Curriculum Book

and

Assessment and Evaluation Scheme

based on

Outcome Based Education (OBE)

and

Choice-Based Credit System (CBCS)

in

Master of Pharmacy

Pharmaceutical Chemistry (MPC)

2 Year Master Program

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

AKS University

Satna 485001, Madhya Pradesh, India

Faculty of Pharmaceutical Science & Technology
Rajiv Gandhi Institute of Pharmacy

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AKS University, Satna

FORWARDING

I am delighted to observe the updated curriculum of the Rajiv Gandhi institute of Pharmacy, for Master Program, which seamlessly integrates the most recent trends and corporate affairs in the field of Pharmaceutical industry and adheres to the guidelines set forth by PCI and UGC. The revised curriculum also thoughtfully incorporates the directives of NEP-2020.

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. Pharmacy program for implementation in the upcoming session.

Er. Anant Kumar Soni
Pro Chancellor & Chairman

AKS University, Satna

Date: 01 Aug 2023

FROM THE DESK OF THE VICE-CHANCELLOR

AKS University is currently undergoing a process store vamp its curriculum into an outcome-based 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, and sustainable goals.

I'm delighted to learn that the revised curriculum has been meticulously crafted by the Rajiv Gandhi Institute of Pharmacy, in consultation with an array of experts from the industry, research institutes, and academia. This curriculum effectively integrates the principles outlined in the NEP-2020 guidelines, as well as sustainable goals. It also adeptly incorporates the latest advancements in the field of business management.

Furthermore, the curriculum takes into account the specific needs of the Indian Industries, focusing on the creation of effective and efficient managers as well as entrepreneurs. This curriculum will not only imparts knowledge but also encourages student's independent thinking for potential enhancements in the area of Pharmaceutical science.

The curriculum goes beyond theoretical learning and embraces practical applications. To enhance students' skills, the curriculum integrates industrial visits, and On-Job Training experiences, research projects. This well- rounded approach ensures that students receive a comprehensive education, fostering their skill development and preparing them for success in the field of Pharmaceutical Science.

I am confident that the updated curriculum for Rajiv Gandhi Institute of Pharmacy will not only enhance students' managerial skills but also contribute significantly to their employability. During the process of revising the curriculum, I am pleased to observe that the Rajiv Gandhi Institute of Pharmacy has diligently adhered to the guidelines provided by the PCI& UGC. Additionally, they have maintained a total credit requirement of 100 for the M. Pharmacy program.

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

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

PROFESSOR B.A. CHOPADE

01 Aug 2023 *Vice-Chancellor*

PREFACE

As part of our commitment to ongoing enhancement, the Department of Rajiv Gandhi Institute of Pharmacy consistently reviews and updates its M. Pharmacy program curriculum every three years. Through this process, we ensure that the curriculum remains aligned with the latest managerial developments, as well as local and global industrial and social demands.

During this procedure, the existing curriculum for the M. Pharmacy Program undergoes evaluation by a panel of industry specialists, and academicians. 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 PCI model syllabus distributed in 2016. It seamlessly integrates the guidelines set forth by the Ministry of Higher Education, Government of India, through NEP- 2020, as well as the principles of Sustainable Development Goals. In order to foster the holistic skill development of students, a range of practical activities, including Industrial Visits, Project planning and execution, Report Writing, Seminars, and Industrial On-Job Training, have been incorporated. Furthermore, in alignment with AICTE's directives, the total credit allocation for the M Pharmacy program is capped at 100 credits.

The Master of Pharmacy program typically follows a credit-based system where each subject is assigned a certain number of credits. These credits reflect the workload and importance of the subject in the curriculum. The credit system is designed to ensure that students receive a balanced education that covers all the necessary areas of pharmaceutical science and practice.

Theory Courses these include lectures and tutorials on subjects like Pharmaceutics, Pharmaceutical Chemistry etc. Each theory course may carry 4 credits. Practical Courses: Laboratory sessions where students apply their theoretical knowledge. Practical courses usually carry fewer credits than theory courses, often around 6 credits. Core Subjects: Subjects that are fundamental to the field may have higher credit values. The importance of these subjects in the pharmaceutical industry cannot be overstated. They provide the foundational knowledge and skills necessary for various roles within the industry, such as:

Research and Development: Understanding the principles of drug action, formulation, and analysis is crucial for developing new medications. Quality Control and Assurance: Knowledge of analytical techniques and standards is essential for ensuring the safety and efficacy of pharmaceutical products.

Regulatory Affairs: Familiarity with pharmaceutical laws and regulations is important for compliance in the industry. Sales and Marketing: A strong grasp of pharmacology and therapeutics helps in effectively promoting pharmaceutical products. The total number of credits required to earn a M. Pharm may vary by institution but is typically around 100 credits.

In terms of career prospects, M. Pharm Post graduates can find opportunities in: Pharmaceutical Companies: In roles such as product development, production, quality control, and marketing. Regulatory Bodies: As drug inspectors or regulatory affairs specialists. Research Institutes: Engaging in cutting-edge research to develop new drugs and therapies. Healthcare Settings: As pharmacists in hospitals, clinics, and community pharmacies.

The subjects studied in the M. Pharm program are directly linked to the practical needs of the pharmaceutical industry, ensuring that graduates are well-prepared for Pharmaceutical industry extractions.

For each course, a thorough mapping of Course Outcomes, Program Outcomes, and Program 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 employ ability of the students.

PROFESSOR (Dr.) GP Richhariya
Dean (I/c)
Rajiv Gandhi Institute of Pharmacy
Faculty of Pharmaceutical Science & Technology
AKS University, Satna
01-August-2023

INTRODUCTION

Rajiv Gandhi Institute of Pharmacy was established in 2006, with the aim of providing quality education in pharmaceutical sciences. The college started with, Bachelor in Pharmacy 2006. The institution became a constituent unit of AKS University Satna, in 2012 and later on other some another courses were add like D. Pharm (2015), M. Pharm (2020), the Ph. D Programme (2021). All courses at the institute are recognized by the Pharmacy Council of India (PCI). The institute has a strong alumni association with over 1100 active members, who are placed globally at various positions in Pharma Marketing, Industrial, Regulatory and Entrepreneurial services.

VISION

To be established as globally recognized academic &research excellence to sustain theneeds of pharmacy profession and the society.

MISSION

M1: To promote & trained as per global requirement of social and pharmaceutical needs in pharmaceutical education and research through prescribed training programmes like B. Pharm., M. Pharm. and PhD with professional pharmaceutical education and effective competency.

M2: Achieve academic excellence in Pharmaceutical science through the innovative teaching learning process.

M3: To establish recognized research center for needs of pharmacy profession and the society.

M4: To Promote Skills through experimental knowledge as per global requirement of social and pharmaceutical industry.

Program Educational Objectives (PEOs)

PEO 1. Knowledge & Learning: To impart sound pharmaceutical knowledge, scientific principles to make them ever-ready for producing quality, safety and effective pharmaceutical formulations.

PEO 2. Expertise: To develop creative thinking, innovative strategies to overcome therapeutic challenges with customized medicines time to time for society.

PEO 3. Leadership: To produce skilled pharmaceutical professionals, leaders, policy makers and entrepreneurs for building healthy nation.

PEO 4. Employment & Entrepreneur: Enable graduate to succeed in technical or professional careers in various pharmaceutical industry/institute or health care system.

PEO 5. Professional Practice: Enable graduate to practice profession and adapt in a globe of constantly developing trends.

Program outcomes (POs)

1. **Scientific knowledge:** To apply the scientific and technological principles to design, develop effective pharmaceutical dosage forms and drug delivery systems for better therapeutic results.
2. **Technological applications:** To utilize technical knowledge and identify any factors affecting the quality of pharmaceutical production.
3. **Modern tool usage:** Learn, select, apply appropriate methods, procedures, resources, and modern pharmacy-related computing tools with an understanding of the limitations.
4. **Entrepreneurship:** To understand the basics of establishing and management of pharmaceutical enterprise.
5. **Practical skills:** To gain practical expertise in formulating and evaluating various novel drug release systems for minor ailments to major diseases.
6. **Applied science:** To employ contemporary scientific knowledge viz., pharmacology, biotechnology for designing disease-centric pharmaceuticals.
7. **Computational and statistical methodologies:** Applying and utilizing the statistical tools with the aid of computer software to optimize the formulations.
8. **Pharmaceutical ethics:** To respect personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural, personal variability in values, communication and lifestyles. Use ethical frameworks; apply ethical principles while making decisions and take responsibility for the outcomes associated with the decisions.
9. **Environment and sustainability:** To understand, protect and cooperate environmental concerns for sustaining biodiversity.
10. **Life-long learning:** To develop the habit of updating knowledge from time to time to meet industrial demands and social needs for having a fruitful career.

Program Specific outcomes (PSOs)

The Post Graduate shall be able to:

PSO 1. Analytical thinking and problem solving ability: Perform quality evaluation of pharmaceuticals, problems eg those in isolation, separation, synthesis, purification, identification and screening of chemical entities and provide principle-based solutions.

PSO 2. **Create and Innovate:** Design and synthesize new chemical entities and develop evaluation models using economic and eco-friendly strategies.

PSO 3. **Quality management and translational research:** Apply principles of quality through use of state of art tools and techniques for designing solutions to healthcare, societal and industrial problems.

Consistence/Mapping of PEOs with Mission of Department

PEO	M1	M2	M3	M4
PEO1	**2**	**3**	**3**	**2**
PEO2	**3**	**3**	**2**	**2**
PEO3	**3**	**2**	**3**	**3**
PEO4	**2**	**2**	**3**	**2**
PEO5	**3**	**2**	**2**	**3**

Correlation Indices: 1–Low, 2–Medium, 3–High

GENERAL COURSE STRUCTURE & THEME

1. Definition of Credit:

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

2. Range of Credits:

In the light of the fact that a typical Model Two-year Postgraduate master program in Pharmacy has about 100 credits, the total number of credits proposed for the two year Master of Pharmacy is kept as 100 considering NEP-20 and NAAC guideline.

3. Structure of PG Program in Pharmacy:

The structure of PG Program in Pharmacy shall have essentially the following categories of courses with the breakup of credits as given:

COMPONENTS OF CURRICULUM

(Program curriculum grouping based on course components)

Sr.No	CourseComponent	% of total number of Credits of the Program	Total number of Credits
1	Pharmacy Core Course (PCC)	52	52
2	Research Methodology and Biostatistics (RM)	4	4
3	Journal club (JC)	2	2
4	Discussion/Presentation(Proposal Presentation) (PP)	2	2
5	Research Work (RW)	30	30
6	Discussion/Final Presentation (FP)	3	3
7	Co-curricular Activities (CCA) (Attending Conference, Scientific Presentations and Other Scholarly Activities)	7	7
TOTAL		**100%**	**100**

GENERAL COURSE STRUCTURE AND CREDIT DISTRIBUTION
Curriculum of Master of Pharmacy

SEMESTER-I		SEMESTER-II	
Course Title	**Credit**	**Course Title**	**Credit**
Modern Pharmaceutical Analytical Techniques	4:0:0=4	Advanced Spectral Analysis	4:0:0=4
Advanced Organic Chemistry -I	4:0:0=4	Advanced Organic Chemistry -II	4:0:0=4
Advanced Medicinal chemistry	4:0:0=4	Computer Aided Drug Design	4:0:0=4
Chemistry of Natural Products	4:0:0=4	Pharmaceutical Process Chemistry	4:0:0=4
Pharmaceutical Chemistry Practical I	6:0:0=6	Pharmaceutical Chemistry Practical II	6:0:0=6
Seminar/Assignment	4:0:0=4	Seminar/Assignment	4:0:0=4
TOTAL CREDIT	**26**	**TOTAL CREDIT**	**26**
SEMESTER-III		**SEMESTER-IV**	
Course Title	**Credit**	**Course Title**	**Credit**
Research Methodology and Biostatistics*	4:0:0=4	Journal Club	1:0:0=1
Journal club	1:0:0=1	Research Work	16:0:0=16
Discussion / Presentation (Proposal Presentation)	2:0:0=2	Discussion/Final Presentation	3:0:0=3
Research Work	14:0:0=14		
TOTAL CREDIT	**21**	**TOTAL CREDIT**	**20**
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)			**7**

TotalCredit:100

GENERAL COURSE STRUCTURE AND CREDIT DISTRIBUTION

Program/Course credit structure As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, tutorial hours, practical classes, etc. are measured in terms of credits. On satisfactory completion of the courses, a candidate earns credits. The amount of credit associated with a course is dependent upon the number of hours of instruction per week in that course. Similarly, the credit associated with any of the other academic, co/extra-curricular activities is dependent upon the quantum of work expected to be put in for each of these activities per week.

A Credit assignment

Theory and Laboratory courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and /or tutorial (T) hours, and Practical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the numberof hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and tutorial hours, and for practical (laboratory) hours. Thus, for example, a theory course having three lectures and one tutorial per week throughout the semester carries a credit of 4. Similarly, a practical having 12 laboratory hours per week throughout semester carries a credit of 6.

Maximum credit requirements the maximum credit points required for award of a M. Pharm. is 100. These credits are divided into theory courses, Tutorials, Practical, and Project over the duration of forth semesters. The credits are distributed semester-wise as shown in Table. Courses generally progress in sequences, building competencies and their positioning indicates certain academic maturity on the part of the learners. Learners are expected to follow the semester-wise schedule of courses given in the syllabus.

Semester wise credits distribution
Table-

Semester	Credit Points
I	26
II	26
III	21
IV	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	Minimum=02 Maximum=07*
Total Credit Points	Minimum=95 Maximum=100*
*Credit Points for Co-curricular Activities	

Course code and definition:

L **T** **P** **C**	Lecture Tutorial Practical Credit
PCC	Pharmacy Core Course
RM	Research Methodology and Biostatistics
JC	Journal club
PP	Discussion/Presentation (Proposal Presentation)
RW	Research Work
FP	Discussion/Final Presentation
CCA	Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)

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.

MPC 101T, MPC 102T ---for first semester
MPC 201T, MPC 202T ---for second semester
MRM 301T---for third semester

CATEGORY-WISE COURSES

Pharmacy Core Course (PCC)

1. Number of Pharmacy Core Course (PCC): 12, Credits: 52

Sr. No	Code No	Subject	Semester	Credits
1	PCC	Modern Pharmaceutical Analytical Techniques	I	4
2	PCC	Advanced Organic Chemistry -I	I	4
3	PCC	Advanced Medicinal chemistry	I	4
4	PCC	Chemistry of Natural Products	I	4
5	PCC	Pharmaceutical Chemistry Practical I	I	6
6	PCC	Seminar/Assignment	I	4
7	PCC	Advanced Spectral Analysis	II	4
8	PCC	Advanced Organic Chemistry -II	II	4
9	PCC	Computer Aided Drug Design	II	4
10	PCC	Pharmaceutical Process Chemistry	II	4
11	PCC	Pharmaceutical Chemistry Practical II	II	6
12	PCC	Seminar/Assignment	II	4
Total Credits				**52**

2. Number of Research Methodology and Biostatistics (RM): 01,Credits: 4

Sr. No	Code No	Subject	Semester	Credits
1	RM	Research Methodology and Biostatistics	III	4
Total Credits				**4**

3. Number of Journal club (JC): 02,Credits: 2

Sr. No	Code No	Subject	Semester	Credits
1	JC	Journal club	III	1
2	JC	Journal club	IV	1
Total Credits				**2**

4. Number of Discussion/Presentation (Proposal Presentation) (PP): 01,Credits: 2

Sr. No	Code No	Subject	Semester	Credits
1	PP	Discussion/Presentation (Proposal Presentation)	III	2
Total Credits				**2**

5. Number of Research Work (RW): 02,Credits: 30

Sr. No	Code No	Subject	Semester	Credits
1	RW	Research Work	III	14
2	RW	Research Work	IV	16
Total Credits				**30**

6. Number of Discussion/Final Presentation (FP): 02,Credits: 30

Sr. No	Code No	Subject	Semester	Credits
1	FP	Discussion/Final Presentation	IV	3
Total Credits				**3**

7. Number of Co-curricular Activities (CCA): 01,Credits: 7

Sr. No	Code No	Subject	Semester	Credits
1	CCA	Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)	-	7
Total Credits				**7**

INDUCTION PROGRAM

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

1. Physical activity
2. Creative Arts
3. Universal Human Values
4. Literary
5. Proficiency Modules
6. Lectures by Eminent speakers
7. Visits to local Areas
8. Familiarization to Dept./Branch & Innovations

MANDATORY VISITS/WORKSHOP/EXPERT LECTURES

1. It is mandatory to arrange one industrial visit every semester for the students.
2. It is mandatory to organize at least one expert lecture per semester for each branch by expert resource persons from industry.

EVALUATION SCHEME

1. **For Theory Courses:**
    - The weightage of Internal assessment is 25% and;
    - End Semester Exam is 75%. The student has to obtain at least 50% marks individually both in internal assessment and end semester Exams to pass.
2. **For Practical Courses:**
    - The weightage of Internal assessment is 33.33% and;
    - End Semester Exam is 66.66%. The student has to obtain at least 50% marks individually both in internal assessment and end semester exams to pass.
3. **For Presentation/Journal Club/Seminar etc.:** Evaluation is based on work done, quality of report, performance in viva-voce, presentation etc.

