FACULTY OF PHARMACY

KARPAGAM ACADEMY OF HIGHER EDUCATION

Deemed to be University

(Established Under Section 3 of UGC Act 1956)

Eachanari Post, Pollachi Main Road, Coimbatore – 641021.

M.PHARMACY DEGREE COURSE (2024-25)

(PHARMACEUTICAL CHEMISTRY)

Enable | Enlighten | Enrich

KARPAGAM

ACADEMY OF HIGHER EDUCATION

(Deemed to be University)

(Established Under Section 3 of UGC Act, 1956)

REGULATIONS 2024

COURSE OF STUDY AND SCHEME OF EXAMINATION

& SYLLABUS

CHAPTER – I: REGULATIONS

1. Short Title and Commencement

These regulations shall be called as "The Revised Regulations for the Master of Pharmacy (M. Pharm.)Degree Program - Credit Based Semester System (CBSS) of the Pharmacy Council of India, New Delhi". They shall come into effect from the Academic Year 2023-23. The regulations framed are subject to modifications from time to time by the authorities of the university.

2. Minimum qualification for admission

A Pass in the following examinations

a) B. Pharm Degree examination of an Indian university established by law in India from an institution approved by Pharmacy Council of India and has scored not less than 55 % of the maximum marks (aggregate of 4 years of B.Pharm.).

b) Every student, selected for admission to post graduate pharmacy program in any PCI approved institution should have obtained registration with the State Pharmacy Council or should obtain the same within one month from the date of his/her admission, failing which the admission of the candidate shall be cancelled.

Note: It is mandatory to submit a migration certificate obtained from the respective university where the candidate had passed his/her qualifying degree (B.Pharm).

3. Duration of the program

The program of study for M.Pharm shall extend over a period of four semesters (two academic years). The curricula and syllabi for the program shall be prescribed from time to time by Pharmacy Council of India, New Delhi.

4. Medium of instruction and examinations

Medium of instruction and examination shall be in English.

5. Working days in each semester

Each semester shall consist of not less than 100 working days. The odd semesters shall be conducted from the month of June/July to November/December and the even semesters shall be conducted from the month of December/January to May/June in every calendar year.

6. Attendance and progress

A candidate is required to put in at least 80% attendance in individual courses considering theory and practical separately. The candidate shall complete the prescribed course satisfactorily to be eligible to appear for the respective examinations.

7. Program/Course credit structure

As per the philosophy of Credit Based Semester System, certain quantum of academic work viz. theory classes, practical classes, seminars, assignments, 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/per activity.

Credit assignment

Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) andPractical (P) courses consist of hours spent in the laboratory. Credits (C) for a course is dependent on the number of hours of instruction per week in that course, and is obtained by using a multiplier of one (1) for lecture and a multiplier of half (1/2) for practical (laboratory) hours. Thus, for example, a theory course having four lectures per week throughout the semester carries a credit of 4. Similarly, a practical having four laboratory hours per week throughout semester carries a credit of 2.

The contact hours of seminars, assignments and research work shall be treated as that of practical courses for the purpose of calculating credits. i.e., the contact hours shall be multiplied by 1/2. Similarly, the contact hours of journal club, research work presentations and discussions with the supervisor shall be considered as theory course and multiplied by 1.

Minimum credit requirements

The minimum credit points required for the award of M.Pharm degree is 95. However based on the credit points earned by the students under the head of co- curricular activities, a student shall earn a maximum of 100 credit points. These credits are divided into Theory courses, Practical, Seminars, Assignments, Research work, Discussions with the supervisor, Journal club and Co- Curricular activities over the duration of four semesters. The credits are distributed semester- wise as shown in Table V. Courses generally progress in sequence, 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.

8. Academic work

A regular record of attendance both in Theory, Practical, Seminar, Assignment, Journal club, Discussion with the supervisor, Research work presentation and Dissertation shall be maintained by the department / teaching staff of respective courses.

