Curriculum Book

and

Assessment and Evaluation Scheme

based on

Outcome Based Education (OBE)

M.Sc. (Ag.) in Soil Science

2 Year Degree Program

Revised as on 01 August 2023 Applicable w.e.f. Academic Session 2023-24



AKS University

Satna 485001, Madhya Pradesh, India

Faculty of Agriculture Science and Technology Department of Soil Science



AKS University Faculty of Agriculture Sciences and Technology **Department of Soil Science** Curriculum & Syllabus of M.Sc.(Ag.) program (Revised as on 01 August 2023)

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A K S University Faculty of Agriculture Science and Technology Department of Soil Science Curriculum & Syllabus of M.Sc. (Ag) in Soil Science program (Revised as on 01 August 2023)

Forwarding

I am thrilled to observe the updated curriculum of the Soil Science Department for M. Sc. (Ag) in Soil Science Program, which seamlessly integrates the most recent genetically plant advancements and adheres to the guidelines set forth by National Core Group and BSMA Committees appointed by ICAR. 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 M. Sc. (Ag) in Soil Science program for implementation in the upcoming session.

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

01 August 2023



A K S University Faculty of Agriculture Science and Technology Department of Soil Science Curriculum & Syllabus of M.Sc. (Ag) in Soil Science program (Revised as on 01 August 2023)

From the Desk of the Vice-Chancellor

AKS University is currently undergoing a process to revamp its curriculum into an outcomebased approach, with the aim of enhancing the teaching and learning process. The foundation of quality of quality education lies in the implementation of a curriculum that aligns with both societal and industrial needs, focusing on relevant outcomes. This entails dedicated and inspired faculty members, as well as impactful industry internships.

Hence, it is of utmost importance to begin this endeavor by crafting an outcome-based curriculum in collaboration with academia and industry experts. This curriculum design should be informed by the latest technological advancements, market demands, the guidelines outlined in the National Education Policy (NEP) of 2020, National Core Group and BSMA Committees appointed by ICAR, and sustainable goals.

I'm delighted to learn that the revised curriculum has been meticulously crafted by the Genetics and Plant Breeding Department, in consultation with an array of experts from the Seed industry, research institutes, and academia. This curriculum effectively integrates the principles outlined in the NEP-2020 guidelines, National Core Group and BSMA Committees appointed by ICAR, as well as sustainable goals. It also adeptly incorporates the latest advancements in development of new varieties and seed production technology.

To enhance students' skills, the curriculum integrates Hands On Training, industrial visits, and Training experiences, research and progress. This well-rounded approach ensures that students receive a comprehensive education, fostering their skill development and preparing them for success in the seed industry.

I am confident that the updated curriculum for Soil Science will not only enhance students' technical skills but also contribute significantly to their employability. During the process of revising the curriculum, I am pleased to observe that the Soil Science department has diligently adhered to the guidelines provided by the National Core Group and BSMA Committees appointed by ICAR. Additionally, they have maintained a total credit requirement of 75 for M. Sc. (Ag) in Soil Science program. It's worth noting that 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 government agriculture departments farmers, entrepreneurs, industry experts and technocrats and Alumni students 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.

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

01 August 2023



A K S University Faculty of Agriculture Science and Technology Department of Soil Science Curriculum & Syllabus of M.Sc. (Ag) in Soil Science program (Revised as on 01 August 2023)

Preface

As part of our commitment to ongoing enhancement, the Department of **Soil Science** consistently reviews and updates its **M. Sc. (Ag) in Soil Science** program curriculum as per recommendation and need of ICAR. 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 **M. Sc. (Ag) in Soil Science** 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 National Core Group and BSMA Committees appointed by ICAR, syllabus distributed in August 2021. It seamlessly integrates the guidelines set forth by the Ministry of Higher Education, Government of India, through NEP2020, 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 Training, have been incorporated.

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.

Dr. S. S. Tomar DEAN (FAST) AKS University Satna

01 August 2023

Introduction :

AKS University is running multidisciplinary courses out of which Soil Science is one of the core branch of Faculty of Agriculture Sciences continuing from 2012 in the university campus. AKS University is the 1st private organization in Satna region has a systematized Soil Science Laboratory facilities with all the basic and advanced technologies used during nutrient analysis in both plant and soil. The department facilitates the training and demonstration programme for both students, farmers and stake holders as a part of course curriculum in both field and advanced classes in college premises.

Vision :

The AKS university is fully focused in crating the ecofriendly environment by reducing the use of synthetic fertilizers with more emphasis on production and use of organic compost, Manures.

University put more emphasis on increasing the soil health and quality, there by soil nutrient status and creating abundance the beneficial microbes population in soil their by reduces the soil born diseases and increasing the nutrient status in long run.

University promotes, motivate and create awareness among the local farming communities / farmers towards the recent schemes run by the government its use and its importance.

Mission :

- M 01 : Achieve academic excellence in Soil Science through an innovative teaching- learning process.
- M 02 : Evaluate the basic necessary soil physical, chemical and biological properties in both field and in laboratory
- **M 03 :** To identify the deficiency symptoms of essential nutrients in both agricultural and horticultural crops .
- **M 04 :** To understand the process involved in formation of soil and interpret the soils as per their generic classification.
- **M 05 :** To organize the research in leading areas of soil analysis techniques, Organic farming practices and nutrient analysis procedure in both surface and subsurface.
- **M 06 :** To innovate, share and apply the knowledge of integrated nutrient management practices for students and local farming society.

Program Educational Objectives (PEO)

- **PEO 01:** To develop technical and managerial skills among the students with practical knowledge in collecting the soil samples and deal the problems occurred during collection.
- **PEO 02 :** To diagnose the soil profile on the basis of their genesis classification, various process involved in formation of particular soil profile and parent material.

POE03: To formulate the organic manure its use in soil and classification there by reduces the soil born diseases.

Program Outcomes (POs)

Graduate and post graduate students of department of Soil science will able to perform:

- **PO-1: Basic Knowledge of Agriculture:** General information of Agricultural practices used in growing crop in field and basic management tactics used.
- **PO-2: Classification of Soils:** Distribution of soil on basis of agro climatic zones in India and world and its basic properties.
- **PO-3: Nutrient analysis:** Analysis the available macro, secondary and micronutrient status in soil, plant and seed for various crops.
- **PO-4: Identification and amelioration of problem soil**: Formation, reclamation and precaution measure should be taken during amelioration of acidic/Alkaline / salt effected.
- **PO-5: Preparation and recommendation of Compost / Manure**: Manufacturing of various Organic compost, its classification and application method.
- **PO-6: Composition and manufacture of various fertilizers**: Formation of various synthetic Fertilizers, its composition of application method in various crops and different soil types.
- **PO-7 : Modern concept of Soil Science :** Various Soil techniques used in increasing the fertility, productivity and sustainability of soils of India and World.
- **PO 8: Environment and sustainability**: The various tactics used in maintaining the soil/ land environment and its sustainability for better production and promote the growth of useful microbes in soil.
- PO-9: Use of Engineering tools/ software's : Handling and application of various software's for data analysis and GIS system software's to know and locate the various properties of soil(agricultural area, buildings, lake/river) in map
- **PO-10 : Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the agricultural practices.
- **PO-11 : 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 changes
- **PO- 12: Project management**: Application method used by the farmers for better productivity of crop of various organic or biological microbes in soil.

Program Specific Outcomes (PSOs)

PSO-1: Ability to prepare Nano fertilizer and their application: Preparation and composition of various nutrients (Macro, secondary or micro) nutrients in fertilizers

- **PSO-2: Ability to understand the soil microbial classification**: Identify the process in calculating the microbial population and their contribution in Agricultural crop production.
- **PSO-3:** Ability to prepare the various bio fertilizers and their application in field: Preparation and application of Bio fertilizers in various crop.
- **PSO-4: The ability to apply technical & engineering knowledge for increased soil fertility and productivity :** Use of various software's in running the agricultural equipment's and analysis of field with drown systems preparation of maps with the help of GPS in GIS software and handling of remote sensing .

		<i>.</i>	0				
	PEO	M 1	M 2	M 3	M 4	M5	M6
Ī	PEO 1	3	2	2	2	2	1
	PEO 2	2	3	1	3	3	1
	PEO 3	3	2	2	1	2	2
							1

Consistency/Mapping of PEOs with Mission of the Department

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

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 Two-year Post Graduate degree program in Masters in Soil Science has minimum credits of about 70credits, the total number of credits proposed for the Two-year M. Sc.(Ag.) is kept minimum of 70 by PG Restructuring Committee.

3. Structure of PG Program in Soil Science:

The structure of PG program in Soil Science shall have essentially the following categories of courses with the breakup of credits as given:

	C.(Ag.) Son Science		
S.No.	Nature of Papers	Credit hours	Percentage of total credits in the Program
1	Major Courses	22	30.14
2	Minor Courses	08	10.95
3	Supporting Courses	07	9.60
4	Non Credit	05	6.85
5	Master's Seminar	01	1.36
6	Research	30	41.10
	Total Credits	73	100

Components of Curriculum M.Sc. (Ag.) Soil Science

• Not consider in total credit

Semester -I		Semester - II							
Course Title	Credit	Course Title	Credit						
1. Soil Biology and	2:0:1=3	1. Soil Chemistry	2:0:1 = 3						
Biochemistry									
2. Soil, Water and Air Pollution	2:0:1 = 3	2. Soil Physics	2:0:1 = 3						
3. Soil Fertility and Fertilizer Use	3:0:1 = 4	3. Soil Mineralogy, Genesis and Classification	2:0:1 = 3						
4. Soil Erosion and	2:0:1 = 3	4. Remote Sensing and GIS	2:0:1 = 3						
Conservation		Technique for Soil, Water and crop Studies							
5. Statistical Method for	3:0:1 = 4	5. Experimental Designs	2:0:1 = 3						
Applied Science									
6. Technical Writing and	0:0:1 = 1	6. Intellectual Property and its	1:0:0 = 1						
Communications Skill		management in Agriculture							
7. Library and Information	0:0:1 =1	Basic concept sin laboratory	0:0:1=1						
Services		techniques							
Total Credit	19	Total Credit	17						
Semester -III		Semester - IV							
Course Title	Credit	Course Title	Credit						
1. Management of Problem	2:0:1 = 3	1. Master Research	0:0:20 = 20						
soils and water									
2. Soil Survey and Land Use Planning	2:0:0=2								
3. Agricultural research,	1:0:0=1								
Research ethics and Rural	1.0.0 1								
development programmes									
4. Master Seminar	0:1:0 = 1								
5. Master Research	0:0:10 = 10								
Total Credit	17	Total Credit	20						

General Course Structure & Credit Distribution

- **a. Major courses:** From the Discipline in which a student takes admission. Among the listed courses, the core courses compulsorily to be taken may be given *mark
- **b.** Minor courses: From the subjects closely related to a student's major subject
- **c. Supporting courses:** The subject not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.
- **d.** Common Courses: The following courses (one credit each) will be offered to all students undergoing

Master's Degree Programme :

- 1. Library and Information Services
- 2. Technical Writing and Communications Skills
- 3. Intellectual Property and its management in Agriculture
- 4. Basic Concepts in Laboratory Techniques
- 5. Agricultural Research, Research Ethics and Rural Development Programmes

Some of these courses are already in the form of e-courses/ MOOCs. The students may be allowed to register these courses/ similar courses on these aspects, if available online on SWAYAM or any other platform. If a student has already completed any of these courses during UG, he/ she may be permitted to register for other related courses with the prior approval of the Head of Department (HoD)/Board of Studies (BoS).

Total Credit : 73

Course co	Course code and definition:									
S.No.	Ξ	Serial Number								
L	=	Lecture								
Т	=	Tutorial								
РС	=	Practical Credit								
CL	CL = Classroom Instruction									
LI	=	Laboratory Instruction								
SL	=	Self Learning								
СТ	Ξ	Class Test								
CA	=	Class/ Home Assignment								
SA	=	Seminar One								
AT	=	Class Attendance								
CAT	Ш	Class Activity any one								
С	=	Total Credits								
SW	=	Sessional Work								
PRA	=	Progressive Assessment								
ESA	Ш	End Semester Assessment								
PO	II	Programme Outcome								
PSO	=	Programme Specific Outcome								
SOs	=	Session Outcome								
РСС	=	Professional core courses								
OEC	=	Open Elective courses								
LC	Н	Laboratory course								
SOIL	=	Soil Science Courses								
STAT	=	Statistic Courses								
PGS	Ξ	Non Credit Courses								

Course code and definition:

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

Category-wise Courses

Sl.	Code No.	Subject	Semester	Credits					
		L: T: P							
1	Soil-501	Soil Physics	2	2:0:1 =3					
2	Soil-502	Soil Fertility And Fertilizer Use	1	3:0:1 =4					
3	Soil-503	Soil Chemistry	2	2:0:1 =3					
4	Soil-504	Soil Mineralogy, Genesis And Classification	2	2:0:1 =3					
5	Soil-506	Soil Biology And Biochemistry	1	2:0:1 =3					
6	Soil-508	Soil, Water And Air Pollution	1	2:0:1 =3					
7	Soil-511	Management of Problematic Soils And Water	3	2:0:1 =3					
		Minor Course	I						
8	Soil-509	Remote Sensing And GIS Technique For Soil And Crop Studies	2	2:0:1 =3					
9	Soil-505	Soil Erosion And Conservation	2:0:1 =3						
10	Soil-513 Soil Survey And Land Use Planning 3								
<u> </u>		Supporting Course	L						
11	STAT-502	Statistical Methods For Applied Science	1	3:0:1 =4					
12	STAT-511	Experimental Designs	2	2:0:1 =3					
		Non Credits	1						
13	PGS-503	Intellectual Property And Its Management In Agriculture	2	1:0:0 =1					
14	PGS-502	Technical Writing And Communication Skills	1	0:0:1 =1					
15	PGS-501	Library And Information Services	1	0:0:1 =1					
16	PGS-505	Agricultural Research, Research Ethics and Rural Development programmes	3	1:0:0=1					
17	PGS 504	Basic concept sin laboratory techniques	2	0:0:1=1					
18	Soil 591	Master Seminar	3	0:1:0=1					
19	Soil 599	Master Research	30	0:0:30=30					
	Total Credits:								

Induction Program

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

Physical activity

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

Evaluation Scheme:

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.

For Practical Courses:

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- 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.

Semester wise Course Structure Semester wise Brief of total Cerits and Teaching Hours

Semester	mester L T P Total Hour		Total Hour	Total Credit	
	(Lecture)	(Tutorial)	(Practical)	Per week	
Semester -I	12	0	7	27	19
Semester -II	11	0	6	23	17
Semester -III	5	1	11	28	17
Semester - IV	0	0	20	40	20
Total	28	01	44	118	73

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Details of SemesterWiseCourseStructure Program: M.Sc.(Ag.) Soil Science 2 years Curriculum Structure Total Credit (2 year Course) Semester wise Structure Curriculum (L= Lecture , T= Tutorial, P= Practical & H = Hours per week)

SEMESTER-1

S.No.	Category	Code	Course Title	L	Т	Р	Total Hours	Credits
1.	M.Sc.(Ag.)	Soil 502	Soil Fertility and Fertilizer Use	3	-	1	5	4
2.	M.Sc.(Ag.)	Soil 506	Soil Biology and Biochemistry	2	-	1	4	3
3.	M.Sc.(Ag.)	Soil 508	Soil, Water and Air Pollution	2	-	1	4	3
4.	M.Sc.(Ag.)	Soil 505	Soil Erosion and Conservation	2	-	1	4	3
5.	M.Sc.(Ag.)	STAT 502	Statistical methods for Applied Sciences	3	-	1	5	4
6	M.Sc.(Ag.)	PGS 502	Technical Writing and Communication Skills	0	-	1	1	1
7.	M.Sc.(Ag.)	PGS 501	Library and Information Services	0	-	1	1	1
		Т	otal	12	0	7	24	19

SEMESTER-II

S.No.	Category	Code	Course Title	L	T	Р	Total H	Credits
1.	M.Sc.(Ag.)	Soil 501	Soil Physics	2	-	1	4	3
2.	M.Sc.(Ag.)	Soil 503	Soil Chemistry	2	-	1	4	3
3.	M.Sc.(Ag.)	Soil 504	Soil mineralogy, Genesis and Classification	2	-	1	4	3
4.	M.Sc.(Ag.)	Soil 509	Remote sensing and GIS Technique for soil, water and crop studies	2	-	1	4	3
5.	M.Sc.(Ag.)	STAT 511	Experimental Designs	2	-	1	4	3
6	M.Sc.(Ag.)	PGS 503	Intellectual property and its management in Agriculture	1	-	-	1	1
7	M.Sc.(Ag.)	PGS 504	Basic Concepts in Laboratory Techniques	0	-	1	1	1
		Total		11	0	6	22	17

SEMESTER-III

S.No.	Category	Code	Course Title	L	T	Р	Total Hour	Credits
1.	M.Sc.(Ag.)	Soil 513	Soil survey and Land use planning	2	-	-	2	2
2.	M.Sc.(Ag.)	Soil 511	Management of problem soils and water	2	-	1	4	3
3.	M.Sc.(Ag.)	PGS 505	Agricultural Research, Research Ethics and Rural Development programmes	1	-	-	1	1
4.	M.Sc.(Ag.)	Soil 591	Research Seminar	-	1	-	2	1
5	M.Sc.(Ag.)	Soil 599	Master Research	-	-	10	20	10
	Total						29	17

SEMESTER-IV

S.No.	Category	Code	Course Title	L	Т	Р	Total Hours	Credits
1.	M.Sc.(Ag.)	Soil 599	Master Research	-	-	20	1000	20
	То	tal		-	-	20	1000	20

Total credit : 73

Semester-I

Course Code:	SOIL 506
Course Title :	Soil Biology and Biochemistry
Pre- requisite:	Student should have basic knowledge of bio fertilizers and useful microorganisms available in soil help in transforming the fixed forms of nutrients. They know about the various organic waste (plant /animal/rural and urban wastes).
Rationale:	The Student learn about available soil microorganisms help in dissolving the fixed form of plant essential nutrients absorbed by the crop. Transformation and lifecycle of all essential plant nutrients. The manufacturing of various bio fertilizers available in market, their composition, combination, properties and use. Importance, principle and role organic farming with the use of consortium for maintaining fertility and sustainability in soil.
Course Outcomes:	

- Soil 506.1: To classification of soil biota, its ecosystem and various interaction occurs with soil organisms
- Soil 506.2: To learn the various Interactions of Soil microbes with plants
- Soil 506.3: To understand transformation of nutrients with various interaction of soil organism and formation of humus
- Soil 506.4: Identification, production, role, importance and use of bio pesticides, organic waste its degradation process and manure application in various crop for sustainable agriculture
- Soil 506.5: Role, importance, preparation and properties of various organic manure in different crop to maintain the sustainability of soil
- Soil 506.6: To learn the classification, specification and role in crop production and quality of bio fertilizers
- Soil 507: To understand the biological indicators of soil quality and Soil genomics and bio prospecting

Course		Course Title		Scheme	e of st	udies (1	Hours/Week)	Total
Category	Code		Cl	LI	SW		Total Study Hours (CI+LI+SW+SL)	Credits (C)
Major Course	Soil 506	Soil Biology and Biochemistry	2	2	1	1	5	3

Scheme of Studies:

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.

T	Theory	7		Scł	neme	of Asse	ssment	(Marks)		
			Progres					,	End	Total
			nent ich	LT)		one		Total Marks (Semester Assessment	Marks
Course Category	Couse Code	Course Title	Class/ Home Assignment 5 number 3 marks each (CA)	Class Test 2 (2 best out of 3) 10 marks each (C7	Seminar one (SA)	Class Activity any o (CAT)	Class Attendance (AT)	CA+CT+SA+CAT +AT)	(ESA)	(PRA+ES A)
Major Course	Soil 506	Soil Biology and Biochem istry	15	30	0	0	5	50	50	100

Scheme of Assessment:

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.

Soil 506.1: To classification of soil biota, its ecosystem and various interaction occurs with soil organisms

Approximate Hours				
Item AppX Hrs				
Cl	6			
LI	4			
SW	2			
SL	1			
Total	13			

4 TT

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learni ng (SL)
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 SO1.1: It gives General introduction on bio fertilizers, its use and importance. SO1.2: To recall the diversity in soil microbes, there ecosystem and life cycle SO1.3 To learn the different interactions occurs 	 Determination of soil microbial population Determination of Soil microbial biomass 	 Unit-1 General introduction about soil biota, its ecosystem and various interaction occurs with soil organisms 1.1 Classification of soil biota and its ecosystem 1.2 Classification of soil microbes 1.3 Importance of soil biota in ecosystem 1.4 Role of soil organisms 1.5 Interaction process occurs with soil organisms 1.6 factors affecting the growth 	1. To know about various types of soil organis ms
interactions occurs between soil and soil organisms		1.6 factors affecting the growth of soil organisms	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

•Enlist the classification of soil microbes

•Define soil biota its population and ecosystem

b. Mini Project:

c. Other Activities (Specify): NA

Soil 506.2: To learn the various Interactions of Soil microbes with plants

Approximate Hours

Item	AppX Hrs
Cl	5
LI	4
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learnin g (SL)
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 SO2.1 To relate the different types of interaction of soil microbes with crop, there growth SO2.2 To understand the principle and role of soil microbes SO2.3 To discriminate the various enzymes and chemicals released by the microbes. 1. Determination of Soil enzymes released by soil microbes 2. Study or rhizosphere e effect 	 f importance and role of soil microbes 2.1 To learn the classification of soil microbes 1 2.2 To understand the role of soil microbes in increasing soil fertility 	1. To know about the importa nce of soil organis ms
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SW-2 Suggested Sessional Work(SW):

- a. Assignments:
 - Classification, composition and properties of major nutrient fertilizers.
- **b.** Mini Project:
 - Prepare flow chart of integrated nutrient management
- c. Other Activities (Specify): NA

Soil 506 .3: To understand transformation of nutrients with various interaction of soil organism and formation of humus

Approximate Hours			
Item	AppX Hrs		
Cl	5		
LI	8		
SW	2		
SL	1		
Total	20		

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

 SO3.1 To learn the various process involved during transformation of different nutrients(macro, secondary and micro nutrients) through microbial activity in soil SO3.2 To Understand and learn the nutrient cycle. SO3.3 To assess the ability to understand the Mechanisms of nutrient transport to plants factors 	 Measurement of important soil microbial processes such as ammonification, nitrification, N2 To determine the process involved in solubilization of S from a given soil To estimate the Phosphorus solubilization and mineralization process in soil Estimation of micro nutrients solubilization and mineralization 	 mineralization of essential plant nutrient 3.1 Microbial transformation of Major nutrients 3.2 Microbial transformation of secondary and Micro nutrients 3.3 Role of soil organic matter and crop residue in maintaining soil fertility and productivity 3.4 Formation and components of humus and 	1. Making chart of available forms to essential plants nutrients
plants, factors affecting nutrient availability to plants.		3.5 To learn the importance of humus in maintaining soil fertility	

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Humus formation its classification and components
- Transformation of soil nutrients and factor affecting each of them
- b. Other Activities (Specify): NA

Soil 506.4: Identification, production, role, importance and use of bio pesticides,

organic waste its degradation process and manure application in various

crop for sustainable agriculture

Approximate Hours					
Item AppX Hrs					
Cl	6				
LI	6				
SW	2				
SL 2					
Total	16				

Session Outcomes (SOs)	Laborator y Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
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		Unit-4: Production, role and	
SO4.1 To	1. To study	Importance of various bio	1. Making
Relate difference	the	pesticides, degradable substances	chart of
between the	Elemental	and organic waste	useful bio
Biodegradation of	composition		pesticide
pesticides	of a given	4.1 To learn the Production techniques	available in
	soil	of biodegradable pesticides	market
SO4.2 To			_
Understand		4.2: To know the application methods	2.
and learn	2. To study	of biodegradable pesticides in	Identificati
The production	the	maintaining soil health and increase	on of
and	functional	the crop yield	different
use of organic	groups of a given		organic
wastes	sample	4.3: To learn the Production	manures and
and manures.	sample	techniques of biodegradable	nutrient
SO4.3 To	3. То	substances	content in
Understand and	prepare the	4.4: To understand the role of	it
learn the	bio	biodegradable substances in maintaining soil health	n
production and use	degradable	4.5: Role of various microbial toxins	
of biogas plant	substances	released in soil and	
and use of slurry in		released in son and	
increasing the		4.6 : Production, importance and use	
sustainability of		of organic waste with role of various	
soil		biotic factors involved in soil	
		developments	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

• Identification of different organic manures and nutrient content in it

- b. Mini-Project
 - Preparation of various bio pesticides and its application in different crop
- c. Other Activities (Specify): NA

Soil 506.5: Role, importance , preparation and properties of various organic manure and bio fertilizer if different crop to maintain the sustainability of soil

Approximate Hours					
AppX Hrs					
3					
4					
2					
1					
10					

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

SO5.1 To know the Effective knowledge on formation and application method of different types of compost, FYM, Vermicomposting.	 Decomposition of organic matter in soil To determine the fractionation of organic matter of a given sample 	 Unit 5: Preparation and Application of organic manure in soil 5.1 To learn the preparation methods of different bulky organic manures 5.2: To learn the preparation 	1. Enlist the different Methods of organic waste available in
SO5.2 Understand the procedure , importance, and classification of different organic manures		methods of different concentrated organic manures5.3: To learn the Application method used during supply of various organic manure in different crops	market

SW-5 Suggested Sessional Work (SW):

- a. Assignments:
 - Preparation Methods of different organic manure in various crops.
- Soil 506.6: To learn the classification, specification and role in crop production and quality of bio fertilizers

Approximate Hours				
Item	AppX Hrs			
Cl	2			
LI	2			
SW	2			
SL	1			
Total	7			

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO6.1 To know the Effective knowledge on formation and application of Bio fertilizers	1.Preper ation of bio fertilizers	 Unit6: Preparation and Application of bio fertilizers in soil 6.1 Classification and preparation of various bio fertilizers 	1. Enlist the different Methods of bio fertilizer available in market
SO6.2 Understand the procedure , importance, and classification of different Bio fertilizers		6.2: To learn the Application method used during supply of various bio fertilizers in different crop	

SW-6 Suggested Sessional Work (SW):

a. Assignments:

• Preparation Methods of different bio-fertilizers and is application in various crops.

