCC-CT203.4: To understand fundamental concepts related to vapor-liquid equilibrium including	3	2	2	2	3	2	1	3	2	1	2	2	3	3	3	1

vapor pressure, boiling points and phase diagrams.																
PCC-CT203.5: To apply concepts related to thermodynamic properties of solutions such as entropy, enthalpy, and Gibbs free energy.	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map: Thermodynamics

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning(SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-1: To understand the thermodynamic fundamentals before studying their application in applied thermodynamics..	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1, 2, 3	**Unit-1: Fundamental concepts in thermodynamics** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8, 1.9,1.10,1.11,1.12,1.13,1.14	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-2: To determine the thermodynamic efficiency of different energy related processes.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5	1, 2, 3	**Unit-2**: **Volumetric properties of pure fluids and Thermal Effects** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9, 2.10,2.11,2.12,2.13	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-3: To learn the device a technically feasible refrigerator for wide applications.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5	1, 2, 3	**Unit-3 : Thermodynamic properties of pure fluids** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10, 3.11	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-4: To understand fundamental concepts related to vapor-liquid equilibrium including vapor pressure, boiling points and phase diagrams.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5	1, 2, 3	**Unit-4 : Introduction of Vapour-Liquid Equilibrium** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	CO-5: To apply concepts related to thermodynamic properties of solutions such as entropy, enthalpy, and Gibbs free energy	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5	1, 2, 3	**Unit 5: Solution Thermodynamics** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10, 5.11	

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Semester-IV

Course Code: **PCC-CT205**

Course Title: **Raw Mix Design & Cement Chemistry**

Pre-requisite: Students should possess fundamental knowledge of the chemical and physical properties of raw materials used in cement production.

Rationale: Students will be familiar with the process of proportioning cement raw materials for the production of Portland cement clinker. They will also comprehend how different minerals and chemical constituents affect the manufacturing process and the quality of cement clinker. Furthermore, students will gain an understanding of the chemistry of Portland cement minerals and their significance in the development of concrete strength.

Course Outcomes:

PCC-CT205.1: Learn the Raw mix design prerequisites within the cement manufacturing process and perform calculations for different modulus values to ensure the production of quality clinker

PCC-CT205.1: Comprehend the principles of phase behaviour in the formation of clinker minerals, including their morphology, distribution, and phase relationships.

PCC-CT205.1: Determine the amount of clinker minerals from the Raw mix design and the formation of clinker phases. Additionally, grasp the thermo chemistry in formation of cement minerals.

PCC-CT205.1: Gain insight into the significance of fluxes and mineralisers in the manufacturing of Portland cement clinker, as well as their impact on the burn ability mechanism.

PCC-CT205.1: Understand the process of cement hydration and the contribution of clinker minerals to the development of strength in cement concrete.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT205	Raw Mix Design & Cement Chemistry	4	0	1	1	8	4

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Curriculum of B. Tech. (Cement Technology) Program

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Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Seasonal Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT205	Raw Mix Design & Cement Chemistry	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT205.1: Learn the Raw mix design prerequisites within the cement manufacturing process and perform calculations for different modulus values to ensure the production of quality clinker.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	2
Total	17

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO1.1 Understand the Significance of Raw mix Design in Clinker Manufacturing. **SO1.2** Estimation of Moduli values **SO1.3** Estimation of Raw mix design considering fuel ash content **SO1.4.** Proportioning of cement raw materials and optimization of Raw mix design. **SO1.5.** Engaging in Raw mix Design Calculations Using an Excel Spreadsheet..	.	**Unit-1.0 Raw Mix Design and its role in Portland Cement Manufacture** **1.1** Importance of Raw mix in clinker manufacture **1.2** Chemical composition of various Raw materials for estimation of moduli values **1.3** Estimation of various moduli values and liquid content **1.4** Tutorial -1 **1.5** Method of propositioning of Raw materials **1.6** Estimation of Raw mix design considering fuel ash content **1.7** Estimation of moduli values considering MgO and SO3 content of raw mix **1.8** Tutorial -2 **1.9** Impact of moduli values on process of manufacture **1.10** Impact of Raw mix on burnability of clinker **1.11** Impact of moduli values on quality of clinker **1.12** Demonstrations on estimation of moduli value on excel spreadsheet. **1.13** Tutorial 3	**1.** Chemical Properties of various Cement Raw materials **2.** Coal Ash constituents. **3.** Fundamentals of chemical phase rules **4.** About Excel Spreadsheet

SW-1 Suggested Sessional Work(SW):

a. **Assignments:**
Impact of LSF, SM and AM in the process and quality of Portland cement, Estimation of limestone consumption factor.

b. **Mini Project:**
Poster having formula for estimation of LSF, Silica Modulus ,Alumina Modulus and liquid content of the Raw Mix. Preparation Excel spread sheet for estimation of Modulai values of raw mix.

c. **Other Activities (Specify):**
Composition of Fuel Ash and its impact of modular value of ram mix.

PCC-CT205.2: Comprehend the principles of phase behaviour in the formation of clinker minerals, including their morphology, distribution, and phase relationships.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Understand the phase rules **SO2.2** Understand the phase rule of CaO-SiO2 and formation of belie and elite clinker minerals **SO2.3** Understand the phase rule of CaO-SiO2-Al2O3 phases and formation of Cacium aluminate **SO2.4** Understand the phase rule of CaO- Al2O3 – Fe2O3 phases and formation of Cacium alumino ferrite minerals (C4AF)	.	**Unit-2 Phase Rule and Portland Cement clinker Phases** **2.1** Introduction to phase rule, **2.2** phase diagram $CaO-SiO_2$ system, **2.3** $CaO-Al_2O_3$ system, **2.4** $CaO-SiO_2-Al_2O_3$ System, **2.5** $CaO-SiO_2-Al_2O_3-Fe_2O_3$ system: **2.6** Tutorial -1 **2.7** Alite, Belite, Aluminate and Ferrite phase, **2.8** Effect of MgO on equilibrium $CaO--Al_2O_3-Fe_2O_3-SiO_2$ System, **2.9** Size Shape distribution of clinker minerals.	i. Drawing of various phase diagrams. Ii. composition of clinker minerals

SO2.5 Study the polymorphism property of Clinker mineral and eutectic points		**2.10** Tutorial -2 **2.11** polymorphism, properties cement component and their phase relation, **2.12** Binary and ternary compounds of cement and formation of eutectic. **2.13** Tutorial -3	

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Properties of Clinker mineral,

ii. Role of MgO in phase formation

b. Mini Project: Draw the phase diagram of i. $CaO\text{-}SiO_2$, ii. $CaO\text{-}Al_2O_3$ iii. $CaO\text{-}Al_2O_3\text{-}F_2O_3$

c. Other Activities (Specify): Size and distribution of clinker minerals and their impact on cement manufacture

PCC-CT205.3: Determine the amount of clinker minerals from the raw mix design and the formation of clinker phases. Additionally, grasp the thermo chemistry in formation of cement minerals.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1: Methods of estimation of clinker minerals. **SO3.2:** Estimation of C3S,C2S,C3A and C4AF % in clinker for particular Raw mix **SO3.3:** Thermochemical Reaction occurred during clinker formation	.	**Unit-3 :Estimation of Clinker Minerals by Boug's methods and role of miner constituents** **3.1** Bauge's calculation for estimation of minerals in Portland cement clinker **3.2** Estimation of C_3S with example **3.3** Estimation of C_2S with example **3.4** Estimation of C_3A and C_4AF with example **3.5** Tutorial -1	I. Properties of clinker minerals II. Miner Minerals present in the raw meal and coal

SO3.4: Role of miner constituents in formation of clinker minerals **SO3.5:** Formation of free lime and role of MgO in clinker mineral formation		**3.6** Absorption of constituents in clinker phases, **3.7** Chemical reaction during clinkerisation, **3.8** Role of minor constituents in clinkerization, **3.9** Thermo chemistry of clinker formation. **3.10** Role of MgO in clinker formation and control in formation of periclase. **3.11** Tutorial -2	

SW-3 Suggested Sessional Work (SW):

a. Assignments:
   i. Write the formula for estimation of C_2S, C_3S, C_3A, C_4AF.
   ii. Write the role of MgO in clinker formation.
   iii. iii. Measure to control in formation in clinker.

b. Mini Project: Physical and chemical properties of Clinker minerals poster

PCC-CT205.4: Gain insight into the significance of fluxes and mineralisers in the manufacturing of Portland cement clinker, as well as their impact on the burnability mechanism.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Role of additives in clinker formation **SO4.2**Use of mineralizer in clinker manufacture **SO4.3**Estimation of Burnability index and evaluation of burnability of clinker. **SO4.4**Build-up and coating formation cause and remedial measure	.	**Unit-4: Role of Fluxes Mineraliser in clinker formation** **4.1** Role of additive in clinker formation, **4.2** Types of fluxes used for manufacture of Portland clinker, and its role **4.3** Types of mineraliser used for clinker manufacture and its role in process.	i. Types of mineralizer used in Portland clinker manufacture. ii. Effect of mineralizer on property of

SO4.5 Advantages and disadvantages of use of mineralizer in clinker formation.		**4.4** Tutorial -1 **4.5** Clinker burnabilty, Burnability Index. **4.6** Procedure to evaluate the burnability of Clinker (liter weight) **4.7** Coating formation in manufacturing process its cause **4.8** Tutorial -2 **4.9** Estimation of liquid content in various temp, **4.10** Advantages and disadvantages of use of mineraliser in clinker manufacture. **4.11** Tutorial -3	clinker

SW-4: Suggested Sessional Work (SW):

Assignments:

i. Mineralizer used in clinker manufacture and its effect on properties of clinker mineral and process of manufacture.

ii. Burnability of clinker

iii. Build-up coating formation in clinker manufacturing process.

Mini Project: Figure showing build-up coating in cement kiln

PCC-CT205.5: Understand the process of cement hydration and the contribution of clinker minerals to the development of strength in cement concrete.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1: Hydration Mechanism of C2S and C3S in strength development of Portland cement concrete and mortar **SO5.2:** Hydration mechanism of C3A and C4AF of Portland cement clinker. **SO5.3:** Role of Gypsum in cement hydration **SO5.4:** Portland cement hydration product and role on hydration process. **SO5.5**: Hydration of blended and composite cement.		**Unit 5: Portland Cement Hydration:** **4.1** Hydration of calcium silicate phases & Structural model of C-S-H gel **4.2** Hydration of C3A, C4AF **4.3** Hydration products of Portland cement and strength development in concrete and mortar **4.4** Tutorial -1 **4.5** Role of gypsum in cement hydration process **4.6** Factors that affect the hydration process of Portland cement. **4.7** Hydration of Portland cements at high and low temperature. **4.8** Tutorial 2 **4.9** Hydration chemistry of fly Ash cement. **4.10** Hydration of blended and composite cement **4.11** Overview of hydration reaction (strength development) **4.12** Tutorial -3	i. Clinker minerals and its properties ii. Chemical composition of pozzolanic materials used for Portland cement manufacture

SW-5 Suggested Sessional Work (SW):

a. Assignments:

Chemical and physical properties of clinker minerals fly Ash and GGBF Slag, Hydration mechanism and strength Development

b. Mini Project:

Type of Ash produced in thermal power plant, manufacturing process Granulated Slag in steel plant

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self-Learning (SL)	Total hour (CI+SW+SL)
PCC-CT205.1: Learn the Raw mix design prerequisites within the cement manufacturing process and perform calculations for different modulus values to ensure the production of quality clinker.	13	2	1	16
PCC-CT205.2: Comprehend the principles of phase behavior in the formation of clinker minerals, including their morphology, distribution, and phase relationships.	13	2	1	16
PCC-CT205.3: Determine the amount of clinker minerals from the Raw mix design and the formation of clinker phases. Additionally, grasp the thermo chemistry in formation of cement minerals.	11	2	1	14
PCC-CT205.4: Gain insight into the significance of fluxes and mineralizers in the manufacturing of Portland cement clinker, as well as their impact on the burnability mechanism	11	2	1	14
PCC-CT205.5: Understand the process of cement hydration and the contribution of clinker minerals to the development of strength in cement concrete.	12	2	1	15
Total Hours	60	10	5	75

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Unit-1:** Raw Mix Design and its role in Portland Cement Manufacture	02	03	02	07
CO-2	**Unit-2:** Phase Rule and Portland Cement clinker Phases		08	02	10
CO-3	**Unit-3 :** Estimation of Clinker Minerals by Boug's methos and role of miner constituents	01	06	04	11
CO-4	**Unit-4:** Role of Fluxes Mineraliser in clinker formation	-	08	07	15
CO-5	**Unit 5:** Portland Cement Hydration	-	03	004	07
Total		03	28	19	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture, Tutorial
2. Case Method
3. Group Discussion, Role Play
4. Visit to cement plant
5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration /Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
7. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition &Year
1	Chemistry Of Cement And Concrete	F M Le	Chemical Publishing Co Inc, US	Revised edition 21 edition 2020
2	Cement Chemistry	F W Taylor	Academic Press	2^{nd} Edition, 1990
3	Cement Data Book:	W. H Duda	French & European Pubns	1999
4	Norms For Limestone Exploration For Cement Manufacture	National Council for Cement and Building Materials	National Council for Cement and Building Materials	1985
5	Cement Production Principle and Practice	A K Chatterjee		2018
6	Holcim Training Manual			
7	FLS Training Manual			

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

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COs, POs and PSOs Mapping

Course Title: B. Tech. Cement Tech Program Code: PCC-CT205 Course Title: Raw Mix Design & Cement Chemistry

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PCC-CT205.1: Learn the Raw mix design prerequisites within the cement manufacturing process and perform calculations for different modulus values to ensure the production of quality clinker.	1	1	2	2	3	2	3	2	2	1	3	2	2	3	3	1
PCC-CT205.2: Comprehend the principles of phase behavior in the formation of clinker minerals, including their morphology, distribution, and phase relationships.	1	1	2	2	1	2	3	2	1	1	2	2	2	2	2	1

PCC-CT205.3: Determine the amount of clinker minerals from the Raw mix design and the formation of clinker phases. Additionally, grasp the thermo chemistry in formation of cement minerals.	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**2**	**1**	**2**	**1**	**1**	**2**	**2**
PCC-CT205.4: Gain insight into the significance of fluxes and mineralizers in the manufacturing of Portland cement clinker, as well as their impact on the burnability mechanism	**3**	**2**	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**3**	**3**	**3**	**3**	**2**
PCC-CT205.5: Understand the process of cement hydration and the contribution of clinker minerals to the development of strength in cement concrete.	**-**	**-**	**-**	**1**	**1**	**3**	**3**	**3**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Raw Mix Design & Cement Chemistry

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT205.1:** Learn the Raw mix design prerequisites within the cement manufacturing process and perform calculations for different modulus values to ensure the production of quality clinker.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1:** Raw Mix Design and its role in Portland Cement Manufacture 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8, 1.9,1.10,1.11,1.12,1.13	As mentioned, in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT205.2:** Comprehend the principles of phase behavior in the formation of clinker minerals, including their morphology, distribution, and phase relationships.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2:** Phase Rule and Portland Cement clinker Phases 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10,2.11,2.12,2.13	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT205.3:** Determine the amount of clinker minerals from the Raw mix design and the formation of clinker phases. Additionally, grasp the thermo chemistry in formation of cement minerals.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3:** Estimation of Clinker Minerals by Boug's methos and role of miner constituents 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10 3.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT205.4:** Gain insight into the significance of fluxes and mineralizers in the manufacturing of Portland cement clinker, as well as	SO4.1 SO4.2 SO4.3		**Unit-4:** Role of Fluxes Mineraliser in clinker formation 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10	

	their impact on the burnability mechanism	SO4.4 SO4.5		4.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT205.5:** Understand the process of cement hydration and the contribution of clinker minerals to the development of strength in cement concrete.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5:** Portland Cement Hydration 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10 5.11,5.12	

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Semester-IV

Course Code: **PCC-CT206**

Course Title: **Size Reduction and Comminution Engineering**

Pre-requisite: Student should have fundamental understanding of mineral processing, grinding systems and particle size reduction. Additionally, students should familiarize with cement production processes and relevant technologies.

Rationale: Comminution processes significantly impact energy consumption in cement manufacturing. Efficient comminution engineering helps minimize energy usage, contributing to sustainability and cost-effectiveness. Controlling particle size is essential for achieving desired cement properties. Comminution engineering ensures precise control over the size distribution of raw materials, influencing the final product's strength and characteristics. By optimizing comminution processes, it's possible to minimize waste and emissions associated with cement production. This contributes to environmentally friendly practices and compliance with regulatory standards.

Course Outcomes:

PCC-CT206.1: To understand the fundamental principles underlying size reduction processes in cement manufacturing.

PCC-CT206.2: To understand the principles and functionality of separators used in cement plants. Additionally, to understand and analyze various techniques for particle size analysis.

PCC-CT206.3: To learn how to select and apply tube mills, roller mills and raw grinding systems based on raw material characteristics and production requirements.

PCC-CT206.4: To learn various strategies for pre-blending raw materials, considering factors such as chemical composition, particle size distribution and physical properties.

PCC-CT206.5: To analyze various homogenization techniques and equipments used in cement plants such as silos, blending beds and automated systems.

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Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT206	Comminution Engineering	4	0	1	1	6	4

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT206	Comminution Engineering	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

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PCC-CT206.1: To understand the fundamental principles underlying size reduction processes in cement manufacturing.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1: To understand how to apply comminuting laws in the selection and optimization of size reduction equipments such as crushers and mills within the cement plant. **SO1.2:** To learn the techniques and procedures for measuring the Hardgrove Grindability Index. **SO1.3:** To understand the specific applications of each crusher type in the cement industry, including their roles in the crushing and size reduction of raw materials. **SO1.4:** To learn how material characteristics influence the selection of the appropriate mobile crushing plant for a given application. **SO1.5:** To Understands how closed-circuit systems contribute to efficiency and throughput, optimizing the overall material processing workflow.		**Unit-1: Size Reduction (Crushing)** **1.1** Concept and Importance of Size Reduction **1.2** Laws of Size Reduction: Rittinger's Law and Kick's Law **1.3** Bond's Law and Work Index **1.4** Hardgrove Index **1.5** Crushing Efficiency **1.6** Crushing Stages **1.7** Gyratory crusher **1.8** Cone and Jaw crushers **1.9** Roller and Impact crushers **1.10** Mobile Crushing Plant, Semi Mobile Crusher **1.11** Closed Circuit Crushing **1.12** Choke or Regulated Crushing **1.13** Selection of Crusher System	i. Applications of Size Reduction in cement plants ii. Concept of reduction ratio for crushers.

SW-1 Suggested Sessional Work(SW):

a. Assignments:

i. Explain the working operation of vibrating screen with diagram.
ii. Define Hardgrove Grindability Index (HGI). Describe the procedure of its measurement.

b. Mini Project:

Discuss about different factors for selecting a crusher system:
(a) Characteristics of the material, (b) Capacity, (c) Product size, (d) Quarry equipment

c. Other Activities(Specify):

Prepare the power point presentation on the working of mobile crushing plant.

PCC-CT206.2: To understand the principles and functionality of separators used in cement plants. Additionally to understand and analyze various techniques for particle size analysis.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1: To understand the principles of separation employed by static separators, including the separation of particles based on size, density and other relevant factors. **SO2.2:** To learn about different types of dynamic separators, including high-efficiency separators, air classifiers and other designs commonly used in cement plants. **SO2.3:** To understand how sieve analysis contributes to quality assurance in raw materials, facilitating effective blending and pre-blending strategies.	.	**Unit-2:Separators and Particle Size Analysis** **2.1** Cyclone separator **2.2** Grit separator **2.3** VS Separator **2.4** Dynamic Separators **2.5** Closed grinding circuit **2.6** Separator efficiency **2.7** Sieve analysis **2.8** Sphericity **2.9** Screening and	i.Difference between ideal and actual screen ii.Mass balance for closed grinding circuit

SO2.4: To learn different types of screens used in cement plants such as vibrating screens, trammel screens and other designs, understanding their specific functions. **SO2.5:** To understand and analyze the key factors that influences the screen capacity and effectiveness.		Classification of screens **2.10** Grizzlies and Trommel screens **2.11** Gyratory and Vibrating screens **2.12** Screen Capacity **2.13** Screen Efficiency	

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Find the sphericity of cuboid whose length is 1 mm, breadth is 2 mm and height is 3 mm.

ii. Describe the principle of operation and application for cyclone separator.

b. Mini Project:

Find out the Fineness Modulus (FM) for different IS sieves to analyze the sieve analysis of fine aggregate.

c. Other Activities (Specify):

Prepare the power point presentation on the working of vibrating screen with diagram.

PCC-CT206.3: To learn how to select and apply tube mills, roller mills and raw grinding systems based on raw material characteristics and production requirements.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1: To understand the principles of material grinding within tube mill, focusing on the impact of grinding media and the resulting particle size reduction. **SO3.2:** To understand the function of roller mill, including	.	**Unit-3 :Tube Mill, Roller Mill and Raw Grinding System** **3.1** Dimensions and Operation for tube mill **3.2** Filling Degree for tube mill **3.3** Weight of grinding media	i. Critical speed of tube mill ii. Design features for different suppliers of roller mills

their role in grinding and milling processes for various materials. **SO3.3:** To understand the principles of material grinding within the end discharge and air swept mills, emphasizing the interaction between grinding elements and the resulting particle size reduction. **SO3.4:** To learn how to conduct a comparative analysis of different roller mill suppliers, considering factors such as cost, delivery time, warranty and after-sales support. **SO3.5:** To understand the principles of operation for roller presses, emphasizing their role in material grinding and compaction.		and mill speed for tube mill **3.4** Driving Power for tube mill **3.5** Roller Mill: Introduction and Function **3.6** Roller Mill Design **3.7** Roller Mill: Operational Aspects and Performance **3.8** Manufacture and Suppliers of Roller Mills **3.9** Raw grinding system with end discharge/ Gravity Discharge mill **3.10** Raw grinding system with air swept mill **3.11** Comparison among vertical roller mill, ball mill and roller press	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the working principle of Vertical Roller Mill (VRM) with neat and clean diagram.
ii. Describe the working of raw grinding system with air swept mill.

b. Mini Project:

Describe the operational aspects for grinding and separation of roller mill.

c. Other Activities (Specify):

Prepare the power point presentation on the working of roller press with diagram.

PCC-CT206.4: To learn various strategies for pre-blending raw materials, considering factors such as chemical composition, particle size distribution and physical properties.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1: To understand the key components of pre-blending systems such as stacker/reclaimer systems, blending beds and associated equipment, explaining their role in the process. **SO4.2:** To understand the principles behind longitudinal pre-blending, including the systematic layering of materials and the utilization of stacker/reclaimer systems for consistent blending. **SO4.3:** To understand the principles behind circular pre-blending, emphasizing the circular motion of stacker/reclaimer systems and its impact on material homogeneity. **SO4.4:** To recognize the importance of site analysis and planning in determining the optimal location and layout for pre-blending systems within the cement plant. **SO4.5:** To understand the various applications of pre-	.	**Unit-4 :Pre-blending of Raw materials** 4.1 Introduction of Pre-blending 4.2 Homogenizing Efficiency of Pre-blending 4.3 Longitudinal Pre-blending - Stacking Method 4.4 Longitudinal Pre-blending – Reclaiming Method 4.5 Circular Pre-blending System 4.6 Materials Segregation in Pre-blending 4.7 Pre-blending layouts for parallel stockpile 4.8 Pre-blending layouts for inline stockpile 4.9 Pre-blending layouts for circular stockpile 4.10 Pre-blending layouts for Homogenizing pit 4.11 Pre-blending	i. Pile geometry for longitudinal pre-blending. ii. Automatic storage pre-blending system concept.

blending in cement manufacturing and its role in optimizing raw material composition.		Applications	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Describe Chevron and Windrow stacking with diagram.
ii. Discuss about material segregation in the pre-blending system

b. Mini Project:

Describe the advantages and disadvantages of pre-blending layouts for parallel stockpile, inline stockpile, circular stockpile and homogenizing pit.

c. Other Activities (Specify):

Prepare the power point presentation for different stacking and reclaiming machines of longitudinal pre-blending.

PCC-CT206.5: To analyze various homogenization techniques and equipments used in cement plants such as silos, blending beds and automated systems.

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Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1: To understand the key components and equipments involved in blending and homogenization. **SO5.2:** To understand the principles of operation for each types of homogenizing silo, emphasizing how their design contributes to the homogenization of raw materials. **SO5.3:** To understand the fundamental principles underlying blending beds, emphasizing the layering and		**Unit 5: Blending & Homogenization** **5.1** Introduction of blending and homogenization **5.2** Reactivity of raw mix **5.3** Preparation of cement raw meal as per raw mix design **5.4** Methods of homogenization;	1.General composition of cement raw materials 2.Reasons for the necessity of blending and homogenization in modern cement plants

reclaiming processes that contribute to material mixing. **SO5.4:** To understand the fundamental principles underlying batch homogenization, highlighting the process of mixing and blending materials in discrete batches **SO5.5:** To understand the fundamental principles underlying continuous homogenization, emphasizing the uninterrupted and steady blending of materials in a continuous flow.		Fuller's one-eight blending method **5.5** Basics of homogenization silos **5.6** Fluidized homogenizing systems **5.7** Continuous blending silos **5.8** Multi pack systems **5.9** Stacking of blending beds **5.10** Blending bed theory **5.11** Batch homogenization **5.12** Continuous homogenization	

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Discuss the advantages of blending bed as an intermediate storage and as a raw material homogenization unit.

ii. Describe the Fuller's one-eight blending method with diagram.

b. Mini Project:

Explain in detail about continuous, alternate and axial stockpiling for cement plants.

c. Other Activities (Specify):

Prepare the power point presentation for working of batch and continuous homogenization.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (CI+SW+Sl)
PCC-CT206.1: To understand the fundamental principles underlying size reduction processes in cement manufacturing.	13	2	1	16
PCC-CT206.2: To understand the principles and functionality of separators used in cement plants. Additionally, to understand and analyze various techniques for particle size analysis.	13	2	1	16
PCC-CT206.3: To learn how to select and apply tube mills, roller mills and raw grinding systems based on raw material characteristics and production requirements.	11	2	1	14
PCC-CT206.4: To learn various strategies for pre-blending raw materials, considering factors such as	11	2	1	14

chemical composition, particle size distribution and physical properties.				
PCC-CT206.5: To analyze various homogenization techniques and equipments used in cement plants such as silos, blending beds and automated systems.	12	2	1	15
Total Hours	60	10	5	75

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Unit-1: Size Reduction (Crushing)	04	05	01	10
CO-2	Unit-2: Separators and Particle Size Analysis	02	06	02	10
CO-3	Unit-3: Tube Mill, Roller Mill and Raw Grinding System	02	06	02	10
CO-4	Unit-4: Pre-blending of Raw materials	03	05	02	10
CO-5	Unit 5: Blending & Homogenization	03	04	03	10
Total		14	26	10	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/ Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)

9. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition&Year
1	Cement Engineers Hand Book	B. Kolhaans and Otto Labahn	Intl Public Service	4^{th} Edition, 1982
2	Cement Data Book	W. H. Duda	Bauverlag GmbH, Berlin	1999
3	Cement Production Technology Principle and practice	Anjan Kumar Chatterjee	CRC Press , London	1^{st} Edition, 2018
4	Innovations in Portland Cement Manufacturing	J. I. Bhatty, F. M. Miller, R. P. Boahn	Portland Cement Association	2^{nd} Edition, 2011
5	Unit Operations – I: Fluid Flow And Mechanical Operations	K. A. Gavhane	NiraliPrakashan	26^{th} Edition, 2015
6	Operational Norms for cement plant		NCCBM publication	5^{th} Edition, 2004

Curriculum Development Team

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Course Title: B. Tech Cement Tech Program Code: PCC-CT206

Course Title: Size Reduction and Comminution Engineering

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PCC-CT206.1: To understand the fundamental principles underlying size reduction processes in cement manufacturing.	3	3	2	2	3	2	1	1	2	1	1	2	2	2	2	3
PCC-CT206.2: To understand the principles and functionality of separators used in cement plants. Additionally to understand and analyze various techniques for particle size analysis.	2	3	3	2	1	2	1	1	1	1	2	2	2	2	2	2
PCC-CT206.3: To learn how to select and apply tube mills,	3	3	2	1	1	2	2	2	1	1	2	3	1	2	2	3

roller mills and raw grinding systems based on raw material characteristics and production requirements.																
PCC-CT206.4: To learn various strategies for pre-blending raw materials, considering factors such as chemical composition, particle size distribution and physical properties.	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**1**
PCC-CT206.5: To analyze various homogenization techniques and equipments used in cement plants such as silos, blending beds and automated systems.	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

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Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

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Course Curriculum Map: Size Reduction and Comminution Engineering

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT206.1:** To understand the fundamental principles underlying size reduction processes in cement manufacturing.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Size Reduction (Crushing)** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10, 1.11,1.12,1.13	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT206.2:** To understand the principles and functionality of separators used in cement plants. Additionally to understand and analyze various techniques for particle size analysis.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2**: **Separators and Particle Size Analysis** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9, 2.10,2.11,2.12,2.13	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT206.3:** To learn how to select and apply tube mills, roller mills and raw grinding systems based on raw material characteristics and production requirements.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3 : Tube Mill, Roller Mill and Raw Grinding System** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10 3.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT206.4:** To learn various strategies for pre-blending raw materials, considering factors such as chemical composition, particle size distribution and physical properties.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4 : Pre-blending of Raw materials** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10, 4.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT206.5:** To analyze various homogenization techniques and equipment used in cement plants such as silos, blending beds and automated systems.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Blending & Homogenization** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10, 5.11,5.12	

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Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Semester-IV

Course Code: **PCC-CT207**

Course Title : **Geology and Mining of Limestone**

Pre- requisite: Student should have basic knowledge of Geology, Chemistry and Statistics.

Rationale: Limestone is the primary raw material for Portland cement manufacture, making knowledge of its quality and quantity crucial for a cement plant's success. This course aims to provide comprehensive knowledge of the geology of limestone deposits, including the quality and assessment of cement-grade limestone deposits. It details the origin, geographical, and geological distribution of limestone deposits in India, along with basic limestone mining methods. The course covers the quantitative assessment of limestone deposits and describes both conventional and advanced surface mining technologies, including computer-aided deposit evaluation and mine planning. Additionally, the syllabus offers insights into maintaining consistent pit-head limestone quality to ensure uniformity in cement production. Understanding these aspects is essential for the efficient and successful operation of a Portland cement plant.

Course Outcomes:

PCC-CT207.1: Gain fundamental knowledge of geology, rock formation processes, including limestone, and its distribution in Indian stratigraphy.

PCC-CT207.2: Understand the physical and chemical properties of cement-grade limestone, along with the classification of limestone deposits.

PCC-CT207.3: Explore the geographical distribution of cement-grade limestone in India, its properties, and its influence on cement quality and manufacturing processes.

PCC-CT207.4: Acquire knowledge of exploration and evaluation techniques for limestone deposits, including deposit modeling and UNFC classification.

PCC-CT207.5: Learn about basic surface mining techniques, Computer-Aided Deposit Evaluation and Mine Planning, mine production scheduling, pit-head quality control, and the procedures for approving mining plans.

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Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT207	Geology and Mining of Limestone	4	0	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), SL**:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT207	Geology and Mining of Limestone	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT207.1: Gain fundamental knowledge of geology, rock formation processes, including limestone, and its distribution in Indian stratigraphy.

Approximate Hours

Item	Appx. Hrs
CI	14
LI	0
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1: Understand the geology of the Earth and rock formation processes. SO1.2: Acquire knowledge of limestone deposit formation and the sand-clay-carbonate system. SO1.3: Gain an overview of structural geology and its significance. SO1.4: Explore the geological time scale and the history of rock formation. SO1.5: Study the distribution and availability of cement-grade limestone in Indian stratigraphy.		. **Unit -1: Introduction to Geology of Limestone :** 1. Importance of geology in the mineral processing industry 2. Structure of the Earth and composition of the lithosphere 3. Chemical composition of the Earth, lithosphere, and Portland cement 4. Basics of global plate tectonics 5. Rock classification: igneous, sedimentary, and metamorphic 6. Tutorial -1 7. Geological processes and rock formation 8. Formation and diagenesis of limestone deposits 9. Classification of limestone 10. Tutorial -2 11. Sand-clay-carbonate system. 12. Overview of structural geology: dip, strike, fold, fault, joint, and unconformities 13. Geological time scale and distribution of cement-grade limestone in Indian stratigraphy. 14. Tutorial 3	1. Geology of earth formation 2. Types of Rock and rock forming minerals

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. . Origin and distribution of limestone deposits in India

ii. Geological time scale and the distribution of limestone in Indian stratigraphy

iii. Classification of limestone deposits

iv. Overview of structural geology and its importance

Mini Project:
Marking of major limestone belts in India map

PCC-CT207.2: Understand the physical and chemical properties of cement-grade limestone, along with the classification of limestone deposits.

Approximate Hours

Item	Appx. Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1: Understand the characteristics of cement-grade limestone. SO2.2: Study the mineralogical composition of limestone using a microscope. SO2.3: Explore the major and minor chemical compositions of cement-grade limestone and their effects on processes and quality. SO2.4: Classify cement-grade limestone based on its properties. SO2.5: Examine the distribution of cement-grade limestone deposits across India.		**Unit -2 : Characteristic Cement Grade Limestone :** 1. Physical and chemical characteristic of cement grade limestone, 2. Mineralogical composition of cement grade limestone 3. Presence of impurities in limestone and its impact on quality 4. Tutorial -1 5. Major and Minor chemical components of cement grade limestone 6. Impact of major and minor minerals of limestone on manufacturing process and cement quality 7. Petrographic study of limestone, 8. Classification cement grade limestone deposits, 9. Geographical distribution of cement grade limestone deposits in India 10. Tutorial -2	1. Mineral present in limestone and its composition

SW-2 Suggested Sessional Work (SW):

Assignments:

- **a.** . Mineralogical and chemical composition of cement-grade limestone
- **b.** Distribution of limestone deposits in India and logistics of supplying limestone to cement plants
- **c.** Potential impurities in limestone and their effects on cement quality and production

Mini Project: Write a table on geographical and geological distribution of limestone in Inda

PCC-CT207.3: Explore the geographical distribution of cement-grade limestone in India, its properties, and its influence on cement quality and manufacturing processes.

Approximate Hours

Item	Appx. Hrs
CI	8
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1: Distribution of limestone in Indian stratigraphy with quality considerations SO3.2: Geographical distribution of limestone deposits in India SO3.3: Estimation of limestone requirements for cement plants of various capacities.		**Unit 3: Limestone Deposits and its distribution in India** 1. National inventory of cement grade limestone deposits of India, 2. Zone wise distribution of limestone deposits in India 3. Distribution of limestone Indian stratigraphy and its physical and chemical properties 4. Tutorial 1 5. Estimation of requirement of limestone for various capacity of cement plants , 6. Presence of minor constituents in limestone 7. Impact minor constituents of limestone in quality of cement properties 8. Tutorial -2	1. Geology of different states and rocks/mineral/ ore available in India

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i i. Status of cement-grade limestone in India
ii. Quality and availability of cement-grade limestone in India
iii. Norms for cement-grade limestone in cement manufacture.

b. Mini Project:

Estimation of quantity of limestone requirement for various capacity of cement plants

PCC-CT207.4: Acquire knowledge of exploration and evaluation techniques for limestone deposits, including deposit modeling and UNFC classification.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1: Exploration methods for limestone deposits SO4.2: Techniques for sampling and recording exploration data SO4.3: Preparation of maps and sections for reserve estimation SO4.4: Statistical and geostatistical evaluation of limestone deposits SO4.5.UNFC classification of limestone deposits		**Unit 4: Limestone Exploration and Deposit Evaluation:** 1. Phases of geological exploration with reference to limestone deposits, 2. Brief idea about geological Mapping and Surveying 3. Sampling practices in limestone exploration. 4. Recoding of exploration data, 5. Tutorial -1 6. Preparation of geological maps and section, Methods of reserve estimation, 7. Category of limestone reserve 8. Statistical Evaluation of exploration data 9. Geo statistical evaluation of bore hole dat 10. Computer Aided Deposit Evaluation and 3-D deposit model. 11. United Frame Work Classification (UNFC) of limestone deposits. 12. Tutorial -2	1. Calculation of volume of various geometrical shape 2. Specific gravity of various limestone 3. Basic statistics

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Exploration and prospecting of limestone
2. Category of limestone reserves
3. Geostatistical evaluation of limestone deposit
4. Methods for estimation of limestone reserves

c. Mini Projects

UNFC of various category of Limestone Deposits

PCC-CT207.5: Learn about basic surface mining techniques, Computer-Aided Deposit Evaluation and Mine Planning, mine production scheduling, pit-head quality control, and the procedures for approving mining plans.

Item	Appx. Hrs
CI	16
LI	0
SW	2
SL	2
Total	20

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1: Surface mining technology and limestone extraction methods. SO2.2: Block-wise and bench-wise reserve estimation and mine production planning. SO3.3: Advanced surface mining technologies. SO4.4: Pit head quality control and the supply of uniform materials. CO5.5: Requirements for mine plan approval, including Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP)		**Unit -5: Mining of Limestone** 1. Introduction to surface mining technology 2. Method of mining of limestone deposits, 3. Estimation of block size and bench height, 4. Estimation of block wise bench wise grade and tonnage, 5. Tutorial -1 6. Selection of mining equipment (excavator, dozer, dumper etc.) 7. Blasting techniques, type of explosive use 8. Advance method of limestone mining, 9. Brief about surface miner mining 10. Tutorial -2 11. Mine production	1. Introduction to surface mining technology 2. Mining equipment selection for surface mining

studies.		scheduling and planning, (Long term and short term) 12. Mining plan for approval from IBM 13. Pit head quality control practices, 14. Brief idea about PL and ML and statutory requirement to obtain for clearance from Govt 15. EIA and EMP of limestone mines. 16. Tutorial -3	

SW-5 Suggested Sessional Work (SW):

Assignments:

a. Selection of bench height and bench-wise categorization of grade and tonnage.
b. Short-term and long-term mining plans for limestone extraction.
c. EIA (Environmental Impact Assessment) and EMP (Environmental Management Plan) for mining operations.
d. Utilization of surface miners for limestone extraction.

Mini Project:

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PCC-CT207.1: Gain fundamental knowledge of geology, rock formation processes, including limestone, and its distribution in Indian stratigraphy.	14	0	2	1	17
PCC-CT207.2: Understand the physical and chemical properties of cement-grade limestone, along with the classification of limestone deposits.	10	0	2	1	13
PCC-CT207.3: Explore the geographical distribution of cement-grade limestone in India, its properties, and its influence on cement quality and manufacturing processes.	8	0	2	1	11

PCC-CT207.4: Acquire knowledge of exploration and evaluation techniques for limestone deposits, including deposit modeling and UNFC classification.	12	0	2	1	15
PCC-CT207.5: Learn about basic surface mining techniques, Computer-Aided Deposit Evaluation and Mine Planning, mine production scheduling, pit-head quality control, and the procedures for approving mining plans.	16	0	2	2	20
Total Hours	60	0	10	6	76

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	**Unit -1: Introduction to Geology of Limestone**	04	05	01	10
CO-2	**Unit -2: Characteristic Cement Grade Limestone:**	03	01	01	05
CO-3	**Unit 3: Limestone Deposits and its distribution in India**	04	05	06	15
CO-4	**Unit 4: Limestone Exploration and Deposit Evaluation**	03	06	06	15
CO-5	**Unit -5: Mining of Limestone**	03	02	-	05
Total		17	19	14	50

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for Geology and Mining of Limestone will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	A Textbook of Geology	P.K. Mukerjee	World Press	1999
2	Cement Production Technology Principles and Practice	A. K. Chatterjee	CRC Press, Taylor & Francis Group	2018
3	Handbook on Surface Mining Technology	Samir Kumar Das	Sagar Deep Prakashan Kharagpur	2018
4	Raw materials selection, in Innovations in Portland Cement Manufacturing (Eds J. I. Bhatty, E. M. Miller and S. Kosmatka).	A. K. Chatterjee,	Portland Cement Association, USA	2004
5	Chemico-mineralogical Characteristics of Raw Materials," Advances in Cement. Technology, Ed. Ghosh, S. N.,	A. K. Chatterjee,	Pergamon Press, Oxford, pages 39-68.	1983
6	Guidelines under MCDR for United Nations Framework Classification of Mineral Reserves/Resources,		Indian Bureau of Mines, Nagpur,	2003

7	Norms for Limestone Exploration for Cement Manufacture		NCCBM	
8	Norms for Proving Limestone Deposits for Cement Manufacture,		NCB, New Delhi	2003
9	National Inventory of Cement Grade Limestone Deposits in India		NCCBM	
10	SME Mining Engineering Handbook, Volume 1	Arthur B. Cummins, Ivan A. Given	Society of Mining Engineers, American Institute of Mining, Metallurgical, and Petroleum Engineers	1973

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Course Title: B. Tech Cement Tech **Course Code:** PCC-CT207 **Course Title:** Geology and Mining of Limestone

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PCC-CT207.1: Acquire the basic knowledge of Mineralogy, Petrology and Stratigraphy for better understanding of genesis, nature and their distribution of cement raw materials.	2	1	1	1	1	3	3	1	1	1	1	2	2	1	1	3
PCC-CT207.2: Apply the basic knowledge of geology and dynamic earth process to understanding the rock deformation in the earth's crust.	3	1	2	2	2	3	3	1	1	1	1	2	2	2	1	3

PCC-CT207.3: Understanding of the various activities of geological prospecting and exploration for the evaluation of reserve and their categorization of limestone deposit.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**3**	**3**	**3**	**2**	**3**	**1**
PCC-CT207.4: Familiarize with the mining activities for better planning of raw material for the production of quality cement.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**1**
PCC-CT207.5: Role of environmental regulatory bodies for mining and understand the zone-wise distribution of cement grade of limestone in India.	**2**	**2**	**2**	**1**	**1**	**3**	**3**	**3**	**1**	**2**	**2**	**3**	**2**	**1**	**2**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Geology and Mining of Limestone

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT207.1:** Acquire the basic knowledge of Mineralogy, Petrology and Stratigraphy for better understanding of genesis, nature and their distribution of cement raw materials.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6 SO1.7	1.1 1.2	**Unit-1: Mineralogy & Petrology Limestone & Other Raw Cement Materials** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT207.2:** Apply the basic knowledge of geology and dynamic earth process to understanding the rock deformation in the earth's crust.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5 SO2.6	2.1 2.2	**Unit-2: Geology & Dynamic Earth** 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT207.3:** Understanding of the various activities of geological prospecting and exploration for the evaluation of reserve and their categorization of limestone deposit.	SO3.1 SO3.2 SO3.3 SO3.4	3.1 3.2 3.3	**Unit-3 : Exploration & Deposit Evaluation** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT207.4:** Familiarize with the mining activities for better planning of raw material for the production of quality cement.	SO4.1 SO4.2 SO4.3 SO4.4	4.1 4.2 4.3	**Unit-4 : Mining of Limestone** 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12	

		SO4.5 SO3.6			
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT207.5:** Role of environmental regulatory bodies for mining and understand the zone-wise distribution of cement grade of limestone in India.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit-5: Characteristic and Distribution Cement Grade Limestone** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9,	

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

Semester-V

Course Code: **PCC-CT304**

Course Title: **Total Quality Management**

Pre- requisite: Students ought to be knowledgeable about the BIS standards for the quality of Portland cement.

Rationale: Students will gain an understanding of quality control fundamentals for Portland cement, including the practices adopted in cement manufacturing facilities. They will learn about various statistical quality control methods, such as control charts, types of errors, and sampling techniques. The course includes a study of Quality Management Plans, detailing the criteria for quality control labs. This will enable students to comprehend the processes and uses of quality control methods in Portland Cement production.

Course Outcomes:

PCC-CT304.1: Students will grasp the significance of product quality and the statistical techniques used for quality control.

PCC-CT304.2: Students will acquire skills to construct control charts for quality control, comprehend error types, and understand process capability.

PCC-CT304.3: Students will be educated on sampling methods and the implementation of quality control measures in the production of Portland cement.

PCC-CT304.4: Students will learn about the quality assurance system and the correlation between quality costs and sales.

PCC-CT304.5: Students will explore various quality system parameters relevant to the cement manufacturing process and operational practices in a cement plant.

Scheme of Studies:

Board of Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
PCC	PCC-CT304	Total Quality Management	3	0	2	2	7	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT304	Total Quality Management	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT304.1: Students will grasp the significance of product quality and the statistical techniques used for quality control.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	1
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: Understand need of quality control. **SO1.2** : Understand quality function and economics of quality. **SO1.3**: To understand the types of inspection and its role in quality control. **SO1.3**: Statistical Quality Control Techniques and its importance **SO1.4**: Estimation of various statistical parameters in quality control. **SO1.5**. Concept of six sigma technique in quality control.	.	**Unit-01: Importance of Quality control in cement manufacture and Statistical Quality control techniques.** 1.1 Definition and Need of quality 1.2 Aspects of quality & Quality characteristic, 1.3 Quality function, and Economics of quality. 1.4 Inspection and its objectives and types, 1.5 Inspection versus Quality Control, 1.6 Statistical Quality Control, its Tools, 1.7 Definition, Measures of Central tendency & Dispersion, 1.8Concept of Variation, Variable and attribute data, 1.9 Correlation & regression analysis, 1.10 Test of hypothesis: F test, t test and X^2 test. 1.11 Application of six sigma in quality control	1. Fundamental of Statistics, .

SW-1 Suggested Sessional Work (SW):

a. **Assignments:** Estimation Standard Deviation, F test , t test , X^2 test with examples of Portland cement data
b. **Mini Project:** Requirement for NABL accreditation of testing laboratory
c. **Other Activities (Specify):** Note on advantages of six sigma technique in quality control

PCC-CT304.2: Student will learn to draw control chart for quality control, understand the types of error and process capability.

Approximate Hours

Item	Appx. Hrs
CI	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes	Laboratory	Class room Instruction	Self Learning

(SOs)	Instruction (LI)	(CI)	(SL)
SO2.1 To comprehend sample variability and tolerance thresholds. **SO2.2**. Introduction to control chart and objective various control chart **SO2.3** Design the control Chart of variable for quality control in cement production **SO2.4** To evaluate type – I and Type -II error in process control **SO2.5**: Estimation of various process capability	.	**Unit-2 Process Control Charts and types of error .** 2.1 Concept of variability, 2.2 Assignable & chance causes, 2.3 Concept of specifications and tolerances, 2.4 Definition and objectives of control charts, 2.5 Control charts for variables and attributes & related problems, 2.6 Variable charts vs attribute charts, 2.7 Patterns on control charts, 2.8 Type–I & Type-II Errors, Process capability 2.9 Methods of determination of process variability	i. Portland cement manufacturing process and Raw materials quality. ii. Various process parameters of cement manufacture

SW-2 Suggested Sessional Work (SW):

a. **Assignments:** i. Draw of control charts for mean, standard deviation ii Draw of attribute chart. Ii. Types of error in cement manufacturing process.

b. **Mini Project:** Draw of control chart with a case study for manufacture of Portland cement.