9. Course of study

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

Course Code	Course	Credit Hours	Credit Points	Hrs./week	Marks
Semester I					
24MPC101T	Modern Pharmaceutical Analytical Techniques - Theory	4	4	4	100
24MPC102T	Advanced Organic Chemistry I -Theory	4	4	4	100
24MPC103T	Advanced Medicinal Chemistry - Theory	4	4	4	100
24MPC104T	Chemistry of Natural Products – Theory	4	4	4	100
24MPC105P	Pharmaceutical Chemistry - Practical I	6	3	6	75
24MPC106P	Modern Pharmaceutical Analytical Techniques - Practical	6	3	6	75
24MPC107S	Seminar/Assignment	7	4	7	100
Total		35	26	35	650
Semester II					
24MPC201T	Advanced Spectral Analysis – Theory	4	4	4	100
24MPC202T	Advanced Organic Chemistry II – Theory	4	4	4	100
24MPC203T	Computer Aided Drug Design – Theory	4	4	4	100
24MPC204T	Pharmaceutical Process Chemistry – Theory	4	4	4	100
24MPC205P	Pharmaceutical Chemistry – Practical II	12	6	12	150
24MPC206S	Seminar/Assignment	7	4	7	100
Total		35	26	35	650

Table II: Course of study for M. Pharm III Semester (M.PHARM Pharmaceutical chemistry)

Course Code	Course	Credit Hours	Credit Points
24MPC301T	Research Methodology and Biostatistics - Theory*	4	4
24MPC302J	Journal Club	1	1
24MPC303D	Discussion / Presentation(Proposal Presentation)	2	2
24MPC304RW	Research Work	28	14
Total		35	21

*** Non University Exam**

Table III: Course of study for M. Pharm IV Semester
(M.PHARM Pharmaceutical Chemistry)

Course Code	Course	Credit Hours	Credit Points
24MPC401J	Journal Club	1	1
24MPC402RW	Research Work	31	16
24MPC403D	Discussion / Presentation(Proposal Presentation)	3	3
Total		35	20

Table VI: Semester wise credits distribution

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

*Credit Points for Co-curricular Activities

Table V: Guidelines for Awarding Credit Points for Co-curricular Activities

Name of the Activity	Maximum Credit Points Eligible / Activity
Participation in National Level Seminar/Conference/Workshop/Symposium/Training Programs (related to the specialization of the student)	01
Participation in international Level Seminar/Conference/Workshop/Symposium/Training Programs (related to the specialization of the student)	02
Academic Award/Research Award from State Level/National Agencies	01
Academic Award/Research Award from International Agencies	02
Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)	01

Research / Review Publication in International Journals (Indexed in Scopus / Web of Science)	02

Note: International Conference: Held outside India International Journal: The Editorial Board outside India

* The credit points assigned for extracurricular and or co-curricular activities shall be given by the Principals of the colleges and the same shall be submitted to the University. The criteria to acquire this credit point shall be defined by the colleges from time to time.

10. Program Committee

1. The M. Pharm programme shall have a Programme Committee constituted by the Head of the institution in consultation with all the Heads of the departments.
2. The composition of the Programme Committee shall be as follows:

   A teacher at the cadre of Professor shall be the Chairperson; One Teacher from each M.Pharm specialization and four student representatives (two from each academic year),nominated by the Head of the institution.
3. Duties of the Programme Committee:

i. Periodically reviewing the progress of the classes.
ii. Discussing the problems concerning curriculum, syllabus and the conduct of classes.
iii. Discussing with the course teachers on the nature and scope of assessment for the course and the same shall be announced to the students at the beginning of respective semesters.
iv. Communicating its recommendation to the Head of the institution on academic matters.
v. The Programme Committee shall meet at least twice in a semester preferably at the end of each sessional exam and before the end semester exam.

11. Examinations/Assessments

The schemes for internal assessment and end semester examinations are given in Table – VIII.

End semester examinations

The End Semester Examinations for each theory and practical course through semesters I to IV shall be conducted by the respective university except for the subject with asterix symbol (*) in table I and II for which examinations shall be conducted by the subject experts at college level and the marks/grades shall be submitted to the university.