Soil 507: To understand the biological indicators, management of soil quality,

Soil genomics and bio prospecting measures

Approximate Hours				
Item	AppX Hrs			
Cl	3			
LI	2			
SW	2			
SL	1			
Total	7			

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO6.1 To learn the bioremediation of soil	1.Identific ation of	Unit7: Identification of biological indicators in improving soil quality	1. Enlist the different
 SO6.2 Understand the transformation of different heavy metals in soil SO6.3 To learn the genomics and bio prospecting agents of soil 	biological indicators	 6.1 To learn the various bio remediation techniques in managing contaminated 6.2: To learn the transformation of different heavy metals in soil 6.3 To learn the role of soil genomics and bio prospecting agents of soil 	bio prospect ing agents available in market

Brief of Hours suggested for the Course Outcome

Course Outcomes	Clas s Lectu re (Cl)	Lab Instructio ns (LI)	Sessiona l Work (SW)	Self Learning (Sl)	Total hour (Cl+LI+ SW+Sl)
Soil 506.1: To classification of soil biota, its ecosystem and various interaction occurs with soil organisms	6	4	2	1	13
Soil 506.2: To learn the various interactions of soil microbes with plants	5	4	2	1	12
Soil 506 .3: To understand transformation of nutrients with various interaction of soil organism and formation of humus	5	8	2	1	16
Soil 5064: Identification, production, role, importance and use of bio pesticides, organic waste its degradation process and manure application in various crop for sustainable agriculture	6	6	2	2	16
Soil 506.5: : Role, importance , preparation and properties of various organic manure and bio fertilizer if different crop to maintain the sustainability of soil	3	4	2	1	10

Soil 506.6: To learn the classification, specification and role in crop production and quality of bio fertilizers	2	2	2	1	7
Soil 506.7: To understand the biological indicators, management of soil quality, Soil genomics and bio prospecting measures	3	2	2	1	8
Total Hours	30	30	14	8	82

Suggestion for End Semester Assessment

СО	Unit Titles	Μ	arks Dist	ribution	Total
		R	U	Α	Marks
CO-1	General introduction about soil biota, its ecosystem and various interaction occurs with soil organisms		01	01	05
CO-2	The basic concept , importance and role of soil microbes	02	06	02	10
CO-3	Transformation solubilization and mineralization of essential plant nutrient	03	02	05	10
CO-4	Production, role and Importance of various bio pesticides, degradable substances and organic waste	03	02	05	10
CO-5	Preparation and application of organic manure	03	02	-	05
CO-6	Preparation and Application of bio fertilizers in soil	03	02	-	05
CO-7	Identification of biological indicators in improving soil quality	02	02	01	05
	Total	19	17	14	50
	Legend: R:Remember,	U:Understa	und,	A: App	ly

The end of semester assessment for Soil Biology and Biochemistry 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	The Nature and Properties of Soils.	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013
2	Principles and Applications of Soil Microbiology	Sylvia DN.	Pearson Edu	2005
3	Fundamental of Soil Science	Indian Society of Soil Science	ISSS, National Societies Block, Pusa, New Delhi	Revised 2012
4	Introduction to Soil Microbiology	Alexander M	John Wiley & Sons	1977
5	Soil Microbial Ecology – Applications in Agricultural and Environmental Management.	Metting FB.	ICAR, New Delhi	1993
6	Soil Biochemistry	Paul EA and Ladd JN.	Marcel Dekker	1981
7	Soil Biochemistry	Stotzky G & Bollag JM	Vol. VIII. Marcel Dekker	1993
8	Soil Microbiology	Subba Rao N.S	Medtech Scientific International	Revised 2017

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Cos, POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 506

Course Title: Soil Biology and Biochemistry

				Prog	am Outco	omes		- 8,					Program Specific Outcome			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of Problem soil	Preparation and recommendation of compost/manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of engineering	Ethics	Life-long learning	Project management	Ability to prepare and use the doses of various Nano	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity
Soil506.1:Toclassificationofsoilbiota, itsecosystemandvariousinteractionoccurswithsoilorganisms	2	2	1	1	1	1	2	3	1	2	3	2	1	3	1	2
Soil 506.2: To learn the various interactions of soil microbes with plants	2	2	1	1	1	1	2	3	1	2	3	2	1	3	1	2
Soil 506 .3: To understand transformation of nutrients with various interaction of soil	2	2	2	1	1	1	2	3	1	2	3	2	1	3	2	2

organism and formation															
of humus															
Soil 5064: Identification, production, role , importance and use of bio pesticides , organic waste its degradation process and manure application in various crop for sustainable agriculture	2	1	2	1	3	2	2	3	1	2 3	2	1	3	1	2
Soil 506.5: : Role, importance , preparation and properties of various organic manure in different crop to maintain the sustainability of soil	2	1	2	1	3	2	2	3	1	2 3	2	1	3	1	2
Soil 506.6: To learn the classification, specification and role in crop production and quality of bio fertilizer	-	1	2	1	3	2	2	3	1	2 3	2	1	3	1	2
Soil 506.7: To understand the biological indicators, management of soil quality, Soil genomics and bio prospecting measures	2	1	2	1	3	2	2	3	1	2 3	2	1	3	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

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	Soil 506.1: To classification of soil biota, its ecosystem and various interaction occurs with soil organisms	SOs: 1.1, SOs:1.2, SOs:1.3	LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4	Unit-1.0 General introduction about soil biota, its ecosystem and various interaction occurs with soil organisms 1.1,1.2,1.3,1.4,1.5,1.6	As mentioned in page number 2 to 6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 506.2 : To learn the various interactions of soil microbes with plants	SOs: 1.1, SOs:1.2, SOs:1.3	LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4	Unit 2.0 The basic concept , importance and role of soil microbes 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	Soil 506.3 :: To understand transformation of nutrients with various interaction of soil organism and formation of humus	SOs: 1.1, SOs:1.2, SOs:1.3	LI: 1.1, LI:1.2, LI:1.3, LI:1.4, LI:1.5, LI:1.6, LI:1.7, LI:1.8, LI:1.9, LI:1.10, LI:1.11, LI:1.12	Unit-3.0: Transformation solubilization and mineralization of essential plant nutrient 3.1, 3.2,3.3,3.4,3.5	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 506.4 :Identification, production, role , importance and use of bio pesticides , organic waste its degradation process and manure application in various crop for sustainable agriculture	SOs: 1.1, SOs:1.2, SOs:1.3	LI: 1.1, LI:1.2, LI:1.3, LI:1.4, LI: 1.5, LI: 1.6	Unit-4.0 : Production, role and Importance of various bio pesticides, degradable substances and organic waste 4.1,4.2,4.3,4.4,4.5,4.6	

Course Curriculum Map: Soil 506: Soil Biology and Biochemistry

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 506.5 :Role, importance , preparation and properties of various organic manure and bio fertilizer if different crop to maintain the sustainability of soil	SOs: 1.1, SOs:1.2	LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4	Unit-5.0 : Preparation and Application of organic manure and bio fertilizers in soil 5.1,5.2,5.3	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 506.6: To learn the classification, specification and role in crop production and quality of bio fertilizer	SOs:6.1 SOs:6.2	LI: 6.1	Unit-6.0: Preparation and Application of bio fertilizers in soil 6.1,6.2	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 506.7: To understand the biological indicators, management of soil quality, Soil genomics and bio prospecting measures	SOs:7.1 SOs:7.2	LI: 7.1,	Unit-7.0: Identification of biological indicators in improving soil quality 7.1,7.2, 7.3	

Semester-I

Course Code:	SOIL 508
Course Title :	Soil Water and Air Pollution
Pre- requisite:	Student should have basic knowledge of various forms of pollutants present in soil, water and air.
Rationale:	The Student learn about the measurement of soil, water and air pollution, their optimum level. What are the norms to reduce the pollution from soil, air and water used by government in India and world for maintaining ecofriendly nature.
Course Outcomes:	

- **Soil 508.1:** To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level
- Soil 508.2: To learn the Nature, sources and effect of various pollutants on fertility, production and productivity of soil and crop including human health
- **Soil 508.3** Assess the forms and properties of various effluents released from Sewage and different industrial waste their by effect on growth of living organisms
- Soil 508.4: Classification and behavior of pesticides in soil, and their effect on soil microorganisms
- Soil 508.5: To understand the sources and behavior of released toxic substances affect in Soil, water , Air and human health
- **Soil 508.6:** To understand the sources and reclamation tactics in managing the effect of release of GH gasses contribution and pesticide on reducing Soil, plant, water and Air Scheme of Studies
- Soil 508.7: Risk assessment of polluted soil and reclamation of contaminated Soil, water, Air and human health

			Sche	Scheme of studies(Hours/Week)						
Course Category	Course Code	Course Title	Cl	LI	SW		Total Study Hours (CI+LI+SW+SL)	Credits (C)		
Major Course	Soil 509	Soil Water and Air Pollution	2	2	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:

11	heory	7								
			Scheme of Assessment (Marks) Progressive Assessment (PRA)							
ory			ome Assignment 5 3 marks each	t best out of 3) (CT)	Seminar one (SA)	Class Activity any one (CAT)		Total Marks (CA+CT+SA+CA	End Semester Assessment	Total Marks
Course Category	Couse Code	Course Title	Class/ Home number 3 mai (CA)	Class Test 2 (2 10 marks each	Seminar	Class Acti (C	Class A	T+AT)	(ESA)	(PRA+ES A)
Major Cours e	Soil 509	Soil, Water and Air Polluti	15	30	0	0	5	50	50	100
		on								

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.

Soil 508.1: To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level

Approxi	Approximate Hours						
Item	AppX Hrs						
Cl	4						
LI	4						
SW	2						
SL	1						
Total	11						

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To recall the various types of pollution and there sources SO1.2: To discriminate the different types of pollution occur in agricultural field, their source.	 To determine the nutrient content and sampling process of sewage water and sewage Sludge To determine the nutrient content and sampling process of liquid industrial wastes 	 Unit-1 Source of air, water and soil pollution which affect the crop production 1.1Understand the various types and source of soil pollution 1.2Understand the various types and source of water pollution 1.3 Understand the various types and source of air pollution 1.4 Effect of soil, water and air pollution on growth and development of crop 	1. To know about various pollutants and their sources of soil, water and air pollution

SW-1 Suggested Sessional Work (SW):

a) Assignments:

Enlist the various pollutants affecting soil, water and air

b) Mini Project: NA

c) Other Activities (Specify): NA

Soil 508.2: To learn the Nature , sources and effect of various pollutants on fertility, production and productivity of soil and crop including human health

Approximate mours							
Item	AppX Hrs						
Cl	4						
LI	6						
SW	2						
SL	1						
Total	13						

Approximate Hours

Session Outcomes Laboratory Class room Instruction	Self
(SOs) Instruction (CI)	Learning
(LI)	(SL)
 SO2.1 To assess the nature and sources of pollutants originates from agricultural field (through fertilizers and pesticides) SO2.2 To assess the nature and sources of pollutants originates from, industrial area, SO2.3 To assess the nature and sources of pollutants originates from urban wastes lands, acid rains. I. To determine the BOD of a given water sample To determine the COD of a given water sample To estimate the dissolved and suspended solids from a given sample I.2 To discuss about the water pollution I.2 To discuss about the water pollution I.3 To discuss about the a pollution I.4 To Learn the problems 	 various role of fertilizers, pesticides and herbicides in increasing the Soil, water and air pollution increasing the Soil, water

SW-2 Suggested Sessional Work(SW):

a. Assignments:

- 1. Enlist the nature and sources of pollutants originates from urban wastes lands
- 2. Factors responsible in cause of acid rains
- b. Mini Project: NA
- c. Other Activities (Specify): NA

Soil 508 .3: Assess the forms and properties of various effluents released from Sewage and different industrial waste their by effect on growth of living organisms

Approximate Hours		
Item	AppX Hrs	
Cl	4	
LI	6	
SW	2	
SL	1	
Total	13	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO3.1 Evaluate the effect of sewage water on plant growth and human beings SO3.2 To Understand the effect of industrial effluents on growth and development of living beings 	To know the Sampling method and precaution measure should be taken during colleting polluted soils and plant	Unit-3 : To understand the forms and properties of various effluents released from Sewage and industrial 1.1 To learn about Sewage effluents-their composition 1.2 To learn about industrial effluents-their composition 1.3 To understand the effect of Sewage & industrial effluents on soil properties/ health, and plant growth and human beings 1.4 To understand the soil as sink for waste disposal	1. To know about the various industries running in your surrounding and their discarded material

SW-3 Suggested Sessional Work (SW):

a) Assignments:

• Effect of industrial effluents on growth and development of living beings

Soil 508:4: Classification and behavior of pesticides in soil, and their effect on soil

microorganisms

Approximate Hours		
Item	AppX Hrs	
Cl	4	
LI	4	
SW	2	
SL	2	
Total	10	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO4.1 Recognize the different type of Pesticides and available nutrients. SO4.2 Relate the behavior of pesticides and available nutrients in soil with different crops 	 1.To understand the management of contaminants in Soil to safe guard food safety 2.To understand the management of contaminants in plants to safe guard food safety 	Unit-4: Study the pesticides-their classification, and soil microorganisms.4.1To study the classification of Pesticides4.1To study the classification of Pesticides4.2To learn the effect of Pesticides in soil properties4.3To learn the effect of Pesticides on growth and development of soil microorganisms4.4To understand the effect of Pesticides on growth and development of crop	 Making chart of useful bio pesticide available in market Identification of different banned pesticides but still supplied in market

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Role of pesticides in affecting the population of useful microorganisms
- b. Other Activities (Specify): NA

Soil 508.5: To understand the sources and behavior of released toxic substances

affect in Soil, water , Air and human health

Approximate Hours

Item	AppX Hrs
Cl	4
LI	6
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction	Class room Instruction (CI)	Self Learning
	(LI)		(SL)
SO5.1 To identify the	1. To		1. Enlist
various sources and	determine the	Unit-5: Study the Toxic	the
behavior of released of	nitrate and	elements and there	different
release of toxic	ammonium	management	types of
substances in soil	nitrogen content		toxic
	of a given soil, and water sample	5.1 To learn about different types of Toxic elements present in soil	substances affect the soil, water
 SO5.2 To identify the various sources and behavior of released of toxic substances in plants SO5:3. To identify the various sources and behavior of released of toxic substances in human beings 	 2.To determine the available phosphorus content in a give soil and water sample 3.To determine the available heavy metal content in given soil /water effluents 	 5.2 To learn the different sources of Toxic elements present in soil 5.3 To learn the behavior of different Toxic elements present in soil 5.4 Understand the effect on nutrients availability, effect on plant and human health. 	and air

SW-5 Suggested Sessional Work (SW):

- a. Assignments:
 - Enlist the various sources and behavior of released of toxic substances in soil and plants
 - Enlist the various sources and behavior of released of toxic substances in water
 - Enlist the various sources and behavior of released of toxic substances in Air
 - Enlist the various sources and behavior of released of toxic substances in human beings

b. Mini Project:

- Llist of toxic substances released from various industries affect the soil, water and air
- c. Other Activities (Specify): NA
- Soil 508.6: To understand the sources and reclamation tactics in managing the effect of release of GH gasses contribution and pesticide on reducing Soil, plant, water and Air

Approximate Hours

Item	AppX Hrs	
Cl	5	
LI	6	
SW	2	
SL	1	
Total	16	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO6.1 To review on cause of Pollution of water resources and its reclamation strategies	1. To determine of Heavy metals in contaminated plants sample	 Unit .6: Study the pollution of water and green house gasses. 6.1 To learn about the various ways of water Pollution resources due to leaching of nutrients and pesticides from soil. 	1. Enlist the various GH Gases and their contribution in depletion of ozone layer of
SO6.2 To understand the cause of release of GH gasses and its reclamation strategies	2.To determine the NO ₂ , O ₂ & sulphate content in a given area air sample 3. To estimation of particulate	 6.2 To learn about the various ways of water Pollution resources due to effect of pesticides in soil 6.3 To understand the various sources responsible in emission of green house gases-carbon dioxide, methane and nitrous oxide in atmosphere 6.4 To know the emission of green 	earth
SO6:3. To identify the forms of pesticides affect the soil health	matter content in a particular area	 6.5 To study the different practices to manage both water and air pollution through leaching and emission of GHG respectively 	

SW-6 Suggested Sessional Work (SW):

- a) Assignments:
 - Identify the sources of GH gasses its contribution in affecting the ozone layer depletion
- b) Mini Project: NA
- c) Other Activities (Specify): NA

Soil 508.7: Risk assessment of polluted soil and reclamation of contaminated Soil, water , Air and human health

Approxi	mate Hours
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rippi ominute riours								
Item	AppX Hrs							
Cl	5							
LI	6							
SW	2							
SL	1							
Total	14							

Session Outcomes	Laboratory	Class room Instruction	Self
(SOs)	Instruction	(CI)	Learning
	(LI)		(SL)
SO7.1 To assess the	1.Visit to	Unit-7: Study the polluted	1. To learn the
soil pollution	various	contaminated soil and water and	use of
	industrial sites	there management	interment and
SO7.2To reclamation	to study the		basic computer
the polluted soil, and	impact of	7.1 To learn about the Risk assessment	knowledge in
water	pollutants on	of polluted soil	operating GIS
	soil and plants		software
SO7.3 To learn the		7.2 Remediation/ amelioration of	
use of remote		contaminated soil and water	
sensing in assessing			
the management of		7.3 Remediation/ amelioration of	
polluted soil and		contaminated water	
water			
		7.4 To know the remote sensing	
		applications in monitoring	
		7.5 To know the remote sensing	
		applications in management of soil	
		and water pollution.	
		_	

SW-7 Suggested Sessional Work (SW):

a. Assignments:

• To use the remote sensing in assessing the management of polluted soil and water and locating techniques in map

b. Mini Project :NA

c. Other Activities (Specify): NA

Course Outcomes		Laboratory Instruction (LI)	Sessiona l Work (SW)	Self Learning (Sl)	Total hour (Cl+SW+ Sl)
Soil 508.1: To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level	4	4	2	1	11
Soil 508.2: To learn the Nature , sources and effect of various pollutants on fertility, production and productivity of soil and crop including human health	4	6	2	1	13
Soil 508.3: Assess the forms and properties of various effluents released from Sewage and different industrial waste their by effect on growth of living organisms	4	2	2	1	9
Soil 508.4.: Classification and behavior of pesticides in soil, and their effect on soil microorganisms	4	4	2	1	11
Soil 508.5: To understand the sources and behavior of released toxic substances affect in Soil, water , Air and human health	4	6	2	1	13
Soil 508.6: To understand the sources and reclamation tactics in managing the effect of release of GH gasses contribution and pesticide on reducing Soil, plant, water and Air	5	6	2	1	14
Soil 508.7: Risk assessment of polluted soil and reclamation of contaminated Soil, water , Air and human health	5	2	2	1	10
Total Hours	30	30	14	7	81

Brief of Hours suggested for the Course Outcome

Suggestion for End Semester Assessment

	Unit Titles	M	arks Dis	tribution	Total
CO		R	U	Α	Marks
CO-1	Source of air, water and soil pollution which affect the crop production	03	02	02	07
CO-2	To Study the Soil, water and air pollution and there problems	02	03	03	8
CO-3	To understand the forms and properties of various effluents released from Sewage and industrial	03	03	02	8
CO-4	Study the pesticides–their classification, and soil microorganisms.	02	02	03	7
CO-5	Study the Toxic elements and there management	03	02	02	7
CO-6	Study the pollution of water and Green House Gases	02	02	02	6
CO-7	Study the polluted contaminated soil and water and there management	03	02	02	7
	Total	18	16	16	50

Suggested Specification Table (For ESA)

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

The end of semester assessment for **Soil Water and Air Pollution** 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
- ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 8. Brainstorming

Suggested Learning Resources:

	Title	Author	Publisł	Publisher					
S.No.					& Year				
1	Fundamental of Soil	Indian Society of	ISSS,	National	Revised				
	Science	Soil Science	Societies	Block,	2012				
			Pusa, New	Delhi					
2	The Nature and	Nyle B Brady and	Pearson E	Revised					
	properties of Soils	Ray R Weil			2013				
3	. Industrial	Middlebrooks EJ.	John Wiley	Interscience	1979				
	Pollution Control		-						
4	Toxic Metals in	Ross SM.	John Wile	ey & Sons	1998				
	Soil Plant Systems.			-					
5	Environmental	Vesilund PA and	Ann Arbo	or Science	1983				
	Pollution and	Pierce	Public	cation					
	Control								

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Cos. POs and PSOs Mapping

Course Title:: M.Sc. (Ag.) CourseCourse Code: Soil 508Course Title: Soil Water and Air Pollution

			1			Program	n Outc	omes					P	rogram Sp	ecific Outco	ome
	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
Course Outcomes	Basic knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of Problemn soil	Preparation and recommendation of compost/manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of engineering tools	Ethics	Life-long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity
To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level	2	2	3	2	2	2	1	3	1	2	3	2	2	2	2	2
To Study the Soil, water and air pollution and there problems	2	2	2	3	2	2	1	3	1	1	2	3	2	2	1	2

To understand the forms and properties of various effluents released from Sewage and industrial	1	2	2	3	1	1	1	3	1	1	2	2	1	1	1	2
Study the pesticides–their classification, and soil microorganisms.	1	1	1	2	2	2	1	2	1	1	2	1	1	3	2	2
Study the Toxic elements and there management	2	2	3	3	3	2	3	3	1	2	3	2	2	3	1	2
Study the pollution of water and green house gases	2	2	3	3	3	2	3	3	1	2	3	2	2	3	1	2
Study the polluted contaminated soil and water and there management	2	2	3	3	3	2	3	3	1	2	3	2	2	3	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

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	COs.1: To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level	SO1.1 SO1.2	LI. 1.1, LI. 1.2	Unit-1 I Source of air, water and soil pollution which affect the crop production 1.1,1.2,1.3,1.4	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	COs.2: To study the soil, water and air pollution and there problems	SO2.1 SO2.2 SO2.3	LI. 2.1, LI. 2.2, LI. 2.3	Unit-2 To Study the Soil, water and air pollution and there problems 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, 5	COs.3: To understand the forms and properties of various effluents released from Sewage and industrial	SO3.1 SO3.2 SO3.3 SO3.4	LI. 3.1	Unit-3 Study the pesticides-their classification, and soil microorganisms. 3.1,3.2,3.3,3.4	As mentioned in page
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	COs.4: Study the pesticides–their classification, and soil microorganisms.	SO4.1 SO4.2 SO4.3 SO4.4	LI. 4.1 LI. 4.2	Unit-4 Study the pesticides-their classification, and soil microorganisms. 4.1,4.2,4.3,4.4	number _ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Cos.5: Study the Toxic elements and there management	SO5.1 SO5.2 SO5.3 SO5.4	LI. 5.1, LI. 5.2, LI. 5.3	Unit-5 Study the pesticides–their classification, and soil microorganisms. 5.1, 5.2, 5.3, 5.4	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Cos.6: Study the pollution of water and green house gases	SO6.1 SO6.2 SO6.3	LI. 6.1, LI. 6.2, LI. 6.3	Unit 6. Study the pollution of water and green house gases 6.1,6.2,6.3,6.4,6.5	

Course Curriculum Map: Soil 508: Soil Water and Air Pollution

PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Cos.7: Study the polluted contaminated soil and water and there management	SO7.1 SO7.2 SO7.3	LI. 7.1	Unit 7: Study the polluted contaminated soil and water and there management	
				7.1,7.2,7.3,7.4,7.5	

Semester-I

Course Code:	SOIL 502
Course Title :	Soil Fertility and Fertilizer use
Pre- requisite:	Student should have basic knowledge of different fertilizers and nutrients available in soil for growth and development of crops. They also know about the various organic waste (plant /animal/rural and urban wastes)used in increasing soil fertility.
Rationale:	To impart knowledge about soil fertility and its control. To understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency. The manufacturing of various fertilizers available in market, their composition, combination, properties and use for maintaining fertility and sustainability in soil.
Course Outcomes:	
	tion of, their uptake and available forms play a important role in ng soil fertility and productivity

- Soil 502.2: To understand the mineralization and immobilization of various Nitrogen in soil and plants
- **Soil 502 .3:** To understand the mineralization and immobilization of various Phosphorus and potassium in soil and plants
- Soil 502 .4: To understand the mineralization and immobilization of various secondary nutrients (Ca, Mg and S) in soil and plant
- Soil 502.5: To understand the mineralization and immobilization of various Micronutrient (Fe, Mn, Cu, Zn, B, Mo, Ni) content in soil and plants
- Soil 502.6: To evaluate the soil test methods used for application of various fertilizers in different crop
- Soil 502.7: To understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture

Soil 502.8: To learn the physical, biological and chemical ways to assess the fertility of soil **Soil 502.9**: To understand concept of soil health and quality

	Build	Inc of Stud	105.						
				S	chem	e of st	Hours/Week)	Total	
Cours Catego		Course Code	Course Title	Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	Credits (C)
Ma Cou	5	Soil 502	Soil Fertility and Fertilizer use	3	1	1	1	6	4

Scheme of Studies:

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:

T	heory	y	1							
			Scheme of Assessment (Marks)							
				F	Progres	ssive A	ssessm	ent (PRA)	_	
Course Category	ise Code	Course Title	Iome Assignment 5 3 marks each (CA)	best out of 3) (CT)	ne (SA)	ty any one T)	endance	Total Marks (CA+CT+SA+CAT+A T)	End Semester Assessmen t	Total Marks
Course	Couse	Cour	Class/ Home A number 3 marks	Class Test 2 (2 best 10 marks each (CT)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (AT)	T)	(ESA)	(PRA + ESA)
Major Course	Soil 502	Soil Fertility and Fertilizer use	15	30	0	0	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.

Soil 502.1: Classification of , their uptake and available forms play a important role in maintaining soil fertility and productivity

Approximate Hours			
Item	AppX Hrs		
Cl	5		
LI	4		
SW	2		
SL	1		
Total	12		

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO1.1: It gives General introduction about Differentiate between soil fertility and productivity. SO1.2: To evaluate the optimal dose, deficiency symptoms ,function and sources of nutrients. 	 1.To determine the available Macro nutrients (N,P,K) content in plants 2.To determine the available Macro nutrients(N,P,K) content in soil 	 Unit-1 Soil fertility and productivity 1.1 Classification, availability, functions of essential plant nutrients in soil 1.2 To know the deficiency symptoms of essential plant nutrients in soil 1.3 Classification of different types of manure 1.4 Classification of different types of fertilizer 	1. To know about various types of nutrients and minerals present in soil
SO1.3 To learn the different types of fertilizers and manure		1.5 To learn the interaction of various nutrients in soils and plants	

SW-1 Suggested Sessional Work (SW):

- a. Assignments:
 - Enlist the classification of essential plant nutrients with its functions • and deficiency symptoms
 - Classification of fertilizers their formation, nutrient content and • application methods in soil
 - Classification of Organic manures their formation, nutrient content ٠ and application methods in soil
- b. Mini Project: NA
- Other Activities(Specify): NA c.

Soil 502.2: To understand the mineralization and immobilization of various Nitrogen in soil and plants

Approximate Hours		
Item	AppX Hrs	
Cl	5	
LI	2	
SW	2	
SL	1	
Total	10	

Annrovimata Hours

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO2.1 To Assess the Soil macronutrient status, available forms of Nitrogen SO2.2 To Evaluate the fixation and transformation of available N in soil SO2.3 To understand the factors affecting N availability and their fate soil SO2.4 To evaluate the N management tactics used in maintaining soil fertility in both upland and low land condition 	1.To estimate the available nitrogen content through kjeldahl method	 Unit : 2: Immobilization and mineralization of nitrogen 2.1. To learn the available and unavailable forms of N in soil 2.2 To know the transformation of N in soil 2.3 To understand the factors affecting N availability in soils and plants 2.4 Management of N in upland condition 2.5 Management of N in low land condition 	1. To know the role of useful microbes in mineralizatio n of different nutrients in soils

SW-2 Suggested Sessional Work(SW):

a. Assignments:

- Role, function and deficiency symptoms of Nitrogen in plants
- Transformation, mineralization, of N in plants
- d. Other Activities (Specify): NA

Soil 502 .3: To understand the mineralization and immobilization of various Phosphorus and potassium in soil and plants

Appro	oximate Hours
Item	AppX Hrs
Cl	5
LI	8
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO3.1 To Assess the Soil macronutrient status, available forms of Phosphorus and Potassium. SO3.2 To Evaluate the fixation and transformation of available P and K in soil. SO3.3 To understand the factors affecting P and K availability and their fate soil SO3.4 To evaluate the P and K management tactics used in maintaining soil fertility in both upland and low land condition 	 Chemical analysis of soil for total and available phosphorus of a given soil through spectrophotometer Estimation of available potassium of given soil sample through flame photometer Estimation of available potassium of given plant sample through flame photometer Estimation of available phosphorus of given plant sample through flame photometer 	 Unit : 3: Immobilization and mineralization of P and K 1. To learn the available and unavailable forms of P and K in soil 2. To know the transformation of P and K in soil 3. To understand the factors affecting P and K availability in soils and plants 4. Management of P and K in both upland land condition 5. Management of P and K in low land condition 	1.To know the role of useful microbes in mineralization of different Phosphorus and potassium in soils

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Role, function and deficiency symptoms of P and K in plants
- Transformation, mineralization, of P and K in soil
- b. Other Activities (Specify): NA

Soil 502 .4: To understand the mineralization and immobilization of various secondary nutrients(Ca, Mg and S) in soil and plant

Appro	Approximate Hours		
Item	AppX Hrs		
Cl	5		
LI	8		
SW	2		
SL	1		
Total	16		

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO4.1 To Assess the Soil macronutrient status, available forms of secondary nutrients. SO4.2 To Evaluate the fixation and transformation of available secondary nutrients in soil. SO4.3 To understand the factors affecting secondary nutrients availability and their fate soil SO2.4 To evaluate the secondary nutrients management tactics used in maintaining soil fertility in both upland and low land condition 	 Estimation of available Ca, Mg in given soil Estimation of available Ca, Mg in plant Estimation of available Sulphur in plant through flame photometer Estimation of available Sulphur in soil through flame photometer 	 Unit : 4: Immobilization and mineralization of secondary nutrients 4.1To learn the available forms of secondary nutrients in soil 4.2 1To learn the unavailable forms of secondary nutrients in soil 4.3 To know the transformation of secondary nutrients in soil To understand the factors affecting secondary nutrients availability in soils and plants 4.4 Management of secondary nutrients in both upland and low land condition 4.5 Management of secondary nutrients in low land condition 	1.To know the role of useful microbes in mineralization of different secondary nutrients in soils

SW-4 Suggested Sessional Work (SW):

- a. Assignments:
- Role, function and deficiency symptoms of Ca and Mg in plants
- Transformation, mineralization, of Ca and Mg in plants
- b. Other Activities (Specify): NA

Soil 502.5: To understand the mineralization and immobilization of various Micronutrient (Fe, Mn, Cu, Zn, B, Mo, Ni) content in soil and plants

Approximate Hours

Item	AppX Hrs
Cl	5
LI	6
SW	2
SL	1
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO5.1 To Assess the Soil macronutrient status, available forms of Micro nutrients (Fe, Mn, Cu, Zn, B, Mo, Ni) . SO5.2 To Evaluate the fixation and transformation of available Micro nutrients in soil. SO5.3 To understand the factors affecting Micro nutrients availability and their fate soil SO5.4 To evaluate the Micro nutrients management tactics used in maintaining soil fertility in both upland and low land condition 	 1.To estimate the micro(Fe, Mn, Cu, Zn) nutrient content in a given soil through AAS 2.To estimate the micro(Fe, Mn, Cu, Zn) nutrient content in a given water through AAS 3.To estimate the available boron content in soil 	 Unit : 5: Immobilization and mineralization of Micro nutrients 5.1: To learn the available and unavailable forms of Micro nutrients in soil 5.2: To know the transformation of Micro nutrients in soil 5.3: To understand the factors affecting Micro nutrients availability in soils and plants 5.4: Management of Micro nutrients in both upland and low land condition 5.5: Management of Micro nutrients in low land condition 	1.To know the role of useful microbes in mineralization of different Micro nutrients in soils

SW-5 Suggested Sessional Work (SW):

- a. Assignments:
 - Role, function and deficiency symptoms of Micronutrients in plants
 - Transformation, mineralization, of micronutrients in plants
- b. Other Activities (Specify): NA

Soil 502.6: To evaluate the soil test methods used for application of various fertilizers in different crop

Approximate Hours		
Item	AppX Hrs	
Cl	5	
LI	2	
SW	2	
SL	1	
Total	10	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO6.1 To Apply the various soil testing methods for fertilizer application in different crops SO6.2 To Evaluate the correlation of soil test crop response 	1.To determine the nutrient content through colorimetric method	 Unit : 6: Soil testing methods and there role in soil an 6.1 To study Common soil test methods for fertilizer 6.2: To study application methods used for fertilizer recommendations in different crop 6.3: To understand the quantity relationships of various nutrients in soil 6.4: To understand the intensity relationships of various nutrients in soil 6.5: To learn about soil test crop response correlations and response functions in soil and plant. 	1.List of Common soil test methods for fertilizer recommendations

SW-6 Suggested Sessional Work (SW):

a. Assignments:

- To enlist the various soil test methods for fertilizer recommendation
- b. Other Activities (Specify): NA

Soil 502.7: To understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture

Approximate Hours

Item	AppX Hrs
Cl	5
LI	0
SW	2
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO7.1 To Assess the fertilizer use efficiency in soil and plants		Unit : 7: To understand the integrated nutrient management and there role in soil and plants	1. List Current status of specific
SO7.2 To Evaluate the role of INM and assess the		7.1 To calculate the Fertilizer use efficiency	fertilizers use in soils and crops of
principle and concept behind SSNM		7.2 To understand the concept of site- specific nutrient management	India
SO7.3 To evaluate the use		7.3 To understand plant need based nutrient management techniques	
of fertilizers in field		7.4 To understand the basic concept and principle of integrated nutrient management specialty fertilizers concept need and category	
		7.5 Current status of specialty fertilizers use in soils and crops of India	

SW-7 Suggested Sessional Work (SW):

a. Assignments:

- Principle, concept and importance of INM, SSNM techniques
- b. Other Activities (Specify): NA

Soil 502.8: To learn the physical, biological and chemical ways to assess the fertility of soil

Approxima	ate Hours
Item	AppX Hrs
Cl	5
LI	0
SW	2
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO8.1 To Assess the fertility of Soil through various physical methods SO8.2 To Assess the fertility of Soil through various physical methods SO8.3 To Assess the fertility of Soil through various physical methods 	(LI)	 Unit : 8 Soil fertility evaluation and determination of critical limit, DRIS 8.1 To learn the Soil fertility evaluation techniques come under biological methods, soil, plant and tissue tests 8.2: To learn the Soil fertility evaluation techniques come under physical and Chemical methods of soil 8.3: to learn the visual symptoms occur due to deficiency of nutrients and indicator plants 8.4: To learn and understand the tissue tests methods in plants 	(SL) 1 To know the parameters cones under physical, chemical and biological methods of determinatio n
		8.5: soil quality in relation to sustainable agriculture, Determination of critical limit, DRIS.	