PCC-CT304.3: Students will be educated on sampling methods and the implementation of quality control measures in the production of Portland cement.

Approximate Hours

Item	Appx. Hrs
CI	10
LI	0
SW	01
SL	01
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Learn about sampling practices and determine the appropriate sample size for quality control in cement manufacturing.	.	**Unit -3 Sampling method, scheme and process and materials measurement for quality control.** 3.1 Methods of taking samples, 3.2 Guideline for sample size and	i. BIS Specification of Portland cement. ii. Various process parameters in cement production

SO3.2 Understand the sampling scheme and frequency required for quality control in a cement plant. **SO3.3** Gain insights into online quality control methods in cement production. **SO3.4** Get introduced to reference standards necessary for calibrating testing methods and equipment. **SO3.5** Explore process measurements used in quality control for the production of Portland cement.		sample frequency, 3.3 Establishing sampling scheme, 3.4 Sampling stations in cement plant, 3.5 Computer Aided Run of Mines Quality control,, 3.6 Raw mix control, monitoring raw mix homoginity, 3.7 Online quality control in cement plant, 3.8 Reference materials for calibration, 3.9 .Flue gas analysis, Sampling technique for gas 3.10 Process measurements for quality control.	

SW-3 Suggested Sessional Work (SW)

a. Assignments:

i. Pit head quality control in limestone mines for cement production ii. Online and off line control measures in cement production, iii. Advance Quality control process in cement manufacture

b. Mini projects: Computer aided mine planning and quality control of limestone in mines**.**

Other Activities (Specify): Visit a large capacity cement plant to see the quality control measures.

PCC-CT304.4: Students will learn about the quality assurance system and the correlation between quality costs and sales.

Approximate Hours

Item	Appx. Hrs
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO-4.1 : Understand the principles of quality assurance and its importance. **SO-4.2** Evaluate the quality plan within the cement manufacturing process.	.	**Unit – 4: Quality assurance and Quality Cost concept** 4.1 Need, Principles Quality Assurance 4.2 Essentials objective QAS 4.3 Advantages of Quality	i. Cost of cement production ii. Marketing cost of cement iii. Cement Quality requirement of client

SO-4.3 Outline the procedures and plans for conducting a quality audit of processes and parameters. **SO-4.4** Learn about the concept of quality costs and their effects. **SO-4.5** Examine the impact of quality costs on cement production and sailing cost of cement.		Assurance System 4.4 Activities in Quality Assurance, 4.5 Quality plan, Quality control, 4.6 Quality Audit, Quality Manual, 4.7 Quality Control vs Quality Assurance, 4.8 Quality Cost, Elements of Quality Cost, 4.9 Relationship of Quality Costs to Sales.	

SW-4 **Suggested Sessional Work (SW):**

a. **Assignments**: i. Quality plan in quality cement quality control. Ii. Quality audit in cement plant for cement production. Ii. Sampling scheme for quality control in cement plant.

PCC-CT304.5: Students will explore various quality system parameters relevant to the cement manufacturing process and operational practices in a cement plant.

Approximate Hours

Item	Appx. Hrs
CI	06
LI	0
SW	2
SL	2
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO-5.1 Brief about ISO -9001: 2015 Quality Management System **SO-5.2.** To understand ISO -14040 and ISO 14044 on life cycle Assessment of cement plant **SO-5.3** Introduction to **ISO; IS:17025 :** Testing and Calibration laboratory system and its importance in cement manufacture **SO-5.4** Procedure for NABL Accreditation of Testing and Calibration laboratory of cement plant.		**Unit -5: ISO guideline for quality control and TQM quality circle** 5.1 Brief on, ISO: 9001–2015,Quality Management System 5.2 ISO: 14040 on Life cycle assessment 5.3 Iso IS 17025 : Testing and calibration laboratories. 5.4 Procedure for NABL accreditation. 5.5 Practices of quality Control system in a cement plant. Brief about	**i.** Various chemical and physical testing of cement by BIS method

SO-5.5 :TQM concept and quality circle of cement production.		laboratory quality control system (NABL). 5.6 Description of TQM Concept of quality circles	

SW-5 Suggested Sessional Work (SW):

a. **Assignments:** I. Life cycle assessment of cement plant. ii Procedure for NABL accreditation of Cement plant Quality Control Laboaratory,

b. Measurement of Uncertainty in testing

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
PCC-CT304.1: Students will grasp the significance of product quality and the statistical techniques used for quality control.	11	01	01	13
PCC-CT304.2: Students will acquire skills to construct control charts for quality control, comprehend error types, and understand process capability.	09	01	01	11
PCC-CT304.3: Students will be educated on sampling methods and the implementation of quality control measures in the production of Portland cement.	10	01	01	12
PCC-CT304.4: Students will learn about the quality assurance system and the correlation between quality costs and sales.	09	02	01	12

PCC-CT304.5: Students will explore various quality system parameters relevant to the cement manufacturing process and operational practices in a cement plant.	06	02	02	10
Total Hours	45	07	6	58

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Unit-01 : Importance of Quality control in cement manufacture and Statistical Quality control techniques	1	6	7	14
CO-2	Unit-02 Process Control Charts and types of error.	0	5	6	11
CO-3	Unit -03 Sampling method, scheme and process and materials measurement for quality control	1	4	5	10
CO-4	Unit – 4: Quality assurance, quality audit and Quality Cost concept	1	4	4	9
CO-5	Unit -5: ISO guideline for quality control and TQM quality circle	1	2	3	6
Total		4	21	25	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture, Tutorial
2. Cased study Method
3. Group Discussion, Role Play
4. Visit to cement plant
5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
7. Brainstorming

Suggested Learning Resources:

(a) Books :

S.No.	Title	Author	Publisher	Edition & Year
1	Total Quality Management	Poornima M. Charantimath	Pearson India	3rd edition 2017
2	Total Quality Management Key Concepts and Case Studies	D.R. Kiran	Elsevier Science	2017
3	Total Quality Management	Sunil Luthra, Dixit Garg, Ashish Agarwal, Sachin K. Mangla	CRC Press	2020
4	Holcim Training Manual			
5	FLS Training Manual			

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A K S University

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Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

COs,POs and PSOs Mapping

Program Title: B. Tech. Cement Technology **Course Code: PCC-CT304** **Course Title: Total Quality Management**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Students will grasp the significance of product quality and the statistical techniques used for quality control.	1	1	2		1	2	2	1	3	1	3	2	2	3	3	2
CO-2: Students will acquire skills to construct control charts for quality control, comprehend error types, and understand process capability.	2	2	2	1	1	1	2	1	2	1	3	1	1	2	1	1

CO-3: Students will be educated on sampling methods and the implementation of quality control measures in the production of Portland cement.	**1**	**1**	**1**	**3**	**2**	**1**	**1**	**1**	**2**	**1**	**1**	**3**	**3**	**2**	**2**	**2**
CO-4: Students will learn about the quality assurance system and the correlation between quality costs and sales.	**2**	**2**	**2**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**2**	**3**	**3**	**2**	**1**
CO-5: Students will explore various quality system parameters relevant to the cement manufacturing process and operational practices in a cement plant.	**1**	**2**	**2**	**2**	**3**	**2**	**3**	**1**	**1**	**2**	**2**	**2**	**2**	**1**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

Course Curriculum Map: Total Quality Management

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1**: Students will grasp the significance of product quality and the statistical techniques used for quality control.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-01 : Importance of Quality control in cement manufacture and Statistical Quality control techniques 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11	As mentioned in the above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CT 203.CO-2**: Students will acquire skills to construct control charts for quality control, comprehend error types, and understand process capability.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 Process Control Charts and types of error 2.1, 2.2 ,2.3, 2.4,2.5,2.6,2.7,2.8,2.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CT 203.CO-3**: Students will be educated on sampling methods and the implementation of quality control measures in the production of Portland cement.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit -3 Sampling method, scheme and process and materials measurement for quality control. 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CT 203.CO-4**: Students will learn about the quality assurance system and the correlation between quality costs and sales.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit – 4: Quality assurance and Quality Cost concept 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CT 203.CO-5**: Students will explore various quality system parameters relevant to the cement manufacturing process and operational practices in a cement plant	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit -5 : ISO guideline for quality control and TQM quality circle 5.1, 5.2,5.3,5.4,5.5,5.6	

Semester V

Course Code: **PCC-CT301**

Course Title : **Pyro processing & Clinker manufacture**

Pre-requisite: Student should have basic knowledge of Pyro processing and Clinker manufacturing.

Rationale: Pyro processing describes the burning process for Clinker manufacture. The requirement of the thermal energy to maintain a temperature profile so that the raw meal that ground in the Raw meal is gradually calcined during the preheating & calcination stage, which is then converted into Clinker in the Clinkerisation process. The Clinkerisation process needs high temperature intensity with controls so that desired minerology is obtained in the Clinker. It also involves a suitable mineral composition in the Raw meal which is known as "Raw Mix Design" for given fuel composition. As the requirement of Cement increased exponentially, technological upgradations with increased productivity came up, with state of art technologies. Process cost reduction, involving thermal & electrical energy became one of the vital factors for optimization and operation with improved Quality assurance. The course, teaches the development of process technology from very initial stages to latest state of art.

Course Outcomes:

PCC-CT301.1: Understand formation of Clinker mineral phases with respect to the temperature profile, property of each phase, Development of Clinkerisation process from initial stage of wet process to dry process

PCC-CT301.2: Further developments in dry process kiln. Calculation of most critical parameters for process development like Calciner residence time, parameters for Kiln Design & maximum potential capacity of a pyro-process.

PCC-CT301.3: Process fans and their vital importance in pyro-process. Capacity assessment for matching process capacity, flow measurement & fan efficiency determination. Fan curves & fan laws for capacity adjustments.

PCC-CT301.4: Understand Clinker cooling and its purpose, Gradual development of cooling technology along with the development of Pyro process, Calculation of Cooler heat recuperation efficiency

PCC-CT301.5: Learn Cement milling technologies, Comparative study of Cement milling technologies, Open & Closed-circuit ball mills, VRMs, Finish & semi-finish mode of grinding in Roller press, Recirculation factor, circulating load & Separator efficiency determination in closed circuit ball mills.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT301	Pyro processing & Clinker manufacture	4	0	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT301	Pyro processing & Clinker manufacture	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT301.1: Understand formation of Clinker mineral phases with respect to the temperature profile, property of each phase, Development of Clinkerisation process from initial stage of wet process to dry process

Approximate Hours

Item	Appx. Hrs
CI	9
LI	0
SW	3
SL	2
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Learnt reaction sequence in rotary kilns & formation of various mineral phases in Clinker. **SO1.2** Understand the types of Clinkerisation process. **SO1.3** Understand the **c**omparative study of types of kilns. **SO1.4** Approach and calculation of a Dry process kiln design. **SO1.5** Understand the Modern-day Dry kiln: Kiln float support,	.	**Unit-1:Chronological Development of Cement process & processing equipment** **1.1** Clinker phases and related properties **1.2** Type of kilns based on Moisture content in Raw Meal **1.3** Additional thermal energy cost due to moisture content in the Raw meal **1.4** Kiln design & type, dependence on moisture content of Raw meal. **1.5** Latest kiln type in operation **1.6** Comparison of Critical Parameters-Thermal& Electrical Energy consumption. **1.7** Calculation of kiln % filling, variable control and healthy operating range	**1.** Requirements and gradual development to latest technology. **2.** Work zones in wet-process, semi-wet process, Semi-dry process and Dry process. **3.** Most critical parameters for development of pyro-process

riding rings, nose ring and Air seals.		**1.8** Calculation of critical parameters for kiln sustainable operation. **1.9** Material retention time in Kiln	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Formation of Clinker phases at required temperatures, Determination of Heat of reaction in Clinkerisation process, Function of Kiln Inlet & Outlet seals, Riding ring relative movement & limiting value.

b. Mini Project:

Verification of specific heat consumption.

c. Other Activities (Specify):

Control of floating movement of kiln

PCC-CT301.2: Further developments in dry process kiln. Calculation of most critical parameters for process development like Calciner residence time, parameters for Kiln Design & maximum potential capacity of a pyro-process.

Approximate Hours

Item	Appx. Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Learn the history & development of Preheater system **SO2.2** Understand the Heat exchange between Hot flue gas and Kiln feed in	.	**Unit-2: Chronological Development of Suspension Preheater and Separate line Calciner, Inline Calciner Kilns, SLC_ILC Kilns** **2.1** Requirement & development of various type of Preheaters with Kiln process **2.2** Difference between SLC, ILC Kilns and SLC-ILC Kilns and their layout & Circuit diagram **2.3** Kiln Inlet Hot meal characteristics	1. Requirement of Calciner for optimum productivity of kiln. 2. Understanding Calciner residence time and Calciner sizing for

Riser ducts **SO2.3** Precalcining System, Features of Calciner **SO2.4** Kiln heat balance study & its verification of Specific heat consumption **SO2.5** Determination of false air in the Preheater system		corresponding to Calciner type **2.4** Kiln feed Quality parameters specific to the Kiln process requirements. **2.5** Mechanical arrangement & Refractory requirements for de-coating in the Preheater **2.6** Fuel type and fineness for complete combustion in Calciner. targeting excess oxygen at Calciner outlet **2.7** Calculation of Kiln Inlet flue gas with targeted excess Oxygen & air and corresponding Flue gas volume at Calciner outlet with targeted excess oxygen & air **2.8** Calculation of Calciner sizing/design based on fuel type &Residence time **2.9** Determination of, "Degree of Calcination" in various stages & in Hot meal to Kiln **2.10** Factors influencing kiln output	Capacity enhancement. 3. Preheater outlet specific gas and absolute gas volume with false air for required venting.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Calculation of Kiln Inlet flue gas volume & Specific gas volume on basic data,

ii. Determination of Calciner Residence time based on basic data of Kiln TPD, Fuel type, Specific fuel consumption & Calciner ID& Height.

b. Mini Project:

Line diagram of SLC, ILC & ILC_SLC Dry process Cement Kilns.

c. **Other Activities (Specify):**

Optimization techniques in Cement Kilns

PCC-CT301.3: Process fans and their vital importance in pyro-process. Capacity assessment for matching process capacity, flow measurement & fan efficiency determination. Fan curves & fan laws for capacity adjustments.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Understand the purpose of Process fans. **SO3.2** Learnt Fan types & types of fan impellers. **SO3.3** Determination of Fan capacity requirements based on location and purpose. **SO3.4** Understand Fan behavior & System Characteristics. **SO3.5** Determination of Fan operating performance &requirements for fan capacity adjustments. .	.	**Unit-3: Process fan location and its suitability in Process with Chronological Process Technology Development** **3.1** Determination of Flue gas flow at Preheater Outlet, based on kiln capacity and type of fuel **3.2** Determination of false air in the Preheater system **3.3** Impacts of high PH outlet flow due to false air, LOI of Kiln Feed and excess air for combustion **3.4** Fan type with related efficiency, Fan Impeller type and related efficiency, best operating efficiency of Process fans corresponding to location **3.5** System pressure development in an induced system **3.6** Suitability of fan with system characteristics & related fan static efficiency **3.7** Measurement techniques of velocity pressure, static pressure & total pressure of Gas/Air stream, Dust laden gas/Air stream & Calculation of flow **3.8** Fan static efficiency: Depending factors & parameters **3.9** Understood Fan Laws for fan operating behavior **3.10** Fan Control loops, parameter controls for optimum and safe operation of kiln	1. Effect of RPM & Impeller modifications on Fan capacity 2. Understanding Fan performance & operating capacity on productivity 3. Possible problems in the fans-Vibration, buildups, erosion, wear protection, troubleshooting in fans

		3.11 Knowledge of possible fan operation and performance problems **3.12** General maintenance of PH fan for best operating efficiency **3.13** Energy saving drives in Process fans	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Calculation of PH outlet flow& Specific gas volume on basic data by flow measurement
2. Determination of fan flows with corresponding variation of fan rpm

b. Mini Project:

Cooler fan control parameters and controlling loops

c. Other Activities (Specify):

General maintenance in Process fans

PCC-CT301.4: Understand Clinker cooling and its purpose, Gradual development of cooling technology along with the development of Pyro process, Calculation of Cooler heat recuperation efficiency

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 Understand **"**Purpose of clinker cooling" **SO4.2** Learnt "Technological development of Cooling technology"	.	**Unit-4: Factors affecting Clinker quality due to Cooling with primary aspect of Cement mill grindability and Cement expansion after casting.** **4.1** Clinker Grate Cooler operating circuit & layout **4.2** Cooler Internals &auxiliaries	1. Grate Cooler fans control loops-action/reaction. 2. Understanding grate Cooler Vent fan

SO4.3 Understand "Development of Grate plate design" **SO4.4** Learnt "OPEX & CAPEX" of Cooler **SO4.5** Aspects of WHPRS for AQC boiler in Cooler		**4.3** Difference between various types of Coolers and its development to latest design **4.4** Cooler air balance & air distribution for heat recuperation and combustion **4.5** Cooler Heat balance and recuperation efficiency **4.6** Control loops in Grate cooler for optimum operation & operating efficiency **4.7** Indicators of heat recuperation efficiency during operation **4.8** Operating actions to increase the Heat recuperation efficiency **4.9** OPEX costs of Cooler: Electrical energy consumption & General maintenance; **4.10** Feasibility of CAPEX based on Heat & Electrical energy savings & reduction in stoppages **4.11** High temperature & Medium temperature Mid-air taps not affecting the heat recuperation for pyro process **4.12** False air determination method in Cooler vent and its impacts **4.13** Cooler vent, dedusting and clinker conveying	operation & its control loop operation. 3. Impact of false air in the Cooler vent on Cooler heat loss

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Calculation of Cooler heat recuperation efficiency from basic data and measured parameters
2. Determination of air balance in Cooler, with air requirement for combustion in Kiln firing and Calciner firing

b. Mini Project:

Cooler control parameters and controlling loops

c. Other Activities (Specify):

Possibility of increase in Cooler heat recuperation efficiency

PCC-CT301.5: Learn Cement milling technologies, Comparative study of Cement milling technologies, Open & Closed-circuit ball mills, VRMs, Finish & semi-finish mode of grinding in Roller press, Recirculation factor, circulating load & Separator efficiency determination in closed circuit ball mills.

Approximate Hours

Item	Appx. Hrs
CI	15
LI	0
SW	3
SL	1
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Understand Gantry & Silos for Clinker storage: Stacking & Extraction. **SO5.2** Requirement of Cement raw materials & additives, and their purpose. Location of addition. **SO5.3** Types of Cement grinding mills, Comparison. **SO5.4** Critical parameters in Closed circuit Ball Mill for performance assessment. **SO5.5** Cement packing and		**Unit-5: Cement grinding systems, suitability in terms of Cement fineness and Specific Electrical energy consumption.** **5.1** Factors for determination of Capacities of Clinker storage yard and/or Clinker silos. **5.2** Clinker stacking &reclaiming methods for Cement grinding in Gantry & Silos **5.3** Impacts of Fly ash addition system at Mill Inlet & outlet in Closed circuit Ball Mill. Its advantages & disadvantages **5.4** Conceptual circuit diagram of Open Circuit Ball Mill, &Closed-Circuit Ball Mill **5.5** Control parameters in open circuit Ball mill with intended effects **5.6** Control parameters in Closed Circuit Ball Mill with intended effects **5.7** Purpose & advantages of Closed-circuit Ball mill w.r.t. Open circuit **5.8** Determination of Circulating load and Separator efficiency in a Closed-Circuit Ball mill **5.9** Impact of circulating factor & separator efficiency as recovery of fines and reduction in power consumption **5.10** VRM layout & circuit diagram **5.11** VRM internals	**1.** Factors influencing selection of “Most suitable grinding system” **2.** Feasibility of Grinding aid usage **3.** Determination of false air in the Cement Grinding system

loading.		**5.12** Blender for fly ash addition for PPC in VRM ground OPC **5.13** Finish & Semi-finish Roll Press system, layout, circuit diagram **5.14** Grinding aid purpose & feasibility of usage **5.15** Cement conveying systems to Silos, Packing plant	

SW-5 Suggested Sessional Work (SW):

a. Assignments:

1. Determination of minimum increase in additive fly ash for given grinding aid usage %
2. Calculation of Circulating factor and Separator efficiency
3. Control loop operation in Closed Circuit Ball mill for intended values of variables

b. Mini Project:

Demonstration of advantages of Fly ash addition at Mill outlet in Closed circuit Ball Mill

c. **Other Activities (Specify):**

Modes of Cement conveying to Cement Silos

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (CI+SW+Sl)
PCC-CT301.1: Understand formation of Clinker mineral phases with respect to the temperature profile, property of each phase, Development of Clinkerisation process from initial stage of wet process to dry process	09	3	2	14
PCC-CT301.2: Further developments in dry process kiln. Calculation of most critical parameters for process development like Calciner residence time, parameters for Kiln Design & maximum potential capacity of a pyro-process.	10	2	1	13
PCC-CT301.3: Process fans and their vital importance in pyro-process. Capacity assessment for matching process capacity, flow measurement & fan efficiency determination. Fan curves & fan laws for capacity adjustments.	13	2	1	16
PCC-CT301.4: Understand Clinker cooling and its purpose, Gradual development of	13	2	1	16

cooling technology along with the development of Pyro process, Calculation of Cooler heat recuperation efficiency				
PCC-CT301.5: Learn Cement milling technologies, Comparative study of Cement milling technologies, Open & Closed-circuit ball mills, VRMs, Finish & semi-finish mode of grinding in Roller press, Recirculation factor, circulating load & Separator efficiency determination in closed circuit ball mills.	15	3	1	19
Total Hours	60	12	6	78

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Chronological Development of Cement process & processing equipment	03	02	05	10
CO-2	Chronological Development of Suspension Preheater and Separate line Calciner, Inline Calciner Kilns, SLC_ILC Kilns	03	03	06	12
CO-3	Process fan location and its suitability in Process with Chronological Process Technology Development	03	02	05	10
CO-4	Factors affecting Clinker quality due to Cooling with primary aspect of Cement mill grindability and Cement expansion after casting.	03	02	05	10
CO-5	Cement grinding systems, suitability in terms of Cement fineness and Specific Electrical energy consumption.	03	02	03	08
Total		15	11	24	50

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for Pyroprocessing and Clinker Manufacture will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition&Year
1	Cement Plant Operations Handbook	Philip A Alsop, Hung Chen, Arthur L Chin, Andrew J Jackura, Michael I McCabe, Merman H Tseng	Tradeship Publications Ltd	Tradeship Publications Ltd
2	Cement Data Book	W.H Duda, VerlagGmBh, Berlin	-	-
3	Process technology	Holcim	Holcim	Volume 4, Process Technology II
4	FL Smidth Comminution manual	FLS	FLS	2007
5	Book 3- Energy Efficiency in Electrical Utilities	Bureau of Energy Efficiency	BEE	Third Edition 2010

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech. Course Code: PCC-CT301 Course Title: Pyroprocessing and Clinker Manufacture

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Understand formation of Clinker mineral phases with respect to the temperature profile, property of each phase, Development of Clinkerisation process from initial stage of wet process to dry process	3	3	3	2	3	2	2	1	3	3	1	2	3	3	3	2
CO-2: Further developments in dry process kiln. Calculation of most critical parameters for process development like Calciner residence time, parameters for Kiln Design & maximum potential capacity of a pyro-process.	3	3	3	2	3	2	2	1	3	2	1	2	3	3	1	2

CO-3: Process fans and their vital importance in pyro-process. Capacity assessment for matching process capacity, flow measurement & fan efficiency determination. Fan curves & fan laws for capacity adjustments.	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**
CO-4: Understand Clinker cooling and its purpose, Gradual development of cooling technology along with the development of Pyro process, Calculation of Cooler heat recuperation efficiency	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**
CO-5: Learn Cement milling technologies, Comparative study of Cement milling technologies, Open & Closed-circuit ball mills, VRMs, Finish & semi-finish mode of grinding in Roller press, Recirculation factor, circulating load & Separator efficiency determination in closed circuit ball mills.	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Pyro processing & Clinker Manufacture

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Understand formation of Clinker mineral phases with respect to the temperature profile, property of each phase, Development of Clinkerisation process from initial stage of wet process to dry process	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1 Chronological Development of Cement process & processing equipment** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Further developments in dry process kiln. Calculation of most critical parameters for process development like Calciner residence time, parameters for Kiln Design & maximum potential capacity of a pyro-process.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2 Chronological Development of Suspension Preheater and Separate line Calciner, Inline Calciner Kilns, SLC_ILC Kilns** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Process fans and their vital importance in pyro-process. Capacity assessment for matching process capacity, flow measurement & fan efficiency determination. Fan curves & fan laws for capacity adjustments.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Process fan location and its suitability in Process with Chronological Process Technology Development** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11 ,3.12,3.13	

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Understand Clinker cooling and its purpose, Gradual development of cooling technology along with the development of Pyro process, Calculation of Cooler heat recuperation efficiency	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Factors affecting Clinker quality due to Cooling with primary aspect of Cement mill grindability and Cement expansion after casting.** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11, 4.12,4.13	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Learn Cement milling technologies, Comparative study of Cement milling technologies, Open & Closed-circuit ball mills, VRMs, Finish & semi-finish mode of grinding in Roller press, Recirculation factor, circulating load & Separator efficiency determination in closed circuit ball mills.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Cement grinding systems, suitability in terms of Cement fineness and Specific Electrical energy consumption** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.1 1,5.12,5.13,5.14,5.15	

Semester-V

Course Code:	**PCC-CT303**
Course Title :	**Pollution Control in Cement Plant**
Pre-requisite:	Student Should have basic knowledge on Manufacturing process of Portland cement and different types of pollution.
Rationale:	Cement plants can present notable environmental challenges due to pollution, but the good news is that there are several control measures available to address these issues. This course covers the diverse sources of pollution and the corresponding control measures to tackle them. The course curriculum incorporates the government's periodic imposition of various acts, rules, and regulations to control pollution caused by the cement process. Air pollution in cement manufacturing arises from the grinding and heating of raw materials, releasing particulate matter into the atmosphere. Elevated temperatures in cement kilns can also give rise to nitrogen oxides (NOx) and SOx, contributing to air pollution and smog formation. Additionally, cement production produces wastewater containing contaminants like heavy metals and suspended solids. Improper disposal or runoff can lead to water pollution in nearby water bodies. The machinery used in cement plants, including crushers and mills, can generate substantial noise levels, impacting the surrounding environment and communities. Addressing these pollution sources is crucial to reducing pollution levels and promoting a cleaner environment in cement plants.

Course Outcomes:

PCC-CT303.1: Pollution during manufacture of Portland cement and its impact on environment.
PCC-CT303.2: Source of pollution in cement plant and its measurement.
PCC-CT303.3: Various pollution control measures in cement plant for environmental improvement
PCC-CT303.4: Pollution control measures of limestone mines of cement plant.
PCC-CT303.5: Environmental Management for pollution control in cement plant and Clean Development Mechanism.

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Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT303	Pollution Control in Cement Plant	4	0	2	1	7	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT303	Pollution Control in Cement Plant	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT303.1: Pollution during manufacture of Portland cement and its impact on environment.

Approximate Hours

Item	Appx. Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Environment Pollution and Role of engineer in cement plant. **SO1.2** Types of pollution in cement industry **SO1.3** Impact of pollution on environment and human **SO1.4** Standards and limits of pollutants for Cement plant	.	**Unit-1: Introduction Environment pollution** **1.1** Interaction of Humans and Environment and Role of an engineer in Environmental improvement, **1.2** Types of pollution, **1.3** Air quality-sources and classification of pollutants, **1.4** Influence of meteorological phenomena on air quality, **1.5** Tutorial -1 **1.6** Water Quality - physical, chemical & biological parameters, **1.7** Noise and ground vibration, **1.8** Standards & limits for air, water, waste water, noise, **1.9** MOEF limits of pollutants for Cement Plant **1.10** Tutorial -2	**1.** Quality of air, water, noise for the human to sustain

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Types of pollutant and its impact on environment
2. Limits of air, noise, and gaseous pollutant by MOEF for cement industry
3. Noise and ground vibration in cement plant
4. Air Pollutant and influence on meteorological phenomena.

PCC-CT303.2: Source of pollution in cement plant and its measurement.

Approximate Hours

Item	Appx. Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Source of pollution in cement plant. **SO2.2** Fugitive dust and Gaseous pollution in plant. **SO2.3** Water pollution in Cement plant **SO2.4** Noise pollution in cement plant. **SO2.5** Solis and Hazardous waste in cement plant.	.	**Unit-2: Sources of Pollution in Cement Industry** **2.1** Ambient Air Quality and Fugitive dust, Point Source **2.2** Green House Gas in cement plant **2.3** Particulate matter (PM), SO_2, NOx, CO, HCl, HF, **2.4** Heavy Metals, **2.5** Tutorial -1 **2.6** Dioxins, Furans, TOC, TVOC etc. **2.7** Water – Consumption, sources of water, waste water generation, **2.8** Noise – Sources, **2.9** Solid and Hazardous Waste in cement plant **2.10** Tutorial -2	1. Different types of pollution in Cement manufacturing process

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Ambient air quality and fugitive dust generation in cement plant
2. Greenhouse gases generation in cement manufacturing process
3. Noise pollution in cement plant
4. Particulate matter generation in cement manufacturing process.

PCC-CT303.3: Various pollution control measures in cement plant for environmental improvement

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Approximate Hours

Item	Appx. Hrs
CI	15
LI	0
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Monitoring method of fugitive dust in cement plant **SO3.2** Function of bag filter, its advantages and disadvantages **SO3.3** Function and mechanism of ESP **SO3.4** Control of gaseous emission in cement plant **SO3.5** Continuous emission monitoring system in cement plant	.	**Unit-3: Control measures in cement plant for environmental improvement.** **3.1** Control measures for improving ambient air quality (AAQ) **3.2** Fugitive dust, AAQ – Monitoring methods, **3.3** Air Pollution Control Equipment for controlling Point Source Emissions **3.4** Bag Filter / Bag House, **3.5** Tutorial -1 **3.6** ESP, **3.7** Hybrid Filter, **3.8** Multi Cyclones, **3.9** Wet Scrubber, Gravity Setling chamber, **3.10** Tutorial 2 **3.11** Control of gaseous emissions by primary and secondary (SCR/ SNCR) techniques. **3.12** Stack monitoring for particulate matter and gases. **3.13** GHG control – Blended cement, use of alternate fuels, carbon sequestration. **3.14** Continuous emission Monitoring (CEM) in cement plant **3.15** Tutorial -3	1. Different alternate fuels in cement plants.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Stack monitoring system in cement plant
2. Control of gaseous pollution in cement plant
3. ESP function in plant
4. Pollution monitoring equipment in cement plant.

PCC-CT303.4: Pollution control measures of limestone mines of cement plant.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self -Learning (SL)
SO4.1 Source of Pollution due to limestone mining operation. **SO4.2** Air pollution during mining of limestone deposit and its control measure. **SO4.3** Noise Pollution due to limestone mining activity and control measure. **SO4.4** EIA and EMP of Limestone mines **SO4.5** Control of dust at the crusher	.	**Unit-4: Pollution control at limestone mines.** **4.1** Pollution due to Mining of limestone **4.2** Air Pollution due to mining and dust generation. **4.3** Measures for dust control during mining operation **4.4** Noise pollution due to mining activities **4.5** Tutorial -1 **4.6** Control blasting and noise control **4.7** Ground vibration due to the mining activity and control measures. **4.8** Waste water – treatment methods and reuse in mines **4.9** Tutorial 2 **4.10** EIA study of Mines. **4.11** EMP of Mines **4.12** Dust control at the crusher **4.13** Tutorial -3	1. Methods of Limestone mining

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Limestone mining methods and source of pollution.
2. Noise and vibration control in the limestone mining
3. EIA and EMP study of limestone mines
4. Generation of dust and control measure at the crusher.

PCC-CT303.5: Environmental Management for Pollution control in cement plant and Clean Development Mechanism

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Various acts for Environmental control. **SO5.2** Environmental Audit for control of plant environment. **SO5.3** Corporate Responsibility for ENV protection **SO5.4** Various Environmental Management Tools **SO5.5** CDM for cement plant.		**Unit-5: Environment Management:** **5.1** Introduction to various Environmental Act & Regulations, Environment Protection Act 1986, **5.2** Water Prevention and Control of Pollution act, **5.3** Air (Prevention and Control of Pollution) act, **5.4** Hazardous Waste Management, rules, **5.5** Tutorial -1 **5.6** Solid Waste Management Rules, **5.7** Corporate Responsibility for ENV Protection (CREP). **5.8** Environment Management Tools and EMS – ISO 14001 **5.9** Tutorial -2 **5.10** Environmental Audit **5.11** Clean Development Mechanism (CDM) **5.12** Tutorial -3	1. MOEF functions in environmental control. 2. Various statutory bodies for environmental Control.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

1. ENV acts for pollution control
2. ENV management tools
3. Clean Development Mechanism
4. ENV audit of cement plant
5. Solid waste management in cement plant.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (CI+SW+Sl)
PCC-CT303.1: Pollution during manufacture of Portland cement and its impact on environment.	10	2	1	13
PCC-CT303.2: Source of pollution in cement plant and its measurement	10	2	1	13
PCC-CT303.3: Various pollution control measures in cement plant for environmental improvement	15	2	1	18
PCC-CT303.4: Pollution control measures of limestone mines of cement plant.	13	2	1	16
PCC-CT303.5: Environmental Management for Pollution control in cement plant and Clean Development Mechanism	12	2	1	15
Total Hours	60	10	5	75

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction Environment pollution	02	03	02	07
CO-2	Sources of Pollution in Cement Industry		08	02	10
CO-3	Control measures in cement plant for environmental improvement	01	06	04	11
CO-4	Pollution control at limestone mines.	-	08	07	15
CO-5	Environment Management	-	03	04	07
Total		03	28	19	50

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for Pollution Control in Cement Plant will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:
(a) Books:

S.No.	Title	Author	Publisher	Edition&Year
1	Environmental Pollution Control Engineering	C S Rao	New Age International Publishers	3rd Edition,2018
2	Air Pollution:	M N Rao, H.V.N. Rao	McGraw Hill Education	1st Edition, 2017
3	Environmental Engineering	Peavy and Rowe	McGraw Hill Education	1st Edition, 2017
4	Air Pollution Control	S P Mahajan, T.V. Ramachandra	The Energy and Resources Institute, TERI	2019
5	Pollution Control in Process Industries	S P Mahajan	McGraw Hill Education	2017
6	Holcim Training Manual			
7	FLS Training Manual			

Curriculum Development Team

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6. Er Priyanka Singh, Assistant Professor, Dept. of Cement Technology
7. Er A K Bhattacharya, Faculty, Dept. of Cement Tech. (Former GM M/s Dalmia Cement)
8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech | Course Code: PCC-CT303 | Course Title: Pollution Control in Cement Plant

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Pollution during manufacture of Portland cement and its impact on environment.	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**3**	**1**	**2**	**2**	**3**	**3**	**2**
CO-2: Source of pollution in cement plant and its measurement	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**3**	**2**	**1**	**2**	**3**	**3**	**1**	**2**
CO-3: Various pollution control measures in cement plant for environmental improvement	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**3**	**2**	**3**	**3**	**3**
CO-4: Pollution control measures of limestone mines of cement plant.	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**
CO-5: Environmental Management for Pollution control in cement plant and Clean Development Mechanism	**3**	**2**	**3**	**3**	**2**	**3**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**2**	**3**	**2**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Pollution Control in Cement Plant

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Pollution during manufacture of Portland cement and its impact on environment.	SO1.1 SO1.2 SO1.3 SO1.4		**Unit-1: Introduction Environment pollution** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10	As mentioned inabove pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Source of pollution in cement plant and its measurement	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Sources of Pollution in Cement Industry** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Various pollution control measures in cement plant for environmental improvement	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Control measures in cement plant for environmental improvement** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11, 3.12,3.13,3.14,3.15	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Pollution control measures of limestone mines of cement plant.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Pollution control at limestone mines.** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11, 4.12,4.13	

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Environmental Management for Pollution control in cement plant and Clean Development Mechanism	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit-5: Environment Management** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11, 5.12	

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Semester V

Course Code: **PCC-CT302**

Course Title : **Fuel and Alternate Fuel & Raw Materials**

Pre-requisite: Student should have knowledge of Organic chemistry, Pyro-processing and Portland clinker formation.

Rationale: The cement industry has always been concerned with selecting and using the right type of fuel. This essential material is crucial for the clinkering process in the kiln and is also used in dryers for raw materials or additives, as well as in hot gas generators. With intense competition in the cement market and the significant impact of fuel costs on the final product price, companies are seeking the most cost-effective fuel mix for their kilns. However, it's important for this search to prioritize the quality of the clinker and also be environmentally friendly.

Course Outcomes:

PCC-CT302.1: Fuel for Portland cement clinker manufacture and its impact of the manufacturing process and Quality of cement.

PCC-CT302.2: Characteristic and preparation of conventional and alternate fuel for cement kiln and its safety measures.

PCC-CT302.3: Combustion mechanism and control system in cement kiln.

PCC-CT302.4: Coprocessing of Hazardous waste fuel of cement kiln and WHR system for thermal fuel efficiency

PCC-CT302.5: Cement kiln burners and efficiency of burning system.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT302	Fuel and Alternate Fuel & Raw Materials	4	0	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), SL**:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT302	Fuel and Alternate Fuel & Raw Materials	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT302.1: **Fuel for Portland cement clinker manufacture and its impact of the manufacturing process and Quality of cement.**

Approximate Hours

Item	Appx. Hrs
CI	10
LI	0
SW	02
SL	01
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1: Type and characteristic of fuel used for cement manufacture **SO2:** Alternate fuel for cement manufacture **SO3:** Analysis of Coal and lignite **SO4:** Estimation of GCV and NCV of coal and lignite **SO5:** Influence of Fuel in process and quality of clinker.		**Unit -I Introduction to fuel of cement kiln** **1.1** Type of fuels, Coal, Lignite, Oil and Natural Gas and its use as fuel for cement manufacture. **1.2** Geological Origin of coal and Lignite **1.3** Distribution of coal and lignite deposits in India with its characteristic. **1.4** Introduction to alternative fuels for cement manufacture. **1.5** Tutorial -1 **1.6** Physical and Chemical characteristics of different types of fuel and alternate fuel **1.7** Ultimate and Proximate analysis of fuels **1.8** Estimation of gross calorific value and net calorific value of fuel **1.9** Influence of fuel in burning and quality of Portland cement clinker. **1.10** Tutorial-2	1. Geology of India and Indian stratigraphy

SW-1 Suggested Sessional Work (SW):

Assignments: Distribution of Coal and lignite in India, Proximate and Ultimate analysis of Fuel, Alternate fuel for cement manufacture and its advantages, Influence of fuel in pyro-processing and quality of clinker.

PCC-CT302.2: **Characteristic and preparation of conventional and alternate fuel for cement kiln and its safety measures.**

Approximate Hours

Item	Appx Hrs
CI	15
LI	0
SW	2
SL	1
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1: Storage and preparation of fuel and alternate fuel for cement kiln. **SO2:** Safety in coal handling and coal mill **SO3:** Characteristic of alternate fuel. **SO4**: Handling and preparation of alternate fuel.		**Unit -II: Characteristic and preparation of conventional and alternate fuel for cement kiln** **2.1** Coal Storage coal, lignite & preparation for firing in rotary kiln **2.2** Preparation of coal for cement kiln. **2.3** Storage of Pulverised coal, lignite and safety in handling of Pulverised coal and lignite **2.4** Coal mill explosion and its prevention **2.5** Tutorial - 1 **2.6** Alternative Fuels: Chemical & physical characteristics of alternate fuels for cement kiln: Refused Derived Fuel(RDF) from Municipal Solid Waste (MSW) **2.7** Used tyres as alternate fuel for cement kiln **2.8** Biomass, saw dust, rice husk, spent wash, Domestic waste as cement kiln fuel **2.9** Industrial plastics types and characteristic as fuel **2.10** Tutorial 2 **2.11** Waste oils and solvents as fuel for cement kiln **2.12** Use Pharmaceutical waste in cement kiln as fuel. **2.13** Various handling &pre processing equipment of alternate fuels **2.14** Advantages and	

		disadvantages of alternate fuels for cement manufacture **2.15** Tutorial-3	

SW-2 Suggested Sessional Work (SW):

Assignments: Handling of coal and lignite in cement plant, Coal mill explosion and safety measures, Alternate fuel characteristic for cement manufacture. Advantages and disadvantages of alternate fuels, RDF as fuel for cement manufacture.

PCC-CT302.3: Combustion mechanism and control system in cement kiln

Approximate Hours

Item	Appx Hrs
CI	15
LI	0
SW	2
SL	1
Total	18

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1: Mechanism of solid fuel combustion and heat generation. **SO2:** Estimation of air requirement for complete combustion in cement kiln **SO3:** False air and its influence in combustion. **SO4:** Combustion indicators for complete combustion **SO5:** Optimization of heat consumption		**Unit -III Combustion Theory** **3.1** Mechanism combustion, Combustion air **3.2** Estimation of theoretical air and excess air. **3.3** Impact of fuel change on flame & combustion, **3.4** Fuel Air Mixing & its Effect on Flame **3.5** Tutorial –I **3.6** Change in Air inputs For Petcoke **3.7** Firing of petcoke in calciner and kiln **3.8** Calculation flame momentum and optimization of heat consumption **3.9** Influence of false air in SP and ILC kiln and steps to reduce leakage air **3.10** Combustion indicators:	1.Firing system of dry process cement rotary kiln

		clinker quality, sintering zone temp., coating formation **3.11** Exhaust gas analysis, SO_3& NOx formation **3.12** Tutorial -2 **3.13** MOEF Guide line for collection, storage and transportation of hazardous waste **3.14** Recovery of thermal energy in cement industry-Possible utilization **3.15** Tutorial -3	

SW-3 Suggested Sessional Work (SW):
Assignments: Estimation of combustion air, Influence of false air in ILC kiln, Use of Alternate fuel and Thermal substitute rate of India, Combustion indicator of cement process.

PCC-CT302.4: **Co-processing of Hazardous waste fuel of cement kiln and WHR system for thermal fuel efficiency**

Approximate Hours

Item	Appx Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO1: Hazardous waste fuel and MOEF Guide line to use in cement kiln **SO2:** Coprocessing AF in cement kiln **SO3.** WHR system in cement kiln **SO4:** Kalina cycle, & Rankine Cycle, Organic Rankin cycle for efficient		**Unit IV: Guidelines for Co-Processing of Hazardous Waste and WHR system in cement plant** **4.1** Hazardous waste fuel, Biological parameter in clarifying hazardous wastes **4.2** MOEF Guide line for collection, storage and transportation of hazardous waste **4.3** Preprocessing to prepare homogeneous waste mixes suitable for co-processing	

waste heat recovery system.		**4.4** Emission standards for co-processing of alternate fuel in cement plant, monitoring **4.5** Tutorial – 1 **4.6** Waste Heat Recovery in cement kiln **4.7** Recovery of thermal energy from in cement industry-Possible Heat Sources **4.8** Waste heat recovery/thermal energy storage applications :Kalina cycle, & Rankine Cycle **4.9** Organic Rankin cycle. **4.10** Tutorial – 2	

SW-4 Suggested Sessional Work (SW):

Assignments: MOEF Guide line for collection, storage and transportation of hazardous waste, Pre processing to prepare homogeneous waste mixes suitable for co-processing, Emission standards for co-processing of alternate fuel in cement plant, monitoring, Recovery of thermal energy from in cement industry-Possible Heat Sources.