Table VI: Schemes for Internal Assessments and End Semester Examinations (Pharmaceutical Chemistry)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER I								
24MPC101T	Modern Pharmaceutical Analytical Techniques - Theory	10	15	1 Hr	25	75	3 Hrs	100
24MPC102T	Advanced Organic Chemistry I -Theory	10	15	1 Hr	25	75	3 Hrs	100
24MPC103T	Advanced Medicinal Chemistry - Theory	10	15	1 Hr	25	75	3 Hrs	100
24MPC104T	Chemistry of Natural Products - Theory	10	15	1 Hr	25	75	3 Hrs	100
24MPC105P	Pharmaceutical Chemistry - Practical I	10	15	3 Hrs	25	50	3 Hrs	75
24MPC106P	Modern Pharmaceutical Analytical Techniques - Practical	10	15	3 Hrs	25	50	3Hrs	75
24MPC107S	Seminar /Assignment	-	100	-	100	-	-	100
Total								650

SEMESTER II								
24MPC201T	Advanced Spectral Analysis - Theory	10	15	1 Hr	25	75	3 Hrs	100
24MPC202T	Advanced Organic Chemistry II - Theory	10	15	1 Hr	25	75	3 Hrs	100
24MPC203T	Computer Aided Drug Design - Theory	10	15	1 Hr	25	75	3 Hrs	100
24MPC204T	Pharmaceutical Process Chemistry - Theory	10	15	1 Hr	25	75	3 Hrs	100
24MPC205P	Pharmaceutical Chemistry – Practical II	20	30	6 Hrs	50	100	6	150
24MPC206S	Seminar /Assignment -	-	100	-	100	-	-	100
Total								650

Table VII: Schemes for internal assessments and end semester examinations(Semester III& IV) (Pharmaceutical Chemistry)

Course Code	Course	Internal Assessment				End Semester Exams		Total Marks
		Continuous Mode	Sessional Exams		Total	Marks	Duration	
			Marks	Duration				
SEMESTER III								
24MPC301T	Research Methodology and Biostatistics-Theory *	10	15	1 HR	25	75	3 HR	100
24MPC302J	Journal Club	-	-	-	25	-	-	25
24MPC303D	Discussion / Presentation (Proposal Presentation)	-	-	-	50	-	-	50
24MPC304RW	Research Work	-	-	-	-	350	1 HR	350
Total								525
SEMESTER IV								
24MPC401J	Journal club	-	-	-	25	-	-	25
24MPC402RW	Research Work	-	-	-	75	-	-	75
24MPC403D	Discussion/Final Presentation	-	-	-	-	400	1 HR	400
Total								500

*Non University Exam

Internal assessment: Continuous mode

The marks allocated for Continuous mode of Internal Assessment shall be awarded as per the scheme given below.

Table: VIII: Scheme for awarding internal assessment: Continuous mode

Theory		
Criteria	Maximum Marks	
Attendance (Refer Table– 30)	8	
Student – Teacher interaction	2	
Total	10	
Practical		
Attendance (Refer Table– 30)	5	10
Based on Practical Records, Regular viva voce, etc.	5	10
Total	10	20

Table IX: 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

Sessional Exams

Two Sessional exams shall be conducted for each theory / practical course as per the schedule fixed by the college(s). The scheme of question paper for theory and practical sessional examinations is given below.

The average marks of two Sessional exams shall be computed for internal assessment as per theRequirements given in tables – VI.

12. Promotion and award of grades

A student shall be declared PASS and eligible for getting grade in a course of M.Pharm programmeif he/she secures at least 50% marks in that particular course including internal assessment.

13. Carry forward of marks

In case a student fails to secure the minimum 50% in any Theory or Practical course as

specified in 12, then he/she shall reappear for the end semester examination of that course. However his/her marks of the Internal Assessment shall be carried over and he/she shall be entitled for grade obtainedby him/her on passing.

14. Improvement of internal assessment

A student shall have the opportunity to improve his/her performance only once in the sessional exam component of the internal assessment. The re-conduct of the sessional exam shall be completed before the commencement of next end semester theory examinations.

15. Re-examination of end semester examinations

Reexamination of end semester examination shall be conducted as per the schedule given in table XIII.The exact dates of examinations shall be notified from time to time.

Table X: Tentative schedule of end semester examinations

Semester	For Regular Candidates	For Failed Candidates
I and III	November / December	May / June
II and IV	May / June	November / December

16. Allowed to keep terms (ATKT):

No student shall be admitted to any examination unless he/she fulfills the norms given in 6. ATKTrules are applicable as follows:

A student shall be eligible to carry forward all the courses of I and II semesters till the III semester examinations. However, he/she shall not be eligible to attend the courses of IV semester until all thecourses of I, II and III semesters are successfully completed.