SW-8 Suggested Sessional Work (SW):

a. Assignments:

- Assessment of soil fertility evaluation through DRIS methods
- b. Other Activities (Specify): NA

Soil 502.9: To understand concept of soil health and quality

Approximate Hours

Item	AppX Hrs
Cl	5
LI	0
SW	2
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO9.1 To Assess the concept and various parameter in measuring Soil quality SO9.2 To Assess the concept and various parameter in measuring Soil Health 		 Unit : 9: Soil quality and health 9.1: To learn the concept and principle of soil health 9.2: To assess the measure should be taken in maintaining soil health 9.3: Study the long term effects of fertilizers 9.4: To learn the concept and principle of soil quality 9.5: To assess the measure should be taken in maintaining soil quality 	1.To know the parameters of soil quality and health

SW-9 Suggested Sessional Work (SW):

a) Assignments:

- Assessment of soil quality parameters
- Assessment of soil Health parameters
- b) 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)
Soil 502.1: Classification of , their uptake and available forms play a important role in maintaining soil fertility and productivity	5	4	2	1	12
Soil502.2:Tounderstandthemineralizationand	5	2	2	1	10

Soil502.3:To understand5Soil502.3:To understand5Soil502.4:To understand5Soil502.4:To understand5Soil502.4:To understand5Soil502.4:To understand5Soil502.5:To understand5Soil502.5:To understand5Soil502.5:To understand6Soil502.5:To understand5Soil502.5:To understand5Soil502.5:To understand5Soil502.5:To understand5Soil 502.6:To evaluate the soil test methods used for application of various fertilizers in different crop5Soil 502.7:To understand5Soil 502.8:To earn the physical, biological and chemical ways to assess the fertility of soil5Soil 502.9:To understand doncept of soil5Soil 502.9:To understand concept of soil hath and quality5Soil 502.9:To understand concept of soil hath and quality5	immobilization of various Nitrogen in soil and plants					
understand mineralization immobilization of various secondary nutrients(Ca, Mg and 	understand the mineralization and immobilization of various Phosphorus and potassium in soil	5	8	2	1	16
understand mineralization immobilization of various Micronutrient((Fe, Mn, Cu, Zn, B, Mo, Ni) content in soil and plants562114Soil 502.6: To evaluate the soil test methods used for application of various fertilizers in 	understand the mineralization and immobilization of various secondary nutrients(Ca, Mg and S) in soil and plant	5	8	2	1	16
the soil test methods used for application of various fertilizers in different crop22110Soil 502.7: To understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture52108Soil 502.8: To learn the physical, biological and chemical ways to assess the fertility of soil52108Soil 502.9: To understand concept of52108	understand the mineralization and immobilization of various Micronutrient((Fe, Mn, Cu, Zn, B, Mo, Ni) content in soil	5	6	2	1	14
understand principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture5 2108Soil 502.8: To learn the physical, biological and chemical ways to assess the fertility of soil5 2108Soil 502.9: To understand concept of52108	the soil test methods used for application of various fertilizers in different crop	5	2	2	1	10
physical, biological and chemical ways to assess the fertility of soil2108Soil502.9:To 552108	understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in	5		2	1	08
understand concept of 2 1 08	physical, biological and chemical ways to assess the fertility of	5		2	1	08
Total Hours 45 30 18 9 102	understand concept of soil health and quality					

Suggestion for End Semester Assessment

СО	Unit Titles	Marks Distribution			Total
00		R	U	Α	Marks
CO-1	Soil fertility and productivity	1	2	2	5
CO-2	Immobilization and mineralization of nitrogen	2	3	2	7
CO-3	Immobilization and mineralization of P and K	1	2	2	5
CO-4	Immobilization and mineralization of secondary nutrients	1	2	2	5
CO-5	Immobilization and mineralization of Micro nutrients	2	2	2	6
CO-6	Soil testing methods and there role in soil and plant	2	2	2	6
CO-7	To understand the integrated nutrient management and there role in soil and plants	2	2	2	6
CO-8	Soil fertility evaluation and determination of critical limit, DRIS	2	1	2	5
CO-9	Soil quality and health	2	2	1	5
	Total	11	26	13	50

Suggested Specification Table (For ESA)

Legend:	R:Remember,	U:Understand,	A: Apply
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The end of semester assessment for **Soil Fertility and Fertilizer Use** 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:

S.No.	Title	Author	Publisher	Edition & Year
1	The Nature and Properties of Soils.	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013
2	Trace Elements in Soils and Plants.	Kabata-Pendias A and Pendias H.	CRC Press.	1992
3	Biofertilizers Technology	Kannaiyan S, Kumar K and Govindarajan K.	Technology. Scientific Publ	2004
4	Nitrogen Fixation at the Millennium	Leigh J G.	Elsevier	2002
5	Principles of Plant Nutrition	Mengel K and Kirkby EA.	International Potash Institute, Switzerland	1982
6	Micronutrients in Agriculture	Mortvedt JJ, Shuman LM, Cox FR and Welch RM.	2nd Ed. SSSA, Madison	1991
7	Soils and Environmental Quality	Pierzinsky GM, Sims TJ and Vance JF.	2nd Ed. CRC Press	2002

(a) Books :

Curriculum Development Team

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Cos, POs and PSOs Mapping

Code : Soil 502

Course Title: Soil Fertility and Fertilizer Use

		Program Outcomes						1		Progran	n Specific Ou	tcome				
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of Problem soil	Preparation and recommendation of compost/manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of engineering tools	Ethics	Life-long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity
Classification of their uptake and available forms play a important role in maintaining soil fertility and	2	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3
productivityTounderstandmineralizationandimmobilizationofvariousNitrogen in soil and plants	2	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3

To understand the mineralization and immobilization of various Phosphorus and potassium in soil and plants	2	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3
Tounderstandthemineralizationandimmobilizationofvarioussecondarynutrients(Ca,Mg and S) in soil and plant	2	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3
To understand the mineralization and immobilization of various Micronutrient (Fe, Mn, Cu, Zn, B, Mo, Ni) content in soil and plants	1.	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3
To evaluate the soil test methods used for application of various fertilizers in different crop	2	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3
To understand the principle, concept and importance of SSNM, INM, and fertilizer use efficiency in agriculture	4	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3
To learn the physical, biological and chemical ways to assess the fertility of soil	2	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3
To understand concept of soil health and quality	2	1	3	2	3	3	3	2	2	2	3	3	2	3	3	3

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self- Learning(S L)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.1. Classification of , their uptake and available forms play a important role in maintaining soil fertility and productivity	SO1.1 SO1.2 SO1.3	LI. 1.1, LI. 1.2, LI. 1.3, LI. 1.4	Unit-1 Soil fertility and productivity 1.1,1.2,1.3,1.4,1.5	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.2. To understand the mineralization and immobilization of various Nitrogen in soil and plants	SO2.1 SO2.2 SO2.3 SO2.4	LI. 2.1, LI. 2.2	Unit : 2: Immobilization and mineralization of nitrogen 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, 5	CO.3. To understand the mineralization and immobilization of various Phosphorus and potassium in soil and plants	SO3.1 SO3.2 SO3.3 SO3.4	LI. 3.1, LI. 3.2, LI. 3.3, LI. 3.4, LI. 3.5, LI. 3.6, LI. 3.7, LI. 3.8	Unit : 3: Immobilization and mineralization of P and K 3.1,3.2,3.3,3.4,3.5	As mentioned in page numbe r
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.4. To understand the mineralization and immobilization of various secondary nutrients(Ca, Mg and S) in soil and plant	SO4.1 SO4.2 SO4.3 SO4.4	LI.4.1, LI. 4.2, LI. 4.3, LI. 4.4, LI. 4.5, LI. 4.6, LI. 4.6, LI. 4.7, LI. 4.8	Unit : 4: Immobilization and mineralization of secondary nutrients 4.1,4.2,4.3,4.4,4.5	_ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.5. To understand the mineralization and immobilization of various Micronutrient (Fe, Mn,Cu, Zn,	SO5.1 SO5.2 SO5.3 SO5.4	LI. 5.1, LI. 5.2, LI. 5.3, LI. 5.4,	Unit : 5: Immobilization and mineralization of Micro nutrients 5.1,5.2,5.3,5.4,5.5	

Course Curriculum	Map: Soil 502	: Soil Fertility	and Fertilizer use

	B, Mo, Ni) content in soil and plants		LI. 5.5, LI. 5.6	
PO 1,2,3,4,5,6,7, 8,9,10,11,12	CO.6. To evaluate the soil test methods used for application of various fertilizers in different	SO6.1 SO6.2	LI. 6.1, LI. 6.2	Unit : 6: Soil testing methods and there role in soil and plant
PSO 1,2, 3, 4, 5	crop			6.1,6.2,6.3,6.4,6.5
PO 1,2,3,4,5,6,7, 8,9,10,11,12	CO.7. To understand the principle, concept and importance of SSNM, INM, and fertilizer use	SO7.1 SO7.2 SO7.3	-	Unit : 7: To understand the integrated nutrient management and there role in soil and plants
PSO 1,2, 3, 4, 5	efficiency in agriculture			7.1,7.2,7.3,7.4,7.5
PO 1,2,3,4,5,6,7, 8,9,10,11,12	CO.8. To learn the physical, biological and chemical ways to	SO8.1 SO8.2	-	Unit : 8 Soil fertility evaluation and determination of critical limit, DRIS
PSO 1,2, 3, 4, 5	assess the fertility of soil	SO8.3		8.1,8.2,8.3,8.4,8.5
PO 1,2,3,4,5,6,7, 8,9,10,11,12	CO.9. To understand concept of soil health and quality	SO9.1 SO9.2	-	Unit : 9: Soil quality and Health
PSO 1,2, 3, 4, 5	ncuren and quanty	507.2		9.1,9.2,9.3,9.4,9.5

Semester-I

Course Code:	Soil 505
Course Title:	Soil Erosion and Conservation
Pre- requisite:	Students should know about the distribution of eroded land of India and world
Rationale:	To enable students to understand various types of soil erosion and measures to be taken for controlling soil erosion to conserve soil and water

Course Outcomes:

Soil 505.1: To understand the distribution and identification of probes regarding soil erosion in India

- **Soil 505.2:** To identify the types, cause, mechanisms and factor affecting soil and water erosion
- Soil 505.3: To understand the cause of wind erosion, its types, mechanisms involved and

Factors affecting wind erosion

- Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques
- Soil 505.5: To understand the land capability classification and evaluate the soil conservation strategies Under wet land, waterlogged conditions
- Soil 505.6: To measure the watershed management techniques

Scheme of Studies:

				Scheme of studies(Hours/Week)							
Course Category	Course Code	Course Title	Cl	LI	sw	SL	Total Study Hours (CI+LI+SW+SL)	Total Credits (C)			
Minor Course	Soil 505	Soil Erosion and Conservation	2	1	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 appringer and feadback of tageher to ansure

continuous guidance and feedback of teacher to ensure outcome of Learning.

Scheme of Assessment: Theory

	1 11	eory								
						Scher	ne of A	Assessment (Marks)		
			Progressive Assessment (PRA)				(PRA)		Total	
			5	3)				Total Marks	End	Marks
			lent			one			Semester	
			çnm ıch	out	SA)	any o	nce		Assessment	
~			ome Assignment 3 marks each	best out of (CT)	ne (y aı D	Attendance (AT)			
gory			_	(2 b th ((IL 0]	ctivity (CAT)	Atter AT	(
Course Category	Code	itle	Home r 3 ma ()		Seminar one (SA)	Class Activity (CAT)	A SSI	CA+CT+SA+CAT+		(PR
e C		Course Title		Class Test 2 10 marks ead	Sen	ass	Class .	AT)		A+
ours	Couse	sinc	Class/ H number (CA)	ass ma		C			(ESA)	ESA
CC	Ŭ	C	n CI	CI 10)
	Soi	Soil	1.5	20	0	0	~	50	50	100
Mino	I	Erosion	15	30	0	0	5	50	50	100
r Course	50 5	and								
Cours e		Conservati								
C		on								

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.

Soil 505.1: To understand the distribution and identification of probes regarding soil erosion in India

Approximate He	AppXHrs
Cl	3
LI	6
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To identify the soil erosion problem in India SO1.2 To recollect the history and distribution of soil erosion problem in India	 To understand the agro climatic zones of India To understand the Soil type of India To understand the Soil type of world 	 Unit-1.0 Distribution of eroded soil in India 1.1To recall the history of classification of eroded soil 1.2 To identify the distribution of eroded land 1.3 To identify the major cause of soil erosion 1.4 To understand the geotopography of India 1.5 To understand the geotopography of world 	1. To know the various cause of soil erosion

SW-1 Suggested Sessional Work (SW):

Assignments:

a)

b)

- Enlist the various types of eroded soils present in India
- Enlist the cause of soil erosion in India
- Other Activities(Specify): NA

Soil 505.2: To identify the types, cause, mechanisms and factor affecting soil and water erosion

Approximate Hours					
Item	AppXHrs				
Cl	7				
LI	8				
SW	2				
SL	1				
Total	18				

Approximate Hours

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO2.1: To understand the types, cause, mechanisms and management of soil erosion SO2.2: To identify the types, cause, mechanisms and management of water erosion SO2.3: Evaluate the measurement and prediction of runoff water SO2.4: To understand the factors affecting soil and water erosion 	 Determination of percolation ratio Estimation of raindrop erodibility index Estimation of suspension percentage Computation of kinetic energy of falling rain drop 	 Unit-2 To understand source and factors responsible for soil and water erosion 1.1 To classify the various forms of soil erosion 1.2 Factors affecting soil erosion 1.3 To understand the sources of water erosion 1.4 To learn the factors affecting water erosion 1.5 To measurement techniques used to manage the eroded land 1.6 To evaluate the empirical and quantitative estimation of water erosion 1.7 To understand the measurement and prediction of runoff water with relation to soil properties and prediction 	1.To know the different types of eroded lands present in India and world

SW-2 Suggested Sessional Work (SW):

a. Assignments

- i. Classification of eroded lands and their management techniques used
- ii. Classification of different cause of soil and water erosion
- b. Other Activities(Specify): NA

Soil 505.3: To understand the cause of wind erosion, its types, mechanisms involved and Factors affecting wind erosion

Approximate Hours					
Item	AppX Hrs				
Cl	5				
LI	4				
SW	2				
SL	1				
Total	12				

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO3.1 To assess the various process involved during wind erosion SO3.2 To assess the factors affecting wind erosion SO.3.3 To evaluate the extent of wind erosion in state, India and world 	 To determine the Soil texture of particular area To study the topography and Industrial location of a particular area 	 Unit-3 : Wind erosion 3.1 To learn the various sources of wind erosion 3.2 To understand the classification of wind erosion 3.3 To assess the factors affecting wind erosion 3.4 To analyze the extent of wind erosion in state and in India 3.5 To analyses the extent of wind erosion in world 	1.To know the area prone to wind erosion

SW-3 Suggested Sessional Work (SW):

a) Assignments:

- Enlist the factors affecting wind erosion
- Distribution of area prone to wind erosion
- b) Other Activities(Specify): NA

Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques

Approximate Hours	
Item	AppX Hrs
Cl	4
LI	6
SW	2
SL	2
Total	14

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1. To recollect the knowledge of historical development with modern development of soil classification	of erosion ratio		1. To study soil map of India
SO4.2 To understand the classification, importance and use of various soil maps	 2. Estimation of dispersion ratio 3. Determination of 	principles of erosion controlling measure	2. To study soil map of world
	clay ratio/ moisture evaluating ratio	4.2 Application of agronomic practices in controlling the erosion	
		4.3 Utilization of engineering strategies in controlling the erosion	
		4.4 Preparation of erosion controlling structures	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the agronomic practices used in controlling the erosion
- Enlist the engineering techniques in maintaining the eroded lands

b. Other Specific :

• Prepare the models in managing the agronomic measures to preserve the soil from erosion in different topography of India and World

Soil 504.5: To understand the land capability classification and evaluate the soil

conservation strategies under wet land, waterlogged conditions

Approximate Hours					
Item	AppX Hrs				
Cl	5				
LI	2				
SW	2				
SL	1				
Total	10				

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1. To evaluate the soil conservation techniques SO5.2 To understand the land capability classification	computation of rainfall erosivity index (EI30) using rain gauge data	 Unit-5: Soil conservation measures 1.1. To learn the concept of soil conservation planning in arid and semiarid regions 1.2. To learn the concept of soil conservation planning in hilly regions 1.3. To learn the concept of soil conservation planning in waterlogged condition 5.1 To learn the concept of soil conservation planning in wetland 5.5. To understand the concept land capability classification 	1. To know the region of waterlogged soil

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- Classify the various techniques used for soil conservation planning Classify the land capability classification of soil •
- •

Soil 505.6: To measure the watershed management techniques

Approximate Hours					
Item	AppX Hrs				
Cl	5				
LI	4				
SW	2				
SL	1				
Total	12				

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learnin g (SL)
SO6.1. To monitor the watershed management techniques SO6.2 To understand and evaluate the water harvesting and recycling strategies	land capability classification of a watershed2. To visit the watershed area	 Unit-6: Watershed management strategies 6.1. To learn the concept, objectives and approach of water harvesting 6.2 To learn the concept, objectives and approach of water recycling 6.3 To understand the concept, objectives and approach to control the flood though watershed management 6.4To use the GIS and remote sensing techniques in assessment and planning of water shed, sediment management 	1. To know the handling of computer

SW-6 Suggested Sessional Work (SW):

a) Assignments:

- •
- Enlist the watershed management techniques Enlist the water harvesting and recycling strategies to be used under recent • cenario

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)
Soil 505.1: To understand the distribution and identification of probes regarding soil erosion in India	5	6	2	1	14
Soil 505.2: To identify the types, cause, mechanisms and factor affecting soil and water erosion	7	8	2	1	18
Soil 505.3: To understand the cause of wind erosion, its types, mechanisms involved	5	4	2	2	13

and Factors affecting wind erosion					
Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques	4	6	2	1	13
Soil 505.5: To understand the land capability classification and evaluate the soil conservation strategies under wet land, waterlogged conditions	5	2	2	1	10
Soil 505.6: To measure the watershed management techniques	4	4	2	1	11
Total Hours	30	30	12	7	79

Suggestion for End Semester Assessment

СО	Unit Titles		Marks Distribution		
		R		A	Marks
CO-1	Distribution of eroded soil in India	03	01	01	5
CO-2	To understand source and factors responsible for soil and water erosion	05	06	604	10
CO-3	Wind erosion	04	03	02	9
CO-4	Erosion controlling measures	2	4	2	8
CO-5	Soil conservation measures	3	3	3	9
CO-6	Watershed management strategies	3	3	3	9
	Total	20	20	15	5(

L: Legend R: Remember,

U:Understand,

A: Apply

The end of semester assessment for **Soil Erosion and Conservation** 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
- 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	Soil Management in Relation to Land Degradation and Environment	Biswas TD and Narayanasamy G.	Bull. Indian Society of Soil Science No. 17.	1996
2	Methods of Assessing Soil Quality	Doran JW and Jones AJ.	Society of America, Spl Publ. No. 49, Madison, USA.	1996
3	Manual of Soil and Water Conservation Practices.	Gurmal Singh, Venkataramanan C, Sastry G and Joshi BP.	Oxford & IBH	1990
4	Soil Conservation.	Hudson N. 1995.	University Press	1995
5	Fundamentals of Soil Science	Indian Society of Soil Science	ISSS, New Delhi	2002
6	Soil Physics	Oswal MC.	Oxford & IBH.	1994

Curriculum Development Team

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- 5. Dr. Sugyata Shivhare, (Head) Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
- 6. Mr. Atul Kumar Singh, Assistant Professor, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
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Cos.POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 505

Course Title: Soil Erosion and Conservation

		-		Pı	rogram Outco	omes	-				-		Pr	ogram Spec	ific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil505.1:TounderstandthedistributionandidentificationofprobesregardingregardingsoilerosioninIndia	2	3	1	3	1	2	1	3	1	2	2	2	1	2	2	2
Soil 505.2: To identify the types, cause, mechanisms and factor affecting soil and water erosion	2	3	2	3	2	1	2	3	1	2	3	2	1	2	1	2
Soil 505.3: To understand the cause of wind erosion, its types,	2	3	1	3	2	1	2	3	1	2	2	2	1	2	1	2

mechanisms involved and Factors affecting wind erosion																
Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques	2	2	2	3	3	1	3	3	2	2	3	3	1	2	1	2
Soil 505.5: To understand the land capability classification and evaluate the soil conservation strategies under wet land, waterlogged conditions	2	2	2	3	3	1	3	3	2	2	3	3	1	2	1	2
Soil 505.6: To measure the watershed management techniques	2	2	2	3	3	1	3	3	2	2	3	3	1	2	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

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	Soil 505.1: To understand the distribution and identification of probes regarding soil erosion in India	SOs: 1.1, SOs:1.2	LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4	Unit-1.0 Distribution of eroded soil in India 1.1,1.2,1.3,1.4,1.5,1.6	As mentionedin page number 2 to 6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 505.2: To identify the types, cause, mechanisms and factor affecting soil and water erosion	SOs: 2.1, SOs:2.2, SOs:2.3 SOs:2.4	LI: 2.1, LI: 2.2, LI: 2.3, LI:2.4	Unit.2: To understand source and factors responsible for soil and water erosion 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	Soil 505.3: To understand the cause of wind erosion, its types, mechanisms involved and Factors affecting wind erosion	SOs: 3.1, SOs:3.2, SOs:3.3	LI: 3.1, LI:3.2	Unit-3 : Wind erosion 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	Soil 505.4: To apply the erosion controlling measures through agronomic and engineering techniques	SOs: 4.1, SOs:4.2,	LI: 4.1, LI:4.2, LI:4.3	Unit-4: Erosion controlling measures 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	Soil 505.5: To understand the land capability classification and evaluate the soil conservation strategies under wet land, waterlogged conditions	SOs: 5.1, SOs:5.2	LI: 5.1, LI: 5.2, LI: 5.3, LI:5.4	Unit-5: Soil conservation measures 5.1,5.2,5.3,5.4,5.5	

Course Curriculum Map: Soil Erosion and Conservation

PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 505.6: To measure the watershed management techniques	SOs: 6.1, SOs:6.2	LI:6.1 LI:6.2	Unit-6: Watershed management strategies	
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Semester I

Course Code: STAT-502

Course Title: Statistical Methods for Applied Science

Pre-requisite: Statistical knowledge helps you use the proper methods to collect the data, employ the correct analyses, and effectively present the results. Statistics is a crucial process behind how we make discoveries in science, make decisions based on data, and make predictions.

Rationale: Statistical methods involved in carrying out a study include planning, designing,

collecting data, analysing, drawing meaningful interpretation and reporting of the research findings. The statistical analysis gives meaning to the meaningless numbers, thereby breathing life into a lifeless data.

Course Outcomes:

- **CO1** This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study
- **CO2** It can be used to find the best solution to any problem be it simple or complex
- **CO3** Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient
- **CO4** To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data
- **CO5** Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA

Scheme of Studies:

Course	Course	Course Title	Title Schem		e of st	Total		
Category	Code		Cl	LI	SW	SL	Total Study	Credit
							Hours	S
							(CI+LI+SW+SL	(C)
Supporting Course	STAT-502	Statistical Methods for Applied Science	2	01	02	01	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

			Scheme of Assessment (Marks)								
]	Progressive Assessment (PRA)			nt (PRA)	End	Total		
Course Category	Code	Title	Home ment 5 number s each (CA)	Test 2 (2 best out 10 marks each	Seminar one (SA)	Class Activity any one (CAT)	Total Marks (CA+CT+SA+CAT +AT)	Semester Assessme nt	Marks		
Course	Couse (Course Title	Class/ Assignment ' 3 marks each	Class Test 2 of 3) 10 mar (CT)	Sem	Class A		(ESA)	(PRA+ ESA)		
Supportin g Course	-502	Statistica l Methods for Applied Science	5	30	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.

STAT-502.1: To know the application of statistics and learn and apply these techniques in the agriculture field

Approximate Hours					
Item	Appx. Hrs.				
СІ	6				
LI	2				
SW	1				
SL	2				
Total	11				

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self- Learning (SL)
 SO1.1 Apply laws probability to concruption problems. SO1.2 Perform statistic inference in seven circumstances and interpret to results in an applied context. SO1.3 Communicate conception in probability and statistic using both technical and not technical language. SO1.4 Use a statistical software package for computations with data, 	f 1) To impart e knowledge on Statistical concepts like d Exploratory d data analysis. e s	 Unit-1. Box-plot, Descriptive statistics, Exploratory data analysis, Theory of probability, Random variable and mathematical expectation. 1.1. Box-plot 1.2 Descriptive statistics 1.3 Exploratory data analysis 1.2 Theory of probability. 1.5 Random variable 1.6 Mathematical expectation 	1. Prepare the assignment on Random variable and mathematical expectation.

SW-1 Suggested Sessional Work (SW):

- a. Assignments: Prepare the assignment on Random variable and mathematical expectation.b. Mini Project: NA
- c. Other Activities (Specify):- NA

STAT-502.2 Find the best solution to any problem be it simple or complex

Арр	proximate Hours
Item	Appx. Hrs.
СІ	6
LI	8
SW	1
SL	2
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO2.1 Recognize the binomial probability distribution and apply it appropriately.	 Fitting of Binomial distributions. Fitting of Poisson 	Unit-2 Discrete and continuous probability distributions, Binomial, Poisson, Negative Binomial, Normal distribution, Beta and Gamma distributions	assignment on Binomial,

 SO2.2 Recognize the Poisson probability distribution and apply it appropriately. SO2.3 Recognize and understand discrete probability distribution functions in general. 	3- Fitting of	and their applications. Concept of sampling distribution: chi- square, t and F distributions. Tests of significance based on Normal, chi-square, t and F distributions	Normal distribution,
functions, in general. SO2.4 Recognize the standard normal probability distribution and apply it appropriately. SO2.5 Compare normal probabilities by converting to the standard normal distribution.		 1.1 Discrete and continuous probability distributions 1.2 Binomial, Poisson, Negative Binomial 1.3. Normal distribution, Beta and Gamma distributions and their applications 1.4 Concept of sampling distribution: chi-square, t and F distributions. 1.5 Tests of significance based on Normal, chi-square. 1.6 Tests of significance based on t and F distributions. 	

SW-2 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Simple Problems Based on Probability. Binomial & Poisson Distributions.

a. Other Activities (Specify): NA

STAT-502.3 Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.

Approximate Hours							
Item	Appx. Hrs.						
CI	6						
LI	6						
SW	2						
SL	1						
Total	15						

Session Out	Laboratory Instruction	Classroom Instruction	Self-		
Comes	(LI)	(CI)	Learning		
(SOs)			(SL)		
SO3.1 Create and analyze scatter plots.	1- Large sample tests, testing of hypothesis based on eXact sampling distributions ~ chi square, t	Correlation,ScatterDiagram.KarlPearson's	1. Prepare the assignment on Karl Pearson's Coefficient of		
SO3.2 Discuss basic ideas of linear regression	and F. 2- Large sample tests, testing of hypothesis based	Linear Regression			
and correlation. SO3.3 Create and interpret a line of best fit.	on exact sampling	Correlation 1.2 Types of Correlation	Equations.		
SO3.4 Calculate and interpret the correlation coefficient.	distributions ~F- test.	Coefficient of Correlation 1.5 DefinitionOf Regression. 1.6 .LinearLinearRegressionEquations			

SW-3 Suggested Sessional Work (SW):

- a. Assignments: Prepare the assignment on Karl Pearson's Coefficient of Correlation. Linear Regression Equations.
- **b.** Other Activities (Specify): NA
- STAT-502.4 To understand the process of hypothesis testing and its significance Testing of hypothesis using non-Parametric tests like Median test, runs test, U test, Kruskal Wallis test etc. and ability to use the judiciously for the testing of given data.

Approximate Hours									
Item	Appx Hrs.								
CI	6								
LI	8								
SW	2								
SL	1								
Total	17								

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)		
 SO4.1 Conduct and interpret hypothesis tests for a single population mean, population standard deviation known. SO4.2 Conduct and interpret hypothesis tests for a single 	 Confidence interval estimation and 2- Correlation analysis Regression analysis Fitting of Linear and Quadratic Model. 	 Unit-4 Introduction to Test of Significance, One sample & two sample test t for Means, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table. 1.1 Introduction to Test of Significance 1.2 One sample 1.3 Two sample test t for 	the assignment on Chi-Square Test of Independence of Attributes in		

population mean, population standard deviation unknown.	Means 1.4 Definition of Chi-Square 1.5 Application of Chi-	
SO4.3 Describe hypothesis testing in general and in practice	square test 1.6 Chi-Square Test of Independence of Attributes in 2×2 Contingency Table	
SO4.4 Interpret the chi- square probability distribution as the sample size changes.		
SO4.5 Conduct and interpret chi-square goodness-of-fit hypothesis tests.		