PCC-CT302.5: **Cement kiln burners and efficiency of burning system.**

Approximate Hours

Item	Appx Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1: Flame requirement in cement kiln and its impact **SO2:** Types of cement kiln burner. **SO3:** Multichannel fuel efficient burner **SO4:** Burner alignment in cement kiln and burning		**Unit -V: Flame & Burners of cement kiln** **5.1** Types of flame, flame characteristics, flame adjustment, flame momentum **5.2** Effects on Refractory Lining of Kiln due to different flame shapes, Effect of flame on protective coating **5.3** Combustion in Secondary firing in pre-calcinator **5.4** Mono-channel burner and multichannel burner **5.5** Tutorial -1	1. Cement rotary kiln and heat requirement for pyroprocessing

efficiency		**5.6** Pillard Rota flam burner, FLS Duoflex Burnerr and KHD Project Burner **5.7** Burner alignment, Burner adjustments **5.8** Special types of burner used for Alternate fuel (hot disc plate) **5.9** Control of axial and radial air flow. **5.10** Tutorial -2	

SW-5 Suggested Sessional Work (SW):

1. **Assignments:** Types of burner and alignment in cement kiln, Flame and flame adjustment in cement kiln, FLS Duoflex Burnerr, KHD Project Burner, Effect of burner on Rotary kiln lining.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (SL)	Total hour (CI+SW+SL)
PCC-CT302.1: Fuel for Portland cement clinker manufacture and its impact of the manufacturing process and Quality of cement.	10	2	1	13
PCC-CT302.2: Characteristic and preparation of conventional and alternate fuel for cement kiln and its safety measures.	15	2	1	18
PCC-CT302.3: Combustion mechanism and control system in cement kiln	15	2	1	18
PCC-CT302.4: Co-processing of Hazardous waste fuel of cement kiln and WHR system for thermal fuel efficiency.	10	2	1	13
PCC-CT302.5: Cement kiln burners and efficiency of burning system	10	2	1	13
Total Hours	60	10	5	75

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Fuel for Portland cement clinker manufacture and its impact of the manufacturing process and Quality of cement.	02	03	02	07
CO-2	Characteristic and preparation of conventional and alternate fuel for cement kiln and its safety measures.	0	08	02	10

CO-3	Combustion mechanism and control system in cement kiln	01	06	04	11
CO-4	Co-processing of Hazardous waste fuel of cement kiln and WHR system for thermal fuel efficiency.	-	08	07	15
CO-5	Cement kiln burners and efficiency of burning system	-	03	04	07
Total		03	28	19	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Engineering Graphics & Design will be held with writtenexamination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT,Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) **Books**:

S. No.	Title	Author	Publisher	Edition & Year
1	Cement Production Technology Principle and Practice	AK Chatterjee	CRC Press	2018
2	Case Study Manual on Alternative Fuels & Raw Materials Utilization in Indian Cement Industry	G Jayaraman Ulhas V Parlikar	Confederation of Indian Industry - CII	2011
3	Increasing The Use of Alternative Fuels at Cement Plants: International Best Practice	S.N. Ghosh	International Finance Corporation	2017
4	Fuels and combustion:	Samir Sarkar	Universities Press	2009
5	Firing System: Process		Holderbank	

	Technology: Cement Seminar,			
6	Flame & Burners: Process Technology: Cement Seminar,		Holderbank	
7	Cement Plant operation handbook	Philip A. Alsop	Tradeship Publications Ltd,	2007
8	Holcim Training Manual			
9	FLS Training Manual			
	https://www.cementequipment.org/home/alternative-fuels-and-raw-materials/			

Curriculum Development Team

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5. Dr Gaurav Shukla, Assistant Professor, Dept of Cement Technology
6. Er Priyanka Singh, Assistant Professor, Dept. of Cement Technology
7. Er A K Bhattacharya, Faculty, Dept. of Cement Tech. (Former GM M/s Dalmia Cement)
8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

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COs, POs and PSOs Mapping

Course Title: B. Tech Cement Tech   Course Code: PCC-CT302   Course Title: Fuel and Alternate Fuel & Raw Materials

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PCC-CT302.1: Fuel for Portland cement clinker manufacture and its impact of the manufacturing process and Quality of cement.	2	1	1	1	1	3	3	1	1	1	1	2	2	1	1	3
PCC-CT302.2: Characteristic and preparation of conventional and alternate fuel for cement kiln and its safety measures.	3	1	2	2	2	3	3	1	1	1	1	2	2	2	1	3

PCC-CT302.3: Combustion mechanism and control system in cement kiln	3	3	3	3	3	3	3	2	3	1	3	3	3	2	3	1
PCC-CT302.4: Co-processing of Hazardous waste fuel of cement kiln and WHR system for thermal fuel efficiency.	3	3	3	3	3	3	3	2	3	2	3	2	3	3	3	1
PCC-CT302.5: Cement kiln burners and efficiency of burning system	2	2	2	1	1	3	3	3	1	2	2	3	2	1	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map: Fuel and Alternate Fuel & Raw Materials

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT302.1:** Fuel for Portland cement clinker manufacture and its impact of the manufacturing process and Quality of cement.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1: Fuel for Portland cement clinker manufacture and its impact of the manufacturing process and Quality of cement. 1.1,1.2,1.3,1.4,1.5,1.6,1.7, 1.8, 1.9, 1.10	As mentioned, in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT302.2:** Characteristic and preparation of conventional and alternate fuel for cement kiln and its safety measures.	SO2.1 SO2.2 SO2.3 SO2.4		Unit-2: Characteristic and preparation of conventional and alternate fuel for cement kiln and its safety measures. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6,	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT302.3:** Combustion mechanism and control system in cement kiln	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3: Combustion mechanism and control system in cement kiln 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9, 3.10, 3.11, 3.12, 3.13, 3.14, 3.15	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT302.4:** Co-processing of Hazardous waste fuel of cement kiln and WHR system for thermal fuel efficiency.	SO4.1 SO4.2 SO4.3 SO4.4		Unit-4: Co-processing of Hazardous waste fuel of cement kiln and WHR system for thermal fuel efficiency. 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,	

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	**PCC-CT302.5:** Cement kiln burners and efficiency of burning system	SO5.1 SO5.2 SO5.3 SO5.4		Unit 5: Cement kiln burners and efficiency of burning system 5.1,5.2,5.3,5.4,5.5, 5.6, 5.7, 5.8, 5.9, 5.10	

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Semester-V

Course Code: **PCC-CT305-L**

Course Title: Cement Tech Lab I (Raw Material and Fuel Testing)

Pre- requisite: Student should have basic knowledge of Mineralogical and chemical composition of limestone and Coal.

Rationale: The manufacture of Portland cement relies on the chemical composition of limestone and coal, the primary raw material and fuel. This composition is crucial for the raw mix design used in cement clinker production. Additionally, understanding the properties of coal is necessary for the pyroprocessing of Portland cement clinker. It is also important to assess the impact of minor minerals on the process and the quality of the cement. This practical outline the procedures for analyzing and estimating various chemical parameters of limestone and coal.

Course Outcomes:

PCC-CT305-L .1: Gain the knowledge and hands on training on chemical testing of limestone and determination of various chemical constituents.

PCC-CT305-L .2: Gain the knowledge and hands on training on physical testing of limestone and coal on determination of various chemical constituents.

PCC-CT305-L .3: Gain the knowledge and hands on training on proximate analysis of coal

PCC-CT305-L .4: Gain the knowledge and hands on training on ultimate analysis of coal and determination of gross and net calorific value of coal.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT305-L	Cement Tech Lab I (Raw Material and Fuel Testing)	0	2	1	1	4	1

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies) **SW:** Sessional Work (includes assignment, seminar, mini project etc.), SL**:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

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Scheme of Assessment:

Practical

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)				End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 7 marks each (LA)	VIVA (VV)	Class Attendance (TA)	Total Marks (LA+VV+ TA)		
PCC	PCC-CT305-L	Cement Tech Lab I (Raw Material and Fuel Testing)	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT305-L .1: Gain the knowledge and hands on training on testing of limestone and determination of various chemical constituents.

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Approximate Hours

Item	Appx. Hrs
CI	0
LI	12
SW	2
SL	2
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: Hand on training on	**Unit -1: Chemical analysis of Limestone:** 1. Determination of moisture content and LoI of coal and	.	1. Basic knowledge on chemical and physical

determination of moisture and LOI of Limestone SO1.2: Hand on training on analysis of Calcium and Magnesium Collaborate of limestone. SO1.3: Hands on training on analysis of SiO2, AL2O3, Fe2O3 and MgO of limestone	limestone 2. Determination of Calcium carbonate, magnesium carbonate, and total carbonate of limestone 3. Determination of SiO_2 content of limestone 4. Determination of Al_2O_3 content of limestone 5. Determination of Fe_2O_3 content of limestone 6. Determination of MgO content of limestone		composition of limestone 2. Basic knowledge of chemistry of various element (Periodic Table)

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Procedure for analysis of various chemical constituents of limestone such as

- Total carbonate
- CaO
- SiO2
- Al2O3
- Fe2O3
- MgO

PCC-CT305-L.2: Gain the knowledge and hands on training on testing of limestone and coal on determination of various chemical constituents.

Approximate Hours

Item	Appx. Hrs
CI	0
LI	8
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1: Hand on training on determination of bulk density	**Unit -2: Analysis of Physical**	.	1. Basic knowledge

and Sp. gravity of limestone **SO2.2:** Hand on training on determination of compressive strength of limestone. **SO2.3:** Hands on training for identification of Calcite and quartz under microscope **SO2.4:** Determination of Bond index of limestone	**parameter of Limestone:** 1. Determination of Specific gravity and bulk density of limestone 2. Determination of compressive strength a 3. Determination of bond index of limestone 4. Petrographic analysis of limestone for identification of calcite and quartz		on chemical and physical composition of limestone 2. Basic knowledge of chemistry of various element (Periodic Table)

SW-2 Suggested Sessional Work (SW):
Assignments:

a. Procedure to determine the following

i. Compressive strength of limestone
ii. Bond index of limestone
iii. Microscopic procedure for identification of calcite and quartz in limestone thin section

PCC-CT305-L .3: Gain the knowledge and hands on training on proximate analysis of coal

Approximate Hours

Item	Appx. Hrs
CI	0
LI	6
SW	2
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1: Hand on training on determination of Moisture and ash content of coal **SO3.2:** Hand on training on determination of Volatile matter of coal and fix carbon of coal.	**Unit -3: Proximate analysis of coal** Determination of following parameters of coal 1. Moisture and Ash content 2. Volatile matter and fix carbon 3. Coal ash analysis		1. Basic knowledge on chemical and physical composition of coal

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. determination of following parameters of coal and lignite

- Moisture content
- Ash content
- Volatile matter
- Fix carbon

PCC-CT305-L .4: To gain the knowledge and hands on training on ultimate analysis of coal

Approximate Hours

Item	Appx. Hrs
CI	0
LI	4
SW	2
SL	1
Total	7

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1: Hand on training on determination of Carbon, Hydrogen, Nitrogen, Sulphur, and Oxygen content of coal **SO4.2:** Hand on training on determination of calorific vale (Gross and Net) of coal.	**Unit -4: Ultimate analysis and determination of Calorific value of coal** Determination of following parameters of coal 1. Carbon, Hydrogen, Nitrogen, Sulphur, and Oxygen content present in solid fuel. 2. Determination of gross and net calorific value of coal	.	1. Basic knowledge on calorific value

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Exploration and prospecting of limestone
2. Category of limestone reserves
3. Geostatistical evaluation of limestone deposit
4. Methods for estimation of limestone reserves

b. Mini Projects

UNFC of various category of Limestone Deposits

Brief of Hours suggested for the Course Outcome

Course Outcome	Class	Laboratory	Sessional	Self-	Total hour

	Lecture (Cl)	Instruction (LI)	Work (SW)	Learning (Sl)	(Cl+SW+Sl)
PCC-CT305-L .1: Gain the knowledge and hands on training on chemical testing of limestone and determination of various chemical constituents.	0	12	2	1	15
PCC-CT305-L .2:Gain the knowledge and hands on training on physical testing of limestone and coal on determination of various chemical constituents.	0	8	2	1	11
PCC-CT305-L .3: Gain the knowledge and hands on training on proximate analysis of coal.	0	6	2	1	9
PCC-CT305-L .4:Gain the knowledge and hands on training on ultimate analysis of coal and determination of gross and net calorific value of coal.	0	4	2	1	7
Total Hours	0	30	8	4	42

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Unit -1: Chemical analysis of Limestone	04	05	04	13
CO-2	Unit -2: Analysis of Physical parameter of Limestone	04	05	03	12
CO-3	Unit 3: Proximate analysis of coal	04	05	04	13
CO-4	Unit 4: Ultimate analysis and determination of Calorific value of coal	06	05	03	12
Total		16	20	14	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Geology and Mining of Limestone will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture

2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) **Books** :

S.No.	Title	Author	Publisher	Edition &Year
1	Ordinary Portland Cement	IS 269-2015	6^{th} Edition BIS	2015
2	Concrete Technology Lab Manual	Dr. Bharadwaj Nanda and Prof. A.N. Nayak	Concrete Technology Lab Manual	
3	Concrete Technology Lab Manual	Nanditha Mandava,	MLRITM	2022
4	Methods of physical tests for hydraulic cement	IS 4031-1	BIS	1996
5	Method of chemical analysis of hydraulic cement	IS 4032	BIS	1985

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COs, POs and PSOs Mapping

Course Title: B. Tech Cement Tech **Course Code:** PCC-CT 206 **Course Title:** Cement Tech Lab I (Raw Material and Fuel Testing)

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PCC-CT305-L.1:Gain the knowledge and hands on training on chemical testing of limestone and determination of various chemical constituents	**2**	**1**	**1**	**1**	**1**	**3**	**3**	**1**	**1**	**1**	**1**	**2**	**2**	**1**	**1**	**3**

PCC-CT305-L.2: Gain the knowledge and hands on training on physical testing of limestone and coal on determination of various chemical constituents	**3**	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**1**	**3**
PCC-CT305-L.3: Gain the knowledge and hands on training on proximate analysis of coal	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**3**	**3**	**3**	**2**	**3**	**1**
PCC-CT305-L.4: Gain the knowledge and hands on training on ultimate analysis of coal and determination of gross and net calorific value of coal.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**1**

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map: Cement Tech Lab I (Raw Material and Fuel Testing)

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**PCC-CT305-L.1:** Gain the knowledge and hands on training on chemical testing of limestone and determination of various chemical constituents	SO1.1 SO1.2 SO1.3	Unit-1: Chemical analysis of Limestone 1.1, 1.2, 1.3, 1.4, 1.5, 1.6		As mentioned, in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	PCC-CT305-L.2: Gain the knowledge and hands on training on physical testing of limestone and coal on determination of various chemical constituents	SO2.1 SO2.2 SO2.3 SO2.4	Unit-2: Analysis of Physical parameter of Limestone 2.1, 2.2, 2.3, 2.4		
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	PCC-CT305-L.3: Gain the knowledge and hands on training on proximate analysis of coal	SO3.1 SO3.2	Unit-3: Proximate analysis of coal 3.1, 3.2, 3.3		
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	PCC-CT305-L.4: Gain the knowledge and hands on training on ultimate analysis of coal and determination of gross and net calorific value of coal.	SO4.1 SO4.2	Unit 4: Ultimate analysis and determination of Calorific value of coal 4.1,4.2		

Semester V

Course Code: **HSMC302**

Course Title: **Industrial Psychology**

Pre- requisite: Student should have basic knowledge General Psychology, Research Methods and Statistics, Human Resource Management (HRM) etc.

Rationale: Workplaces worldwide are rapidly evolving to meet the increasing expectations of their employees and cultural changes that prioritize well-being and retention as much as productivity. Industrial-organizational psychology is a field that equips companies with the tools to adapt to this ever-changing environment. The aim of this course is to develop an awareness of the major perspectives underlying industrial psychology and to understand the potential that it holds for society and organizations in the present and future.

Course Outcomes: After the completion of this subject, students will be able to

HSMC302.1: Understand key concepts, theoretical perspectives, and trends in industrial psychology.

HSMC302.2: Create a better work environment for better performance.

HSMC302.3: Understand customer behavior.

HSMC302.4: Apply different work methods to improve industrial efficiency.

HSMC302.5: Understand Criteria's in evaluation of job-related factor

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
HSMC	HSMC302	Industrial Psychology	3	0	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.), SL**:** Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
HSMC	HSMC302	Industrial Psychology	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

HSMC302.1: Understand key concepts, theoretical perspectives, and trends in industrial psychology.

Approximate Hours

Item	Appx. Hrs
CI	08
LI	0
SW	1
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Role of the psychologist in industry **SO1.2** Study behavior in work situation **SO1.3** Applications of Psychological principles to problems of Placement, counselling and training		**Unit-1 : Introduction**: **1.1** The role of the psychologist in industry, **1.2** The field of occupational Psychology **1.3** Study of behavior in work situation **1.4** Applications of Psychological principles to problems of selection **1.5** Applications of Psychological principles to problems of Placement, **1.6** Applications of Psychological principles to problems of Counselling **1.7** Applications of Psychological principles to problems of training **1.8** Tutorial	1. General Psychology

SW-1 Suggested Sessional Work (SW):

a) **Assignments:**
i. Definitions, Historical Development, and Characteristics of OR.

b) **Mini Project:**
i. Make a chart on role of the psychologist in industry

HSMC302.2: Create a better work environment for better performance.

Approximate Hours

Item	Appx Hrs
CI	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

SO2.1 Student will understand physical environment techniques. **SO2.2** Students will understand Group dynamics in Industry		**Unit- 2: Design of Work Environments**: **2.1** Human engineering and physical environment techniques of job analysis. **2.2** Social environment: Group dynamics in Industry **2.3** Personal psychology, Selection, training **2.4** placement, promotion, counselling **2.5** Job motivations, **2.6** Job satisfaction. **2.7** Special study of problem of fatigue **2.8** boredom and accidents **2.9** Tutorial	1. Human Engineering

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Analyze role of physical environment in industrial efficiency.

ii. Effect of social environment

HSMC302.3: Understand customer behavior.

Approximate Hours

Item	Appx Hrs
CI	6
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Student will		**Unit- 3: Understanding**	1. customer Behavior

understand Customer behavior **SO3.2** Student will understand the role of engineering psychology		**Consumer Behavior:** **3.1** Consumer behavior **3.2** study of consumer preference **3.3** effects of advertising **3.4** Industrial morale: The nature and scope of engineering psychology **3.5** application of engineering psychology to industry **3.6** Tutorial	

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Study of Customer Behavior.
   ii. Significance of engineering psychology in industry.

HSMC302.4: Apply different work methods to improve industrial efficiency.

Approximate Hours

Item	Appx Hrs
CI	13
LI	0
SW	1
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Student will be able to understand the efficiency at work. **SO4.2** Student will be able to understand work curve and its characteristic. **SO4.3** analyze personal factors the affects efficiency	.	**Unit- 4: Work Methods:** **4.1** Efficiency at work, **4.2** The concept of efficiency, **4.3** The work curve and its characteristics **4.4** The work methods; hours of work. **4.5** Nature of work, fatigue and boredom. **4.6** Rest pauses.	**1.** Work efficiency and its parameters

SO4.4 Student will understand the effect of working environment. .		**4.7** The personal factors; age abilities **4.8** Interest, job satisfaction, **4.9** The working environment, noise, illumination. **4.10** Atmospheric conditions. **4.11** Increasing efficiency at work; improving the work methods. **4.12** Time and motion study, its contribution and failure resistance to time and motion studies. **4.13** Need for allowances in time and motion study.	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. Factors that affects work efficiency

ii. Effect of environmental factors

HSMC302.5: Understand Criteria's in evaluation of job-related factor

Approximate Hours

Item	Appx Hrs
CI	9
LI	0
SW	1
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)

SO5.1 Student will be understand evaluation of job-related factor **SO5.2** Student will be able understand different processes involve in work and equipment design **SO5.3** Student will understand different factors involve in industrial accidents.		**Unit 5: Work and Equipment Design**: **5.1** Criteria in evaluation of job-related factor, **5.2** job design, human factors, Engineering information, **5.3** input processes, mediation processes, action processes, **5.4** methods design, work space and its arrangement, **5.5** Human factors in job design. Accident and Safety **5.6** The human and economic costs of accidents **5.7** Accident record and statistics **5.8** the causes of accidents **5.9** Situational and individual factors related to accident reduction.	1.industrial accidents and their cause

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Study of Criteria in evaluation of job-related factor.
   ii. Situational and individual factors related to accident reduction

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (SI)	Total hour (CI+SW+SI)
HSMC302.1: Understand key concepts, theoretical perspectives, and trends in industrial psychology.	8	1	1	10
HSMC302.2: Create a better work environment for better performance	9	1	1	11
HSMC302.3: Understand customer behavior.	6	1	1	08
HSMC302.4: Apply different work methods to improve industrial efficiency.	13	1	1	15

HSMC302.5: Understand Criteria's in evaluation of job-related factor	9	1	1	11
Total Hours	45	5	5	55

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction	2	4	4	10
CO-2	Design of Work Environments	-	5	5	10
CO-3	Understanding Consumer Behavior	3	3	4	10
CO-4	Work Methods	-	5	5	10
CO-5	Work and Equipment Design.	3	4	3	10
Total		8	21	21	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Industrial Psychology will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Demonstration
7. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)

8. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Industrial Psychology	Tiffin and McCormick	Prentice Hall	6^{th} Edn., 1975
2	Human Factors Engineering and Design	McCormick	McGraw Hill	4th Edn.,1976
3	Principles of Human relations	N.R.F Mair,	WILEY, NEW YORK	1961
4	Personnel and Industrial Psychology	Ghiselli & Brown	McGraw-Hill Inc.,US	1955

Curriculum Development Team

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech. Cement Technology   Course Code: HSMC302   Course Title: Industrial Psychology

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO1: Understand key concepts, theoretical perspectives, and trends in industrial psychology.	1	2	1	1	2	2	2	3	3	3	2	2	2	2	1	2
CO2: Create a better work environment for better performance	1	2	1	1	2	3	3	2	2	2	2	2	2	2	1	2
CO3: Understand customer behavior.	1	2	1	1	2	3	2	3	2	2	2	3	2	3	1	2
CO4: Apply different work methods to improve industrial efficiency.	1	2	1	1	2	2	3	3	2	2	2	2	2	2	1	2
CO5: Understand Criteria's in evaluation of job-related factor	1	2	1	1	2	3	2	3	2	2	2	2	2	2	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Industrial Psychology

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2,3,4	**CO1:** Understand key concepts, theoretical perspectives, and trends in industrial psychology.	SO1.1 SO1.2 SO1.3		**Unit-1:** Introduction 1.1, 1.2, 1.3, 1.4, 1.5,1.6,1.7,1.8	As mentioned in above pages
PO 1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2,3,4	**CO2:** Create a better work environment for better performance	SO2.1 SO2.2		**Unit-2:** Design of Work Environments 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9	
PO 1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2,3,4	**CO3:** Understand customer behavior.	SO3.1 SO3.2		**Unit-3:** Understanding Consumer Behavior 3.1, 3.2, 3.3, 3.4, 3.5, 3.6	
PO 1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2,3,4	**CO4:** Apply different work methods to improve industrial efficiency.	SO4.1 SO4.2 SO4.3 SO4.4		**Unit-4:** Work Methods 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12, 4.13	
PO 1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2,3,4	**CO5:** Understand Criteria's in evaluation of job-related factor	SO5.1 SO5.2 SO5.3		**Unit 5:** Work and Equipment Design 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9	

Semester V

Course Code: **HSMC303**

Course Title: **Operations Research**

Pre- requisite: Student should have basic knowledge of mathematics and business operations.

Rationale: Executives are required to take prompt and accurate decisions, if decision is taken merely on the basis of experience and intuition that may not be fruitful and accurate, but decision taken on the basis of data is more accurate. Operation Research provides quantitative basis or

data to take accurate decisions. The tools and models of operations research provide us optimal solutions of the business operations problems; hence the study of operations research is very important to management students.

Course Outcomes:

HSMC303.1: The student will demonstrate the process of problem solving in Operations Research.

HSMC303.2: The student will apply the linear programming problem method to solve the various business management problems quantitatively.

HSMC303.3: The student will use the transportation and assignment techniques to solve the transportation and assignment problems quantitatively.

HSMC303.4: The student will apply network analysis techniques like PERT and CPM to solve the scheduling of activities and resource allocation related problems.

HSMC303.5: The student will calculate the optimum value of game and optimum replacement period using game theory and replacement theory respectively.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies (Hours per Week)					Total Credits(C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
HSMC	HSMC303	Operations Research	3	0	1	1	5	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop,field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)					End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 Assignments 3 marks Each (CA)	2 Class Test (best 2 out of 3) 10 marks Each (CT)	One Seminar (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+AT)		
HSMC	HSMC303	Operations Research	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

HSMC303.1: The student will demonstrate the process of problem solving in Operations Research.

Approximate Hours

Item	Appx. Hrs
CI	07
LI	0
SW	1
SL	1
Total	9

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Student will explain about the development of Operations Research **SO1.2** Student will explain about the characteristics and scope of Operations Research **SO1.3** Student will demonstrate the process of operations research to problem solving. **SO1.4** Student will classify different models of operations research.	.	**Unit-1 : Introduction to Operations Research** **1.1** Meaning and Definitions of Operations Research. **1.2** Development of Operations Research in India. **1.3** Characteristics of Operations Research **1.4** Scope of Operations Research. **1.5** Operations Research Methodology. **1.6** Operations Research Models. **1.7** Advantages and Limitations of Operations Research.	**1.** Quantitative approach to decision making. **2.** Quantitative Analysis and Computer-Based Information System

SW-1 Suggested Sessional Work (SW):

a) Assignments:

i. Definitions, Historical Development, and Characteristics of OR.

ii. Process and Models of OR.

b) Mini Project:

i. Prepare a flowchart of process of OR to problem solving in a chart paper.

HSMC303.2: The student will apply the linear programming problem method to solve the various business management problems quantitatively.

Approximate Hours

Item	Appx Hrs
CI	13
LI	0
SW	2
SL	2
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Student will explain about the Concept, Assumptions and Requirements of LPP. **SO2.2** Students will formulate the LPP **SO2.3** Student will solve the LPP by Graphical Method **SO2.4** Student will Solve the LPP by Simplex Method. **SO2.5** Student will solve the LPP by Big-M and Two phase methods	.	**Unit- 2: Linear Programming** **2.1** Meaning and Requirements of Linear Programming. **2.2** Formulation of two variable Maximization type Linear Programming Problem **2.3** Formulation of two variable Minimization type Linear Programming Problem **2.4** Solution of Maximization Type LPP by Graphical Method **2.5** Solution of Minimization Type LPP by Graphical Method **2.6** Solution of LPP by Graphical Method: Special Cases- Multiple Optimal Solutions. **2.7** Solution of LPP by Graphical Method: Special Cases- Infeasibility, Unboundedness. **2.8** Introduction to Simplex method of LPP **2.9** Solution of LPP by Simplex Method: Maximization Type Two and more than two Variables Problem **2.10** Solution of LPP by Simplex Big-M Method: Minimization type two and More than two variables Problem **2.11** Solution of LPP by Simplex Method: Mixed Constraints Problem **2.12** Solution of LPP by Simplex Two- Phase Method **2.13** Special Cases Advantages and Limitations of LPP.	**1.** Practice:- Solution of LPP by Graphical Method **2.** Practice:- Solution of LPP by Simplex Method..

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Formulate the LPP (Problem will be given by the subject teacher)

ii. Solve the LPP by Graphical and Simplex Methods (Problem will be given by the subject teacher)

b. Mini Project:

Assignment Problem: Introduction and as a particular case of transportation model

HSMC303.3: The student will use the transportation and assignment techniques to solve the transportation and assignment problems quantitatively.

Approximate Hours

Item	Appx Hrs
CI	10
LI	0
SW	2
SL	2
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Student will formulate the transportation problem **SO3.2** Student will solve the transportation problem **SO3.3** Student will formulate the assignment problem **SO3.4** Student will solve the assignment problem.	.	**Unit- 3: Transportation and Assignment Problem** **3.1** Concept of Transportation Problem **3.2** Initial Basic Feasible Solution by NWC Rule and LCM Method. **3.3** Initial Basic Feasible Solution by Vogel's Approximation Method (VAM) **3.4** Optimality Test: Minimization type problem stepping stone method **3.5** Optimality Test: Minimization type problem by Modified Distribution Method (MODI) **3.6** Optimality Test: Maximization type problem by Modified Distribution Method (MODI) **3.7** Transportation Problem: Special Cases (Unbalanced, Multiple Optimal Solution and Prohibited Route Problem) **3.8** Transportation Problem: Special Cases -Degeneracy Case **3.9** Assignment Problem: Introduction and as a particular case of transportation model, and solution by Complete Enumeration Method **3.10** Assignment Problem: Solution by Hungarian Assignment Method (HAM) - Special Cases	i) Practice- Solution of transportation Problems ii) Practice- Solution of Assignment Problems.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Formulation and solution of the transportation problem
ii. Formulation and solution of the assignment problem

b. Mini Project: Make flowchart of the solution of a Transportation and Assignment Problems in a chart paper

HSMC303.4: The student will apply network analysis techniques like PERT and CPM to solve the scheduling of activities and resource allocation related problems.

Approximate Hours

Item	Appx Hrs
CI	8
LI	0
SW	2
SL	2
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Student will be able to describe the network construction rules. **SO4.2** Student will be able to use the CPM in project management. **SO4.3** Student will be able to use the PERT in project management. **SO4.4** Student will find out the shortest route and longest routes by dynamic programming. **SO4.5** Student will explain about the simulation and process of simulation.	.	**Unit- 4: PERT and CPM, Dynamic Programming, and Simulation.** **4.1** Introduction to Network Analysis **4.2** Rules of Network Construction **4.3** Calculation of Earliest Start and Finish Times and Latest Start and Finish Times **4.4** Determining the critical path and calculation of project completion time **4.5** Calculation of Float Times **4.6** Resource Allocation **4.7** PERT: Introduction **4.8** Difference Between PERT and CPM	**i.** Practice:- Network construction and determination of critical path **ii.** Practice:- Calculation of Earliest start and Finish Times as well as Latest Starting and Finish time **iii.** Practice-: PERT-Calculation of Expected time and Variances.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i) Network Construction, Critical Path Determination, Calculation of Earliest and Latest starting and finish times, Calculation of float times. Resource analysis and allocation.

ii) PERT- Calculation of Expected time and Variances

b. Mini Project: Construction of a network and determination of critical path and project completion time for a real project (Project will be detailed by a subject teacher)

HSMC303.5: The student will calculate the optimum value of game and optimum replacement period using game theory and replacement theory respectively.

Approximate Hours

Item	Appx Hrs
CI	7
LI	0
SW	2
SL	2
Total	11

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO5.1 Student will be able to apply the game theory in the competitive business world as a strategic tool. **SO5.2** Student will be able to determine the optimal replacement time which will help in the formulation of replacement policy **SO5.3** Student will describe the general structure of a queuing system.		**Unit 5: Game Theory, Replacement Theory and Queuing Theory.** **5.1** Meaning of a Two Person Game, N Person Game, Pure Strategy Game, Mixed Strategy Game, Zero Sum Game, Non-Zero-Sum Game, Fair Game. **5.2** Solution of a game when saddle point exists. **5.3** Solution of a 2x2 game when saddle point does not exist. **5.4** Solution of a m x n game with dominance rule **5.5** Introduction and Scope of Replacement Theory in Management. **5.6** Replacement policy for equipment which deteriorates gradually **5.7** Queuing Theory: Introduction, and General Structure of a queuing System	i. Practice: - Formulation and solution of a game. ii. Practice: - Solution of a replacement problem.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i) Formulation and Solution of a game theory problems

ii) Solution of replacement theory problems

b. Mini Project: i) Make a flowchart of a solution to a game theory problem.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (SI)	Total hour (CI+SW+SI)
HSMC303.1: The student will demonstrate the process of problem solving in Operations Research.	7	1	1	9
HSMC303.2: The student will apply the linear programming problem method to solve the various business management problems quantitatively.	13	2	2	17
HSMC303.3: The student will use the transportation and assignment techniques to solve the transportation and assignment problems quantitatively.	10	2	2	14
HSMC303.4: The student will apply network analysis techniques like PERT and CPM to solve the scheduling of activities and resource allocation related problems.	8	2	2	12
HSMC303.5: The student will calculate the optimum value of game and optimum replacement period using game theory and replacement theory respectively.	7	2	2	11
Total Hours	45	9	9	63

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Unit 1 : Introduction to Operations Research	04	05	01	10
CO-2	Unit 2: Linear Programming	03	01	01	05
CO-3	Unit 3: Transportation and Assignment Problem	04	05	06	15

CO-4	Unit 4: PERT and CPM, Dynamic Programming, and Simulation	03	06	06	15
CO-5	Unit 5: Game Theory, Replacement Theory and Queuing Theory.	03	02	-	05
Total		17	19	14	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Geology and Mining of Limestone will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition &Year
1	Quantitative Techniques in Management	Vohra, N D	TMH, New Delhi	2002
2	Problems and Solutions in Operations Research	V. K. Kapoor	Sultan Chand and Sons, New Delhi	2005
3	Principles of Operations Research with Application to Managerial Decisions	H.M. Wagner	PHI Learning	2008
4	Operations Research	Kanti Swarup, P K Gupta and Man Mohan	Sultan Chand & Sons, New Delhi	2010
5	Operations Research	Heera & Gupta	S. Chand	2011

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech | Course Code: HSMC303 | Course Title: Operations Research

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
HSMC303.1: The student will demonstrate the process of problem solving in Operations Research.	**2**	**3**	**3**	2	2	1	1	1	1	1	2	1	**2**	**1**	**1**	**3**
HSMC303.2: The student will apply the linear programming problem method to solve the various business management problems quantitatively.	**2**	**3**	**3**	3	3	1	1	1	1	1	3	1	**2**	**2**	**1**	**3**

HSMC303.3: The student will use the transportation and assignment techniques to solve the transportation and assignment problems quantitatively.	**2**	**3**	**3**	3	3	1	1	1	1	1	3	1	**3**	**2**	**3**	**1**
HSMC303.4: The student will apply network analysis techniques like PERT and CPM to solve the scheduling of activities and resource allocation related problems.	2	3	3	3	3	1	1	1	1	1	3	1	3	3	3	1
HSMC303.5: The student will calculate the optimum value of game and optimum replacement period using game theory and replacement theory respectively.	2	3	3	3	3	1	1	1	1	1	3	1	2	1	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Operations Research

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC303.1:** The student will demonstrate the process of problem solving in Operations Research.	SO1.1 SO1.2 SO1.3 SO1.4		**Unit-1: Introduction To Operations Research** 1.1, 1.2, 1.3, 1.4, 1.5,1.6,1.7	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC303.2:** The student will apply the linear programming problem method to solve the various business management problems quantitatively.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Linear Programming** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12, 2.13	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC303.3:** The student will use the transportation and assignment techniques to solve the transportation and assignment problems quantitatively.	SO3.1 SO3.2 SO3.3 SO3.4		**Unit-3: Transportation And Assignment Problem** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC303.4:** The student will apply network analysis techniques like PERT and CPM to solve the scheduling of activities and resource allocation related problems.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Pert And Cpm, Dynamic Programming, And Simulation.** 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**HSMC303.5:** The student will calculate the optimum value of game and optimum replacement period using game theory and replacement theory respectively.	SO5.1 SO5.2 SO5.3		**Unit 5: Game Theory, Replacement Theory And Queuing Theory**. 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7	

Semester: V

Course Code: **OEC-CT01**

Course Title: **Carbon Credit in Cement Manufacture**

Pre-requisite: Student should have basic knowledge of Carbon footprint in Cement Manufacture

Rationale: Cement manufacturing is an energy intensive process, which uses fossil fuel for its heat energy requirement and electrical energy from thermal power plants. The total energy used which uses fossil fuel for its generation, produces CO_2. Now CO_2 is also generated during calcination of "Raw Meal or Kiln feed "as it produced by grinding limestone (a major component) along with suitable additives. The total CO_2 hence generated is the Carbon footprint of the unit process. Due to global warming and climate change, every sector has decided to reduce the CO_2 emission to levels which shall contain further temperature rise. It further pledges to become carbon negative by 2040, so that the environment may be passed on to next generation. The course discusses the unit operation of CO_2 emission, quantification of CO_2 generated, steps to reduce the CO_2 emission both in material and energy consumption, through Energy savings, technical advances and upgrades of the existing system, usage of Biomass/ Biofuels substituting the fossil fuel, alternate materials and alternate fuels. It also encourages usage of "Renewable Energy". Finally, the CO_2 separation and utilizing technology is discussed, which shall mitigate the Carbon footprint, to desired levels, once commercially feasible.

Course Outcomes:

OEC-CT01.1: Understand Carbon footprint in the industry and share of Cement sector. Key indicators in Cement industry.

OEC-CT01.2: CO_2 emission sources in unit process and quantification from each source. Calculation of total CO_2 emission in the pyroprocess with breakups

OEC-CT01.3: Primary measures to reduce Carbon footprint. Use of alternative materials & fuels, Technological advances & upgrades. Power generation through "Waste heat power recovery system"

OEC-CT01.4: Blended cements and respective blending materials thus reducing the Carbon intensive & energy intensive Clinker usage for Cement grinding. Technological advances and upgrades in grinding technology.

OEC-CT01.5: Sourcing renewable electrical energy substituting power usage from thermal power plants. Installing and implementing Carbon Capture and utilization technologies, CO_2 separation technology for Carbon negative unit process.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies (Hours per Week)					Total Credits(C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
OEC	OEC-CT01	Carbon Credit in Cement Manufacture	3	0	1	1	5	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others), **LI:** Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies), **SW:** Sessional Work (includes assignment, seminar, mini project etc.), **SL:** Self Learning, **C:** Credits.
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)					End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 Assignments 3 marks Each (CA)	2 Class Test (best 2 out of 3) 10 marks Each (CT)	One Seminar (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+AT)		
OEC	OEC-CT01	Carbon Credit in Cement Manufacture	15	20	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

OEC-CT01.1: Understand Carbon footprint in the industry and share of Cement sector. Key indicators in Cement industry

Approximate Hours

Item	Approx. Hrs.
CI	09
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
S01.1. Carbon Footprint-Introduction **S01.2** Carbon footprint sources in a Manufacturing unit **S01.3** Determination of Carbon footprint in a Cement plant **SO1.4** Carbon footprint reduction & equivalent CER **S01.5** Carbon footprint and related Climate change	.	**Unit-1.0 Carbon footprint – Introduction** **1.1** Share of Cement Industry towards CO_2 emission in Industrial sector **1.2** Key indicators in Cement industry **1.3** Total CO_2 emission in an Integrated Cement plant **1.4** Present and Projected Cement demand **1.5** Present trends & developments **1.6** Capacity expansion by key players **1.7** High demand of Cement, strong drivers & leaders in Cement demand **1.8** Strategies adopted for sustainable Cement consumption & demand **1.9** Necessity of CO_2 mitigation hence reduction in Carbon footprint	**1.** Blanketing of atmosphere by CO_2 resulting in temperature rise **2.** Increase in Glacier melting resulting in floods **3.** Rise in sea levels

SW-1 Suggested Sessional Work (SW):

a. **Assignments:**
Mention the key indicators in Cement Industry indicating energy efficiency and Carbon footprint
b. **Mini Project:**
Sectors crucial for the sustainable growth in Cement Industry
c. **Other Activities (Specify):**
Air quality at Metros at various seasons and related health problems

OEC-CT01.2: CO_2 emission due to Material processing, Thermal & Electrical energy usage in a Cement manufacturing unit

Approximate Hours

Item	Approximate Hours
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
S02.1 CO_2 Emission sources in a Cement Plant **S02.2** Heat loss in the Preheater, Cooler, and Radiation& Convection losses **S02.3** Heat of reaction in Clinkerisation **S02.4** Conversion ratios: Raw Meal to Clinker and Clinker to Cement	-	**Unit-2.0 Carbon footprint-Breakups in unit process** **2.1** CO_2 emission from Calcination of Raw meal (mainly comprising Limestone) **2.2** Combustion of fossil fuel and corresponding CO_2 emission **2.3** Heat consumption in Cement plant corresponding to fossil fuel consumption **2.4** Heat of Reaction in Clinkerisation resulting in Heat consumption and CO_2 emission **2.5** Source of Electrical energy: Thermal Power Plants and	1. Heat balance study in Pyro-process 2. Factors contributing to high heat losses 3. Factors contributing to high electrical energy consumption

SO2.5 CO_2 emission due to Electrical Energy consumption sourced from Thermal power plants		consecutive CO_2 emission **2.6** Electrical energy consumption sourced from Thermal Power Plant and corresponding CO_2 emission **2.7** Total CO_2 emission in Pyro process **2.8** Breakups and total CO_2 emission section wise, up to Clinkerisation and up to Cement **2.9** Making unit operations more energy efficient resulting in lower CO_2 emission- Calculation	

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**
Calculate CO_2 emission due to combustion of unit mass of coal and unit mass of pet coke.
Calculate CO_2 emission from Calcination of Raw meal/Net Kiln Feed designed for unit mass of Clinker.
b. **Mini Project:**
Determination of CO_2 emission from a Pyro processing of 4500 tpd Clinker production, with following data: PH outlet dust loss: 6%, LOI raw meal: 35.5%, Specific heat consumption: 745 kCal/kg Clinker, Coal NCV: 5500 kCal/kg Clinker; Fixed carbon in coal: 52%
c. **Other Activities (Specify):**
Compile a list of domestic activities/uses which may reduce the CO_2 emission

OEC-CT01.3: Primary measures to reduce Carbon footprint. Use of alternative materials & fuels, Technological advances & upgrades. Power generation through "Waste heat power recovery system"

Approximate Hours

Item	Approximate Hours
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
S03.1 Use of low Burnability & easy burning Raw meal **S03.2** Use of mineralizers in Raw meal **S03.3** Enhancing use of low ash fuels resulting in low lime Raw meal for desired Clinker quality **S03.4** Enhancing use of hazardous fuels, pharma waste& Alternative fuels **S03.5** Technological advancements & upgrades	-	**Unit-3.0 CO_2 mitigation steps in Pyro-processing** **3.1** Low burnability & high reactivity Raw mix reduces heat consumption **3.2** Use of "Mineralizers" like Fluorides, alkali or calcium fluorosilicates for reducing heat consumption **3.3** Use of low ash fuel, thus reducing the lime content in the Raw meal and hence heat of reaction **3.4** Use of hazardous fuels, pharma waste and alternative fuels shall reduce the fossil fuel usage corresponding to "Thermal substitution rate" hence Carbon footprint **3.5** Use of Grinding aids in Cement Grinding allowing higher dosage of other building materials substituting high-Carbon & high-energy Clinker **3.6** Multichannel burners replacing monochannel burners, thus saving heat energy and better Clinker quality **3.7** Inline Calciner with hot disc for alternative or waste fuel firing especially waste tyre **3.8** Generating electricity from waste heat, the "Waste Heat Power Recovery system" **3.9** Utilizing renewable forms of energy to the extent possible in place of fossil fuel	1. Most contributing component of heat consumption 2. Energy efficient measures commonly practiced in Cement plants 3. Effects on "Heat of Reaction" with different lime content

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**
   i) Calculation of “Thermal Substitution rate” by substituting Coal by 5%, using Pharma waste with 50% NCV of Coal
   ii) Reduction of Carbon footprint in above case

b. **Mini Project:**
   Explore alternate fuels available within 50 km radius of a Integrated Cement Plant located nearest to your place of stay. Detail it with economic feasibility and reduction in Carbon footprint

c. **Other Activities (Specify):**
   Hazardous waste used in Cement sectors and other industries with intended purpose

OEC-CT01.4: Blended cements and respective blending materials thus reducing the Carbon intensive & energy intensive Clinker usage for Cement grinding. Technological advances and upgrades in grinding technology.

Approximate Hours

Item	Approximate Hours
CL	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
S04.1 Fly ash type & quality suitable for Blended Cement grinding PPC **S04.2** Methodology of fly ash addition to maximize production rate and energy savings **S04.3** Slag type &quality suitable for Blended Cement grinding PSC	-	**Unit-4.0 CO_2 mitigation due to Blended cement** **4.1** Minimum and maximum limit of building material in Blended Cement **4.2** Grinding methodology in various grinding mills with maximum fly ash addition and energy savings **4.3** PSC grinding methodology in various grinding mills with maximum possible fly ash	**1.** Closed loop optimization of Cement Mills **2.** Types & modes of Grinding and corresponding energy consumption intensity **3.** Determination of fly ash behavior as building material

S04.4 Clay type &quality, suitable for Calcined clay manufacture & its usage as Bended cement in Limestone Calcined clay cement **S04.5** Technological advances in Grinding with low energy consumption		addition and energy savings **4.4** Clay type and quality for Calcination for LC3 grade. **4.5** Methods of Clay Calcination and selection of process **4.6** Composite Cement manufacture **4.7** Calculation of up to cement specific energy consumption,and specific Carbon footprint **4.8** Novacem Cement- Carbon negative Cement– Commercial production **4.9** Solidia Cement- Low Carbon Cement	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

Calculation of up to cement specific electrical energy consumption in OPC, PPC & PSC.

Determination of Specific Carbon footprint in each case

b. Mini Project:

Identification of Clays that can be calcined and can be used as blending material in Cement grinding

c. Other Activities (Specify):

Building materials used in past for construction before Cement invention

OEC-CT01.5: Sourcing renewable electrical energy substituting power usage from thermal power plants. Installing and implementing Carbon Capture and utilization technologies, CO2 separation technology for Carbon negative unit process.

Approximate Hours

Item	Approximate Hours
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
S05.1 Renewable energy power generation: Solar power plants, wind energy, hydroelectricity, etc **S05.2** Biomass cultivation and use as fuel replacing fossil fuel **S05.3** Low Carbon technologies: Algae growth promotion & use of bio-fuels **S05.4** General CO_2 capture technologies **S05.5** General CO_2 separation technologies		**Unit-5: CO_2 mitigation due to Renewable energy and Carbon negative due to CCU & CCS** **5.1** Renewable energy generation and supply in less intensive and usage in unit operations other than sensitive areas of tripping like pyro-process **5.2** Biomass cultivation which absorbs CO_2 and usage ensuring continuous cycle of usage **5.3** Algae growth in kiln stack and use as biofuels **5.4** Application of bioreactor in kiln stack for using CO_2 **5.5** CO_2 Capture technologies: a) Pre-combustion capture b) Oxy-fuel & c)Post combustion capture **5.6** CO_2 separation technologies: Absorption, Adsorption, Membrane separation, Hydrate based separation, Cryogenic distillation **5.7** CO_2 transportation **5.8** CO_2 utilization **5.9** CO_2 geological storage	1.Use of Solar power for domestic purpose 2.Prospects of Biomass/Bamboo cultivation with or with water requirements 3. MOEF status of Biomass/Bamboo harvest from Forest areas

SW-5 Suggested Sessional Work (SW):

a. Assignments:

Calculate the Carbon footprint reduction for replacing power supply from Thermal power plant by 1MW through renewal energy

Explain the CO_2 capture technologies

b. Mini Project:

CO_2utilization technologies and products

c. Other Activities (Specify):

Biomass/Bamboo chemical analysis and NCV, Best available for Cement plant for Heat energy, other uses of Bamboo

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self-Learning (SL)	Total hour (CI+SW+SL)
OEC-CT01.1: Understand Carbon footprint in the Industry and share of Cement sector. Key indicators in Cement industry. Reason of Global temperature rise and Climate change	09	2	1	12
OEC-CT01.2: Understood the CO_2 emission sources in unit process and quantification from each source. Calculation of total CO_2 emission in the pyro process with breakups	09	2	1	12
OEC-CT01.3: CO_2 mitigation steps in Pyroprocess. Use of alternative & hazardous fuels and calculation of "Thermal substitution rate" and Carbon footprint reduction. Use of grinding aids for production increase and reduction in specific power consumption. Technological upgrades & advances	09	2	1	12
OEC-CT01.4: Calculation of Carbon footprint reduction in Blended cements reducing the Carbon intensive & energy intensive Clinker usage for Cement grinding. Calculation of Technological advances and upgrades in grinding technology	09	2	1	12
OEC-CT01.5: Calculation of reduced carbon footprint due to usage of renewable energy substituting energy from thermal power plants using fossil fuels, installation of CCU & CCS technologies for Carbon negative perspective	09	2	1	12
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Unit 1: Carbon footprint – Introduction	03	02	05	10
CO-2	Unit 2: Carbon footprint-Breakups in unit process	03	02	05	10
CO-3	Unit 3: CO_2 mitigation steps in Pyro processing	03	02	05	10

CO-4	Unit 4: CO_2 mitigation due to Blended cement	03	02	05	10
CO-5	Unit 5: CO_2 mitigation due to Renewable energy and Carbon negative due to CCU & CCS	03	02	05	10
Total		15	10	25	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Geology and Mining of Limestone will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition & Year
1	Cement production Technology	Anjan Kumar Chatterjee	CRC Press	2018
2	Intelligent and Sustainable Cement Production	Anjan Kumar Chatterjee	CRC Press-	2021
3	Handbook of Low Carbon Concrete	Ali Nazari, Jay G. Sanjayan	Elsevier Science	2016
4	Designing Green Cement Plants	S.P. Deolalkar	Elsevier Science	2015

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

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COs, POs and PSOs Mapping

Program Title: B. Tech. Cement Tech. Course Code: OEC-CT01 Course Title: Carbon Credit in Cement Manufacture

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
OEC-CT01.1: Understand Carbon footprint in the Industry and share of Cement sector. Key indicators in Cement industry. Reason of Global temperature rise and	3	2	2	2	2	3	3	1	1	1	2	1	1	2	2	1

Climate change																
OEC-CT01.2: Understood the CO_2 emission sources in unit process and quantification from each source. Calculation of total CO_2 emission in the pyro process with breakups	3	3	2	2	2	3	3	1	1	1	3	1	2	2	2	1
OEC-CT01.3: CO_2 mitigation steps in Pyroprocess. Use of alternative & hazardous fuels and calculation of "Thermal substitution rate" and Carbon footprint reduction. Use of grinding aids for production increase and reduction in specific power consumption. Technological upgrades & advances	3	3	2	2	2	3	3	1	1	1	3	1	2	2	2	1
OEC-CT01.4: Calculation of Carbon footprint reduction in Blended cements reducing the Carbon intensive & energy intensive Clinker usage for	3	3	2	2	2	3	3	1	1	1	3	1	2	2	2	1

Cement grinding. Calculation of Technological advances and upgrades in grinding technology																
OEC-CT01.5: Calculation of reduced carbon footprint due to usage of renewable energy substituting energy from thermal power plants using fossil fuels, installation of CCU & CCS technologies for Carbon negative perspective	2	3	3	3	3	1	1	1	1	1	3	1	2	1	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Carbon Credit in Cement Manufacture

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**OEC-CT01.1:** Understand Carbon footprint in the Industry and share of Cement sector. Key indicators in Cement industry. Reason of Global temperature rise and Climate change	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit 1: Carbon footprint – Introduction** 1.1, 1.2, 1.3, 1.4, 1.5,1.6,1.7, 1.8, 1.9	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**OEC-CT01.2:** Understood the CO_2 emission sources in unit process and quantification from each source. Calculation of total CO_2 emission in the pyro process with breakups	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit 2: Carbon footprint- Breakups in unit process** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**OEC-CT01.3:** CO_2 mitigation steps in Pyroprocess. Use of alternative & hazardous fuels and calculation of “Thermal substitution rate” and Carbon footprint reduction. Use of grinding aids for production increase and reduction in specific power consumption. Technological upgrades & advances	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit 3: CO2 mitigation steps in Pyro processing** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9,	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**OEC-CT01.4:** Calculation of Carbon footprint reduction in Blended cements reducing the Carbon intensive & energy intensive Clinker usage for Cement grinding. Calculation of Technological	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit 4: CO2 mitigation due to Blended cement** 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9,	

	advances and upgrades in grinding technology				
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**OEC-CT01.5:** Calculation of reduced carbon footprint due to usage of renewable energy substituting energy from thermal power plants using fossil fuels, installation of CCU & CCS technologies for Carbon negative perspective	SO5.1 SO5.2 SO5.3		**Unit 5: CO2 mitigation due to Renewable energy and Carbon negative due to CCU & CCS** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9,	

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Semester V

Course Code: **OE-CT04**

Course Title : **Concrete Technology**

Pre- requisite: Student Should have knowledge on chinker chemistry and hydration of cement

Rationale: Concrete technology offers a thorough exploration of both the theoretical and hands-on facets of the subject, encompassing the most recent advancements in concrete construction. The content integrates the latest Indian standard specifications and codes governing concrete construction. It delves extensively into the properties of concrete and its components, highlighting the influence of various admixtures in tailoring these properties to meet specific needs. Topics covered include ready mix concrete, reinforcement detailing, disaster-resistant construction, concrete machinery, and special concrete formulations like self-healing concrete. Furthermore, the course thoroughly addresses aspects of durability, maintenance, and quality control pertaining to concrete structures.