A student shall be eligible to get his/her CGPA upon successful completion of the courses of I to IVsemesters within the stipulated time period as per the norms.

Note: Grade AB should be considered as failed and treated as one head for deciding ATKT. Suchrules are also applicable for those students who fail to register for examination(s) of any course in any semester.

17. Grading of performances

17.1. Letter grades and grade points allocations:

Based on the performances, each student shall be awarded a final letter grade at the end of thesemester for each course. The letter grades and their corresponding grade points are given in Table–10.

Table XI: Letter grades and grade points equivalent to Percentage of marks and performances

Letter Grade	Marks Range	Grade Point	Description
O	91 – 100	10	OUTSTANDING
A+	81 – 90	9	EXCELLENT
A	71-80	8	VERY GOOD
B+	66-70	7	GOOD
B	61-65	6	ABOVE AVERAGE
C	55-60	5	AVERAGE
D	50-54	4	PASS
RA	<50	0	REAPPEARANCE
AB	-	0	ABSENT

A learner who remains absent for any end semester examination shall be assigned a letter grade of AB and a corresponding grade point of zero. He/she should reappear for the said evaluation/examination in due course.

18. The Semester grade point average (SGPA)

The performance of a student in a semester is indicated by a number called 'Semester Grade Point Average' (SGPA). The SGPA is the weighted average of the grade points obtained in all the coursesby the student during the semester. For example, if a student takes five courses (Theory/Practical) in asemester with credits C1, C2, C3 and C4 and the student's grade points in these courses are G1, G2,G3 and G4, respectively, and then students' SGPA is equal to:

$$SGPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4G_4}{C_1 + C_2 + C_3 + C_4}$$

The SGPA is calculated to two decimal points. It should be noted that, the SGPA for any semester shall take into consideration the F and ABS grade awarded in that semester. For example if a learner has a F or ABS grade in course 4, the SGPA shall then be computed as:

$$SGPA = \frac{C_1G_1 + C_2G_2 + C_3G_3 + C_4 * \text{ZERO}}{C_1 + C_2 + C_3 + C_4}$$

19. Cumulative Grade Point Average (CGPA)

The CGPA is calculated with the SGPA of all the IV semesters to two decimal points and is indicated in final grade report card/final transcript showing the grades of all IV semesters and

their courses. The CGPA shall reflect the failed statusin case of F grade(s), till the course(s) is/are passed. When the course(s) is/are passedby obtaining a pass grade on subsequent examination(s) theCGPA shall only reflect the new grade and not the fail grades earned earlier.The CGPA is calculated as:

$$\textbf{CGPA} = \frac{C_1S_1 + C_2S_2 + C_3S_3 + C_4S_4}{C_1 + C_2 + C_3 + C_4}$$

where $C_1, C_2, C_3, \ldots$ is the total number of credits for semester I,II,III,…. and $S_1, S_2, S_3, \ldots$ is the SGPA of semester I,II,III,…..

20. Declaration of class

The class shall be awarded on the basis of CGPA as follows: First Class with Distinction = 8 and above

First Class = 6.50 to 7.99

Second Class = 5.00 to 6.49

21. Project work

All the students shall undertake a project under the supervision of a teacher in Semester III to 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 thetime 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	100 Marks
Communication skills	50 Marks
Question and answer skills	100 Marks

Total 250 Marks

22. Award of Ranks

Ranks and Medals shall be awarded on the basis of final CGPA. However, candidates who fail in one or more courses during the M.Pharm program shall not be eligible for award of ranks. Moreover, the candidates should have completed the M. Pharm program in minimum prescribed number of years, (two years) for the award of Ranks.

23. Award of degree

Candidates who fulfill the requirements mentioned above shall be eligible for award of degree during the ensuing convocation.

24. Duration for completion of the program of study

The duration for the completion of the program shall be fixed as double the actual duration of the program and the students have to pass within the said period, otherwise they have to get fresh Registration.

25. Revaluation I Retotaling of answer papers

There is no provision for revaluation of the answer papers in any examination. However, the candidates can apply for retotaling by paying prescribed fee.