SW-4 Suggested Sessional Work (SW):

- **a.** Assignments: Prepare the assignment on Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table
- b. Other Activities (Specify): NA

STAT-502.5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.

Approximate Hours							
Item	Appx Hrs.						
CI	6						
LI	6						
SW	2						
SL	1						
Total	15						

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)		
 SO5.1 Recognize and differentiate between key terms. SO5.2 Apply various types of sampling methods to data collection. SO5.3 Create and interpret frequency 	 Non- parametric tests. ANOVA: One way ANOVA: Two Way 	Unit-5 Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods, Sampling versus Complete Enumeration, Simple Random Sampling with and without replacement, Use of Random Number Tables for selection of Simple Random Sample.	Prepare the assignment on Introduction to Analysis of Variance, Analysis of One Way Classification. Introduction to Sampling Methods,		

tables.		Sampling
	1.1 Introduction to Analysis of	versus
	Variance	Complete
	1.2 . Analysis of One Way	Enumeration.
	Classification	
	1.3 . Introduction to Sampling	
	Methods	
	1.4 Sampling versus Complete	
	Enumeration	
	1.5 Simple Random Sampling	
	with and without replacement	
	1.6 Use of Random Number	
	Tables for selection of Simple	
	Random Sample.	

SW-5 Suggested Sessional Work (SW):

a. Assignments: NA

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (C l)	Laboratory Lecture (L I)	Sessional Work (SW)	Self Learning (S l)	Total hour (C l + LI+ SW +S l)
01: This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.	06	02	01	02	15
02: It can be used to find the best solution to any problem be it simple or complex.	06	08	01	02	15
03: Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.	06	06	01	02	15
04: To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non- Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	06	08	01	02	15
05: Apply the different sampling methods for designing and	06	06	01	02	15

selecting a sample from a					
population. Compare the pairs of					
treatment means using different					
methods when null hypothesis in					
rejected in ANOVA.					
Total Hours	30	30	05	10	75
	•••	•••	00	20	

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit title		arks		Total
		Distri		n	Marks
		R	U	Α	
CO-1	This course will help students to know the applications of	02	02	02	06
	Statistics and learn and apply these techniques in the				
	agriculture field of their study.				
CO-2	It can be used to find the best solution to any problem be	02	03	03	08
	it simple or complex.				
CO-3	Concept of correlation, various correlation coefficients-	02	04	04	10
	Pearson's correlation coefficient, Spearman's rank				
	correlation coefficient, partial correlation coefficient and				
	Multiple correlation coefficient.				
CO-4	To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	03	04	05	12
CO-5	Apply the different sampling methods for designing and	04	05	05	14
	selecting a sample from a population. Compare the pairs				
	of treatment means using different methods when null				
	hypothesis in rejected in ANOVA.				
	Total	13	18	19	50

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

The end of semester assessment for **Statistical Methods for Applied Science** 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:

S. No.	Title	Author	Publisher	Edition & Year
01	An Outline of Statistical Theory	Goon AM, Gupta MK &Dasgupta B.	The World Press	1977 1 st adition
02	Fundamentals of Statistics	Goon AM, Gupta MK &Dasgupta B	The World Press	1983. First edition
03	Introduction to Mathematical Statistics	Hoel PG	John Wiley	05th Edition 1971
04	An Introduction to Multivariate Statistical Analysis	T.W. Anderson	John Wiley.	3rd Edition 2009
05	Introduction to Mathematical Statistics	Robert V. Hogg, Joseph W. McKean, Allen T. Craig	Hogg	7th Edition 2012

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Cos.POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : STAT -502

Course Title: Statistical Method For Applied Science

		Program Outcomes									Program Specific Outcome					
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost /Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
STAT-502.1: To know the application of statistics and learn and apply these techniques in the agriculture field	1	1	2	1	1	2	2	2	3	2	3	2	1	1	1	3
STAT-502 CO-2 Find the best solution to any problem be it simple or complex.		1	2	1	1	2	2	2	3	2	3	2	1	1	1	3
STAT-502.3: Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation	1	1	2	1	1	2	2	2	3	2	3	2	1	1	1	3

coefficient, partial correlation coefficient and Multiple correlation coefficient.																
STAT-502.4: To understand the process of hypothesis testing and its significance. Testing of hypothesis using non- Parametric tests like Median test, runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	-	1	2	1	1	2	2	2	3	2	3	2	1	1	1	3
STAT-502 CO-5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.		1	2	1	1	2	2	2	3	2	3	2	1	1	1	3

Legend: 1 – Low, 2 – Medium, 3 – High

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self- Learning(S L)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	STAT-502.1: To know the application of statistics and learn and apply these techniques in the agriculture field	SO1.1	LI. 1.1,	Unit-1 This course will help students to know the applications of Statistics and learn and apply these techniques in the agriculture field of their study.	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	STAT-502 CO-2 Find the best solution to any problem be it simple or complex.	SUZ.	LI. 2.1, LI. 2.2, LI. 2.3, LI. 2.4	1.1,1.2,1.3,1.4,1.5,1.6Unit-2 It can be used to find the best solution to any problem be it simple or complex.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	STAT-502.3: Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient.	SO3.2 SO3.3 SO3.4	LI. 3.1 LI. 3.2 LI. 3.3 LI. 3.4	 Unit-3 Concept of correlation, various correlation coefficients- Pearson's correlation coefficient, Spearman's rank correlation coefficient, partial correlation coefficient and Multiple correlation coefficient. 3.1,3.2,3.3,3.4,3.5,3.6 	As mentioned in page numbe r _ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	STAT-502.4: To understand the process of hypothesis testing and its significance. Testing of hypothesis using non-Parametric tests like Median test, runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data.	SO4.1 SO4.2 SO4.3	LI. 4.1 LI. 4.2 LI. 4.3 LI. 4.4	 Unit-4 To understand the process of hypothesis testing and its significance. Testing of hypothesis using Non-Parametric tests like Median test, Runs test, U test, Kruskal Wallis test etc. and ability to use them judiciously for the testing of given data. 4.1,4.2,4.3,4.4,4.5,4.6 	

Course Curriculum Map: STAT 502: Statistical Method For Applied Science

PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	STAT-502 CO-5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.	SO5.1	LI. 5.1, LI. 5.2, LI. 5.3	Unit-5 Apply the different sampling methods for designing and selecting a sample from a population. Compare the pairs of treatment means using different methods when null hypothesis in rejected in ANOVA.	
				5.1, 5.2, 5.3, 5.4, 5.5, 5.6	

Semester-I

Course Code:	PGS 501
Course Title :	Library and Information Services
Pre-requisite:	Student should have basic knowledge of library because course aims to familiarize the learners with the basic concept of use of library services.
Rationale:	To impart to the students an understanding of knowledge classification and the theories of library classification, to develop skills in document classification and content analysis. The course provides the opportunity, ensuring freedom and equal access to information for all members of the community, to educate and enlighten them. To maintain and preserve books, materials and resources with historical, cultural, social, economic and archival value, and other related materials in an organized collection to provide members of the community these materials and enriched their personal and professional lives.

Course Outcomes:

PGS 501.1. Able to understand about various concepts of Library, its functions, objective and connect Foundational concepts, theories, and principles of information organization and access to professional contexts.

Scheme of Studies:

~	x		Sc	hem	es(Hours/Week)	Total		
Course Category	Course Code	Course Title	Cl	LI	SW	SI	Total StudyHours (CI+LI+SW+SL)	Credits (C)
Non Credit Course	PGS 501	Library and Information Services	0	1	1	1	3	1

Legend:

- **CI:** Classroom 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, mini project etc.),

SL: Self Learning,

C: Credits.

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

Scheme of Assessment: Theory

			Scheme of Assessment (Marks)											
			Pro	gress	End	T ()								
Course Category	ode	Title		Class Test 2 (2 best out of 3) 10 marks each (CT)	· one (SA)	ctivity any one	Class Attendance (AT)	Total Marks (CA+CT + SA+CAT	Semester Assessme nt	Total Marks				
Course	Couse Code	Course Title	Class/Home number 3 n CA)	Class Test 3) 10 mark	Seminar	Class Activity (CAT)	Class At (AT)	+AT)	(ESA)	(PRA+ ESA)				
Non Credit Course	PGS 501	Library and Informatio n Services	0	0	0	0	0	0	100	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

PGS 501.1: Able to understand about various concepts of Library, its functions, objective and connect foundational concepts, theories, and principles of information organization and access to professional contexts.

Approxin	nate Hours	
	Item	Appx Hrs.
	Cl	0
	LI	30
	SW	6
	SL	3
	Total	39

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Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	(SL)
SO1.1Understand the	1.1 Introduction to library,		
Concept, Definition &	1.2 Types of library,		1. How to
Characteristics of	1.3 Role of library in society		Accessioning
Library	1.4 Role of Education sector,		of Books on
	1.5 Classification scheme,		software
SO1.2 Understand the	1.6 Types of Information		
Importance	sources		2 How to
&Functions of	1.7 Abstracting and indexing		Books search
Library	services,		in Library
	1.8 Use of Databases, OPAC		through the
SO1.3 Understand the Role of	1.9 Computerized library		OPAC
Library and	services		
Information Service	1.10 Library Services		3. Difference
	1.11 Online Public Access		Between
	Catalogue		Library and
	1.12 Types of Information		Information
	Centers		Services
	1.13 Library Automation		
	1.14 Create a Digital Library		
	1.15 Use of e resources		

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- 1. Introduction to library and its services;
- 2. Role of libraries in education, research and technology transfer,
- 3. Classification systems and organization of library;
- 4. Sources of information-, Primary Sources, Secondary Sources and Tertiary Sources;
- 5. Intricacies of abstracting and indexing services (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.);
- 6. Tracing information from reference sources;

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class	Laboratory	Sessional	Self-	Total hour
	Lecture	Instruction	Work	Learning	(CL+SW+
	(CL)	(LI)	(SW)	(SL)	SL)
Able to understand about various concepts of Library, its functions, objective and connect foundational concepts, theories, and principles of information organization and access to professional contexts.	0	30	6	3	39

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	Mark	ks Distri	Total Marks	
		R	U	Α	
CO1	Library and Information Services	0	30	70	100

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

The end of semester assessment for **Library and Information Services** 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:

Sl. No.	Title	Author	Publisher	Edition and Year				
01								
02								

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Cos.POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : PGS 501

Course Title: Library and Information Services

			•	Р	rogram O	outcomes						-		Program S	pecific Out	come
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
PGS 501. Able to understand about various concepts of library, its functions, objective and connect foundational concepts, theories, and principles of information organization and access to professional contexts.	1	1	1	1	2	2	3	2	3	3	3	2	1	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum N	Map: PGS 501: Library	y and Information Services
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POs &	COs No.& Titles	SOs	Laboratory Instruction	Classroom	Self-
PSOs No.		No.	(LI)	Instruction(CI)	Learning(SL)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 501. Able to understand about various concepts of library, its functions, objective and connect foundational concepts, theories, and principles of information organization and access to professional contexts.	SO1.1 SO1.2 SO1.3	LI. 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		As mentioned in page number _ to _

Semester- I

Course Code:	PGS 502
Course Title:	Technical writing and communication
Pre- requisite:	Understanding the principles of various technical writing including thesis, reviews, abstracts and developing communication skills through the proper use of language.
Rationale:	The basic purpose of technical writing is to convey complex information in a simple manner. It explains a topic in detail using proper abstract and citations having communication skills being accessible to a general audience.

Course Outcomes:

PGS 502.1: Learning the various form of scientific writing and implementing skills for Formulation of research based documents.

PGS 502.2: Acquisition of technical communication skill and articulate in English (verbal as writing)

Scheme of Studies:

Course	Course	Course Title	S	Scheme of studies(Hours/Week)			(Hours/Week)	Total
Category	Code		CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	Credits (C)
Non Credit Course	PGS 502	Technical writing and communication.	0	2	0	0	2	0+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

						essment ssessme	`	/		
Course Category	Course Code	Course Title	lass/Home Assignmer i number 3 marks eac (CA)	lass 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+CA T+AT)	End Semester Assessment (ESA)	Total Marks (PRA+ESA)
Non	PGS	Technical								
Credit	502	writing and	0	0	0	0	0	0	100	100
		communication								

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.

PGS 502.1: Learning the various form of scientific writing and implementing skills for Formulation of research based documents.

Item	Approximate Hours
CI	00
LI	08
SW	01
SL	02
Total	11

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO1.1. To understand about various form writing research documents. SO1.2. To understand about various technical writing approaches for scientific strengting of research documents. SO1.3. To understand about editing and press reading method to avoid plagiarism.	 Technical writing 1. Various form of scientific writing – thesis, technical papers, reviews, manuals etc. 2. Various part of thesis and research communication Title page, Authorship content page, Preface, Introduction, Review of literature Material and methods, Experimental result, Discussion citations etc. 3. Commonly used abbreviations in the thesis and research communication, Illustrations, photography and drawing with suitable captions pagination numbering of tables and illustrations. 4. Writing of numbers and dates in scientific write ups, Editing and press reading and Writing of review articles. 		Enlisting and write description of research communication contents.

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- i. Various part of thesis and research communications.
- ii. Writing of abstract, summaries, précis, citations.
- iii. Commonly used abbreviations in the thesis and research communication.
- iv. Write down the principal of editing and press reading.
- b. Mini Project: NA
- c. Other Activities (Specify): NA

PGS 502.2: Acquisition of technical communication skill and articulate in English (verbal as writing).

ximate Hours
Approximate Hours
0
08
01
01
10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self-Learning (SL)
SO2.1.Tounderstand the types,forms, tenses clausesand their uses.SO2.2.Tounderstand commonerrors, punctuation inthe sentences.SO2.3.Tounderstand part ofspeech or word classand their uses.SO2.4.Tounderstanddiscussion in groupsand interviews.	and transcription.3 Accentual pattern: weak forms in connected speech.		1.Enlisting and write the description of communication using proper language skills.

SW-2 Suggested Sessional Work (SW):

a. Assignments:

- 1 Writing types of clauses.
- 1 Writing the sentences using correct punctuation.
- 2 Writing the types and forms of tenses.
- b. Mini Project:
- c. Other Activities (Specify):

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class	Laboratory	Sessional	Self	Total hour
	Lecture	Instruction	Work	Learning	(Cl+SW+Sl)
	(Cl)	(LI)	(SW)	(Sl)	
PGS 502.1: Learning the various	0	8	2	1	11
form of scientific writing and					
implementing skills for Formulation					
of research based documents.					
PGS 502.2: Acquisition of	0	8	1	1	10
technical communication skill and					

articulate in English (verbal as writing)					
Total	0	16	3	2	21

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles	N Dist	on	Total Marks	
		R	U	Α	
CO 1	Technical writing 1.1 Various form of scientific writing – thesis, technical papers, reviews, manuals etc.	00	05	05	10
	1.2 Various part of thesis and research communicationTitle page	03	03	04	10
	- Authorship content page				
	- Preface				
	- Introduction				
	- Review of literature	00	05	05	10
	- Material and methods	03	02	05	10
	- Experimental result	00	00	10	10
	- Discussion				
	1.3 citations etc.	00	05	05	10
		04 03	02	04	10
	1.4 Commonly used abbreviations in the thesis and research communication .	03	02	05	10
	1.5 Illustrations, photography and drawing with suitable				
	captions pagination numbering of tables and illustrations.				
	1.6 Writing of numbers and dates in scientific write ups.				
	1.7 Editing and press reading				
	1.8 Writing of review articles.				
CO 2	Communication skill-	0.7			
	1.1 Grammar (Tenses, part of speed, clauses, punctuation	03	02	05	10
	marks)	02	03	05	10
		02 04	03	00	08
	Error analysis (common error), concord, collocation, phonetic,	04	02	00	07
	symbols and transcription. Accentual pattern: weak forms in connected speech.	00	02	05	10
	Accentual pattern: weak forms in connected speech. Participation in group discussion	00	05	05	10
	Facing of interview. Presentation of scientific paper.				

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

The end of semester assessment for **Technical writing and communication Skill** 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.	Title	Author	Publisher	Edition &
No.				Year
1	1 0	Barnes and Noble. Robert C. (Ed.).	Flourish Your Language	2005
2		Mike markel Stular A. Selber	Bedford/St. Martins, 12 th edition	2017
3	The Essentials of Technical communication	Elizabeth tebeaux sam dragga.	Oxford university press,4 th edition	2017
4	<u> </u>	Kieran morgan and sanja spajic	Better on paper publications, 1th edition	2015
5	Developing quality technical information	Moira Mcfadden lanyi, Deirdrelongo	IBM press 3th edition	2014

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Cos.POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : PGS 502

Course Title: Technical writing and communication Skills

	Program Outcomes						Program S	pecific Out	come							
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
PGS 501. Learning the various form of scientific writing and implementing skills for Formulation of research based documents.	2	1	1	1	1	1	2	1	2	3	3	1	1	1	1	2
PGS 502. Acquisition of technical communication skill and articulate in English (verbal as writing).	1	1	1	1	1	1	1	1	2	3	3	1	1	1	1	2

Legend: 1 – Low, 2 – Medium, 3 – High

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	PGS 502.1. Learning the various form of scientific writing and implementing skills for Formulation of research based documents.	SO1.1 SO1.2 SO1.3	Technical writing LI. 1.1, LI. 1.2, LI. 1.3, LI. 1.4	-	As mentioned in page
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 502. 2.Acquisition of technical communication skill and articulate in English (verbal as writing).	SO2.1 SO2.2 SO2.3 SO2.4	Communication skill LI.2.1 LI.2.2 LI.2.3 LI.2.4	-	number _ to _

Course Curriculum Map: PGS 502: Technical writing and communication

Semester-II

Course Code:	SOIL 501					
Course Title :	Soil Physics					
Pre- requisite:	Student should have basic knowledge of various laws of physics (law of gravity etc.,) and basic mathematical calculation.					
Rationale:	The Student learn about the measurement the physical parameters come under analysis of soil fertility. To impart basic knowledge about soil physical properties and processes in relation to plant growth.					
Course Outcomes:						
in growth Soil 501.2: To underst analysis Soil 501.3: To unders Soil 501.4: To unders affecting Soil 501.5: To learn th techniqu Soil 501.6: To under	ne classification of soil water and its measuring					
Soil 501.7: To understand the different process in managing the field water balance						

- Soil 501.7: To understand the different process in managing the field water balance and soil plant atmosphere continuum
- Soil 501.8: To understand the components, importance and measurement of air in soil for growth and development of plants
- Soil 501.9: To understand the concept, role and measurement of soil temperature

				S	Total			
Course Category	Course Code	Course Title	Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	Credits (C)
Major Course	Soil 501	Soil physics	2	1	1	1	5	3

Scheme of Studies:

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

ry				Scheme of Assessment (Marks) Progressive Assessment (PRA)				End Semester	Total Morks	
Course Category	Couse Code	Course Title	Assignment 5 Assignment 5 number 3 marks each	best out of 3) 10 marks	mina (SA	Class Activity any one	Att (A'	Total Marks CA+CT+SA ⁽ +CAT+AT)	Assessment	Marks (PRA+ ESA)
Major Course	Soil 501	Soil Physics	15	30	0	0	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.

Soil 501.1: To understand the various physical properties of soil responsible in growth and development of crop in field

Approximate Hours					
Item	AppX Hrs				
Cl	3				
LI	4				
SW	2				
SL	2				
Total	11				

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: Relate the various branches of soil physics and classify the various physical properties of soil	1. To determine the bulk density, particle density and porosity of	Unit-1 General introduction about physical properties of soil	1. To know about basic calculation of force, density
 SO1.2: To discriminate the various soil physical properties(Air, color, structureetc) in growth and development of crop SO1.3 To understand the soil water relationship 	 a soil 2. To calculate the mass volume relationship 	1.1 To understand the basic knowledge of physical properties of soil1.2 Learning the parameter involved under soil physics	2. To learn the formulas for calculating volume of different shapes
		1.3 Estimation and calculation of soil bulk density ,particle density and porosity of soil	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Classification of soil and formation of soil
- Enlist the various physical properties come under estimation of soil physical properties

Soil 501.2: To understand the distribution of soil of India on basis of soil texture, its formation, analysis techniques and factors affecting it

Approximate Hours					
Item	AppX Hrs				
Cl	3				
LI	2				
SW	2				
SL	1				
Total	8				

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1 To recollect the knowledge on soil texture and its various classes	1.To measure the soil texture through international pipette method and	Unit-2.0 Soil texture 1.1 To learn about the textural classes of	1. To know about the calculation of density
SO2.2 To learn the various mechanical techniques used to analyses the soil texture	hydrometer method	soil 1.2 Estimation and calculation of soil bulk density, particle	

density and porosity of soil of soil	
1.3 To learn the color variation of coil and factors affecting it	

SW-2 Suggested Sessional Work(SW):

a. Assignments:

- Enlist the various textural classes and percentage of sand silt and clay in it
- Classification of soil of India on basis of soil texture in map
- **b.** Other Activities(Specify): NA

Soil 501 .3: To understand the consistency and plasticity of soil

Approximate Hours					
Item	AppX Hrs				
Cl	4				
LI	2				
SW	2				
SL	1				
Total	9				

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO3.1 Evaluate the consistency and plasticity of soil on growth of cropSO3.2 To know the factors responsible in soil erosion	1. To measure the Atterbergs limit of a soil	 Unit-3 : To understand the soil consistence erosion and edibility 3.1 To learn about the soil consistence dispersion and workability of soils. 3.2 Study the soil compaction, Consolidation and soil strength; swelling and shrinkage 3.3 Learn the basic concepts of Alleviation and soil physical constraints for crop production. 3.4 Knowledge the Soil erosion and edibility. 	1. To know about the basic factors responsible in soil erosion

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Write the concept, principle of soil consistency and plastic limits
- b. Other Activities (Specify): NA

Soil 501:4: To understand the classification soil structure and factors responsible in affecting it

Approximate Hours		
Item	AppX Hrs	
Cl	4	
LI	2	
SW	2	
SL	1	
Total	9	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO4.1 Recognize the Indian soil on basis of its structure SO4.2 Classification soil structure and factors responsible in affecting it SO4.3 Relate the soil tilth, crusting and aggregation on nutrients availability in different crops 	1. To estimate the soil, aggregates in both dry and wet condition	 Unit-4: To Understand the Soil structure of physical properties in soils 4.1 Understand the soil structure and Learning the genesis, types, characterization and management of Soil Structure 4.2 Study the aggregation, aggregate stability, soil tilth, and characteristics of good soil tilth 4.3 Study the soil crusting mechanism, factors affecting and evaluation. 4.4 Understand the soil conditioners; puddling, its effect on soil physical properties and formation of clods in soil 	

Annrovimate Hours

SW-4 Suggested Sessional Work (SW):

- a. Assignments:
 - Role and classification of soil structure in increasing productivity

b. Other Activities (Specify): NA

Soil 501.5: To learn the classification of soil water and its measuring techniques

	Approximate Hours	
Item	AppX Hrs	
Cl	3	
LI	6	
SW	2	
SL	1	
Total	12	

Session Outcom es (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO5.1 To classify the soil water and plant available water SO5.2 To evaluate the soil moisture content and use of soil water characteristics curve SO5:3. To analyze the soil moisture potential and retentions SO5.4 To understand the hysteresis curve of soil 	 To Measure the soil-water content by different methods To Measure the soil-water potential by using tensiometer To Measure the soil-water potential by using gypsum blocks 	 Unit-5: Behaviors of Soil water in soil and their characters 5.2 To learn about content and potential and retention of soil water. 5.3 Study the water constants, measurement of water content, energy state of water in soil. 5.4 Understand the soil water potential, soil moisture there character and Learn the curve hysteresis and measurement of soil moisture potential 	1. To learn about nature , source and properties of water used during irrigation

SW-5 Suggested Sessional Work (SW):

- a. Assignments:
 - Classification of soil water
 - Soil water retention
- b. Other Activities (Specify): NA

Soil 501.6: To understand the application of the various laws applied during measurement of moving water in soil

Approximate Hours						
Item	AppX Hrs					
Cl	3					
LI	4					
SW	2					
SL	1					
Total	12					

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO6.1 To identification and classification of saturated and unsaturated soil water SO6.2 To understand the different law come under soil water measurement and their application and function SO6:3. To measure the hydraulic conductivity of saturated and unsaturated water 	 Determination of hydraulic conductivity under saturated and unsaturated conditions Determination of soil-moisture characteristics curve and computation of pore-size distribution 	 Unit .6: Study the law applied in analyzing the running soil water 6.1 Understand the water flow in saturated and unsaturated soils 6.2 Understand the Poiseuille's law and Darcy's law 6.3 To learning the hydraulic conductivity, permeability, fluidity and hydraulic diffusivity and their measurement 	

SW-6 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the saturated and unsaturated flow of water in soil
- Measurement of hydraulic conductivity in saturated and unsaturated soil
- b. Other Activities (Specify): NA

Soil 501.7: To understand the different process in managing the field water balance and soil plant atmosphere continuum

Approximate Hours							
Item	AppX Hrs						
Cl	3						
LI	4						
SW	2						
SL	1						
Total	10						

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO7.1 To assess the role and process involved in internal drainage and redistribution of soil water SO7.2 To understand the hydrologic cycle in soil for establish the balance of water in field SO7:3. To understand and learn about the soil plant atmosphere condition 	 Determination of infiltration rate of soil Estimation of water balance components in bare and cropped fields 	 Unit-7: Infiltration and hydrologic cycle in soil for water balance and soil plant atmosphere. 7.1 Study the infiltration, internal drainage and redistribution in soil. 7.2 To know about evaporation, hydrologic cycle and field water balance in soil. 7.3 Study the soil-plant- atmosphere continuum in soil water 	1. To know the basic differenc e between infiltrati on and percolati on of water

SW-7 Suggested Sessional Work (SW):

- a. Assignments:
 - Enlist the role and process involved in internal drainage and redistribution of soil water
- b. Other Activities (Specify): NA

Soil 501.8: To understand the components, importance and measurement of air in soil for growth and development of plants

	Approximate Hours
Item	AppX Hrs
Cl	3
LI	4
SW	2
SL	1
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO8.1 To understand the components, principle and importance of air in soil SO8.2 To understand the its role in growth and development of crop SO8:3. To assess the management and measurement of soil air 	 To determine the aeration porosity in soil To estimate the oxygen diffusion rate in soil 	 Unit 8: Soil air, composition and there management 8.1 Understand the importance and components and composition and renewal of soil air 8.2 Learning the convective flow and diffusion of soil air 8.3 Study the measurement of soil aeration and Understand the requirements of aeration for plant growth 	1. To know the contribution of various gasses in atmosphere and in soil

SW-8 Suggested Sessional Work (SW):

- a. Assignments:
 - Enlist the components, role and importance of soil air
 - Measuring techniques used to measure the content of air in soil
- b. Other Activities (Specify): NA

Soil 501.9: To understand the concept , role and measurement of soil temperature

Approximate Hours

Item	AppX Hrs
Cl	4
LI	2
SW	2
SL	2
Total	10

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO9.1 To assess the role and process involved in transfer of energy in soil with its properties SO9.2 To measure the soil temperature SO9:3. To learn about the basic concept, importance of thermodynamics law in soil SO9.4. To assess the effect of soil temperature on growth of plants 	1.To measure the Soil temperature measurement s by different methods	 Unit-9: Soil temperature 9.1 Understanding the infiltration in soil. 9.2 Study the infiltration internal drainage and redistribution in soil. 9.3 To know about evaporation, hydrologic cycle and field water balance in soil. 9.4 Study the soil-plant-atmosphere continuum in soil water. 	 To know about the mode of transfer of heat in solid , liquid and gas To learn about the law of thermodynami cs

SW-9 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the law of thermodynamics and its role in maintaining soil temperature
- Strategies involved in maintaining soil temperature in soil
- Enlist the factors affecting soil temperature

b. 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)
Soil 501.1: To understand the various physical properties of soil responsible in growth and development of crop in field	3	4	2	2	11
Soil 501.2: To understand the distribution of soil of India on basis of soil texture, its formation, analysis techniques and factors affecting it	3	2	2	1	8
Soil 501.3: To understand the consistency and plasticity of soil	4	2	2	1	9
Soil 501.4: Classification soil structure and factors responsible in affecting it	4	2	2	1	9
Soil 501.5: To learn the classification of soil water and its measuring techniques	3	6	2	1	12
Soil 501.6: To understand the application of the various laws applied during measurement of moving water in soil	3	4	2	1	10
Soil 501.7: To understand the different process in managing the field water balance and soil plant atmosphere relationship	3	4	2	1	10
Soil 501.8: To understand the components, importance and measurement of air in soil for growth and development of plants	3	4	2	1	10
Soil 501.9: To understand the concept , role and measurement of soil temperature	4	2	2	2	10
Total Hours	30	30	18	11	89

Suggestion for End Semester Assessment

СО	Unit Titles		Ma Distril	Total Marks	
		R	U	A	iviui Ko
CO -1	General introduction about physical properties of soil	02	01	01	04
CO -2	Soil texture	02	02	02	06
CO -3	To understand the consistency and plasticity of soil	02	02	01	05
CO -4	To Understand the Soil structure of physical properties in soils	03	02	02	07
CO -5	Behaviors of Soil water in soil and their characters	03	02	02	07
CO-6	Study the law applied in analyzing the running soil water	02	02	02	06
CO-7	Infiltration and hydrologic cycle in soil for water balance and soil plant atmosphere	03	01	01	05
CO-8	Soil air, composition and there management	02	02	01	05
CO-9	Soil temperature	02	02	01	05
	Total	21	16		50
	Legend: R:Rememb	er,	U	:Under	stand, A:

Suggested Specification Table (For ESA)

Apply

The end of semester assessment for **Soil physics** 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	Publisher	Edition & Year	
1	Soil Physics	Baver LD, Gardner WH and Gardner WR.	John Wiley & Sons.	1972.
2	Soil Physics	Ghildyal BP and Tripathi RP.	New Age International	2001
3	Applied Soil Physics.	Hanks JR and Ashcroft GL.	Springer Verlag	1980.
4	Optimizing the Soil Physical Environment toward Greater Crop Yields	Hillel D.	Academic Press	1972
5	Principles of Soil Physics	Lal R and Shukla MK.	Marcel Dekker	2004
6	Fundamentals of Soil Science	Indian Society of Soil Science	ISSS, New Delhi	2002
7	Environmental Soil Physics	Hillel D.	Academic Press	1998

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Cos.POs and PSOs Mapping

Course Title: : M.Sc. (Ag.) Course

Code : Soil 501

Course Title: Soil Physics

	Program Outcomes										Program	Specific Outc	ome			
Course Outcomes	PO 1	РО 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO8	PO 9	P O 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of Problem soil	Preparation and recommendation of compost/manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of engineering tools	Ethics	Life-long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity
SOIL 501.1: To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level	2	2	2	1	1	2	2	3	1	2	3	2	2	1	2	2
SOIL 501.2: To understand the distribution of soil of India on basis of soil texture, its formation, analysis techniques and factors affecting it	2	2	1	1	2	2	2	2	1	2	2	2	1	2	2	3

			1				r		1	r		1			1	
SOIL 501.3: To understand the consistency and plasticity of soil	2	2	1	1	2	2	2	2	1	2	2	2	1	2	2	3
SOIL 504.4: To understand the classification soil structure and factors responsible in affecting it	2	2	1	1	2	2	2	2	1	2	2	2	1	2	2	3
SOIL 501.5:																
To learn the classification of soil water and its measuring techniques	1	1	1	2	1	1	2	2	1	2	2	2	1	2	1	3
SOIL 501.6: To understand the application of the various laws applied during measurement of moving water in soil	1	1	1	2	1	1	3	2	2	2	2	2	1	2	1	3
SOIL 501.7: To understand the different process in managing the field water balance and soil plant atmosphere continuum	1	1	1	2	1	1	3	3	2	2	2	2	1	2	1	3
SOIL 501.8: To understand the components, importance and measurement of air In soil for growth and development of plants	2	2	3	3	3	3	3	2	1	1	2	2	2	2	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Soil 501; Soil Physics

POs & PSOs No.	COs No.& Titles	SOs No.	Laboratory Instruction (LI)	Classroom Instruction(CI)	Self- Learning(S L)
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.1; To identify the problems occur in agriculture sector regarding polluted water, air and soil their mode of occurrence and extended level	SO1.1, SO1.2, SO1.3	LI. 1.1, LI. 1.2, LI. 1.3, LI. 1.4	Unit-1 General introduction about physical properties of soil 1.1,1.2,1.3	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.2; To understand the distribution of soil of India on basis of soil texture, its formation, analysis techniques and factors affecting it	SO2.1, SO2.2	LI. 2.1, LI. 2.2	Unit-2.0 Soil texture 2.1,2.2	As mentioned in
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.3; To understand the consistency and plasticity of soil	SO3.1, SO3.2	LI. 3.1, LI. 3.2	Unit-3 : To understand the soil consistence erosion and edibility 3.1,3.2,3.3,3.4	page numbe r _ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.4; To understand the classification soil structure and factors responsible in affecting it	SO4.1, SO4.2, SO4.3	LI. 4.1 LI. 4.2	Unit-4: To Understand the Soil structure of physical properties in soils	

				4.1,4.2,4.3,4.4
PO 1,2,3,4,5,6,7, 8,9,10,11,12	CO.5; To learn the classification of	SO5.1 SO5.2	LI. 5.1, LI. 5.2, LI. 5.3,	Unit-5: Behaviors of Soil water in soil and their characters
PSO 1,2, 3, 4, 5	soil water and its measuring techniques	SO5.3 SO5.4	LI. 5.4, LI. 5.5, LI. 5.6	5.1, 5.2, 5.3
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.6; To understand the application of the various laws applied during measurement of	SO6.1, SO6.2, SO6.3	LI. 6.1, LI. 6.2, LI. 6.3, LI. 6.4	Unit .6: Study the law applied in analyzing the running soil water 6.1,6.2,6.3
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	moving water in soil CO.7; To understand the different process in managing the field water balance and soil plant atmosphere continuum	SO7.1, SO7.2, SO7.3	LI. 7.1, LI. 7.2, LI. 7.3, LI. 7.4	Unit-7: Infiltration and hydrologic cycle in soil for water balance and soil plant atmosphere. 7.1,7.2,7.3
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.8; To understand the components, importance and measurement of air in soil for growth and development of plants	SO8.1, SO8.2, SO8.3	LI. 8.1, LI. 8.2, LI. 8.3	Unit8:Soil air, composition and there management 8.1,8.2,8.3
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	CO.9 ; To understand the concept , role and measurement of soil temperature	SO9.1, SO9.2, SO9.3, SO9.4	LI. 9.1, LI. 9.2	Unit-9: Soil temperature 9.1, 9.2, 9.3, 9.4

Semester-II

Course Code:	SOIL 503
Course Title :	Soil Chemistry
Pre- requisite:	Student should have basic knowledge of chemical formula of different chemicals, balancing the chemical reaction, atomic number, valence of elements. They also know about the various essential plant nutrients present in soil for maintaining soil fertility.
	To introduce the basic concepts of soil chemistry and chemical ction occur in soil with essential plant nutrients. The various forms of s and charges present in soil their adsorption and absorption process occur oil.

Course Outcomes:

- **Soil 503.1:** To know the chemical composition in earth crust, soil and in different rocks and minerals
- **Soil 503.2:** To understand and apply the chemical kinetics, equilibrium thermodynamics and chemical equilibrium of elements in soil
- **Soil 503 .3:** To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil
- **Soil 503 .4:** To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands
- Soil 503.5: To understand the adsorption desorption of N, P and K in soil with basic concept of quantity-intensity relationship of each of them in soil
- Soil 503.6: To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil
- Soil 503.7: To understand the formation, classification, properties and management of salt affected soil
- Soil 503.8: To assess the electrochemistry and chemical reaction occur in submerged soil

			Sch					
Course Category	Course Code	Course Title	Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	Total Credits (C)
Major Course	Soil 503	Soil Chemistry	2	1	1	1	5	3

Scheme of Studies:

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:

T	heory									
	Scheme of Assessment (Marks)									
					Prog	gress	ive As	sessment (PRA)	End	Total
			int 5 Ch	of 3))		(CAT)			Semester Assessment	Marks
Course Category	Couse Code	Course Title	Class/Home Assignment number 3 marks each (CA)	Class Test 2 (2 best out of 10 marks each (CT)	Seminar one (SA)	Class Activity any one (Activity any one Class Attendanc (AT)	Total Marks (CA+CT+SA+CAT+ AT)	(ESA)	(PRA + ESA)
Major Course	Soil 503	Soil chemistry	15	30	0	0	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.

Soil 503.1: To know the chemical composition in earth crust, soil and in different rocks and minerals

Approximate Hours					
Item	AppX Hrs				
Cl	3				
LI	2				
SW	2				
SL	1				
Total	08				

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO1.1: To understand the chemical composition of soil, earth crust SO1.2 To learn the process of formation of soil, rocks and minerals and factors affecting it 	1.Determination of pH, EC, Eh of a given soil sample by Eh-pH meter and conductivity meter	 Unit-1 Components of earth, soil and rocks and minerals 1.1 Classification of rocks and minerals with nutrient content in it 1.2 Composition of earth crust 1.3 Formation and composition of nutrients in Soil 	1. To know about various types of nutrients and minerals present in soil

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Classification of soils of India on basis of nutrient availability
- **b.** Other Activities(Specify): NA

Soil 503.2: To understand and apply the chemical kinetics, equilibrium thermodynamics and chemical equilibrium of elements in soil

Approximate Hours

11	
Item	AppX Hrs
Cl	4
LI	2
SW	2
SL	1
Total	09

Session Outcom (SOs)	es	Laboratory Instruction (LI)	Class room Instruction (CI)	Self- Learning (SL)
derivation	cal the and of	1.Determination of point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method from a given soil sample	Unit : 2: To learn the thermodynamics and chemical kinetics of soil 2.1 To learn the application of	1. To know the valences and available forms of
~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~ ~	To the		 1st, 2nd and 3rd law of thermodynamics in soil 2.2 To learn the derivation of 1st 	elements

and and and low
$,2^{nd}$ and 3^{rd} law
thermodynamics
in soil
2.3 To understand
the soil
electrochemistry
2.4 To know the
chemical kinetics
of soil

SW-2 Suggested Sessional Work(SW):

- b. Assignments:
 - State the application of thermodynamics in soil with its derivation
- c. Other Activities (Specify): NA

Soil 503 .3: To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil

	Approximate Hours
Item	AppX Hrs
Cl	4
LI	8
SW	2
SL	1
Total	15

(SOs)	(LI)	Instruction (CI)	(SL)
SO3.1 To Assess the propertiessu on classification of soil 	Extraction of humic substances from given organic matter Determination of humic and fulvic acids through Potentiometric titration from a given soil Determination of humic and fulvic acids through conductivity metric ditration from a given soil Determination of (E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies and the D (E4/E6) values at two pH values	 Unit : 3: To learn about colloids and organic matter of soil 3.1: To learn about the Classification of organic and inorganic colloids with its properties, origin of charges and characterization of charges in soil 3.2 To know the components of pH dependent and independent charges and their importance in soil 	1.To know the importance of organic matter in increasing the fertility of soil

the interaction of	3.3 To understand the
soil organic matter	concept of diffused
with clay	double layer theories
	3.4 To know the fractionation, characterization of SOM and its interaction with clay

SW-3 Suggested Sessional Work (SW):

- a. Assignments:
- Enlist the components and characterization of organic matter present in soil
- Classify the interaction of soil organic matter with clay
 - b. Other Activities (Specify): NA

Soil 503 .4: To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands

	Approximate Hours
Item	AppX Hrs
Cl	4
LI	6
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO4.1 To understand the ion exchange theories in soil SO4.2 To assess the donnan membrane equilibrium concept and its limitations SO4.3 To understand the factors affecting ion exchange 	 2. Determination of adsorbed and ligand exchanged phosphate from a given soil sample 3. Determination of adsorbed and ligand exchanged fluoride an sulphate from a given soil sample 	 Unit : 4: Ion exchange process in soil 4.1: To learn the theories of cation exchange based on law of mass action 4.2: To understand the concept of donnan membrane equilibrium 4.3 To understand the concept of adsorption isotherm process 4.4: to know the concept 	1.To know the role of useful microbes in mineralization of different secondary nutrients in soils

theories SO2.4 To	and principles of anion and ligand exchange theory	
evaluate sorption desorption of anions and ligands in soil and study the ion exchange phenomena	4.5 Implementation techniques of ion exchange phenomena and practical implications in plant nutrition.	

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the therioes of cation exchange based on law of mass action (Gapon equation, hysterises, Jennt's and kerr-vanselow concept
- Concept and importance of Donnan-membrane equilibrium
- Explain the concept, procedure and limitations of diffused double layer

Soil 503.5: To understand the adsorption desorption of N, P and K in soil with basic concept of quantity-intensity relationship of each of them in soil

	Γ
Item	AppX Hrs
Cl	4
LI	4
SW	2
SL	1
Total	11

Approximate Hour

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO5.1 To understand and evaluate the phosphorus and potassium fixation, precipitation- dissolution equilibria in soil SO5.2 To understand and evaluate the ammonium fixation in soil covering specific and non specific sorption SO5.3 To understand and evaluate the concept and management of Q/I relationship of nutrients 	1.Determination of Q/I relationship of potassium and Phosphate in a given soil		1.To know the role difference between the process of adsorption, absorption and sorption of nutrients in soil

SW-5 Suggested Sessional Work (SW):

- a. Assignments:
 - Adsorption, desorption and Q/I relationship of phosphorus in soil
 - Ammonium fixation, precipitation and dissolution in specific and non specific soil

Soil 503.6: To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil

Approximate Hour		
Item	AppX Hrs	
Cl	4	
LI	8	
SW	2	
SL	1	
Total	15	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO6.1 To understand the formation, classification and chemical reaction occurs in acidic soil SO6.2 To Evaluate liming potential of different liming materials used during amelioration of acidic soil 	 Determination of measurement of pH, EC of a given acidic soil Determination of HCO, Ca, Mg, K and Na from a given soil Determination of titratable acidity of an acid soil by BaCl2- TEA method Determination of lime requirement of an acid soil by buffer method 	 Unit : 6: Chemistry of acidity of soil 6.1 To understand the classification and formation of acidic soil 6.2 To assess and understand the chemistry of acidic soil in surface soil 6.3 To assess and understand the chemistry of acidic soil in subsurface soil 6.4 To learn the reclamation of acidic soil through liming potential 	 List of liming material, their formation and properties Distribution of acidic soil in India

SW-6 Suggested Sessional Work (SW):

a. Assignments:

- Enlist the liming potential of limning materials produced from your surrounding industries/ industrial waste used as amelioration of acidic soil
- b. Other Activities (Specify): NA

Soil 503.7: To understand the formation, classification, properties and management of salt affected soil

Approximate	Hour
Item	AppX Hrs
Cl	3
LI	2
SW	2
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO7.1 To Assess the chemistry of salt affected soilSO7.2 To Evaluate the management of salt affected soil	1. Determination of gypsum requirement in alkali soil	 Unit : 7: Chemistry and management of salt affected soil 7.1 To know the formation of salt affected soil 7.2 To understand the chemical properties and nutrient availability in salt affected soil 7.3 To assess the management of salt affected soil 	1. Distribution of salt affected soil in India and their source of formation

SW-7 Suggested Sessional Work (SW):

a. Assignments:

- Formation, classification, properties and management of salt affected soil
- Nutrient availability in salt affected soil

b. Other Activities (Specify): NA

Soil 503.8: To assess the electrochemistry and chemical reaction occur in submerged soil Approximate Hour

Item	AppX Hrs
Cl	3
LI	2
SW	2
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
chemical reaction and	1. Determination of CEC and AEC of submerged soils	 Unit : 8 Chemistry of submerged soil 8.1 To understand the formation, classification and properties of submerged soil 8.2 To assess the geochemistry of micronutrients in submerged soil 	1 To know the factors responsible for formation of submerged soil

8.3 To learn the factors affecting submergence and chemical reactions occur in submerged soil	

SW-8 Suggested Sessional Work (SW):

a. Assignments:

- Distribution and formation of submerged soils of India
- b. 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)
Soil 503.1: To know the chemical composition in earth crust, soil and in different rocks and minerals	3	2	2	1	8
Soil 503.2: To understand and apply the chemical kinetics, equilibrium thermodynamics and chemical equilibria of elements in soil	4	2	2	1	9
Soil 503.3: To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil	4	8	2	1	15
Soil 503.4: To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands	5	4	2	1	12
Soil503.5:Tounderstandtheadsorption desorptionof N, P and K in soil	4	2	2	1	9

with basic concept of quantity-intensity relationship of each of them in soil					
Soil 503.6: To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil	4	8	2	2	16
Soil503.7:Tounderstandtheformation,classification,propertiesandmanagementofsaltaffectedsoil	3	2	2	1	8
Soil 503.8: To assess the electrochemistry and chemical reaction occur in submerged soil	3	2	2	1	8
Total Hours	30	30	16	9	85

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

СО	Unit Titles	N I R	Total Marks		
CO-1	Components of earth, soil and rocks and minerals	1	2	2	5
CO-2	To learn the thermodynamics and chemical kinetics of soil	2	2	2	6
СО-3	To learn about colloids and organic matter of soil	1	4	2	7
CO-4	Ion exchange process in soil	2	3	2	7
CO-5	To understand the N,P and K adsorption desorption and Q/I relationship of each nutrients in soil	2	3	2	7
CO-6	Chemistry of acidity of soil	2	2	2	6

CO-7	Chemistry and management of salt affected soil	2	2	2	6
CO-8	Chemistry of submerged soil	2	2	2	6
	Total	14	20	16	50

Legend:	R:Remember,	U:Understand,	A: Apply
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The end of semester assessment for **Soil Chemistry** 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.	Title	Author	Publisher	Edition &
No.	The	Tutio	i uonsiici	Year
1	The Nature and Properties of Soils.	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013
2	Fundamental of Soil Science	Indian Society of Soil Science	ISSS, National Societies Block, Pusa, New Delhi	Revised 2012
3	Principles of Soil Chemistry	Kim H Tan	Routledge Bo CRC Press	4 th Edition 2024
4	Chemistry of the Soil	Bear RE.	Oxford and IBH	1964
5	Soil Chemistry	Bolt GH and Bruggenwert MGM.	Elsevier	1978
6	Chemistry of Soil Processes	Greenland DJ and Hayes MHB.	John Wiley & Sons	1981
7	Chemistry of Soil Constituents.	Greenland DJ and Hayes MHB.	John Wiley & Sons.	1981
8	Environmental Chemistry of Soils	McBride MB.	Oxford University Press.	1994

9	The Thermodynamics of Soil Solutions	Sposito G.	Oxford University Press	1981
10	The Surface Chemistry of Soils	Sposito G.	Oxford University Press	1984

Curriculum Development Team

- 1. Professor G C Mishra, Director Cement Technology, AKS University
- 2. Dr.S S Tomar (Dean), Faculty of Agriculture Science and Technology, AKS University
- 3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
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Cos.POs and PSOs Mapping

Course Title: : M.Sc. (Ag.)

Course Code : Soil 503

Course Title : Soil Chemistry

		Program Outcomes													Program Specific Outcome			
Course Outcomes	PO1	PO2	Р О 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4		
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity		
Soil 503.1: To know the chemical composition in	2	2	1	1	1	1	1	2	2	2	3	1	1	1	1	2		
earth crust, soil and in different rocks and minerals																		
Soil503.2:Tounderstand and apply thechemicalkinetics,equilibriumthermodynamicsandchemicalequilibriaofelements in soil	2	2	2	1	1	2	2	2	1	2	2	1	1	1	1	3		

Soil 503.3: To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil	2	1	3	1	2	2	3	2	1	2	2	2	1	3	3	3
Soil 503.4: To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands	1	2	3	1	1	1	2	2	1	1	1	3	1	2	2	3
Soil503.5:Tounderstandtheadsorptiondesorption ofN, P and K in soil withbasic concept of quantity-intensityrelationshipofeach of them in soil		2	3	1	1	1	2	2	1	1	1	3	1	2	2	3
Soil 503.6: To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil	1	2	3	1	1	1	2	2	1	1	1	3	1	2	2	3
Soil503.7:Tounderstandtheformation,classification,propertiesandmanagementofsaltaffected soil	2	2	2	3	3	2	2	2	1	1	2	3	1	2	2	2

Soil 503.8: To assess the	2	2	2	1	2	2	2	2	1	2	2	3	2	3	2	2
electrochemistry and																
chemical reaction occur																
in submerged soil																

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: SOIL 503: Soil 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	Soil 503.1: To know the chemical composition in earth crust, soil and in different rocks and minerals	SOs: 1.1, SOs:1.2,	LI: 1.1, LI: 1.2,	Unit-1 Components of earth, soil and rocks and minerals 1.1,1.2,1.3,1.4,1.5,1.6	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 503.2: To understand and apply the chemical kinetics, equilibrium thermodynamics and chemical equilibria of elements in soil	SOs: 2.1, SOs:2.2, SOs:2.3	LI: 2.1, LI: 2.2,	Unit : 2: To learn the thermodynamics and chemical kinetics of soil 2.1, 2.2, 2.3, 2.4, 2.5,2.6	As mentioned in page number 2 to 6
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 503.3: To learn the classification of soil colloids, origin of charges, fractionation and characterization of OM in soil	SOs: 3.1, SOs:3.2, SOs:3.3 SOs:3.4	LI: 3.1, LI:3.2, LI:3.3, LI:3.4, LI:3.5, LI:3.6, LI:3.7, LI:3.8,	Unit : 3: To learn about colloids and organic matter of soil 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	Soil 503.4: To understand the concept, principle and working of ion exchange theories and hysteresis of sorption-desorption of oxyanions and ligands	SOs:41.1, SOs:4.2, SOs:4.3 SOs:4.4	LI: 4.1, LI:4.2, LI:4.3, LI:4.4,	Unit : 4: Ion exchange process in soil 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	Soil 503.5: To understand the adsorption desorption of N, P and K in soil with basic concept of quantity-intensity relationship of each of them in soil	SOs: 5.1, SOs:5.2 SOs:51.3	LI: 5.1, LI: 5.2,	Unit : 5: To understand the N,P and K adsorption desorption and Q/I relationship of each nutrients in soil 5.1,5.2,5.3,5.4,5.5	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 503.6: To understand and evaluate the chemistry of soil acidity, its formation, types in surface and subsurface soil	SOs:61.1, SOs:61.2	LI:6.1, LI:6.2, LI:6.3, LI:6.4, LI:6.5, LI:6.6, LI:6.7, LI:6.8	Unit : 6: Chemistry of acidity of soil	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 503.7: To understand the formation, classification, properties and management of salt affected soil	SOs:71.1, SOs:71.2	LI:7.1, LI:7.2	Unit : 7: Chemistry and management of salt affected soil	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 503.8: To assess the electrochemistry and chemical reaction occur in submerged soil	SOs:81.1, SOs:81.2	LI:8.1, LI:8.2	Unit : 8 Chemistry of submerged soil	

Semester-II

Course Code:	Soil 504
Course Title :	Soil Mineralogy, Genesis and Classification
Pre- requisite:	Students should know about the distribution of soils of India and world
Rationale:	To acquaint students with basic structure of alumino-silicate minerals and genesis of clay minerals; soil genesis in terms of factors and processes of soil formation, and to enable students conduct soil survey and interpret soil survey reports in terms of land use planning
Course Outcomes:	
Soil 504.1: '	To understand the fundamental of crystallography, space lattice, coordination theory isomorphism and polymorphisms in soil
	To understand the classification, structure, chemical composition of clay minerals and its interaction with humus, pesticides and heavy metals
Soil 504.3:	To determine the various soil formation process, weathering of

soil 504.3: To determine the various soil formation process, weathering of rocks and minerals and soil profile

Soil 504.4: To recollect the knowledge of soil classification its comparison with modern classification and representation of soil mineralogy in soil map

Scheme of Studies:

Course	Course		Schen	Total				
category	Course Code	Course Title	C l	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	Credits (C)
Major Course	Soil 504	Soil Mineralogy, Genesis and Classification	2	1	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:

	Theo	ry								
				Sch	em	e of As	sessme	nt (Marks)		
			Prog	ressive	As	sessme	ent (PF	RA)	End	Total
ategory Code		e Title	ne umber ch	(2 best out 3)	(SA)	ny one	ance	Total Marks	Semester Assessment	Marks
Course category	Couse Code	Course Title	Class/Home Assignment 5 number 3 marks each	Class Test 2 (2 b of 3)	Seminar one (SA)	Class Activity any one (CAT)	Class Attendance (CAT)	CA+CT+SA+CAT+AT)		
			Assig	Class	Ser	Class	CIa		(ESA)	(PRA + ESA)
Major Cours e		Soil Mineralogy , Genesis and classificatio n	15	30	0	5	0	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.

Soil 504.1: To understand the fundamental of crystallography, space lattice, coordination theory , isomorphism and polymorphisms in soil

Approximate Hours				
Item	AppXHrs			
Cl	4			
LI	8			
SW	2			
SL	1			
Total	15			

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: They discriminate about the Isomorphs substitution, polymorphisms SO1.2 To understand the concept and importance of crystallography and space lattice	 To separate the sand silt and clay fractions of soil To determine the soil structure of a given area To estimate the pH of a given soil To study the colour variation of a soil profile 	 Unit-1.0 Concept of space lattice, crystallography and isomorphism 1.1To understand concept of crystallography 4.2 To assess the importance and principle of isomorphism's 4.3 To learn the polymorphisms its importance 4.4 To understand these of space lattice and radius ration of nutrients 	1. To know about the principles and concept of basic properties of chemistry

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Concept and principle of isomorphs substitution
- Classify the space lattice and radius ratio of various nutrients

b. Other Activities(Specify):

• Prepare a chart of radius ratio and space lattice structure of all the nutrients

Soil 504.2: To understand the classification, structure, chemical composition of clay minerals and its interaction with humus, pesticides and heavy metals

Approximate Hours				
Item	AppX Hrs			
Cl	9			
LI	10			
SW	2			
SL	1			
Total	22			

Approximate Hours

SW-2 Suggested Sessional Work (SW):

a. Assignments:

- Classification of silicate clay structure with diagram and example
- Taxonomical classification and distribution of soil of India and world
- b. Other Activities(Specify): Preparation of presentation of different silicate clay structure

Soil 504.3: To determine the various soil formation process , weathering of rocks and minerals and soil profile

Approximate Hours

11	
Item	AppX Hrs
Cl	09
LI	10
SW	2
SL	1
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO3.1 To assess the various process involved in soil and soil profile formation and factors affecting them SO3.2 To understand the weathering of rocks and minerals and factors affecting them SO.3.3 To evaluate the modern system of soil classification, importance and its representation in map 	 To study the morphological properties of soil profile in upland To study the morphological properties of soil profile in lowland To study the morphological properties of soil profile in coastal area To study the morphological properties of soil profile in Hilly area Calculation and application of weathering indices during soil formation 	 Unit-3 : Soil profile its formation through weathering 3.1 To learn the process involved in soil and soil profile formation with its components 3.2 Identification of different horizons in soil profile with its properties 3.3 To learn the Specific process involved in soil formation 3.4 Factors affection soil and soil profile formation 3.5 Classify the various types of weathering 3.6 importance of weathering in soil formation 3.7 Factors affecting weathering of rocks 3.8 Transformation of minerals in soil 3.9 To learn the weathering sequences of minerals with special reference to Indian soils 	

SW-3 Suggested Sessional Work (SW):

- a. Assignments:
 - Enlist the factors affecting soil formation and weathering of rocks
 - Enlist the process of soil formation
 - Classification, nutrient content and structure of silicate clay structure
- b. Other Activities(Specify): NA

Soil 504.4: To recollect the knowledge of soil classification its comparison with modern classification and representation of soil mineralogy in soil map

Approximate Hours				
Item	AppX Hrs			
Cl	8			
LI	2			
SW	2			
SL	2			
Total	14			

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO4.1. To recollect the knowledge of historical development with modern development of soil classification SO4.2 To understand the classification, importance and use of various soil maps 	1.To study the grouping of soil survey available data base in terms of soil quality	 Unit-4: Learning the Ion exchange processes in soil and ion exchange phenomena and practical implications in plant nutrition. 4.1. To learn the concept and importance of soil classification system 4.2: To study the history of classification soil taxonomy 4.3: Modern concept and classification of soil taxonomy 4.4: To know about the nutrient content and chemical properties of soil of different taxonomy of India 4.5: To know the distribution of soils of India 4.6: To classify the Soil maps and its importance 4.7: To importance of different Soil maps 4.8: To learn the application of different soil maps 	 To study soil map of India 1. To study soil map of world

SW-4 Suggested Sessional Work (SW):

a. Assignments:

- Classification and use of soil map
- Enlist the historical classification of soil taxonomy

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lectur e (Cl)	Laboratory instruction (LI)	Sessional Work (SW)		Total hour (Cl+SW+Sl)
Soil 504.1: To understand the fundamental of crystallography, space lattice, coordination theory , isomorphism and polymorphisms in soil	4	8	2	1	7
Soil 504.2: To understand the classification , structure, chemical composition of clay minerals and its interaction with humus, pesticides and heavy metals	9	10	2	1	12
Soil 504.3: To determine the various soil formation process , weathering of rocks and minerals and soil profile	9	10	2	1	12
Soil 504.4: To recollect the knowledge of soil classification its comparison with modern classification and representation of soil mineralogy in soil map	8	2	2	2	12
Total Hours	30	30	8	5	43

Suggestion for End Semester Assessment

CO Unit Titles			Total	
		Marks Distribution		
R	U	Α	Marks	
CO- 1Concept of space lattice, crystallography and isomorphism03	01	01	5	
CO- 2Classification of clay minerals and its interaction with humus, pesticides and heavy metals05	06	04	15	
CO- 3Soil profile its formation through weathering05	04	06	15	
CO- 4Learning the Ion exchange processes in soil and ion exchange phenomena and practical implications in plant nutritions4	6	05	15	
Total 17	17	16	50	

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

The end of semester assessment for Soil Mineralogy, Genesis and Classification 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	The Nature and Properties of Soils	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013	
2	Fundamentals of Soil Science	Indian Society of Soil Science	ISSS, New Delhi	2002	
3	Soil Genesis and Classification	Buol EW, Hole ED, MacCracken RJ and Southard RJ.	4th Ed. Panima Publication	1997	
4	Minerals in Soil Environments.	Dixon JB and Weed SB.	2nd Ed. Soil Science Society of America, Madison	1989	
5	Clay Mineralogy.	Grim RE.	McGraw Hill	1968.	
6	Elements of Crystallography and Mineralogy	Wade FA and Mattox RB.	Oxford & IBH.	1960	
7	Introductory Pedology: Concepts and Applications	Sehgal J.	New Delhi	2002.	