Course Outcomes:

OE-CT04.1: Explore the characteristics of materials used in concrete production and their influence on concrete quality.

OE-CT04.2: Gain insight into the role of admixtures in the concrete manufacturing process.

OE-CT04.3: Acquire knowledge about the characteristics of both Fresh and Hardened concrete.

OE-CT04.4: Delve into the intricacies of concrete mix design, production techniques, and quality control measures.

OE-CT04.5: Explore the manufacturing processes and unique properties of special concrete

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies (Hours per Week)					Total Credits(C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
OEC	OE-CT04	Concrete Technology	3	0	2	1	6	3

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Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop,field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)					End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 Assignments 3 marks Each (CA)	2 Class Test (best 2 out of 3) 10 marks Each (CT)	One Seminar (SA)	Class Attendance (AT)	Total Marks (CA+CT+SA+AT)		
OEC	OE-CT04	Concrete Technology	15	20	10	5	50	50	100

OE-CT04.1: **Explore the characteristics of materials used in concrete production and their influence on concrete quality.**

Approximate Hours

Item	Appx Hrs
CL	07
LI	0
SW	01
SL	01
Total	09

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1: Concrete and its advantages as construction materials **SO2:** Type of Aggregate use for concrete manufacture. **SO3:** Properties of Aggregate and its impact on concrete. **SO4:** Deleterious Substances in aggregate and its impact of concrete quality. **SO5:** Quality of water mixing of concrete and concrete curing		**Unit-I: Materials for Concrete manufacture :** **Concrete** **1.1** Concrete as construction material, classification, properties, grades, advantages, disadvantages, **Concrete making materials -I** **1.2** Types of cement, **1.3** Cement Classifications, **1.4** Storage of cement, **Concrete making materials –II:** **1.5** **Aggregates** Classification, characteristics, size required for concrete **1.6** Deleterious substances in aggregates, **1.7** Properties of Aggregate soundness, AAR, Thermal properties, **1.8** Fineness modulus of fine aggregate. **1.9** Testing of aggregates for concrete manufacture. **Concrete Making Materials –III:** **1. 10 Water-** Quality of mixing water for concrete and curing water	1. classification and properties of rock

SW-1 Suggested Sessional Work (SW):

Assignments: Course aggregate for concrete manufacture, Fine aggerate for concrete manufacture, Quality of water for manufacture of concrete**.**

OE-CT04.2: **Gain insight into the role of admixtures in the concrete manufacturing process.**

Approximate Hours

Item	**Appx Hrs**
CL	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1: Types And use of admixture in concrete manufacture **SO2:** Specification of admixture. **SO3:** Concrete admixture and enhancement of concrete properties **SO4**: Mineral admixture and its use in concrete		**Unit-II: Admixtures and its function in concrete.** **2.1** Types and Functions of admixtures in concrete **2.2** Classification of chemical admixture **2.3** Requirements of admixture **2.4** Indian Standard Specification of admixture **2.5** Supplementary additives. **2.6** Water-reducing admixtures **2.7** Accelerating admixtures **2.8** Water-reducing retarding admixtures **2.9** Types and properties Mineral Admixture **2.10** Use of mineral admixture	1. Properties of fly ash, silica fumes, Metakioline etc

SW-2 Suggested Sessional Work (SW):

Assignments: Types and use of mineral admixture, Super Plasticizer and its use in concrete, Types of chemical Admixture and its properties**.**

OE-CT04.3 Acquire knowledge about the characteristics of both fresh and hardened concrete

Approximate Hours

Item	Appx Hrs
CL	08
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1: Properties of Fresh concrete **SO2:** Slump test and workability of concrete **SO3** Hydration of fresh concrete **SO4.** Physical properties of harden concrete. **SO5.** Durability of concrete		**Unit-III: Properties of Fresh and Hardened concrete:** **3.1** Properties fresh concrete **3.2** Workability of concrete and consistency **3.3** Slump test and facture affect the concrete slump **3.4** Settlement and bleeding, Plastic shrinkage **3.5** Hydration in fresh concrete **Properties of Harden concrete** **3.6** Strengths of concrete, **3.7** Stress and strain characteristics of concrete, dimensional stability, creep, **3.8** Permeability and durability **3.9** Thermal properties of concrete, **3.10** Micro cracking of concrete.	1. Clinker properties 2. Cement Hydration

SW-3 Suggested Sessional Work (SW):

- **a. Assignments:** Slump test, Measurement of strength of concrete, Crack development in concrete, properties of fresh concrete, properties of harden concrete.
- **b. Mini Project.** Slump test, Making of concrete cube and compressive strength test.

OE-CT04.4: **Delve into the intricacies of concrete mix design, production techniques, and quality control measures.**

Approximate Hours

Item	Appx Hrs
CL	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1: Types of concrete and Concrete mix design **SO2:** Ready mix concrete **SO3:** Placing and compaction of concrete **SO4:** Inspection and testing of concrete. **SO5:** Quality control of concrete, Field control, Statistical quality control		**Unit-IV: Production of concrete:** **4.1** Types of concrete and design mix **4.2** Concrete mix design **4.3** Production of concrete **4.4** Ready mix concrete **4.5** Placing and compaction of concrete **4.6** Placing, finishing and curing of concrete. **4.7** Inspection and testing of concrete. **4.8** Quality control of concrete: factors causing variations in the quality of concrete, **4.9** Field control, **4.10** Statistical quality control and its advantages	1. Concrete mix design, Statistical Quality control in concrete

SW-4 Suggested Sessional Work (SW):

Assignments: Concrete mix design, Statistical Quality control in concrete manufacture, Rady mix concrete and its advantages, Manufacture of durable concrete.

OE-CT04.5: Explore the manufacturing processes and unique properties of special concrete.

Approximate Hours

Item	Appx Hrs
CL	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1: Types of special concrete and its use. **SO2:** Light weight concrete, Vacuum concrete and roller compacted concrete etc. **SO3:** Self healing concrete and its use **SO4:** Fiber reinforced concrete, nuclear concrete, heat resistant concrete production and use.		**Unit V: Special concrete and concreting techniques:** **5.1** Types of special concrete and its use **5.2** Lightweight and ultralight weight concrete, **5.3** Vacuum concrete, **5.4** Mass concrete and roller compacted concrete, **5.5** Waste material based concrete, **5.6** Self healing concrete **5.7** Shotcrete or guniting, **5.8** Ferrocement, fiber reinforced concrete, **5.9** Nuclear concrete, **5.10** Heat resisting and refractory concretes.	1. Manufacture of concrete.

SW-5 Suggested Sessional Work (SW):

1. **Assignments:** Types of special concrete and its use, Notes on fiber reinforced concrete, Self healing concrete, Shotcrete.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
OE-CT04.1: Explore the characteristics of materials used in concrete production and their influence on concrete quality.	10	2	1	13
OE-CT04.2: Gain insight into the role of admixtures in the concrete manufacturing process.	7	2	1	10
OE-CT04.3: Acquire knowledge about the characteristics of both Fresh and Hardened concrete	10	2	1	13
OE-CT04.4: Delve into the intricacies of concrete mix design, production techniques, and quality control measures.	8	2	1	11
OE-CT04.5: Explore the manufacturing processes and unique properties of special concrete**.**	10	2	1	13
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Explore the characteristics of materials used in concrete production and their influence on concrete quality.	02	03	02	07
CO-2	Gain insight into the role of admixtures in the concrete manufacturing process.		08	02	10
CO-3	Acquire knowledge about the characteristics of both Fresh and Hardened concrete.	01	06	04	11
CO-4	Delve into the intricacies of concrete mix design, production techniques, and quality control measures.	-	08	07	15
CO-5	Explore the manufacturing processes and unique properties of special concrete**.**	-	03	04	07
Total		03	28	19	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture, Tutorial
2. Case Method
3. Group Discussion, Role Play
4. Visit to cement plant
5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
7. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Concrete Technology (Theory and Practice)	F W Taylor	S. Chand Publishing	2019
2	Concrete Technology	Neville	Pearson Education	2006
3	Norms For Limestone Exploration For Cement Manufacture	National Council for Cement and Building Materials	National Council for Cement and Building Materials	1985
4	Concrete Technology	S. S. Bhavikatti	I K International Publishing House Pvt. Ltd	2015
5	Construction and Concrete Technology	R.V. Singh	Vayu Education of India	2020
6	Holcim Training Manual			
7	FLS Training Manual			

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Curriculum Development Team

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10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

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COs, POs and PSOs Mapping

Course Title: B. Tech. Cement Tech. **Course Code: OE-CT04** **Course Title: Concrete Technology**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
OE-CT04.1: Explore the characteristics of materials used in concrete production and their influence on concrete quality.	3	3	3	3	3	3	3	2	2	1	2	3	3	3	3	3
OE-CT04.2: Gain insight into the role of admixtures in the concrete manufacturing process.	3	3	3	3	3	3	3	2	2	1	2	3	3	3	3	3
OE-CT04.3: Acquire knowledge about the characteristics of both Fresh and Hardened concrete	3	3	3	3	3	3	3	2	3	1	2	3	3	3	3	3
OE-CT04.4: Delve into the intricacies of concrete mix	3	3	3	3	3	3	3	2	2	1	2	3	3	3	3	3

design, production techniques, and quality control measures.																
OE-CT04.5: Explore the manufacturing processes and unique properties of special concrete**.**	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**2**	**3**	**3**	**3**	**3**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Concrete Technology

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**OE-CT04.1:** Explore the characteristics of materials used in concrete production and their influence on concrete quality.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1: Explore the characteristics of materials used in concrete production and their influence on concrete quality. 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**OE-CT04.2:** Gain insight into the role of admixtures in the concrete manufacturing process.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2: Gain insight into the role of admixtures in the concrete manufacturing process. 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**OE-CT04.3:** Acquire knowledge about the characteristics of both Fresh and Hardened concrete	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3: Acquire knowledge about the characteristics of both Fresh and Hardened concrete. 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**OE-CT04.4:** Delve into the intricacies of concrete mix design, production techniques, and quality control measures.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: Delve into the intricacies of concrete mix design, production techniques, and quality control measures. 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**OE-CT04.5:** Explore the manufacturing processes and unique properties of special concrete.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit 5: Explore the manufacturing processes and unique properties of special concrete. 5.1,5.2,5.3,5.4,5.5	

Course Code: **PCC-CT306**

Course Title : **Instrumentation and Process Control**

Pre-requisite: Student should have basic knowledge of Mathematics.

Rationale: This course follows a unified approach to introduce the Instrumentation and Process Control. The principal topics covered include identification and importance of the process measurement mechanism and their applications in cement industries. Process control has become increasingly important in the process industries as a consequence of global competition, rapidly changing economic conditions, and more stringent environmental and safety regulations. It is a sub-discipline of automatic control that involves tailoring methods for efficient operation of industrial processes.

Course Outcomes:

PCC-CT306.1: Demonstrate knowledge of process systems as well as the operating principles of common instruments.

PCC-CT306.2: Understand concepts of the mathematical modeling and develop transfer functions of open loop control systems and their responses with different forcing functions.

PCC-CT306.3: Analyze the stability of the control system with time and frequency domain analysis techniques.

PCC-CT306.4: Compare different advanced control schemes to various processes.

PCC-CT306.5: The students will be able to prepare a basic scheme for process unit such as Fuzzy logic rotary kiln and understand the programs for DDC/DCS/PLC and SCADA.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT306	Instrumentation and Process Control	4	0	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT306	Instrumentation and Process Control	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:
This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT306.1: Demonstrate knowledge of process systems as well as the operating principles of common instruments.

Approximate Hours

Item	Appx. Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understand and interpret control diagrams **SO1.2** Understand and apply the knowledge of tuning of controllers in real life systems. **SO1.3** Understand the dynamic modeling of physical process using first and second order ordinary differential equations.	.	**Unit-1: Introduction to Process control systems** **1.1** Introduction to Process control systems **1.2** Feed Forward control **1.3** Feed backward control **1.4** Negative & Positive Feed backward Control **1.5** Variables & Physical Elements of a Control system **1.6** Physical, Block Diagram **1.7** Use of Laplace Transformation in study of Process Dynamics **1.8** Use of Inverse Laplace Transformation in study of Process Dynamics **1.9** Numerical Problems of Laplace Transformation **1.10** Numerical Problems of Inverse Laplace Transformation	**1.** Application of Process control systems **2.** Feed backward Control and Feed Forward control system

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Numerical Problems on Laplace and Inverse Laplace Transformation

b. Mini Project:

i. Draw the Block Diagram of Feed backward Control and Feed Forward control system.

PCC-CT306.2: Understand concepts of the mathematical modeling and develop transfer functions of open loop control systems and their responses with different forcing functions.

Approximate Hours

Item	Appx. Hrs
CI	8
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 The students will be able to prepare a basic scheme for process unit **SO2.2** The students will be able to calculate the output of various measuring scheme. **SO2.3** Check the stability of systems using stability criterion.	.	**Unit-2: Dynamic Modeling of a Process control systems** **2.1** Dynamic Modeling of a process **2.2** Dynamic behavior of First order systems **2.3** First order systems in series for Non-interacting System **2.4** First order systems in series for Interacting System **2.5** Dynamic behavior of second order systems **2.6** Step Response of Second order system **2.7** Transportation & Transfer Lag Stability **2.8** Stability	1. Remember the Response of First and Second order system

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Derivation of First order systems in series for Non-interacting System
ii. Derivation of First order systems in series for Interacting System
iii. Derivation of Dynamic behavior of second order systems

b. Mini Project:

a. Writing the theorems of Routh test for Stability

PCC-CT306.3: Analyze the stability of the control system with time and frequency domain analysis techniques.

Approximate Hours

Item	Appx. Hrs
CI	14
LI	0
SW	2
SL	1
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Design and tuning of controllers for specific applications **SO3.2** Calculate the dynamic response of closed loop systems **SO3.3** Describe principles of modes of controllers and their general characteristics and study the stability analysis of digital control system. **SO3.4** Design of various control schemes and apply the control system in various processes.	.	**Unit-3 :Control System** **3.1** Introduction of Control System **3.2** Controllers & Final control Elements **3.3** Reduction of Block Diagrams **3.4** Closed loop transfer function **3.5** Response of closed loop control system for various type of control actions **3.6** On Off controller **3.7** P controller **3.8** PI controller **3.9** PID controller **3.10** Motivation for addition of integral and derivative control modes **3.11** Material level control in silos and bins **3.12** Level indicators with rotating paddles **3.13** Continuous level indicators, **3.14** Tunic fork level indicators	1. Remember the transfer function equation for P, PI, PD, PID controllers

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Writing the transfer function equation for P, PI, PD, PID controllers

ii. Draw the Reduction of Block Diagrams

b. **Mini Project:**

Schematic representation of response of typical control system

PCC-CT306.4: Compare different advanced control schemes to various processes.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	4
SL	2
Total	19

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 The students will be able to select the appropriate type of instrument for any application **SO4.2** Understand the principals involved in measurements. Attain knowledge on different measurement methods employed in industrial processing and manufacturing. **SO4.3** Application of different pressure measurement devices in cement industries. **SO4.4** Application of different temperature measurement devices in cement industries. **SO4.5** Application of various level and flow measurement devices in cement industries.	.	**Unit-4: Measurement Instruments in cement plant** **4.1** Measurement of Temperature: temperature of secondary air **4.2** Measuring temperature in grate and satellite coolers **4.3** Temperature of burning zone **4.4** Measuring with thermocouples **4.5** Pyrometers, optical pyrometers, radiation pyrometers **4.6** Shell temperature of rotary kiln-scanners **4.7** Measurement of Pressure & Vacuum **4.8** Weighing installations: Weight measurement & Weigh feeder **4.9** Gravimetric and volumetric feed system in cement plant **4.10** Flow measuring instruments **4.11** Environment monitoring instruments **4.12** Calibration of process instrumentation **4.13** Instrumentation error	1. Remember the Principals of Measurement Instruments in cement plant

SW-4 Suggested Sessional Work (SW):

a. Assignments:

i. What is the significance of material level control in silos and bins?

ii. What are the principles on which functioning of material level indicators based?

b. **Mini Project:** Writing the formula of Flow measuring calculations

PCC-CT306.5: The students will be able to prepare a basic scheme for process unit such as Fuzzy logic rotary kiln and understand the programs for DDC/DCS/PLC and SCADA.

Approximate Hours

Item	Appx. Hrs
CI	15
LI	0
SW	4
SL	2
Total	21

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self Learning (SL)**
SO5.1 Operate instrumentation and automation systems in modern cement plant operation. **SO5.2** The students will be able to prepare a basic scheme for process unit such as Fuzzy logic rotary kiln. **SO5.3** The students will be able to understand the programs for DDC/DCS/PLC and SCADA.		**Unit 5: Computer control in cement plant** **5.1** Process computer control: history of computer control in cement industry **5.2** Control panels: development of control panels **5.3** Control panels and control rooms **5.4** Decentralized control panels **5.5** Use of expert system **5.6** Fuzzy logic rotary kiln control **5.7** Foxboro control system **5.8** Control technique of hierarchical structure and distributed intelligence **5.9** Process control advances for cement industry: DDC **5.10** Process control advances for cement industry: DCS **5.11** Process control advances for cement industry: PLC **5.12** Process control advances for cement industry: SCADA5.13 Introduction of Automation **5.13** Process automation in sampling and Automation in sample transport **5.14** Sample preparation and testing data transmission	1. Function of CCR in cement plant 2. Working of CCR in Cement plant

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. What are the objectives of automation in cement plant? Describe in detail any two automated systems developed for analysis of samples in the cement plant?

ii. Why Digital Control System is preferred over analog control systems? Explain centralized control system and distributed control system along with block diagram.

b. Mini Project:

i. Schematic representation of the Process control through CCR in cement plant
ii. Schematic representation of the Fuzzy logic control application in cement plant

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (CI+SW+Sl)
PCC-CT306.1: Demonstrate knowledge of process systems as well as the operating principles of common instruments.	10	2	1	13
PCC-CT306.2: Understand concepts of the mathematical modeling and develop transfer functions of open loop control systems and their responses with different forcing functions.	8	2	1	11
PCC-CT306.3: Analyze the stability of the control system with time and frequency domain analysis techniques.	14	2	1	17
PCC-CT306.4: Compare different advanced control schemes to various processes.	13	4	2	19
PCC-CT306.5: The students will be able to prepare a basic scheme for process unit such as Fuzzy logic rotary kiln and understand the programs for DDC/DCS/PLC and SCADA.	15	4	2	21
Total Hours	60	14	7	81

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction to Process control systems	03	01	01	05
CO-2	Dynamic Modeling of a Process control systems	02	06	02	10

CO-3	Control System	01	08	06	15
CO-4	Measurement Instruments in cement plant	04	06	05	15
CO-5	Computer control in cement plant	02	02	01	05
Total		12	23	15	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Instrumentation and Process Control will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition&Year
1	Process Systems Analysis and Control	Coughnour and Koppel	McGraw-Hill, New York	1986
2	Chemical Process Control	George Stephanopolous	Prentice-Hall of India Pvt-Ltd., New Delhi	1990
3	Process Dynamics and Control	P. K. Sarkar	Prentice Hall India	2014
4	Industrial Instrumentation and Control	Singh, S. K	Prentice Hall of India	2016
5	Industrial Instrumentation	Eckman, D.P.	Wiley Eastern Ltd., New York	1990

6	Principles of industrial instrumentation	Patranabis	Tata Mcgraw Hill	2008
7	Mechanical and Industrial Measurements	Jain, R.K.,	Khanna Publishers	2005
8	Industrial Instrumentation: Principles and Design	Tattamangalam R. Padmanabhan	Springer Publishing Company	2009
9	Instumentation Measurement and Analysis	Nakra and Chaudhary	Tata McGraw Hill	1978
10	Fundamental of Instrumentation and Process Control	Rahul Omar	Notion Press	2022
11	Holcim Training Manual			
12	FLS Training Manual			
13	Lecture note provided by Dept. of Cement Technology, AKS University, Satna.			

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Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech   Course Code: PCC-CT306   Course Title: Instrumentation and Process Control

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Demonstrate knowledge of process systems as well as the operating principles of common instruments.	3	3	2	1	3	2	2	1	2	1	3	2	2	3	1	2
CO-2: Understand concepts of the mathematical modeling and develop transfer functions of open loop control systems and their responses with different forcing functions.	3	3	2	1	1	3	2	1	2	1	2	2	2	2	2	3
CO-3: Analyze the stability of the control system with time and frequency domain analysis techniques.	2	2	1	1	1	2	1	2	2	1	1	3	3	3	2	2

CO-4: Compare different advanced control schemes to various processes.	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**1**	**2**	**3**	**3**	**3**	**1**	**2**
CO-5: The students will be able to prepare a basic scheme for process unit such as Fuzzy logic rotary kiln and understand the programs for DDC/DCS/PLC and SCADA.	**3**	**3**	**3**	**1**	**1**	**3**	**1**	**1**	**1**	**1**	**2**	**3**	**3**	**3**	**2**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Course Curriculum Map: Instrumentation and Process Control

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Demonstrate knowledge of process systems as well as the operating principles of common instruments.	SO1.1 SO1.2 SO1.3		**Unit-1 Introduction to Process control systems** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Understand concepts of the mathematical modeling and develop transfer functions of open loop control systems and their responses with different forcing functions.	SO2.1 SO2.2 SO2.3		**Unit-2 Dynamic Modeling of a Process control systems** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Analyze the stability of the control system with time and frequency domain analysis techniques.	SO3.1 SO3.2 SO3.3 SO3.4		**Unit-3: Control system** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11, 3.12,3.13,3.14	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Compare different advanced control schemes to various processes.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Measurement Instruments in cement plant** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11, 4.12,4.13	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** The students will be able to prepare a basic scheme for process unit such as Fuzzy logic rotary kiln and understand the programs for DDC/DCS/PLC and SCADA.	SO5.1 SO5.2 SO5.3		**Unit 5: Computer control in cement plant** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12, 5.13,5.14,5.15	

Semester-VI

Course Code: **PCC-CT307**

Course Title: **Maintenance Practices in Cement Plant**

Pre-requisite: Student should have basic knowledge of Mathematics and normal distribution, some related probability, etc.

Rationale: The students studying Maintenance practices in cement technology should possess maintenance understanding in cement technology This encompasses familiarity with the failure rate, hazard rate and evolution of condition-based maintenance Additionally, students ought to acquire fundamental insights into various Maintenance concepts and strategies and their applications, as well as the Indian regulatory authorities responsible for supervising Maintenance effectiveness.

Course Outcomes:

PCC-CT307.1: Understand the Basic Concepts of Reliability so that students can calculate Binomial distribution, discrete distribution, Mean time to failure, Mean time between failures etc.

PCC-CT307.2: Acquired the knowledge of System reliability models to understand system reliability assessment models Redundancy techniques in system design along with its Reliability quality and unreliability.

PCC-CT307.3: Understanding of the various concepts of maintenance management, objectives and functions of maintenance planning and scheduling of maintenance organization, and their utilization in Maintenance development.

PCC-CT307.4: Familiarize with a concise overview of the Condition based maintenance.

PCC-CT307.5: Comprehend the functions of Reliability centered Maintenance, Total Productive Maintenance regulatory bodies in India that oversee the Failure modes and effects analysis.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT307	Maintenance Practices In Cement Plant	4	0	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT307	Maintenance Practices in Cement Plant	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT307.1: Understand the Basic Concepts of Reliability so that students can calculate Binomial distribution, discrete distribution, Mean time to failure, Mean time between failures etc.

Approximate Hours

Item	Appx. Hrs
CI	17
LI	0
SW	2
SL	2
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 To Understand Reliability, Probability distributions used in reliability evaluation. **SO1.2** Understands maintenance engineering. **SO1.3** Poisson distribution, Weibull distribution used in maintenance management, **SO1.4** Calculation of failure modes. **SO1.5** Failure rate, hazard model, Mean time between failures		**Unit-1: Basic Concepts of Reliability** **1.1** Probability Distributions. **1.2** Probability Distributions used in Maintenance Engineering. **1.3** Binomial Distribution **1.4** Numerical on Binomial Distribution **1.5** Poisson Distribution. **1.6** Numerical on Poisson Distribution **1.7** Exponential Distribution. **1.8** Numerical on Exponential Distribution **1.9** Normal Distribution. **1.10** Numerical on Normal Distribution. **1.11** Log-normal. Distribution. **1.12** Gamma Distribution. **1.13** Weibull Distribution. **1.14** Failure Rate **1.15** Hazard rate **1.16** Failure Modes. **1.17** MTTR, MTBF, MTTF	1. Properties of Reliability management. 2. Calculation dependent on Binomial distribution, Poisson distribution.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Reliability and its management and probability, types of reliability distribution, mean time to failure, mean time between failure, failure rate and its related model, Reliability testing.

b. Mini Project:

Flow diagram of Probability distribution.

PCC-CT307.2: Acquired the knowledge of System reliability models to understand system reliability assessment models Redundancy techniques in system design along with its Reliability quality and unreliability.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 To Understand the Introduction to system reliability models. **SO2.2** To learn about various types of components used in system reliability. **SO2.3** To understand the requirement of Redundancy techniques in system design. **SO2.4** To understand the types of reliability or unreliability.		**Unit-2: System Reliability Models** **2.1** System reliability-n-component Series Systems. **2.2** Types, chemical and physical properties of system reliability. **2.3** M-Component Combined System **2.4** Standby Systems. **2.5** K-out-of-m Systems **2.6** Redundancy Techniques in System Design. **2.7** Event Space. **2.8** Decomposition (Key Stone), **2.9** Cut and Tie sets. **2.10** Markov Analysis. **2.11** Reliability and Quality. **2.12** Unreliability, Maintainability, Availability	**i.** System reliability models and their properties. **ii.** Standby systems and Markov analysis.

SW-2 Suggested Sessional Work (SW):

Assignments:

1. System reliability assessment models, k-out-of-m system, redundancy techniques in system design.
2. Markov analysis for reliability and quality, Maintainability and reliability & availability analysis.

PCC-CT307.3: Understanding of the various concepts of maintenance management, objectives and functions of maintenance planning and scheduling of maintenance organization, and their utilization in Maintenance development.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	3
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Purpose of Maintenance and Problems in maintenance. **SO3.2** Maintenance management. **SO3.3** Properties and functions of maintenance management. **SO3.4** Maintenance planning and scheduling and objectives and contribution. **SO3.5** Types of maintenance system.	.	**Unit-3: Maintenance Concepts and Strategies and General Introduction to Maintenance Types** **3.1** Introduction of maintenance concepts. **3.2** Maintenance Functions and Objectives. **3.3** Maintenance Organization. **3.4** Breakdown. Emergency. **3.5** Corrective, Predictive and Preventive. **3.6** Maintenance Organization. **3.7** Breakdown. Emergency. **3.8** Corrective, Predictive and Preventive. **3.9** Maintenance Prevention. **3.10** Design-out Maintenance, Productive maintenance.	**i.** Impact of maintenance in the maintenance department. **ii.** Planned and unplanned maintenance. **iii.** Maintenance organization.

		3.11 Shutdown Maintenance, Scheduled Maintenance. **3.12** Upset kiln condition- causes and control.	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. Introduction of maintenance concepts and Advantages of use of Maintenance.
2. Properties and use Breakdown or unplanned maintenance.

b. Mini Project:

Make a table containing various maintenance strategies and their types.

PCC-CT307.4: Familiarize with a concise overview of the Condition based maintenance.

Approximate Hours

Item	Appx. Hrs
CI	09
LI	0
SW	3
SL	2
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Introduction to condition-based maintenance. **SO4.2** Understanding the Principles of condition-based maintenance. **SO4.3** Understanding the implementation of condition-based maintenance. **SO4.4** Level of condition Monitoring and performance monitoring.	.	**Unit-4 : Condition Based Maintenance:** **4.1** Principles of CBM **4.2** Pillars of Condition Monitoring. **4.3** CBM implementation and benefits. **4.4** Condition Monitoring Techniques. **4.5** Visual Monitoring. **4.6** Vibration Monitoring. **4.7** Wear Debris Monitoring. **4.8** Corrosion Monitoring. **4.9** Performance Monitoring	**i.** Properties of condition-based maintenance. **ii.** Value of Condition-based maintenance and the challenges of Condition-based maintenance.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Write the principles of Condition-based maintenance and condition monitoring.
2. Describe visual monitoring and vibration monitoring.

b. Mini Project:
Visit to a cement a cement plant and writing a Maintenance report.

c. Other Activities (Specify):
Prepare the Power Point Presentation of cement plant Maintenance report.

PCC-CT307.5: Comprehend the functions of Reliability centered Maintenance, Total Productive Maintenance regulatory bodies in India that oversee the Failure modes and effects analysis.

Approximate Hours

Item	AppX Hrs
Cl	10
LI	0
SW	3
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1. Introduction to Reliability Centered Maintenance (RCM). **SO5.2** Over view of the concepts behind RCM, RCM goals and RCM Principles. **SO5.3** Role of the Maintenance bodies and total productive maintenance department in Cement quality and production. **SO5.4** Overview of Total Productive Maintenance (TPM) Goals, TPM	.	**Unit 5: Reliability Centered Maintenance (RCM):** **5.1** Concept, Methodology, Benefits of RCM Indian cement industry in global prospective. **5.2** Total Productive Maintenance **5.3** Evolution of TPM **5.4** TPM Objectives, concept. **5.5** Pillars of TPM **5.6** Failure Modes and Effects Analysis (FMEA)/ Failure Modes. **5.7** Effects and Criticality Analysis. **5.8** Elements of FMECA. **5.9** Qualitative and Quantitative	**1.** How to initiate RCM. **2.** Why do FMEA (Failure Modes and Effects Analysis), When to conduct an FMEA. .

Targets, Benefits of TPM. **SO5.5** Basic requirement for Failure Modes and Effects analysis.		approach to FMECA. **5.10** Design FMEA and Steps for Carrying out Design FMEA	

SW-5 Suggested Sessional Work (SW):

a. Assignments:

1. Concepts of RCM, RCM goals, RCM principles.
2. Motives of TPM, Benefits of TPM, TPM introduction at production unit.

b. Mini Project:

Maintenance Control norms for Indian Cement Industry.

c. **Other Activities (Specify):**

List of Organization/Institution in India for Maintenance regulation of Cement Production.

Brief of Hours suggested for the Course Outcome

Course Outcomes	**Class Lecture (CI)**	**Sessional Work (SW)**	**Self Learning (Sl)**	**Total hour (CI+SW+Sl)**
PCC-CT307.1: Understand the Basic Concepts of Reliability so that students can calculate Binomial distribution, discrete distribution, Mean time to failure, Mean time between failures etc.	17	2	2	21
PCC-CT307.2: Acquired the knowledge of System reliability models to understand system reliability assessment models Redundancy techniques in system design along with its Reliability quality and unreliability.	12	1	2	15
PCC-CT307.3: Understanding of the various concepts of maintenance management, objectives and functions of maintenance planning and scheduling of maintenance organization, and their utilization in Maintenance development.	12	2	3	17
PCC-CT307.4: Familiarize with a concise overview of the Condition based maintenance.	09	3	2	14
PCC-CT307.5: Comprehend the functions of Reliability centered Maintenance, Total Productive Maintenance regulatory bodies in India that oversee the Failure modes and effects analysis.	10	3	2	15
Total Hours	60	12	11	83

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Basic Concepts of Reliability.	05	03	02	10
CO-2	System Reliability Models.	04	03	03	10
CO-3	Maintenance Concepts and Strategies and General Introduction to Maintenance Types.	06	02	02	10
CO-4	Condition Based Maintenance.	03	02	05	10
CO-5	Reliability Centered Maintenance (RCM).	05	02	03	10
Total		23	12	15	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Maintenance Practices in Cement Plant will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition&Year
1	Chemistry Of Cement And Concrete	F M Le	Chemical Publishing Co Inc, US	Revised edition 21 edition 2020

2	Cement Data Book:	W. H Duda		1999
3	Norms For Limestone Exploration For Cement Manufacture	National Council for Cement and Building Materials	National Council for Cement and Building Materials	1985
4	Cement Production Principle and Practice	A K Chatterjee		2018
5	Holcim Training Manual			
6	FLS Training Manual			
7	Lecture note provided by Dept. of Cement Technology, AKS University, Satna .			

Curriculum Development Team

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7. Er A K Bhattacharya, Faculty, Dept. of Cement Tech. (Former GM M/s Dalmia Cement)
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9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** PCC-CT307 **Course Title:** Maintenance Practices In Cement Plant

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Understand the Basic Concepts of Reliability so that students can calculate Binomial distribution, discrete distribution, Mean time to failure, Mean time between failures etc.	3	2	3	2	3	2	1	1	2	1	1	2	2	2	2	3
CO-2: Acquired the knowledge of System reliability models to understand system reliability assessment models Redundancy techniques in system design along with its Reliability quality and	2	3	2	2	1	2	1	1	1	1	3	2	2	2	2	2

unreliability.																
CO-3: Understanding of the various concepts of maintenance management, objectives and functions of maintenance planning and scheduling of maintenance organization, and their utilization in Maintenance development.	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**1**	**2**	**3**	**1**	**2**	**2**	**3**
CO-4: Familiarize with a concise overview of the Condition based maintenance.	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**1**
CO-5: Comprehend the functions of Reliability centered Maintenance, Total Productive Maintenance regulatory bodies in India that oversee the Failure modes and effects analysis.	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Maintenance Practices In Cement Plant

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1**: Understand the Basic Concepts of Reliability so that students can calculate Binomial distribution, discrete distribution, Mean time to failure, Mean time between failures etc.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Basic Concepts of Reliability.** 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14,1.15,1.16,1.17	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Acquired the knowledge of System reliability models to understand system reliability assessment models Redundancy techniques in system design along with its Reliability quality and unreliability.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: System Reliability Models.** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9,2.10,2.11,2.12	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Understanding of the various concepts of maintenance management, objectives and functions of maintenance planning and scheduling of maintenance organization, and their utilization in Maintenance development.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Maintenance Concepts and Strategies and General Introduction to Maintenance Types**. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Familiarize with a concise overview of the Condition based maintenance.	SO4.1 SO4.2 SO4.3 SO4.4		**Unit-4: Condition Based Maintenance.** 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9	

PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Comprehend the functions of Reliability centered Maintenance, Total Productive Maintenance regulatory bodies in India that oversee the Failure modes and effects analysis.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit-5: Reliability Centered Maintenance (RCM).** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8,5.9,5.10	

Semester-VI

Course Code: **PCC-CT308**

Course Title : **OPTIMIZATION TECHNIQUE**

Pre-requisite: Student should have basic knowledge of basic calculus, determination of maxima and minima

Rationale: A course on optimization techniques typically aims to provide students with a solid understanding of various optimization methods and their application such as understanding of optimization concepts, linear programming, convex optimization. By achieving these outcomes, students should be well-prepared to apply optimization techniques to a wide range of problems and contribute to the efficient decision-making processes in their respective fields.

Course Outcomes:

PCC-CT308.1: Acquiring the knowledge of fundamentals of process optimization.

PCC-CT308.2: Familiarize with technique of optimization of one dimensional function

PCC-CT308.3: Gain an understanding of Multivariable Optimization

PCC-CT308.4: Familiarize with a Constrained Optimization

PCC-CT308.5: Comprehend the functions of different Linear and Quadratic Programming

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT308	OPTIMIZATION TECHNIQUE	4	0	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT308	OPTIMIZATION TECHNIQUE	15	20	5	5	5	50	50	100

Course-Curriculum Detailing: Optimization Technique

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT308.1: Acquiring the knowledge of fundamentals of process optimization

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Fundamental understanding of what process optimization is, its importance in cement industry **SO1.2** To develop linear and nonlinear mathematical models **SO1.3** Understand constraints for process optimization problems **SO1.4** Type Familiarity with various optimization techniques **SO1.5** Application of process optimization principles to real-world problems .	.	**Unit-1:** **Fundamentals of Process Optimization** **1.1** Introduction to process optimization **1.2** Carrying out process analyses **1.3** Formulation of various process optimization **1.4** Formulation of optimization problems **1.5** Classification of optimization problem **1.6** Basic concepts of optimization **1.7** convex function **1.8** Basic concepts of optimization-concave function **1.9** Necessary conditions for stationary points **1.10** sufficient conditions for stationary points **1.11** Graphical method **1.12** Process optimization	**i.** Research and read introductory materials on process optimization **ii.** Solve problems and case studies related to process optimization.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. The purpose of this assignment is to strengthen their comprehension of the fundamental ideas and concepts of process optimization. This assignment's goal is to find areas for improvement in a real-world manufacturing process by applying the principles of process optimization.

b. Mini Project:

i. Optimization of manufacturing process

c. Other Activities (Specify):

Analyze real-world case studies related to process optimization in cement industry.

PCC-CT308.2: Familiarize with technique of optimization of one-dimensional function

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 To Understand of the basic principles of one-dimensional function optimization **SO2.2** Ability to develop mathematical models to represent one-dimensional functions **SO2.3** Proficiency in identifying and classifying critical points, including local maxima, local minima **SO2.4** Familiarity with derivative-free optimization methods **SO2.5** Application of one-dimensional function optimization techniques to real-world problems	.	**Unit-2: Optimization of One Dimensional Function** **2.1** Optimization of one dimensional functions **2.2** Unconstrained multivariable optimization-direct search method **2.3** Region elimination methods **2.4** Fibonacci search method **2.5** Golden section search method manufacture **2.6** Gradient-based methods: Newton- Raphson method, **2.7** Bisection method **2.8** Local maximum **2.9** Local minimum **2.10** Search for a local optimum **2.11** Deterministic global optimization **2.12** Quasi-Newton methods	1. Practice solving one-dimensional optimization problems. 2. Skills for analyzing problems, identifying sources of error in optimization results

SW-2 Suggested Sessional Work (SW):

a. Assignments:

The objective of this assignment is to apply optimization techniques to a one-dimensional function and identify its critical points.

b. **Mini Project:**
The objective of this mini-project is to apply optimization techniques to a real-world problem or a mathematical function and analyze the results.

c. **Other Activities (Specify):**
Explore the other method for optimization of one dimensional function.

PCC-CT308.3: Gain an understanding of Multivariable Optimization

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Develop a clear understanding of what multivariable optimization **SO3.2** Proficiency in dealing with functions with multiple independent variables **SO3.3** To understand the gradient vector **SO3.4** Understanding of derivative-free optimization methods **SO3.5** Knowledge of constrained optimization	.	**Unit-3: Different methods of Multivariable Optimization** **3.1** Multivariable Optimization Algorithms **3.2** Optimality criteria **3.3** Unidirectional search **3.4** direct search methods **3.5** Simplex search method, **3.6** Powell's conjugate direction method **3.7** Gradient-based methods **3.8** Cauchy's (steepest descent) **3.9** Newton's method **3.10** ε-constraint method **3.11** Goal programming **3.12** Decision-making software	**i.** Information about the latest developments in multivariable optimization **ii.** Practice solving a variety of multivariable optimization problems

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**

The objective of this sessional work project is to apply multivariable optimization techniques to solve a real-world problem or a mathematical function with multiple independent variables.

b. **Mini Project:**

Optimize a complex multivariable system design, in a cement plant considering multiple design parameters and constraints that maximize or minimize a specific objective, such as efficiency, cost, or performance.

c. **Other Activities (Specify):**

Explore recent method for multivariable optimization

PCC-CT308.4: Familiarize with a Constrained Optimization

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	4
SL	2
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO4.1 Understand the fundamentals of constrained optimization problems. **SO4.2** Comprehend the concept of linear programming and its applications **SO4.3** Formulate linear and nonlinear problems with inequality constraints **SO4.4** Formulate and solve QP problems, including quadratic cost functions and constraints	.	**Unit-4: Constrained Optimization** **4.1** Constrained Optimization Algorithms **4.2** Kuhn-Tucker conditions **4.3** Transformation methods: Penalty function method **4.4** Direct search for constraint minimization **4.5** Random search method **4.6** complex search method **4.7** Lagrange multiplier **4.8** Constraint programming **4.9** Geometric optimality conditions	**i.** Distinguish between equality and inequality constraints **ii.** Find examples and real-world situations where restricted optimization can be used.

SO4.5 Explore real-world applications of constrained optimization in various fields		**4.10** Simplex Method **4.11** Ellipsoid Method **4.12** Interval methods	

SW-4 Suggested Sessional Work (SW):

a. Assignments:
1. Production planning in the cement industry
2. Supply chain optimization

b. Mini Project:
Visit to a cement plant to obtain a real supply and production data

c. Other Activities (Specify):
Power Point Presentation of optimization techniques

PCC-CT308.5: Comprehend the functions of different Linear and Quadratic Programming:

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO5.1 Understand the basic concepts of linear programming (LP) and quadratic programming (QP) **SO5.2** Study the simplex method		**Unit 5: Tools for linear and quadratic programming** **5.1** Linear programming **5.2** Application of linear programming **5.3** Standard form a linear programming problem **5.4** Characteristics of a linear	**i.** Study the graphical method for solving linear programming problems **ii.** Explore optimization

SO5.3 Analyze case studies that demonstrate the practical use of LP in decision-making **SO5.4** Grasp the concept of quadratic programming and its relevance in optimization problems **SO5.5** Review key concepts and techniques covered in the course.		programming problem **5.5** Basic definitions of a linear programming problem **5.6** Quadratic programming **5.7** Calculation of a feasible solution of linear programming **5.8** problem to basic feasible solution **5.9** Duality in linear programming **5.10** gradient projection **5.11** extensions of the simplex algorithm **5.12** Criss-cross algorithm	software tools

SW-5 Suggested Sessional Work (SW):

a. Assignments:
1. Differentiate between linear and quadratic objective functions and constraints.
2. Formulate quadratic programming problems with both equality and inequality constraints.

b. Mini Project:
Formulate the linear programming model for cement production

c. Other Activities (Specify):
List of available software for Linear and Quadratic Programming

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PCC-CT308.1: Acquiring the knowledge of fundamentals of process optimization	12	2	1	15
PCC-CT308.2: Familiarize with technique of optimization of one dimensional function	12	2	1	15
PCC-CT308.3: Gain an understanding of Multivariable Optimization	12	2	1	15
PCC-CT308.4: Familiarize with a	12	4	2	18

Constrained Optimization				
PCC-CT308.5: Comprehend the functions of different Linear and Quadratic Programming	12	2	1	15
Total Hours	60	12	6	78

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	**U**	**A**	
CO-1	Acquiring the knowledge of fundamentals of process optimization	03	01	01	05
CO-2	Familiarize with technique of optimization of one dimensional function	02	06	02	10
CO-3	Gain an understanding of Multivariable Optimization	03	07	05	15
CO-4	Familiarize with a Constrained Optimization	-	10	05	15
CO-5	Comprehend the functions of different Linear and Quadratic Programming	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Optimization Technique will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion

5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition&Year
1	Optimization of Chemical Processes	T.F. Edgar and D.M. Himmelblau	McGraw Hill	1989
2	Optimal Design of Process Equipment	K. Urbanier and C. McDermott	John Wiley	1986
3	Optimization theory and practice	G.S. Beveridge and R.S. Schechter	McGrawHil	1989
4	Engineering Optimization-Methods and Applications	Rekllitis, G.V., Ravindran, A., and Ragdell, K.M	John Wiley	1983
5	SS Rao, Optimization Theory and Applications			
6	Optimization manual for optimization available on online			
7	Lecture note provided by Dept. of Cement Technology, AKS University, Satna .			