Semester	**Lecture**	**Practical**	**Seminar/Assignment**	**Journal Club**	**Discussion/Presentation (Proposal Presentation)**	**Research Work**	**Discussion/Final Presentation**	**Total Hours**	**No of Hours Per Sem.**	**Total Credit**
Semester– I	16	12	7	-	-	-	-	35	35 x15=525	26
Semester– II	16	12	7	-	-	-	-	35	35 x15=525	26
Semester– III	4	-	-	1	2	28	-	35	35 x15=525	21
Semester– IV	-	-	-	1	-	31	3	35	35 x15=525	20
Co-curricular Activities (Attending Conference, Scientific Presentations and Other Scholarly Activities)									-	7
Total	**36**	**24**	**14**	**2**	**2**	**59**	**3**	**140**	**2100**	**100**

SEMESTR WISE COURSE STRUCTURE

Table-I: Course of study for M. Pharm. (Pharmaceutical Chemistry) semester I

Course Code	Course	Credit Hours	Credit Points	Hrs./wk	Marks
MPC101T	Modern Pharmaceutical Analytical Techniques	4	4	4	100
MPC102T	Advanced Organic Chemistry -I	4	4	4	100
MPC103T	Advanced Medicinal chemistry	4	4	4	100
MPC104T	Chemistry of Natural Products	4	4	4	100
MPC105P	Pharmaceutical Chemistry Practical I	12	6	12	150
--	Seminar/Assignment	7	4	7	100
Total		35	26	35	650

Table-II: Course of study for M. Pharm. (Pharmaceutical Chemistry) semester II

Course Code	Course	Credit Hours	Credit Points	Hrs./wk	Marks
MPC201T	Advanced Spectral Analysis	4	4	4	100
MPC202T	Advanced Organic Chemistry -II	4	4	4	100
MPC203T	Computer Aided Drug Design	4	4	4	100
MPC204T	Pharmaceutical Process Chemistry	4	4	4	100
MPC205P	Pharmaceutical Chemistry Practical II	12	6	12	150
--	Seminar/Assignment	7	4	7	100
Total		35	26	35	650

Table-III: Course of study for M. Pharm. (Pharmaceutical Chemistry) semester III

Course Code	Course	Credit Hours	Credit Points
MRM 301T	Research Methodology and Biostatistics*	4	4
MPC302	Journal club	1	1
MPC303	Discussion / Presentation (Proposal Presentation)	2	2
MPC304	Research Work	28	14
Total		35	21

* Non University Exam

Table-IV: Course of study for M. Pharm. (Pharmaceutical Chemistry) semester IV

Course Code	Course	Credit Hours	Credit Points
MPC401	Journal Club	1	1
MPC402	Research Work	31	16
MPC403	Discussion/Final Presentation	3	3
Total		35	20

A K S University

Faculty of Pharmaceutical Science & Technology
Rajiv Gandhi Institute of Pharmacy
Curriculum of M. Pharmacy (Pharmaceutical Chemistry-MPC) Program
(Revised as on 01 August 2023)
Semester-I

Course Code: MPC 101T
Course Title: Modern Pharmaceutical Analytical Techniques

Pre-requisite: Student should have basic knowledge of Spectroscopy,Ultraviolet and Visible radiation, Infra red rays, Chromatography.

Rationale/Objectives:

Up on completion of the course student shall be able to understand

- To understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
- To understand the chromatographic separation and analysis of drugs.
- To Perform quantitative & qualitative analysis of drugs using various analytical instruments.
- To analysis of various drugs in single and combination dosage forms.

Course Out comes:

CO-MPC 101-1: To understand the basic principle, instrumentation & application of UV-Visible spectroscopy, IR spectroscopy, Spectroflourimetry, Flame emission spectroscopy & Atomic absorption spectroscopy.
CO-MPC 101-2: To acquired the knowledge of principle, instrumentation & application of NMR spectroscopy.
CO-MPC 101-3: To understanding the Mass Spectroscopy.
CO-MPC 101-4: To familiarize with basic concept of chromatography & various different types of Chromatography.
CO-MPC 101-5: To comprehend the basic concepts of Electrophoresis & X ray Crystallography.
CO-MPC 101-6: To understand the basic principle, instrumentation & application of Potentiometry & Thermal Techniques.

Scheme of Studies

Course code	Title of the course	Program Name	Total Number of contact hours/Week					Credit
			Class room Instruction (A) Lecture	Practical (P)	SW	SL	Total Hours (H)	
MPC 101T	Modern Pharmaceutical Analytical Techniques Theory	M. Pharmacy	4	-	1	1	6	4

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

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

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

SL: Self Learning, Credits

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

Theory Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 101T	Modern Pharmaceutical Analytical Techniques	10	15	1 Hr	25	75	3 Hrs	100

Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

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.

Unit I

CO-MPC 101-1: To understand the basic principle, instrumentation & application of UV-Visible spectroscopy, IR spectroscopy, Spectroflourimetry, Flame emission spectroscopy & Atomic absorption spectroscopy.

Item	Approx Hrs
Lecture	10
Practical (P)	0
SW	1
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO1.1:** UV-Visible spectroscopy **SO1.2:** IR spectroscopy **SO1.3:** Spectroflourimetry **SO1.4:** Flame emission spectroscopy **SO1.5:** Atomic absorption spectroscopy	**NA**	**1.1:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy **1.2:** Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy **1.3:** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer **1.4:** Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation **1.5:** Theory of Fluorescence, Factors affecting Fluorescence, Quenchers **1.6:** Instrumentation and Applications of fluorescence spectrophotometer **1.7:** Principle, Instrumentation of Flame emission spectroscopy **1.8:** Interferences and Applications of Flame emission spectroscopy **1.9:** Principle, Instrumentation of Atomic absorption Spectroscopy **1.10:** Interferences and Applications of Atomic absorption Spectroscopy	**1.1:** Electronic transitions, chromophores, auxochromes in UV Visible spectroscopy

Suggested Assignments:

1. Explain Beer and Lambert's law.

Unit II

CO-MPC 101-2: To acquired the knowledge of principle, instrumentation & application of NMR spectroscopy.

Item	Approx Hrs
Lecture	10
Practical (P)	0
SW	1
SL	1
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO2.1:** Principle of NMR **SO2.2:** Instrumentation of IR **SO2.3:** FT-NMR & 13C NMR **SO2.4**: Applications of NMR	**NA**	**2.1:** Quantum numbers and their role in NMR **2.2:** Principle & Instrumentation of NMR **2.3:** Solvent requirement in NMR & Relaxation process **2.4:** NMR signals in various compounds **2.5:** Chemical shift **2.6:** Factors influencing chemical shift **2.7:** Spin-Spin Coupling & Coupling constant **2.8:** Nuclear magnetic double resonance **2.9:** Brief outline of principles of FT-NMR and 13C NMR **2.10:** Applications of NMR spectroscopy	**2.1:** Applications of NMR & Principles of FT-NMR & 13C NMR

Suggested Assignments:

1. Write note on factors affecting vibrations.

Unit III
CO-MPC 101-3: To understanding the Mass Spectroscopy.

Item	Approx Hrs
Lecture	10
Practical (P)	0
SW	1
SL	2
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO3.1:** Principle & Theory of Mass Spectroscopy **SO3.2:** Instrumentation of Mass Spectroscopy **SO3.3:** Mass fragmentation and its rules **SO3.4:** Meta stable ions	**NA**	**3.1:** Principle & Theory of Mass Spectroscopy **3.2:** Instrumentation of Mass Spectroscopy **3.3:** Different types of ionization like electron impact & Chemical **3.4:** Field, FAB and MALDI **3.5:** APCI, ESI **3.6:** APPI Analyzers of Quadrupole and Time of Flight **3.7:** Mass fragmentation and its rules **3.8:** Meta stable ions **3.9:** Isotopic peaks **3.10:** Applications of Mass spectroscopy	**3.1:** Theory of Mass Spectroscopy **3.2:** Applications of Mass spectroscopy

Suggested Assignments:
1. Explain FAB.

Unit IV

CO-MPC 101-4: To familiarize with basic concept of Gas chromatography & Highperformance liquid chromatography (HPLC).

Item	Approx Hrs
Lecture	10
Practical (P)	0
SW	1
SL	2
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction(CI)	Self Learning (SL)
Theory **SO4.1:** Gas chromatography. **SO4.2:** High performance liquid chromatography (HPLC).	**NA**	**4.1:** Introduction, theory of GC **4.2:** Instrumentation, derivatization, temperature **4.3:** Programming of GC **4.4:** Advantages, disadvantages of GC **4.5:** Applications of GC **4.6:** Introduction to HPLC **4.7:** Theory of HPLC **4.8:** Instrumentation ofHPLC **4.9:** Advantages and applications of HPLC **4.10:** Introduction to Chromatography	**4.1:** Introduction to GC **4.2:** Introduction toHPLC

Suggested Assignments:

1. Explain GC.

Unit V

CO-MPC 101-5: To comprehend the basic concepts of Ion exchange chromatography, Gel chromatography & Affinity chromatography.

Item	Approx Hrs
Lecture	10
Practical (P)	0
SW	1
SL	2
Total	13

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO5.1:** Ion exchange chromatography **SO5.2:**Gel chromatography **SO5.3:** Affinity chromatography	**NA**	**5.1:** Introduction, classification, ion exchange resins of Ion exchange chromatography **5.2:** Mechanism of ion exchange process, factors affecting ion exchange of Ion exchange chromatography **5.3:** Methodology and applications of Ion exchange chromatography **5.4:** Introduction, theory of Gel chromatography **5.5:** Instrumentation and applications of Gel chromatography **5.6:** Introduction, theory of Affinity chromatography **5.7:** Instrumentation and applications of Affinity chromatography **5.8:** Production of X-rays **5.9:** X-rays powder techniques **5.10:** Applications of X-ray diffraction	**5.1:** Mechanism of ion exchange process **5.2:**Factors affecting ion exchange

Suggested Assignments:

1. Explain ion exchange chromatography.

Unit VI

CO-MPC 101-6: To understand the basic principle, instrumentation & application of Potentiometry & Thermal Techniques.

Item	Approx Hrs
Lecture	10
Practical (P)	0
SW	2
SL	2
Total	17

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO6.1:** Potentiometry **SO6.2:** Hyper DSC, experimental parameters **SO6.3:** TGA	**NA**	**6.1:** Potentiometry: Principle, working. **6.2:** Ion selective Electrodes and Application of potentiometry **6.3:** Thermal Techniques: Principle, thermal transitions. **6.4:** Instrumentation (Heat flux and power-compensation and designs), Modulated DSC. **6.5:** Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates. **6.6:** Resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications. **6.7:** Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages. **6.8:** Pharmaceutical applications, derivative differential thermal analysis (DDTA). **6.9:** TGA: Principle, instrumentation, factors affecting results, **6.10:** Advantage and disadvantages, pharmaceutical applications.	**6.1:** Potentiometry: Principle,working, uses & importance in current circumstances **6.2:** TGA: Principle, instrumentation, factors affecting results

Suggested Assignments:

1. Explain potentiometry: Principle & working.
2. Explain Differential Thermal Analysis.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (CL)	Laboratory Instructions (LI)	Sessional Work (SW)	Self Learning (SL)	Total Hour (CL+SW+ SL+LI)
CO-MPC 101-1: To understand the basic principle, instrumentation & application of UV Visible spectroscopy & Fluorimetry.	10	0	1	1	12
CO-MPC 101-2: To acquired the knowledge of principle, instrumentation & application of NMR spectroscopy.	10	0	1	1	12
CO-MPC 101-3: To understanding the Mass Spectroscopy.	10	0	1	2	13
CO-MPC 101-4: To familiarize with basic concept of chromatography & various different types of Chromatography.	10	0	1	2	13
CO-MPC 101-5: To comprehend the basic concepts of Ion exchange chromatography, Gel chromatography & Affinity chromatography.	10	0	1	2	13
CO-MPC 101-6: To understand the basic principle, instrumentation & application of Potentiometry & Thermal Techniques.	10	0	2	2	14
Total Hours	**60**	**0**	**7**	**10**	**77**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

Course Outcome	Unit Titles	Marks Distribution			Total Marks
		A	C	E	
CO-MPC 101T-1:	To understand the basic principle, instrumentation & application of UV Visible spectroscopy & Fluorimetry.	08	06	01	15
CO-MPC 101T-2:	To acquired the knowledge of principle, instrumentation & application of NMR spectroscopy.	12	07	01	20
CO-MPC 101T-3:	To understanding the Mass Spectroscopy.	08	06	02	16
CO-MPC 101T-4:	To familiarize with basic concept of Gas chromatography & High performance liquid chromatography (HPLC).	10	02	03	15
CO-MPC 101T-5:	To comprehend the basic concepts of Ionexchange chromatography, Gel Chromatography & Affinity chromatography.	10	07	03	20
CO-MPC 101T-6:	To understand the basic principle, instrumentation & application of Potentiometry & Thermal Techniques.	10	02	02	14
Total		**58**	**30**	**12**	**100**

Legend: A: Analyze, C: create, E: Evaluate

The end of semester assessment for Modern Pharmaceutical Analytical Techniques will be held with written examination of 75 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:

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

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	Spectrometric Identification of Organic compounds	Robert M Silverstein	John Wiley & Sons	Sixth edition, 2004
2	Principles of Instrumental Analysis Doglas A Skoog	F. James Holler, Timothy A. Nieman	Cengate india private limlted	7th edition, 2020
3	Instrumental methods of analysis	Willards	CBS publishers	7th edition, 2023
4	Practical Pharmaceutical Chemistry	Beckett and Stenlake, Vol II,	CBS Publishers	4th edition, New Delhi, 2023
5	Organic Spectroscopy	William Kemp	ELBS	3rd edition, 2022
6	Quantitative Analysis of Drugs in Pharmaceutical formulation	P D Sethi	CBS Publishers	4th Edition, New Delhi, 2022
7	Pharmaceutical Analysis-Modern methods Part B	J W Munson, Volume-11	CRC Press	2nd edition 2012

Curriculum Development Team:

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Course Outcome & Program Outcome Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	Scientific Knowledge	Technological Application	Modern tool usage	Entrepreneur ship	Practical Skill	Applied Science	Computational and Statistical methodologies	Pharmaceutical Ethics	Environment and sustainability	Life-long learning	Analytical thinking and problem solving ability	Create and Innovate	Quality management and translational research
CO-MPC 101T-1: UV Visible spectroscopy	3	2	3	1	3	2	1	3	2	3	1	2	3
CO-MPC 101T-2: NMR spectroscopy	2	2	3	2	1	3	2	2	1	3	1	1	1
CO-MPC 101T-3: Mass Spectroscopy	1	2	1	3	3	2	3	3	2	2	1	1	3
CO-MPC 101T-4: Gas chromatography & High performance liquid chromatography (HPLC).	2	1	3	2	2	3	2	2	2	3	2	2	1
CO-MPC 101T-5: Chromatography	3	2	2	1	3	2	3	3	1	2	1	2	1
CO-MPC 101T-6: Potentiometry & Thermal Techniques	3	2	3	1	3	2	1	3	2	3	2	1	2

Legend: 1- Low, 2-Medium, 3-High

Course Curriculum Mapping

POs & PSOs No.	COs No. & Title	SOs No.	Class Room Instructions	Laboratory Instructions	Self learning
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 101T-1:** To understand the basic principle, instrumentation & application of UV Visible spectroscopy & Fluorimetry	SO1.1 SO1.2 SO1.3 SO1.4 SO1.5	1.1,1.2,1.3,1.4,1.5,1.6, 1.7,1.8,1.9,1.10	--	SL-1.1 SL-1.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 101T-2:** To acquired the knowledge of principle, instrumentation & application of NMR spectroscopy.	SO2.1 SO2.2 SO2.3 SO2.4	2.1,2.2,2.3,2.4,2.5,2.6, 2.7,2.8,2.9,2.10	--	SL-2.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 101T- 3:** To understanding the Mass Spectroscopy.	SO3.1 SO3.2 SO3.3 SO3.4	3.1,3.2,3.3,3.4,3.5,3.6, 3.7,3.8,3.9,3.10	--	SL3.1 SL3.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 101T-4:** To familiarize with basic concept of Gas chromatography & High performance liquid chromatography (HPLC).	SO4.1 SO4.2	4.1,4.2,4.3,4.4,4.5,4.6, 4.7,4.8	--	SL-4.1 SL-4.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 101T-5:** To understand the Synthon approach and retrosynthesis applications.	SO5.1 SO5.2 SO5.3	5.1,5.2,5.3,5.4,5.5,5.6, 5.7	--	SL-5.1 SL-5.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 101T-6:** To understand the basic principle, instrumentation & application of Potentiometry & Thermal Techniques.	SO6.1 SO6.2 SO6.3	6.1,6.2,6.3,6.4,6.5,6.6, 6.7,6.8,6.9,6.10	--	SL-6.1 SL-6.2

A K S University

Faculty of Pharmaceutical Science & Technology
Rajiv Gandhi Institute of Pharmacy
Curriculum of M. Pharmacy (Pharmaceutical Chemistry-MPC) Program
(Revised as on 01 August 2023)
Semester-I

Course Code: MPC 102T

Course Title: Advanced Organic Chemistry - I

Pre-requisite: Student should have basic knowledge of elementary organic and physical chemistry. The mechanisms of organic reactions, structure of organic molecules, and theories of reactivity.

Rationale/Objectives: Upon completion of course, the student shall be to understand

- The principles and applications of reterosynthesis.
- The mechanism & applications of various named reactions.
- The concept of disconnection to develop synthetic routes for small.
- Target molecule.
- The various catalysts used in organic reactions.
- The chemistry of heterocyclic compounds.

Course Out comes:
CO-MPC 102T-1: To understand the basic aspects of organic chemistry and addition reactions.
CO-MPC 102T-2: To understand the Study of mechanism and synthetic applications of following named reactions.
CO-MPC 102T-3: To understand the Synthetic Reagents & Applications and Protecting groups.
CO-MPC 102T-4: To understand the Heterocyclic Chemistry.
CO-MPC 102T-5: To understand the Synthon approach and retrosynthesis applications.