26. Re-admission after break of study

Candidate who seeks re-admission to the program after break of study has to get the approval from the university by paying a condonation fee

FACULTY OF PHARMACY

PG PROGRAM (CBSS) – M.PHARM (PHARMACEUTICAL CHEMISTRY)

(2024–2025 Batch and onwards)

Course code	Name of the course	Objectives and out comes		Instruction hours / week			Credit(s)	Maximum Marks		
		PEOs	POs	L	T	P		CIA	ESE	Total
								25	75	100
SEMESTER - I										
24MPC101T	Modern Pharmaceutical Analytical Techniques - Theory	1,2,4	a,c,d, h,j	4	-	-	4	25	75	100
24MPC102T	Advanced Organic Chemistry I - Theory	1,2	a,c,d, h,i,j	4	-	-	4	25	75	100
24MPC103T	Advanced Medicinal Chemistry -Theory	1,2	a,c,d, h,j	4	-	-	4	25	75	100
24MPC104T	Chemistry of Natural Products -Theory	1,2	a,c,d, h,j	4	-	-	4	25	75	100
24MPC105P	Pharmaceutical Chemistry - Practical I	1,2, 4	a,b, c,d ,h,I,j	-	-	6	3	25	50	75
24MPC106P	Modern Pharmaceutical Analytical Techniques - Practical	1,2, 4	a,b, c,d ,h,I,j	-	-	6	3	25	50	75
24MPC107S	Seminar/Assignment	-	-	7	-	-	4	100	-	100
Semester Total				**23**	**-**	**12**	**26**	**150**	**400**	**650**
SEMESTER – II										
24MPC201T	Advanced Spectral Analysis-Theory	1,2,4	a,c,d, h,i,j	4	-	-	4	25	75	100
24MPC202T	Advanced Organic Chemistry II - Theory	1,2	a,c,d, h,i,j	4	-	-	4	25	75	100
24MPC203T	Computer Aided Drug Design -Theory	1,2	a,c,d, h,i,j	4	-	-	4	25	75	100
24MPC204T	Pharmaceutical Process Chemistry - Theory	1,2	a,b,c, d,h,j	4	-	-	4	25	75	100
24MPC205P	Pharmaceutical Chemistry – Practicals II	1,2,4	a,b,c, d,e,h, i,j	-	-	12	6	50	100	150
24MPC206S	Seminar/Assignment	1,2,5	a,b,e, f,h,j	7	-	-	4	100	-	100
Semester Total				**23**	**-**	**12**	**26**	**150**	**400**	**650**
SEMESTER – III										
24MPC301T	Research Methodology and Biostatistics - Theory*	2,5	b,c,j	4	-	-	4	25	75	100

24MPC302J	Journal Club	1,2,3,4,5	a,b,c,d,e,f,h,i,j	1	-	-	1	25	-	25
24MPC303D	Discussion / Presentation (Proposal Presentation)	1,2,4,5	a,b,c,d,e,f,h,I,j	2	-	-	2	50	-	50
24MPC304RW	Research Work	1,2,3,4,5	a,b,c,d,e,f,g,h,i,j	-	-	28	14	-	350	350
Semester Total				**7**	**-**	**28**	**21**	**100**	**425**	**525**
SEMESTER – IV										
24MPC401J	Journal Club	1,2,3,4,5	a,b,c,d,e,f,h,i,j	1	-	-	1	25	-	25
24MPC402RW	Research Work	1,2,3,4,5	a,b,c,d,e,f,g,h,i,j	-	-	31	16	75	-	75
24MPC403D	Discussion / Final Presentation	1,2,4,5	a,b,c,d,e,f,h,i,j	3	-	-	3	-	400	400
Semester Total				**4**	**-**	**31**	**20**	**100**	**400**	**500**

* Non-University Exam

PROGRAMME OUTCOMES (PO)

a. **Pharmacy Knowledge:** Demonstrate knowledge of the basic pharmaceutical sciences and the ability to acquire, manage and use current information for problem solving. Describe the synthesis, formulation, analysis, pharmacological, Pharmacognostical, biotechnological and regulatory aspects of drugs and biopharmaceuticals. Identify the rules and regulations involved in the drug discovery and development, manufacture, distribution and sale of medicines.