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** PCC-CT308 **Course Title:** Optimization Technique

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Acquiring the knowledge of fundamentals of process optimization	3	2	2	2	3	2	1	2	2	1	1	2	2	1	3	3
CO-2: Familiarize with technique of optimization of one dimensional function	3	2	2	2	3	2	1	2	1	1	1	2	2	1	3	2

CO-3: Gain an understanding of Multivariable Optimization	**3**	**3**	**2**	**2**	**2**	**2**	**1**	**3**	**2**	**1**	**2**	**3**	**2**	**2**	**2**	**3**
CO-4: Familiarize with a Constrained Optimization	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**3**	**3**
CO-5: Comprehend the functions of different Linear and Quadratic Programming	**3**	**3**	**3**	**1**	**1**	**3**	**2**	**2**	**1**	**1**	**2**	**3**	**3**	**2**	**2**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Optimization Technique

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Acquiring the knowledge of fundamentals of process optimization	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Scope of industrial economics and its history** 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Familiarize with technique of optimization of one dimensional function	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Demand Analysis** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Gain an understanding of Multivariable Optimization	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3 : Diversification , vertical Integration and merger** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Familiarize with a Constrained Optimization	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4 : Determinants of profitability** 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11, 4.12	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Comprehend the functions of different Linear and Quadratic Programming	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit-5: Advertising strategy** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 5.9,5.10,5.11,5.12	

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Semester-VI

Course Code: PCC-CT309

Course Title: Material Handling System, Safety and Occupational Health

Pre-requisite: Student should have basic knowledge of Mathematics, gravity and some material handling processes used in industries.

Rationale: The students studying cement technology should possess Material handling properties about material handling system employed in plants. This encompasses familiarity with the invention and evolution of cement. Additionally, students ought to acquire fundamental insights into various raw material types, their applications, as well as the Indian regulatory authorities responsible for supervising movement of cement.

Course Outcomes:

PCC-CT309.1: Students will be able to understand the basic concepts of material handling equipment.

PCC-CT309.2: Select appropriate material handling system such as unit load concepts.

PCC-CT309.3: Explain and distinguish the various types of estimation illustrate the various specifications of material handling used in handling of raw materials or finished products.

PCC-CT309.4: Evaluate the various engineering works and their safety used in cement plants like safety equipments and safety management

PCC-CT309.5: Estimate the quantities of works and evaluate the occupational health and safety from industrial accidents.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT309	Material Handling System, Safety and Occupational Health	4	0	1	1	6	4

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL**:** Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PCC	PCC-CT309	Material Handling System, Safety and Occupational Health	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

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PCC-CT309.1: Students will be able to understand the basic concepts of material handling equipment.

Approximate Hours

Item	Appx. Hrs
CI	16
LI	0
SW	3
SL	2
Total	21

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Understand material handling system. **SO1.2** Objective and benefits of material handling. **SO1.3** Understanding of material handling principles. **SO1.4** To understand the components of material handling. **SO1.5** Space utilization, Gravity principles. .	.	**Unit-1: Introduction to material handling** **1.1** Objective and benefit of better handling. **1.2** Limitation of handling. **1.3** Importance of handling of materials. **1.4** Objective of plant layout. **1.5** Objective of material handling. **1.6** The material flow cycle. **1.7** Material handling equation. **1.8** Principle of material handling. **1.9** Material handling Systems. **1.10** Material flow. **1.11** Simplification, Gravity. **1.12** Space utilization. **1.13** Safety and mechanization equipment selection. **1.14** Flexibility, Dead weight. **1.15** Motion, idle time, maintenance. **1.16** Control capacity and performance.	**1.** Material handling activities and their functions. **2.** Material handling equations.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Material handling system, Benefits of Material handling.
2. The Material handling equation.

b. Mini Project:

Chart prepared for Material flow cycle.

c. Other Activities (Specify):

Note on steps analyzing Material handling problems.

PCC-CT309.2: Select appropriate material handling system such as unit load concepts.

Approximate Hours

Item	Appx. Hrs
CI	09
LI	0
SW	3
SL	2
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 To Understand the Unit load concept, Advantages and disadvantages of unit load. **SO2.2** To learn about Basic ways to move a unit load. **SO2.3** To understand the Material handling equipment's. **SO2.4** To understand the types of motion in which the various equipment's moved.	.	**Unit-2 Material handling equipment's**. **2.1** Basic handling equipment's types & systems. **2.2** Equipment's classification. **2.3** The unit load concept. **2.4** Types of unit loads. **2.5** Advantages and disadvantages of unit loads. **2.6** Unit load efficiency. **2.7** Selected material handling equipment; Conveyors, Cranes. Elevators, Hoists, Monorails. **2.8** Industrial Vehicles Container and supports. **2.9** Auxiliary Equipment's.	1) Advantages of unit load. 2) Study on Relationships between unit load and other factors.

SW-2 Suggested Sessional Work (SW):

a. Assignments:
1. Unit load concepts, Advantages and disadvantages of unit load.
2. Material handling equipment's, and their classification.

b. Mini Project:
Prepare a chart on unit load efficiency.

c. Other Activities (Specify):
Visit to a plant and see what equipment's are used for the movement of raw materials or finished products.

PCC-CT309.3: Explain and distinguish the various types of estimation illustrate the various specifications of material handling used in handling of raw materials or finished products.

Approximate Hours

Item	Appx. Hrs
CI	16
LI	0
SW	2
SL	2
Total	20

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Classroom Instruction (CI)**	**Self-Learning (SL)**
SO3.1 Introduction to linear programming and dynamic programming. **SO3.2** Methods Transportation problems. **SO3.3** Methods of estimation of various cost used in plant. **SO3.4** Estimation of assignment cost.	.	**Unit-3**: **Materials Handling Problems.** **3.1** Basic Analytical Techniques of Material Handling problems. **3.2** Quantitative technique for material handling analysis: **3.3** Linear programming. **3.4** Problem on Linear programming. **3.5** Transportation programming. **3.6** Numerical on Transportation programming. **3.7** Transshipment Programming,	1) Application of linear programming and dynamic programming. 2) Cost of production and production unit.

SO3.5 Queuing theory and their model.		**3.8** Dynamic Programming. **3.9** Queuing Theory **3.10** Conveyor analysis. **3.11** Shutdown maintenance, and machineries' **3.12** Material Handling at Work place. **3.13** Equipment Cost Determination. **3.14** Evaluation of Direct and Indirect cost. Evaluation of intermediate Cost factor. **3.15** Evaluation of intangible factors, Evaluation of investment alternatives. **3.16** Determination of Total Handling cost of material handling.	

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**
   1. Solving problems on linear programming.
   2. Problems on Transportation and assignment.
b. **Mini Project:**
   Make a table of different Methods used in transportation problems.

PCC-CT309.4: Evaluate the various engineering works and their safety used in cement plants like safety equipment's and safety management.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	2
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Introduction to Hazards in the workplace. **SO4.2** Prevention of hazards. **SO4.3** Various cleaning and safety processes used for the equipment's such as Preheater. **SO4.4** Uses of PPE (Personal protective equipment's). **SO4.5** Audit plan and audit observation.	.	**Unit-4 Safety in cement plant.** **4.1** Overview of Hazards **4.2** Hazard identification and control confined space. **4.3** Working at height **4.4** Hot working, mobile equipment **4.5** Electrical safety. **4.6** Preheater cleaning. **4.7** Refractory lining, welding. **4.8** grinding, industrial fires, contractors and visitors' safety near misses. **4.9** Safety Equipment PPE's process interlocks. common occupation health issues in cement plant and their mitigation. **4.10** Laminar And Turbulent Flow Explanation. **4.11** Safety Management: Safety manager /Safety committee, Safety Policy Safety planning, Safety awareness, Total management Commitment, Safety audits.	i. Hazard identification and their Prevention. ii. Plant safety and safety manager responsibility.

SW-4 Suggested Sessional Work (SW):

a. Assignments:

1. Explanation about different types of Hazards.
2. Describe briefly safety methods used in cement plants.

b. Mini Project:

Visit to a cement plant and writing a report on safety equipment's used in plant.

PCC-CT309.5: Estimate the quantities of works and evaluate the occupational health and safety from industrial accidents.

Approximate Hours

Item	Appx. Hrs
CI	08
LI	0
SW	3
SL	2
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO5.1 Introduction to occupational safety. **SO5.2** Over view of Auditing Methodology. **SO5.3** Role of the Auditors and audit team. **SO5.4** Prevention of industrial accidents.		**Unit 5: Occupational Health & Safety** **5.1** Importance of Safety Performance & its monitoring. **5.2** Importance of Safety Performance & its monitoring, **5.3** Classification of Industrial Accidents **5.4** Plant Safety Inspection. **5.5** Plant safety Procedures. **5.6** Accident Investigation System. **5.7** Concept of root cause analysis **5.8** Method for computation of Frequency and Severity rates for Industrial injuries/ accidents as per IS 3786: 1983.	1. Audit goals and Audit responsibility. 2. Auditing Methodology.

SW-5 Suggested Sessional Work (SW):

a. Assignments:

1. List the Code of practices of Occupational safety.
2. Auditor's Activities in cement plant.

b. Mini Project:
Visit a plant and making a report on audit used in plant.

c. Other Activities (Specify):
Making a Power point presentation for occupational Safety and health audit report

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CI)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (CI+SW+Sl)
PCC-CT309.1: Students will be able to understand the basic concepts of material handling equipment	16	3	2	21
PCC-CT309.2: Select appropriate material handling system such as unit load concepts.	9	3	2	14
PCC-CT309.3: Explain and distinguish the various types of estimation illustrate the various specifications of material handling used in handling of raw materials or finished products.	16	2	2	20
PCC-CT309.4: Evaluate the various engineering works and their safety used in cement plants like safety equipment's and safety management.	11	2	2	15
PCC-CT309.5: Estimate the quantities of works and evaluate the occupational health and safety from industrial accidents.	8	3	2	13
Total Hours	60	13	10	83

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction to material handling.	05	03	02	10
CO-2	Material handling equipment's.	06	02	02	10
CO-3	Materials Handling Problems.	07	02	01	10

CO-4	Safety in cement plant.	04	02	04	10
CO-5	Occupational Health & Safety.	03	02	05	10
Total		25	11	14	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Material Handling System, Safety and Occupational Health will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	Chemistry Of Cement And Concrete	F M Le	Chemical Publishing Co Inc, US	Revised edition 21 edition 2020
2	Cement Data Book:	W. H Duda		1999
3	Norms For Limestone Exploration For Cement Manufacture	National Council for Cement and Building Materials	National Council for Cement and Building Materials	1985

4	Cement Production Principle and Practice	A K Chatterjee		2018
5	Holcim Training Manual			
6	FLS Training Manual			
7	Lecture note provided by Dept. of Cement Technology, AKS University, Satna .			

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6. Er Priyanka Singh, Assistant Professor, Dept. of Cement Technology
7. Er A K Bhattacharya, Faculty, Dept. of Cement Tech. (Former GM M/s Dalmia Cement)
8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** PCC-CT309

Course Title: Material Handling System, Safety and Occupational Health

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Students will be able to understand the basic concepts of material handling equipment	2	3	2	2	3	2	1	1	2	1	3	2	2	2	2	3
CO-2: Select appropriate material handling system such as unit load concepts.	3	2	3	2	1	2	1	1	1	1	2	2	2	2	1	2

CO-3: Explain and distinguish the various types of estimation illustrate the various specifications of material handling used in handling of raw materials or finished products.	**3**	**3**	**2**	**1**	**1**	**2**	**2**	**3**	**1**	**1**	**1**	**3**	**1**	**3**	**2**	**3**
CO-4: Evaluate the various engineering works and their safety used in cement plants like safety equipment's and safety management.	**3**	**2**	**2**	**3**	**3**	**2**	**1**	**3**	**2**	**1**	**2**	**2**	**3**	**3**	**2**	**1**
CO-5: Estimate the quantities of works and evaluate the occupational health and safety from industrial accidents.	**2**	**2**	**3**	**1**	**2**	**3**	**2**	**3**	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Students will be able to understand the basic concepts of material handling equipment	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1**: **Introduction to material handling.** 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8, 1.9, 1.10, 1.11, 1.12, 1.13, 1.14,1.15,1.16	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Select appropriate material handling system such as unit load concepts.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: Material handling equipment's.** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Explain and distinguish the various types of estimation illustrate the various specifications of material handling used in handling of raw materials or finished products.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Materials Handling Problems.** 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11, 3.12, 3.13,3.14, 3.15,3.16	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Evaluate the various engineering works and their safety used in cement plants like safety equipment's and safety management.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Safety in cement plant.** 4.1, 4.2, 4.3, 4.4, 4.5, 4.6, 4.7, 4.8, 4.9, 4.10, 4.11	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Estimate the quantities of works and evaluate the occupational health and safety from industrial accidents.	SO5.1 SO5.2 SO5.3 SO5.4		**Unit-5: Occupational Health & Safety.** 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8	

Semester-VI

Course Code: **PCC-CT310-L**

Course Title : **Cement Technology lab -II (Testing Cement & Concrete)**

Pre-requisite: Student should have basic knowledge of civil construction and Chemistry.

Rationale: The durable construction practices require comprehending the physical and mechanical properties of concrete as well as its components like cement, aggregates and water. This course covers the physico-mechanical of concrete and mechanical-chemical properties of cement, fine and coarse aggregates.

Course Outcomes:

PCC-CT310-L.1: Able to analyze, determine and interpret the physical and chemical characteristics of Cement and Concrete

PCC-CT310-L.2: Able to analyze the chemical characteristics of Cement.

PCC-CT310-L.3: Able to determine mechanical properties of Concrete and its components.

Scheme of Studies:

Code	Course Code	Course Title	Scheme of studies (Hours per Week)					Total Credits(C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PCC	PCC-CT310-L	Cement Technology lab -II (Testing Cement & Concrete Lab)	0	2	1	1	4	1

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop,field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning, **C:** Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback ofteacher to ensure outcome of Learning.

Scheme of Assessment:

Laboratory

Course category	Course Code	Course Title	Scheme of Assessment (Marks)			
			Progressive Assessment (PRA)			Total Marks
			Lab Work Assignment (Best of 5 of the total) (LA)	Viva-Voice on Lab Work (VV)	Lab Attendance (LA)	
PCC	PCC-CT310-L	Cement Technology lab -II (Testing Cement & Concrete Lab)	35	10	5	50

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Lab Work Assignment (LA) Best of 5 of the total, Viva-Voice on Lab Work (VV), and Lab Attendance (LA). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PCC-CT310-L.1: Able to analyze, determine and interpret the physical and mechanical characteristics of Cement.

Approximate Hours

Item	Appx. Hrs
CL	0
LI	14
SW	7
SL	3
Total	24

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Able to determine the Density & Surface Area of Cement **SO1.2** Able to determine the Standard Consistency of Cement **SO1.3** Able to determine the Initial and Final Setting Time of Cement **SO1.4** Able to determine the Soundness and Dry Shrinkage of Cement **SO1.5** Able to determine the Compressive Strength of Cement	**Unit1: Physico-mechanical Analysis of Cement** **1.1** Determination of Density of Cement **1.2** Determination of Specific Surface Area of Cement **1.3** Determination of Standard Consistency of Cement **1.4** Determination of Initial and Final Setting Time of Cement **1.5** Determination of Soundness of Cement byLe-Chatelier Method **1.6** Determination of Soundness of Cement byAutoclave Method and Dry Shrinkage Test **1.7** Determination of Compressive Strength of Cement		1. Physical and Chemical Properties of other raw Materials of Cement

SW-1 Suggested Sessional Work (SW):

a. Assignments:

Make Lab Assignment.

b. Mini Project:

Prepare flow-chart and model laboratory procedures.

PCC-CT310-L.2: Able to analyze the chemical characteristics of Cement.

Approximate Hours

Item	Appx. Hrs
CL	0
LI	6
SW	3
SL	2
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1: To determine the Loss on Ignition(LOI)of Cement **SO2.2:** To determine the Major Oxides of Cement **SO2.3:** To determine the Insoluble residue of Cement	**Unit 2: Chemical Analysis of Cement** **2.1** Determination of LOI of Cement **2.2** Determination of CaO, SiO_2, Al_2O_3, Fe_2O_3, MgO of Cement **2.3** Determination of insoluble residue and SO_3 of cement		1. Physical and Chemical Properties of other raw Materials of Cement

SW-1 Suggested Sessional Work (SW):

a. **Assignments:** Make Lab Assignment.
b. **Mini Project:** Prepare flow-chart and model laboratory procedures.

PCC-CT310-L.3: Able to determine mechanical properties of Concrete and its components.

Approximate Hours

Item	Appx. Hrs
CL	0
LI	10
SW	5
SL	2
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1: Able to determine the Sieve Analysis Test for Fine & Coarse Aggregates **SO3.2:** Able to conduct the Impact Value Test for Coarse Aggregates **SO3.3:** Able to determine theFlakiness and Elongation for Coarse Aggregates **SO1.4:** Able to conduct the	**Unit 3: Concrete Testing** 3.1 Sieve Analysis Test for Fine & Coarse Aggregates 3.2 Aggregate Impact Value for Coarse Aggregates 3.3 Flakiness and Elongation for Coarse Aggregates 3.4 Slump & Flow Table Test for Fresh Concrete		1. Physical and Chemical Properties of other raw Materials of Cement

Slump & Flow Table Test for Fresh Concrete **SO1.5:** Able to determine the Compressive Strength of Concrete	3.5 Compressive Strength of M20 & M30 Concrete		

SW-1 Suggested Sessional Work(SW):

a. Assignments:

Make Lab Assignment.

b. Mini Project:

Prepare flow-chart and model laboratory procedures.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Lab Instruction (LI)	Sessional Work (SW)	Self Learning (SL)	Total hour (LI+SW+SL)
PCC-CT310-L.1: Able to analyze, determine and interpret the physical and mechanical characteristics of Cement.	14	07	03	24
PCC-CT310-L.2: Able to analyze the chemical characteristics of Cement.	06	03	02	11
PCC-CT310-L.3: Able to determine mechanical properties of Concrete and its components.	10	05	02	17
Total Hours	30	15	07	52

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	**Unit Titles**	**Marks Distribution**			**Total Marks**
		R	**U**	**A**	
CO-1	Unit1: Physico-mechanical Analysis of Cement	04	04	06	14
CO-2	Unit 2: Chemical Analysis of Cement	04	08	06	18
CO-3	Unit 3: Concrete Testing	04	08	06	18
Total		12	20	18	50

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for Geology and Mining of Limestone will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/ Tutorials CBT, Blog, Facebook,Twitter,Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition &Year
1	Ordinary Portland Cement	IS 269-2015	6th Edition BIS	2015
2	Concrete Technology Lab Manual	Dr. Bharadwaj Nanda and Prof. A.N. Nayak	Concrete Technology Lab Manual	
3	Concrete Technology Lab Manual	Nanditha Mandava,	MLRITM	2022
4	Methods of physical tests for hydraulic cement	IS 4031-1	BIS	1996
5	Method of chemical analysis of hydraulic cement	IS 4032	BIS	1985

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Curriculum of B. Tech. (Cement Technology) Program

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech. **Course Code: PCC-CT310-L**

Course Title: Cement Technology lab –II(Testing of Cement & Concrete Lab)

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PCC-CT310-L.1: Able to analyze, determine and interpret the physical and mechanical characteristics of Cement.	3	3	3	3	3	3	3	2	2	1	2	3	3	3	3	3
PCC-CT310-L.2: Able to analyze the chemical characteristics of Cement.	3	3	3	3	3	3	3	2	2	1	2	3	3	3	3	3
PCC-CT310-L.3: Able to determine mechanical properties of Concrete and its components.	3	3	3	3	3	3	3	2	3	1	2	3	3	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Cement Technology lab –II(Testing of Cement & Concrete Lab)

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning(SL)
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO 1,2, 3, 4	**CT 20.1:** Able to analyze, determine and interpret the physical and mechanical characteristics of Cement.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	**Unit 1: Physico-mechanical Analysis of Cement** 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7		As mentioned in above pages
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO 1,2, 3, 4	**CT 20.2:** Able to analyze the chemical characteristics of Cement.	SO2.1 SO2.2 SO2.3	**Unit 2: Chemical Analysis of Cement** 2.1, 2.2, 2.3		
PO:1,2,3,4,5,6,7,8,9,10,11,12 PSO 1,2, 3, 4	**CT 20.3:** Able to determine mechanical properties of Concrete and its components.	SO3.1 SO3.2 SO3.3	**Unit 3: Concrete Testing** 3.1, 3.2, 3.3, 3.4,3.5		

Semester-VI

Course Code: **HSMC-304**

Course Title : **Project Management**

Pre- requisite: Student should have basic knowledge of Geometry, Geometrical Shapes, basic knowledge of Computer, Mouse and keyboard use, navigating menus and dialogs, managing files and directories, etc.

Rationale: The rationale of measurement and metrology lies in ensuring precision, accuracy, and reliability across various fields. It is crucial for quality control, scientific research, safety, innovation, and international standards. Measurement and metrology contribute to efficiency, standardization, and progress in technology and society.

Course Outcomes:

HSMC-304.1: Students will demonstrate an understanding of fundamental project management principles, including project lifecycle, stakeholders, constraints, and success criteria.

HSMC-304.2: Students will be able to apply various project management methodologies.

HSMC-304.3: Students will develop comprehensive project plans that include scope definition, scheduling, resource allocation, budgeting, risk management, and communication strategies.

HSMC-304.4: Students will gain hands-on experience with project management tools and software.

HSMC-304.5: Students will assess project performance using key performance indicators (KPIs), metrics, and benchmarks, and make data-driven decisions to optimize project outcomes.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
HSMC	HSMC-304	Project Management	3	0	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
HSMC	HSMC-304	Project Management	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

HSMC-304.1: Student gain a comprehensive understanding of project management.

Approximate Hours

Item	Appx. Hrs
CI	12
LI	0
SW	2

SL	2
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Define basic project management terms and concepts. **SO1.2** Explain the purpose and importance of project management. **SO1.3** Apply project management principles to analyze and solve basic project scenarios. **SO1.4** Develop a project plan for a hypothetical project, integrating elements such as scope, schedule, budget, and risk management.		**Unit–1: Introduction to Project Management** **1.1** Introduction **1.2** Concept of Project **1.3** Meaning **1.4** Characteristics **1.5** Classification of Projects **1.6** Project Life Cycle and Phases **1.7** Project Selection criteria **1.8** Project Management **1.9** Line Management **1.10** Project Manager **1.11** Roles and Responsibilities **1.12** Project Management as a Profession	**1.** What are the Basic element of measurement system **2.** What are the different technique used for the measurement of displacement

HSMC-304.2: Student understood the fundamentals of Project Execution and Monitoring.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	3
SL	2
Total	16

Session Outcomes (SO3)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Recall the key activities involved in project execution and monitoring. **SO2.2**		**Unit –2: Project Execution and Monitoring** **2.1** Generating and Screening Ideas **2.2** Steps, Monitoring the	**1.** Explain types of monitoring. **2.** Explain the objective of communication.

Explain the purpose and importance of project execution and monitoring in achieving project objectives. **SO2.3** Apply project management methodologies to execute project tasks effectively. **SO2.4** Design a project communication plan to keep stakeholders informed about project progress and changes.		Environment **2.3** Scouting for Project Ideas **2.4** Preliminarily Screening, Project Rating Index. **2.5** Feasibility Studies **2.6** Technical, Financial Managerial **2.7** Economic Managerial **2.8** Social, Legal and Managerial. **2.9** Team formation and roles **2.10** Communication and leadership in project management **2.11** Resource allocation and management	.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

1. Explain the Project Rating Index.
2. Explain the function of Financial Managerial.
3. Write the principle of leadership in project management

HSMC-304.3: Learn techniques and methodologies in Financial Estimates and Projections.

Approximate Hours

Item	Appx. Hrs
CI	09
LI	0
SW	02
SL	03
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Recall the basic financial terms and concepts related to estimates and projections. **SO3.2** Explain the purpose and importance of financial estimates and projections in project planning and decision-making. **SO3.3** Evaluate the financial viability of a project based on projected costs, revenues, and expected returns. **SO3.4** Develop a comprehensive financial plan for a project, including cost estimates, revenue projections, and cash flow forecasts.		**Unit–3: Financial Estimates and Projections** **3.1** Project cost estimation & working capital requirements, **3.2** Sources of funds **3.3** Equity, debentures, term loans & their Cost of Capital. **3.4** Projected Cash Flow Statement & fund flow statement, **3.5** Projected Income statement and Balance sheet **3.6** Capital budgeting decisions **3.7** Payback Period, Accounting Rate of Return **3.8** NPV, Internal Rate of Return and BCR Method **3.9** project financing	**1.** Write the short note on term loans. **2.** Write the steps to make balance sheet

SW-3 Suggested Sessional Work (SW):

a. Assignments:

1. What are the sources of funds?
2. Explain the Capital budgeting decisions.

HSMC-304.4: Understood the different Project Appraisal and Risk Management techniques.

Approximate Hours

Item	Appx. Hrs
CI	06
LI	0
SW	02
SL	02
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Memorize the types of risks commonly encountered in project management. **SO4.2** Explain the purpose and importance of project appraisal in evaluating project feasibility and investment decisions. **SO4.3** Utilize risk management tools and techniques, such as risk assessment matrices and probability impact grids, to identify, assess, and prioritize project risks.		**Unit-4: Project Appraisal and Risk Management techniques** **4.1** Project Appraisal Techniques **4.2** Objectives **4.3** Types and Method **4.4** Environmental appraisal, **4.5** Market appraisal **4.6** market survey for forecasting future demand and sales	1. Explain the Risk management Market appraisal

SW-4 Suggested Sessional Work (SW):

a. **Assignments:**
   1. Explain the future demand and sales.
   2. Write short note on risk management tools and techniques.

HSMC-304.5: Student get the knowledge about agile techniques in Project Management.

Approximate Hours

Item	Appx. Hrs
CI	07
LI	0
SW	02
SL	02
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO 5.1 Explain the Agile approach to project management and its differences from traditional waterfall methodologies. **SO 5.2** Evaluate Agile project metrics and performance indicators to assess project progress and identify areas for improvement. **SO 5.3** Develop an Agile project plan that includes iteration planning, sprint goals, and release planning.		**Unit 5: Agile techniques in Project Management** **5.1** Introduction to Agile **5.2** principles, **5.3** Scrum, Kanban **5.4** Other Agile methodologies, **5.5** Agile project management tools **5.6** Traditional project management **5.7** Agile vs. Traditional project management	**1.** What do you mean by project planning. **2.** Write the short note on agile projects**.**

SW-5 Suggested Sessional Work (SW):

a. Assignments:

1. Explain Agile project metrics and performance indicators.
2. Explain the Traditional project management

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
HSMC-304.1: Student gain a comprehensive understanding of project management.	12	0	02	02	16
HSMC-304.2: Student understood the fundamentals of Project Execution and Monitoring.	11	0	03	02	16
HSMC-304.3: Learn techniques and methodologies in Financial Estimates and Projections.	09	0	02	03	14

HSMC-304.4: Understood the different Project Appraisal and Risk Management techniques.	06	0	02	02	10
HSMC-304.5: Student get the knowledge about Agile techniques in Project Management.	07	0	02	02	11
Total Hours	45	0	11	11	67

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction to Project Management	03	01	01	05
CO-2	Project Execution and Monitoring	02	06	02	10
CO-3	Financial Estimates and Projections	03	07	05	15
CO-4	Project Appraisal and Risk Management techniques	-	10	05	15
CO-5	Agile techniques in Project Management	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Project Management will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition& Year
1	Project Management	Choudhary	Tata McGraw Hill	2017
2	Project Management: The Managerial Process	Clifford F Gray	Visions	2023
3	Project Management: Planning and Control Techniques	R. L. Srivastava	New Age International Publishers	2021
4	Training Manual			
5	Lecture note provided by Dept. of Mechanical Engineering, AKS University, Satna			

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Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech. **Course Code: HSMC-304** **Course Title: Project Management**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Student gain a comprehensive understanding of project management.	1	1	2	2	2	2	3	1	2	2	1	2	2	2	1	-
CO-2: Student understood the fundamentals of Project Execution and Monitoring.	1	2	2	2	1	2	2	1	1	1	2	3	2	2	2	1
CO-3: Learn techniques and methodologies in Financial Estimates and Projections.	2	2	1	1	2	2	2	1	1	2	1	2	2	1	2	2

CO-4: Understood the different Project Appraisal and Risk Management techniques.	**3**	**2**	**2**	**-**	**3**	**1**	**3**	**1**	**2**	**1**	**-**	**2**	**3**	**3**	**3**	**2**
CO-5: Student get the knowledge about Agile techniques in Project Management.	**1**	**2**	**2**	**-**	**1**	**1**	**3**	**1**	**1**	**1**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Project Management

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Student gain a comprehensive understanding of project management.	SO1.1 SO1.2 SO1.3 SO1.4		**Unit 1: Introduction to Project Management** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9, 1.10,1.11,1.12	As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Student understood the fundamentals of Project Execution and Monitoring.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: Project Execution and Monitoring** 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9,2.10,2.11	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Learn techniques and methodologies in Financial Estimates and Projections.	SO3.1 SO3.2 SO3.3 SO3.4		**Unit 3: Financial Estimates and Projections** 3.1,3.2,3.3,3.4,3.5,3.6,3.7, 3.8.3.9	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Understood the different Project Appraisal and Risk Management techniques.	SO4.1 SO4.2 SO4.3		**Unit 4: Project Appraisal and Risk Management techniques** 4.1,4.2,4.3,4.4,4.5,4.6	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Student get the knowledge about Agile techniques in Project Management.	SO5.1 SO5.2 SO5.3		**Unit 5: Agile techniques in Project Management** 5.1,5.2,5.3,5.4,5.5,5.6,5.7	

Semester-VI

Course Code: **HSMC-305**

Course Title : **Finance and Accounting**

Pre- requisite: The primary objective of studying accounting is to facilitate transparent and accurate financial reporting.

Rationale: Accounting provides a structured and standardized system for recording, summarizing, and analyzing financial transactions.. This transparency is crucial for stakeholders, including investors, creditors, and management, to make informed decisions. Accounting helps maintain the integrity and reliability of financial information, contributing to trust and accountability in business and financial management

Course Outcomes:

HSMC-305.1: Ability to understand and apply financial management principles in decision-making.
HSMC-305.2: Analyzing and determining optimal capital structures, assessing cost of capital.
HSMC-305.3: Proficiency in preparing financial statements and handling various aspects of company accounts.
HSMC-305.4: Competence in handling debenture-related transactions and accounting entries.
HSMC-305.5: Understanding and complying with accounting standards, including Ind AS, IFRS, and international reporting standards.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
HSMC	HSMC-305	Finance and Accounting	3	0	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
HSMC	HSMC-305	Finance and Accounting	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

HSMC-305.1: Ability to understand and apply financial management principles in decision-making.

Approximate Hours

Item	Appx. Hrs
CI	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Financial Management: Ability to apply financial management principles for effective fund utilization. **SO1.2** Risk-Return Analysis: Proficiency in evaluating risks and returns to enhance firm value. **SO1.3** Skill in balancing profit maximization and wealth maximization as organizational objectives. **SO1.4** Competence in applying discounted and non-discounted cash flow methods for investment decisions		**Unit–1: Nature and Scope of Financial Management** **1.1** Nature, Scope and Objectives of Financial Management **1.2** Risk-Return and Value of the Firm **1.3** Objectives of the firm **1.4** Profit Maximization vs. Wealth Maximization **1.5** Emerging roles of Finance Managers **1.6** Capital Budgeting: Compounding and Discounting techniques **1.7** Concepts of Annuity and Perpetuity **1.8** Capital Budgeting Process **1.9** Techniques of Capital Budgeting **1.10** Discounted and Non-Discounted **1.11** Cash Flow Methods **1.12** Capital Rationing **1.13** Risk Evaluation and Sensitivity Analysis.	1. Engage in online simulations or case studies to self-learn the risk evaluation and sensitivity analysis in financial decision-making.

SW-1 Suggested Sessional Work (SW):

a. Assignments:
Calculate the Net Present Value (NPV) and Internal Rate of Return (IRR) for a given capital budgeting project using discounted cash flow methods.

b. Mini project:
Develop a proposal for a capital budgeting project, including a brief description, estimated costs, and potential return.

c. Other Activities (Specify):

Compare and contrast Profit Maximization and Wealth Maximization as objectives of the firm. Discuss their implications on long-term sustainability.

HSMC-305.2: Analyzing and determining optimal capital structures, assessing cost of capital.

Approximate Hours

Item	Appx. Hrs
CI	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SO3)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 Capability in determining optimal capital structure and analyzing its impact on risk and shareholder returns. **SO2.2** Skill in exploring diverse sources for raising long-term finance. **SO2.3** Cost of Capital Analysis: Proficiency in calculating and understanding the Weighted Average Cost of Capital (WACC). **SO2.4** Competence in analyzing the effects of leverage on shareholders' returns.		**Unit –2: Capital Structure** **2.1** Introduction- Meaning and Significance **2.2** Optimal Capital Structure **2.3** Determinants of Capital Structure **2.4** Theories of Capital Structure **2.5** EBIT – EPS Analysis **2.6** EBITDA Analysis; Risk and Leverage **2.7** Effects of Leverage on Shareholders' Returns. **2.8** Sources of raising long-term finance **2.9** Cost of Capital: **2.10** Sources, Meaning of Cost of Capital **2.11** Factors Affecting Cost of Capital;	Create a presentation outlining the capital budgeting process, incorporating concepts of annuity and perpetuity, discounted and non-discounted cash flow methods .

SW-2 Suggested Sessional Work (SW):

a. Assignments:
Calculate the Weighted Average Cost of Capital (WACC) for a given company. Discuss the implications of the WACC in the context of the company's capital structure and investment decisions.

b. Mini project:
Assign a project where students assess the impact of the scope of supply on businesses in specific industries. This could involve considering how the definition affects pricing, tax liability, and compliance.

c. Other Activities (Specify):
Compare and contrast Profit Maximization and Wealth Maximization as objectives of the firm. Discuss their implications on long-term sustainability.

HSMC-305.3: Proficiency in preparing financial statements and handling various aspects of company accounts.

Approximate Hours

Item	Appx. Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Able to understand meaning and features of company. **SO3.2** Competence in handling share capital, bonus shares, rights shares, and related journal entries.		**Unit–3: Introduction to Company Account** **3.1** Introduction, Meaning of Company, **3.2** Salient Features of a Company, **3.3** Types of Companies, Books of Account, **3.4** Preparation of Financial Statements. **3.5** Introduction, Issue of Shares **3.6** Forfeiture of Shares **3.7** Reissue of Shares **3.8** Share Capital **3.9** Types of Shares.	1. Formulate a buyback strategy for a real or hypothetical company.

		3.10 Bonus share, Right share, Issue of Shares for Cash,	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

Investigate the company's share capital structure. Identify and explain the different types of shares issued by the company.

b. Mini project:

Research and report if the company has issued bonus shares or rights shares in recent years.

c. Other Activities (Specify):

Discuss the impact of these actions on the company's equity structure

HSMC-305.4: Competence in handling debenture-related transactions and accounting entries.

Approximate Hours

Item	Appx. Hrs
CI	5
LI	0
SW	2
SL	1
Total	8

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 Ability to identify and explain features and types of debentures, along with understanding the issuance process. **SO4.2** Able to differentiate between debentures and shares.		**Unit–4: Issue of Debentures** **4.1** Introduction, Meaning, Features of Debentures **4.2** Distinction between Debentures and Shares **4.3** Types of Debentures **4.4** Issue of Debentures **4.5** Accounting for interest payment on debentures.	1. How to gain skill on accurately accounting for interest payments on debentures?

SW-4 Suggested Sessional Work (SW):

a. Assignments:

Identify the types of debentures issued and elaborate on their terms and conditions. Explain how these terms align with the company's financial goals.

b. **Mini project**:
Analyze the impact of the debenture issuance on the company's financial statements.

c. **Other Activities (Specify):**
Choose a publicly traded company that has recently issued debentures. Obtain relevant financial reports and announcements.

HSMC-305.5: Understanding and complying with accounting standards, including Ind AS, IFRS, and international reporting standards.

Approximate Hours

Item	Appx. Hrs
CI	6
LI	0
SW	2
SL	1
Total	9

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO 5.1 Ability to comprehend the meaning and significance of corporate reporting **SO5.2** Proficiency in applying accounting standards, including Ind AS, IFRS, and understanding their applicability and scope. **SO5.3** Capability to ensure compliance with international accounting standards, including an overview of International Financial Reporting Standard **SO5.4**		**Unit 5: Corporate Reporting** **5.1** Meaning of Corporate Reporting; **5.2** Accounting Standards **5.3** Applicability of Accounting Standards **5.4** Scope and Compliance of Accounting Standards **5.5** Ind AS, IFRS **5.6** International Financial Reporting Standard Overview (National and International accounting Authorities)	Review case studies or examples of companies that effectively demonstrate compliance with accounting standards.

Skill in preparing comprehensive financial reports that adhere to the relevant accounting standards.			

SW-5 Suggested Sessional Work (SW):

a. Assignments:

Analyze how the company's corporate reporting practices impact various stakeholders, including investors, creditors, and employees

b. Mini project:

Examine the company's compliance with relevant accounting standards and regulatory requirements. Highlight any instances of non-compliance or areas of improvement.

c. Other Activities (Specify):

Prepare a presentation on corporate reporting.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Laboratory Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
HSMC-305.1: Ability to understand and apply financial management principles in decision-making.	13	0	02	01	16
HSMC-305.2: Analyzing and determining optimal capital structures, assessing cost of capital.	11	0	02	01	14
HSMC-305.3: Proficiency in preparing financial statements and handling various aspects of company accounts.	10	0	02	01	13
HSMC-305.4: Competence in handling debenture-related issues.	05	0	02	01	08
HSMC-305.5: Understanding and complying with accounting standards, including Ind AS, IFRS, and international reporting standards.	06	0	02	01	09
Total Hours	45	0	10	05	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Nature and Scope of Financial Management	01	01	03	05
CO-2	Capital Structure	01	01	03	05
CO-3	Introduction to Company Account	-	03	10	13
CO-4	Issue of Debentures	-	03	10	13
CO-5	Corporate Reporting	01	03	10	14
Total		03	11	36	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Finance and Accounting will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher
1.	Principles of Corporate Finance" by Richard A. Brealey.	Singhania Vinod K. and Monica Singhania	McGraw-Hill Education)
2.	"Fundamentals of Financial Management".	Eugene F. Brigham and Joel F. Housto	Cengage Learning)
3.	"Financial Management: Theory & Practice"	Eugene F. Brigham and Michael C. Ehrhardt	Cengage Learning)
4.	"Financial Management: Principles and Application.	Sheridan Titman, Arthur J. Keown, and John D. Martin.	Pearson
5.	Lecture note provided by Dept. of Commerce AKS University, Satna.		

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech. **Course Code:** HSMC-305 **Course Title:** Finance and Accounting

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Ability to understand and apply financial management principles in decision-making.	1	1	2	2	2	2	3	1	2	2	1	2	1	2	1	2
CO-2: Analyzing and determining optimal capital structures, assessing cost of capital.	1	2	2	2	1	2	2	1	1	1	2	3	2	2	2	1
CO-3: Proficiency in preparing financial statements and handling various aspects of company accounts.	2	2	1	1	2	2	2	1	1	2	1	2	2	1	2	2

CO-4: Competence in handling debenture-related issues.	**3**	**2**	**2**	**2**	**3**	**1**	**3**	**1**	**2**	**1**	**-**	**2**	**2**	**3**	**3**	**2**
CO-5: Understanding and complying with accounting standards, including Ind AS, IFRS, and international reporting standards.	**1**	**2**	**2**	**1**	**1**	**1**	**3**	**1**	**1**	**1**	**2**	**2**	**2**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Finance and Accounting

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Ability to understand and apply financial management principles in decision-making.	SO1.1 SO1.2 SO1.3 SO1.4		**Unit 1: Nature and Scope of Financial Management** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9, 1.10,1.11,1.12,1.13	As mentioned, in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Analyzing and determining optimal capital structures, assessing cost of capital.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: Capital Structure** 2.1,2.2,2.3,2.4,2.5,2.6,2.7, 2.8,2.9,2.10,2.11	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Proficiency in preparing financial statements and handling various aspects of company accounts.	SO3.1 SO3.2		**Unit 3: Introduction to Company Account** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Competence in handling debenture-related issues.	SO4.1 SO4.2		**Unit 4: Issue of Debentures** 4.1,4.2,4.3,4.4,4.5	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Understanding and complying with accounting standards, including Ind AS, IFRS, and international reporting standards.	SO5.1 SO5.2 SO5.3 SO5.4		**Unit 5: Corporate Reporting** 5.1,5.2,5.3,5.4,5.5,5,5.6	

Semester-VI

Course Code: **PROJ-CT01**

Course Title : **Engineering Project-1 (Literature Review)**

Pre-requisite: Students should have basic knowledge of English grammarandChemistry.

Rationale: A literature review might be a class assignment or the foundation research project for a graduate and engineer. A literature review synthesizes current knowledge about the topic of interest and regarding the research question for future attainment. Literature review should increase the skills, knowledgeand ability to learn and also to have the satisfaction of completing a successful project.

Course Outcomes:

PROJ-CT01.1: Able toIdentify the area of interest/research topic or subject for study and collect the relevant literature.

PROJ-CT01.2: Able to critique the Literature.

PROJ-CT01.3: Able to review the Literature and publication.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PROJ	PROJ- CT01	Engineering Project-1 (Literature Review)	1	2	1	1	5	2

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (HA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (TSN)	Class Activity any one (TCA)	Class Attendance (TA)	Total Mark (HA+CT+TSN+TCA+TA)		
PROJ	PROJ-CT-312	Engineering Project-1 (Literature Review)	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Lab Work Assignment (LA) Best of 5 of the total, Viva-Voice on Lab Work (VV), and Lab Attendance (LA). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PROJ-CT01.1: Able to Identify the area of interest/research topic or subject for study and collect the relevant literature.

Approximate Hours

Item	Appx. Hrs
CI	5
LI	10
SW	5
SL	2
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO1.1 Able toIdentify a Subject for Study **SO1.2** Able to plan of literature collection from various sources **SO1.3** Able to summarise the relavent statement of research topic	**Unit 1: Project Task** **1.1** Prepare a subjectSelection plan **1.2** Make a collection and abstracting the relavent literature (hard and soft) **1.3** Make a collection and abstracting the relavent literature (hard and soft) **1.4** Tune the Topicand find the gap of Reaserch **1.5** Tune the Topicand find the gap of Reaserch	**Unit 1: Identification the area of interest and collection of literature.** **1.1** Identify a Subject for Study **1.2** Link the Research Query to the Appropriate Discipline **1.3** Write the Preliminary Research Topic Statement **1.4** Conduct a Literature Search **1.5** Refine Your Topic	**1.** Basic structure of English grammer

SW-1 Suggested Sessional Work (SW):

a. Assignments:

1. Make statement note-book.
2. Make model paper of on Word MS-Office

b. Mini Project:

Use basic tools of Excel for preparation of tables of data records of literature collection

PROJ- 301.2: Able to critique the Literature

Approximate Hours

Item	Appx. Hrs
CI	5
LI	10
SW	5
SL	2
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO2.1 To understand the Literature critique **SO2.2** To understand the parts of an argument **SO2.3** To differentiate the descriptive and Implicated patterns of arguments **SO2.4** To Build the Advocacy Argument	**Unit 2: Literature Analysis Task** **2.1** Determining the Implicative Logic Pattern **2.2** Reframe Claims to Meet the Prerequisite Conditions **2.3** Reframe Claims to Meet the Prerequisite Conditions **2.4** Build the Advocacy Argument **2.5** Build the Advocacy Argument	**Unit 2: Appraisal to Literature** **2.1** What Is a Literature Critique? **2.2** Building the Case for a critique theLiterature and Basic Parts of an Argument **2.3** Descriptive Argument Patterns: Factual Reasoning **2.4** Implicative Argument Patterns: Implicative Reasoning **2.5** Critique of the Literature: Building the AdvocacyArgument	1. Basic MS-Office tools

SW-2 SuggestedSessionalWork(SW):

a. **Assignments:**
Use the excel for data management and graphical plotting
Make model paper of review atricle

b. **Mini Project:**
Use basic tools of PPT for Slidepresentation

PROJ- 301.3: Able to review the Literature & publication.

Approximate Hours

Item	Appx Hrs
CI	5
LI	10
SW	5
SL	2
Total	22

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
SO3.1 Able to quick & deep reading of literature. **SO3.2** Able to manage the literature review **SO3.3** Able to write & publish the reviewed literature	**Unit 3: Review & Publication** **3.1** Practice, How short can a literature review be? **3.2** Writing a literature review—structural concerns **3.3** Writing a literature review—structural concerns **3.4** Writing a literature review—structural concerns **3.5** Publication of reviewed artricle	**Unit 3: Deep reading and Literature review** **3.1** The Writing Process: Overview and Role of the Literature Review **3.2** Finding and selecting literature, Using what you have read **3.3** Iterative reading: from quick reviews toward deep reading **3.4** Managing the literature and Record keeping **3.5** Writing a literature review—structural concerns	1. Online search of research materials

SW-3 Suggested Sessional Work(SW):

a. Assignments:

1. First iteration: title and publication information
2. Second iteration: abstract
3. Third iteration: single sections

b. Mini Project:

Reading checklist/questionnaire

Brief of Hours suggested for the Course Outcome

Course Outcomes	Classroom Instruction (CI)	Lab Instruction (LI)	Sessional Work (SW)	Self Learning (Sl)	Total hour (LI+SW+Sl)
PROJ- 301.1: Able to Identify the area of interest/research topic or subject for study and collect the relevant literature.	5	10	05	02	22
PROJ- 301.2: Able to critique the Literature	5	10	05	02	22
PROJ- 301.3: Able to review the Literature & publication	5	10	05	02	22
Total Hours	15	30	15	06	66

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

CO	UnitTitles	MarksDistribution			Total Marks
		R	U	A	
CO-1	Identification the area of interest and collection of literature	02	04	04	10
CO-2	Appraisal to Literature	04	08	08	20
CO-3	Deep reading and Literature review	04	04	12	20
Total		12	19	14	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Engineering Project-1 (Literature Review) will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wiseteachers for above tasks. Teachers can also design different tasks as per requirement, for endsemesterassessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant

7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition &Year
1	The literature review : six steps to success	Lawrence A. Machi, Brenda T. McEvoy.	Corwin Press, Inc	2022
2	Literature Review and Research Design: A Guide to Effective ResearchPractice	Dave Harris	Routledge	2020
3	How to Write Your Literature Review	Bryan Greetham	Red Globe Press and Macmillan Education Limited	2021
4	So, You Have to Write a Literature Review: A Guided Workbook for Engineers	Catherine G.P. Berdanier & Joshua B. Lenart	IEEE PCS &John Wiley & Sons, Inc., Hoboken, New Jersey.	2021
5	Conducting Your Literature Review	Hempel, Susanne,	American Psychological Association	2020

Curriculum Development Team

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8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** PROJ-CT01 **Course Title:** Engineering Project-1 (Literature Review)

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Able to Identify the area of interest/research topic or subject for study and collect the relevant literature.	3	2	2	2	3	2	1	2	2	1	1	2	3	1	3	3
CO-2: Able to critique the Literature	3	2	2	2	3	2	1	2	1	1	1	2	2	1	3	2
CO-3: Able to review the Literature & publication	3	3	2	2	2	2	1	3	2	1	2	3	2	2	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Engineering Project-1 (Literature Review)

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Able to Identify the area of interest/research topic or subject for study and collect the relevant literature.	SO1.1 SO1.2 SO1.3	1.1, 1.2, 1.3	**Unit-1: Identification the area of interest and collection of literature** 1.1, 1.2, 1.3, 1.4, 1.5	As mentioned, in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Able to critique the Literature	SO2.1 SO2.2 SO2.3 SO2.4	2.1, 2.2, 2.3	**Unit-2: Appraisal to Literature** 2.1, 2.2, 2.3, 2.4, 2.5	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3**: Able to review the Literature & publication	SO3.1 SO3.2 SO3.3	3.1, 3.2, 3.3	**Unit-3: Deep reading and Literature review** 3.1, 3.2, 3.3, 3.4, 3.5	

Semester-VII

Course Code: **PEC-CT-01**

Course Title: **Energy Audit in Cement plant**

Pre- requisite: Student should have basic knowledge of energy management, mathematics, deep knowledge of equipment

Rationale: The course outcome for an engineering course on energy audit in a cement plant typically aims to equip students with the knowledge and skills necessary to conduct comprehensive energy audits in the context of cement manufacturing. Energy audits in industrial settings like cement plants are crucial for identifying opportunities for energy efficiency improvement and cost savings.