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CO. POs and PSOs Mapping

Course Title: M.Sc. Soil Science and Agricultural Chemistry

Course Code : Soil 504

Course Title: Soil Mineralogy, Genesis and Classification

				Pro	ogram Outcon	mes							Pi	rogram Specif	ïc Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil.504:1.Concept of space lattice, crystallography and isomorphism	2	2	1	1	1	1	3	2	2	2	3	2	2	2	2	3
Soil.504:2.Classification of clay minerals and its interaction with humus, pesticides and heavy metals	1	2	3	1	1	1	3	2	2	1	2	3	1	1	1	2
Soil.504:3.Soil profile its formation through weathering	3	3	1	2	1	1	2	1	1	2	3	2	1	1	1	2
Soil.504:4.Learning the Ion exchange processes in soil and ion exchange phenomena and practical	2	2	1	1	1	1	3	2	2	2	3	2	2	2	2	3

implications nutritions	in	plant								

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: SOIL 504: Soil Mineralogy Genesis and Classification

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	Soil 504.1: To understand the fundamental of crystallography, space lattice, coordination theory , isomorphism and polymorphisms in soil	SO1.1 SO1.2	LI. 1.1, LI. 1.2 LI. 1.3 LI. 1.4 LI. 1.5 LI. 1.6 LI. 1.7 LI. 1.8	Unit-1 Concept of space lattice, crystallography and isomorphism 1.1,1.2,1.3,1.4	As mentioned in page number _ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 504.2: To understand the classification , structure, chemical composition of clay minerals and its interaction with humus, pesticides and heavy metals	SO2.1 SO2.2 SO2.3 SO2.4	LI. 2.1, LI. 2.2, LI. 2.3 LI. 2.4 LI. 2.5 LI. 2.6 LI. 2.7 LI. 2.8 LI. 2.9 LI. 2.10	Unit-2 Classification of clay minerals and its interaction with humus, pesticides and heavy metals 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	Soil 504.3: To determine the various soil formation process, weathering of rocks and minerals and soil profile	SO3.1 SO3.2 SO3.3	LI. 3.1, LI. 3.2 LI. 3.3, LI. 3.4 LI. 3.5, LI. 3.6 LI. 3.7, LI. 3.8 LI. 3.9, LI. 3.10	Unit-3 : Soil profile its formation through weathering 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	Soil 504.4: To recollect the knowledge of soil classification its comparison with modern classification and representation of soil mineralogy in soil map	SO4.1 SO4.2	LI. 4.1 LI. 4.2	Unit-4: Learning the Ion exchange processes in soil and ion exchange phenomena and practical implications in plant nutrition. 4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8	

Semester-II

Course Code:	Soil 509
Course Title :	Remote Sensing and GIS Techniques for Soil, Water and Crop studies
Pre- requisite:	Students should know about the computer handling , use of internet and knowledge of study of map
Rationale:	To impart knowledge about the basic concepts of remote sensing, aerial photographs and imageries, and their interpretation; application of remote sensing in general and with special reference to soil, plants and yield forecasting; to impart knowledge about geo- statistical techniques with special reference to krigging, and GIS and applications in agriculture
Course Outcomes:	
Soil 509.1: History, and GIS	concept, principle and application of Remote sensing system

- **Soil 509.2:** To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation
- Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey
- **Soil 509.4:** To understand the significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability
- **Soil 509.5:** To understand the application of GIS for water resources, agriculture, precision farming, disaster management, e governance and ARIS

Scheme of Studies:

				Scheme of studies(Hours/Week)					
Course Category	Course Code	Course Title	Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	Credits (C)	
Minor Course	Soil 509	Remote sensing and GIS Technique for soil, water and crop studies		1	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

	Theo	r y								
			Sche	eme of A	Assess	ment ((Marks)			
				Pro	ogress	ive As	sessment	(PRA)		
Course Category	Couse Code	Course Title	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+CA T+AT)	End Semester Assessmen t (ESA)	Total Marks (PRA + ESA)
Minor Cours e	Soil 509	Remote sensing and GIS Techniqu e for soil, water and crop studies	5	30	15	0	0	50	5 0	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.

Soil 509.1: History, concept , principle and application of Remote sensing and GIS system

Appro	Approximate Hours							
Item	AppX Hrs							
Cl	7							
LI	8							
SW	2							
SL	1							
Total	18							

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learni ng (SL)
SO1.1: To identify the required hardware and software use in application of GIS and Remote sensing software's SO1.2 To understand the terminologies used in understanding the basic concept, principle and application of Remote sensing and GIS software	 To familiarized with the different remote sensing equipment's To familiarized with the different GIS equipment's To familiarized with the different GPS Software understand the working of Computer Microsoft office 	 Unit-1.0 Introduction and terminologies used in application of GIS and Remote sensing system 1.1To learn the Introduction, basic concept, principle and application of remote sensing software 1.2 To learn the Introduction, basic concept, principle and application of GIS software 1.3 Source , Propagation of radiations in atmosphere , interaction with matter 1.4 To understand the requirement of hardware used in Remote sensing 1.5 To understand the requirement of software used in Remote sensing 1.6 To understand the requirement of hardware and software used in GIS system 1.7 To understand the requirement of software used in GIS system 	1. Basic knowl edge of Remot e sensin g and GIS softwa re

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Principle, concept, application of Remote sensing software and locate the different location with the help in Indian Map
- Principle, concept, application of GIS software and locate the different location with the help in Indian Map
- b. Other Activities(Specify): NA

Soil 509.2: To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation

Approximate Hours

Item	AppX Hrs						
Cl	7						
LI	8						
SW	2						
SL	1						
Total	18						

Session Outcomes	Laboratory	Class room Instruction	Self
(SOs)	Instruction	(CI)	Learnin
	(LI)		g (SL)
 SO2.1: To understand the concept, principle and importance of different types of sensors, camera and images used in GIS system SO2.2: To assess the processing and interpretation of sensors , images and waves in GIS system 	 Interpretation of aerial photographs for mapping of land resources Interpretation of satellite data for mapping of land resources To understand the representation of various boundaries of city, state, country and world To understand the Image over lapping for better understand of the area 	 Unit-2 Sensor system- camera, microwave radio meters and scanners 2.1: To study the classification of different types of sensors and sensor system 2.2: To study the application of different types of camera in different sensors 2.3: To learn the use of microwaves, radio meter 2.4To understand fundamental principle, concept, and use of aerial photographs and multi spectral imagines 2.5 to understand the use of hyper spectral imaging and thermal imagines 2.5To understand the application of processing and interpretations of images 	1.To kno w diffe rent types of satell ite
		2.7. To understand the interpretations of images	

SW-2 Suggested Sessional Work (SW):

a. Assignments:

- Classification of different types of sensors and images used in locating the locations in Map
- Enlist the different types of satellites
- b. Other Activities(Specify): NA

Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey

Approximate Hours	
Item	AppXHrs
Cl	6
LI	4
SW	2
SL	1
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self- Learning (SL)
SO3.1 To assess the various application of remote sensing techniques and land use soil survey SO3.2 To understand and evaluate the management techniques used in drought and waste land identification	 To enable the students to conduct soil survey and interept soil survey reports in terms of land use planning in upland To enable the students to conduct soil survey and interept soil survey reports in terms of land use planning in lowland 	 Unit-3 : Management and identification of wasteland, drought area , and prioritization of water shed area 3.1: To management and identification of the drought area 3.2: To manage and identification of waste land 3.2 Prioritization of watershed 3.3 Application of remote sensing in land use soil survey 3.5. Application of remote sensing techniques on crop stress management 3.6. Application of remote sensing techniques on yield forecasting 	1.To know about use of remote sensing in agricult ure

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- i. Enlist the techniques used in Prioritization of watershed area through remote sensing
- b. Other Activities (Specify): NA

Soil 509.4: To understand the significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability

Ар	proximate Hours
Item	AppX Hrs
Cl	5
LI	6
SW	2
SL	0
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO4.1. To understand the significance and sources of spatial and temporal variability in soil SO4.2 To identify geo statistical techniques of evolution of soil variability 	 To learn the operating process of GPS software Analysis of variability of different soil properties with classical Analysis of variability of different soil properties with geostatistical techniques 	 Unit-4: To evaluate and learn the significance and sources of the spatial and temporal variability in soil 4.1 To understand the variability in relation to size of sampling 4.2 To evaluate the classical statistical techniques of evolution of soil variability 4.3 To learn the significance of spatial and temporal variability in soil 4.4 To learn the sources of spatial and temporal variability in soil 4.5 To Evaluate the geo statistical techniques of evolution of soil variability 	

SW-4 Suggested Sessional Work (SW):

a.Assignments:

• Enlist the application of **geo statistical techniques of evolution of soil variability**

Soil 509.5: To understand the application of GIS for water resources, agriculture, precision farming, Disaster management, e governance and ARIS

Approximate	Approximate Hours							
Item	AppX Hrs							
Cl	5							
LI	4							
SW	2							
SL	1							
Total	10							

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class Room Instruction (CI)	Self Learning (SL)
SO5.1. To evaluate the application of GIS in Agriculture soil/ water management SO5.2 To understand the ARIS system	 To creation of data files in a data base programme To understand the working of GPS system on field 	 Unit-5: To understand the application of GIS for water resources, agriculture and ARIS 5.1 To learn the concept behind the use of GIS in water resource management 5.2 . To understand the use of GIS in precision farming 5.3 .To understand the use of GIS in disaster management 5.4 To understand the use of GIS in managing the e governance 5.5. To understand the use of GIS in Agricultural Research Information System(ARIS) 	

SW-5 Suggested Sessional Work (SW):

a. Assignments: NA

b. **Other specific:** Preparation of PowerPoint presentation of use of GIS in managing agricultural practices

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)
Soil 509.1: To understand the History, concept, principle and application of Remote sensing and GIS system	7	8	2	1	18
Soil 509.2: To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation	7	8	2	1	18
Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey	6	4	2	1	13
Soil 509.4: To understand the significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability	5	6	2	0	13
Soil 509.5: To understand the application of GIS for water resources, agriculture, precision farming, disaster management, e governance and ARIS	5	4	2	1	12
Total Hours	30	30	10	4	74

Suggestion for End Semester Assessment

CO **Unit Titles** Marks Total Distribution Marks R UA Introduction and terminologies used in 03 04 03 10 **CO-1** application of GIS and Remote sensing system Sensor system- camera, microwave radio 03 04 03 10 **CO-2** meters and scanners Management and identification of wasteland, 10 03 04 03 **CO-3** drought area, and prioritization of water shed area To evaluate and learn the significance and 03 04 03 10 sources of the spatial and temporal variability **CO-4** in soil To understand the application of GIS for 03 04 03 10 **CO-5** water resources, agriculture and ARIS Total 15 20 15 50

Suggested Specification Table (For ESA)

L: Legend R: Remember,

U:Understand,

A: Apply

The end of semester assessment for **Remote sensing and GIS Technique for soil**, **water and crop studies** 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	The Nature and Properties of Soils	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2013

2	GIS Fundamentals, Applications and Implementations	Elangovan K.	New India Publ. Agency.	2006
3	Remote Sensing and Image Interpretation	Lillesand TM and Kiefer RW.	3rd Ed. Wiley	1994
4	Spatial and Temporal Statistics	Nielsen DR and Wendroth O.	Catena Verloggmbh	2003
5	Geographic Information System: An Introduction	Star J and Esles J.	Prentice Hall	1990

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- 3. Dr. Neeraj Verma (Coordinator), Faculty of Agriculture Science and Technology, AKS University
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- 6. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

Cos.POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course Course Code: Soil 509 Course Title: Remote Sensing and GIS Technique for soil, water and crop studies

				Р	rogram C	Outcomes								Program Spe	cific Outcome	
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 509.1: To understand the History, concept, principle and application of Remote sensing and GIS system	1	1	1	1	1	1	2	2	3	2	3	3	1	1	1	3
Soil 509.2: To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation	1	1	1	1	1	1	3	2	3	2	3	3	1	1	1	3

Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey	1	1	1	1	1	1	2	2	3	2	3	3	1	1	1	3
Soil 509.4: To understand the significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability	1	1	1	1	1	1	3	2	3	2	3	3	1	1	1	3
Soil 509.5: To understand the application of GIS for water resources, agriculture, precision farming, disaster management, e governance and ARIS	2	2	3	3	3	3	3	2	3	2	3	3	2	2	2	3

Legend: 1 – Low, 2 – Medium, 3 – High

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	Soil 509.1: To understand the History, concept, principle and application of Remote sensing and GIS system	SOs: 1.1, SOs:1.2,	LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4	Unit-1.0 Introduction and terminologies used in application of GIS and Remote sensing system	
, _ , _ , _ , _				1.1,1.2,1.3,1.4,1.5,1.6,1.7	
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 509.2: To understand and learn the use of sensor system camera, aerial photographs their processing and interpretation	SOs: 2.1, SOs:2.2,	LI: 1.1, LI: 1.2, LI: 1.3, LI:1.4	Unit 2.0 Sensor system- camera, microwave radio meters and scanners 2.1, 2.2, 2.3, 2.4, 2.5,2.6,2.7	As mentionedin page
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4	Soil 509.3: To understand the application of remote sensing and land use techniques for soil survey	SOs: 3.1, SOs:3.2,	LI: 1.1, LI:1.2,	Unit-3.0: Management and identification of wasteland, drought area , and prioritization of water shed area 3.1, 3.2,3.3,3.4,3.5,3.6	number 2 to 6
PO 1,2,3,4,5,6 7,8,9,10,11,12	Soil 509.4: To understand the	SOs: 4.1,	LI: 1.1, LI:1.2,	Unit-4.0 : To evaluate and learn the	

Course Curriculum Map: Remote Sensing and GIS Technique for soil, water and crop studies

PSO 1,2, 3, 4	significance and sources of the spatial and temporal variability in soil and use of geo statistical techniques of evolution of soil variability	,	LI:1.3,	significance and sources of the spatial and temporal variability in soil 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	Soil 509.5: To understand the application of GIS for water resources, agriculture, precision farming , disaster management, e governance and ARIS	SOs: 5.1, SOs:5.2	LI: 1.1, LI: 1.2,	Unit-5.0 : To understand the application of GIS for water resources, agriculture and ARIS 5.1,5.2,5.3,5.4,5.5	

Semester II

Course Code: STAT 512

Course Title: EXPERIMENTAL DESIGNS

- **Pre-requisite:** Experimental design is the process of carrying out research in an objective and controlled fashion so that precision is maximized and specific conclusions can be drawn regarding a hypothesis statement. Generally, the purpose is to establish the effect that a factor or independent variable has on a dependent variable.
- **Rationale:** Experimental design is used to establish the effect an independent variable has on a dependent variable. An experimental design helps a researcher to objectively analyze the relationship between variables, thus increasing the accuracy of the result.

Course Outcomes:

- **STAT 512: 1** Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.
- STAT 512:2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.
- **STAT 512:3** Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.
- **STAT 512:4** Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.

Scheme of	f Studies:
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Course	Course	Course Title	S	Scheme of studies(Hours/Week)				Total
Categ	Code						Total Study	Credits
ory			Cl	LI	SW	SL	Hours	(C)
							(CI+LI+SW+SL)	
Minor Cours e	STAT 512	EXPERIMENTAL DESIGNS	2	01	02	01	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

			Scheme of Assessment (Marks)						
			Progressive Assessment (PRA)						
y.			Assignment marks each	t best out of tch (CT)	me (SA)	ty any one T)	Total Marks	End Semester Assessment	Total Marks
Course Category	Course Code	Course Title	Class/ Home 5 number 3 (CA)	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one (SA)	Activi (CA	(CA+CT+PA +AT)	(ESA)	(PRA+ ESA)
Minor Cours e	STAT 512	Experimen tal Design	5	30	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.

STAT 512. 1 Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.

Approximate Hours			
Item	Appx. Hrs.		
CI	3		
LI	4		
SW	2		
SL	1		
Total	10		

Session Out Comes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self-Learning (SL)
SO1.1 Design of Experiment	1-Uniformity	Unit-1. Need for designing	1. Prepare the
is a tool to develop an	trial data	of experiments, characteristics	assignment on
experimentation	analysis.	of a good design. Basic	Basic
strategy that maximizes	2- formation of	principles of designs-	principles of
learning using a	plots and	randomization, replication	designs-
minimum of resources.	blocks,	and local control.	randomization,

SO1.2 Extensively used by	Fairfield Smith	1.1 . Need for designing of	replication and
engineers and scientists	Law	experiments	local control.
involved in the improvement		1.2 characteristics of a good	
of manufacturing processes		design	
to maximize yield and		1.3 Basic principles of	
decrease variability.		designs- randomization,	
SO1.3 It is widely used in		replication and local control	
many fields with broad			
application across all the			
natural and social sciences,			
to name a few: Biostatistics,			
Agriculture, Marketing,			
Software engineering,			
Industry etc.			

SW-1 Suggested Sessional Work (SW):

- **a.** Assignments: Prepare the assignment on Basic principles of designs- randomization, replication and local control.
- b. Mini Project: NA

c. Other Activities (Specify):- NA

STAT 512:2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.

Approximate Hours			
Item	Appx. Hrs.		
CI	5		
LI	6		
SW	2		
SL	1		
Total	14		

Session Outcomes (SOs)	Laboratory Instruction	Classroom Instruction (CI)	Self- Learning
	v		
between variables.		 1.4 Analysis of variance; randomized block design 1.5 Analysis of variance; Latin square design. 	square design.

SW-2 Suggested Sessional Work (SW):

- **a. Assignments:** Prepare the assignment on Simple Problems Based on Analysis of variance; Completely randomized design, randomized block design and Latin square design.
- b. Other Activities (Specify): NA

STAT 512.3: Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.

Approximate Hours				
Item	Appx. Hrs.			
CI	6			
LI	14			
SW	2			
SL	1			
Total	23			

Session Out Comes	Laboratory	Classroom Instruction	Self-
(SOs)	Instruction	(CI)	Learning
	(LI)		(SL)
 exogeneity, allowing researchers to draw conclusions about the effects of an event or a program. SO3.2. An experimental design helps a researcher to objectively analyze the relationship between variables, thus increasing the accuracy of the result. 	 (LI) 1- Analysis of factorial experiments without confounding. 2- Analysis of factorial experiments with confounding. 3- Analysis with missing data in CRD. 4- Analysis with missing data in RBD. 5- Analysis with missing data in LSD. 6- Split plot designs. 	 Unit-3 Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment. 1.1. Factorial experiments, (symmetrical) 1.2 Factorial experiments, (asymmetrical) 1.3 orthogonality 1.4 partitioning of degrees of freedom 1.5. Confounding in symmetrical factorial experiments 1.6. Factorial experiments with control 	1. Prepare the assignment on Factorial experiments with control treatment.

SW-3 Suggested Sessional Work (SW):

Assignments: Prepare the assignment on Factorial experiments with control treatment.

STAT 512: 4 Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment

Approximate Hours			
Item	Appx Hrs.		
CI	16		
LI	6		
SW	1		
SL	2		
Total	25		

Session Out	Laboratory	Classroom Instruction	Self-
Comes	-	Instruction (CI)	
(SOs)	(LI)	(02)	Learning (SL)
	1.Transformation	Unit-4 Split plot and strip plot designs;	1. Prepare the
SO4.1.Ensure	of data	Analysis of covariance and missing plot	assignment on
your experiment		techniques in randomized block and Latin	Analysis of
•	2. Analysis of	square designs; Transformations, crossover	covariance and
	resolvable	designs, balanced incomplete block design,	missing plot
SO4.2 Make	designs	resolvable designs and their applications ~	techniques in
sure your	0	Lattice design, alpha design-concepts,	randomized
•	3 . Fitting of		block and
adequately	response	interpretation of results. Response surfaces.	Latin square
powered	surfaces.	Experiments with mixtures.	designs
1		1.1 Split plot	C
SO4.3 Consider		1.2 strip plot designs	
the range of		1.3 Analysis of covariance 1.4 Missing plot	
applicability of		techniques in randomized block.	
your experiment.		1.5 Missing plot techniques in Latin square	
		designs.	
		1.6 Transformations	
		1.7 crossover designs	
		1.8 balanced incomplete block design	
		1.9 resolvable designs	
		1.10 Applications of resolvable designs	
		Lattice design	
		1.11 Lattice design	
		1.12 Applications of	
		Lattice design	
		1.13 Alpha design-concepts.	
		1.14 Randomization procedure.	
		1.15 Interpretation of results.	
		1.16 Response surfaces. Experiments with	
		mixtures	

SW-4 Suggested Sessional Work (SW):

a. **Assignments:** Prepare the assignment on Analysis of covariance and missing plot techniques in randomized block and Latin square designs

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (C l)	Laborat ory Lecture (L I)	Sessional Work (SW)	Self Learni ng (S l)	Total hour (Cl+LI+ SW+Sl)
STAT 512: 1: Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.	03	04	01	02	10
STAT 512: 2: Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.	05	06	01	02	14
STAT 512: 3: Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	06	14	01	02	25
STAT 512: 4: Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.	16	06	01	02	25
Total Hours	30	30	04	08	74

Suggestion for End Semester Assessment Suggested Specification Table (For ESA)

СО	Unit title	I	Mark	s	Total
		Dis	tribu	tion	Marks
		R	U	Α	
CO- 1	Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.	04	04	04	12
CO- 2	Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design.	04	04	04	12
CO- 3	Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment.	04	04	04	12
CO- 4	Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block	05	04	05	14

design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures.				
Total	17	16	17	50

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

The end of semester assessment for **Experimental Designs** 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:

S. No.	Title	Author	Publish er	Edition & Year
01	Basic Concepts and Application of Experimental Designs and Analysis	Felix Kusanedzie Sylverster Achio Edmund Ameko	Science PG	First Edition 2015
02	Theory and Analysis of Experimental Designs	B.L. Agrawal	CBS	First Edition 2011
03	Design and Analysis of Experiments	Angela Dean Daniel Voss	Springer	Second Edition 2017

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Cos.POs and PSOs Mapping

Code : STAT -512

Course Title: Experimental Design

					Program	n Outcome	es							Program S	Specific Outco	ome
	PO1	PO2	PO 3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes		Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Connost / Manure		Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
STAT 512: 1 Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources.	1	1	1	1	3	2	3	2	1	2	1	3	2	3	3	1
STAT 512.2 Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.		2	2	2	3	2	3	2	2	1	2	3	2	2	2	1

STAT-512.3: Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	1	2	1	1	1	2	3	2	2	2	1	3	1	1	2	2
STAT-502.4: Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.	1	2	-	-	1	-	2	2	1	1	1	3	3	3	3	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: STAT 512: Experimental 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, 5	Understand of basic concepts of design of experiments. Introduction to planning valid and economical experiments within given resources	SO1.1 SO1.2 SO1.3	LI. 1.1, 1.2	Unit-1 Need for designing of experiments, characteristics of a good design. Basic principles of designs- randomization, replication and local control.	As mentioned in page number
				1.1,1.2,1.3	_ to _

PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Analyze completely randomized design, Randomized block design, Latin square design. The conditions and circumstances under which results of the experiment are valid should be extensive.	SO2.1	LI. 2.1, LI. 2.2, LI. 2.3,	 Unit-2 Uniformity trials, size and shape of plots and blocks; Analysis of variance; Completely randomized design, randomized block design and Latin square design. 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, 5	Understand and compute Full and confounded factorial designs with two and three levels. Fractional factorial designs with two levels.	SO3.1 SO3.2	LI. 3.1 LI. 3.2 LI. 3.3 LI. 3.4 LI.3.5 LI.3.5 LI.3.6	Unit-3 Factorial experiments, (symmetrical as well as asymmetrical). orthogonality and partitioning of degrees of freedom, Confounding in symmetrical factorial experiments, Factorial experiments with control treatment. 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, 5	Understand the purpose for balanced incomplete block design, resolvable designs and their applications. Split and Strip plot design will help students to know the applications of DOE and learn and apply these techniques in the field experiment.	SO4.1	LI. 4.1 LI. 4.2 LI. 4.3	Unit-4 Split plot and strip plot designs; Analysis of covariance and missing plot techniques in randomized block and Latin square designs; Transformations, crossover designs, balanced incomplete block design, resolvable designs and their applications ~ Lattice design, alpha design-concepts, randomization procedure, analysis and interpretation of results. Response surfaces. Experiments with mixtures. 4.1,4.2,4.3,4.4,4.5,4.6,4.5,4.6,4.7,4.8,4.9,4. 10,4.11,4.12,4.13,4.14,4.15,4.16

Semester II

Course Code: PGS504

Course Title: PGS504

Pre requisite: No specific requirements

Rationale: Studying basic laboratory techniques are fundamental for scientific research, ensuring accurate experimentation and data analysis. Mastery of these skills cultivates precision, reproducibility, and safety, forming the cornerstone of scientific inquiry across disciplines and facilitating advancements in knowledge and technology.

Course Outcomes:

CO1: PGS: 504 Student will learn about basic instrumentation, its principles, working and use. They will learn about Making solutions of different concentrations, learn acid base interaction. Also, student will learn about Procedural outline of various experiments. Student will learn about Basics of plant tissue culture and seed viability testing.

Scheme of Studies

				S	Total			
Couse Categoey	Course Title		CI	LI	SW	SL	Total Study Hours	Credit (C)
Non credit	PGS-504	Basic Concepts in Laboratory Techniques	00	2	00	00	2	01

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:

Practical

_	Tacilca	-	0.1	C . A			``			
				e of Asso		,	,			T ()
				ssive As	End	Total				
			be					Total	Semester	Marks
			number (A)					Marks	Assessment	(PRA
				3)				(CA+CT	(ESA)	+
				of 3) (CT)			•	+SA+		ESA)
			Assignment s each	t		one	(AT)	CAT+AT		
			un (or Ich			₹))		
ý			ssign each	best out ss each	(SA)	ny	ce			
Category			As s e	est 2 (2 best ou 10 marks each		Activity any	Attendance			
Iteş	Code	tle	Home A marks	2 () na	one	vit	pu			
Ca	C	Title	lon ma	st) 0 I		cti	tte			
se		se	31 3	Ē	na		A			
Course	Course	Course	Class/Home 3 mark	SS	Seminar	Class CAT)	Class .			
ŭ	C	CC	CI	Class	Se		C			
Non	PGS-	Basic	0	0	0	0	0	0	100	100
Credit	504	Concepts in								
		Laboratory								
		Techniques								

Course-Curriculum Detailing:

Laboratory techniques are important for any person conducting an experiment. Every procedure needs to be complete with accuracy and precision with proper safety measures. Student will understand the safety and details of working in scientific laboratory. Student will familiarize with various instruments and their principles. Student will practice and visualize common experimental procedures.

PGS-504: Basic Concept of Laboratory Techniques

Approximate Hours								
Item	Appx Hrs							
CI	0							
LI	30							
SW	0							
SL	0							
Total	30							

Session Outcomes (SOs)	Laboratory Instructions (LI)	Classroom Instructions (CI)	Self- Learning (SL)
SO.L1 Identify safety	L1. Safety measures while in		
measures while in Lab	Lab;		
SO.L2 Recognize use of glassware's.	L2. Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers,		
SO.L3 Discover handling of glassware's.	micropipettes and vaccupets;		
	L3. Washing, drying and		

SO.L4 Recognize Drying of	sterilization of glassware;	
solvents/ chemicals;		
, ,	L4. Drying of solvents/	
SO I 5 Decemiles working with	chemicals;	
SO.L5 Describe working with	chemicals;	
chemicals.		
	L5. Handling of chemical	
SO.L6 Describe working with	substances; Weighing and	
solutions.	preparation of solutions of	
solutions.		
	different strengths and their	
SO.L7 Articulate the	dilution;	
technique of formulating		
doses of agrochemicals	L6. Handling techniques of	
, i i i i i i i i i i i i i i i i i i i	solutions;	
SO.L8 Discover handling	solutions,	
-		
techniques of solutions	L7. Preparation of different	
	agro-chemical doses in field	
SO.L9 Identify the handling	and pot applications;	
of acid and bases		
	L8. Preparation of solutions of	
SO.L10 Discover the	acids;	
	acius,	
formulation of buffer and		
solutions of specific pH.	L9. Neutralization of acid and	
	bases;	
SO.L11 Identify the use of lab		
instruments	L10. Preparation of buffers of	
mstruments	different strengths and pH	
	C 1	
SO.L12 Recognize and	values;	
categorize the media		
requirements and its types	L11. Use and handling of	
	microscope, laminar flow,	
SO.L13 Discover the methods	vacuum pumps, viscometer,	
and application of viability of	thermometer,	
germplasm	magnetic stirrer, micro-ovens,	
	incubators, sand bath, water	
SO.L14 Illustrate procedure	bath, oil bath;	
for plant tissue culture	Electric wiring and earthing;	
- T	,	
SO I 15 Pagagniza flowering	I 12 Propagation of madia and	
SO.L15 Recognize flowering	L12. Preparation of media and	
plant by its taxonomical	methods of sterilization;	
description		
	L13. Seed viability testing,	
	testing of pollen viability;	
	I 14 Tissue culture of area	
	L14. Tissue culture of crop	
	plants;	
	L15. Description of	
	flowering plants in botanical	
	terms in relation to taxonomy	
	terms in relation to taxonomy	

SW-1 Suggested Sessional Work (SW):

a. Assignments: 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)
Basic Concept of Laboratory Techniques	0	30	0	0	30

Suggestion for End Semester Assessment

	Suggested Specification Table (For ESA)							
СО	Unit Titles	Marks	s Distrik	oution	Total			
		R	U	Α	Marks			
CO1	Basic Concept of Laboratory Techniques		30	70	100			

Suggested Learning Resources:

Sl. No.	Title	Author	Publisher	Edition and Year
01	Laboratory Techniques in Organic Chemistry	Jerry R. Mohrig, David G. Alberg, and Gretchen M. Adams	W. H. Freeman and Company.	2014
02	Biotechnology: Expanding Horizons	B D Singh	Kalyani Publishers	2005

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Cos.POs and PSOs Mapping

Code : PGS 504

Course Title: Basic Concept of Laboratory Techniques

				Pro	ogram (Outcom	ies						Progr	am Specific	Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Agricultural knowledge	Soil analysis	Design /Development of solutions	Management of problematic soils	Modern Tool/ concept usage	The engineer and society	Environment and sustain ability	Ethics	Individual and team work	Communication	Project management and finance	Life-long learning	The ability to apply technical & engineering knowledge for Increased soil fertility and productivity	Ability to understand the day to day soil	Ability to understand the latest manure & fertilizer manufacturing technology	Ability to use the research based innovative knowledge for SDGs
Basic Concept of Laboratory Techniques	1	1	1	1	3	2	3	2	1	2	1	3	2	3	3	1
Legend: 1 – I	Legend: 1 – Low, 2 – Medium, 3 – High															

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	Basic Concepts of Laboratory Techniques	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5 SO1.6 SO1.7	LI. 1.1, LI.1.2, LI.1.3, LI.1.4, LI.1.5, LI.1.6, LI.1.7,		As mentioned in page number
PSO 1,2, 3, 4, 5		SO1.8 SO1.9, SO1.10, SO1.11 SO1.12, SO1.13 SO1.14, SO1.15	LI.1.8, LI.1.9, LI.1.10, LI.1.11, LI.1.12, LI.1.13, LI.1.14, LI.1.15		_ to _

Course Curriculum Map: PGS 504 : Basic Concepts of Laboratory Techniques

Semester- II

Course Code:	PGS 503
Course Title:	Intellectual Property and Its Management in Agriculture
Pre- requisite:	To teach the physiology of Intellectual Property and Its Management in Agriculture
Rationale:	The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge based economy.