Scheme of Studies

Course code	Title of the course	Program Name	Total Number of contact hours/Week					Credit
			Class room Instruction (A) Lecture	Practical (P)	SW	SL	Total Hours (H)	
MPC 102T	Advanced Organic Chemistry - I	M. Pharmacy	4	-	1	1	6	4

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others)
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations usingdifferent instructional strategies)
SW: Sessional Work (includes assignment**,** seminar, mini project etc.)
SL: Self Learning, Credits
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcomeof Learning

Theory Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 102T	ADVANCED ORGANIC CHEMISTRY - I	10	15	1 Hr	25	75	3 Hrs	100

Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

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.

Unit I

CO-MPC 102T-1: To understand the basic aspects of organic chemistry and addition reactions.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO1.1:** Basic aspects of organic chemistry **SO1.2:** Addition reactions	**NA**	**1.1:** Detail about Organic intermediates carbocations and Their method of formation, stability and synthetic applications **1.2:** Detail about Organic intermediates carbanions and Their method of formation, stability and synthetic applications **1.3:** Detail about Organic intermediates free radicals and Their method of formation, stability and synthetic applications **1.4:** Detail about Organic intermediates carbenes Their method of formation, stability and synthetic applications **1.5:** Detail about Organic intermediates nitrenes Their method of formation, stability and synthetic applications **1.6:** Types of reaction mechanisms and methods of determining them **1.7:** Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations **1.8:** Explain Nucleophilic uni- and bimolecular reactions SN1 Addition reactions **1.9:** Explain Nucleophilic uni- and bimolecular reactions SN2 Addition reactions **1.10:** Explain Elimination reactions (E1 Hoffman rules) **1.11:** Explain Elimination reactions (E2 Saytzeff's rules) Addition reactions **1.12:** Explain Rearrangement reaction	**1.1:** To study the Basic Aspects of Organic Chemistry and Addition reactions.

Suggested Assignments:

1. Explain Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule).
2. Write the detail about Organic intermediates: Carbocations, carbanions.

Unit II

CO-MPC 102T-2: To understand the Study of mechanism and synthetic applications of following named Reactions.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO2.1:** Study of mechanism and synthetic applications of various named reactions	**NA**	**2.1:** Study of mechanism and synthetic applications of Ugi reaction **2.2:** Brook rearrangement **2.3:** Study of mechanism and synthetic applications of Ullmann coupling reactions **2.4:** Study of mechanism and synthetic applications of Dieckmann Reaction **2.5:** Doebner-Miller Reaction **2.6:** Sandmeyer Reaction **2.7:** Mitsunobu reaction **2.8:** Mannich reaction **2.9:** Vilsmeyer-Haack Reaction **2.10:** Sharpless asymmetric epoxidation, Baeyer-Villiger Oxidation **2.11:** Shapiro & Suzuki reaction **2.12:** Ozonolysis and Michael addition reaction	**2.1:** Study of mechanism and synthetic applications of various named reactions

Suggested Assignments:

1. Explain Reaction Doebner-Miller Reaction, Sandmeyer.
2. Explain Ugi reaction, Brook rearrangement.

Unit III

CO-MPC 102T-3: To understand the Synthetic Reagents & Applications and Protecting groups.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO3.1:** Synthetic Reagents & Applications **SO3.2:** Protecting groups	**NA**	**3.1:** Synthetic Reagents & Applications of Aluminiumisopropoxide N-bromosuccinamide **3.2:** Synthetic Reagents & Applications of diazomethane, Dicyclohexylcarbodimide **3.3:** Synthetic Reagents & Applications of Wilkinson reagent, Witting reagent **3.4:** Synthetic Reagents & Applications of Osmium tetroxide, titanium chloride **3.5:** Synthetic Reagents & Applications of diazopropane, diethyl Azodicarboxylate **3.6:** Synthetic Reagents & Applications of Triphenylphosphine, Benzotriazol-1-yloxy) tris (dimethylamino) phosphonium hexafluoro-phosphate (BOP) **3.7:** Role of protection in organic synthesis **3.8:** Protection for the hydroxyl group, including 1,2-and1,3-diols **3.9:** Protection for the ethers, esters, carbonates, cyclic acetals & ketals **3.10:** Protection for the Carbonyl Group: Acetals and Ketals **3.11:** Protection for the Carboxyl Group: amides and hydrazides, Esters **3.12:** Protection for the Amino Group and Amino acids: carbamates and amides	**3.1:** Synthetic Reagents & Applications

Suggested Assignments:

1. Explain Synthetic Reagents & Applications Aluminiumisopropoxide, N-bromosuccinamide.
2. Write the Protection for the Carbonyl Group: Acetals and Ketals.

Unit IV

CO-MPC 102T-4: To understand the Heterocyclic Chemistry.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO4.1:** Heterocyclic Chemistry	**NA**	**4.1:** Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five **4.2:** Six membered and fused hetrocyclics such as Debus-Radziszewski imidazole synthesis **4.3:** Bernthsen Acridine Synthesis **4.4:** Smiles rearrangement and Traube purine synthesis **4.5:** Synthesis of few representative drugs containing these hetrocyclic nucleus such as Ketoconazole, Metronidazole, Miconazole, celecoxib **4.6:** antipyrin, Metamizole sodium, Terconazole, Alprazolam **4.7:** Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine **4.8:** Quinine, Chloroquine **4.9:**Quinacrine, Amsacrine **4.10:**Prochlorpherazine, Promazine **4.11:** Chlorpromazine,Theophylline **4.12:** Mercaptopurine and Thioguanine	**4.1:** Heterocyclic Chemistry. **4.2:** Synthesis of few representative drugs containing these heterocyclic nucleus.

Suggested Assignments:

1. Write Synthesis of Alprazolam, Triamterene, Sulfamerazine.

Unit V

CO-MPC 102T-5: To understand the synthon approach and retrosynthesis applications.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	18

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO5.1:** Synthon approach and retrosynthesis applications.	**NA**	**5.1:** Basic principles, terminologies and advantages of retrosynthesis **5.2:** guidelines for dissection of molecules **5.3:** Functional group interconvertion and addition (FGI and FGA) **5.4:** C-X disconnections **5.5:** C-C disconnections **5.6:** alcohols and carbonyl compounds **5.7:** 1,2-, 1,3 -difunctionalized Compounds **5.8:** 1,4-, 1,5 difunctionalized Compounds **5.9:** 1,6-difunctionalized Compounds **5.10:** Strategies for synthesis of three membered ring **5.11:** Strategies for synthesis of four, five membered ring **5.12:** Strategies for synthesis of six-membered ring	**5.1:** Basic principles, terminologies and advantages of Retrosynthesis **5.2:** C-X disconnections; C-C disconnections – alcohols and carbonyl compounds

Suggested Assignments:

1. Explain strategies for synthesis of three, four, five and six-membered ring.

Brief of Hours suggested for the Course Outcome

Course Out comes	Class Lecture (Cl)	(LI)	Sessional Work (SW)	Self Learning (Sl)	Total Hour (Cl+SW+ Sl+LI)
CO-MPC 102T-1: To understand the Basic Aspects of Organic Chemistry and Addition reactions.	12	0	2	1	15
CO-MPC 102T-2: To understand the Study of mechanism and synthetic applications of following named Reactions.	12	0	2	1	15
CO-MPC 102T-3: To understand the Synthetic Reagents & Applications and Protecting groups.	12	0	2	1	15
CO-MPC 102T-4: To understand the Heterocyclic Chemistry.	12	0	1	2	15
CO-MPC 102T-5: To understand the Synthon approach and retrosynthesis applications.	12	0	1	2	15
Total Hours	**60**	**0**	**8**	**7**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

Course Outcome	Unit Titles	Marks Distribution			Total Marks
		A	C	E	
CO-MPC 102T-1:	To understand the Basic Aspects of Organic Chemistry and Addition reactions.	08	07	07	22
CO-MPC 102T-2:	To understand the Study of mechanism and synthetic applications of following named Reactions.	08	06	02	16
CO-MPC 102T-3:	To understand the Synthetic Reagents & Applications and Protecting groups.	12	07	01	20
CO-MPC 102T-4:	To understand the Heterocyclic Chemistry.	11	06	03	20
CO-MPC 102T-5:	To understand the Synthon approach and retrosynthesis applications.	08	07	02	22
Total		**47**	**33**	**20**	**100**

Legend: A: Analyze, C: create, E: Evaluate

The end of semester assessment for Advanced Organic Chemistry - I will be held with written examination of 75 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, Face book, Twitter, Whats app, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	"Advanced Organic chemistry, Reaction, Mechanisms and Structure".	J March, John Wiley and Sons.	New York.	2020
2	"Mechanism and Structure in Organic Chemistry".	ES Gould, Hold Rinchart and Winston,	New York.	
3	"Organic Chemistry".	Clayden, Greeves, Warren and Woihers.	Oxford University Press.	2001.
4	"Organic Chemistry".	I.L. Finar. ELBS	Pearson Education Lts, Dorling Kindersley 9India) Pvt. Ltd.,	Vol I and II.
5	A guide to mechanisms in Organic Chemistry.	Peter Skyes	(Orient Longman, New Delhi).	
6	Reactive Intermediates in Organic Chemistry.	Tandom and Gowel	Oxford & IBH Publishers.	
7	Combinational Chemistry – Synthesis and applications.	Stephen R Wilson & Anthony W Czarnik, Wiley – Blackwell.	-	-
8	Organic Chemistry.	Carey	(Viva Books Pvt. Ltd.)	5th Edition
9	Principles of Organic Synthesis	ROC Norman and JM Coxan, Nelson Thorns	-	
10	Organic Synthesis - Special Techniques	VK Ahluwalia and R Agarwal	Narosa Publishers	-
11	Organic Reaction Mechanisms	VK Ahluwalia and RK Parashar	Narosa Publishers	IVth Edtn

Curriculum Development Team:

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3. **Mr. Ashutosh Jain,** Assistant professor, AKS University, Rajiv Gandhi Institute of Pharmacy

Course Outcome & Program Outcome Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	Scientific Knowledge	Technological Application	Modern tool usage	Entrepreneur ship	Practical Skill	Applied Science	Computational and Statistical methodologies	Pharmaceutical Ethics	Environment and sustainability	Life-long learning	Analytical thinking and problem solving ability	Create and Innovate	Quality management and translational research
CO-MPC 102T-1: Organic Chemistry	3	2	3	1	3	2	1	3	2	3	1	2	3
CO-MPC 102T-2: Mechanism and synthetic applications	2	2	3	2	1	3	2	2	1	3	1	1	1
CO-MPC 102T-3: Synthetic Reagents	1	2	1	3	3	2	3	3	2	2	1	1	3
CO-MPC 102T-4: Heterocyclic Chemistry	2	1	3	2	2	3	2	2	2	3	2	2	1
CO-MPC 102T-5: Retrosynthesis applications	3	2	2	1	3	2	3	3	1	2	1	2	1

Legend: 1- Low, 2-Medium, 3-High

Course Curriculum Mapping

POs & PSOs No.	COs No. & Title	SOs No.	Class Room Instructions	Laboratory Instructions	Self learning
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 102T-1:** To understand the Basic Aspects of Organic Chemistry and Addition reactions.	SO1.1 SO1.2	1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11,1.12	--	SL-1.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 102T-2:** To understand the Study of mechanism and synthetic applications of following named Reactions	SO2.1	2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9,2.10,2.11,2.12	--	SL-2.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 102T-3:** To understand the Synthetic Reagents & Applications and Protecting groups	SO3.1 SO3.2	3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12	--	SL-3.1 SL-3.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 102T-4:** To understand the Heterocyclic Chemistry.	SO4.1	4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12	--	SL-4.1 SL-4.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 102T-5:** To understand the Synthon approach and retrosynthesis applications	SO5.1	5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11,5.12	--	SL-5.1 SL-5.2

Course Code: MPC 103T

Course Title: Advanced Medicinal Chemistry

Pre-requisite: Student should have basic knowledge of the subject is designed to provide detail knowledge about on the current state of the art techniques involved in computer assisted drug design.

Rationale/Objective s: Upon completion of course, the student shall be to understand

- Different stages of drug discovery.
- Role of medicinal chemistry in drug research.
- Different techniques for drug discovery.
- Various strategies to design and develop new drug like molecules for biological targets.
- Study of peptidomimetics.

Course Out comes:

CO-MPC 103T-1: To understand the different stages of drug discovery.
CO-MPC 103T-2: To understand the Study of Role of medicinal chemistry in drug research.
CO-MPC 103T-3: To understand the different techniques for drug discovery**.**
CO-MPC 103T-4: To understand the various strategies to design and develop new drug like molecules for biological targets.
CO-MPC 103T-5: To understand the in study of Peptidomimetics.

Scheme of Studies

Course code	Title of the course	Program Name	Total Number of contact hours/Week					Credit
			Classroom Instruction (A) Lecture	Practical (P)	SW	SL	Total Hours (H)	
MPC 103T	Advanced Medicinal Chemistry	M. Pharmacy	3	-	1	1	6	4

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others)
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations usingdifferent instructional strategies)
SW: Sessional Work (includes assignment**,** seminar, mini project etc.)
SL: Self Learning, Credits
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcomeof Learning

Theory Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 103T	Advanced Medicinal Chemistry	10	15	1 Hr	25	75	3 Hrs	100

Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

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.

Unit I

CO-MPC 103T-1: To understand the different stages of drug discovery.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO1.1:** Drug discovery **SO1.2:** Biological drug targets	**NA**	**1.1:** Drug discovery **1.2:** Stages of drug discovery **1.3:** lead discovery **1.4:** Identification of drug targets **1.5:** Validation of drug targets **1.6:** Diversity of drug targets **1.7:** Biological drug targets **1.8:** Receptors of drug receptor interaction **1.9:** Types of drug receptor interaction **1.10:** Binding and activation theories of drug receptor interaction **1.11:** Agonists Vs antagonists **1.12:** Artificial enzymes	**1.1:** Diversity of drug targets **1.2:** Drug receptor interactions

Suggested Assignments:

1. Write the detail about theories of drug receptor interaction.

Unit II

CO-MPC 103T-2: To understand the Study of Role of medicinal chemistry in drug research.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO2.1:** Prodrug Design and Analog design **SO2.2:** Combating drug resistance **SO2.3:** Introduction of Analog Design	**NA**	**2.1:** Basic concept of Prodrug Design **2.2:** Carrier linked prodrugs/ Bioprecursors **2.3:** Prodrugs of functional group **2.4:** Drug absorption and distribution **2.5:** Site specific drug delivery **2.6:** Sustained drug action **2.7:** Rationale of prodrug design and practical consideration of prodrug design **2.8:** Causes for drug resistance **2.9:** Genetic principles of drug **2.10:** Classical & Non classical, Bioisosteric replacement strategies **2.11:** Importance of statistical parameters **2.12:** Geometric of a lead molecule, variation in inter atomic distance	**2.1:** Prodrugs to improve patient acceptability **2.2:** Strategies to combat drug resistance in antibiotics and anticancer therapy

Suggested Assignments:

1. Explain Site specific drug delivery.
2. Write the detail about importance of statistical parameters.

Unit III

CO-MPC 103T-3: To understand the different techniques for drug discovery.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO3.1:** Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of various class of Drug. **SO3.2:** Stereochemistry and Drug action.	NA	**3.1:** Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of Anti-hypertensive drugs **3.2:** Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of Psychoactive drug **3.3:** Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of Anticonvulsant drugs **3.4:** Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of H1 & H2 receptor antagonist **3.5:** Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of COX1 & COX2 inhibitors **3.6:** Systematic study SAR, MOA and synthesis of new generation molecules of Adrenergic & Cholinergic age **3.7:** Realization that stereo selectivity is a pre-requisite for evolution **3.8:** Case study **3.9:** Enantio selectivity in drug adsorption **3.10:** Enantio selectivity in drug metabolism **3.11:** Enantio selectivity in drug distribution **3.12:** Enantio selectivity in drug elimination	**3.1:** Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of Antineoplastic and Antiviral agents **3.2:** Role of chirality in selective and specific therapeutic agents

Suggested Assignments:

1. Explain Systematic study and synthesis of new generation molecules of H1 & H2 receptor antagonist.

Unit IV

CO-MPC 103T-4: To understand the various strategies to design and develop new drug like molecules for biological targets.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO4.1:** Rational Design of Enzyme Inhibitors.	**NA**	**4.1:** Introduction of Enzyme kinetics **4.2:** Mechanism of Enzyme kinetics **4.3:** Importance of Enzyme kinetics **4.4:** Principles of Enzyme inhibitors **4.5:** Enzyme inhibitors in medicine **4.6:** Application of Enzyme inhibitors in medicine **4.7:** Enzyme inhibitors in basic research **4.8:** Importance of Enzyme inhibitors in basic research **4.9:** Rational design of non-covalently **4.10:** Mechanism of rational design of non-covalently **4.11:** Covalently binding enzyme inhibitors **4.12:** Mechanism covalently binding enzyme inhibitors	**4.1:** Application of Enzyme inhibitors in medicine

Suggested Assignments:

1. Explain about analysis of Importance of Enzyme kinetics.
2. Write note on rational design of non-covalently.

Unit V

CO-MPC 103T-5: To understand the in study of Peptidomimetics.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO5.1:** Study of Peptidomimetics.	**NA**	**5.1:** Introduction to Peptidomimetics **5.2:** Concept of Peptidomimetics **5.3:** Therapeutic values of Peptidomimetics **5.4:** Application of Peptidomimetics **5.5:** Design of peptidomimetics by manipulation of the amino acids **5.6:** Conformational search used in manipulation of the amino acids **5.7:** Modification of the peptide backbone **5.8:** Importance of modification of the peptide backbone **5.9:** Incorporating conformational constraints locally or globally **5.10:** Chemistry of prostaglandins **5.11:** Introduction to leukotrienes **5.12:** Concept of thromboxones	**5.1:** Modification of the peptide backbone.