Course Outcomes:

PEC-CT-01.1: Aim to equip students with the knowledge and skills needed to effectively manage and audit energy

PEC-CT-01.2: How to account for and balance the flow of materials and energy in cement plant

PEC-CT-01.3: Focuses on understanding the characteristics of fuels, combustion processes, and their applications

PEC -CT-01.4: Develop a fundamental understanding of electrical systems

PEC-CT-01.5: Develop a fundamental understanding of cogeneration principles

Scheme of Studies:

Course Category	CourseCode	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
PEC	PEC - CT -01	Energy Audit In Cement Plant	3	0	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PEC	PEC-CT-01	Energy Audit In Cement Plant	15	20	5	5	5	50	50	100

Course-Curriculum Detailing: PEC -CT 01 Energy Audit in Cement plant

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PEC-CT-01.1: Aim to equip students with the knowledge and skills needed to effectively manage and audit energy

Approximate Hours

Item	Appx Hrs
CI	7
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 Understand why the energy management is important **SO1.2** Understand the detailing of energy audit **SO1.3** Understand the economic and environmental prospective **SO1.4** Energy optimization **SO1.5** Method involve in energy audit system	.	**Unit-1.0 Energy management & Audit** 1.1 Definition & Objectives of Energy Management 1.2 Energy Audit: Types and Methodology 1.3 Energy Audit Reporting Format 1.4 Understanding Energy Costs and Energy Performance 1.5 Matching Energy Usage to Requirement 1.6 Maximizing System Efficiency 1.7 Energy Audit Instruments	1. Familiarize yourself with energy audit guidelines and standards, such as ASHRAE Standard 211 2. Study various energy efficiency measures and technologies applicable to different types of facilities

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the type of audit methodology involve in the cement industry.
ii. Clearly state the purpose and scope of the energy audit assignment.

b. Mini Project:

Prepare the energy audit report for the real case study.

c. Other Activities (Specify):

Table the energy requirement for cement production in future

PEC-CT-01.2: How to account for and balance the flow of materials and energy in cement plant

Approximate Hours

Item	AppX Hrs
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To Understand the energy and material balance involve in the cement industry **SO2.2** To learn about Energy action planning **SO2.3** To understand the requirement of financial management **SO2.4** To understand the importance of project management **SO2.**5 To lean about the energy monitoring and their importance	.	**Unit-2 Material and energy balance:** 2.1 Basic Principles 2.2 The Sankey Diagram and its Use 2.3 Material Balances, Energy Balances 2.4 Method for Preparing Process: Energy Management System 2.5 Investment Nee Appraisal and Criteria 2.6 Financial Analysis 2.7 Sensitivity and Risk Analysis Financing Options 2.8 Steps in Project Management 2.9 Elements of Monitoring & Targeting System 2.10A Rationale for Monitoring, Targeting and Reporting	SL1. Apply the material and energy balance in the cement plant SL2. Learn about the financial analysis techniques

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Provide an overview of the importance of financial techniques in business and personal finance

ii. Explain the concept of time value of money.

b. **Mini Project:**
Discuss common techniques like Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period.

c. **Other Activities (Specify):**
Explain how to value assets, investments in the company.

PEC-CT-01.3: Focuses on understanding the characteristics of fuels, combustion processes, and their applications

Approximate Hours

Item	AppX Hrs
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Types of fuels involve in the cement industry. **SO3.2** Properties and use of fuels **SO3.3** Understand the combustion theory **SO3.4** Understand the types of boiler and energy conservation opportunity **SO3.5** Evaluation of insulation and refractory	.	**Unit-3 : Fuels and combustion:** 3.1 Introduction to fuels 3.2 Properties of liquid fuels , gaseous fuels 3.3 Combustion of coal, gas 3.4 Draft system, combustion controls 3.5 Boiler types and classifications 3.6 Performance evaluation of boilers 3.7 Energy conservation opportunities 3.8 Performance evaluation of a typical furnace 3.9 General fuel economy measures in furnaces 3.10 Calculation of insulation thickness, Simplified formula for heat loss calculation	SL1. Difference between the fossil fuel and alternative fuel SL2. Numerical practice on heat calculation

SW-3 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Explain the fuel properties and combustion theory

ii. Calculate the fuel economy Indian prospective.

b. Mini Project:

Make a tail considering the fuel economy and their impact on the furnace performance

c. Other Activities (Specify):

Power point presentation on types and classification of different furnace.

PEC -CT-01.4: Develop a fundamental understanding of electrical systems

Approximate Hours

Item	AppX Hrs
Cl	13
LI	0
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Understand the electricity bill and load **SO4.2** Understanding the process of electric motors **SO4.3** Understanding the energy efficiency in electrical utilities **SO4.4** Working principle of fans and blowers **SO4.5** Understand the energy efficient technologies in electrical systems	.	**Unit-4: Electrical system** 4.1 Electricity Billing 4.2 Electrical load management and maximum demand control 4.3 Power factor improvement and benefits 4.4 Transformers 4.5 System distribution losses 4.6 Motor Efficiency 4.7 Motor selection, energy efficient motor 4.8 Factors affecting energy efficiency and minimizing motor 4.9 Motor Load Survey: Methodology: Efficient operation of compressed air system 4.10 Compressor capacity assessment: Fan performance evaluation and efficient system operation 4.10 Maximum demand controllers, automatic power factor controllers 4.11 Energy Efficient Transformers, Electronic Ballasts 4.12 Energy Efficient Lighting Controls	**SL1** Study power systems, including topics like AC and DC power generation, transmission, and distribution. **SL2.** Explore software tools that are commonly used in load calculation

SW-4 **Suggested Sessional Work (SW):**

a. Assignments:

i. Explain the electrical load management and maximum demand control.
ii. Explore renewable energy sources like solar and wind power.
iii. Provide an overview of the importance of electrical systems in various applications, such as power distribution, electronics, and control system

b. Mini Project:

i. Visit to a cement a cement plant and writing a report on electrical system.

c. Other Activities (Specify):

Familiarize yourself with electrical codes and standards in your region

PEC-CT-01.5: Develop a fundamental understanding of cogeneration principles

Approximate Hours

Item	AppX Hrs
Cl	7
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Understand the cogeneration in the cement industry in detail **SO5.2** Detail about the resource optimization **SO5.3** Role of the regulatory bodies in Cement quality and production **SO5.4** Understand the Waste heat recovery **SO5.5** Energy Performance Assessment for Equipment and Utilities Systems		**Unit 5: Cogeneration** 5.1 Need for Cogeneration. 5.2 Principle & technical options for cogeneration 5.3 Classification of Cogeneration Systems 5.4 Typical Cogeneration performance parameter: Classification and Application 5.5 Benefits of Waste Heat Recovery: Commercial waste heat recovery devices 5.6 Waste minimisation and resource conservation 5.7 Turbines, Heat Exchangers Electric Motors and Variable Speed Drives, Fans and Blower	**SL1.** Examine real-world case studies of cogeneration projects. **SL2.** Role of BIS in national standard development.

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**
   Discuss how cogeneration can improve energy efficiency in cement plants
   Explore the environmental advantages of cogeneration

b. **Mini Project:**
   Describe operational challenges related to maintenance, safety, and system optimization

c. **Other Activities (Specify):**
   Attend industry conferences.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PEC-CT-01.1: Aim to equip students with the knowledge and skills needed to effectively manage and audit energy	7	2	1	10
PEC-CT-01.2: How to account for and balance the flow of materials and energy in cement plant	9	2	1	12
PEC-CT-01.3: Focuses on understanding the characteristics of fuels, combustion processes, and their applications	9	2	1	12
PEC-CT-01.4: Develop a fundamental understanding of electrical systems	13	2	1	16
PEC-CT-01.5: Develop a fundamental understanding of cogeneration principles	7	2	1	10
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	PEC -CT 01.1: Aim to equip students with the knowledge and skills needed to effectively manage and audit energy	03	01	01	05
CO-2	PEC -CT 01.2: How to account for and balance the flow of materials and energy in cement plant	02	06	02	10
CO-3	PEC -CT 01.3: Focuses on understanding the characteristics of fuels, combustion processes, and their applications	03	07	04	15
CO-4	PEC -CT 01.4: Develop a fundamental understanding of electrical systems	02	08	05	15
CO-5	PEC-CT 01.4.5: Develop a fundamental understanding of cogeneration principles	03	02	-	05
Total		14	24	12	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Energy Audit in Cement plant will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)

9. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Improving energy efficiency in industrial energy systems: An interdisciplinary perspective on barriers, energy audits, energy management, policies, and programs.	Thollander, P., & Palm, J.	Springer Science & Business Media.	Revised edition 21 edition2012.
2	Energy audits: a workbook for energy management in buildings.	Al-Shemmeri, T	John Wiley & Sons.	Revised edition edition2011.
3	Energy audit of building systems: an engineering approach.	Krarti, M.	CRC press	2020
4	Energy management: Conservation and audits.	Kumar, A., Prakash, O., Chauhan, P. S., & Gautam, S.	CRC Press	2020
5	Energy Management and Energy Audit: Bureau of Energy Efficiency, New Delhi, Govt of India Publication.			
6	FLS Training Manual			
7	Lecture note provided by Dept. of Cement Technology, AKS University, Satna.			

Curriculum Development Team

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs,POs and PSOs Mapping

Program Title: B. Tech. Cement Technology **Course Code:** PEC-CT-01 **Course Title:** ENERGY AUDIT IN CEMENT PLANT

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO1: Aim to equip students with the knowledge and skills needed to effectively manage and audit energy	3	3	2	2	3	3	2	2	3	2	1	2	2	3	2	2
CO2: How to account for and balance the flow of materials and energy in cement plant	2	2	2	2	3	2	2	3	3	2	1	2	3	2	1	2

CO3: Focuses on understanding the characteristics of fuels, combustion processes, and their applications	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**2**	**2**	**3**	**2**	**3**	**2**	**3**
CO 4: Develop a fundamental understanding of electrical systems	**2**	**3**	**3**	**2**	**3**	**2**	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**3**	**1**	**3**
CO 5: Develop a fundamental understanding of cogeneration principles	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**3**	**2**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Course Curriculum Map: Energy Audit in Cement Plant

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning(SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1:** Aim to equip students with the knowledge and skills needed to effectively manage and audit energy	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Scope of industrial economics and its history** 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned, in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2:** How to account for and balance the flow of materials and energy in cement plant	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2 Demand Analysis** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7,2.8,2.9	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3:** Focuses on understanding the characteristics of fuels, combustion processes, and their applications	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Diversification, vertical Integration and merger** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO 4:** Develop a fundamental understanding of electrical systems	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Determinants of Profitability** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9, 4.11,4.12,4.13	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO 5:** Develop a fundamental understanding of cogeneration principles	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Advertising strategy** 5.1,5.2,5.3,5.4,5.5,5.6,5.7	

AKS University

Faculty of Engineering and Technology

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Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Semester: VII

Course Code: **PEC-CT-02**

Course Title: **Transport Phenomena**

Pre-requisite: Student should have basic knowledge of fluid Flow Operation, Process Heat Transfer, Mass Transfer Operation and Vector Calculus

Rationale: Transport Phenomena is the subject which deals with the movement of different physical quantities such as momentum, energy and mass in any chemical or mechanical process and combines the basic principles (conservation laws) and laws of various types of transport

Course Outcomes:

PEC-CT-02.1: Setup overall balances for conservation of momentum, energy and mass.

PEC-CT-02.2: Recognize and apply analogies among momentum, heat and mass transfer.

PEC-CT-02.3: Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration.

PEC-CT-02.4: Utilize information obtained from solutions of the balance equations to obtain Engineering

PEC-CT-02.5: Reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
PEC	PEC-CT-02	Transport Phenomena	3	0	1	1	5	3

Legend: **CI:** Class room Instruction (Includes different instructional strategies. Lecture (L) and Tutorial (T) and others,

LI: Laboratory Instruction (Includes Practical performance sin laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, and mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning

Scheme of Assessment: Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PEC	PEC-CT-02	Transport Phenomena	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PEC-CT-02.1: Setup overall balances for conservation of momentum, energy and mass.

Approximate Hours

Item	Approx. Hrs.
CI	09
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1. Understanding Fundamental Concept **SO1.2** Mathematical Formulation **SO1.3**Analysis of transportation problem **SO1.4**Boundary Value Problem **SO1.5** Initial Value problem	.	**Unit-1.0:** Introduction to Transport Phenomenon: **1.1** Vectors/Tensors **1.2** Newton's law of viscosity **1.3** Temperature, pressure and composition dependence of viscosity **1.4** Kinetic theory of viscosity **1.5** Fourier's law of heat conduction **1.6** Dependence of thermal conductivity **1.7** Kinetic theory of thermal conductivity **1.8** Fick's law of diffusion **1.9** Temperature, pressure and composition dependence of diffusivity	**SL1.**Understand the Fundamentals **SL2.**Experimentation and Simulation **SL3.** Explore Application

SW-1 Suggested Sessional Work (SW):

a. Assignments:
Mention the key factor of Fick's law and Fourier's Law

b. Mini Project:
Design and Analysis of a Heat Exchanger

c. Other Activities (Specify):
To demonstrate and understand the concept of diffusion as a fundamental transport phenomenon.

PEC-CT-02.2: Recognize and apply analogies among momentum, heat and mass transfer.

Approximate Hours

Item	Appx. Hours
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Understanding of Momentum Conservation **SO2.2** Development of Conservation Equations **SO2.3** Application of Newton's Laws **SO2.4** Fluid Flow Characteristics **SO2.5** Dimensional Analysis	-	**Unit-2.0: Principles of Momentum Transport** **2.1** Temperature, pressure and composition dependence of diffusivity **2.2** Shell Momentum balances **2.3** Velocity profiles **2.4** Average velocity **2.5** Momentum flux at the surfaces **2.6** Equations of Change (Isothermal) **2.7** Equation of continuity **2.8** Equation of motion **2.9** Equation of energy (isothermal) **2.10** Kinetic theory of diffusivity.	**SL1.**Understand the fundamental concept such as diffusion, conduction, convection and fluid flow **SL2.**Develop the mathematical formulation **SL3.**Practice solving problem related to transport phenomena

SW-2 Suggested Sessional Work (SW):

a. **Assignments:**

i. Research and summarize the fundamental principles of transport phenomena, including diffusion, conduction, convection, and fluid flow

ii. Explore the historical development of transport phenomena theory

b. **Mini Project:**

Select a practical application that requires heat transfer, such as heating or cooling a fluid, recovering waste heat, or maintaining temperature in a process.

c. **Other Activities (Specify)**

A hands-on experience to understand the concept of diffusion, a fundamental transport phenomenon, through a simulation.

PEC-CT-02.3: Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration

Approximate Hours

Item	Approx. Hours
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO3.1 Understanding of Concepts **SO3.2** Ability to Apply Mathematical Formulations **SO3.3**Awareness of Real-World Applications **SO3.4**Understand the Equation of motion for forced and free convection **SO3.5** Critical Thinking and Analysis	-	**Unit-3.0 Principles of Steady State Heat Transport:** **3.1** Steady State Condition and Fourier's Law **3.2** Shell Energy Balance **3.3** Applications of Shell Energy Balance: Heat Conduction with Electrical Source **3.4** Heat Conduction with Chemical Heat Source **3.5** Temperature Distribution in Two Concentric Cylinder's **3.6** Natural Convention Heat Transfer Governing Equation **3.7** Flow over Flat Plate **3.8** Equation of motion for forced and free convection **3.9** Energy fluxes at surfaces	**SL1.** Understand the Equations of Change **SL2.**Identify the Appropriate Governing Equations **SL3.**Dimensional Analysis

SW-3 Suggested Sessional Work (SW)

a. Assignments:

i) Review of Fundamental Equations

ii) Formulate Governing Equations mass diffusion

b. Mini Project:

Determine flow regime in heat exchanger

c. Other Activities(Specify):

Show that the Hagen-Poiseuille formula is dimensionally consistent

PEC-CT-02.4: Utilize information obtained from solutions of the balance equations to obtain Engineering

Approx. Hours

Item	Approx Hours
CI	8
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO4.1 Understanding of Fundamental Concepts **SO4.2** Equilibrium and Non-Equilibrium Systems **SO4.3** Mass Transfer Operations **SO4.4** Knowledge of different transport mechanisms **SO4.5** Ability to develop mathematical models to describe mass transport phenomena	-	**Unit-4.0 Principles of Mass Transport:** **4.1** Equation of Molecular Mass Transport **4.2** Molecular Diffusion in Gases **4.3** Equimolar Counter Diffusion **4.4** Diffusion of A through Non-Diffusing B **4.5** Mass and Molar Transport by Convection: Mass and Molar Concentrations **4.6** Mass Average and Molar Average Velocity **4.7** Molecular Mass and Molar Fluxes **4.8** Convective Mass and Molar Fluxes	**SL1.**basic concepts of mass transport **SL2.**Solve problems from textbooks **SL3.**Learn about the Computational Fluid Dynamics (CFD) software such as ANSYS

SW-4 Suggested Sessional Work (SW)

a. Assignments:

i. What differences are there between the flow in a circular tube of radius R and the flow in the same tube with a thin wire placed along the axis?

ii. How is the vortices equation obtained and how may it be used.

b. Mini Project:

Develop mathematical models to describe mass transport phenomena in the filtration system.

c. Other Activities(Specify):

Explore ways to optimize the design and performance of the filtration system

PEC-CT-02.5: Reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass.

Approximate Hours

Item	Approx. Hours
CI	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning(SL)
SO5.1 Transport mechanisms molecular diffusion **SO5.2** Transport mechanisms turbulent diffusion **SO5.3** Mathematical models describing mass transport phenomena **SO5.4** Proficiency in using numerical and computational methods to solve mass transport problems **SO5.5** Understanding experimental techniques used to measure mass transport properties	-	**Unit-5.0 Introduction** to the concept of heat and mass transfer coefficients **5.1** Equation of Molecular Mass Transport **5.2** Molecular Diffusion in Gases **5.3** Equimolar Counter Diffusion **5.4** Diffusion of A Through Non-Diffusing B **5.5** Mass and Molar Transport by Convection **5.6** Mass Average and Molar Average **5.7** Velocity, Molecular Mass and Molar Fluxes **5.8** Convective Mass and Molar Fluxes **5.9** Flow over Flat plate	**SL1.**Learn about transfer coefficients **SL2.**Study the theoretical foundations behind heat and mass transfer coefficients **SL3**.Explore real-world applications of heat and mass transfer coefficients

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. How is the macroscopic mechanical energy balance related to the Bernoulli equation for in viscid fluids?

ii. Compare the behavior of Newtonian liquids and polymeric liquids in the various experiments.

b. Mini Project:
Flow through a sudden enlargement

c. Other Activities (Specify):
Velocity distribution in turbulent pipe flow

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
PEC-CT02.1: Setup overall balances for conservation of momentum, energy and mass	09	2	1	12
PEC-CT-02.2: Recognize and apply analogies among momentum, heat and mass transfer.	10	2	1	13
PEC-CT-02.3: Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration.	09	2	1	12
PEC-CT-02.4: Utilize information obtained from solutions of the balance equations to obtain Engineering	08	2	1	11
PEC-CT-02.5: Reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass.	09	2	1	12
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO		Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction to Transport Phenomenon	03	02	05	10
CO-2	Principles of Momentum Transport	03	02	05	10
CO-3	Principles of Steady State Heat Transport	03	02	05	10
CO-4	Principles of Mass Transport	03	02	05	10
CO-5	Introduction to the concept of heat and mass transfer coefficients	03	02	05	10
Total		15	10	25	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for “Carbon Credit in Cement manufacture” will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition Year
1	Transport Phenomena	R. Byron Bird	John Wiley & Sons (Asia) pvt. Ltd	2nd Edition, 2006
2	Transport Processes and Separation Process Principles	Christie John Geankoplis	4th Edition, PHI Learning Private Limited., New Delhi	4th Edition, 2012
3	Modelling in Transport Phenomena	Ismail Tosun	Elsevier Science	2002
4	Transport Phenomena A Unified Approach	Robert S. Brodkey, Harry C. Hershey	Brodkey Pub.	2003
5	Transport Phenomena An Introduction to Advanced Topics	Larry A. Glasgow	Wiley	2010
6	Transport Phenomena Fundamentals	Joel L. Plawsky	CRC Press	2014
7	NPTEL lecture on Transport Phenomena			
8	Lecture note provided by Dept. of Cement Technology, AKS University, Satna.			

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech. Cement Tech **Course Code: PEC-CT-02** **Course Title: Transport Phenomena**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Setup overall balances for conservation of momentum, energy and mass.	3	2	2	2	3	2	1	1	1	2	1	2	2	2	1	3
CO-2: Recognize and apply analogies among momentum, heat and mass transfer.	3	2	2	2	3	2	1	1	1	2	1	2	2	2	1	2
CO-3: Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration.	3	3	2	2	2	2	1	1	2	2	2	3	2	2	1	3

CO-4: Utilize information obtained from solutions of the balance equations to obtain Engineering	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**
CO-5: Reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass.	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**3**

AKS University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Course Curriculum Map: Transport Phenomena

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Setup overall balances for conservation of momentum, energy and mass.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Introduction to Transport Phenomenon 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Recognize and apply analogies among momentum, heat and mass transfer.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Principles of Momentum Transport2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Reduce and solve the appropriate equations of change to obtain desired profiles for velocity, temperature and concentration.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3: Principles of Steady State Heat Transport 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Utilize information obtained from solutions of the balance equations to obtain Engineering	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 : Principles of Mass Transport 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Reduce and solve appropriate macroscopic balances for conservation of momentum, energy and mass.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit 5: Introduction to the concept of heat and mass transfer coefficients 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

Semester-VII

Course Code: **PEC-CT-03**

Course Title : **Special Cements**

Pre- requisite: Student should have knowledge of types of cement produced in India and Hydration of the cement.

Rationale: Students will acquire insights into various concrete manufacturing process, the distinctive features of special cements, and their applications. The course covers the benefits of employing special cements in construction, delving into the hydration mechanism and strength development. Students will grasp the intricacies of concrete chemistry and the production processes behind special cements. Additionally, the curriculum explores the utilization of both natural and chemical materials to augment concrete properties.

Course Outcomes:

PEC-CT-03.1: Investigate the characteristics of different pozzolanic materials in the creation of special cements.

PEC-CT-03.2: Comprehend the chemical, mineralogical, and physical properties associated with various special cements.

PEC-CT-03.3: Analyze the application of cement in the production of concrete and mortar, assessing its performance.

PEC-CT-03.4: Develop an understanding of concrete chemistry and the production of long-lasting, durable concrete.

PEC-CT-03.5: Gain insight into the utilization of diverse admixtures for enhancing the properties of concrete.

Scheme of Studies:

Course Category	CourseCode	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
PEC	PEC-CT-03	Special Cements	3	0	2	1	6	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Couse of study	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (SA)	Class activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PEC	PEC- CT-03	Special Cements	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PEC-CT-03.1:
Investigate the characteristics of different pozzolanic materials in the creation of special cements.

Approximate Hours

Item	Appx Hrs
Cl	07
LI	0
SW	01
SL	01
Total	09

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1. Study of characteristic of Fly Ash and GGBF Slag **SO2:** Production and use of Blended and Composite cement. **SO3:** Alternate cementitious materials available and its use		**Unit-1. Characteristic of blended pozzolanic and alternate Cementous materials** 1.1 Characteristic of fly ash, 1.2 Granulated blast furnace slag, 1.3 other Pozzolanic materials 1.4 Production of blended cement 1.5 Production of composite cement 1.6 Geopolymeric cement, 1.7 Alternate Cementitious Materials other than OPC.	SL1. Manufacturing process of Granulated Slag SL2. Production of various waste materials of Coal based thermal power plant

SW-1 Suggested Sessional Work (SW):

a. **Assignments:** Properties of Fly Ash, waste produced by Coal based thermal power plant and its use, Manufacture and properties of GGBF Salg, Production of PPC and PSC, Production and advantages in use of Blended and composite cement, Alternate cementitious materials available for construction and its advantages

PEC-CT-03.2:
Comprehend the chemical, mineralogical, and physical properties of various special cements

Approximate Hours

Item	Appx Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1 Chemical and physical properties various special cement **SO2** Manufacturing process of various special cements **SO3.** Use of various special cements **SO4**: Advantages in use of various special cements	0	**Unit-2. Chemical, Mineralogical and physical Characteristic and use of some of special cement** 2.1 Portland Pozzolana Cement 2.2 Portland Slag Cement 2.3 Decorative Portland cement 2.4 Supersulphate Cement 2.5 Sulfo Aluminate Belite Cement 2.6 Belite Cement 2.7 Masonary cement 2.8 Oil Well Cement 2.9 Calcium Aluminate Cement 2.10 Low energy Cement	**SL1.** Clinker Chemistry and properties of Portland cement clinker

SW-2 Suggested Sessional Work (SW):

a. **Assignments:** Brief notes on manufacturing process of PPC, PSC and its advantages in use. Notes on belite cement and Salfo-Aluminate belite cement, notes on low energy cement, Notes on oil well cement.

PEC-CT-03.3:

Analyze the application of cement in the production of concrete and mortar, assessing its performance.

Approximate Hours

Item	Appx Hrs
Cl	08
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1: Properties of concrete and motors **SO2**: Effect of physical and chemical properties of cement and particle distribution on concrete performance **SO3.** Deterioration mechanisms of concrete. **SO4.** Manufacture of durable concrete		**Unit-3: Performance of cement and concrete :** 3.1 Introduction to concrete and mortars 3.2 Use of cement for various infrastructure development 3.3 Effect of chemical composition and physical characteristic of cement on performance, 3.4 Impact of setting time and strength of cement on concrete. 3.5 Deterioration mechanisms of concrete 3.6 Particle size distribution of cement and its impact on strength of cement 3.7 Tailoring performance of cements. 3.8 Durability of concrete constructions	**SL1.** Concrete Mix design **SL2.** Types of concrete

SW-3 Suggested Sessional Work (SW):

a. **Assignments:** Particle size distribution of cement and its impact on concrete strength, Physical properties of cement and strength development, Manufacture of durable concrete

PEC-CT-03.4:

Develop an understanding of concrete chemistry and the production of long-lasting, durable concrete.

Approximate Hours

Item	Appx Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO. 1. Hydration of cement and strength development in concrete **SO. 2.** Corrosion mechanising of reinforcement **SO. 3.** Attack of concrete by various aggressive agents **SO. 4** Performance of Blended cement in concrete	.	**Unit-4 Concrete Chemistry & Performance** 4.1 Hydration of Cement and properties of concrete 4.2 Carbonation of concrete 4.3 Chloride penetration of concrete 4.4 Corrosion of reinforcement, 4.5 Akali silica reaction in concrete 4.6 Sulphate attacks of concrete, 4.7 Attack of concrete by acid and other aggressive agencies. 4.8 Performance of Blended Cement, 4.9 advantages of Portland Pozzolana Cements (PPC) 4.10 Advantages of Portland Slag Cement (PSC) in construction	**SL1.** Chemistry of cement and concrete

SW-4 Suggested Sessional Work (SW):

a. **Assignments:** Chlorite attack of concrete, Alkali Silica reaction in concrete, Carbonation of concrete, Performance of PPC and PSC in concrete

PEC-CT-03.5:

Gain insight into the utilization of diverse admixtures for enhancing the properties of concrete

Approximate Hours

Item	Appx Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO.1 Properties of admixture to use in concrete. **SO2**. Functions of admixture in concrete **SO3.** Study various admixture on improvement of concrete properties **SO4** Manufacture of high strength concrete by use of admixture	0	**Unit-5 Use of Admixtures to improve the properties of cement in concrete** 5.1 Chemical Admixtures and mineral additives: 5.2 Function of admixtures, 5.3 Classification of admixtures, 5.4 Organic retarders and accelerator, 5.5 Air entertaining agents 5.6 water reducers 5.7 Superplasticizer and its use 5.8 Inorganic accelerators and retarders, 5.9 Effect of high and low temperature and pressure on concrete, 5.10 Performance enhancer like silica fumes, Meta Kaolin etc	**SL1.** Properties of durable concrete.

SW-5 Suggested Sessional Work (SW):
Assignments: Short note of cement Admixture, Performance improver of cement and concrete, Superplasticizer and its use in concrete, Properties of silica fumes and metakaolin in improvement of cement and concrete properties.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
PEC-CT-03.1: Investigate the characteristics of different pozzolanic materials in the creation of special cements.	07	1	1	09
PEC-CT-03.2: Comprehend the chemical, mineralogical, and physical properties associated with various special cements.	10	2	1	13
PEC-CT-03.3: Analyze the application of cement in the production of concrete and mortar, assessing its performance.	08	2	1	11

PEC-CT-03.4: Develop an understanding of concrete chemistry and the production of long-lasting, durable concrete.	10	2	1	13
PEC-CT-03.5: Gain insight into the utilization of diverse admixtures for enhancing the properties of concrete.	10	2	1	13
Total Hours	45	11	5	61

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Characteristic of blended pozzolanic and alternate Cementous materials	02	03	02	07
CO-2	Chemical, Mineralogical and physical Characteristic and use of some of special cement		08	02	10
CO-3	Performance of cement and concrete	01	06	04	11
CO-4	Concrete Chemistry & Performance	-	08	07	15
CO-5	Use of Admixtures to improve the properties of cement in concrete	-	03	004	07
Total		03	28	19	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks.

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture, Tutorial
2. Case Method
3. Group Discussion, Role Play
4. Visit to cement plant

5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
7. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Cement Chemistry	F W Taylor	2nd Edition	1997
2	Cement Data Book:	W. H Duda	2nd Edition	1999
3	Norms For Limestone Exploration For Cement Manufacture	National Council for Cement and Building Materials	National Council for Cement and Building Materials	1985
4	Cement Production Principle and Practice	A K Chatterjee	1st Edition CRC Press	2018
5	Design of Cement plant	S. P. Deolalkar	BS Publications	2021
6	Holcim Training Manual			
7	FLS Training Manual			

Curriculum Development Team

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8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

Cos, POs and PSOs Mapping

Program Title: B. Tech Cement Tech; Course Code: PEC-CT-03 Course Title: Special Cement

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PEC-CT-03.1: Investigate the characteristics of different pozzolanic materials in the creation of special cements.	3	3	2	2	3	2	1	1	2	1	1	2	2	2	2	3
PEC-CT-03.2: Comprehend the chemical, mineralogical, and physical properties associated with various special cements.	1	2	3	2	1	1	1	2	1	1	2	2	2	2	2	2
PEC-CT-03: Analyze the application of cement in the production of concrete and mortar, assessing its performance.	2	3	3	1	1	2	1	2	1	3	2	2	1	2	2	3

PEC-CT-03.4: Develop an understanding of concrete chemistry and the production of long-lasting, durable concrete.	**1**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**3**	**1**
PEC-CT-03.5: Gain insight into the utilization of diverse admixtures for enhancing the properties of concrete.	**2**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Course Curriculum Map: Special Cements

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Investigate the characteristics of different pozzolanic materials in the creation of special cements.	SO1.1 SO1.2 SO1.3		**Unit-1: Characteristic of blended pozzolanic and alternate Cementous materials** 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned, in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Comprehend the chemical, mineralogical, and physical properties associated with various special cements.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: Chemical, Mineralogical and physical Characteristic and use of some of special cement** 2.1, 2.2, 2.3, 2.4, 2.5,2.6,2.7,2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Analyze the application of cement in the production of concrete and mortar, assessing its performance.	SO3.1 SO3.2 SO3.3 SO3.4		**Unit-3: Performance of cement and concrete** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Develop an understanding of concrete chemistry and the production of long-lasting, durable concrete.	SO4.1 SO4.2 SO4.3 SO4.4		**Unit-4: Concrete Chemistry & Performance** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Gain insight into the utilization of diverse admixtures for enhancing the properties of concrete.	SO5.1 SO5.2 SO5.3 SO5.4		**Unit 5: Use of Admixtures to improve the properties of cement in concrete** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10	

Semester-VII

Course Code: **PEC-CT-04**

Course Title : **Design of Cement Plant**

Pre- requisite: Students ought to have a solid understanding of Limestone Mining, the extraction of Portland Cement Raw materials, the process of Raw meal Preparation, Pyro-processing, Portland clinker manufacture, as well as Cement Grinding and the packing of cement.

Rationale: Students will gain knowledge about the installed capacity and design capacity of cement plants, conduct Techno-economic feasibility studies for establishing a cement plant, design crushing and grinding units, and design coal grinding processes. They will also delve into the design features of the Pre-Heater, Pre-Calciner, and rotary kiln. Furthermore, students will learn about the layout design of a cement plant, encompassing grinding and packing of cement, as well as the handling and storage of coal, gypsum, and other additives. The curriculum will also cover the procurement procedures for cement machinery, along with basic knowledge about installation and commissioning.

Course Outcomes:

PEC-CT-04.1: To know the fundamental prerequisites for establishing a cement plant and identifying the machinery needed for the production of Portland cement.

PEC-CT-04.2: To study techno-economic studies related to establishing a cement plant and investigating the factors that dictate the size of the cement manufacturing factory

PEC-CT-04.3: Gaining insight into the civil design, electrical instrumentation, and layout of different sections within a cement plant.

PEC-CT-04.4: To comprehend the detailed engineering of the raw mill section, pyro-processing of clinker minerals, cement grinding, and packing, encompassing the layout of each respective section.

PEC-CT-04.5: To grasp the procurement process for plant machinery and create data sheets for inquiries, including the design aspect.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
PEC	PEC-CT-04	Design of Cement Plant	3	0	2	1	6	3

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Multiple Reactions	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PEC	PEC-CT-04	Design of Cement Plant	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PEC-CT-04.1: To know the fundamental prerequisites for establishing a cement plant and identifying the machinery needed for the production of Portland cement.

Approximate Hours

Item	Appx Hrs
CI	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1. Basic Parameter for design of a cement plant **SO2:** Process Flow Chart design **SO3**: Estimation of Running Hours of Various Section **SO4:** Selection of Kiln, PH, PC, Cooler & mills etc **SO5:** Selection of Fan, blower, Compressor, Motors & Gears		**Unit-1. To know about basic parameter for design and process flow chart of Cement plant.** 1.1 Basic Parameters for Design of a Cement Plant 1.2 Process Flow Chart and Estimation Plant Capacities 1.3 Estimation of Running Hour of Various Sections of Cement Plant 1.4 Quarrying Operations, Selection of Crushers 1.5 Stacker Reclaimer Systems of Cement Plant 1.6 Grinding Mills, Screens & separators 1.7 Blending System 1.8 Selection of Preheaters & Pre Calciner 1.9 Selection of Kilns and cooler 1.10 Selection of Fan, Blowers, Compressor 1.11 Selection of Motors and Gear Boxes of Cement Plant.	1. Physical and Chemical characteristic of Portland Cement Raw materials 2. Basic method of limestone mining

SW-1 Suggested Sessional Work (SW):

a. **Assignments:** Basic parameters required for design of cement plant, Mills of cement manufacturing process, Fan Law, Blending system of cement process. Separators of mills.

b. **Mini Project:** Process flow chart, Poster on in line and off line calciner.

c. **Other Activities (Specify):** Note on Estimation of CO_2 generation during cement manufacturing process

PEC-CT-04.2: To study techno-economic studies related to establishing a cement plant and investigating the factors that dictate the size of the cement manufacturing Unit.

Approximate Hours

Item	Appx Hrs
CI	8
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1: Techno-Economic Study of Cement Project **SO2:** Raw Materials, Water, Infrastructure & manpower Requirement **SO3. I**mplementation, Erection and commissioning of cement plant**.** **SO4**: Cost Benefit Analysis **SO5**: Civil design of cement plant	0	**Unit-2.0 TEFS and civil design for setting up cement plant** **2.1.** Techno Economic Feasibility Study for Setting up Cement Plant **2.2.** Raw Materials Requirement for setting up a cement plant. **2.3.** Infrastructure and manpower Requirement **2.4.** Implementation schedule, Erection and Commissioning **2.5.** Cost benefit analysis of cement production **2.6.** Factors Governing Size of Cement Plant **2.7.** Civil Design in construction of Cement Plant **2.8.** Water requirement and supply system of Cement Plant	1. Types of limestone reserves 2. Break even analysis

SW-2 Suggested Sessional Work (SW):

a. **Assignments:** Requirement for TEFS of a cement plant, Raw Materials requirement for manufacture of Portland cement, Water requirement of dry process cement plant. cost benefit analysis of cement production.

PEC-CT-04.3: Gaining insight into the civil design, electrical instrumentation, and layout of different sections within a cement plant.

Approximate Hours

Item	Appx Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO1: Power distribution system of cement plant **SO2**: Instrumentation and process control in cement plant **SO3:** Setting up Quality control Lab **SO4:** Lay outs of various sections		**Unit-3: Power distribution in cement plants** **3.1** Power Distribution & Cables **3.2** Power consumptions in cement plant and Calculation **3.3** Instrumentation and Process Control in Cement Plant **3.4** Setting up quality control lab in cement plant **3.5** Department Lay Outs, Lay Out of Crushing Plant **3.6** Storage of Limestone and Stacker Reclaimer System **3.7** Mill Systems of Cement Plant, Layouts of Coal Mill. **3.8** Batch blending and continuous blending systems **3.9** Kiln Feed System of cement plant **3.10** Lay out of Pyro-processing Systems of Cement Plant	1.Electrical Power requirement of cement plant 2. NABL function in setting of Quality control lab

SW-3 Suggested Sessional Work (SW):

a. **Assignments:** Power Distribution system of cement plant, storage of limestone, Homogenization of Raw meal,
b. **Mini Project:** Lay out of pyro-processing system
c. **Other Activities (Specify):** Visit to cement plant

PEC-CT-04.4: To comprehend the detailed engineering of the raw mill section, pyro-processing of clinker minerals, cement grinding, and packing, encompassing the layout of each respective section.

Approximate Hours

Item	Appx Hrs
CI	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO1 Design feature of Cement Kiln **SO2.** Firing system of cement kiln **SO3.** Clinker cooler and conveying system **SO4** Handling of Blending materials **SO5 :** WHR system of cement plant	.	**Unit-4 Design of clinker coolers and Rotary kiln** **4.1** Some design features of rotary kiln. **4.2** Coal firing and metering system. **4.3** Clinker cooler – collecting spillage and product. **4.4** Cooling air fans. **4.5** Clinker coolers cooler vent and dust collectors. **4.6** Clinker conveying and storage. **4.7** Coal and Gypsum handing system. **4.8** Handling of GBFS & Fly Ash. **4.9** Cement grinding and layout of Cement grinding section and packing **4.10** WHR system of Cement Plant	1. Rotary kiln system for cement manufacture 2. Quality of blended materials 3. Waste Heat available in cement plant

SW-4 Suggested Sessional Work (SW):

a. **Assignments:** WHR system of cement plant, Storage and handling of Fly Ash and GBF slag in cement plant, Design feature of rotary kiln, Coal and Gypsum Handling in cement plant.

b. Mini Project:
Draw the section of Rotary kiln

PEC-CT-04.5: To grasp the procurement process for plant machinery and create data sheets for inquiries, including the design aspect.

Approximate Hours

Item	Appx Hrs
CI	6
LI	0
SW	1
SL	1
Total	8

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO.1 General procurement Procedure of plant Machinery **SO2**. Preparation of Technical Data sheet for Cement Kiln, PH, PC and cooler **SO3.** Critical operational and design parameter of cement plant. **SO4.** Evaluation of data sheet		**Unit-5 : Procurement of Plant machinery.** **5.1** Procurement procedure and ordering Machinery. **5.2** Technical Data Sheet for kiln **5.3** Technical Data Sheet for Pre Heater & Pre Calciner. **5.4** Technical Data Sheet for Cooler. **5.5** Critical operational and design parameters of cement plant. **5.6** Evaluation of Technical Data Sheet and Time Factor in procurement.	SL1 Material management SL2. Inventory control

SW-1 Suggested Sessional Work (SW):

a. **Assignments:** General procedure for procurement of Plant machinery, data sheet for Kiln, Data sheet for PH and PC, Data sheet for cooler, Evaluation of data sheet.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
PEC-CT-04.1: To know the fundamental prerequisites for establishing a cement plant and identifying the machinery needed for the production of Portland cement.	11	2	1	14
PEC-CT-04.2: To study techno-economic studies related to establishing a cement plant and investigating the factors that dictate the size of the cement manufacturing Unit	8	2	1	11
PEC-CT-04.3: Gaining insight into the civil design, electrical instrumentation, and layout of different sections within a cement plant.	10	2	1	13
PEC-CT-04.4: To comprehend the detailed engineering of the raw mill section, pyro-processing of clinker minerals, cement grinding, and packing, encompassing the layout of each respective section.	10	2	1	13
PEC-CT-04.5: To grasp the procurement process for plant machinery and create data sheets for inquiries, including the design aspect.	6	1	1	8
Total Hours	45	9	5	59

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	To know about basic parameter for design and process flow chart of Cement plant.	02	03	02	07
CO-2	TEFS and civil design for setting up cement plant	-	08	02	10
CO-3	Power distribution in cement plants	01	06	04	11
CO-4	Design of clinker coolers and Rotary kiln	-	08	07	15
CO-5	Procurement of Plant machinery.	-	03	04	07
Total		03	28	19	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture, Tutorial
2. Case Method
3. Group Discussion, Role Play
4. Visit to cement plant
5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, WhatsApp, Mobile, Online sources)
7. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition & Year
1	Cement Chemistry	F W Taylor	Thomas Telford	1997
2	Cement Data Book	W. H Duda	French & European	1995

			Pubns	
3	Norms For Limestone Exploration For Cement Manufacture	National Council for Cement and Building Materials	National Council for Cement and Building Materials	1985
4	Cement Production Principle and Practice	A K Chatterjee		2018
5	Holcim Training Manual			
6	FLS Training Manual			

Curriculum Development Team

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8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech. Cement Tech **Course Code: PEC-CT-04** **Course Title: Design of Cement Plant**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it	Ability to use the research based innovative knowledge for sustainable
CO-1: To know the fundamental prerequisites for establishing a cement plant and identifying the machinery needed for the production of Portland cement.	3	2	2	2	3	2	1	1	1	2	1	2	2	2	1	2
CO-2: To study techno-economic studies related to establishing a cement plant and investigating the factors that dictate the size of the cement manufacturing Unit	3	2	2	2	3	2	1	1	1	2	1	2	2	2	1	2
CO-3: Gaining insight into the civil design, electrical instrumentation, and layout of different sections within a	3	3	2	2	2	2	1	1	2	2	2	3	2	2	1	3

cement plant.																
CO-4: To comprehend the detailed engineering of the raw mill section, pyro-processing of clinker minerals, cement grinding, and packing, encompassing the layout of each respective section.	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**2**
CO-5: To grasp the procurement process for plant machinery and create data sheets for inquiries, including the design aspect.	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**3**

Course Curriculum Map: Design of Cement Plant

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1**: To know the fundamental prerequisites for establishing a cement plant and identifying the machinery needed for the production of Portland cement.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 To know about basic parameter for design and process flow chart of Cement plant. 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2**: To study techno-economic studies related to establishing a cement plant and investigating the factors that dictate the size of the cement manufacturing Unit	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 TEFS and civil design for setting up cement plant 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Gaining insight into the civil design, electrical instrumentation, and layout of different sections within a cement plant.	SO3.1 SO3.2 SO3.3 SO3.4		Unit-3 : Power distribution in cement plants 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4**: To comprehend the detailed engineering of the raw mill section, pyro-processing of clinker minerals, cement grinding, and packing, encompassing the layout of each respective section.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4 : Design of clinker coolers and Rotary kiln 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5**: To grasp the procurement process for plant machinery and create data sheets for inquiries, including the design aspect.	SO5.1 SO5.2 SO5.3 SO5.4		Unit 5: Procurement of Plant machinery. 5.1,5.2,5.3,5.4,5.5,5.6	

Semester-VII

Course Code: **PEC-CT-05**

Course Title: **Marketing of Cement**

Pre- requisite: Student should have fundamental understanding of marketing concepts.

Rationale: The students studying marketing strategy should understand about market demand and customer satisfaction which is crucial for the success in cement plants. Developing marketing strategies helps in identifying market segments, customer needs, and product variations required to meet specific demand. Efficient strategies are needed to ensure timely and cost-effective distribution of cement to construction sites and retailers. Marketing plays a role in optimizing distribution channels and logistics. With increasing focus on sustainability and environmental regulations, marketing strategies can communicate a cement plant's commitment to eco-friendly practices, which can be a significant selling point.

Course Outcomes:

PEC-CT-05.1: To identify the latest trends and developments in marketing, including digital marketing, sustainability and customer experience.