b. **Planning Abilities:** Demonstrate effective planning abilities including time management, resource management, delegation skills and organizational skills. Develop and implement plans and organize work to meet deadlines using modern tools.

c. **Research:** An ability to independently carry out research /investigation and development work to solve practical problems. Apply critical thinking skills, including investigation, application, analysis, creativity, evaluation of information, data and documents related to research investigation.

d. **Problem analysis:** Develop problem-based learning approach and analytical thinking in his/her academic and professional life. Utilize the principles of scientific enquiry, thinking analytically, clearly and critically, while solving problems and making decisions during daily practice. Find, analyze, evaluate and apply information systematically and shall make defensible decisions.

e. **Leadership qualities:** Demonstrate the ability to plan and implement professional activities. Act efficiently as a leader in the diverse areas of the profession.

f. **Communication Skills:** Communicate effectively with the pharmacy community and with society at large, such as, being able to comprehend and write effective reports, make effective presentations and documentation, and give and receive clear instructions. Imbibe the skills of scientific communication and research writing.

g. **The Pharmacist and society:** Apply the knowledge and skills gained through education to gain recognition in professional circle and society. Participate in healthcare initiatives to create awareness in society about the effective and safe use of medicines.

h. **Professional Ethics:** Exercise ethical practices and moral values in personal and professional endeavors. Honor personal values and apply ethical principles in professional and social contexts. Demonstrate behavior that recognizes cultural and 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.

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

j. **Life-long learning:** Tackle professional challenges through lifelong learning attitude. Work in a team and participate in lifelong learning and continuous improvement in the profession.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO k: Understand a core and basic knowledge in different subjects of Pharmaceutical Sciences. To prepare graduate to success in technical or professional careers in various pharmaceutical industry and/ or institute and /or Health care system through excellent real time exposure to rigorous education.

PSO l: Analyse the relationships among Pharmaceutics, Pharmaceutical and Medicinal Chemistry, Pharmacology and Pharmacognosy subjects. Understand the applications of Pharmaceutical Sciences in drug and formulation development, drug analysis, drug safety and efficacy in medicine.

PSO m: Perform procedures as per laboratory standards in the areas of Pharmaceutical Sciences.

PSO n: To strengthen the professional and ethical attitude, effective communication skills, teamwork skills, multidisciplinary approach, and an ability to relate pharmaceutical sciences issues to broader social context.

PSO o: To streams a lifelong career of personal and practicing professional growth with ethical codes and self-esteem for a highly productive career and to relate the concepts of Pharmaceutical Sciences towards serving the cause of the society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO 1

To provide a comprehensive and advanced pharmaceutical education leading to M. Pharm. Degree.

PEO 2

To integrate pharmacy knowledge and skills with pharmaceutical research.

PEO 3

To develop pharmacists to contribute effectively in the social health care system.

PEO 4

To provide hands on training through state of art infrastructure to inculcate research aptitude in pharmaceutical sciences.

PEO 5

To inculcate leadership and entrepreneurship capabilities in future pharmacy professionals.

MAPPING

PO	a	b	c	d	e	f	g	h	I	j	PSO k	PSO l	PSO m	PSO n	PSO o
PEO 1	X						X	X		X	X	X	X	X	
PEO 2	X	X	X	X		X		X		X	X	X	X	X	X
PEO 3	X	X		X		X	X	X	X	X	X	X		X	X
PEO 4	X	X	X	X						X	X	X	X	X	X
PEO 5	X	X	X	X	X	X		X	X	X				X	X

Note: (a-k denoted the above mentioned PO)

M.PHARM
PHARMACEUTICAL CHEMISTRY (MPC)

24MPC101T SEMESTER I

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES - THEORY 4H 4C

Instruction hours/ week: L:4 T:0 P:0 Marks: Internal: 25 External:75 Total:100
External Semester Exam: 3Hours

COURSE OBJECTIVES:

- This subject deals with the applications of qualitative and quantitative analysis
- To discuss about principle involved in spectroscopy and Separation techniques.
- To discuss the principle involved in X ray diffraction, Thermal analysis and analysis of immunological techniques.
- To discuss the instrumental analysis of spectroscopy and chromatographic techniques
- To acquired skills in basic concepts of spectral data analysis
- To deal with the applications of pharmaceutical dosage forms