Suggested Assignments:

1. Give the Application of Peptidomimetics .
2. Discuss in detail structure based chemistry of prostaglandins.

Brief of Hours suggested for the Course Outcome

Course Out comes	Class Lecture (Cl)	(LI)	Sessional Work (SW)	Self Learning (Sl)	Total Hour (Cl+SW+ Sl+LI)
CO-MPC 103T-1: To understand the different stages of drug discovery.	12	0	1	2	15
CO-MPC 103T-2: To understand the Study of Role of medicinal chemistry in drug research.	12	0	1	2	15
CO-MPC 103T-3: To understand the different techniques for drug discovery**.**	12	0	1	2	15
CO-MPC 103T-4: To understand the various strategies to design and develop new drug like molecules for biological targets.	12	0	2	1	15
CO-MPC 103T-5: To understand the in study of Peptidomimetics.	15	0	2	1	**1**5
Total Hours	**60**	**0**	**7**	**8**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

Course Outcome	Unit Titles	Marks Distribution			Total Marks
		A	C	E	
CO-MPC 103T-1:	To understand the different stages of drug discovery.	08	07	07	22
CO-MPC 103T-2:	To understand the Study of Role of medicinal chemistry in drug research.	08	06	02	16
CO-MPC 103T-3:	To understand the different techniques for drug discovery**.**	12	07	01	20
CO-MPC 103T-4:	To understand the various strategies to design and develop new drug like molecules for biological targets.	11	06	03	20
CO-MPC 103T-5:	To understand the in study of Peptidomimetics.	08	07	02	22
Total		**47**	**33**	**20**	**100**

Legend: A: Apply C: Creative E: Evaluate

The end of semester assessment for Advanced Medicinal Chemistry will be held with written examination of 75 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, Face book, Twitter, Whats app, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	Medicinal Chemistry	Burger,	Wiley Publishing Co	8th Edition2021
2	Text book of Organic Medicinal and Pharmaceutical Chemistry.	Wilson and Gisvold's	Ippincott Williams & Wilkin.	12th Edition2011
3	Comprehensive Medicinal Chemistry.	Corwin and Hansch,	Pergamon Publishers.	1st Edition1990
4	Biopharmaceutics and pharmacokinetics.	DM.Brahmanka r, Sunil B. Jaiswal	Vallabh Prakashan, New Delhi.	II Edition, 2014,
5	An Introduction to Medicinal Chemistry.	Graham L.Patrick	Oxford University Press, USA.	III Edition, 2005
6	The Organic Chemistry of the Drug Design and Drug action.	Richard B.Silverman	Elsevier Publishers, New Delhi.	II Edition, 2004
7	Principles of Medicinal Chemistry.	William Foye, Ippincott Williams & Wilkins,	Woltess Kluwer (India) Pvt.Ltd, New Delhi	7th Edition, 2012

Curriculum Development Team:

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3. **Mr. Prabhakar Singh Tiwari,** Associate Professor, Rajiv Gandhi Institute of Pharmacy, AKS University

Course Outcome & Program Outcome Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	Scientific Knowledge	Technological Application	Modern tool usage	Entrepreneur ship	Practical Skill	Applied Science	Computational and Statistical methodologies	Pharmaceutical Ethics	Environment and sustainability	Life-long learning	Analytical thinking and problem solving ability	Create and Innovate	Quality management and translational research
CO-MPC 103T-1: Drug discovery	3	2	3	1	3	2	1	3	2	3	2	1	3
CO-MPC 103T-2: Drug research	2	2	3	2	1	3	2	2	1	3	3	2	2
CO-MPC 103T-3: Different techniques	1	2	1	3	3	2	3	3	2	2	2	2	3
CO-MPC 103T-4: Molecules for biological targets	2	1	3	2	2	3	2	2	2	3	2	3	2
CO-MPC 103T-5: Peptidomimetics	3	2	2	1	3	2	3	3	1	2	3	1	2

Legend: 1- Low, 2-Medium, 3-High

Course Curriculum Mapping

POs & PSOs No.	COs No. & Title	SOs No.	Class Room Instructions	Laboratory Instructions	Self learning
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 103T.1:** To understand the different stages of drug discovery.	SO1.1 SO1.2	1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11. 1.12	--	SI-1.1 SI-1.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 103T.2:** To understand the Study of Role of medicinal chemistry in drug research.	SO2.1 SO2.2 SO2.3	2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12	--	SI-2.1 SI-2.2 SI-2.3
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 103T.3:** To understand the different techniques for drug discovery**.**	SO3.1 SO3.2	3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12.	--	SI-3.1 SI-3.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 103T.4:** To understand the various strategies to design and develop new drug like molecules for biological targets.	SO4.1	4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12.	--	SI-4.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 103T.5:** To understand the in study of Peptidomimetics.	SO5.1	5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11. 5.12	--	SI-5.1

A K S University

Faculty of Pharmaceutical Science & Technology
Rajiv Gandhi Institute of Pharmacy
Curriculum of M. Pharmacy (Pharmaceutical Chemistry-MPC) Program
(Revised as on 01 August 2023)

Semester-I

Course Code: MPC 104T

Course Title: Chemistry of Natural Products

Pre-requisite: Student should have basic knowledge of The subject is designed to provide detail knowledge about chemistry of medicinal compounds from natural origin and general methods of structural elucidation of such compounds. It also emphasizes on isolation, purification and characterization of medicinal compounds from natural origin.

Rationale/Objective s:

Upon completion of course, the student shall be to understand

- Different types of natural compounds and their chemistry and medicinal importance.
- The importance of natural compounds as lead molecules for new drug discovery.
- The concept of rDNA technology tool for new drug discovery.
- General methods of structural elucidation of compounds of natural origin.
- Isolation, purification and characterization of simple chemical constituents from natural source.

Course Out comes:

CO-MPC 104T-1: To understand the Basic Aspects of natural compounds and their chemistry and medicinal importance.
CO-MPC 104T-2: To understand the Study of natural compounds as lead molecules for new drug discovery.
CO-MPC 104T-3: To understand the the concept of rDNA technology tool for new drug discovery**.**

CO-MPC 104T-4: To understand the structural elucidation of compounds of natural origin.

CO-MPC 104T-5: To understand the Isolation, purification and characterization of simple chemical constituents from natural source.

Scheme of Studies

Course code	Title of the course	Program Name	Total Number of contact hours/Week					Credit
			Classroom Instruction (A) Lecture	Practical (P)	SW	SL	Total Hours (H)	
MPC 104T	Chemistry of Natural Products	M. Pharmacy	4	-	1	1	6	4

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

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

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

SL: Self Learning, Credits

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

Theory Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 104T	Chemistry of Natural Products	10	15	1 Hr	25	75	3 Hrs	100

Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

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.

Unit I

CO-MPC 104T-1: To understand the Basic Aspects of natural compounds and their chemistry and medicinal importance.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO1.1:** Basic Aspects of natural compounds **SO1.2:** chemistry and medicinal importance	**NA**	**1.1:** Drugs Affecting the Central Nervous System: Morphine Alkaloids **1.2:** Anticancer Drugs: Paclitaxel and Docetaxe **1.3:** Anticancer Drugs: Etoposide, and Teniposide **1.4:** Cardiovascular Drugs: Lovastatin **1.5:** Cardiovascular Drugs: Teprotide and Dicoumarol **1.6:** Neuromuscular Blocking Drugs: Curare alkaloids **1.7:** Anti-malarial drugs and Analogues **1.8:** Chemistry of macrolid antibiotics **1.9:** Erythromycin, Azithromycin. **1.10:** Roxithromycin, and Clarithromycin **1.11:** β - Lactam antibiotics **1.12:** Cephalosporins and Carbapenem	**1.1:** To study the Study of Natural products as leads for new pharmaceuticals **1.2:** Chemistry of macrolid antibiotics

Suggested Assignments:

1. Write the detail about Anti-malarial drugs and Analogues.

Unit II

CO-MPC 104T-2: To understand the Study of natural compounds as lead molecules for new drug discovery.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO2.1:** Study of natural compounds as lead molecules for new drug discovery .	**NA**	**2.1:** General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids **2.2:** Study of general methods of structural determination of alkaloids **2.3:** Structural elucidation and stereochemistry of ephedrine **2.4:** Structural elucidation and stereochemistry of, morphine **2.5:** Structural elucidation and stereochemistry of ergot **2.6:** Structural elucidation and stereochemistry of emetine and reserpine **2.7:** Introduction, isolation and purification of flavonoids **2.8:** General methods of structural determination of flavonoids **2.9:** Structural elucidation of quercetin **2.10:** General introduction, chemistry of sterols, sapogenin and cardiac glycosides **2.11:** Stereochemistry and nomenclature of steroids **2.12:** Chemistry of contraceptive agent's male & female sex hormones	**2.1:** General methods of structural determination of alkaloids

Suggested Assignments:

1. Write chemistry of contraceptive agent's male & female sex hormones.
2. Explain testosterone, estradiol, progesterone.

Unit III

CO-MPC 104T-3: To understand the concept of rDNA technology tool for new drug discovery.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO3.1:** Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids **SO3.2:** Chemistry and Physiological significance of Vitamin	**NA**	**3.1:** Classification, isolation, isoprene rule and general methods of Terpenoids **3.2:** Structural elucidation of Terpenoids **3.3:** Structural elucidation of drugs belonging to mono citral, menthol, camphor **3.4:** Structural elucidation of drugs belonging to di(retinol, Phytol, taxol) **3.5:** Tri terpenoids (Squalene,Ginsenoside) carotinoids (β carotene) **3.6:** Chemistry and Physiological significance of Vitamin A **3.7:** Chemistry and Physiological significance of Vitamin B1 **3.8:** Chemistry and Physiological significance of Vitamin B2 **3.9:** Chemistry and Physiological significance of Vitamin B12 **3.10:** Chemistry and Physiological significance of Vitamin C **3.11:** Chemistry and Physiological significance of Vitamin E **3.12:** Chemistry and Physiological significance of Vitamin Folic acid and Niacin	**3.1:** Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids **3.2:** Physiological significance of Vitamin

Suggested Assignments:

1. Explain structural elucidation of Terpenoids.

Unit IV

CO-MPC 104T-4: To understand the structural elucidation of compounds of natural origin.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO4.1:** Recombinant DNA technology and drug discovery **SO4.2:** Active constituent of certain crude drugs used in Indigenous system	**NA**	**4.1:** Recombinant DNA technology and drug discovery **4.2:** rDNA technology, hybridoma technology **4.3:** New pharmaceuticals derived from biotechnology **4.4:** Oligonucleotide therapy **4.5:** Gene therapy: Introduction, Clinical applications **4.6:** Recent advances in gene therapy, principles of RNA & DNA estimation **4.7:** Active constituent of certain crude drugs used in Indigenous system Diabetic therapy **4.8:** Gymnema sylvestre, Salacia reticulate **4.9:** Pterocarpus marsupiam, Swertia **4.10:** Trigonella foenum graccum **4.11:** Liver dysfunction: Phyllanthus niruri **4.12:** Antitumor – Curcuma longa Linn	**4.1:** Oligonucleotide therapy. Gene therapy: Introduction, Clinical application and recent advances in gene therapy **4.2:** Gymnema sylvestre, Salacia reticulate, Pterocarpus marsup.

Suggested Assignments:

1. Write note on new pharmaceuticals derived from biotechnology.

Unit V

CO-MPC 104T-5: To understand the Isolation, purification and characterization of simple chemical constituents from natural source.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO5.1:** Structural Characterization of natural compounds	**NA**	**5.1:** Structural Characterization of natural compounds **5.2:** Structural characterization of natural compounds using IR **5.3:** Structural characterization of natural compounds using 1H NMR **5.4:** Structural characterization of natural compounds using 13C NMR **5.5:** MS Spectroscopy of specific drug Penicillin. **5.6:** MS Spectroscopy of specific drug morphine **5.7:** MS Spectroscopy of specific drug camphor **5.8:** MS Spectroscopy of specific drug Vit-D **5.9:** MS Spectroscopy of specific drug quercetin **5.10:** MS Spectroscopy of specific drug Digitalis **5.11:** MS Spectroscopy of specific drug glycosides **5.12:** MS Spectroscopy of specific drug glycosides	**5.1:** Structural characterization of natural compounds using 13C NMR

Suggested Assignments:

1. Give the Structural characterization of natural compounds using IR.
2. Discuss in detail MS Spectroscopy of specific drug glycosides.

Brief of Hours suggested for the Course Outcome

Course Out comes	Class Lecture (Cl)	(LI)	Sessional Work (SW)	Self Learning (Sl)	Total Hour (Cl+SW+ Sl+LI)
CO-MPC 104T-1: To understand the Basic Aspects of natural compounds and their chemistry and medicinal importance.	12	0	1	2	15
CO-MPC 104T-2: To understand the Study of natural compounds as lead molecules for new drug discovery.	12	0	2	1	15
CO-MPC 104T-3: To understand the concept of rDNA technology tool for new drug discovery	15	0	1	2	15
CO-MPC 104T-4: To understand the structural elucidation of compounds of natural origin.	12	0	1	2	15
CO-MPC 104T-5: To understand the Isolation, purification and characterization of simple chemical constituents from natural source.	12	0	2	1	15
Total Hours	**60**	**0**	**7**	**8**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

Course Outcome	Unit Titles	Marks Distribution			Total Marks
		A	C	E	
CO-MPC 104T-1:	To understand the Basic Aspects of natural compounds and their chemistry and medicinal importance.	08	07	07	22
CO-MPC 104T-2:	To understand the Study of natural compounds as lead molecules for new drug discovery.	08	06	02	16
CO-MPC 104T-3:	To understand the the concept of rDNA technology tool for new drug discovery	12	07	01	20
CO-MPC 104T-4:	To understand the structural elucidation of compounds of natural origin	11	06	03	20
CO-MPC 104T-5:	To understand the Isolation, purification and characterization of simple chemical constituents from natural source	08	07	07	22
Total		**47**	**33**	**20**	**100**

Legend: A: Apply C: Creative E: Evaluate

The end of semester assessment for Chemistry of Natural Products will be held with written examination of 75 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, Face book, Twitter, Whats app, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	"Modern Methods of Plant Analysis".	Peech and M.V.Tracey	----	-2013
2	"Phytochemistry Vol. I and II".	Jan Nostrant Rein Hld,	-----	-
3	"Recent advances in Phytochemistry Vol. I to IV".	Scikel Runeckles.	Springer Science & Business Media.	------
5	Natural Product Chemistry.	Nakanishi Gggolo	University Science Book, California	
6	Natural Product Chemistry "A laboratory guide"	Rapheal Khan..	----	1965
7	The Alkaloid Chemistry and Physiology.	RHF Mans	- Academic Press.	- 1959
8	Introduction to molecular Phytochemistry.	CHJ Wells, Chapmannstall		2018
9	Organic Chemistry of Natural Products . - Vol I and II	Gurdeep and Chatwall	- Himalaya Publishing	38th Edition,2010
10	Organic Chemistry of Natural Products Vol. I and II	O.P. Agarwal	- Krishan Prakashsn.	2015
11	Elements of Biotechnology.	P.K. Gupta	Rastogi Publishers	2010
12	Pharmaceutical Biotechnology .	S.P.Vyas and V.K.Dixit	CBS Publishers	2009

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3. **Mr. Prabhakar Singh Tiwari,** Associate Professor, Rajiv Gandhi Institute of Pharmacy, AKS University

Course Outcome & Program Outcome Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	Scientific Knowledge	Technological Application	Modern tool usage	Entrepreneur ship	Practical Skill	Applied Science	Computational and Statistical methodologies	Pharmaceutical Ethics	Environment and sustainability	Life-long learning	Analytical thinking and problem solving ability	Create and Innovate	Quality management and translational research
CO-MPC 104T-1: Natural compounds	3	2	3	1	3	2	1	3	2	3	2	1	3
CO-MPC 104T-2: Molecules for new drug discovery	2	2	3	2	1	3	2	2	1	3	3	2	2
CO-MPC 104T-3: rDNA technology tool	1	2	1	3	3	2	3	3	2	2	2	2	3
CO-MPC 104T-4: Structural elucidation of compounds	2	1	3	2	2	3	2	2	2	3	2	3	2
CO-MPC 104T-5: Isolation, purification and characterization	3	2	2	1	3	2	3	3	1	2	3	1	2

Legend: 1- Low, 2-Medium, 3-High

Course Curriculum Mapping

POs & PSOs No.	COs No. & Title	SOs No.	Class Room Instructions	Laboratory Instructions	Self learning
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 104T-1:** To understand the Basic Aspects of natural compounds and their chemistry and medicinal importance.	SO1.1 SO1.2	1.1,1.2,1.3,1.4,1.5,1.6,1.7 ,1.8,1.9,1.10,1.11. 1.12	----	SI-1.1 SI-1.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 104T-2:** To understand the Study of natural compounds as lead molecules for new drug discovery.	SO2.1	2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12	----	SI-2.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 104T-3:** To understand the the concept of rDNA technology tool for new drug discovery.	SO3.1 SO3.2	3.1,3.2,3.3,3.4,3.5,3.6,3.7 ,3.8,3.9,3.10,3.11,3.12.	----	SI-3.1 SI-3.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 104T-4:** To understand the structural elucidation of compounds of natural origin.	SO4.1 SO4.2	4.1,4.2,4.3,4.4,4.5,4.6,4.7 ,4.8,4.9,4.10,4.11,4.12.	-----	SI-4.1 SI-4.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 104T-5:** To understand the Isolation, purification and characterization of simple chemical constituents from natural source.	SO5.1	5.1,5.2,5.3,5.4,5.5,5.6,5.7 ,5.8,5.9,5.10,5.11. 5.12	------	SI-5.1

A K S University

Faculty of Pharmaceutical Science & Technology
Rajiv Gandhi Institute of Pharmacy
Curriculum of M. Pharmacy (Pharmaceutical Chemistry-MPC) Program
(Revised as on 01 August 2023)
Semester-I

Course Code: MPC 105P
Course Title: Pharmaceutical Chemistry Practical - I

Practical Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exam (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 105P	Pharmaceutical Chemistry Practical -I	20	30	6 Hrs	50	100	6 Hrs	150

S. No.	List of Practicals
1.	Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation.
2.	Simultaneous estimation of multi component containing formulations by UV spectrophotometry.
3.	Experiments based on Column chromatography.
4.	Experiments based on HPLC.
5.	Experiments based on Gas Chromatography.
6.	Estimation of riboflavin/quinine sulphate by fluorimetry.
7.	Estimation of sodium/potassium by flame photometry.
To perform the following reactions of synthetic importance	
1.	Purification of organic solvents, column chromatograph 3. 4. 5.
2.	Claisen-schimidt reaction.
3.	Benzyllic acid rearrangement.
4.	Beckmann rearrangement.
5.	Hoffmann rearrangement.
6.	Mannich reaction.
7.	Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)
8.	Estimation of elements and functional groups in organic natural compounds.
9.	Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.
10.	Some typical degradation reactions to be carried on selected plant constituents.