Course outcomes:

- **PGS 503.1**: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.
- **PGS 503.2**: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.
- PGS 503.3: Students will be able to understand Research Collaboration Agreement, License agreement

Scheme of Studies:

			Sc	hen	Total			
Course	Course						Total Study	Credits(C)
Category	Code	Course Title	Cl	LI	SW	SL	Hours(CI+LI+S	
							W+SL)	
Non	PGS 503	Intellectual Property	1	0	1	1	3	1
Credit		and Its Management in						
Course		Agriculture						

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

			Scheme o	of Assessi	nen	t (Mar	ks)		
			Pro	gressive	Ass	essmen	t(PRA)	End	Total
Course Category	e Code	se Title	Class/HomeAssignme nt1number 5 marks each (CA)	s Test2 (2 best 20 marks each	nar one (SA)	s Attendance	Total Marks	Semester Assessment	Marks
Cours	Course	Course	Class/Home nt1number each (CA)	Class ¹ out) 2 (CT)	Seminar	Class (AT)	(CA+CT+ PA+AT)	(ESA)	PRA+ESA)
		Intellectual Property and Its Management in Agriculture	5	40	0	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.

PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property Right.

A	pproximate Hours					
	Item	AppXHrs				
	Cl	04				
	LI	0				
	SW	01				
	SL	02				
	Total	07				

Session Outcomes(SOs)	Laboratory Instruction(LI)	Classroom Instruction(CI)	Self-Learning (SL)
SO1.1 Student will		Unit-1.0 Historical perspectives and	1. Role
understand the		need for the introduction of	of IPR
Historical perspectives		Intellectual Property Right regime;	and its
and need for the		TRIPs and various provisions in	benefits.
introduction of		TRIPS Agreement; Intellectual	
Intellectual Property		Property and Intellectual Property	2. Role
Right.		Rights (IPR), benefits of securing	of TRIPS
		IPRs.	and its
SO1.2 Student will			benefits
recognize the TRIPs		1.1 Historical perspectives and need	
and various provisions		for the introduction of Intellectual	
in TRIPS Agreement.		Property Right regime.	
SO1.3 Student will understand different Intellectual Property		1.2 TRIPs and various provisions in TRIPS Agreement.	
and Intellectual		1.3 Intellectual Property and	
Property Rights (IPR),		Intellectual Property Rights (IPR)	
benefits of securing		······································	
IPRs		1.4 Benefits of securing IPRs.	

SW-1 Suggested Sessional Work (SW):

a. Assignments:

• Preparation of file and write the role of IPR and TRIPS and their purpose.

PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.

Approximate Hours

Item	AppX Hrs
Cl	06
LI	0
SW	02
SL	03
Total	11

Session Outcomes(SOs)	Laboratory Instruction(LI)		Self-Learning (SL)
 SO2.1 Students will understand the Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout SO2.2Students will understand the trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection. SO2.3 Students will identify the role of Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection. 		 Unit-2 Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and biodiversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection. 2.1 Indian Legislations for the protection of various types of Intellectual Properties. 2.2 Fundamentals of patents, copyrights, geographical indications, designs and layout. 2.3 trade secrets and traditional knowledge and trademarks. 2.4 protection of plant varieties and farmers' rights and biodiversity protection. 2.5 Protectable subject matters, protection of other biological materials, ownership and period of protection. 2.6 protection of other biological materials, ownership and period of protection. 	 Basic Indian Legislature. Plant varieties and farmers' rights act (2001). Biodiversity act (2002).

SW-2 Suggested Seasonal Work (SW): a. Assignments:

- Note on Plant varieties and farmers' rights act (2001).
- Note on Biodiversity act (2002).

PGS 503.3: Students will be able to understand Research Collaboration Agreement, License agreement

Approximate Hours

Item	AppX Hrs
Cl	05
LI	0
SW	02
SL	01
Total	08

Session Outcomes (SOs)	Laboratory Instruction	Classroom Instruction (CI)	Self- Learning
	(LI)		(SL)
 SO3.1 Students will identify the National Biodiversity protection initiatives and Convention on Biological Diversity. SO3.2 Students will understand the International Treaty on Plant Genetic Resources for Food and Agriculture and Licensing of technologies. SO3.3 Students will understand the Material transfer agreements, Research collaboration Agreement and License Agreement. 		 Unit-3: National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement. 3.1 National Biodiversity protection initiatives. 3.2 Conventions on Biological Diversity. 3.3 International Treaty on Plant Genetic Resources for Food and Agriculture. 3.4 Licensing of technologies and Material transfer agreements. 3.5 Research collaboration Agreement and License Agreement. 	1. Plant Genetic Resources.

SW-3 Suggested Sessional Work (SW):

a. Assignments:

- Note on Plant Genetic Resources.
- o Note on National Biodiversity protection initiatives

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self- Learning (Sl)	Total hour (Cl+SW+Sl)
PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property	04	01	02	07

Right.				
PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.	06	02	03	11
PGS 503.3: Students will be able to understand Research collaboration Agreement, License agreement.	05	02	01	08
Total	15	05	06	26

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

CO	Unit Titles		Mark tribut	Total Marks	
		R	U	Α	
CO	Historical perspectives and need for the introduction of	05	03	02	10
1	Intellectual Property Right regime; TRIPs and various				
	provisions in TRIPS Agreement; Intellectual Property and				
	Intellectual Property Rights (IPR), benefits of securing IPRs.				
CO	Indian Legislations for the protection of various types of	05	02	03	10
2	Intellectual Properties; Fundamentals of patents, copyrights,				
	geographical indications, designs and layout, trade secrets and				
	traditional knowledge, trademarks, protection of plant varieties				
	and farmers' rights and biodiversity protection; Protectable				
	subject matters, protection in biotechnology, protection of other				
	biological materials, ownership and period of protection.				
CO	National Biodiversity protection initiatives; Convention on	05	03	02	10
3	Biological Diversity; International Treaty on Plant Genetic				
	Resources for Food and Agriculture; Licensing of technologies,				
	Material transfer agreements, Research collaboration				
	Agreement, License Agreement.				
	Total	15	8	7	30

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

The end of semester assessment for **Intellectual Property and Its Management in Agriculture** 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 organic fields
- 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.	Title	Author	Publisher	Edition &
No.				Year
1	Intellectual Property Rights in	Erbisch FH and	CABI.	1998
	Agricultural Biotechnology	Maredia K		
2	Intellectual Property Rights:	Ganguli P	McGraw-Hill.	2001
	Unleashing Knowledge			
	Economy			
3	Intellectual Property Rights:		NRDC and	2001
	Key to New Wealth Generation		Aesthetic	
			Technologies.	
4	State of Indian Farmer. Vol. V.	Ministry of	Academic	2004
	Technology Generation and IPR	Agriculture,	Foundation	
	Issues	Government of India		
5	Intellectual Property Rights in	Rothschild M and	CABI	2003
	Animal Breeding and Genetics	Scott N		

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Cos, POs and PSOs Mapping

Course Code:- PGS 505 Course Title: - Intellectual Property and Its Management in Agriculture

Course Outcomes	Prog	gram C	outcom	es									Program S	Program Specific Outcome			
Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4	
PGS 503.1:	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity	
PGS 503.1: Students will be able to understand Historical perspectives and need for the introduction of Intellectual Property	3	1	1	2	1	1	1	2	3	2	1	3	3	1	2	1	

Right.																
PGS 503.2: Students will be able to understand National Biodiversity protection initiatives. Convention on Biological Diversity.	3	2	1	2	2	2	1	3	2	1	2	3	3	2	2	3
PGS 503.3: Students will be able to understand Research collaboration Agreement, License agreement.	3	2	1	2	2	2	3	2	1	2	3	3	2	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

POs & PSOs	COs No.& Titles	SOs	Laboratory	Classroom Instruction (CI)	Self Learning
No.		No.	Instruction		(SL)
			(LI)		
PO 1,2,3,4,5,6	PGS 503.1: Students will	SO1.1		Unit-1.0 Historical perspectives and need for the	As mentioned
	be able to understand			introduction of Intellectual Property Right regime;	in page number
7,8,9,10,11,12	Historical perspectives	SO1.2		TRIPs and various provisions in TRIPS Agreement;	
	and need for the	SO1.3		Intellectual Property and Intellectual Property	
	introduction of	501.5		Rights (IPR), benefits of securing IPRs.	
PSO 1,2, 3, 4, 5	Intellectual Property				
	Right.			1.1, 1.2, 1.3, 1.4	
PO 1,2,3,4,5,6	PGS 503.2: Students	SO1.1		Unit-2.0 – Indian Legislations for the protection of	As mentioned
	will be able to	~~		various types of Intellectual Properties;	in page number
7,8,9,10,11,12	understand National	SO1.2		Fundamentals of patents, copyrights, geographical	
	Biodiversity protection	SO1.3		indications, designs and layout, trade secrets and	
	initiatives. Convention	501.0		traditional knowledge, trademarks, protection of	
PSO 1,2, 3, 4, 5	on Biological			plant varieties and farmers' rights and biodiversity	
	Diversity.			protection; Protectable subject matters, protection	
				in biotechnology, protection of other biological	
				materials, ownership and period of protection.	
				2.1, 2.2, 2.3, 2.4, 2.5, 2.6	
PO 1,2,3,4,5,6	PGS 503.3: Students	SO1.1		Unit-3.0 National Biodiversity protection	As mentioned
7 0 0 10 11 10	will be able to	0010		initiatives; Convention on Biological Diversity;	in page number
7,8,9,10,11,12	understand Research	SO1.2		International Treaty on Plant Genetic Resources for	
	collaboration	SO1.3		Food and Agriculture; Licensing of technologies,	
	Agreement, License	2010		Material transfer agreements, Research	
PSO 1,2, 3, 4, 5	agreement.			collaboration Agreement, License Agreement.	
				3.1, 3.2, 3.3, 3.4, 3.5	

Course Curriculum Map: PGS 505 : Intellectual Property Right

Semester-III

Course Code:	Soil 511
Course Title :	Management of Problem soils and water
Pre- requisite:	Students should know about the classification and distribution of problematic soils and water
Rationale:	To educate students about basic concept of problem soils and brackish water, and their management. Attention will be on management of problem soils and safe use of brackish water in relation to crop production

Course Outcomes:

Soil 505:1. Distribution of problematic soils in India

Soil 505.2: To understand the morphological, chemical and biological features of salt affected soils

Soil 505.3: To understand the Management of salt affected soil

Soil 505.4: To understand the origin, nutrient content and management of acidic soil

Soil 505: To understand and analysis the quality of irrigation water

Soil 505.6: Application of agronomic practices in maintaining the quality of ground water

Scheme of Studies:

				Sche					
Course Category	Course Code	Course Title	Cl	LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	Total Credits (C)	
Major Course	Soil 511	Management of problematic soils and water	2	1	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	y								
			Scheme of Assessment (Marks)							
			Progressive Assessment (PRA)				End	Total		
Course Category	Code	litle	Home nent 5 3 marks	Test 2 (2 best [3) 10 marks	Seminar one (SA)	Class Activity any one (CAT)		Total Marks	Semester Assessment	Marks
Course (Couse C	Course Title	Class/ Assignment number	Class Tes out of 3)	Semina	Class A one	Class /	(CA+CT+SA+CAT +AT)	(ESA)	(PRA+ES A)
Major Cours e	DOIL	Manage ment of proble matic soils and water	1 5	30	0	0	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.

Soil 511.1: Distribution of problematic soils in India

Approximate Hours		
Item	AppX Hrs	
Cl	4	
LI	8	
SW	2	
SL	1	
Total	15	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To identify the problematic soil in India, their origin and extend of problem SO1.2 Reasons for problematic soils	 To determine the characters of acidic soils To determine the characters of salt affected soils To determine the characters of acid sulphate soils To determine the characters of acid sulphate soils 	 Unit-1.0 Distribution of problematic soils in India 1.1To learn the origin and basic concept of problematic soils 1.3 Classification of problematic soil on basis of pH 1.4 classification and reason for degraded land 1.4 Reason for conversion of development of problematic soils/ area. 	1. To know the classification of problematic lands in India

SW-1 Suggested Sessional Work (SW):

- a) Assignments:
 - Enlist the properties of acidic, acid sulphate, salt affected and calcareous soil
 - Enlist the cause of soil erosion in India
- b) Other Activities(Specify): NA

Soil 511.2: To understand the morphological, chemical and biological features of salt affected soils

Approximate Hours		
Item	AppX Hrs	
Cl	4	
LI	2	
SW	2	
SL	1	
Total	9	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO2.1: To understand the important characterization morphological features of salt affected soil SO2.2: To assess the chemical and microbiological properties of salt affected soil	2. Determination of gypsum required by the given salt affected soil	 Unit-2 Morphological features of salt affected soil 2.1: To study the Morphological features of saline 2.2, To study the Morphological features of sodic and saline-sodic soils. 2.3: To know characterization of saltaffected soils-soluble salts 2.4 To understand the physical, chemical and microbiological properties 	1.To know the physical, chemical and biological parameters come under estimation

SW-2 Suggested Sessional Work (SW):

- b) Assignments:
 - a. Classification of salt affected soil with its chemical properties
 - b. Distribution of salt affected soil in India and world
- b) Other Activities(Specify): NA

Soil 511.3: To understand the Management of salt affected soil

Approximate Hours			
Item	AppX Hrs		
Cl	5		
LI	4		
SW	2		
SL	1		
Total	12		

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self- Learning (SL)
 SO3.1 To assess the various management techniques used in maintaining salt content in soil SO3.2 To understand the cultivation of suitable crop ti be grown in salt affected area 	 Determina tion of Cations in soil (Na+,K+, Ca2+,and Mg2+) in given soil Determina tion of Cations in soil (Na+,K+, Ca2+,and Mg2+) in given water sample 	 Unit-3 : Management salt affected soil 3.1: To manage the salinity in saline soil 3.2: To manage the salt content in salt affected area/soil 3.3 Cultivation of salt tolerant or sensitive crop 3.4 To understand the management principles for sandy and clayey soils 3.5. to understand the management principles for red lateritic and dry land soils 3.6 To understand the management principles for dry land soils 	1.To know the salt affected area and the climatic situation

SW-3 Suggested Sessional Work (SW):

- a) Assignments:
 - Enlist the area come under salt affected soil
 - Formation, properties and management of salt affected soils
- b) Other Activities(Specify): NA

Soil 511.4: To understand the origin, nutrient content and management of acidic soil

Approximate Hours		
Item	AppX Hrs	
Cl	5	
LI	6	
SW	2	
SL	1	
Total	14	

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO4.1. To understand the origin, chemical properties of acidic soil SO4.2 To identify the management of acidic soil 	 To determination ion content in a given soil sample To determination ion content in a given water sample To estimate the lime requirement in a acidic soil 	 Unit-4: Acidic soil formation and their management 4.1. To understand the origin and source for development of acidic soil 4.2 To evaluate the management strategies in reducing the acidity from soil 5.3 To learn the effect of soil acidity on growth and development of crop 5.4 To identify the use of different types of lime as ameliorating substances 4.5 To understand to biological sickness of soils and its management 	 To study cause of acidity in soil To study distribution of acidic soils in India

SW-4 Suggested Sessional Work (SW):

a. Assignments:

• Enlist the factors affecting soil acidity

Soil 511.5: To understand and analysis the quality of irrigation water

Approximate Ho	ours
Item	AppX Hrs
Cl	5
LI	6
SW	2
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1. To evaluate the quality of irrigation water SO5.2 To understand the management of brackish, water and salt balance in irrigation water	3. to estimate the Na, Ca, Mg and Cl content	 Unit-5: Quality of irrigated water 5.1. To learn the concept behind the management of irrigation water 5.2 To understand the parameter behind analyzing the quality of irrigation water 5.3 To learn the characteristics of brackish water 5.4 To learn the management of brackish water for irrigation / drinking purpose 5.5 Learn to balance the salt content in irrigated water 5.6 To understand the relationship in water use and quality 	irrigation water 2. To know the

SW-5 Suggested Sessional Work (SW):

a. Assignments:

- Classify the brackish water and its management
- Enlist the parameters to classify the quality of irrigation water

Soil 511.6: Application of agronomic practices in maintaining the quality of ground

Water

A	pproximate Hours
Item	AppX Hrs
Cl	5
LI	4
SW	2
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO6.1. To understand and utilize the agronomic practices in maintaining the quality and level of ground water SO6.2 To understand use of various cropping patterns in maintaining the quality of ground water 	 To determine the land capability classification of a watershed To visit the watershed area 	 Unit-6: Agronomic practices in relation to problematic soils 6.1. To learn and apply the agronomic practices used in managing the ground water level 6.2 To learn and apply the cropping pattern used in managing the quality of ground water 6.3 To learn the agronomic practices used in managing the acidic, saline soil 6.4 To learn the cropping system used in managing the degraded land 6.5 To learn the cropping system in managing the ground water level 	1. To know agronomic practices in managing the problematic soil

SW-6 Suggested Sessional Work (SW):

b. Assignments:

• Enlist the agronomic practices used in maintaining the ground water level

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)
Soil 511.1: Distribution of problematic soils in India	4	8	2	1	15
Soil 511.2 To understand the morphological, chemical and biological features of salt affected soils	4	2	2	1	9

Soil 511.3: To understand the Management of salt affected soil	6	4	2	2	14
Soil 511.4:To understand the origin, nutrient content and management of acidic soil	5	6	2	1	14
Soil 511.5: To understand and analysis the quality of irrigation water	6	6	2	1	15
Soil 511.6: Application of agronomic practices in maintaining the quality of ground water	5	4	2	1	12
Total Hours	30	30	12	7	79

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

СО	Unit Titles	Ι		rks bution	Total
		R	U	A	Marks
CO-1	Unit-1.0 Distribution of problematic soils in India	3	1	1	5
CO-2	Unit-2.0 Morphological features of salt affected soil	5	6	4	10
CO-3	Unit-3.0 Management salt affected soil	4	3	2	9
CO-4	Unit-4.0 Acidic soil formation and their management	2	4	2	8
CO-5	Unit-5.0 Quality of irrigated water	3	3	3	9
CO-6	Unit-6.0 Agronomic practices in relation to problematic soils	3	3	3	9
	Total	20	20	15	50

Legend:

U:Understand,

A: Apply

The end of semester assessment for **Management of problem soils and water** will be held with written examination of 50 marks

R:Remember,

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
- 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	The Nature and Properties of Soils	Brady NC and Weil RR	13 th Ed. Pearson Edu.	2013
2	Chemistry of the Soil	Bear FE.	Oxford & IBH	1964
3	Salt-affected Soils. Department of Soil Science & Biometeorology	Jurinak JJ.	Utah State University	1978
4	Diagnosis and improvement of Saline and Alkali Soils.	USDA Handbook No. 60.	Oxford & IBH	1954

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Cos, POs and PSOs Mapping

Course Code:- Soil 511 Course Title: - Management of Problem Soil

				Prog	gram Outco	omes								Program S	Specific Outcon	ne
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 511.1: Distribution of problematic soils in India	1	1	1	1	3	2	3	2	1	2	1	3	2	3	3	1
Soil 511.2 To understand the morphological, chemical and biological features of salt affected soils	1	2	2	2	3	2	3	2	2	1	2	3	2	2	2	1
Soil 511.3: To understand the Management of salt affected soil	1	2	1	1	1	2	3	2	2	2	1	3	1	1	2	2
Soil 511.4: To understand the origin, nutrient	1	2	1	3	1	2	2	2	1	1	1	3	3	3	3	2

content and management of acidic soil																
Soil 511.5: To understand and analysis the quality of irrigation water	2	2	2	3	3	3	3	2	1	1	2	3	3	3	1	3
Soil 511.6: Application of agronomic practices in maintaining the quality of ground water		2	1	1	1	2	3	2	2	2	1	3	1	1	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

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	Soil 511.1: Distribution of problematic soils in India	SO1.1 SO1.2	LI. 1.1, LI. 1.2, LI. 1.3, LI. 1.4,	Unit-1.0 Distribution of problematic soils in India 1.1,1.2,1.3,1.4	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511.2 To understand the morphological, chemical and biological features of salt affected soils	SO2.1 SO2.2	LI. 2.1	Unit-2 Morphological features of salt affected soil 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, 5	Soil 511. 3: To understand the Management of salt affected soil	SO3.1SO3.2	LI. 3.1, LI. 3.2,	Unit-3 Unit-3 : Management salt affected soil 3.1,3.2,3.3,3.4,3.5,3.6	As mentioned in page number
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511.4:To understand the origin, nutrient content and management of acidic soil	SO4.1 SO4.2	LI. 4.1 LI. 4.2 LI. 4.3	Unit-4: Acidic soil formation and their management 4.1,4.2,4.3,4.4,4.5	_ to _
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511.5: To understand and analysis the quality of irrigation water	SO5.1 SO5.2	LI. 5.1, LI. 5.2, LI. 5.3,	Unit-5: Quality of irrigated water 51,5.2,5.3,5.4,5.5,5.6	
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 511.6: Application of agronomic practices in maintaining the quality of ground water	SO6.1 SO6.2	LI. 6.1, LI. 6.2,	Unit-6: Agronomic practices in relation to problematic soils 6.1,6.2,6.3,6.4,6.5	

Course Curriculum Map: Soil 511: Management of Problem Soil

Semester III

Course Code: - PGS 505

Course Title: - Agricultural Research, Research Ethics and Rural Development Programmes

- **Pre requisite:** -Student should have basic knowledge of agricultural research, research ethics, and agricultural history along with fellowship program, rural development programme.
- Rationale: The students studying agricultural research and research ethics should possess understanding about method of research application, research ethics and fellowship for research and other scholars in construction agricultural development. This encompasses familiarity with the invention and evolution of agricultural research and development of agricultural programme, students ought to acquire fundamental insights into various agricultural technologies, their applications, as well as the Indian needs in agricultural developments.

Course Outcomes:

- **PGS 505.1:** Identify the history, levels of research, economic and social welfare through research programme.
- **PGS 505.2:** Apply the functioning, role and significant of regional, national and international research.
- **PGS 505.3:** Asses the agricultural research, research ethics with operating and safety of laboratory.
- **PGS 505.4:** Analyze the various development programmes and their functioning with its impact on agricultural development
- **PGS 505.5:** Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.

Scheme of studies

Cotogonios	Course			Schen	Total Credits			
Categories of Course	Course Code	Course Title	Cl	LI	SW	SL	Total Study Hours	(C)
Non Credit	PGS	Agricultural Research,	01	00	02	01	(CI+LI+SW+SL) 04	01
Course	505	Research Ethics and Rural Development Programmes						

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.

					S	cheme o	of Asses	sment (Marks)			
				Progre	essive	e Assessi	nent (I	PRA)			
Course Category	Course Code	Course Title	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)	End Semester Assessme nt (ESA)	Total Mark s (PRA + ESA)	
Non Credit Cours e	PGS 505	Agricultu ral Research, Research Ethics and Rural Develop ment Program mes	15	30	0	00	5	50	50	100	

Scheme of Assessment:

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.

PGS 505.1 Identify the history, levels of research, economic and social welfare through research programme

Aj	pproximate Hours										
	Item	AppX Hrs									
	C 1	3									
	LI	0									
	SW	2									
	SL	1									
	Total	06									

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1- Introduce about the history of agriculture in brief SO1.2 - Brief the basic concept global agricultural research system. SO1.3 - Discuss about the need, scope, opportunities; Role in promoting food security of global agricultural research system. SO1.4- Describes the reducing poverty and protecting the environment through global agricultural research system SO1.5 Asses the functions and use of national Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions.		Unit-I History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; 1.1- History of agriculture in brief 1.2- Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment 1.3- National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions	1.1- Prepare the assignment on Global agricultural research system

SW-1 Suggested Sessional Work (SW):

- a. Assignments: Prepare the assignment on Global agricultural research system
- b. Mini Project: NA
- c. Other Activities (Specify):- NA

PGS 505.2: Apply the functioning, role and significant of regional, national and International research.

Approximate Hours

Item	AppX Hrs
CL	3
LI	0
SW	2
SL	1
Total	06

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO2.1 – introduce to the Consultative Group on International Agricultural Research (CGIAR) SO2.2 – learned about the International Agricultural Research Centers (IARC), SO2.3- Briefing the partnership with NARS, role as a partner in the global 		Unit-II Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at	2.1 – Prepare the assignment on partnership with NARS, role as a partner in the global agricultura
agricultural research system SO2.4- Briefing the strengthening capacities at national levels; International fellowships for scientific mobility SO2.5 –Discuss to the strengthening		 national and regional levels; International fellowships for scientific mobility 2.1 - Consultative Group on International Agricultural Research (CGIAR): 	l research system
capacities at regional levels; International fellowships for scientific mobility		ResearchAgriculturalResearch Centers (IARC)2.2-PartnershipwithNARS,roleasa partnerintheglobalagriculturalresearchsystem.	
SW-2 Suggested Ses		2.3-, Strengthening capacities at national and regional levels; International fellowships for scientific mobility.	

SW-2 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on partnership with NARS, role as a partner in the global agricultural research system.

b. Mini Project: NA

c. Other Activities (Specify): NA

PGS 505 CO 3: Asses the agricultural research, research ethics with operating and safety of laboratory.

Approximate Hours				
Item	AppX Hrs			
C 1	3			
LI	0			
SW	2			
SL	1			
Total	06			

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
 SO3.1 – Identify to the Research ethics SO3.2 – Discuss to the research integrity, research safety in laboratories SO3.3 - Apply the welfare of animals used in research SO3.4 - Discuss to computer ethics and standards SO3.5 - Describe the problems in research ethics 		 Unit-3 Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics 3.1-Research ethic and research integrity 3.2- Research safety in laboratories, welfare of animals used in research. 3.3- Computer ethics, standards and problems in research ethics. 	3.1 Prepare the assignment on Research ethic and research integrity.

SW-3 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Research ethic and research integrity

b. Mini Project: NA

c. Other Activities (Specify): NA

PGS 505.4: Analyze the various development programmes and their functioning with its impact on agricultural development

Approximate Hours					
	Item App X H				
	Cl	3			
	LI	0			
	SW	2			
	SL	1			
	Total	06			

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1 –Identify the Concept	LE1.1 -	Unit-4.0 - I	1.1- Prepare
and connotations of rural		Concept and connotations of	the
development.		rural development, rural	assignment
		development policies and	on
SO4.2 - Apply the rural		strategies. Rural development	Community
development policies and		programmes: Community	Development
strategies		Development Programme,	Programme.
		Intensive Agricultural District	-
SO4.3- Asses the Rural		Programme, Special group –	
development programmes:		Area Specific Programme,	
Community Development		Integrated Rural Development	

Programme, Intensive Agricultural District	Programme (IRDP)
Programme. SO4.4- Describes the Special group – Area	4.1- Concept and connotations of rural development, rural development policies and strategies
Special gloup – Alea Specific Programme. SO4.5– Brief the Integrated Rural Development Programme (IRDP)	strategies4.2-Ruraldevelopmentprogrammes:CommunityDevelopmentProgramme,IntensiveAgriculturalDistrictProgramme
	4.3- Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP)

SW-4 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Community Development Programme **b. Mini Project:** Prepare a project report of leadership styles and influence process; leadership theories, leadership styles and effective leader

c. Other Activities (Specify):

PGS 505 CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.

Approximate Hours

Item	App X Hrs
Cl	06
LI	00
SW	02
SL	1
Total	09

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO5.1 –Indentify		Unit-5.0	1.1 - Prepare
Panchayati Raj		Panchayati Raj Institutions, Co-	the assignment
Institutions and Co-		operatives, Voluntary	on Panchayati
operatives.		Agencies/Non-Governmental	Raj
		Organisations. Critical	Institutions,
SO5.2- Identify the		evaluation of rural development	
Voluntary Agencies		policies and programmes.	
SO5.3- Identify the		Constraints in implementation of	
Non-Governmental		rural policies and programmes	
Organisations		5.1- Panchayati Raj Institutions,	
SO5.4- Discuss the , Critical evaluation of rural development		Co-operatives, Voluntary Agencies/Non-Governmental Organisations	

policies	5.2- Critical evaluation of rural	
SO5.5- Briefs the programmes.	development policies and programmes	
Constraints in implementation of rural policies and	5.3- Constraints in implementation of rural policies and programmes	
programmes		

SW-5 Suggested Sessional Work (SW):

a. Assignments: Prepare the assignment on Panchayati Raj Institutions, **b.Other Activities (Specify): NA**

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (C l)	Sessional Work (SW)	Self Learning (S l)	Total hour (C l + LI+ SW +S l)
PGS 505.1 Identify the history, levels of research, economic and social welfare through research programme	3	2	1	06
PGS 505.2: Apply the functioning, role and significant of regional, national and international research.	3	2	1	06
PGS 505.3: Asses the agricultural research, research ethics with operating and safety of laboratory.	3	2	1	06
PGS 505.4: Analyze the various development programmes and their functioning with its impact on agricultural development	3	2	1	06
PGS 505.5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.	3	2	1	06
Total Hours	15	10	05	30

Suggested Specification Table (For ESA)

СО	Unit title		Marks Distribution		Total Marks
		R	U	Α	
CO-1	Identify the history, levels of research, economic and social welfare through research programme.	02	03	00	05

CO-2	Apply the functioning, role and significant of regional, national and international research.	02	05	03	10
CO-3	Asses the agricultural research, research ethics with operating and safety of laboratory.	00	08	07	15
CO-4	Analyze the various development programmes and their functioning with its impact on agricultural development.	02	05	08	15
CO-5	Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program	00	03	02	05
	Total	06	24	20	50

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

The end of semester assessment for Agricultural Research, Research Ethics and Rural Development Programmes 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
- 7. Demonstration
- **8.** ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Face book, Twitter, Whatsapp, Mobile, Online sources) Brainstorming

Suggested Learning Resources:

S.No.	Title	Author	Publisher	Edition &
				Year
01	Indian Agriculture - Four Decades of Development	Bhalla GS & Singh G.	Sage Publ	2001
02	Manual on International Research and Research Ethics	Punia MS	CCS, Haryana Agricultural University, Hisar.	
03	Rural Development Strategies and Role of Institutions Issues, Innovations and Initiatives.	Rao BSV.	Mittal Publ	2007
	Rural Development - Principles, Policies and Management	Singh K	Sage Publ	1998.