PEC-CT-05.2: To learn how to identify and define target market segments based on demographics, psychographics, geographic and behavioral factors.

PEC-CT-05.3: To learn about various promotional tools and techniques such as advertising, public relations, sales promotion, and personal selling.

PEC-CT-05.4: To understand the alignment of distribution strategies with overall marketing and business strategies.

PEC-CT-05.5: To understand the ethical considerations and responsible marketing practices in rural areas, including social responsibility and sustainability.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
PEC	PEC-CT-05	Marketing of Cement	3	0	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PEC	PEC-CT-05	Marketing of Cement	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PEC-CT-05.1: To identify the latest trends and developments in marketing, including digital marketing, sustainability and customer experience.

Approximate Hours

Item	Appx Hrs
CI	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1 To understand the fundamentals of marketing concepts, including the marketing mix (4 Ps) and the role of marketing in business. **SO1.2** To learn about the different orientations and philosophies in marketing, such as product orientation, customer orientation, and societal marketing. **SO1.3** To understand the role of social media platforms and influencer marketing in modern marketing strategies. **SO1.4** To understand the macro-environmental factors that influence marketing decisions, such as economic, social, cultural, political, and technological factors. **SO1.5** To Learn how to analyze market demand, including methods for measuring and understanding consumer demand for products.	.	**Unit-1: Introduction to marketing, Emerging issues in marketing, Marketing environment and demand forecasting** **1.1** Marketing Management Task and Demand **1.2** Marketing Concept and Evaluation **1.3** Element of Marketing mixes **1.4** Factors affecting marketing mixes **1.5** Core concept of Marketing **1.6** Recent Trend in Marketing **1.7** Integrated Marketing **1.8** Quantitative Techniques for Marketing Decisions **1.9** Consumerism **1.10** Analysis of Market Environment **1.11** Marketing Demand **1.12** Marketing Forecasting	SL1. Different demand situations in marketing management SL2. Important acts employed by government for consumer protection.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Describe the difference among selling concept, marketing concept and societal concept of marketing management.

ii. Describe the different factors that impact marketing environment.

b. Mini Project:

Different techniques for demand forecasting in marketing based on previous data available.

c. Other Activities (Specify):

Explore different platforms for recent trend in marketing.

PEC-CT-05.2: To learn how to identify and define target market segments based on demographics, psychographics, geographic and behavioral factors.

Approximate Hours

Item	AppX Hrs
Cl	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To understand the different factors such as psychological, social and cultural factors that impact consumer choices. **SO2.2** To recall the knowledge of different segmentation criteria such as demographic, psychographic, geographic and behavioral. **SO2.3**	.	**Unit-2: Consumer behaviour and market segmentation, Product decisions, Product related strategies, Pricing decisions** **2.1** Consumer Behaviour **2.2** Industrial marketing segmentation **2.3** Benefits of Marketing segmentation **2.4** Market targeting	**SL1.** Alternative strategies for market targeting **SL2.** Different reasons and constraints for development of new product

To understand the importance of product quality for satisfaction of customer. **SO2.4** To apply marketing strategies for each stage of the product life cycle (Introduction, growth, maturity and decline). **SO2.5** To understand the process of creating a pricing policy that aligns with overall business goals and strategies.		**2.5** Product positioning **2.6** Product decisions: definition, type **2.7** Product mixes **2.8** Product life cycles **2.9** Branding; Packaging and Labeling **2.10** Pricing and its objectives **2.11** Pricing policies and methods	

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Discuss about the need and benefits of market segmentation in marketing.
ii. Describe the marketing strategy for different stages of product life cycle.

b. Mini Project:

Discuss the different factors that affect the consumer behavior in selling the cement products.

c. Other Activities (Specify):

Explore different factors that affect the price and pricing policy of the product.

PEC-CT-05.3: To learn about various promotional tools and techniques such as advertising, public relations, sales promotion, and personal selling.

Approximate Hours

Item	Appx Hrs
CI	7
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 To understand the key elements of the marketing promotion mix, such as advertising, sales promotion, public relations, personal selling, and digital marketing. **SO3.2** To identify the target audience and market segments for a specific product or service. **SO3.3** To develop a promotional strategy that aligns with the marketing objectives and budget constraints. **SO3.4** To learn how to create effective marketing messages and promotional materials. **SO3.5** To analyze the effectiveness of different promotion channels and adjusting the mix as needed to achieve marketing goals.	.	**Unit-3 : Market promotion mix** **3.1** Element of Promotion Mix **3.2** Factors affecting Promotion mix **3.3** Advertisement **3.4** Personal Selling **3.5** Sales Promotion **3.6** Sales Farce management **3.7** Publicity and Public relations	**SL1** Merits and demerits of sales promotion **SL2** Importance of personal selling

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Describe the different factors that affect the promotion mix.

ii. Discuss the key points to differentiate between advertising and personal selling.

b. Mini Project:

Describe the key characteristics of public relations. Explore different media or tools of public relations.

c. Other Activities (Specify):

Describe the different factors that affect the sales force size. Explore different methods for determining the sales force size.

PEC-CT-05.4: To understand the alignment of distribution strategies with overall marketing and business strategies.

Approximate Hours

Item	Appx Hrs
CI	8
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 To understand the importance of distribution channels in getting products to consumers. **SO4.2** To identify the challenges and opportunities in distribution, such as e-commerce and Omni channel distribution. **SO4.3** To identify various data sources that can be integrated into marketing information system such as customer data, market research and sales data. **SO4.4** To understand how to address consumer's complaint promptly and effectively, leading to a resolution that satisfies the customer. **SO4.5** To analyze case studies to see how companies effectively use distribution strategies to reach their target markets.	.	**Unit-4 : Physical distribution and channel of distribution** **4.1** Physical distribution **4.2** Channel distribution **4.3** Marketing Information system **4.4** Marketing research **4.5** Cement market of India **4.6** Techno Marketing **4.7** Consumer Complaint **4.8** Customer Satisfaction	SL1. Key points to consider for maximize the selling. SL2. Different methods of marketing research data collection.

SW-4 **Suggested Sessional Work (SW):**

a. Assignments:

i. Discuss the key points of eligibility for techno marketing officials of cement plants.

ii. Discuss the main objectives of physical distribution.

b. Mini Project:

Describe the typical intermediate used for availing or distributing the different products.

c. Other Activities (Specify):

Power Point Presentation to describe the different strategies for green marketing.

PEC-CT-05.5: To understand the ethical considerations and responsible marketing practices in rural areas, including social responsibility and sustainability.

. **Approximate Hours**

Item	Appx. Hrs
CI	7
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 To identify different ways to adapt products or services to better suit the rural market. **SO5.2** To ensure the alignment of marketing activities with overall marketing strategy and goals. **SO5.3** To understand the company's strengths, weaknesses, opportunities and threats (SWOT analysis) in the context of marketing efforts. **SO5.4** To review the marketing budgets and resource allocation to ensure efficient use of resources.		**Unit 5: Rural marketing and analyzing competition** **5.1** Rural Marketing **5.2** Marketing of Services **5.3** Marketing profitability analysis **5.4** Marketing control **5.5** Marketing audit **5.6** Retail marketing **5.7** Case study of cement marketing	**SL1.** Characteristics of marketing services **SL2.** Different processes for analyzing the marketing profitability

SO5.5 To identify and monitor the key performance indicators (KPIs) to assess the success of retail marketing efforts.			

SW-5 Suggested Sessional Work (SW):

a. **Assignments:**
   i. Describe the importance of rural marketing.
   ii. Discuss the key components of marketing audit.

b. **Mini Project:**
   Discuss the case study for marketing strategy of ACC cement

c. **Other Activities (Specify):**
   Explore the different methods for marketing control.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PEC-CT-05.1: To identify the latest trends and developments in marketing, including digital marketing, sustainability and customer experience.	12	2	1	15
PEC-CT-05.2: To learn how to identify and define target market segments based on demographics, psychographics, geographic and behavioral factors.	11	2	1	14
PEC-CT-05.3: To learn about various promotional tools and techniques such as advertising, public relations, sales promotion, and personal selling.	7	2	1	10
PEC-CT-05.4: To understand the alignment of distribution strategies with overall marketing and business strategies.	8	2	1	11
PEC-CT-05.5: To understand the ethical considerations and responsible marketing practices in rural areas, including social responsibility and sustainability.	7	2	1	10
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Introduction to marketing, Emerging issue in marketing, Marketing environment an demand forecasting	03	01	01	05
CO-2	Consumer behaviour and market segmentation, Product decisions, Product related strategies, Pricing decisions	02	06	02	10
CO-3	Market promotion mix	03	07	05	15
CO-4	Physical distribution and channel of distribution	-	10	05	15
CO-5	Rural marketing and analyzing competition	03	02	-	05
Total		11	26	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books :

S. No.	Title	Author	Publisher	Edition & Year
1	Principles of marketing management	Philip Kotler	Financial Times Prentice Hall	Revised edition 17 edition 2018
2	Marketing Management : A strategic and decision Making Approach	John W. Mullins, Orville Walker	McGraw-Hill Education	2001
3	Marketing Management	S.Ramaswamy and S.Namakumari	McGraw-Hill Education	2018
4	Marketing Management in Cement Industry	Isabel Agudelo	Palgrave Macmillan	2014

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5. Dr Gaurav Shukla, Assistant Professor, Dept of Cement Technology
6. Er Priyanka Singh, Assistant Professor, Dept. of Cement Technology
7. Er A K Bhattacharya, Faculty, Dept. of Cement Tech. (Former GM M/s Dalmia Cement)
8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code: PEC-CT-05** **Course Title: Marketing of Cement**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Investigate the characteristics of different pozzolanic materials in the creation of special cements.	3	3	2	2	3	2	1	1	2	1	1	2	2	2	2	3
CO-2: Comprehend the chemical, mineralogical, and physical properties associated with various special cements.	1	2	3	2	1	1	1	2	1	1	2	2	2	2	2	2
CO-3: Analyze the application of cement in the production of concrete and mortar, assessing its performance.	2	3	3	1	1	2	1	2	1	3	2	2	1	2	2	3

CO-4: Develop an understanding of concrete chemistry and the production of long-lasting, durable concrete.	**1**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**3**	**2**	**3**	**1**
CO-5: Gain insight into the utilization of diverse admixtures for enhancing the properties of concrete.	**2**	**3**	**3**	**2**	**1**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**1**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Marketing of Cement

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Investigate the characteristics of different pozzolanic materials in the creation of special cements.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Introduction to marketing, Emerging issues in marketing, Marketing environment and demand forecasting** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Comprehend the chemical, mineralogical, and physical properties associated with various special cements.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Consumer behaviour and market segmentation, Product decisions, Product related strategies, Pricing decisions** 2.1, 2.2, 2.3, 2.4, 2.5,2.6,2.7,2.8,2.9,2.10,2.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Analyze the application of cement in the production of concrete and mortar, assessing its performance.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Market promotion mix** 3.1,3.2,3.3,3.4,3.5,3.6,3.7	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Develop an understanding of concrete chemistry and the production of long-lasting, durable concrete.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Physical distribution and channel of distribution** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Gain insight into the utilization of diverse admixtures for enhancing the properties of concrete.	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit-5: Rural marketing and analyzing competition** 5.1,5.2,5.3,5.4,5.5,5.6,5.7	

Semester-VII

Course Code: **PEC-CT-06**

Course Title: **Refractory Engineering**

Pre- requisite: Student Should have knowledge on Refractory raw materials and pyro-processing of Portland cement.

Rationale: Manufacturing Portland cement is quite the energy-intensive process. It involves pyro processing the raw materials, known as kiln feed, at incredibly high temperatures in rotary kilns. This kiln feed is mainly composed of limestone, with some clay, sand, and iron oxide. These elements chemically interact to create cement clinker. The kiln feed tends to be alkaline, but the raw materials often having components that can produce corrosive substances in both solid and gaseous forms. In the dynamic rotary kiln, where these reactions unfold at temperatures ranging from 1250°C to 1450°C, having a refractory lining that can handle the heat, alkalinity, and corrosive conditions is absolutely crucial. The refractory requirements for kilns equipped with cyclone preheaters and pre-calciners vary significantly. Regardless of the setup, the refractories need to possess robust hot strength, resistance to abrasion, a compatible chemical composition, and solid thermal characteristics. This course delves into the significance of refractories, exploring their types and applications in the realm of cement manufacturing.

Course Outcomes:

PEC-CT-06.1: Exploring Refractory Types and Raw Materials

PEC-CT-06.2: Unveiling the Manufacturing Processes of Different Refractories

PEC-CT-06.3: Analyzing the Chemical and Physical Properties of Refractories and Methods of Measurement

PEC-CT-06.4: Navigating the Selection and Installation of Refractories in Cement Kilns

PEC-CT-06.5: Efficient Refractory Management in Cement Plants, Emphasizing Safety in Installation in Cement Kilns

Scheme of Studies:

Course of Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
PEC	PEC-CT-06	Refractory Engineering	3	0	2	1	6	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
PEC	PEC-CT-06	Refractory Engineering	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

PEC-CT-06.1: Exploring Refractory Types and Raw Materials

Approximate Hours

Item	Appx Hrs
Cl	07
LI	0
SW	02
SL	01
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1: Refractories and its use. **SO1.2**: Classification of refractories and its application in cement kiln **SO1.3:** Raw materials refractories **SO1.4:** Role of refractories in cement kiln **SO1.5:** Latest trend in refractories		**Unit-1. Refractory Fundamentals**: **1.1** Fundamentals of refractories and its use. **1.2** Classification and types of refractories **1.3** Application of refractories in cement plant **1.4** Raw materials of refractories and its properties **1.5** Role of refractories in cement plant. **1.6** Castables and mortars its types, composition and use, **1.7** Latest trends in refractories	**SL1.** Non-metallic mineral and ores

SW-1 Suggested Sessional Work (SW):

Assignments: Raw Materials of refractories, Application of refractories in cement kiln, Classification and types of refractories.

PEC-CT06.2: **Unveiling the Manufacturing Processes of Different Refractories**

Approximate Hours

Item	Appx Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO2.1: Chemistry and phase diagram of refractories **SO2.2:** Manufacturing process of refractories **SO2.3:** Properties of various refractories **SO2.4:** Carbon based refractories	**0**	**Unit -II: Manufacture of Various Refractory:** **2.1** Phase diagrams of refractory **2.2** Manufacturing process of various refractories **2.3** Properties of silica refractory **2.4** Properties of alumina silicate refractories, **2.5** Properties of Periclase, **2.6** Properties of magnesite refractory **2.7** Properties of magnesite- chrome, **2.8** Properties of dolomite refractory **2.9** High and low temperature insulating refractories, **2.10** Carbon based refractories	

SW-2 Suggested Sessional Work (SW):

Assignments: Phase diagram of Alumina refractories, Phase diagram of basic refractories, Properties of Alumina and basic refractories, Notes on carbon based refractories.

PEC-CT-06.3: Analyzing the Chemical and Physical Properties of Refractories and Methods of Measurement.

Approximate Hours

Item	Appx Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1: Properties of refractories SO3.2: Measurement of properties of refractories SO3.3: Reaction of gases with gases generated during Pyro-processing. SO3.4: Corrosion of refractories of cement kiln.		**Unit 3: Properties of Refractories and Their Measurement** 3.1 Properties of refractories and their importance 3.2 Measurement of porosity, bulk density 3.3 Measurement of permeability, 3.4 Measurement of fusion point, 3.5 Measurement of cold crushing strength 3.6 Measurement of refractoriness under load (RUL) and hot modulus of rapture, 3.7 Measurement of Pyrometric Cone Equivalent of Refractories 3.8 Creep behavior of refractories, 3.9 Abrasive resistance measurement Measurement of thermal conductivity and thermal expansion 3.10 Reaction and corrosion of refractories with various gases	**SL1.** Gases generated during pyro-processing of Portland cement clinker.

SW-3 Suggested Sessional Work (SW):

Assignments: Properties of refractories and its importance, Measurement of porosity and permeability of refractories, Determination of CCS and PCE of refractories, Notes on Reaction and corrosion of refractories in cement kiln.

PEC-CT-06.4: **Navigating the Selection and Installation of Refractories in Cement Kilns**

Approximate Hours

Item	Appx Hrs
CI	09
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self Learning (SL)**
SO1: Installation zones of cement kiln and suitable refractories **SO2:** Lining of PH and PC **SO3:** Mortor and monolithic lining in cement kiln **SO4:** Method of lining in cement kiln **SO5:** Essential of good refractories works.		**Unit IV: Refractory Engineering-** **4.1** Installation zones and methods of installation refractory in cement kiln **4.2** Subdivision of burning process & selection of refractory in kiln drying zone, preheating zone, calcining zone, transition zone, sintering zone, cooling zone, **4.3** Lining of preheater, kiln hood, coolers, features of refractory installation (brick joints, shapes, dimension) **4.4** Brick lining scheme, **4.5** Essential of good refractory work, **4.6** Mortar lining, **4.7** Installation of steel plates in radial joints, **4.8** Methods of installation with kiln running and kiln stop, **4.9** Monolithic refractories types, properties and installation.	**SL1.** Structure Cement Rotary Kiln

SW-4 Suggested Sessional Work (SW):

Assignments: Installation of refractories in cement kiln, Lining of mortor and monolithic in cement kiln, Brick lining scheme of cement kiln,

PEC-CT-06.5: Efficient Refractory Management in Cement Plants, Emphasizing Safety in Installation in Cement Kilns

Approximate Hours

Item	Appx Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1: Procedure to improve the life of refractories of cement kiln SO2: Selection of refractories for cement kiln SO3: Evaluation of performance of refractory in cement kiln and cost optimization. SO4: Safety during the refractory brick lining in cement kiln. SO5: Refractory Management in cement plant.		**Unit-V: Refractory Management**: 5.1 Procedure for startup and stoppage of kiln to improve refractory life in rotary kiln in cement plant 5.2 Selection of Refractory, 5.3 Evaluation of performance based lining material 5.4 Consideration mechanical factors during lining 5.5 Safety feature during lining. 5.6 Specific Refractory consumption, 5.7 Optimizing refractory cost, 5.8 Cost effectiveness of refractories. 5.9 Refractory storage management.	SL1. Cement kiln operation

SW-5 Suggested Sessional Work (SW):
Assignments: Selection of refractories, Performance evaluation of refractories, Refractories management in cement plant, Rectory cost optimization in cement plant, Safety feature during installation of refractories in cement kiln.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
PEC-CT-06.1: Exploring Refractory Types and Raw Materials	07	2	1	10
PEC-CT-06.2: Unveiling the Manufacturing Processes of Different Refractories	10	2	1	13
PEC-CT-06.3: Analyzing the Chemical and Physical Properties of Refractories and Methods of Measurement	10	2	1	13

PEC-CT-06.4: Navigating the Selection and Installation of Refractories in Cement Kilns	09	2	1	12
PEC-CT-06.5: Efficient Refractory Management in Cement Plants, Emphasizing Safety in Installation in Cement Kilns	09	2	11	12
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Refractory Fundamentals:	02	03	02	07
CO-2	Manufacture of Various Refractory:		08	02	10
CO-3	Properties of Refractories and Their Measurement	01	06	04	11
CO-4	Refractory Engineering-	-	08	07	15
CO-5	Refractory Management	-	03	04	07
Total		03	28	19	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture, Tutorial
2. Case Method
3. Group Discussion, Role Play
4. Visit to cement plant

5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
7. Brainstorming

Suggested Learning Resource

S. No.	Title	Author	Publisher	Edition & Year
1	Refractory Engineering and Kiln Maintenance in Cement Plant	J P Saxena,	CRC Press, Technology & Engineering	1999
2	Hand Book of Industrial Refractories Technology:	Stephen C, Carniglia Godon L Barma,	Noyes Publication	1999
3	Refractory Linings Thermo mechanical Design and Applications	Charles Schacht,	CRC Press, Technology & Engineering.	2003
4	Refractory technology –Fundamentals and Applications	Cement Seminar	Holder bank	
5	Refractory Lining of Cement Kiln System : Process Technology	Cement Seminar	Holder bank	
6	Holcim Training Manual			
7	FLS Training Manual			

Curriculum Development Team

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** PEC-CT-06 **Course Title:** Refractory Engineering

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PEC-CT-06.1 Exploring Refractory Types and Raw Materials	2	1	2	2	3	3	1	1	2	1	1	2	2	2	2	3
PEC-CT-06.2 Unveiling the Manufacturing Processes of Different Refractories	3	3	3	2	1	2	1	1	1	1	2	2	2	2	2	2
PEC-CT-06.3 Analyzing the Chemical and Physical Properties of Refractories and Methods of Measurement	2	3	2	1	1	2	1	2	1	2	2	2	1	2	2	3

PEC-CT-06.4 Navigating the Selection and Installation of Refractories in Cement Kilns	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**1**
PEC-CT-06.5 Efficient Refractory Management in Cement Plants, Emphasizing Safety in Installation in Cement Kilns	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Refractory Engineering

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO1: Exploring Refractory Types and Raw Materials	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1:** Refractory Fundamentals: 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO2: Unveiling the Manufacturing Processes of Different Refractories	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2:** Manufacture of Various Refractory 2.1, 2.2, 2.3, 2.4, 2.5,2.6,2.7,2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO3: Analyzing the Chemical and Physical Properties of Refractories and Methods of Measurement	SO3.1 SO3.2 SO3.3 SO3.4		**Unit-3:** Properties of Refractories and Their Measurement 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO4: Navigating the Selection and Installation of Refractories in Cement Kilns	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4:** Refractory Engineering- 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	CO5: Efficient Refractory Management in Cement Plants, Emphasizing Safety in Installation in Cement Kilns	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5**: Refractory Management 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

Semester-VII

Course Code: **OE-CT02**

Course Title: **EIA & EMP OF CEMENT PLANT**

Pre- requisite: Student Should have knowledge on chinker chemistry and hydration of cement

Rationale: Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) are crucial components in ensuring sustainable and responsible industrial practices, such as those in the cement plant industry.

Environmental Impact Assessment (EIA) is a systematic process that evaluates the potential environmental consequences of a proposed project, in this case, a cement plant. The primary goal is to identify, predict, assess, and mitigate the adverse environmental effects, allowing for informed decision-making and sustainable development. The EIA for a cement plant would typically cover various aspects, including: Air Quality, Water, Land use, Noise & vibration and waste management. Developing a comprehensive plan for the proper management of solid and hazardous wastes generated by the cement plant, including recycling, reuse, and safe disposal methods. The Environmental Management Plan (EMP) is a set of measures and strategies developed based on the findings of the EIA. It serves as a guide for the effective implementation of environmental safeguards and mitigation measures. The EMP for a cement plant typically includes: Monitoring and Compliance: Establishing a robust system for continuous monitoring of key environmental parameters to ensure compliance with regulatory standards. In summary, the EIA and EMP for a cement plant play a pivotal role in promoting responsible industrial practices, minimizing environmental impacts, and ensuring the long-term sustainability of the project.

Course Outcomes:

OE-CT02.1: Environmental Scenarios and Pollution due to cement manufacture

OE-CT02.2: Pollution Sources of Cement Plants and quality of environmental parameters

OE-CT02.3: Impact of Environmental Pollution due Cement manufacture on Air, Water, Fauna, and Flora surrounding cement plants.

OE-CT02.4: Various Acts, guideline and norms of State and central govt for Environmental Management to Prevent and Control Pollution.

OE-CT02.5: Guideline for preparation of Environmental Management Plan for Cement Plants

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Scheme of Studies:

Course Category	CourseCode	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
OEC	OE-CT02	EIA & EMP Of Cement Plant	3	0	2	1	6	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3)10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
OEC	OE-CT02	Design of Cement Plant	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

OE-CT02.1: Environmental Scenarios and Pollution due to cement manufacture

Approximate Hours

Item	Appx Hrs
Cl	07
LI	0
SW	01
SL	01
Total	09

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1: Present environment Scenario **SO2**: Air Quality and its measurement **SO3**: Water Quality and water pollutant **SO4:** Noise level in industrial area **SO5:** Buffer zone and demographic profile		**Unit-1. Introduction to environment pollution** **1.1** Interaction of Humans and Environment, and Role of an engineer in Environmental improvement. **1.2** Present Environmental Scenario: socio economic studies, **1.3** Air quality and its measurement **1.4** Air Pollutants, **1.5** Water quality and water Pollutant **1.6** Noise level and Pollutant in industrial area **1.7** Buffer zone and demographic profile	SL1.Cement manufacturing process and use of materials

SW-1 Suggested Sessional Work (SW):

Assignments: Air Pollutant and Air Quality, Water Pollutants, Noise pollutant bin industrial area, Role of Engineer in protection of environment.

OE-CT02.2: Pollution Sources of Cement Plants and quality of environmental parameters

Approximate Hours

Item	Appx Hrs
Cl	09
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO 2.1: Source of Pollutant for Air, Noise, Water in cement plant **SO2.2:** Control measures in cement plant to improve air quality **SO2.3:** Equipment to improve air Quality in cement plant **SO2.4:** Stack monitoring system in cement plant **SO2.5.** Carbon sequestration in cement plant		**Unit -2: Sources of Pollution in Cement Industry:** 2.1 Air, Water, Noise quality 2.2 Solid and Hazardous Waste in cement plant 2.3 Control measures for improving ambient air quality (AAQ) 2.4 Pollution Control Equipment and Controlling Point Source Emissions 2.5 Bag Filter / Bag House, ESP 2.6 Multi Cyclones, Wet Scrubber, 2.7 Gravity Setting chamber, primary and (SCR/ SNCR) techniques. 2.8 Stack monitoring in cement plant 2.9 Carbon sequestration	SL 1. Hazardous and Non-hazardous waste

SW-2 Suggested Sessional Work (SW):

Assignments: Air Control system in cement plant, Stack monitoring in cement plant, Notes on ESP and bag filter, Carbon sequestration in cement plant.

OE-CT02.3: Impact of Environmental Pollution due Cement manufacture on Air, Water, Fauna, and Flora surrounding cement plants.

Approximate Hours

Item	Appx Hrs
Cl	11
LI	0
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1: Impact on topography and drainage due to land degradation SO3.2: Impact due to coal and other solid waste in cement plant SO3.3: Impact on Air, water, fauna and flora due to cement plant SO3.4: Dispersion modelling of air pollutant of cement plant. SO3.5: Environmental evaluation system for cement plant.		**Unit 3: Impact of Environmental Pollution due Cement manufacture on Air, Water, Fauna, and Flora surrounding cement plants** 3.1 Impact on socio economic factors 3.2 Impact due to land degradation 3.3 Impact on topography and drainage, 3.4 Impact due to solid waste, 3.5 Impact due to coal stocks, 3.6 Impact on flora and fauna, 3.7 Impact on environmental quality, 3.8 Impact on water quality, 3.9 Impact on noise levels, 3.10. Mathematical modelling for dispersion of air pollutants, 3.11 Battelle Environmental Evaluation System.	SL1. Quality of ambient air SL2. Water Quality

SW-3 Suggested Sessional Work (SW):

Assignments: Impact of Air and water quality due to cement plant operation. Mathematical modelling on Air dispersion, Impact of pollution on flora and fauna. Water quality monitoring system in cement plant.

OE-CT02.4: Various Acts, guideline and norms of State and central govt for Environmental Management to Prevent and Control Pollution.

Approximate Hours

Item	Appx Hrs
Cl	08
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
Student will understand the following SO4.1: Environmental Protection ACT 1986 SO4.2: Air & water prevention and control act. SO4.3: Forest conservation act SO4.4: Hazardous waste rule SO4.5: Environmental Audit		**Unit 4: Environment Management ACTs, norms and guidelines** 4.1 Introduction to various Environmental Act & Regulations, Environment Protection Act 1986 4.2 Water (Prevention and Control of Pollution) act, Water (Prevention and Control of Pollution) Cess act, 4.3 Air (Prevention and Control of Pollution) act 4.4 Forest (Conservation) Act 4.5 Hazardous Waste (Management, Handling and trans boundary movement) Rules, 4.6 Solid Waste Management Rules, 4.7 Environment Management Tools: EMS – ISO 14001, 4.8 Environmental Audit / Statement, Clean Development Mechanism (CDM)	SL 1. CPCB function on environment control

SW-4 Suggested Sessional Work (SW):

Assignments: Environmental act 1986, Water act for prevention and control, Environmental Audit, Hazardous Waste Management Rules.

OE-CT02.5: Guideline for preparation of Environmental Management Plan for Cement Plants

Approximate Hours

Item	Appx Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1: EMP for Air Quality monitoring SO5.2: EMP for afforestation and green belt development SO5.3: Environmental monitoring plan SO5.4: Occupational Heath in cement plant SO5.5: Budget for EMP		**Unit 5: Guideline for preparation of Environmental Management plan for cement plant.** 5.1 Socio economic factors, 5.2 Rehabilitation, compensatory a forestation, 5.3 Ambient air quality, 5.4 Green belt development, 5.5 Water quality and noise levels control measures, 5.6 Occupational health, 5.7 Disaster and hazard management. 5.8 Post Project environmental monitoring programmer: 5.9 Organizational structure and monitoring scheme, 5.10Budgetary provision for EMP	SL1: ISO 14001 :2015 on Environment management plan

SW-5 Suggested Sessional Work (SW):

Assignments: Green belt development around cement plant and its impact, Occupational health in cement plant, Disaster and hazard management, Safety measures in cement plant, Budgetary provision for EIA and EMP of cement plant, Case study on EIA and EMP of cement plant.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
OE-CT02.1: Environmental Scenarios and Pollution due to cement manufacture.	07	01	01	09
OE-CT02.2: Pollution Sources of Cement Plants and quality of environmental parameters	09	02	01	12
OE-CT02.3: Impact of Environmental Pollution due Cement manufacture on Air, Water, Fauna, and Flora surrounding cement plants.	11	02	01	14

OE-CT02.4: Various Acts, guideline and norms of State and central govt for Environmental Management to Prevent and Control Pollution.	8	2	01	11
OE-CT02.5: Guideline for preparation of Environmental Management Plan for Cement Plants	10	2	01	13
Total Hours	45	09	5	59

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Environmental Scenarios and Pollution due to cement manufacture.	02	03	02	07
CO-2	Pollution Sources of Cement Plants and quality of environmental parameters	-	08	02	10
CO-3	Impact of Environmental Pollution due Cement manufacture on Air, Water, Fauna, and Flora surrounding cement plants.	01	06	04	11
CO-4	Various Acts, guideline and norms of State and central govt for Environmental Management to Prevent and Control Pollution.	-	08	07	15
CO-5	Guideline for preparation of Environmental Management Plan for Cement Plants	-	03	004	07
Total		03	28	19	50

Legend: **R: Remember,** **U: Understand,** **A: Apply**

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture, Tutorial
2. Case Method
3. Group Discussion, Role Play
4. Visit to cement plant
5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, WhatsApp, Mobile, Online sources)
7. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition & Year
1	Environmental Pollution Control Engineering:	C S Rao	New Age International (P) Limited	2nd Edition ,2006
2	Air Pollution:	M N Rao, H.V.N. Rao	McGraw Hill Publication	1st Edition, 2017
3	Environmental Engineering:	Peavy and Rowe	McGraw Hill Publication	7th Edition, 1985
4	Design of Cement plant	S P Deolalkar	Bsp Books Pvt. Limited	2nd Edition, 2021
5	ISO: 14001:2015 on Environment Management Plan	ISO		2015

Curriculum Development Team

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8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Cos, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** OE-CT02 **Course Title:** EIA & EMP OF CEMENT PLANT

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
	Engineering knowledge	**Problem analysis**	**Design/development of solutions**	**Conduct investigations of complex problems**	**Modern tool usage**	**The engineer and society**	**Environment and sustainability**	**Ethics**	**Individual and team work**	**Communication**	**Project management and finance**	**Life-long learning**	**The ability to apply technical & engineering knowledge for production quality cement**	**Ability to understand the day to plant operational problems of cement manufacture**	**Ability to understand the latest cement manufacturing technology and it application**	**Ability to use the research based innovative knowledge for sustainable development**
OE-CT02.1: Environmental Scenarios and Pollution due to cement manufacture.	**1**	**3**	**1**	**2**	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**2**	**2**	**2**	**2**	**3**
OE-CT02.**2:** Pollution Sources of Cement Plants and quality of environmental parameters	**2**	**3**	**3**	**2**	**1**	**2**	**1**	**1**	**1**	**1**	**2**	**2**	**2**	**2**	**2**	**2**
OE-CT02.3: Impact of Environmental Pollution due Cement manufacture on Air, Water, Fauna, and Flora surrounding cement plants.	**3**	**3**	**1**	**1**	**1**	**2**	**1**	**2**	**1**	**2**	**2**	**2**	**1**	**2**	**2**	**3**

OE-CT02.4: Various Acts, guideline and norms of State and central govt for Environmental Management to Prevent and Control Pollution.	**2**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**1**
OE-CT02.5: Guideline for preparation of Environmental Management Plan for Cement Plants	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

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Course Curriculum Map: EIA & EMP OF CEMENT PLANT

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	OE-CT02.1: Environmental Scenarios and Pollution due to cement manufacture.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Introduction** 1.1,1.2,1.3,1.4,1.5,1.6,1.7	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	OE-CT02.**2:** Pollution Sources of Cement Plants and quality of environmental parameters	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2: Sources of Pollution in Cement Industr** 2.1, 2.2, 2.3, 2.4, 2.5,2.6,2.7,2.8,2.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	OE-CT02.3: Impact of Environmental Pollution due Cement manufacture on Air, Water, Fauna, and Flora surrounding cement plants.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Environmental Impact Assessment** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	OE-CT02.4: Various Acts, guideline and norms of State and central govt for Environmental Management to Prevent and Control Pollution.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Environment Management ACT** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	OE-CT02.5: Guideline for preparation of Environmental Management Plan for Cement Plants	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Environmental management plan** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10	

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Semester VII

Course Code: **OE-CT03**

Course Title: **Industrial Economics**

Pre-requisite: Basic understanding of Industrial Economics principles.

Rationale: Understanding foundational Industrial Economics principles is essential for comprehending the topics covered in this course and for analyzing firm behavior and market outcomes effectively.

Course Outcomes:

OE-CT03.1: Understand the foundational concepts and terminologies of Industrial Economics, including market structures, economies of scale, and industrial policy.

OE-CT03.2: Analyze different market structures and their implications for firm behavior, pricing strategies, and market outcomes.

OE-CT03.3: Evaluate theories of industrial organization and apply them to analyze strategic interactions among firms, regulatory frameworks, and market dynamics.

OE-CT03.4: Critically assess the role of government policies and regulations in shaping industrial development, competition, and market efficiency.

OE-CT03.5: Apply theoretical frameworks and empirical evidence to analyze real-world industrial scenarios, including industrial clusters, technological innovation, globalization, and sustainability.

Scheme of Studies:

Course Study	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
OEC	OE-CT03	Industrial Economics	3	0	2	1	6	3

Legend: **CI:** Classroom Instruction (Includes different in structional strategies i.e. Lecture(L) and Tutorial (T)and others,

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback teachers ensure outcome of Learning.

Scheme of Assessment:
Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks (PRA+ ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
OEC	OEC- CT03	Industrial Economics	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

OE-CT03.1: Understand the foundational concepts and terminologies of Industrial Economics, including market structures, economies of scale, and industrial policy.

Approximate Hours

Item	Approx. Hrs.
Cl	09
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	(LI)	Classroom Instruction (CI)	(SL)
SO1.1. Define key concepts in Industrial Economics. **SO1.2.** Race the historical evolution of Industrial Economics. **SO1.3.** Understand the significance of industrial policy in shaping economic development.		**Unit 1: Introduction to Industrial Economics** 1.1 Overview of Industrial Economics 1.2 Evolution and Development of Industrial Economics 1.3 Basic Concepts and Terminologies 1.4 Industry 1.5 Economics of Scale 1.6 Economies of Scope 1.7 Market Structure 1.8 Industrial Policy 1.9 Industrial Structure and Organization	**SL1.**Explore online resources and academic journals to understand recent developments in industrial economics theory and practice.

SW- 1 Suggested Sessional Work (SW):

1. **Assignment**: Assignment: Research and prepare a report on the evolution of industrial economics in a specific country or region.
2. **Mini Project:** Analyze the market structure of a local industry and present findings on its competitiveness and market dynamics.
3. **Other Activity**: Conduct a group discussion on current industrial policies and their impact on local businesses.

OE-CT03.2: Analyze different market structures and their implications for firm behavior, pricing strategies, and market outcomes.

Approximate Hours

Item	Appx Hrs.
Cl	09
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	(LI)	Classroom Instruction (CI)	(SL)
SO2.1. Identify and differentiate between different market structures. **SO2.2. Analyze** the behavior of firms in different market environments. **SO2.3.** Evaluate the efficiency and welfare implications of various market structure.		**Unit 2: Market Structures** 2.1 Perfect Competition 2.2 Monopoly 2.3 Monopolistic Competition 2.4 Oligopoly 2.5 Duopoly 2.6 Characteristics 2.7 Features and Examples of Each Market Structure 2.8 Market Power and Market Concentration Measures 2.9 Price Determination in Perfectly Competitive	**SL1.** Read case studies and analyze historical examples of market structures to gain insights into their effects on economic outcomes.

SW- 2 Suggested Sessional Work (SW):

a. **Assignment:** Compare and contrast two different market structures using real-world examples and discuss their implications for consumer welfare.

b. **Mini Project**: Conduct a survey among local businesses to assess market concentration and competition in a specific industry.

c. **Other Activity**: Organize a role-play simulation of a market scenario under different market structures to understand firm behavior.

OEC-CT404.3: Evaluate theories of industrial organization and apply them to analyze strategic interactions among firms, regulatory frameworks, and market dynamics.

Approximate Hours

Item	Appx Hrs.
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**(LI)**	**Classroom Instruction (CI)**	**(SL)**
SO3.1: Explain the Structure-Conduct-Performance paradigm. **SO3.2:** Apply game theory to analyze strategic interactions among firms. **SO3.3:** Evaluate pricing and non-price competition strategies employed by firms.		**Unit 3: Industrial Organization Theory** **3.1** Structure-Conduct-Performance Paradigm **3.2** Game Theory in Industrial Economics **3.3** Pricing Strategies **3.4** Non-Price Competition **3.5** Strategic Behavior of Firms **3.6** Entry and Exit Barriers **3.7** Transaction Cost Economics and Internalization Theory **3.8** Behavioral Economics and Its Application to Industrial Behavior **3.9** Principal-Agent Theory and Its Relevance to Firm Behavior	SL1.Explore advanced topics in industrial organization theory, such as transaction cost economics and agency theory, through supplementary readings and online lectures.

SW- 3 Suggested Sessional Work (SW):

a. **Assignment**: Critically evaluate the Structure-Conduct-Performance paradigm in the context of a selected industry and provide recommendations for policy interventions
b. **Mini Project**: Create a game theory model to simulate strategic interactions among firms in an oligopolistic market and analyze the outcomes.

c. **Other Activity:** Invite a guest speaker from the industry to discuss real-world applications of industrial organization theory.

OE-CT03.4 Critically assess the role of government policies and regulations in shaping industrial development, competition, and market efficiency.

Approximate Hours

Item	Appx Hrs.
Cl	09
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	(LI)	Classroom Instruction (CI)	(SL)
SO 4.1: Understand the objectives and formulation of industrial policy. **SO 4.2:** Analyze the role of government regulations in different industrial sectors. **SO 4.3:** Evaluate the impact of antitrust laws and competition policy on market competition.		**Unit 4: Industrial Policy and Regulation** **4.1**Role of Government in Industrial Development **4.2** Industrial Policy Formulation and Implementation **4.3** Regulatory Framework for Industries **4.4**Antitrust Laws and Competition Policy **4.5** Sector-specific Regulations (e.g., Energy, Telecom, Banking) **4.6** Industrial Clusters and Regional Development Policies **4.7** Trade Policies and Their Impact on Industrial Competitiveness **4.8** Environmental Regulations and Green Industrial Policies **4.9** Intellectual Property Rights and Innovation Policies	SL 1. Study international case studies of successful industrial policies and regulatory frameworks to understand best practices and lessons learned.

SW-4 Suggested Sessional Work (SW):

a. **Assignment:** Analyze the effectiveness of recent industrial policies in promoting economic growth and competitiveness in a specific sector.

b. **Mini Project:** Develop a proposal for a new industrial policy aimed at fostering innovation and sustainable development in a selected industry.

c. **Other Activity**: Organize a debate on the pros and cons of government intervention in industrial markets, with students taking on different perspectives

OEC-CT 404.5: Apply theoretical frameworks and empirical evidence to analyze real-world industrial scenarios, including industrial clusters, technological innovation, globalization, and sustainability

Approximate Hours

Item	Appx Hrs.
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	**(LI)**	**Classroom Instruction (CI)**	**(SL)**
SO 5.1 Identify and analyze industrial clusters and value chains. **SO 5.2**. Evaluate the role of technological innovation in industrial dynamics. **SO 5.3**. Assess the implications of globalization and sustainability on industrial restructuring		**Unit 5: Industrial Economics in Practice** **5.1** Industrial Clusters and Value Chains **5.2** Technological Innovation and Industrial Dynamics **5.3** Globalization **5.4** Industrial Restructuring Industrial Economics **5.5** Sustainable Development Case Studies and Real-world Applications **5.6** Technological Spillovers and Knowledge Diffusion Mechanisms **5.7** Industrial Resilience and Adaptive Strategies in Times of Economic Crisis **5.8** Corporate Social Responsibility and Its Role in Industrial Sustainability **5.9** Industry 4.0 and the Future of Manufacturing and Services Industries.	**SL 1.**Attend workshops or seminars on topics related to industrial economics, such as innovation management and supply chain optimization, to broaden your knowledge and skills.

SW –5 Suggested Sessional Work (SW):

a. **Assignment:** Investigate the role of industrial clusters in promoting regional development and present a case study highlighting their impact on local economies.

b. **Mini Project:** Collaborate with local businesses to analyze the adoption of new technologies and their effects on productivity and competitiveness.

c. **Other Activity**: Host a panel discussion with industry experts on the challenges and opportunities of globalization for domestic firms.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
CO1.Understand the foundational concepts and terminologies of Industrial Economics, including market structures, economies of scale, and industrial policy.	09	2	1	12
CO2..Analyze different market structures and their implications for firm behavior, pricing strategies, and market outcomes.	09	2	1	12
CO3.Evaluate theories of industrial organization and apply them to analyze strategic interactions among firms, regulatory frameworks, and market dynamics.	09	2	1	12
CO4.Critically assess the role of government policies and regulations in shaping industrial development, competition, and market efficiency.	09	2	1	12
CO5.Apply theoretical frameworks and empirical evidence to analyze real-world industrial scenarios, including industrial clusters technological innovation globalization, and sustainability.	09	2	1	12
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Understand the foundational concepts and terminologies of Industrial Economics, including market structures, economies of scale, and industrial policy.	01	01	03	05
CO-2	Analyze different market structures and their implications for firm behavior, pricing strategies, and market outcomes.	01	01	03	05
CO-3	Evaluate theories of industrial organization and apply them to analyze strategic interactions among firms, regulatory frameworks, and market dynamics.	-	03	10	13
CO-4	Critically assess the role of government policies and regulations in shaping industrial development, competition, and market efficiency.	-	03	10	13
CO-5	Apply theoretical frameworks and empirical evidence to analyze real-world industrial scenarios, including industrial clusters, technological innovation, globalization, and sustainability.	01	03	10	14
Total		03	11	36	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Financial Services and Insurance will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Brainstorming

Suggested Learning Resources:

(a) Books:

S. No.	Title	Author	Publisher	Edition Year
1	Industrial Economics	Martin Beckmann	Wiley-Blackwell	1st
2	Principles of Industrial Economics	James E. Smith	Oxford University Press	3rd
3	Industrial Economics: Theory and Practice	Donald S. Siegel	Routledge	2nd
4	Applied Industrial Economics	Thomas R. Howell	Cambridge University Press	1st
5	Lecture note provided by Dept. of Commerce AKS University, Satna.			

Curriculum Development Team

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5. Dr Gaurav Shukla, Assistant Professor, Dept of Cement Technology
6. Er Priyanka Singh, Assistant Professor, Dept. of Cement Technology
7. Er A K Bhattacharya, Faculty, Dept. of Cement Tech. (Former GM M/s Dalmia Cement)
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9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
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Program Title: B. Tech Cement Tech. **Course Code: OE-CT03** **Course Title: Industrial Economics**

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO1: Understand the foundational concepts and terminologies of Industrial Economics, including market structures, economies of scale, and industrial policy.	3	3	2	2	3	2	2	2	2	1	3	2	2	1	2	3
CO 2: Analyze different market structures and their implications for firm behavior, pricing strategies, and market outcomes.	3	3	2	2	3	2	2	2	1	1	2	2	2	1	3	2
CO3: Evaluate theories of industrial organization and apply them to analyze strategic interactions among firms, regulatory frameworks, and market dynamics	2	3	2	2	2	2	2	2	2	2	2	3	2	2	2	3

CO 4: Critically assess the role of government policies and regulations in shaping industrial development, competition, and market efficiency.	3	2	3	2	3	2	2	2	2	1	2	3	2	1	3	3
CO 5: Apply theoretical frameworks and empirical evidence to analyze real-world industrial scenarios, including industrial clusters, technological innovation, globalization, and sustainability	3	2	3	1	1	3	2	2	1	1	2	3	3	1	1	3

Course Curriculum Map: Industrial Economics

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning(SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO1: Understand the foundational concepts and terminologies of Industrial Economics, including market structures, economies of scale, and industrial policy.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		Unit-1.0 Introduction to Industrial Economics 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 2: Analyze different market structures and their implications for firm behavior, pricing strategies, and market outcomes.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		Unit-2 Market Structures 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8,2.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO3: Evaluate theories of industrial organization and apply them to analyze strategic interactions among firms, regulatory frameworks, and market dynamics	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		Unit-3: Industrial Organization Theory 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 4: Critically assess the role of government policies and regulations in shaping industrial development, competition, and market efficiency.	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		Unit-4: Industrial Policy and Regulation 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	CO 5: Apply theoretical frameworks and empirical evidence to analyze real-world industrial scenarios, including industrial clusters, technological innovation, globalization, and sustainability	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		Unit 5: Industrial Economics in Practice 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Semester-VII

Course Code: **OE-CT05**

Course Title: **Beneficiation of Low-Grade limestone for Cement Manufacture**

Pre- requisite: Student Should have knowledge on grade of limestone and clinker minerals

Rationale: If limestone doesn't boast the desired chemical composition, it falls into the category of low-grade limestone. In such cases, the CaO content is below 40%, the SiO2 content exceeds 18%, and occasionally, the MgO content surpasses 5%. These limestone varieties are unsuitable for cement production and need enhancements to meet the quality standards necessary for manufacturing Portland cement. This course is crafted to explore cost-effective beneficiation techniques aimed at enhancing limestone quality and rendering it suitable for cement production.