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Semester-II

Course Code: MPC 201T

Course Title: Advanced Spectral Analysis

Pre-requisite: Student should have basic knowledge of various spectroscopy techniques and their importance in pharmaceutical chemistry.

Rationale/Objectives: Upon completion of course, the student shall be to understand

- Interpretation of the NMR, Mass and IR spectra of various organic Identification of organic compounds
- Theoretical and practical skills of the hyphenated instruments compounds

Course Out comes:

CO-MPC 201T-1: To understand about the basic concept of UV and IR spectroscopy.
CO-MPC 201T-2: To understand about the concept, working and importance of NMR spectroscopy.
CO-MPC 201T-3: To understand the concept of Mass spectroscopy and fragmentation.
CO-MPC 201T-4: To understand the principle, instrumentation and application of Chromatography.
CO-MPC 201T-5: To understand about the Raman spectroscopy and Radio immune assay.

Scheme of Studies

Course code	Title of the course	Program Name	Total Number of contact hours/Week					Credit
			Classroom Instruction (A)	Practical (P)	SW	SL	Total Hours (H)	
			Lecture					
MPC 201T	Advanced Spectral Analysis	M. Pharmacy	4	-	1	1	6	4

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others)
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations usingdifferent instructional strategies)
SW: Sessional Work (includes assignment**,** seminar, mini project etc.)
SL: Self Learning, Credits
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcomeof Learning

Theory Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 201T	Advanced Spectral Analysis	10	15	1 Hr	25	75	3 Hrs	100

Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

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.

Unit I

CO-MPC 201T-1: To understand about the basic concept of UV and IR spectroscopy.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO1.1:** Introduction UV spectroscopy **SO1.2:** Intermediates nitrenes	**NA**	**1.1:** Introduction UV spectroscopy **1.2:** Introduction of IR spectroscopy **1.3:** Wood ward – Fieser rule for butadienes **1.4:** Cyclic dienes **1.5:** α,β-carbonyl compounds **1.6:** Interpretation compounds of enones **1.7:** ATR-IR **1.8:** IR Interpretation of organic compounds **1.9:** Intermediates nitrenes **1.10:** Their method of formation **1.11:** Stability **1.12:** Synthetic applications	**1.1:** Can read about the various different uses of UV and IR spectroscopy

Suggested Assignments:

1. Introduction UV spectroscopy.
2. IR Interpretation of organic compounds.

Unit II

CO-MPC 201T-2: To understand about the concept, working and importance of NMR spectroscopy.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO2.1:** Interpretation of organic compounds **SO2.2:** Interpretation of organic compounds	**NA**	**2.1:** Introduction NMR spectroscopy **2.2:** 1-D NMR **2.3:** 2-D NMR **2.4:** NOESY **2.5:** COSY **2.6:** HECTOR **2.7:** HECTOR advanced **2.8:** INADEQUATE techniques **2.9:** INADEQUATE techniques Interpretation **2.10:** Interpretation **2.11:** Interpretation of organic compounds **2.12:** Interpretation of organic compounds	**2.1:** Understand about different feature and uses of NMR

Suggested Assignments:

1. Explain INADEQUATE techniques.
2. Explain HECTOR advanced.

Unit III

CO-MPC 201T-3: To understand the concept of Mass spectroscopy and fragmentation**.**

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO3.1:** Mass Spectroscopy **SO3.2:** Fragmentation **SO3.3:** Interpretation of organic compounds	**NA**	**3.1:** Mass Spectroscopy **3.2:** Mass fragmentation **3.3:** Its rules **3.4:** Fragmentation of important functional groups like alcohols **3.5:** Amines **3.6:** Carbonyl groups **3.7:** Alkanes **3.8:** Meta stable ions **3.9:** Mc Lafferty rearrangement **3.10:** Ring rule **3.11:** Isotopic peaks **3.12:** Interpretation of organic compounds	**3.1:** Can read about the comparative study of Mass, NMR, and IR spectroscopy with importance

Suggested Assignments:

1. Write note on fragmentation of important functional groups like alcohols.
2. Explain carbonyl groups.

Unit IV

CO-MPC 201T-4: To understand the principle, instrumentation and application of Chromatography.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO4.1:** All features of chromatography techniques	**NA**	**4.1:** Chromatography **4.2:** Principle, Instrumentation and Applications **4.3:** GC-MS & GC-AAS **4.4:** LC-MS **4.5:** LC-FTIR **4.6:** LC-NMR **4.7:** CE- MS **4.8:** High Performance Thin Layer chromatography **4.9:** Super critical fluid chromatography **4.10:** Ion Chromatography **4.11:** I-EC (Ion Exclusion Chromatography) **4.12:** Flash chromatography	**4.1:** Can understand all uses and application of different chromatography techniques

Suggested Assignments:

1. Give details on Principle, Instrumentation and Applications of the following- GC-MS.
2. Write note on High Performance Thin Layer chromatography.

Unit V

CO-MPC 201T-5: To understand about the Raman spectroscopy and Radio immune assay.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO5.1:** Thermal methods of analysis Introduction **SO5.2:** Raman Spectroscopy Introduction **SO5.3:** Radioimmuno assay	**NA**	**5.1:** Thermal methods of analysis Introduction **5.2:** Principle, instrumentation and application of DSC **5.3:** DTA **5.4:** TGA **5.5:** Raman Spectroscopy Introduction **5.6:** Principle of Raman Spectroscopy **5.7:** Instrumentation of Raman Spectroscopy **5.8:** Applications of Raman Spectroscopy **5.9:** Radio immuno assay Biological standardization **5.10:** Bioassay **5.11:** ELISA **5.12:** Radioimmuno assay of digitalis and insulin	**5.1:** Can read about some more products Radioimmuno assay

Suggested Assignments:

1. Give description on Thermal methods of analysis Introduction.
2. Write note on Radioimmuno assay.

Brief of Hours suggested for the Course Outcome

Course Out comes	Class Lecture (Cl)	(LI)	Session a l Work (SW)	Self Learning (Sl)	Total Hour (Cl+SW+ Sl+LI)
CO-MPC 201T-1: To understand the Basic Aspects of Organic Chemistry and Addition reactions.	12	0	2	1	15
CO-MPC 201T-2: To understand about the concept, working and importance of NMR spectroscopy.	12	0	2	1	15
CO-MPC 201T-3: To understand the concept of Mass spectroscopy and fragmentation.	12	0	2	1	15
CO-MPC 201T-4: To understand the principle, instrumentation and application of Chromatography	12	0	2	1	15
CO-MPC 201T-5: To understand about the Raman spectroscopy and Radio immune assay.	12	0	2	1	15
Total Hours	**60**	**0**	**10**	**5**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

Course Outcome	Unit Titles	Marks Distribution			Total Marks
		A	C	E	
CO-MPC 201T-1:	Understand about the basic concept of UV and IR spectroscopy.	08	07	07	22
CO-MPC 201T-2:	To understand about the concept, working and importance of NMR spectroscopy.	08	06	02	16
CO-MPC 201T-3:	To understand the concept of Mass spectroscopy and fragmentation.	12	07	01	20
CO-MPC 201T-4:	To understand the principle, instrumentation and application of Chromatography.	11	06	03	20
CO-MPC 201T-5:	To understand about the Raman spectroscopy and Radio immune assay.	08	07	07	22
Total		**47**	**33**	**20**	**100**

Legend: A: Apply C: Creative E: Evaluate

The end of semester assessment for Advanced Spectral Analysis will be held with written examination of 75 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, Face book, Twitter, Whats app, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	Pharmaceutical Analysis-Modern methods – Part B	J W Munson.	Marcel Dekker Series	Volume 11
2	Quantitative Analysis of Drugs in Pharmaceutical formulation	P D Sethi	CBS Publishers, New Delhi, 1997	3 rd Edition,
3	Quantitative analysis of Pharmaceutical formulations by HPTLC	P D Sethi.	CBS Publishers, New Delhi, 1997	-
4	Instrumental methods of analysis	Willards	CBS Publishers	7 th Edition
5	Principles of Instrumental Analysis	Doglas A Skoog, F. James Holler, Timothy A. Nieman,	Eastern press, Bangalore, 1998	5th Editon
6	Spectrometric Identification of Organic compound	Robert M Silverstein	John Wiley & Sons, 2004.	6th editon

Curriculum Development Team:

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Course Outcome & Program Outcome Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	Scientific Knowledge	Technological Application	Modern tool usage	Entrepreneur ship	Practical Skill	Applied Science	Computational and Statistical methodologies	Pharmaceutical Ethics	Environment and sustainability	Life-long learning	Analytical thinking and problem solving ability	Create and Innovate	Quality management and translational research
CO-MPC 201T-1: UV and IR spectroscopy	3	2	3	1	3	2	1	3	2	3	2	1	3
CO-MPC 201T-2: NMR spectroscopy	2	2	3	2	1	3	2	2	1	3	3	2	2
CO-MPC 201T-3: Mass spectroscopy	1	2	1	3	3	2	3	3	2	2	2	2	3
CO-MPC 201T-4: Chromatography	2	1	3	2	2	3	2	2	2	3	2	3	2
CO-MPC 201T-5: Raman spectroscopy and Radio immune assay	3	2	2	1	3	2	3	3	1	2	3	1	2

Legend: 1- Low, 2-Medium, 3-High

Course Curriculum Mapping

POs & PSOs No.	COs No. & Title	SOs No.	Class Room Instructions	Laboratory Instructions	Self learning
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 201T.1:** Understand about the basic concept of UV and IR spectroscopy.	SO1.1 SO1.2	1.1,1.2,1.3,1.4,1.5,1.6 ,1.7,1.8,1.9,1.10,1.11, 1.12	--	SL-1.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 201T.2:** To understand about the concept, working and importance of NMR spectroscopy.	SO2.1 SO2.2	2.1,2.2,2.3,2.4,2.5,2.6 ,2.7,2.8,2.9,2.10,2.11, 2.12	--	SL-2.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 201T.3:** To understand the concept of Mass spectroscopy and fragmentation.	SO3.1 SO3.2 SO3.3	3.1,3.2,3.3,3.4,3.5,3.6 ,3.7,3.8,3.9,3.10,3.11, 3.12	--	SL3.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 201T.4:** To understand the principle, instrumentation and application of Chromatography.	SO4.1	4.1,4.2,4.3,4.4,4.5,4.6 ,4.7,4.8,4.9,4.10,4.11, 4.12	--	SL-4.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 201T.5:** To understand about the Raman spectroscopy and Radio immune assay.	SO5.1 SO5.2 SO5.3	5.1,5.2,5.3,5.4,5.5,5.6 ,5.7,5.8,5.9,5.10,5.11, 5.12	--	SL 5.1

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Curriculum of M. Pharmacy (Pharmaceutical Chemistry-MPC) Program
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Semester-II

Course Code: MPC 202T

Course Title: Advanced Organic Chemistry – II

Pre-requisite: Student should have basic knowledge of elementary organic and physical chemistry. The mechanisms of organic reactions, structure of organic molecules, and theories of reactivity.

Rationale/Objectives: Upon completion of course, the student shall able to understand

- The principles and applications of Green chemistry.
- The concept of peptide chemistry.
- The various catalysts used in organic reactions
- The concept of stereochemistry and asymmetric synthesis.

Course Out comes:

CO-MPC 202T-1: To understand the Basic Aspects of Green Chemistry and Introduction, principles of green chemistry addition reactions.
CO-MPC 202T-2: To understand the Study of Chemistry of peptides and Coupling reactions in peptide synthesis.
CO-MPC 202T-3: To understand the Synthetic Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation.
CO-MPC 202T-4: To understand the Catalysis.
CO-MPC 202T-5: To understand the Stereochemistry & Asymmetric Synthesis.

Scheme of Studies

Course code	Title of the course	Program Name	Total Number of contact hours/Week					Credit
			Classroom Instruction (A) Lecture	Practical (P)	SW	SL	Total Hours (H)	
MPC 202T	Advanced Organic Chemistry - II	M. Pharmacy	4	-	1	1	6	4

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others),
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment, seminar, mini project etc.),
SL: Self Learning, Credits.
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Theory Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 202T	Advanced Organic Chemistry - II	10	15	1 Hr	25	75	3 Hrs	100

Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

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.

Unit I

CO-MPC 202T-1: To understand the Basic Aspects of Green Chemistry and Introduction, principles of green chemistry addition reactions.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO1.1:** Basic aspects Green of Chemistry **SO1.2:** Green Chemistry Addition reactions	**NA**	**1.1:** Introduction, principles of green chemistry **1.2:** Microwave assisted reactions **1.3:** Merit and demerits of its use, increased reaction rates **1.4:** Mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis **1.5:** Microwave technology in process optimization **1.6:** Its applications in various organic reactions and heterocycles synthesis **1.7:** Types of sonochemical reactions **1.8:** Homogenous, heterogeneous liquid-liquid **1.9:** liquid-solid reactions **1.10:** Synthetic applications **1.11:** Continuous flow reactors: Working principle **1.12:** Advantages and synthetic applications	**1.1:** To understand the Basic Aspects of Green Chemistry and Introduction, principles of green chemistry addition reactions

Suggested Assignments:

1. Explain introduction, principles of green chemistry.
2. Write merit and demerits of its use, increased reaction rates.

Unit II

CO-MPC 202T-2: To understand the Study of Chemistry of peptides and Coupling reactions in peptide synthesis.

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Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO2.1:** Study of Chemistry of peptides a. Coupling reactions in peptide synthesis.	**NA**	**2.1:** Coupling reactions in peptide synthesis **2.2:** Principles of solid phase peptide synthesis **2.3:** t-BOC and FMOC protocols, various solid supports and linkers **2.4:** Activation procedures, peptide bond formation **2.5:** Deprotection and cleavage from resin **2.6:** Low and high HF cleavage protocols **2.7:** Formation of free peptides and peptide amides **2.8:** Purification and case studies, site-specific chemical **2.9:** Modifications of peptides c. Segment and sequential strategies for solution phase peptide **2.10:** Synthesis with any two case studies **2.11:** Side reactions in peptide synthesis: Deletion peptides **2.12:** Side reactions initiated by proton abstraction, protonation, overactivation and side reactions of individual amino acids	**2.1:** Chemistry of peptides Coupling reactions in peptide synthesis

Suggested Assignments:

1. Write note on coupling reactions in peptide synthesis.
2. Give note on activation procedures, peptide bond formation.

Unit III

CO-MPC 202T-3: To understand the Synthetic Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO3.1:** Study of basic principles of photochemical reactions	**NA**	**3.1:** Introduction of Photochemical Reactions **3.2:** Basic principles of photochemical reactions **3.3:** Photo-oxidation, photo-addition with example **3.4:** Photochemical reactions **3.5:** Photo-oxidation **3.6:** Photo-addition **3.7:** Photo-fragmentation **3.8:** Pericyclic reactions **3.9:** Mechanism of Pericyclic reactions **3.10:** Types of pericyclic reactions such as cyclo addition **3.11:** Electrocyclic reaction and sigmatrophic rearrangement reactions **3.12:** Sigmatrophic rearrangement reactions with examples	**3.1:** Photochemical Reactions Basic principles of photochemical reactions

Suggested Assignments:

1. Write basic principles of photochemical reactions.
2. Give mechanism of pericyclic reactions.

Unit IV

CO-MPC 202T.4: To understand the Catalysis.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO4.1:** Discuss the applications of biocatalysis and phase transfer catalysis in organic reaction	**NA**	**4.1:** Types of catalysis, heterogeneous and homogenous catalysis **4.2:** Catalysis: advantages and disadvantages **4.3:** Heterogeneous catalysis – preparation. Characterization, kinetics, supported catalysts, catalyst deactivation **4.4:** Regeneration, some examples of heterogeneous catalysis used in synthesis of drugs **4.5:** Homogenous catalysis, hydrogenation, hydroformylation, hydrocyanation **4.6:** Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts **4.7:** Some examples of homogenous catalysis used in synthesis of drugs **4.8:** Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions **4.9:** Biocatalysis: Use of enzymes in organic synthesis **4.10:** Biocatalysis: immobilized enzymes/cells in organic reaction **4.11:** Phase transfer catalysis **4.12:** Theory and applications	**4.1:** Explain the applications of homogeneous and heterogeneous catalysis in the synthesis of drugs **4.2:** Discuss the applications of biocatalysis and phase transfer catalysis in organic reaction

Suggested Assignments:

1. Explain catalysis: advantages and disadvantages.

Unit V

CO-MPC 202T-5: To understand the Stereochemistry & Asymmetric Synthesis.