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Cos, POs and PSOs Mapping

Course Code:- PGS 505 Course Title: - Agricultural Research, Research Ethics and Rural Development Programmes

Course Outcomes	Pro	gram C	Outcom	es									Progra	am Specifio	e Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
PGS 505.1 Identify the history, levels of research, economic and social welfare through research programme	3	1	1	2	1	1	1	2	3	2	1	3	3	1	2	1
PGS.505.2: Apply the functioning, role and significant of regional, national and international research.	3	2	1	2	2	2	1	3	2	1	2	3	3	2	2	3

PGS 505.3: Asses the agricultural research, research ethics with operating and safety of laboratory.	3	2	1	2	2	2	3	2	1	2	3	3	2	3	3	3
PGS 505.4: Analyze the various development programmes and their functioning with its impact on agricultural development	2	2	3	1	2	2	3	2	1	2	1	1	3	3	2	2
PGS 505.5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.	2	3	3	1	3	2	2	2	2	1	1	2	2	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

POs & PSOs	COs No.& Titles	SOs No.	Laboratory	Classroom Instruction (CI)	Self Learning (SL)
No.			Instruction		
			(LI)		
PO 1,2,3,4,5,6	PGS 505 CO-1	SO1.1		Unit-1.0	As mentioned in page
7 0 0 10 11 12	Identify the history,	SO1 2		History of agriculture in brief; Global agricultural	number
7,8,9,10,11,12	levels of research, economic and social	SO1.2		research system: need, scope, opportunities; Role in	
	welfare through	SO1.3		promoting food security, reducing poverty and	
	research programme			protecting the environment; National Agricultural	
PSO 1,2, 3, 4, 5	10	SO1.4		Research Systems (NARS) and Regional	
		SO1 5		Agricultural Research Institutions	
		SO1.5		1.1, 1.2, 1.3.	
PO 1,2,3,4,5,6	PGS 505 CO 2: Apply	SO1.1		Unit-2.0 –	As mentioned in page
	the functioning, role			Consultative Group on International Agricultural	number
7,8,9,10,11,12	and significant of	SO1.2		Research (CGIAR): International Agricultural	
	regional, national and	SO1.3		Research Centres (IARC), partnership with NARS,	
	international research.	501.5		role as a partner in the global agricultural research	
PSO 1,2, 3, 4, 5		SO1.4		system, strengthening capacities at national and	
				regional levels; International fellowships for	
		SO1.5		scientific mobility	
				2.1, 2.2, 2.3.	
PO 1,2,3,4,5,6	PGS 505 CO 3: Asses	SO1.1		Unit-3.0	As mentioned in page
7 9 0 10 11 12	the agricultural	501 2		Research ethics: research integrity, research safety	number
7,8,9,10,11,12	research, research ethics with operating	SO1.2		in laboratories, welfare of animals used in research,	
	and safety of	SO1.3		computer ethics, standards and problems in research ethics	
	laboratory.			3.1, 3.2, 3.3.	
PSO 1,2, 3, 4, 5	······································	SO1.4		5.1, 5.2, 5.5.	

Course Curriculum Map: Agricultural Research, Research Ethics and Rural Development Programmes

		SO1.5		
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 505 CO 4: Analyze the various development programmes and their functioning with its impact on agricultural development	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-4.0Conceptandconnotationsofruraldevelopment,ruraldevelopmentpoliciesandstrategies.Ruraldevelopmentprogrammes:CommunityDevelopmentProgramme,IntensiveAgriculturalDistrictProgramme,SpecialAreaSpecificProgramme,IntegratedRuralDevelopmentProgramme (IRDP)4.1, 4.2, 4.3.	10
PO 1,2,3,4,5,6 7,8,9,10,11,12 PSO 1,2, 3, 4, 5	PGS 505 CO 5: Evaluate the role and functioning of panchayati raj, NGO and evaluation of different rural development program.	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	Unit-5.0 Panchayati Raj Institutions, Co-operatives, VoluntaryVoluntaryAgencies/Non-Governmental Organisations.Organisations.Critical evaluation of rural development policies and programmes.constraints in implementation of rural policies and programmes 5.1, 5.2, 5.3.	As mentioned in page number

Semester-III

Course Code:	Soil 513
Course Title :	Soil Survey and Land use planning
Pre- requisite:	Students should know about the computer handling , use of internet and knowledge of study of map
Rationale:	To teach the better utilization of land for agricultural purposes, and better management of runoff or surplus/excessive rain-water in the catchment area for agricultural purposes in a watershed

Course Outcomes:

Soil 513:1. To understand the soil survey, its techniques, types and interpretation in map with the application of remote sensing and geographic information system(GIS)

Soil 513.2: To assess the classification of land capability and irritability classification its Management approaches under ago-ecosystem

Soil 513.3: To understand the concept, management techniques and factor governing present land use cultivation of suitable crops

Soil 513.4: To evaluate and understand the Agro-ecological regions/sub-regions in India its status of LUP and characteristics in relation to crop production

Scheme of Studies:

v			Scł	neme of s	tudies(Hours/	Week)	Total	
Course Category	Course Code	Course Course		LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	Credits (C)	
	Soil 513	Soil Survey and Land Use Planning	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: 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.

, 	Theor	<u>y</u>												
			Scheme of Assessment (Marks)											
				(Progre	essive									
ŗ			Assignment 5 trks each (CA)	best out of 3 each (CT)	ne (SA)	y any one T)	Attendance (AT)	Total Marks	End Semester Assessment	Total Marks				
Course Category	Couse Code	Course Title	Class/Home Assignme number 3 marks each	Class Test 2 (2 best out of 3) 10 marks each (CT)	Seminar one	Class ctivity any one (CAT)	Class Attend	(CA+CT+SA+ CAT+AT)	(ESA)	(PRA+ ESA)				
Minor Cours e		Soil Survey and Land Use Planning	10	40	0	0	0	50	50	100				

Scheme of Assessment:

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.

Soil 513.1: To understand the soil survey, its techniques, types and interpretation in map with the application of remote sensing and geographic information system(GIS)

Approximate Hours									
Item	AppXHrs								
Cl	8								
LI	0								
SW	2								
SL	1								
Total	11								

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1: To understand the types and techniques used in soil survey,its interpretation in Soil map SO1.2 To evaluate the recent techniques used in application of Remote sensing and GIS software in soil survey and mapping of Indian soil		 Unit-1.0 To understand the application of GIS and Remote sensing system in Soil survey its types and techniques used in interpretation of Soil map of India 1.1To learn the Introduction, concept and types soil survey 1.2 To understand the importance and use of both conventional and modern soil survey techniques 1.3 To learn the Soil series its characterization and procedure for establish soil series 1.4 identification of benchmarks for sol series 1.5 To understand the interpretation of soil survey with thematic and cartographic mapping 1.6 To learn the recent techniques for generation of soil maps of India 1.7 Application of Remote sensing in soil survey and mapping of major groups of Indian soil 	1. Basic knowledg e of Remote sensing and GIS software

SW-1 Suggested Sessional Work (SW):

a. Assignments:

- Principle, concept, application of Remote sensing software and locate the different location with the help in Indian Map
- Enlist the soil survey techniques and its interpretation in soil maps of Indian soil
- b. Other Activities(Specify): NA

Soil 513.2: To understand the land forms , types concept , capability and irritability classification with managing approaches as per agro ecosystem

Approximate mours	
Item	AppX Hr
Cl	8
LI	0
SW	2
SL	1
Total	11

Approximate Hours

Session Outcomes (SOs)	Instruction Class room Instruction					
SO2.1: <i>To</i>		Unit-2 Land use types, its relationship	1.To know			
understand the		with soil evaluation and management	different			
concept, types,		with the help of remote sensing and	types of			
irritability and capability		GIS system	satellite			
classification		2.1: To understand the state wise				
of land use		distribution of major soil groups of				
types		India				
		2.2: To understand the representation of				
SO2.2: <i>To</i>		state wise distribution of major soil				
assess the		groups of India in map				
recent		2.3: To study the land capability				
approaches in		classification				
managing soil		2.4: To learn the land irritability				
and land		classification				
scopes in		2.5 To understand the land evaluation				
framework of		techniques				
agro		2.6 To understand the concept and				
ecosystem		application approaches for				
		managing soil in the framework of				
		agro-ecosystem				
		2.7 To understand the concept and				
		application approaches for				
		managing landscape in the				
		framework of agro-ecosystem				
		2.8. To understand distribution and				
		concept of LUT				

SW-2 Suggested Sessional Work (SW):

a.Assignments:

• Classification of different soil groups of India Map

Soil 513.3: To understand the concept, management techniques and factor governing present land use cultivation of suitable crops

Арргохішате поц	rs
Item	AppX Hrs
Cl	9
LI	0
SW	2
SL	1
Total	12

Session Outcomes	Laboratory	Class room Instruction	Self-
(SOs)	Instruction	(CI)	Learning
	(LI)		(SL)
		Unit-3 : To understand the basic concept	1.To know
SO3.1 To assess		of land use planning , techniques used	about
the various		and factors governing current land use	classificati
application of		3.1: To understand the concept and	on of lands
remote sensing		importance of land use planning	of India
techniques and		3.2: To understand recent techniques used	
land use soil		under land use planning	
survey		3.3 Assess the factors governing land use planning	
SO3.2 To		3.4 To learn the land evaluation methods	
understand and		3.5. application of land evaluation method	
evaluate the		sand soil-site suitability evaluation for	
management		different crops	
techniques used		3.6. To classify the land capability	
in drought and		classification	
waste land identification		3.7. To understand the contains under land capability classification	
		3.8 To understand the factors affecting	
		land capability classification	
		3.9. To understand the factors affecting	
		land irritability classification	

SW-3 Suggested Sessional Work (SW):

a.Assignments:

• Enlist the techniques used in land use planning for suitable evaluation of different crops

b.Other Activities(Specify): NA

Soil 513.4: To evaluate and understand the Agro-ecological regions/sub-regions in India its status of LUP and characteristics in relation to crop production

	Approximate hours
Item	AppX Hrs
Cl	5
LI	0
SW	2
SL	1
Total	08

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO4.1. To evaluate Land use planning as per agro-ecological regions of India SO4.2 To understand the concept , distribution of land as per agro- ecological regions of India in relation to crop production		 Unit-4: To evaluate Land use planning as per agro-ecological regions of India 4.1. To learn the distribution of Agro ecological regions of India 4.2 To learn the distribution of Subregions of India 4.3 To understand the characteristic of agro ecological regions in relation to crop production 4.4 To understand the status of LUP in agro ecological regions 4.5 To understand the use of GIS system in representation of land as per agro ecological regions 	1. To know about the agro ecological distribution of soils of India

SW-4 Suggested Sessional Work (SW):

- a. Assignments:
 - Enlist the evaluate Land use planning as per agro-ecological regions of India

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)
Soil 513.1: Soil survey techniques, its types and application of Remote sensing and GIS system in soil survey and mapping of Indian soil	8	0	2	1	11
Soil513.2:Tounderstandthelandforms, typesconcept,capabilityandirritabilityclassificationwith	8	0	2	1	11

managing approaches as per agro ecosystem					
Soil 513.3: To understand the concept and techniques of land use planning	9	0	2	1	12
Soil513.4:Tounderstandthemanagementanddistribution ofLUPunderAgro-ecologicalregions/subregions/subrelationtocropproduction	5	0	2	1	8
Total Hours	30	0	8	4	42

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

СО	Unit Titles]		rks bution	Total
		R	U	Α	Marks
CO-1	To understand the application of GIS and Remote sensing system in Soil survey its types and techniques used in interpretation of Soil map of India	03	04	06	13
CO-2	Land use types, its relationship with soil evaluation and management with the help of remote sensing and GIS system	03	04	06	13
CO-3	To understand the basic concept of land use planning , techniques used and factors governing current land use	03	04	05	12
CO-4	To evaluate Land use planning as per agro- ecological regions of India	03	04	05	12
	Total	15	20	15	50
	Legend: R:Remember, U:Unders	stand,		A: App	oly

The end of semester assessment for Soil Survey and Land Use Planning 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
- ICT Based Teaching Learning (Video Demonstration/Tutorials CBT, Blog, Facebook, Twitter, Whatsapp, Mobile, Online sources)
- 8. Brainstorming

Suggested Learning Resources:

	(a) Bo	ooks :		
S. No.	Title	Author	Publisher	Edition & Year
1	The Nature and Properties of Soils	Brady NC and Weil RR.	13th Ed. Pearson Edu.	2002
2.	Soil Genesis and Classification	Boul SW, Hole ED, MacCraken RJ and Southard RJ.	4th Ed. Panima Publication	1997
3.	Spatial and Temporal Statistics	Nielsen DR and Wendroth O.	Catena Verloggmbh	2003
4.	Fabric and Mineral Analysis of Soils	Brewer R.	John Wiley & Sons	1976

Curriculum Development Team

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- 6. Mr. Atul Kumar Singh, Assistant Professor, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University
- 7. Ku. Tulika Panigrahi, Teaching Associate, Dept. Soil Science & Agricultural Chemistry, FAST, AKS University

Cos.POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 513

Course Title: Soil Survey and land use Planning

				P	rogram Ou	itcomes	_	-		-	-	-	Pr	ogram Spec	ific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 513.1: Soil survey techniques, its types and application of Remote sensing and GIS system in soil survey and mapping of Indian soil	1	1	1	1	3	2	3	2	1	2	1	3	2	3	3	1
Soil 513.2: To understand the land forms , types concept , capability and irritability classification with managing approaches	1	2	2	2	3	2	3	2	2	1	2	3	2	2	2	1

as per agro ecosystem																
Soil 513.3: To understand the concept and techniques of land use planning	1	2	1	1	1	2	3	2	2	2	1	3	1	1	2	2
Soil 513.4: To understand the management and distribution of LUP under Agro-ecological regions/ sub regions in relation to crop production	1	2	-	-	1	-	2	2	1	1	1	3	3	3	3	2
Legend: 1 – I	.ow,	2 –	Mediu	m,	3 – High											

Course Curriculum Map: Soil Survey and Land Use Planning

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	Soil 513.1: Soil survey techniques, its types and application of Remote sensing and GIS system in soil survey and mapping of Indian soil	SO1.1 SO1.2		Unit-1 To understand the application of GIS and Remote sensing system in Soil survey its types and techniques used in interpretation of Soil map of India 1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8	As mentioned in
PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5	Soil 513.2: To understand the land forms , types concept , capability and irritability classification with managing approaches as per agro	SO2.1 SO2.2		Unit-2 Land use types, its relationship with soil evaluation and management with the help of remote sensing and GIS system 2.1,2.2,2.3,2.4,2.5.2.6,2.7,2.8	page number _ to _

PO 1,2,3,4,5,6,7, 8,9,10,11,12Soil 513.3: To understand the concept and techniques of land use planningPSO 1,2, 3, 4, 5PSO 1,2, 3, 4, 5	SO3.1 SO3.2	Unit-3 To understand the basic concept of land use planning, techniques used and factors governing current land use
PSO 1,2, 3, 4, 5 PO 1,2,3,4,5,6,7, 8,9,10,11,12 PSO 1,2, 3, 4, 5 PSO 1,2, 3, 4, 5 Soil 513.4: To understand the management and distribution of LUP under Agro-ecological regions/ sub regions in relation to crop production	SO3.2 SO4.1 SO4.2	Unit-4 To evaluate Land use planning as per agro-ecological regions of India 4.1,4.2,4.3,4.4,4.5

Semester- III

Course Code: Soil 591

Course Title: Master Seminar

- **Pre- requisite:** Students should have knowledge about basic and futuristic technologies subjected to ICT technology and Soil Science and Agricultural Chemistry.
- **Rationale:** Student will become familiar with fundamental application of ICT technologies related with Soil Science and Agricultural Chemistry that will support students in their career skills and leadership development in order to shape tomorrow's social and educational development in Soil science sector.

Course Outcomes:

SOIL 591.1.Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.

Scheme of Studies:

Course	Course	Course		Sc	dies(Hours/Week)	Total		
Course Category	Course Code	Title	CI	LI	SW	SL	Total Study Hours CI+LI+SW+SL	Total Credits (C)
No Credit Course	SOIL 591	Master Seminar	0	1	1	1	3	(0+1)= 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.

Γ							Scher	ne of Asse	essment (Mar	·ks)	
					Progr	essive	Assess	sment (PR	RA)		
	Course Category	Course Code	Course Title	Class/Home Assignment 5 number3 marks each (CA)	Class Test 2(2 best out of 3)10 marks each (CT)	Seminar one (SA)	Class Activity one (CAT)	Class Attendance(AT)	Total Marks _{(CA+} CT+SA+ CAT+AT)	End Semester Assessment (ESA)	Total Marks(PRA + ESA)
	No Credit Course	SOIL 591	Master Seminar	0	0	0	0	0	0	100	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 show case their mastery of Session Outcomes (SOs), culminating in the overall achievement of Course Outcomes (COs) upon the course's conclusion.

SOIL 591.1. Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.

Approx	Approximate Hours										
Item	Approximate Hours										
CI	0										
LI	2										
SW	0										
SL	2										
Total	4										

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
seminar allows students to work with ICT technologies, refine their skills	 Selection of topic and collection of presentation materials by using the ICT tools related to the Soil Science on selected topic Presentation of acquired material in PPT form. 		 Finding the topic related material. Preparation of PPT related to concerned topic.

SW-1 Suggested Sessional Work (SW):

- a. Assignments: Preparation of PPT slides on the given topics as per the advisor
- b. Other Activities (Specify): NA

Course Outcomes	Class Lecture (Cl)	Sessional Work (SW)	Self - Learning (Sl)	Total hour (Cl+SW+Sl)
SOIL 591.1. Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.	30	0	2	32

Brief of Hours suggested for the Course Outcome

Suggestion for End Semester Assessment Suggested Specification Table (For ESA)

CO	Unit Titles	Di	Marks stributi	Total Marks	
		R	U	Α	
CO 1	Unit 1. Seminar Presentation regarding Soil Science	20	40	40	100

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

The end of semester assessment for Master Seminar will be 100 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	Research publications			
2	Science direct			
3	Research gate			
4	Pub made			
5	Academia			
6	Google scholar			
7	Soil Science journals			
8	Multi authored books			
9	Book chapters			
10	As per directions of course instructor.			

Curriculum Development Team:

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- 2. Dr. S S Tomar(Dean) Dept. of Agriculture Science and Technology
- 3. Dr. T Singh (Head) Dept. of Agriculture Science and Technology
- 4. Dr. Sugyata Shivhare, (Head) Assistant Professor, Dept. of Agriculture Science and Technology
- 5. Mr. Atul Kumar Singh, Assistant Professor, Dept. of Agriculture Science and Technology
- 6. Ms. Tulika Panigrahi, Teaching Associate, Dept. of Agriculture Science and Technology

Cos.POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 591

Course Title: Master Seminar

			-	Pr	ogram Ou	tcomes		-		-	-		Pr	ogram Spec	ific Outcome	
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
Soil 513.1: Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.		2	3	1	3	2	3	2	3	2	1	3	2	3	3	3

Legend: 1 – Low, 2 – Medium, 3 – High

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	Soil 513.1: Students will design professional orientation on the topic with their choice of interest which will helps in development of academic and social sector pertaining to Soil Science and Agricultural Chemistry.	SO1.1 SO1.2	LI 1.1, LI 1.2		As mentioned in page number _ to _

Course Curriculum Map: Master Seminar

Semester- III

Course Code: SOIL 599

Course Title: Master Research

Pre- requisite: Conduct research to resolving the problem of farmers and society by applying advanced technology adopted in field of Soil Science and Agricultural Chemistry.
Rationale: The basic purpose of master's research is to understand the application of research methodology tools to do research on particular topic related to Soil science and Agricultural Chemistry and follow technical writing skill to design the synopsis, thesis, research paper, abstract, articles, etc as per results obtained during research studies.

Course Outcomes:

SOIL 599.1. Prepare various research activities related to Soil science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.

Scheme of Studies:

Course	Course	Course		Sc	idies(Hours/Week)	Total			
Course Category	Course Code	e Course Title		LI	SW	SL	Total Study Hours (CI+LI+SW+SL)	Credits (C)	
Non Credit Course	SOIL 599	Master Research	0	10	0	0	10	(0+10)= 10	

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.

								essment (Marks)		
Course Category	se Code	Course Title	Class/Home Assignment 5 number 3 narks each (CA)	Class Test 2 best out of 3) 10 marks e ach (CT)		Activity any one (CAT)		· · · · · ·	End Semester Assessment (ESA)	Total Marks (PRA + ESA)
Cour	Course	Cour	Class, narks (Class T 2 best ou e ach	Ser	Class	Clas			
Non Credit Course	SOIL 599	Master Research	0	0	0	0	0	0	100	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.

SOIL 599.1. Prepare various research activities related to Soil science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.

Approximate Hours					
Item	Approximate Hours				
CI	0				
LI	30				
SW	0				
SL	30				
Total	60				

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
	Unit .1. Master Research :		1. Finding of
SO1.1. Plan the	1. Submission of research proposal consisting		reviews
proposal of	concern programme		related with
research	2. Explain definition of the problems reference to		the topic of
related to	topic		research.
the topic	3 . Collection of Review of literature		2.Preparation
taken with	as per the Thesis Title		of
the help of	4. Arrange the references of past work of 20 years		manuscripts
guide	5. Collection of data by focusing their objectives		related to
SO1.2. Design	to be taken mentioned in their synopsis		concerned
the layout	6 Collection of data by focusing their observations		topic.
according	to be taken mentioned in their synopsis		_
to topic	7 Nutrient analysis of Soil samples before sowing		
SO1.3.	8 Nutrient analysis of Soil samples after harvest of		
Describe	crop		
the	9 Nutrient analysis of gains/seed of		
terminolog	crop		
y related to	10 Nutrient analysis of Stover's of		
the topic	the crop		
SO1.4. Plan the	11 Calculation of nutrients uptake by		
methodolog	the crop		
y to	12 Statistical calculation of the		
conduct the	collected data		
research on	13 Explanation of results		
the topic	14 Collection of Agro metrological		
SO1.5. Select	data during field preparation till		
the data to	harvest of crop		
be taken	15 Compilation of all the chapters of		
during	the thesis and preparation of		
research	research paper from the thesis		

SW-1 Suggested Sessional Work (SW):

- **a.** Assignments: Preparation of PPT slides on the related topic of dissertation by the advisor
- **b.** Other Activities (Specify): Presentation of the observation taken during the research trial in Kharif session

Course Outcomes	Class Lecture (Cl)	Lab Instruction (LI)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
SOIL 599.1. Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.		30	30	60
Total		30	30	60

Brief of Hours suggested for the Course Outcome

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	Research publications			
2	Science direct			
3	Research gate			
4	Pubmade			
5	Academia			
6	Multi authored books			
7	Book chapters			

Curriculum Development Team:

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- 2. Dr.S S Tomar(Dean) Dept. of Agriculture Science and Technology
- 3. Dr. T Singh (Head) Dept. of Agriculture Science and Technology
- 4. Dr.Sugyata Shivhare, (Head) Assistant Professor, Dept. of Agriculture Science and Technology
- 5. Mr. Atul Kumar Singh, Assistant Professor, Dept. of Agriculture Science and Technology
- 6. Ms. Tulika Panigrahi, Teaching Associate, Dept. of Agriculture Science and Technology

Cos.POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code: Soil 599

Course Title: Master Research

			•]	Program	Outcom	ies	•		•	•]	Program Sp	ecific Outc	ome
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
SOIL 599.1 . Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic	3	3	3	2	3	3	3	2	3	2	3	3	2	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course Curriculum Map: Master 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, 5	SOIL 599.1. Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.	SO1.1 SO1.2		Unit-1 Master Research 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	As mentioned in page number _ to _

Semester- IV

Course Code: SOIL 599

Course Title: Master Research

- Pre- requisite: Conduct research to resolving the problem of farmers and society by applying advanced technology adopted in field of Soil Science and Agricultural Chemistry.Rationale: The basic purpose of master's research is to understand the application of research
- methodology tools to do research on particular topic related to Soil science and Agricultural Chemistry and follow technical writing skill to design the synopsis, thesis, research paper, abstract, articles, etc as per results obtained during research studies.

Course Outcomes:

SOIL 599.1. Prepare various research activities related to Soil science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.

Scheme of Studies:

Course	Course	Commo		S	Total			
Course Category	Code	Course Title	CI	LI	SW	SL	Total Study	Credits
							HoursCI+LI+SW+SL	(C)
Non Credit Course	SOIL 599	Master Research	0	20	0	0	20	(0+20)= 20

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.

								sessment (Ma	rks)	
				Progres	ssive A	ssessi	nent (l	PRA)		
Course Category	Course Code	Course Title	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)	End Semester Assessment (ESA)	Total Marks(PRA + ESA)
Non Credit Course	SOIL 599	Master Research	0	0	0	0	0	0	100	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.

SOIL 599.1. Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.

Approximate Hours				
Item	Approximate Hours			
CI	0			
LI	20			
SW	0			
SL	2			
Total	22			

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
SO1.1. Plan the proposal of research related to the topic taken with the help of guide SO1.2. Design the layout according to topic SO1.3. Describe the terminology related to the topic SO1.4. Plan the methodology to conduct the research on the topic SO1.5. Select the data to be taken during research	 Unit .1. Master Research : 1. Submission of research proposal consisting concern programme 2. Explain definition of the problems reference to topic 3. Collection of Review of literature as per the Thesis Title 4. Arrange the references of past work of 20 years 5. Collection of data by focusing their objectives to be taken mentioned in their synopsis 6 Collection of data by focusing their observations to be taken mentioned in their synopsis 7 Nutrient analysis of Soil samples before sowing & after harvest of crop 8 Nutrient analysis of crop 9 Calculation of nutrients uptake by the crop 10 Statistical calculation of the collected data, Collection of Agro metrological data during field preparation till harvest of crop and Compilation of all the chapters of the thesis and preparation of research paper from the thesis 		Soil survey1.Finding of reviews related with the topic of research. 2.Preparation of manuscripts related to concerned topic.

SW-1 Suggested Sessional Work (SW):

- **a.** Assignments: Preparation of PPT slides on the related topic of dissertation by the advisor
- **b.** Other Activities (Specify): Presentation of the observation taken during the research

trial in Rabi session

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	Lab Instructio n (LI)	Self Learning (Sl)	Total hour (Cl+SW+Sl)
SOIL 599.1. Prepare various research activities related to field analysis of Soil Science and Agricultural Chemistry and compose manuscript i.e., synopsis related to particular topic.		20	2	22
Total		20	2	22

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:

- 9. Improved Lecture
- 10. Group Discussion
- 11. Demonstration
- 12. Brainstorming

Suggested Learning Resources:

(a)	Books:
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S. No.	Title	Author	Publisher	Edition & Year					
1	Research publications								
2	Science direct								
3	Research gate								
4	Pubmade								
5	Academia								
6	Multi authored books								
7	Book chapters								

Curriculum Development Team:

- 1. Professor G C Mishra, Director Cement Technology, AKS University
- 2. Dr.S S Tomar(Dean) Dept. of Agriculture Science and Technology
- 3. Dr. T Singh (Head) Dept. of Agriculture Science and Technology
- 4. Dr.Sugyata Shivhare, (Head) Assistant Professor, Dept. of Agriculture Science and Technology
- 5. Mr. Atul Kumar Singh, Assistant Professor, Dept. of Agriculture Science and Technology
- 6. Ms. Tulika Panigrahi, Teaching Associate, Dept. of Agriculture Science and Technology

Cos.POs and PSOs Mapping

Course Title: M.Sc. (Ag.) Course

Code : Soil 599

Course Title: Master Research

		Program Outcomes							Program Specific Outcome							
		PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
Course Outcomes	Basic Knowledge of Agriculture	Classification of Soils	Nutrient analysis	Identification and amelioration of problem soil	Preparation and recommendation of Compost / Manure	Composition and manufacture of various fertilizers	Modern concept of Soil Science	Environment and sustainability	Use of Engineering tools/ software's	Ethics	Life long learning	Project management	Ability to prepare and use the doses of various Nano fertilizers	Ability to understand the soil microbial classification	Ability to Prepare the various bio fertilizers and their applications in field	The ability to apply technical & engineering knowledge for Increased soil fertility and Productivity
SOIL 599.1. Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.	3	3	3	2	3	3	3	2	3	2	3	3	2	2	2	2

Legend: 1 – Low, 2 – Medium, 3 – High

Course	Curriculum	Man:	SOIL	599:	Master	Research
Course	Curriculum	Trap.			11 I CLUBECT	Iteseul en

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	SOIL 599.1. Prepare various research activities related to Soil Science and Agricultural Chemistry field and compose manuscript i.e., synopsis related to particular topic.	SO1.1 SO1.2	Master Research 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		As mentioned in page number _ to _