Course Outcomes:

OE-CT05.1: Examining the impact of physical, chemical, and mineralogical characteristics of low-grade limestone on the Portland cement production process and quality.

OE-CT05.2: Analyzing the composition and distribution patterns of limestone deposits in India.

OE-CT05.3: Limestone mining practices, the creation of mining rejects, and exploring their utilization in cement manufacture.

OE-CT05.4: Exploring potential beneficiation techniques aimed at enhancing the quality of limestone and its application in cement production.

OE-CT05.5: Exploring strategies for producing low-energy cement using low to marginal grade limestone.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
OEC	OE-CT05	Beneficiation of Low-Grade limestone for Cement Manufacture	3	0	2	1	6	3

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment (ESA)	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number marks each CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
OEC	OE-CT05	Beneficiation of Low-Grade limestone for Cement Manufacture	15	20	5	5	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

OE-CT05.1: Examining the impact of physical, chemical, and mineralogical characteristics of low-grade limestone on the Portland cement production process and quality.

Approximate Hours

Item	Appx Hrs
Cl	08
LI	0
SW	01
SL	01
Total	10

Session Outcomes (SOs)	**Laboratory Instruction (LI)**	**Class room Instruction (CI)**	**Self-Learning (SL)**
SO1: Chemical, Physical and mineralogical composition of Limestone **SO2:** Microstructure of carbonates **SO3:** Quality of limestone presently used for cement manufacture **SO4:** Role of minor constituents of limestone in process and quality of cement		**Unit -1: Properties of Cement Grade Limestone**: 1.1 Mineralogy and Chemical composition of Limestone, 1.2 Crystal chemistry of Calcite, Chemistry of dolomite, 1.3 Characteristics of clay minerals, 1.4 Texture of limestone, 1.5 Microstructure of carbonates, electrical and magnetic 1.6 Properties of carbonate and other associate minerals. 1.7 Quality aspects of limestone being presently used by cement plants, 1.8 Role of minor constituents in limestone for cement manufacture	SL1. Geological Origin of Calcareous rock

SW-1 Suggested Sessional Work (SW):

Assignments: Miner constituent's limestone and its impact on process of cement manufacture, Chemical and mineralogical composition of limestone, Chemistry of limestone and dolomite, Properties of carbonate rocks and associate minerals.

OE-CT05.2: Analyzing the composition and distribution patterns of limestone deposits in India.

Approximate Hours

Item	Appx Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class Room Instruction (CI)	Self-Learning (SL)
SO1: Characterisation of Indian Limestone **SO2:** Characterization of Indian limestone through out the Indian Stratigraphy **SO3:** Limestone deposits in East and west zone states of India **SO4:** Limestone occurrences in south and North Zones states of India		**Unit -2: Categorisation and occurrence of Indian Limestone**: 2.1 Categorization of Indian limestone based on grain size 2.2 The occurrence of limestone in India 2.3 The characteristics of limestone in different stratigraphic horizons. 2.4 Status of Indian Cement Industry Vis-a-Vis utilization of low/marginal grade limestone in various states 2.5 Rajasthan, 2.6 Maharashtra, Gujarat, 2.7 Madhya Pradesh, 2.8 Orissa and Chhattisgarh, 2.9 Andhra Pradesh, 2.10 Tamil Nadu and Karnataka	**SL1.** Geological stratigraphy of India.

SW-2 Suggested Sessional Work (SW):
Assignments: Distribution of limestone deposits in Indian Stratigraphy, Distribution of limestone in East and Waste zone districts of India with characteristic, Distribution of limestone in North and South zone districts of India with characteristic, categorization of Indian limestone deposits.

OE-CT05.3: Limestone mining practices, the creation of mining rejects, and exploring their utilization in cement manufacture

Approximate Hours

Item	Appx Hrs
Cl	08
LI	0
SW	2
SL	1
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1: Methods of mining of limestone deposits in India **SO2**: Generation of mine rejects during mining and its composition **SO3**: Mine Production Scheduling and Pit head quality control **SO4:** Potentiality of mine rejects use as cement Raw Material.		**Unit -3: Mining practices for Utilisation of low / marginal grade limestone deposits**: 3.1. Method of mining of limestone deposits and mine rejects. 3.2. Advanced mining practices 3.3. Computer applications in dealing deposit complexities. 3.4. Mine Production scheduling 3.5. Quality control during mining practices 3.6. Mine rejects generation during mining. 3.7. Composition of mine rejects 3.8. Potentiality of mining rejects use as cement raw materials	**SL1.**Raw mix design for manufacture of Portland cement clinker.

SW-3 Suggested Sessional Work (SW):
Assignments: Methods of Mining of limestone deposits and generation of mining rejects, Composition of mine rejects and its potentiality use as cement raw materials, Pit head quality control and mine rejects. Use of mine rejects as cement raw materials.

OE-CT05.4: Exploring potential beneficiation techniques aimed at enhancing the quality of limestone and its application in cement production.

Approximate Hours

Item	Appx Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1: Methods of beneficiation suitable for limestone **SO2:** Dry beneficiation technique of limestone. **SO3**: Wet beneficiation of limestone		**Unit-4: Potential beneficiation techniques for upgradation of low / marginal grade limestone:** 4.1 . Methods of beneficial techniques and separation of gangue materials. 4.2 Physical, chemical and mineralogical characteristics of limestone for beneficiation 4.3 Mineral Particle size and separation, 4.4 Froth floatation& enrichment of limestone, 4.5 Differential grinding and sieving, 4.6 Air classification techniques,	**SL1.** haracteristics of low-grade limestone and presence of unwanted materials in limestone

SO4: Bio technical method for enrichment of limestone.		4.7 Magnetic separation techniques, 4.8 Electrostatic separation, 4.9 Bio technical methods (beneficiation of limestone through bacterial leaching methods), 4.10 Photometric sorting.	

SW-4 Suggested Sessional Work (SW):

Assignments: Differential Grinding and sieving of limestone, Low grade limestone and dry beneficiation, Wet beneficiation of limestone and its advantages and dis advantages, Technique to enrich the high silica limestone.

OE-CT05.5: Gain insight into the utilization of diverse admixtures for enhancing the properties of concrete

Approximate Hours

Item	Appx Hrs
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1: Low energy cement and its raw materials **SO2**: Production of low energy cement and blended cement form low grade limestone **SO3:** Belit cement, sulfo-aluminate cement and its performance **SO4:** Geo-polymer, high magnesia cement and Gypsum plaster.		Unit-5: Production of low energy cements: 5.1 Introduction to low energy Cement Alkali activated slags and other alumino silicates 5.2 Low energy clinker production, 5.3 Blended cement, 5.4 Calcium aluminate cement manufacture, composition, 5.5 Production of belite cement 5.6 Performance of belite and 5.7 Sulfo-aluminate cements, 5.8 Geo-polymers 5.9 Gypsum plaster cement	1. Properties of GGBF Slag and Fly Ash

SW-5 Suggested Sessional Work (SW):

Assignments: Belite Cement production and Use, Production of sulfo aluminate belite cement, Blast slag and its characteristics, Manufacture of calcium aluminate cement, Geopolymers cement.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
CO1: Examining the impact of physical, chemical, and mineralogical characteristics of low-grade limestone on the Portland cement production process and quality.	08	01	01	10
CO2: Analyzing the composition and distribution patterns of limestone deposits in India.	10	02	01	13
CO3: Limestone mining practices, the creation of mining rejects, and exploring their utilization in cement manufacture.	08	02	01	11
CO4: Exploring potential beneficiation techniques aimed at enhancing the quality of limestone and its application in cement production.	10	02	01	13
CO5: Exploring strategies for producing low-energy cement using low to marginal grade limestone.	09	02	01	12
Total Hours	45	09	05	59

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

COs	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Examining the impact of physical, chemical, and mineralogical characteristics of low-grade limestone on the Portland cement production process and quality.	02	03	02	07
CO-2	Analyzing the composition and distribution patterns of limestone deposits in India.	0	08	02	10
CO-3	Limestone mining practices, the creation of mining rejects, and exploring their utilization in cement manufacture.	01	06	04	11
CO-4	Exploring potential beneficiation techniques aimed at enhancing the quality of limestone and its application in cement	-	08	07	15

	production.				
CO-5	Exploring strategies for producing low-energy cement using low to marginal grade limestone.	-	03	004	07
Total		03	28	19	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Introduction to Portland cement will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture, Tutorial
2. Case Method
3. Group Discussion, Role Play
4. Visit to cement plant
5. Demonstration
6. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, WhatsApp, Mobile, Online sources)
7. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition & Year
1	Cement Chemistry	F. W. Taylor	Thomas Telford,	1997
2	Handbook of mineral dressing, Ores and Industrial Minerals	Taggart,	John Wiley & Sons Canada, Limited	1999
3	Norms for Limestone Exploration For Cement Manufacture	National Council for Cement and Building Materials	National Council for Cement and Building Materials	1985
4	Mineral beneficiation	V Subba Rao,	CRC Press	2018

Curriculum Development Team

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech; Course **Code:** OEC-CT05

Course Title: Beneficiation of Low-Grade limestone for Cement Manufacture

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO-1: Examining the impact of physical, chemical, and mineralogical characteristics of low-grade limestone on the Portland cement production process and quality.	2	1	2	2	3	3	1	1	2	1	1	2	2	2	2	3
CO-2: Analyzing the composition and distribution patterns of limestone deposits in India.	3	3	3	2	1	2	1	1	1	1	2	2	2	2	2	2
CO-3: Limestone mining practices, the creation of mining rejects, and exploring	2	3	2	1	1	2	1	2	1	2	2	2	1	2	2	3

their utilization in cement manufacture.																
CO-4: Exploring potential beneficiation techniques aimed at enhancing the quality of limestone and its application in cement production.	**3**	**2**	**2**	**2**	**3**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**3**	**3**	**3**	**1**
CO-5: Exploring strategies for producing low-energy cement using low to marginal grade limestone.	**2**	**3**	**3**	**1**	**1**	**3**	**2**	**2**	**1**	**3**	**2**	**2**	**3**	**3**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

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(Revised as on 01 August 2023)

Course Curriculum Map: Beneficiation of Low-Grade limestone for Cement Manufacture

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-1:** Examining the impact of physical, chemical, and mineralogical characteristics of low-grade limestone on the Portland cement production process and quality.	SO1.1 SO1.2 SO1.3 SO1.4		**Unit-1: Properties of Limestone** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8	As mentioned, in above pages
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-2:** Analyzing the composition and distribution patterns of limestone deposits in India.	SO2.1 SO2.2 SO2.3 SO2.4		**Unit-2: Categorization and occurrence of Indian Limestone** 2.1, 2.2, 2.3, 2.4, 2.5,2.6,2.7,2.8,2.9,2.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-3:** Limestone mining practices, the creation of mining rejects, and exploring their utilization in cement manufacture.	SO3.1 SO3.2 SO3.3 SO3.4		**Unit-3: Mining practices for Utilization of low / marginal grade limestone deposits** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-4:** Exploring potential beneficiation techniques aimed at enhancing the quality of limestone and its application in cement production.	SO4.1 SO4.2 SO4.3 SO4.4		**Unit-4: Potential beneficiation techniques for upgradation of low / marginal grade limestone** 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO-5:** Exploring strategies for producing low-energy cement using low to marginal gravestone.	SO5.1 SO5.2 SO5.3 SO5.4		**Unit 5: Production of low energy cements** 5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9	

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Curriculum of B.Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

Semester-VII

Course Code: **OE-CT06**

Course Title: **REACTION ENGINEERING**

Pre- requisite: Student should have basic knowledge of chemical engineering, chemistry and mathematics

Rationale: Introduce the students to the fundamental principles of reaction engineering in order to enable them to handle kinetics and kinetic-transport interactions in a variety of situations. To introduce students to the analysis of the kinetics of homogeneous chemical reactions. To apply this analysis and the concepts of material and energy conservation to the design of idealized homogeneous chemical reactors operating both in batch and continuous modes and under both isothermally and non-isothermally conditions. To introduce the analysis of non-ideal flow and, using the flow model, to quantify its effect on an idealized reactor design

Course Outcomes:

OE-CT06.1: Develop a fundamental understanding of chemical reactions and reaction kinetics.

OE-CT06.2: Understanding of the principles of reaction rates, mechanisms, and their applications.

OE-CT06.3: Develop a fundamental understanding of homogeneous single reactions, including their importance in chemical processes.

OE-CT06.4: Understand the Principles of Multiple Reactions.

OE-CT06.5: Understanding the Impact of Temperature on Reaction Rates

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	
OEC	OE-CT06	REACTION ENGINEERING	3	0	1	1	5	3

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Theory

Course Category	Couse Code	Course Title	Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)						End Semester Assessment	Total Marks (PRA+ESA)
			Class/Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	Total Marks (CA+CT+SA+CAT+AT)		
OEC	OE-CT06	REACTION ENGINEERING	15	20	5	5	5	50	50	100

Course-Curriculum Detailing: OEC -CT 06 Reaction Engineering

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self-Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

OE-CT06.1: Develop a fundamental understanding of chemical reactions and reaction kinetics

Approximate Hours

Item	AppX Hrs
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1 Describe the role of chemical reactions in industrial processes **SO1.2** Define reaction kinetics and its importance in chemical engineering **SO1.3** Differentiate between batch and continuous reactors **SO1.4** Understand how reactors are connected in series and parallel. **SO1.5** Discuss real-world applications of batch and continuous reactors in chemical processes.	.	**Unit-1.0 Introduction** 1.1 Overview of chemical reaction engineering, Classification of reactions 1.2 Variables affecting rate, 1.3 Definition of reaction rate 1.4 single and multiple reactions 1.5 Elementary and non-elementary reactions 1.6 Molecularity and order of reaction 1.7 Reaction pathways, Effects of temperature, pressure 1.8 Heat and mass transfer on rate, Arrhenius law, Activation energy, 1.9 Reversible and irreversible reactions, Reaction equilibrium.	**SL1.**Practice solving problems related to mole balances, rate laws, and reactor design **SL2.**Study different types of reactions and their rate expressions

SW-1 Suggested Sessional Work (SW):

a. Assignments:

i. Define the term "reaction rate" in the context of chemical reactions?

ii. Define the term "rate law" and explain its role in describing reaction rates.

b. Mini Project:

What are the advantages and disadvantages of using a continuous stirred-tank reactor (CSTR) in chemical processes? Explain how concentration changes in a CSTR as a function of time.

c. Other Activities (Specify):

To understand the factors influencing reaction rates and how to measure reaction rates experimentally.

OE-CT06.2: Understanding of the principles of reaction rates, mechanisms, and their applications.

Approximate Hours

Item	AppX Hrs
Cl	12
LI	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1 Understand how the rate equation relates the rate of reaction to reactant concentrations. **SO2.2** Explain the concept of reaction order and how it influences the rate equation. **SO2.3** Explain the factors that affect reaction rates **SO2.4** Describe the concept of reaction mechanisms **SO2.5** Discuss the graphical representation of reaction kinetics data	.	**Unit-2 Kinetics of Homogeneous reaction** 2.1 Constant volume 2.2 variable volume batch 2.3 CSTR reactor data 2.4 PFR reactor data 2.5 Analysis of total pressure data 2.6Constant-volume batch reactor 2.7 Integral methods of analysis of data 2.8 Differential methods of analysis of data 2.9 Autocatalytic reactions 2.10 Reversible reactions, 2.11 Bio-chemical reactions 2.12 Rate of the reaction	**SL1.**Familiarizing yourself with the fundamental concepts of chemical kinetics **SL2.** Investigate the effect of temperature on reaction rates.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

i. Define the term "reaction order" and explain why it is a crucial concept in kinetics. Provide examples of zero-order, first-order, and second-order reactions.

ii. Describe the concept of reaction mechanisms in complex reactions. Explain how intermediates and elementary steps contribute to overall reaction kinetics. Provide a real-world example.

b. Mini Project:

Research and find kinetic data or conduct experiments to determine the rate equation for the chosen reaction

c. Other Activities (Specify):

Design a batch reactor for optimal conversion

OE-CT06.3: Develop a fundamental understanding of homogeneous single reactions, including their importance in chemical processes.

Approximate Hours

Item	AppX Hrs
Cl	10
LI	0
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO3.1 Understand the formulation of rate laws for homogeneous reactions **SO3.2** Apply the Arrhenius equation to describe the temperature dependence of rate constants **SO3.3** Describe the reaction mechanism for simple homogeneous single reactions	.	**Unit-3: Homogeneous Single Reactions** 3.1 Performance equations for ideal batch 3.2 Kinetics of Homogeneous Reactions 3.3 Plug flow 3.4 Back-mix flow batch reactors 3.5 semi batch reactors for isothermal condition 3.6 Size comparison of single reactors 3.7 Multiple-reactor systems 3.8 Recycle reactor 3.9 Autocatalytic reactions 3.10 Optimum recycle operations	**SL1.** Analyze real-world applications of homogeneous single reactions in various industries **SL2.** Calculate the reactor volume required to achieve a specific conversion **SL3.** Use graphical representations to illustrate reaction kinetics.

SO3.4 Comprehend the operation and design of batch reactors **SO3.** Define key design parameters for homogeneous single reactions, including space velocity and residence time.			

SW-3 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the role of reaction mechanisms in understanding homogeneous single reactions. How do mechanisms help us interpret reaction kinetics?

ii. Define reaction kinetics and explain why it is crucial in chemical engineering

b. Mini Project:

The objective of this mini-project is to design, conduct, and analyze experiments to study the kinetics and mechanism of a homogeneous single reaction.

c. Activities (Specify):

Power point presentation on mini project

OE-CT06 .4: Understand the Principles of Multiple Reactions

Approximate Hours

Item	AppX Hrs
Cl	7
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO4.1 Define multiple reactions and differentiate between parallel, series, and complex reactions		**Unit-4: Multiple Reactions** 4.1 Parallel reactions of different orders 4.2 Yield and selectivity	**SL1.**Choose a reaction mechanism (e.g., parallel or consecutive

SO4.2 Discuss the concept of intermediates in complex reactions **SO4.3** Understanding the yield and selectivity **SO4.4** Identify the role of catalysts and reaction conditions **SO4.5** Interpret simulation results to gain insights into complex reaction systems.		4.3 Product distribution and design for single and multiple-reactors 4.4 Series reactions: first-order reactions and 4.5 zero-order reactions 4.6 Mixed series parallel complex reaction 4.7 Choice of reactors for simple and complex reactions	reactions) and analyze its kinetics **SL2.**Choose a real-world case study involving multiple reactions

Suggested Sessional Work (SW)

a. **Assignments:**
   i. Write the rate law expression for the parallel reaction A → B + C if the reaction is second-order with resect to A.
   ii. Analyze experimental data for a multiple reaction system with known rate constants.

b. **Mini Project:**
   i. Visit to a cement plant and study the reactors involve in the industry

c. **Other Activities (Specify):**
   Using chemical engineering software (if available) or any simulation tool

OE-CT06 .5: Understanding the Impact of Temperature on Reaction Rates

Approximate Hours

Item	AppX Hrs
Cl	07
LI	0
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO5.1 Understanding the Impact of Temperature on Reaction Rates **SO5.2** Multi-Reaction Systems and Temperature **SO5.3** Recognize the influence of temperature on the selectivity **SO5.4** Describe experimental methods used to activation energies at different temperatures. **SO5.5**To understand Effect of temperature on product distribution for parallel reactions		**Unit 5: Temperature Effects for Single and Multiple Reactions** 5.1. Thermal stability of reactors 5.2. Optimal temperature 5.3. progression for first order reversible reactions 5.4. Adiabatic and heat regulated reactions 5.5. Design of non-isothermal reactors 5.6. Effect of temperature on product distribution for series reactions 5.7. Effect of temperature on product distribution for parallel reactions	**SL1.**Work on problems related to temperature effects on single and multiple reactions **SL2.**Recognize the influence of temperature on the selectivity

SW-5 Suggested Sessional Work (SW):

a. Assignments:

i. Explain the role of thermodynamic and kinetic control in multi-reaction systems and how temperature affects these aspects.

ii. Practice using chemical engineering simulation software like Aspen Plus or COMSOL

b. Mini Project:

Design and conduct your own experiments to explore the temperature effects on reactions.

c. Other Activities (Specify):

Analyze the role of temperature in industrial reactors and the optimization of reaction conditions.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self-Learning (Sl)	Total hour (Cl+SW+Sl)
OE-CT06.1: Develop a fundamental understanding of chemical reactions and reaction kinetics	9	2	1	12
OE-CT06.2: Understanding of the principles of reaction rates, mechanisms, and their applications	12	2	1	15
OE-CT06.3: Develop a fundamental understanding of homogeneous single reactions, including their importance in chemical processes.	10	2	1	13
OE-CT06 .4: Understand the Principles of Multiple Reactions	07	2	1	10
OE-CT06.5: Understanding the Impact of Temperature on Reaction Rates	07	2	1	10
Total Hours	45	10	5	60

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Marks Distribution			Total Marks
		R	U	A	
CO-1	Develop a fundamental understanding of chemical reactions and reaction kinetics	03	01	01	05
CO-2	Understanding of the principles of reaction rates, mechanisms, and their applications	02	06	02	10
CO-3	Develop a fundamental understanding of homogeneous single reactions, including their importance in chemical processes.	03	07	05	15
CO-4	Understand the Principles of Multiple Reactions	03	07	05	15
CO-5	Understanding the Impact of Temperature on Reaction Rates	03	02	-	05
Total		14	23	13	50

Legend: R: Remember, U: Understand, A: Apply

The end of semester assessment for Reaction Engineering will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wise teachers for above tasks. Teachers can also design different tasks as per requirement, for end semester assessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, WhatsApp, Mobile, Online sources)
9. Brainstorm

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition & Year
1	Elements of Chemical Reaction Engineering,	Fogler, H.S.,	Prentice Hall of India	2003
2	Chemical Reaction Engineering	Levenspiel, O.,	John Wiley & Sons	1998
3	Chemical Engineering Kinetics, (1990)	Smith, J.M.,	McGraw Hill, New York	1990
4	Chemical Reactor Theory - An Introduction	Denbigh, K.G., and Turner, J.C.R.,	Cambridge University Press, UK	1984
5	Lecture note provided by Dept. of Cement Technology, AKS University, Satna.			

Curriculum Development Team

1. Prof. G C Mishra, Director Cement Technology, AKS University
2. Dr S K Jha, Head of the Department, Dept. of Cement Technology
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A K S University

Faculty of Engineering and Technology

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(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Course Title: B. Tech. Cement Technology **Course Code:** OE-CT06 **Course Title:** Reaction Engineering

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
CO1: Develop a fundamental understanding of chemical reactions and reaction kinetics	3	2	2	2	3	2	1	1	1	2	1	2	2	2	1	3
CO2: Understanding of the principles of reaction rates, mechanisms, and their applications.	3	2	2	2	3	2	1	1	1	2	1	2	2	2	1	2
CO3: Develop a fundamental understanding of homogeneous single reactions, including their importance in chemical processes.	3	3	2	2	2	2	1	1	2	2	2	3	2	2	1	3

CO4: Understand the Principles of Multiple Reactions	**3**	**3**	**3**	**2**	**3**	**2**	**2**	**1**	**2**	**2**	**2**	**2**	**2**	**2**	**1**	**3**
CO5: Understanding the Impact of Temperature on Reaction Rates	**3**	**3**	**3**	**2**	**2**	**3**	**2**	**2**	**2**	**2**	**2**	**3**	**2**	**2**	**1**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Reaction Engineering

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO1:** Develop a fundamental understanding of chemical reactions and reaction kinetics	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5		**Unit-1: Introduction** 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9	As mentioned, in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO2:** Understanding of the principles of reaction rates, mechanisms, and their applications.	SO2.1 SO2.2 SO2.3 SO2.4 SO2.5		**Unit-2 Kinetics of Homogeneous reaction** 2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7,2.8,2.9,2.10,2.11,2.12	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO3:** Develop a fundamental understanding of homogeneous single reactions, including their importance in chemical processes.	SO3.1 SO3.2 SO3.3 SO3.4 SO3.5		**Unit-3: Homogeneous Single Reactions** 3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8, 3.9,3.10	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO 4:** Understand the Principles of Multiple Reactions	SO4.1 SO4.2 SO4.3 SO4.4 SO4.5		**Unit-4: Multiple Reactions** 4.1, 4.2,4.3,4.4,4.5,4.6,4.7	
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO 5:** Understanding the Impact of Temperature on Reaction Rates	SO5.1 SO5.2 SO5.3 SO5.4 SO5.5		**Unit 5: Temperature Effects for Single and Multiple Reactions** 5.1,5.2,5.3,5.4,5.5,5.6,5.7	

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Semester-VII

Course Code: **PROJ-CT02**

Course Title : **Engineering Project-2 (Design & Analysis)**

Pre-requisite: Students should have basic knowledge for design, development and analysis of project.

Rationale: Students should be well-versed in the cement manufacturing process and concrete production. Keeping abreast of the latest technological trends is crucial for identifying contemporary R&D topics. A fundamental understanding of the physical and chemical properties of cement and concrete is essential. Additionally, students must be proficient in statistical methods for effective data analysis and interpretation. Competence in Microsoft Word and Excel is necessary for report writing and documentation. By combining technical knowledge with analytical and software skills, students will be well-prepared to tackle challenges in the field and contribute meaningfully to research and development efforts.

Course Outcomes:

PROJ-CT02.1: Methodology for project design and project scheduling

PROJ-CT02.2: Methods of Data collection and data compiliation

PROJ-CT02.3: Product development

PROJ-CT02.4: Data analysis and data interpretation

PROJ-CT02.5: Concluding remark and future work

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PROJ	PROJ-CT02	Engineering Project-2 (Design and Analysis)	0	10	0	0	10	5

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)									
			Progressive Assessment (PRA)						**End Semester Assessment**			**Total Marks (PRA+ESA)**
			Project Scheduling	**Data collection and sampling**	**Product design**	**Product analysis and data interporetaion**	**Report writing and concluding remark**	**Total Mark**	**Seminar**	**Project Viva**	**Total Marks**	
PROJ	PROJ-CT02	Engineering Project-2 (Design & Analysis)	05	05	05	25	10	50	15	35	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Lab Work Assignment (LA) Best of 5 of the total, Viva-Voice on Lab Work (VV), and Lab Attendance (LA). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Course Outcome	Activities	Time Schedule (in hours)	
		Class Activity Per week (5 Credit)	Self Learning /Home activity Per week
PROJ-CT02.1: Methodology for design and project scheduling	**1. Literature review and identification of Cement and concrete related projects and project scheduling** 1.1 Examining recent literature on cement and concrete	10	10

	projects unveils advancements, methodologies, and applications. This review identifies emerging trends, innovative materials, and sustainable practices, significantly impacting construction, durability, and environmental outcomes. Noteworthy projects illustrate novel approaches, enriching insights and guiding future developments in cement and concrete technology. **1.2 Project scheduling** : Project scheduling involves planning and organizing tasks to ensure timely completion. It includes defining activities, setting deadlines, and allocating resources efficiently. Effective scheduling helps manage time, costs, and personnel, enhancing productivity and project success. It's crucial for meeting goals, coordinating efforts, and maintaining project momentum		
PROJ-CT02.2: Methods of Data collection and data compiliation	2**. Design and formulation projects** 2.1 Methods of data collection and data compiletion 2.2 Design and formulation projects concentrate on innovating products through meticulous recipe development and methodological refinement. These initiatives prioritize material optimization, functional enhancement, and quality assurance. By blending creativity with technical prowess, they propel advancements across industries, fostering the creation of distinctive, efficient, and commercially viable solutions.	16	15
PROJ-CT02.3: Product development	**3. Sample analysis and product development** 3.1 Testing samples determines their suitability by assessing quality, performance, and compliance with standards. It involves rigorous analysis and evaluation to ensure materials meet project requirements. This process identifies strengths and weaknesses, guiding decision-making and ensuring the reliability and effectiveness of the chosen samples for intended applications. 3.2 Product design and analysis in R&D involve creating and refining products to meet market needs. This process includes conceptualizing, prototyping, and testing to optimize functionality and performance. Analyzing results helps improve designs, ensuring products are innovative, efficient, and ready for successful market	20	25

	introduction.		
PROJ-CT02.4: Data analysis and data interpretation	**i. Product Data analysis & compilation** 4.1 Project data compilation involves collecting and organizing all relevant information for analysis and reporting. This process ensures data accuracy and completeness, facilitating informed decision-making and efficient project management. It helps track progress, identify trends, and generate insights, supporting successful project outcomes and future planning. 4.2 **Statistical data analysis and data interpretation** Statistical data analysis involves examining and processing data to uncover patterns and trends. Data interpretation translates these findings into meaningful insights, aiding decision-making and strategy development. This process enhances understanding, supports evidence-based conclusions,	80	15
PROJ-CT02.5: Concluding remark and future work	**5. Report Writing, Conclusion, Recommendations and Future work in Research work** **5.1 Report Writing** : Comprehensive project report writing **5.2 Conclusion:** The study successfully demonstrated key findings. It underscores implications, validating hypothesis/objectives. This contributes field significance, laying groundwork for applications. **5.3 Recommendation**: Future research should explore expansion areas, emphasizing methodological improvements. Collaboration partners/stakeholders would enrich knowledge transfer. **5.4 Future Work:** Innovations in technology/techniques could advance potential benefits. Addressing challenges would refine outcomes, fostering industry/government support.	24	25
Total		150	90

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

Course Outcome	Unit Titles	MarksDistribution			Total Marks
		R	U	A	
PROJ-CT02.1: Methodology for design and project scheduling	1. Literature review and identification of Cement and concrete related projects and project scheduling	02	03	-	5
PROJ-CT02.2: Methods of Data collection and data compiliation	2. Design and formulation projects	-	05	03	8
PROJ-CT02.3: Product development	3. Sample analysis and product development	-	08	04	12
PROJ-CT02.4: Data analysis and data interpretation	4. Product Data analysis, data interpretation and findings	-	08	12	20
PROJ-CT02.5: Concluding remark and future work	5. Report writing, concluding remark and future work		03	02	5
Total		02	27	21	50

Legend: R:Remember, U:Understand, A:Apply

The end of semester assessment for Engineering Project-1 (Literature Review) will be held with written examination of 50 marks

Note. Detailed Assessment rubric need to be prepared by the course wiseteachers for above tasks. Teachers can also design different tasks as per requirement, for endsemesterassessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration

8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

Suggested Learning Resources:

(a) Books:

S.No.	Title	Author	Publisher	Edition &Year
1	Ordinary Portland Cement	IS 269-2015	6th Edition BIS	2015
2	Concrete Technology Lab Manual	Dr. Bharadwaj Nanda and Prof. A.N. Nayak	Concrete Technology Lab Manual	
3	Concrete Technology Lab Manual	Nanditha Mandava,	MLRITM	2022
4	Methods of physical tests for hydraulic cement	IS 4031-1	BIS	1996
5	Method of chemical analysis of hydraulic cement	IS 4032	BIS	1985

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** PROJ-CT02 **Course Title:** Engineering Project-2 (Design & Analysis)

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PROJ-CT02.1: Methodology for design and project scheduling	**3**	**2**	**2**	2	2	3	3	1	1	1	2	1	**1**	**2**	**2**	**1**
PROJ-CT02.2: Methods of Data collection and data compiliation	**3**	**3**	**2**	2	2	3	3	1	1	1	3	1	**2**	**2**	**2**	**1**
PROJ-CT02.3: Product development	**3**	**3**	**2**	2	2	3	3	1	1	1	3	1	**2**	**2**	**2**	**1**
PROJ-CT02.4: Data analysis and data interpretation	**3**	**3**	**2**	2	2	3	3	1	1	1	3	1	**2**	**2**	**2**	**1**
PROJ-CT02.5: Concluding remark and future work	**2**	**3**	**3**	3	3	1	1	1	1	1	3	1	**2**	**1**	**2**	**3**

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Engineering Project-2 (Design & Analysis)

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	PROJ-CT02.1: Methodology for design and project scheduling	SO1.1 SO1.2	Unit 1: Literature review and identification of Cement and concrete related projects and project scheduling		As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	PROJ-CT02.2: Methods of Data collection and data compiliation	SO2.1 SO2.2	Unit 2: Design and formulation projects		
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	PROJ-CT02.3: Product development	SO3.1 SO3.2	Unit 3: Sample analysis and product development		
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	PROJ-CT02.4: Data analysis and data interpretation	SO4.1 SO4.2	Unit 4: Product Data analysis & compilation		
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	PROJ-CT02.5: Concluding remark and future work	SO5.1 SO5.2 SO5.3 SO5.4	Unit 5: Report Writing, Conclusion, Recommendations and Future work in Research work		

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Semester-VII

Course Code: **PROJ-CT03**

Course Title : **Seminar**

Pre-requisite: Students should have basic knowledge on design and presentation of technical seminar.

Rationale: The student possesses knowledge of the processes involved in the manufacture of cement and concrete. Additionally, the student should be familiar with the latest trends in cement manufacturing and the challenges faced by the cement industry. Presenting the latest technological advancements in cement manufacturing is essential for the seminar.

Course Outcomes:

PROJ-CT03.1: Identification and objective of the seminar topic, along with a literature review that includes recent technological trends.

PROJ-CT03.2: In-depth analysis and interpretation of technical data related to the seminar topic, including case studies and practical implementation examples.

PROJ-CT03.3: Preparation and delivery of the seminar presentation, including a question and answer session.

Scheme of Studies:

Course Category	Course Code	Course Title	Scheme of studies(Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PROJ	PROJ- CT03	Seminar	0	2	0	1	3	1

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)

SW: Sessional Work (includes assignment, seminar, mini project etc.),

SL: Self Learning,

C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)								
			Progressive Assessment (PRA)					End Semester Assessment			Total Marks (PRA+ESA)
			Identification of seminar topic	Data collection	Prepartion presenation	Seminar presentation	Total Mark	Seminar content	Presentation and Question answer	Total Marks	
PROJ	PROJ-CT03	Seminar	05	05	25	15	50	10	40	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Lab Work Assignment (LA) Best of 5 of the total, Viva-Voice on Lab Work (VV), and Lab Attendance (LA). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

Course Outcome	Activities	Time Schedule (in hours)	
		Class Activity Per week (1 Credit)	Self Learning /Home activity Per week
PROJ-CT03.1: Identification and objective of the seminar topic, along with a literature review that includes recent technological trends.	1. **Introduction and fundamentals Seminar** SO1. Objectives of the Seminar SO2. Identification and Overview of Topics to be Covered SO3.Importance and Relevance of the Seminar in Current Industry Trends SO4. Introduction to the Technical Field SO5. Basic Concepts and Terminology SO6.Historical Development and Milestones SO7. Current State of the Technology	6	5

PROJ-CT03.2: In-depth analysis and interpretation of technical data related to the seminar topic, including case studies and practical implementation examples	2.0 **In-depth Technical Sessions and preparation of presentation** SO2.1.**Module 1: Advanced Theoretical Concepts** - Key Theories and Principles - Mathematical Foundations - Models and Algorithms SO 2.2 **Module 2: Practical Applications** - Industry Applications - Case Studies - Real-world Scenarios **SO 2.3 Module 3 : Practical Implementation** - Step-by-step Guide to Solving a Problem - Coding and Development - Debugging and Optimization	14	15
PROJ-CT03.3: Preparation and delivery of the seminar presentation, including a question and answer session.	**Prepartion of seminar content in proper presentation format and seminar presentation** SO3.1 Prsentaion and Quartion answer session SO3.2 Seminar feed back and over view	10	10
Total		30	30

Suggestion for End Semester Assessment

Suggested Specification Table(For ESA)

Course Outcome	UnitTitles	MarksDistribution			Total Marks
		R	U	A	
PROJ-CT03.1: Identification and objective of the seminar topic, along with a literature review that includes recent technological trends.	Introduction and fundamentals Seminar	05	05	0	10
PROJ-CT03.2: In-depth analysis and interpretation of technical data related to the seminar topic, including case studies and practical implementation examples	In-depth Technical Sessions and preparation of presentation	0	10	05	15

PROJ-CT03.3: Preparation and delivery of the seminar presentation, including a question and answer session	Prepartion of seminar content in proper presentation format and seminar presentation	0	10	15	20
Total		05	25	20	50

Legend: **R:Remember,** **U:Understand,** **A:Apply**

Note. Detailed Assessment rubric need to be prepared by the course wiseteachers for above tasks. Teachers can also design different tasks as per requirement, for endsemesterassessment.

Suggested Instructional/Implementation Strategies:

1. Improved Lecture
2. Tutorial
3. Case Method
4. Group Discussion
5. Role Play
6. Visit to cement plant
7. Demonstration
8. ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook,Twitter, Whatsapp, Mobile, Online sources)
9. Brainstorming

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COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** PROJ-CT03 **Course Title:** Seminar

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PROJ-CT03.1: Identification and objective of the seminar topic, along with a literature review that includes recent technological trends.	3	2	2	2	2	3	3	1	1	1	2	1	1	2	2	3
PROJ-CT03.2: In-depth analysis and interpretation of technical data related to the seminar topic, including case studies and practical implementation examples	3	3	2	2	2	3	3	1	1	1	3	1	2	2	2	2
PROJ-CT03.3: Preparation and delivery of the seminar presentation, including a question and answer session.	3	3	2	2	2	3	3	1	1	1	3	1	2	2	2	1

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Seminar

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO.1:** Identification and objective of the seminar topic, along with a literature review that includes recent technological trends.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6 SO1.7	Introduction and fundamentals Seminar		As mentioned in above pages
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO.2:** In-depth analysis and interpretation of technical data related to the seminar topic, including case studies and practical implementation examples	SO2.1 SO2.2 SO2.3	In-depth Technical Sessions and preparation of presentation		
PO:1,2,3,4,5,6, 7,8,9,10,11,12 PSO 1,2, 3, 4	**CO.3:** Preparation and delivery of the seminar presentation, including a question and answer session.	SO3.1 SO3.2	Prepartion of seminar content in proper presentation format and seminar presentation		

Semester VIII

Course Code: PROJ-CT04

Course Title: Engineering Project-3 (Prototype & Testing)/ On job Plant Training

Pre- requisite: Basic Knowledge of Cement Plant

Rationale: The objectives of the Industrial Training include: To give students the opportunity to apply the knowledge and skills they have acquired on campus in a real-life work situation. To provide students with opportunities for practical, hands-on learning from practitioners in the student's areas of specialization. To expose students to a work environment, common practices, employment opportunities and work ethics in their relevant field. To enhance the employability skills of the students. To provide opportunities for students to be offered jobs in the organizations in which they undergo their Industrial Training.

Course Outcomes:

PROJ-CT04.1: Understand the organizational environment and recognize the requirement of the organization and cope with the organizational scenario.

PROJ-CT04.2: Identify career paths taking into account their individual strengths and aptitude and prepare a report about the work experience in the organization.

PROJ-CT04.3: Develop the employability skills and Start-Up skills to increase his/her ability to engage in life-long learning

PROJ-CT04.4: Develop individual confidence to handle various engineering assignments and acquire life skills to meet societal challenges.

Scheme of Studies:

Course Category	CourseCode	Course Title	Scheme of studies (Hours/Week)					Total Credits (C)
			CI	LI	SW	SL	Total Hours (CI+LI+SW+SL)	
PROJ	PROJ-CT04	Engineering Project 3 (Prototype & testing)/ On job Plant Training	0	24	1	1	26	12

Legend: **CI:** Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),

LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning,
C: Credits.

Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment:
Engineering Project

Course Category	Course Code	Course Title	Scheme of Assessment (Marks)					Total Marks (PRA+ESA)
			Progressive Assessment (PRA)				End Semester Assessment Final Project Report + Seminar + Viva (ESA)	
			5 Internal Progress Report Monthly 7 marks each (IPR)	Seminar one (TSN)	Class Attendance (TA)	Total Marks (IPR+TSN+TA)		
PROJ	PROJ-CT04	Engineering Project-3 (Prototype & Testing)/ On job Plant Training	35	10	5	50	50	100

Course-Curriculum Detailing:

This course syllabus illustrates the expected learning achievements, both at the course and session levels, which students are anticipated to accomplish through various modes of instruction including Classroom Instruction (CI), Laboratory Instruction (LI), Sessional Work (SW), and Self Learning (SL). As the course progresses, students should showcase their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

On Job Industrial Training & Time Schedule		
Activity	**Broad Area of Training**	**Time Schedule**
Plant Data	Product information, Capacity of the plant, is the company quoted on the stock exchange, locally, international, if so how has their share price varied during your time with the company? (Type of industry - Public Limited, Private Limited, Co-operative sector etc.) Site Plan, /Plant Layout, Flow Diagram / Process Diagram	48 Hours (1Week)
Process Technology	Manufacturing processes, Drawings (if available), specification of the machinery in use, The type of fuel, process control parameters, CCR operation	48 Hours (1Week)
Raw Materials	Quality and source of the various raw materials used by the Cement plant.	96 Hours (2Weeks)
Limestone Mining	Limestone Mining practices, quarry scale of operation, Pit head Quality control	96 Hours (2Week)
Homogenization and Raw meal preparation	Crushing of limestone pre homogenization stock pile, grinding and homogenisation of raw meal	96 Hours (2Weeks)
Fuel	Quality, source and preparation of fuel for firing including Alternate Fuel (if used by the plant)	96 Hours (2Weeks)
Pyro-processing and Clinker manufacture	Rotary kiln operation, pre heater , pre calciner technique , process control	96 Hours (2Weeks)
Clinker cooling	Clinker cooling practices	96 Hours (2Weeks)
Energy Management	The energy requirements of the company (machinery, lighting, heating and or air conditioning): Source, connected load, Surplus electricity, Correlate items that can reveal major outcomes, e.g. how power factor in electricity bill reveals production rate. Waste heat recovery system and cogeneration of power.	48 Hours (1Week)
Material Handling Systems	Material handling system of cement plant	48 Hours (1Week)

Maintenance Practices of the plant	Maintenance schedule / Programmers: Preventive Maintenance, Stoppages, Breakdown Maintenance, Calibration Systems	48 Hours (1Week)
Instrumentation and control	Process automation, Type of Instrumentation and Control, Fully / Partially automated, Office Automation, Value and system analysis	48 Hours (1Week)
Plant Utilities:	Own source of water or else , Water reservoir, Boiler, DM Plant, Electricity, Power, Compressor, Air Conditioning, Effluent Treatment Plant Production of Cement and Despatch Systems	48 Hours (1Week)
Quality Control & Quality Assurance	Quality control system of the cement plant and quality assurance practices in cement manufacturing process of cement	48 Hours (1Week)
Human Resource Planning and Management	Technical, Non-Technical, Administrative, Direct employment, Indirect employment, Turnover-capital employed	48 Hours (1Week)
Materials Management	Purchasing, Write-off policy, Inventory Control, Competitors, Export achievements, Building and Construction, Budgetary provisions, control and cost analysis, Budgets/Project planning/scheduling	48 Hours (1Week)
Safety and Hygiene	Environmental norms, Fire Safety norms, Industrial Safety norms.	48 Hours (1Week)
Marketing Strategy and Consumer Satisfaction measure	Marketing practices and consumer satisfaction measure taken by the cement plant	48 Hours (1Week)
Total Hours		1152 Hours (24 Weeks)

OR

(In campus Training)

Prototype & Testing & Time Schedule		
Activity	**Broad Area of Training**	**Time Schedule**
Project Planning/ Problem Designing /Gap Identification	This involves clearly defining the problem or research question that needs to be addressed in the laboratory. It includes understanding the context, scope, and significance of the problem.	144 Hours (3 Weeks)
Literature Review	This helps in identifying gaps in knowledge and determining the best approach to address the problem.	144 Hours (3 Weeks)
Experimental Methodology Development & Interpretation	Analysis and interpretation in lab research involve processing data for patterns, using statistical methods for insights, and contextualizing findings to draw conclusions that advance scientific understanding and guide further research.	384 Hours (8 Weeks)
Result & Discussion	Results and discussion in laboratory research entail presenting findings, interpreting their significance, and contextualizing them within existing knowledge to address research objectives and implications effectively.	192 Hours (4 Weeks)
Report Writing	Research writing involves synthesizing literature, presenting methods and findings, interpreting results, and discussing implications succinctly to contribute knowledge, validate findings, and propose further exploration in the field.	288 Hours (6 Weeks)
Total Hours		1152 Hours (24 Weeks)

Curriculum Development Team

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2. Dr S K Jha, Head of the Department, Dept. of Cement Technology
3. Dr Rahul Omar, Assistant Professor, Dept. of Cement Technology
4. Dr Rohit Omar, Assistant Professor, Dept. of Cement Technology
5. Dr Gaurav Shukla, Assistant Professor, Dept of Cement Technology
6. Er Priyanka Singh, Assistant Professor, Dept. of Cement Technology
7. Er A K Bhattacharya, Faculty, Dept. of Cement Tech. (Former GM M/s Dalmia Cement)

8. Sh P.K. Pathak, Sr Faculty, Dept. of Cement Tech. (Former GM M/s JP cement)
9. Sh V K Singh, Sr Faculty, Dept. of Cement Tech. (Former GM M/s Maihar Cement)
10. Dr K Mohan, former Director General of National Council for Cement and Building Materials
11. Er. Ankur Mittal, Group Manager, National Council for Cement and Building Materials

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A K S University

Faculty of Engineering and Technology

Department of Cement Technology

Curriculum of B. Tech. (Cement Technology) Program

(Revised as on 01 August 2023)

COs, POs and PSOs Mapping

Program Title: B. Tech Cement Tech **Course Code:** PROJ-CT04

Course Title: Engineering Project-3 (Prototype & Testing)/ On job Plant Training

Course Outcomes	Program Outcomes												Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
	Engineering knowledge	Problem analysis	Design/development of solutions	Conduct investigations of complex problems	Modern tool usage	The engineer and society	Environment and sustainability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for production quality cement	Ability to understand the day to plant operational problems of cement manufacture	Ability to understand the latest cement manufacturing technology and it application	Ability to use the research based innovative knowledge for sustainable development
PROJ-CT04.1: Understand the organizational environment and recognize the requirement of the organization and cope with the organizational scenario.	2	1	1	1	1	3	3	1	1	1	1	2	3	3	3	3
PROJ-CT04.2: Identify career paths taking into account their individual strengths and aptitude and prepare a report about the work experience in the	3	1	2	2	2	3	3	1	1	1	1	2	3	3	3	3

organization.																
PROJ-CT04.3: Develop the employability skills and Start-Up skills to increase his/her ability to engage in life-long learning	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**1**	**3**	**3**	**3**	**2**	**3**	**1**
PROJ-CT04.4: Develop individual confidence to handle various engineering assignments and acquire life skills to meet societal challenges.	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**2**	**3**	**2**	**3**	**2**	**3**	**3**	**3**	**1**

Legend: 1 – Low, 2 – Medium, 3 – High