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Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO5.1:** Explain the basic concept of stereochemistry	**NA**	**5.1:** Introduction of Stereochemistry & Asymmetric Synthesis **5.2:** Basic concepts in stereochemistry **5.3:** Basic concepts in stereochemistry – optical activity, specific rotation **5.4:** Racemates and resolution of racemates, the Cahn, In gold **5.5:** Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres **5.6:** axes of symmetry, Fischers D and L notation **5.7:** cis-trans isomerism, E and Z notation **5.8:** Methods of asymmetric synthesis using chiral pool **5.9:** Chiral auxiliaries **5.10:** catalytic asymmetric synthesis **5.11:** Enantiopure separation **5.12:** Stereo selective synthesis with examples	**5.1:** Explain the basic concept of stereochemistry **5.2:** Discuss the principle of asymmetric synthesis

Suggested Assignments:

1. Write prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centers.

Brief of Hours suggested for the Course Outcome

Course Out comes	Class Lecture (Cl)	(LI)	Session a l Work (SW)	Self Learning (Sl)	Total Hour (Cl+SW+ Sl+LI)
CO-MPC 202T-1: To understand the Basic Aspects of Green Chemistry and Introduction, principles of green chemistry addition reactions.	12	0	2	1	15
CO-MPC 202T-2: To understand the Study of Chemistry of peptides and Coupling reactions in peptide synthesis.	12	0	2	1	15
CO-MPC 202T-3: To understand the Synthetic Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation.	12	0	2	1	15
CO-MPC 202T-4: To understand the Catalysis.	12	0	1	2	15
CO-MPC 202T-5: To understand the Stereochemistry & Asymmetric Synthesis.	12	0	1	2	15
Total Hours	**60**	**0**	**8**	**7**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

Course Outcome	Unit Titles	Marks Distribution			Total Marks
		A	C	E	
CO-MPC 202T-1:	To understand the Basic Aspects of Green Chemistry and Introduction, principles of green chemistry addition reactions.	08	07	07	22
CO-MPC 202T-2:	To understand the Study of Chemistry of peptides and Coupling reactions in peptide synthesis.	08	06	02	16
CO-MPC 202T-3:	To understand the Synthetic Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation.	12	07	01	20
CO-MPC 202T-4:	To understand the Catalysis.	11	06	03	20
CO-MPC 202T-5:	To understand the Stereochemistry & Asymmetric Synthesis.	08	07	07	22
Total		**47**	**33**	**20**	**100**

Legend: A: Apply C: Creative E: Evaluate

The end of semester assessment for Advanced Organic Chemistry – II will be held with written examination of 75 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, Face book, Twitter, Whats app, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	"Advanced Organic chemistry, Reaction, Mechanisms and Structure".	J March, John Wiley and Sons.	New York.	2020
2	"Mechanism and Structure in Organic Chemistry".	ES Gould, Hold Rinchart and Winston,	New York.	-
3	"Organic Chemistry".	Clayden, Greeves, Warren and Woihers.	Oxford University Press.	2001.
4	"Organic Chemistry".	I.L. Finar. ELBS	Pearson Education Lts, Dorling Kindersley 9India) Pvt. Ltd.,	Vol I and II.
5	A guide to mechanisms in Organic Chemistry.	Peter Skyes	(Orient Longman, New Delhi).	
6	Reactive Intermediates in Organic Chemistry.	Tandom and Gowel	Oxford & IBH Publishers.	
7	Combinational Chemistry – Synthesis and applications.	Stephen R Wilson & Anthony W Czarnik, Wiley – Blackwell.	-	-
8	Organic Chemistry.	Carey	(Viva Books Pvt. Ltd.)	5th Edition
9	Principles of Organic Synthesis	ROC Norman and JM Coxan, Nelson Thorns	-	
10	Organic Synthesis - Special Techniques	VK Ahluwalia and R Agarwal	Narosa Publishers	-
11	Organic Reaction Mechanisms	VK Ahluwalia and RK Parashar	Narosa Publishers	IVth Edtn

Curriculum Development Team:

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2. **Ms. Neha Goel,** Associate Professor, Rajiv Gandhi Institute of Pharmacy, AKS University
3. **Mr. Ashutosh Jain,** Assistant Professor, Rajiv Gandhi Institute of Pharmacy, AKS University

Course Outcome & Program Outcome Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	Scientific Knowledge	Technological Application	Modern tool usage	Entrepreneur ship	Practical Skill	Applied Science	Computational and Statistical methodologies	Pharmaceutical Ethics	Environment and sustainability	Life-long learning	Analytical thinking and problem solving ability	Create and Innovate	Quality management and translational research
CO-MPC 202T-1: Green Chemistry	3	2	3	1	3	2	1	3	2	3	1	2	3
CO-MPC 202T-2: Chemistry of peptides	2	2	3	2	1	3	2	2	1	3	2	1	1
CO-MPC 202T-3: Basic principles of photochemical reactions	1	2	1	3	3	2	3	3	2	2	1	3	3
CO-MPC 202T-4: Catalysis	2	1	3	2	2	3	2	2	2	3	2	2	1
CO-MPC 202T-5: Stereochemistry	3	2	2	1	3	2	3	3	1	2	1	1	1

Legend: 1- Low, 2-Medium, 3-High

Course Curriculum Mapping

POs & PSOs No.	COs No. & Title	SOs No.	Class Room Instructions	Laboratory Instructions	Self learning
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 202T.1:** To understand the Basic Aspects of Green Chemistry and introduction, principles of green chemistry addition reactions.	SO-1.1 SO-1.2	1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9, 1.10,1.11,1.12	--	SL-1.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 202T.2:** To understand the Study of Chemistry of peptides and Coupling reactions in peptide synthesis	SO-2.1	2.1,2.2,2.3,2.4,2.5,2.6,2.7,2.8,2.9, 2.10,2.11,2.12	--	SL-2.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 202T.3:** To understand the Synthetic Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation.	SO-3.1	3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9, 3.10,3.11,3.12	--	SL3.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 202T.4:** To understand the Catalysis	SO-4.1	4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9, 4.10,4.11,4.12	--	SL-4.1 SL-4.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 202T.5:** To understand the Stereochemistry & Asymmetric Synthesis	SO-5.1	5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9, 5.10,5.11,5.12	--	SL-5.1 SL-5.2

A K S University

Faculty of Pharmaceutical Science & Technology
Rajiv Gandhi Institute of Pharmacy
Curriculum of M. Pharmacy (Pharmaceutical Chemistry-MPC) Program
(Revised as on 01 August 2023)
Semester-II

Course Code: MPC 203T

Course Title: Computer Aided Drug Design

Pre-requisite: Student should have basic knowledge of the subject is designed to provide detail knowledge about on the current state of the art techniques involved in computer assisted drug design.

Rationale/Objective s: Upon completion of course, the student shall be to understand

- Role of CADD in drug discovery.
- Different CADD techniques and their applications.
- Various strategies to design and develop new drug like molecules.
- Working with molecular modeling soft ware's to design new drug.
- The in screening virtual screening protocols.

Course Out comes:

CO-MPC 203T-1: To understand the Basic Aspects of Role of Computer aided drug design in drug discovery.
CO-MPC 203T-2: To understand the Study of different Computer aided drug design techniques and their applications.
CO-MPC 203T-3: To understand the various strategies to design and develop new drug like molecules**.**
CO-MPC 203T-4: To understand the working with molecular modeling soft ware's to design new drug.
CO-MPC 203T-5: To understand the in screening virtual screening protocols.

Scheme of Studies

Course code	Title of the course	Program Name	Total Number of contact hours/Week					Credit
			Classroom Instruction (A) Lecture	Practical (P)	SW	SL	Total Hours (H)	
MPC 203T	Computer Aided Drug Design	M. Pharmacy	4	-	1	1	6	4

Legend: CI: Classroom Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others)
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work (includes assignment**,** seminar, mini project etc.),
SL: Self Learning, Credits.
Note: SW & SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning.

Theory Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams(B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 203T	Computer Aided Drug Design	10	15	1 Hr	25	75	3 Hrs	100

Guidelines for the allotment of marks for attendance

Percentage of Attendance	**Theory**	**Practical**
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

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.

Unit I

CO-MPC 203T-1: To understand the Basic Aspects of Role of Computer aided drug design in drug discovery.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO1.1:** Introduction to Computer Aided Drug Design (CADD) **SO1.2:** Quantitative Structure Activity Relationships	**NA**	**1.1:** Introduction to Computer Aided Drug Design (CADD) **1.2:** History, different techniques **1.3:** Quantitative Structure Activity Relationships **1.4:** History and development of QSAR **1.5:** Physicochemical parameters and methods to calculate physicochemical parameters **1.6:** Hammett equation **1.7:** lipophilicity effects and parameters **1.8:** log P, pi-substituent constant **1.9:** Steric effect **1.10:** Taft steric and MR parameters **1.11:** Experimental approaches for the determination of these physicochemical parameters **1.12:** theoretical approaches for the determination	**1.1:** To study the Basic Aspects of Role of Computer aided drug design in drug discovery

Suggested Assignments:

1. Explain history and development of QSAR.
2. Write the detail about Experimental approaches for the determination of these physicochemical parameters.

Unit II

CO-MPC 203T-2: To understand the Study of different Computer aided drug design techniques and their applications.

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Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO2.1:** Study of Quantitative Structure Activity Relationships .	**NA**	**2.1:** Quantitative Structure Activity Relationships **2.2:** Applications Hansch analysis **2.3:** Free Wilson analysis **2.4:** Relationship between them **2.5:** Advantages Deriving 2D-QSAR Equations **2.6:** Disadvantages of Deriving 2D-QSAR equations **2.7:** 3D-QSAR approaches **2.8:** Contour map analysis **2.9:** Statistical methods used in QSAR analysis **2.10:** Statistical methods used in QSAR analysis **2.11:** Importance of statistical parameters **2.12:** Importance of statistical parameters	**2.1:** 3D-QSAR approaches and contour map analysis

Suggested Assignments:

1. Explain Applications Hansch analysis.
2. Write the detail about Statistical methods used in QSAR analysis.

Unit III

CO-MPC 203T-3: To understand the various strategies to design and develop new drug like molecules.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO3.1:** Molecular Modeling and Docking **SO3.2:** Energy Minimization Methods **SO3.3:** Molecular docking and drug receptor interactions	**NA**	**3.1:** Introduction of molecular Modeling and Docking **3.2:** Molecular Mechanics in drug design **3.3:** Quantum Mechanics in drug design **3.4:** Energy Minimization Methods **3.5:** Comparison between global minimum conformation and bioactive conformation **3.6:** Comparison between global minimum conformations **3.7:** Molecular docking **3.8:** Drug receptor interactions **3.9:** Rigid docking **3.10:** Flexible docking and extra-precision docking **3.11:** Agents acting on enzymes such as DHFR, HMG-CoA reductase **3.12:** HIV protease.and choline esterase (AchE & BchE)	**3.1:** Comparison between global minimum conformation and bioactive conformation

Suggested Assignments:

1. Explain Molecular Mechanics in drug design.
2. Discuss the comparison between global minimum conformation and bioactive conformation.

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Unit IV

CO-MPC 203T-4: To understand the working with molecular modeling soft ware's to design new drug.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO4.1:** Molecular Properties and Drug Design	**NA**	**4.1:** Introduction of molecular Properties **4.2:** Prediction of ADMET properties of new molecules **4.3:** Analysis of ADMET properties of new molecules **4.4:** Importance in drug design **4.5:** De novo drug design **4.6:** Receptor-interaction **4.7:** Enzyme-interaction and its analysis **4.8:** Receptor cavity size prediction **4.9:** Enzyme cavity size prediction **4.10:** Predicting the functional components of cavities **4.11:** Fragment based drug design **4.12:** Homology modeling	**4.1:** predicting the functional components of cavities, Fragment based drug design

Suggested Assignments:

1. Explain about analysis of ADMET properties of new molecules.
2. Write note on Homology modeling and generation of 3D-structure of protein.

Unit V

CO-MPC 203T-5: To understand the in screening virtual screening protocols.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO5.1:** Pharmacophore Mapping and Virtual Screening	**NA**	**5.1:** Introduction pharmacophore Mapping and Virtual Screening **5.2:** Concept of pharmacophore **5.3:** Pharmacophore mapping **5.4:** Identification of Pharmacophore features **5.5:** Pharmacophore modeling **5.6:** Conformational search used in pharmacophore mapping **5.7:** Conformational search used in pharmacophore mapping **5.8:** In Silico Drug Design. **5.9:** In Silico Drug Design and Virtual Screening Techniques **5.10:** Similarity based method **5.11:** Pharmacophore based screening **5.12:** Structure based In-silico virtual screening protocols	**5.1:** In Silico Drug Design and Virtual Screening Techniques

Suggested Assignments:

1. Give the Concept of pharmacophore.
2. Discuss in detail structure based In-silico virtual screening protocols.

Brief of Hours suggested for the Course Outcome

Course Out comes	Class Lecture (Cl)	(LI)	Sessional Work (SW)	Self Learning (Sl)	Total Hour (Cl+SW+ Sl+LI)
CO-MPC 203-T: To understand the Basic Aspects of Role of Computer aided drug design in drug discovery.	12	0	2	1	15
CO-MPC 203T-2: To understand the Study of different Computer aided drug design techniques and their applications.	12	0	2	1	15
CO-MPC 203T-3: To understand the various strategies to design and develop new drug like molecules**.**	12	0	2	1	15
CO-MPC 203T-4: To understand the working with molecular modeling soft ware's to design new drug.	12	0	2	1	15
CO-MPC 203T-5: To understand the in screening virtual screening protocols.	12	0	2	1	15
Total Hours	**60**	**0**	**10**	**5**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

Course Outcome	Unit Titles	Marks Distribution			Total Marks
		A	C	E	
CO-MPC 203T-1:	To understand the Basic Aspects of Role of Computer aided drug design in drug discovery.	08	07	07	22
CO-MPC 203T-2:	To understand the Study of different Computer aided drug design techniques and their applications.	08	06	02	16
CO-MPC 203T-3:	To understand the various strategies to design and develop new drug like molecules**.**	12	07	01	20
CO-MPC 203T-4:	To understand the working with molecular modeling soft ware's to design new drug.	11	06	03	20
CO-MPC 203T-5:	To understand the in screening virtual screening protocols.	08	07	07	22
Total		**47**	**33**	**20**	**100**

Legend: A: Apply C: Creative E: Evaluate

The end of semester assessment for Computer Aided Drug Design will be held with written examination of 75 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, Face book, Twitter, Whats app, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	"Computational and structural approaches to drug discovery".	Robert M Stroud and Janet. F Moor	RCS Publishers.	2007
2	"Introduction to Quantitative Drug Desig".	Y.C. Martin,	CRC Press	-
3	"Drug Design by Ariens Volume 1 to 10".	-----.	Elsevier Publishers.	1975
4	"Principles of Drug Design".	Smith and Williams	CRC Press, Taylor & Francis.	4th Edition 2005
5	The Organic Chemistry of the Drug Design and Drug action.	Richard B. Silverman,	Elsevier Publishers.	3rd Edition 2014
6	Medicinal Chemistry	Burger,	Wiley Publishing Co	8th Edition2021
7	An Introduction to Medicinal Chemistry .	Graham L. Patrick	Oxford University Press.	7th Edition2023
8	Text book of Organic Medicinal and Pharmaceutical Chemistry,.	Wilson and Gisvold's	Ippincott Williams & Wilkin.	12th Edition2011
9	Comprehensive Medicinal Chemistry .	Corwin and Hansch,	Pergamon Publishers.	1st Edition1990
10	Computational and structural approaches to drug desig.	Robert M Stroud and Janet. F Moore.	Royal Society of Chemistry	2007

Curriculum Development Team:

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Course Outcome & Program Outcome Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	Scientific Knowledge	Technological Application	Modern tool usage	Entrepreneur ship	Practical Skill	Applied Science	Computational and Statistical methodologies	Pharmaceutical Ethics	Environment and sustainability	Life-long learning	Analytical thinking and problem solving ability	Create and Innovate	Quality management and translational research
CO-MPC 203T-1: Natural compounds	3	2	3	1	3	2	1	3	2	3	1	2	3
CO-MPC 203T-2: Molecules for new drug discovery	2	2	3	2	1	3	2	2	1	3	2	1	1
CO-MPC 203T-3: rDNA technology tool	1	2	1	3	3	2	3	3	2	2	1	3	3
CO-MPC 203T-4: Structural elucidation of compounds	2	1	3	2	2	3	2	2	2	3	2	2	1
CO-MPC 203T-5: Isolation, purification and characterization	3	2	2	1	3	2	3	3	1	2	1	1	1

Legend: 1- Low, 2-Medium, 3-High

Course Curriculum Mapping

POs & PSOs No.	COs No. & Title	SOs No.	Class Room Instructions	Laboratory Instructions	Self learning
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 203T.1:** To understand the Basic Aspects of Role of Computer aided drug design in drug discovery.	SO1.1 SO1.2	1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9,1.10,1.11. 1.12	--	SI-1.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 203T.2:** To understand the Study of different Computer aided drug design techniques and their applications.	SO-2.1	2.1, 2.2, 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9, 2.10, 2.11, 2.12	--	SI-2.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 203T.3:** To understand the various strategies to design and develop new drug like molecules.	SO-3.1 SO-3.2 SO-3.3	3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9,3.10,3.11,3.12.	--	SI-3.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 203T.4:** To understand the working with molecular modeling soft ware's to design new drug.	SO-4.1	4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9,4.10,4.11,4.12.	--	SI-4.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 203T.5:** To understand the in screening virtual screening protocols	SO-5.1	5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9,5.10,5.11. 5.12	--	SI-5.1

A K S University

Faculty of Pharmaceutical Science & Technology
Rajiv Gandhi Institute of Pharmacy
Curriculum of M. Pharmacy (Pharmaceutical Chemistry-MPC) Program
(Revised as on 01 August 2023)
Semester-II

Course Code: MPC 204T

Course Title: Pharmaceutical Process Chemistry

Pre-requisite: Student should have basic knowledge of The subject is designed to provide detail knowledge about on the Process chemistry is often described as scale up reactions, taking them from small quantities created in the research lab to the larger quantities that are needed for further testing and then to even larger quantities required for commercial production.

Rationale/Objective s:

Upon completion of course, the student shall be to understand

- The strategies of scale up process of apis and intermediates.
- The various unit operations and various reactions in process chemistry.
- The process is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient.
- The subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure.
- The manufacture of Active Pharmaceutical Ingredients (APIs) and New Chemical Entities (NCEs) for the drug development phase.

Course Out comes:

CO-MPC 204T-1: To understand the strategies of scale up process of apis and intermediates.
CO-MPC 204T-2: To understand the various unit operations and various reactions in process chemistry.
CO-MPC 204T-3: To understand the process is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient.
CO-MPC 204T-4: To understand the subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure.
CO-MPC 204T-5: To understand the manufacture of active pharmaceutical ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

Scheme of Studies

Course code	Title of the course	Program Name	Total Number of contact hours/Week					Credit
			Classroom Instruction (A) Lecture	Practical (P)	SW	SL	Total Hours (H)	
MPC 204T	Pharmaceutical Process Chemistry	M. Pharmacy	4	-	1	1	6	4

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

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

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

SL: Self Learning, Credits

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

Theory Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 204T	Pharmaceutical Process Chemistry	10	15	1 Hr	25	75	3 Hrs	100

Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95 – 100	8	10
90 – 94	6	7.5
85 – 89	4	5
80 – 84	2	2.5
Less than 80	0	0

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.

Unit I

CO-MPC 204T-1: To understand the strategies of scale up process of apis and intermediates.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO1.1:** Introduction to Process chemistry	**NA**	**1.1:** Process chemistry Introduction **1.2:** Synthetic strategy **1.3:** Stages of scale up process: Bench **1.4:** Stages of scale up process: pilot **1.5:** Stages of scale up process: large scale process **1.6:** In-process control **1.7:** Validation of large scale process **1.8:** Case studies of some scale up process of APIs **1.9:** Impurities in API **1.10:** Types and their sources **1.11:** Types and their sources including genotoxic impurities **1.12:** Types and their sources including genotoxic impurities	**1.1:** To study the Basic Aspects strategies of scale up process of apis and intermediates

Suggested Assignments:

1. Explain Stages of scale up process: Bench, pilot and large scale process.
2. Write the detail about Case studies of some scale up process of API.

Unit II

CO-MPC 204T.2: To understand the various unit operations and various reactions in process chemistry.

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Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO2.1:** Unit operations Extraction, Filtration, Distillation, Evaporation Crystallization	**NA**	**2.1:** Extraction: Liquid equilibria **2.2:** Extraction with reflux **2.3:** Extraction with agitation **2.4:** Counter current extraction **2.5:** Theory of filtration **2.6:** Pressure and vacuum filtration **2.7:** Centrifugal filtration **2.8:** Azeotropic distilltion **2.9:** Steam distillation **2.10:** Evaporation: Types of evaporators, factors affecting evaporation **2.11:** Crystallization from aqueous, nonaqueous solutions factors affecting crystallization **2.12:** Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous API	**2.1:** Factors affecting crystallization, nucleation

Suggested Assignments:

1. Explain factors affecting evaporation.
2. Write the detail about Theory of filtration.

Unit III

CO-MPC 204T-3: To understand the process is to develop synthetic routes that are safe, cost-effective, environmentally friendly and efficient.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO3.1:** Unit Processes – I Nitration **SO3.2:** Unit Processes - I Halogenations **SO3.3:** Unit Processes – I Oxidation	**NA**	**3.1:** Nitrating agents, Aromatic nitration **3.2:** Kinetics and mechanism of aromatic nitration **3.3:** Process equipment for technical nitration **3.4:** Mixed acid for nitration **3.5:** Kinetics of halogenations **3.6:** Types of halogenations **3.7:** Catalytic halogenations **3.8:** Case study on industrial halogenations **3.9:** Introduction, types of oxidative reactions **3.10:** Liquid phase oxidation with oxidizing agents **3.11:** Nonmetallic Oxidizing agents such as H_2O_2 **3.12:** Sodium hypochlorite, Oxygen gas, ozonolysis	**3.1:** Process equipment for technical nitration **3.2:** Oxidation: Introduction, types of oxidative reactions

Suggested Assignments:

1. Explain mechanism of aromatic nitration.

Unit IV

CO-MPC 204T-4: To understand the subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	1
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO4.1:** Unit Processes – II Reduction **SO4.2:** Unit Processes - II Fermentation **SO4.3:** Unit Processes –II kinetic analysis	**NA**	**4.1:** Catalytic hydrogenation **4.2:** Heterogeneous and homogeneous catalyst **4.3:** Hydrogen transfer reactions, Metal hydrides **4.4:** Case study on industrial reduction process **4.5:** Fermentation: Aerobic and anaerobic fermentation **4.6:** Antibiotics; Penicillin and Streptomycin **4.7:** Vitamins: B2 and B12 **4.8:** Statins: Lovastatin, Simvastatin **4.9:** Reaction progress kinetic analysis **4.10:** Streamlining reaction steps, route selection **4.11:** Characteristics of expedient routes, characteristics of cost-effective routes **4.12:** Reagent selection, families of reagents useful for scale-up	**4.1:** Case study on industrial reduction process **4.2:** Production of Antibiotics-Penicillin and Streptomycin

Suggested Assignments:

1. Explain about Heterogeneous and homogeneous catalyst.

Unit V

CO-MPC 204T-5: To understand the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

Item	Approx Hrs
Lecture	12
Practical (P)	0
SW	2
SL	1
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Class room Instruction (CI)	Self Learning (SL)
Theory **SO5.1:** Industrial Safety	**NA**	**5.1:** Material Safety Data Sheet **5.2:** Hazard labels of chemicals **5.3:** Personal Protection Equipment (PPE) **5.4:** Fire hazards **5.5:** Types of hazards **5.6:** Fire extinguishers **5.7:** Occupational Health **5.8:** Safety Assessment Series 1800 **5.9:** OHSAS-1800 **5.10:** ISO-14001 **5.11:** Environmental Management System **5.12:** Effluents and its management	**5.1:** Material Safety Data Sheet

Suggested Assignments:

1. Give the Concept of hazard labels of chemicals and Personal Protection Equipment.
2. Discuss in detail about Effluents and its management.

Brief of Hours suggested for the Course Outcome

Course Out comes	Class Lecture (Cl)	(LI)	Sessional Work (SW)	Self Learning(Sl)	Total Hour (Cl+SW +Sl+LI)
CO-MPC 204T-1: To understand the strategies of scale up process of apis and intermediates.	12	0	2	1	15
CO-MPC 204T-2: To understand the various unit operation and various reactions in process chemistry.	12	0	2	1	15
CO-MPC 204T-3: To understand the process is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient.	12	0	1	2	15
CO-MPC 204T-4: To understand the subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure.	12	0	1	2	15
CO-MPC 204T-5: To understand the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.	12	0	2	1	15
Total Hours	**60**	**0**	**8**	**7**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

Course Outcome	Unit Titles	Marks Distribution			Total Marks
		A	C	E	
CO-MPC 204T-1:	To understand the strategies of scale up process of apis and intermediates.	08	07	07	22
CO-MPC 204T-2:	To understand the various unit operations and various reactions in process chemistry.	08	06	02	16
CO-MPC 204T-3:	To understand the process is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient.	12	07	01	20
CO-MPC 204T-4:	To understand the subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure.	11	06	03	20
CO-MPC 204T-5:	To understand the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.	08	07	07	22
Total		**47**	**33**	**20**	**100**

Legend: A: Apply C: Creative E: Evaluate

The end of semester assessment for Pharmaceutical Process Chemistry will be held with written examination of 75 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, Face book, Twitter, Whats app, Mobile, Online sources)
8. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	"Computational and structural approaches to drug discovery".	Robert M Stroud and Janet. F Moor	RCS Publishers.	2007
2	"Pharmaceutical Manufacturing Encyclopedia".	-------	-----	3 rd edition, Volume 2
3	"Medicinal Chemistry".	Burger	--------.	6 th edition, Volume 1-8
4	"Unit operations of chemical engineering".	W.L. McCabe, J.C Smith, Peter Harriott.	McGraw Hill.	7th edition
5	Polymorphism in Pharmaceutical Solids.	H G Brittain		Volume 95 & 1999
6	Introduction to Chemical Processes: Principles, Analysis, Synthesis	Regina M. Murphy	-----	---
7	Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-U.	Peter J. Harrington	---	----
8	Unit processes in organic synthesis	P.H.Groggins	------	----
9	Dryden's Outlines of Chemical Technology	M.Gopal	WEP East-West Press	
10	A text book of Chemical Technology	S.D. Shukla & G.N. Pandey	Vikas Publishing Hous	Vol. IIs

Curriculum Development Team:

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Course Outcome & Program Outcome Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	Scientific Knowledge	Technological Application	Modern tool usage	Entrepreneur ship	Practical Skill	Applied Science	Computational and Statistical methodologies	Pharmaceutical Ethics	Environment and sustainability	Life-long learning	Analytical thinking and problem solving ability	Create and Innovate	Quality management and translational research
CO-MPC 204T-1: Scale up process	3	2	3	1	3	2	1	3	2	3	1	2	3
CO-MPC 204T-2: Unit operations and various reactions	2	2	3	2	1	3	2	2	1	3	2	1	1
CO-MPC 204T-3: Develop synthetic routes	1	2	1	3	3	2	3	3	2	2	1	3	3
CO-MPC 204T-4: Optimization of synthetic routes	2	1	3	2	2	3	2	2	2	3	2	2	1
CO-MPC 204T-5: Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs)	3	2	2	1	3	2	3	3	1	2	1	1	1

Legend: 1- Low, 2-Medium, 3-High

Course Curriculum Mapping

POs & PSOs No.	COs No. & Title	SOs No.	Class Room Instructions	Laboratory Instructions	Self learning
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 204T-1:** To understand the strategies of scale up process of apis and intermediates.	SO1.1	1.1,1.2,1.3,1.4,1.5,1.6,1.7,1.8,1.9, 1.10,1.11. 1.12	--	SI-1.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 204T-2:** To understand the various unit operations and various reactions in process chemistry.	SO2.1	2.1, 2.2, 2.3, 2.4, 2.5, 2.6. 2.7, 2.8, 2.9, 2.10, 2.11, 2.12	--	SI-2.1
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 204T-3:** To understand the process is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient.	SO3.1 SO3.2 SO3.3	3.1,3.2,3.3,3.4,3.5,3.6,3.7,3.8,3.9, 3.10,3.11,3.12.	--	SI-3.1 SI-3.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 204T-4:** To understand the subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure.	SO4.1 SO4.2 SO4.3	4.1,4.2,4.3,4.4,4.5,4.6,4.7,4.8,4.9, 4.10,4.11,4.12.	--	SI-4.1 SI-4.2
POs:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MPC 204T-5:** To understand the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.	SO5.1	5.1,5.2,5.3,5.4,5.5,5.6,5.7,5.8,5.9, 5.10,5.11. 5.12	--	SI-5.1

A K S University

Faculty of Pharmaceutical Science & Technology
Rajiv Gandhi Institute of Pharmacy
Curriculum of M. Pharmacy (Pharmaceutical Chemistry-MPC) Program
(Revised as on 01 August 2023)
Semester-II

Course Code: MPC 205P
Course Title: Pharmaceutical Chemistry Practical - II

Practical Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MPC 205P	Pharmaceutical Chemistry Practical -II	20	30	6 Hrs	50	100	6 Hrs	150

S. No.	List of Practicals
1.	Synthesis of organic compounds by adapting different approaches involving (3 experiments). a) Oxidation b) Reduction/hydrogenation c) Nitration
2.	Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)
3.	Assignments on regulatory requirements in API (2 experiments).
4.	Comparison of absorption spectra by UV and Wood ward – Fieser rule.
5.	Interpretation of organic compounds by FT-IR.
6.	Interpretation of organic compounds by NMR.
7.	Interpretation of organic compounds by MS.
8.	Determination of purity by DSC in pharmaceuticals.
9.	Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra.
10.	To carry out the preparation of following organic compounds.
11.	Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).
12.	Preparation of 4-iodotolene from p-toluidine.
13.	NaBH4 reduction of vanillin to vanillyl alcohol.
14.	Preparation of umbelliferone by Pechhman reaction.
15.	Preparation of triphenyl imidazole.
16.	To perform the Microwave irradiated reactions of synthetic importance (Any two).
17.	Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares.
18.	Calculation of ADMET properties of drug molecules and its analysis using softwares.
Pharmacophore modeling	
19.	2D-QSAR based experiments
20.	3D-QSAR based experiments
21.	Docking study based experiment
22.	Virtual screening based experiment

Course Code: MRM 301T

Course Title: Research Methodology & Biostatistics

Pre-requisite: Awareness of ethical guidelines related to human and animal research is necessary. Students should know how to search for scientific literature using databases like Pub Med, Scopus, or Google Scholar. Students should have Basic Pharmacology Knowledge.

Rationale/Objectives: Research methodology equips students with critical skills needed for scientific inquiry. It empowers them to contribute to the field of pharmacology by conducting rigorous studies.

Career Relevance: Understanding research methods is crucial for future pharmacists, researchers, and academics. It prepares them for evidence-based practice and scholarly work.

Course Outcomes:

CO-MRM 301-1: Understand General Research Methodology.

CO-MRM 301-2: Evaluation of Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, (students "t" test, ANOVA, Correlation coefficient, regression), null hypothesis.

CO-MRM 301-3: Analysis of Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia.

CO-MRM 301-4: Understand **C**PCSEA guidelines for laboratory animal facility.

CO-MRM 301-5: Understand Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care**.**

Scheme of Studies

Course code	**Title of the course**	**Program Name**	**Total Number of contact hours/Week**					**Credit**
			Class room Instruction (A)	**Practical (P)**	**SW**	**SL**	**Total Hours**	
			Lecture				**(H)**	
MRM 101T	Research Methodology & Biostatistics	M. Pharmacy	4	-	1	1	6	4

Legend: CI: Class room Instruction (Includes different instructional strategies i.e. Lecture (L) and Tutorial (T) and others
LI: Laboratory Instruction (Includes Practical performances in laboratory workshop, field or other locations using different instructional strategies)
SW: Sessional Work **(**includes assignment, seminar, and mini project etc.)
SL: Self Learning, Credits
Note: SW& SL has to be planned and performed under the continuous guidance and feedback of teacher to ensure outcome of Learning

Theory Assessment

Course Code	Course	Internal Assessment (A)				End Semester Exams (B)		Total Marks (A+B)
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
MRM 101T	Research Methodology & Biostatistics	10	15	1 Hr	25	75	3Hrs.	100

Guidelines for the allotment of marks for attendance

Percentage of Attendance	Theory	Practical
95–100	8	10
90–94	6	7.5
85–89	4	5
80–84	2	2.5
Less than 80	0	0

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.

Unit I

CO-MRM 301-1: Understand General Research Methodology.

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Item	Approx Hrs
Lecture	10
Practical (P)	0
SW	3
SL	3
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
Theory **SO1.1:** Understand General Research Methodology: Research, objective, requirements, practical difficulties **SO1.2:** Understand review of literature, study design, types of studies **SO1.3:** To Learn dosage strategies to eliminate errors/bias, controls, randomization **SO1.4:** Understands crossover design, placebo, blinding techniques	**NA**	**1.1:** General Research Methodology: Research **1.2:** Objective, requirements **1.3:** Practical difficulties **1.4:** Review of literature **1.5:** Study design, types of studies **1.6:** Strategies to eliminate **1.7:** Errors/bias, controls **1.8:** Randomization **1.9:** Crossover design **1.10:** Placebo, blinding techniques	**1.1:** Different dosage of animal available in market **1.2:** Different types of dosage and calculation **1.3:** Types of studies

Suggested Assignments:

1. Write different animal species and different dose calculation.
2. What do you know about crossover design?
3. Give note on general research methodology.

Unit II

CO-MRM 301-2: Evaluation of Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size.

Item	Approx Hrs
Lecture	09
Practical (P)	0
SW	4
SL	3
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
Theory **SO2.1:** To Understand definition, application Sample size, importance of sample size **SO2.2:** Understand Factors influencing sample size, dropouts **SO2.3:** To statistical tests of significance analysis of variance, correlation, chi square test **SO2.4:** To understand Non-parametric tests (wilcoxan rank tests) **SO2.5:** To learn about null hypothesis, P values, degree of freedom, interpretation of P values	**NA**	**2.1:** Definition, applications **2.2:** Sample size, importance of sample size **2.3:** Factors influencing sample size, dropouts **2.4:** Statistical tests of significance **2.5:** Analysis of variance, correlation, chi square test) **2.6:** Non-parametric tests (wilcoxan rank tests) **2.7:** Null hypothesis **2.8:** P values, degree of freedom **2.9:** Interpretation of P values	**2.1:** Read research article **2.2:** Work in different software **2.3:** Importance of sample size

Suggested Assignments:

1. Differentiate null hypothesis and alternate hypothesis.
2. Write type of significance tests.
3. Give note on analysis of variance, correlation, chi square test.
4. Write note on importance of sample size.

Unit III

CO-MRM 301-3: Analysis of Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy.

Item	Approx Hrs
Lecture	09
Practical (P)	0
SW	4
SL	3
Total	16

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
Theory **SO3.1:** To Understand definition, application Sample size, importance of sample size **SO3.2:** Understand Factors influencing sample size, dropouts **SO3.3:** To statistical tests of significance analysis of variance, correlation, chi square test **SO3.4:** To understand Non-parametric tests (wilcoxan rank tests) **SO3.5:** To learn about Null hypothesis, P values, degree of freedom, interpretation of P values		**3.1:** History, values in medical ethics, conflicts **3.2:** Autonomy, Beneficence **3.3:** Non-maleficence, double effect **3.4:** Conflicts between autonomy and beneficence/non-maleficence **3.5:** Euthanasia, informed consent, confidentiality **3.6:** Criticisms of orthodox medical ethics, importance of communication **3.7:** Control resolution, guidelines, ethics committees, cultural concerns **3.8:** Truth telling, online business practices, conflicts of interest **3.9:** Referral, vendor relationships, fatality	**3.1:** Different examples of conflict of interest **3.2:** Learn about duplicate research **3.3:** Values in medical ethics

Suggested Assignments:

1. Discuss the History, values in medical ethics.
2. Write conflicts between autonomy and beneficence/non-maleficence.
3. Give importance of communication.
4. Write different examples of conflict of interest.

Unit IV

CO-MRM 301-4: Understand CPCSEA guidelines for laboratory animal facility.

Item	Approx Hrs
Lecture	09
Practical (P)	0
SW	4
SL	2
Total	15

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
Theory **SO4.1:** To learn CPCSEA guidelines for laboratory animal facility. **SO4.2:** Understand Quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene. **SO4.3:** To analyze 5 Euthanasia, physical facilities, environment. **SO4.4:** To Understand SOPs, personnel and training. **SO4.5:** To learn about Transport of lab animals.		**4.1:** Goals, veterinary care **4.2:** Quarantine, surveillance, diagnosis **4.3:** Treatment and control of disease, personal hygiene **4.4:** location of animal facilities to laboratories, anesthesia **4.5:** Euthanasia, physical facilities, environment **4.6:** Animal husbandry, record keeping **4.7:** SOPs **4.8:** Personnel and training **4.9:** Transport of lab animals	**4.1:** Knowledge about animal model **4.2:** Anatomy of different laboratory animals

Suggested Assignments:

1. Note on CPCSEA guidelines for laboratory animal facility.
2. Write different aspect of transport of lab animal.
3. How to learn CPCSEA guidelines for laboratory animal facility.
4. Give note on animal husbandry, record keeping.

Unit V

CO-MPH 301-5: Understand Declaration of Helsinki: Basic principles for all medical research and additional principles for medical research combined with medical care.

Item	Approx Hrs
Lecture	04
Practical (P)	0
SW	4
SL	4
Total	12

Session Outcomes (SOs)	Laboratory Instruction (LI)	Classroom Instruction (CI)	Self Learning (SL)
Theory **SO5.1:** To learn CPCSEA guidelines for laboratory animal facility **SO5.2:** Understand History, introduction, basic principles for all medical research **SO5.3:** To understand Additional principles for medical research combined with medical care		**5.1:** History **5.2:** Introduction **5.3:** Basic principles for all medical research **5.4:** Additional principles for medical research combined with medical care	**5.1:** learn about biostatics **5.2:** learn MS word **5.3:** learn MS office **5.4:** learn MS excel

Suggested Assignments:

1. Write note on basic principles for all medical research.
2. Explain declaration of helsinki.
3. Give note on principles for medical research combined with medical care.
4. How to learn CPCSEA guidelines for laboratory animal facility.

Brief of Hours suggested for the Course Outcome

Course Outcomes	Class Lecture (Cl)	(LI)	Sessional Work (SW)	Self Learning (Sl)	Total Hour (Cl+SW+ Sl+LI)
CO-MRM 301-1: Understand General Research Methodology.	10	0	3	3	16
CO-MRM 301-2: Evaluation of Biostatistics: Definition, application, sample size, importance of sample size.	09	0	4	3	16
CO-MRM 301-3: Analysis of Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy.	09	0	4	3	16
CO-MRM 301-4: Understand CPCSEA guidelines for laboratory animal facility.	09	0	4	2	15
CO-MRM 301-5: Understand declaration of Helsinki: Basic principles for all medical research and additional principles for medical research combined with medical care.	04	0	4	4	12
Total Hours	**41**	**0**	**19**	**15**	**75**

Suggestion for End Semester Assessment

Suggested Specification Table (For ESA)

Course Outcome	Unit Title	Marks Distribution			Total Marks
		A	C	E	
CO-MRM 101T-1:	Understand General Research Methodology.	08	09	03	20
CO-MRM 101T-2:	Evaluation of Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, (students "t" test, ANOVA, Correlation coefficient, regression), null hypothesis.	09	08	03	20
CO-MRM 101T-3:	Analysis of Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia.	08	09	03	20
CO-MRM 101T-4:	Understand CPCSEA guidelines for laboratory animal facility.	09	08	03	20
CO-MRM 101T-5:	Understand Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.	08	09	03	20
Total		**42**	**43**	**15**	**100**

Legend: A: Analyze, C: create, E: Evaluate

The end of semester assessment for Research Methodology & Biostatistics will be held with written examination of 75 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. ICTBasedTeachingLearning(VideoDemonstration/TutorialsCBT,Blog, Face book,Twitter,Whatsapp,Mobile,Onlinesources)
8. Brainstorming

Suggested Learning Resources:

S. No.	Title	Author	Publisher	Edition & Year
1	Research Methodology	C.R KOTHARI	New Age International Publishers	5TH edition 2023
2	Research Methodology and Strategy: Theory and Practice	Patrick X.W. Zou Xiaoxiao Xu	John Wiley & Sons, Ltd.	First published: 2023

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Course Outcome & Program Outcome Mapping

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2	PSO3
	Scientific Knowledge	Technological Application	Modern tool usage	Entrepreneur ship	Practical Skill	Applied Science	Computational and Statistical methodologies	Pharmaceutical Ethics	Environment and sustainability	Life-long learning	Analytical thinking and problem solving ability	Create and Innovate	Quality management and translational research
CO-MRM 301T-1: Research Methodology	3	2	3	1	3	2	1	3	2	3	3	2	3
CO-MRM 301T-2: Evaluation of Biostatistics	2	2	3	2	1	3	2	2	1	3	2	3	2
CO-MRM 301T-3: Analysis of Medical Research	1	2	1	3	3	2	3	3	2	2	2	3	3
CO-MRM 301T-4: CPCSEA guidelines	2	1	3	2	2	3	2	2	2	3	1	2	3
CO-MRM 301T-5: Declaration of Helsinki	3	2	2	1	3	2	3	3	1	2	2	2	3

Legend: 1- Low, 2-Medium, 3-High

Course Curriculum Mapping

POs & PSOs No.	COs No. & Title	SOs No.	Class Room Instructions	Laboratory Instructions	Self learning
Pos:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MRM 301T-1:** Understand General Research Methodology.	SO1.1 SO1.2 SO1.3 SO1.4	1.1,1.2,1.3,1.4,1.5, 1.6,1.7,1.8,1.9,1.1 0	--	SI-1.1 SI-1.2 SI-1.3
Pos:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MRM 301T-2:** Evaluation of Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, (students "t" test, ANOVA, Correlation coefficient, regression), null hypothesis.	SO-2.1 SO-2.2 SO-2.3 SO-2.4 SO-2.5	2.1,2.2,2.3,2.4,2.5, 2.6,2.7,2.8,2.9	--	SI-2.1 SI-2.2 SI-2.3
Pos:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MRM 301T-3:** Analysis of Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia.	SO-3.1 SO-3.2 SO-3.3 SO-3.4 SO-3.5	3.1,3.2,3.3,3.4,3.5, 3.6,3.7,3.8,3.9	--	SI-3.1 SI-3.2 SI-3.3
Pos:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MRM 301T-4:** Understand CPCSEA guidelines for laboratory animal facility.	SO-4.1 SO-4.2 SO-4.3 SO-4.4 SO-4.5	4.1,4.2,4.3,4.4,4.5, 4.6,4.7,4.8,4.9.	--	SI-4.1 SI-4.2
Pos:1,2,3,4,5,6,7,8,9,10 PSOs:1,2,3	**CO-MRM 301T-5:** Understand Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.	SO-5.1 SO-5.2 SO-5.3	5.1,5.2,5.3,5.4.	--	SI-5.1 SI-5.2 SI-5.3 SI-5.4

Course Code: MPC302

Course Title: Journal Club

Every journal club presentation can be approached in this general format:

Introduction
Explain the clinical question that prompted you to consult the literature and what drew you to the article.

Who wrote the paper?
Consider the title of the paper, the authors and their affiliated institution(s). Are there any outstanding features, e.g. a first study of its kind, a well-known author or institution? What is the impact factor of the journal? What is the circulation (i.e. regional, national or international) and who is the readership? Try to ignore the abstract initially. Reading the author's stated conclusions before forming your own ideas about the validity of the paper may influence your appraisal.

The hypothesis
What is the research question? Is it well constructed? Does it observe the four basic components (PICO) of a good research question? Population – who was studied? Intervention – what was the intervention tested? Control – what was the alternative that the intervention was compared to? Outcome – what was the nature of the outcome measured?

Appraise the evidence base
Read the key references and related papers. What is already known on the subject? Is this correctly presented? Is the hypothesis correct? Is the question relevant and important in the context of the existing literature? What does the study contribute to the existing literature? The introduction will usually contain a statement validating the content of the article by placing it in the context of the wider literature. For example, 'Intervention 'x' has been shown to show significant reduction in patient group 'y'. However, no studies to date have assessed the effect of 'x' in patients with a history of 'z'.'

Study design
Consider the following: The study type is it appropriate to the research question and the subject under investigation, e.g. randomized controlled trial, case control, meta-analysis, cross-sectional, descriptive? The study population Can the results of the study are translated to the general population? Is the patient group representative of the normal population? If not, is this addressed in the text? Randomization how are the participants allocated into the groups? Bias this refers to a flaw in impartiality that introduces systematic error into the methodology and results of a study. Is the research method exposed to bias? Has randomization been used to reduce experiment bias?

What form of blinding or masking has been used to reduce experimental or observational bias? Inclusion and exclusion criteria are these appropriate and clearly stated? Can you identify any oversights that may affect the validity of the study?

Are the methods thorough?

A flawed methodology will undermine the validity of the results. Consider the following: Was the method and approach to the study appropriately diligent? Were processes consistent? Was follow up complete and consistent in each group? What outcome measures were used and were they appropriate? Are the statistical tools adopted suitable and correctly interpreted by the investigators? Have the authors made a power statement? What significance level has been used (P value)? Has the power of the study been stated, does it exceed 80%? Was a power analysis carried out? Was this before the study or post-Doc? Is the study sufficiently powered to eliminate errors? Do the data exhibit low variability? What is the effect size?

Results

Are the results clearly stated? Is the result statistically significant, i.e. is the P value less than 0.05 (is the null hypothesis rejected)? Remember to review supplementary graphs and tables and consider whether they are accurate and represent the data presented in the text.

Discussion and interpretation

Discuss the strengths and weaknesses of the study. Do the results support the conclusions? Often the conclusions will exceed the scope of the evidence base in the preceding paper. Consider the statistical significance vs. the clinical significance? Does the article acknowledge the relevant literature and other approaches? Before concluding, the authors will often include a discussion of the limitations of the study. Close attention should be paid to this to ensure a fair appraisal of the author's claims. Have the authors declared any conflicts of interest?

Clinical context

End your appraisal by assessing how the paper might change clinical practice. You might refer back to the clinical question that first drew you to the article.

Output

Having critically appraised and presented the article, consider whether your comments would be of interest to the publishing journal in the form of a letter to the editor. Particular points of merit, in addition to inconsistencies or statistical short fallings, are of interest to the journal, its readership and the author. Writing letters to the editor is a useful way to hone writing skills and, if accepted, are often published quickly and enhance Curriculum vitae. Often, the article may suggest areas for further research.

Reference- https://www.uab.edu/medicine/physci/uab-multidisciplinary-research-stewardship/step-by-step-approach-to-presenting-at-journal-club

Course Code: MPC303

Course Title: Discussion Presentation (Proposal Presentation)

Discussion presentation can be approached in this general format:

- Introduction
- Statement of Problem
- Rationale of Study
- Objectives of Study
- Conceptual Framework
- Research questions and Hypothesis
- Methodology
- Ethical Consideration
- Action Plan
- Annexure

A K S University

Faculty of Pharmaceutical Science & Technology
Rajiv Gandhi Institute of Pharmacy
Curriculum of M. Pharmacy (Pharmaceutical Chemistry-MPC) Program
(Revised as on 01 August 2023)
Semester-III

Course Code: MPC304

Course Title: Research Work

All the students shall undertake a project under the supervision of a teacher in Semester III and submit a report. 4 copies of the project report shall be submitted (typed & bound copy not less than 75 pages). The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). The projects shall be evaluated as per the criteria given below-

Evaluation of Dissertation Book:

Objective(s) of the work done	: 50 Marks
Methodology adopted	: 150 Marks
Results and Discussions	: 250 Marks
Conclusions and Outcomes	: 50 Marks
Total	500 Marks

Evaluation of Presentation:

Presentation of work-	
Presentation of work	: 70 Marks
Quality of Power Point Presentation	: 30 Marks
Communication skills-	
Written	: 25 Marks
Verbal	: 25 Marks
Question and answer skills	
Questions	: 50 Marks
Answers	: 50 Marks
Total	250 Marks

Course Code: MPC401

Course Title: Journal Club

Every journal club presentation can be approached in this general format:

Introduction
Explain the clinical question that prompted you to consult the literature and what drew you to the article.

Who wrote the paper?
Consider the title of the paper, the authors and their affiliated institution(s). Are there any outstanding features, e.g. a first study of its kind, a well-known author or institution? What is the impact factor of the journal? What is the circulation (i.e. regional, national or international) and who is the readership? Try to ignore the abstract initially. Reading the author's stated conclusions before forming your own ideas about the validity of the paper may influence your appraisal.

The hypothesis
What is the research question? Is it well constructed? Does it observe the four basic components (PICO) of a good research question? Population – who was studied? Intervention – what was the intervention tested? Control – what was the alternative that the intervention was compared to? Outcome – what was the nature of the outcome measured?

Appraise the evidence base
Read the key references and related papers. What is already known on the subject? Is this correctly presented? Is the hypothesis correct? Is the question relevant and important in the context of the existing literature? What does the study contribute to the existing literature? The introduction will usually contain a statement validating the content of the article by placing it in the context of the wider literature. For example, 'Intervention 'x' has been shown to show significant reduction in patient group 'y'. However, no studies to date have assessed the effect of 'x' in patients with a history of 'z'.'

Study design
Consider the following: The study type is it appropriate to the research question and the subject under investigation, e.g. randomized controlled trial, case control, meta-analysis, cross-sectional, descriptive? The study population Can the results of the study are translated to the general population? Is the patient group representative of the normal population? If not, is this addressed in the text? Randomization how are the participants allocated into the groups? Bias this refers to a flaw in impartiality that introduces systematic error into the methodology and results of a study. Is the research method exposed to bias? Has randomization been used to reduce experiment bias?

What form of blinding or masking has been used to reduce experimental or observational bias? Inclusion and exclusion criteria are these appropriate and clearly stated? Can you identify any oversights that may affect the validity of the study?

Are the methods thorough?

A flawed methodology will undermine the validity of the results. Consider the following: Was the method and approach to the study appropriately diligent? Were processes consistent? Was follow up complete and consistent in each group? What outcome measures were used and were they appropriate? Are the statistical tools adopted suitable and correctly interpreted by the investigators? Have the authors made a power statement? What significance level has been used (P value)? Has the power of the study been stated, does it exceed 80%? Was a power analysis carried out? Was this before the study or post-Doc? Is the study sufficiently powered to eliminate errors? Do the data exhibit low variability? What is the effect size?

Results

Are the results clearly stated? Is the result statistically significant, i.e. is the P value less than 0.05 (is the null hypothesis rejected)? Remember to review supplementary graphs and tables and consider whether they are accurate and represent the data presented in the text.

Discussion and interpretation

Discuss the strengths and weaknesses of the study. Do the results support the conclusions? Often the conclusions will exceed the scope of the evidence base in the preceding paper. Consider the statistical significance vs. the clinical significance? Does the article acknowledge the relevant literature and other approaches? Before concluding, the authors will often include a discussion of the limitations of the study. Close attention should be paid to this to ensure a fair appraisal of the author's claims. Have the authors declared any conflicts of interest?

Clinical context

End your appraisal by assessing how the paper might change clinical practice. You might refer back to the clinical question that first drew you to the article.

Output

Having critically appraised and presented the article, consider whether your comments would be of interest to the publishing journal in the form of a letter to the editor. Particular points of merit, in addition to inconsistencies or statistical short fallings, are of interest to the journal, its readership and the author. Writing letters to the editor is a useful way to hone writing skills and, if accepted, are often published quickly and enhance Curriculum vitae. Often, the article may suggest areas for further research.

Reference- https://www.uab.edu/medicine/physci/uab-multidisciplinary-research-stewardship/step-by-step-approach-to-presenting-at-journal-club

Course Code: MPC402

Course Title: Research Work

All the students shall undertake a project under the supervision of a teacher in Semester IV and submit a report. 4 copies of the project report shall be submitted (typed & bound copy not less than 75 pages). The internal and external examiner appointed by the University shall evaluate the project at the time of the Practical examinations of other semester(s). The projects shall be evaluated as per the criteria given below-

Evaluation of Dissertation Book:

Objective(s) of the work done	: 50 Marks
Methodology adopted	: 150 Marks
Results and Discussions	: 250 Marks
Conclusions and Outcomes	: 50 Marks
Total	500 Marks

Evaluation of Presentation:

Presentation of work-	
Presentation of work	: 70 Marks
Quality of Power Point Presentation	: 30 Marks
Communication skills-	
Written	: 25 Marks
Verbal	: 25 Marks
Question and answer skills-	
Questions	: 50 Marks
Answers	: 50 Marks
Total	250 Marks

Course Code: MPC403

Course Title: Discussion/ Final Presentation

Discussion presentation can be approached in this general format:

- Introduction
- Statement of Problem
- Rationale of Study
- Objectives of Study
- Conceptual Framework
- Research questions and Hypothesis
- Methodology
- Ethical Consideration
- Action Plan
- Annexures