After completion of course student will

COs	Course Outcomes	Blooms Level
CO1	Explain the principle involved in spectroscopy	Understand
CO2	Explain the principle involved in Chromatographic Techniques	Apply
CO3	Describe the instrumentation of various instrumental Techniques	Creat
CO4	Interpret the basic concepts of Spectral data analysis	Evaluate
CO5	Describe the qualitative /quantitative analysis of various API/ drug dosage from through Spectroscopic Techniques.	Understand
CO6	Describe the qualitative /quantitative analysis of various API/ drug dosage from through Chromatographic techniques	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		S										
CO2		S										
CO3			S						M			
CO4			S									
CO5	S											
CO6		S										

S-Strong; M-Medium; L-Low

THEORY 60 hrs

Unit I 10 h

1. **UV-Visible spectroscopy:** Introduction, Theory, Laws, Instrumentation associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and Applications of UV-Visible spectroscopy, Difference/ Derivative spectroscopy.
2. **IR spectroscopy:** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and Applications of IR spectroscopy, Data Interpretation.
3. **Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.
4. Flame emission spectroscopy and atomic absorption spectroscopy: Principle, Instrumentation, Interferences and Applications.

Unit II 8 h

NMR spectroscopy: Quantum numbers and their role in NMR, Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and 13C NMR. Applications of NMR spectroscopy.

Unit III 8 h

Mass Spectroscopy: Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy.

Unit IV 9 h

Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following:

a) Thin Layer chromatography
b) High Performance Thin Layer Chromatography
c) Ion exchange chromatography
d) Column chromatography
e) Gas chromatography
f) High Performance Liquid chromatography
g) Ultra High Performance Liquid chromatography
h) Affinity chromatography
i) Gel Chromatography

Unit V 9 h

1. **Electrophoresis:** Principle, Instrumentation, working conditions, factors affecting separation and applications of the following:

a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing

2. **X ray Crystallography:** Production of X rays, Different X ray methods, Bragg‘s law, Rotating crystal

technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.

Unit VI 12 h

1. **Electro Chemical Analysis:** Principle, instrumentation and Application of poentiometry, conductometry, polarography and Amprometry.
2. **Thermal Techniques:** Principle, thermal transitions and Instrumentation (Heat flux and power-compensation and designs), Modulated DSC, Hyper DSC, experimental parameters (sample preparation, experimental conditions, calibration, heating and cooling rates, resolution, source of errors) and their influence, advantage and disadvantages, pharmaceutical applications.

Differential Thermal Analysis (DTA): Principle, instrumentation and advantage and disadvantages, pharmaceutical applications, derivative differential thermal analysis (DDTA).

TGA: Principle, instrumentation, factors affecting results, advantage and disadvantages, pharmaceutical applications.

3. **Immunological Assay** Basic concepts of RIA (Radio immuno assay), ELISA, Bioluminescence assay.

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. Dekker Series
8. Spectroscopy of Organic Compounds, 2nd edn., P.S/Kalsi, Wiley estern Ltd., Delhi.
9. Textbook of Pharmaceutical Analysis, KA. Connors, 3rd Edition, John Wiley & Sons, 1982.

24MPC102T SEMESTER I

ADVANCED ORGANIC CHEMISTRY-I THEORY 4H 4C

Instruction hours/ week: L:4 T:0 P:0 Marks: Internal: 25 External:75 Total:100

External Semester Exam: 3Hours

SCOPE

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

COURSE OBJECTIVES:

Upon completion of course, the student shall be able to understand

- 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 various protecting groups in organic chemistry
- The chemistry of heterocyclic compounds
- The principles and applications of retrosynthesis

COURSE OUTCOMES

COs	Course Outcomes	Blooms Level
CO1	Understand the basic concepts of organic chemistry and reaction mechanism.	Understand
CO2	Explain the mechanism and applications of named reactions.	Understand
CO3	Discuss important synthetic reagents and protecting groups.	Apply
CO4	Discuss the importance and applications of protecting groups.	Apply
CO5	Elaborate the mechanism and applications of reactions involved in synthesis of drugs containing five, six membered and fused heterocyclics.	Apply
CO6	Explain synthon and retrosynthetic approaches.	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S										
CO3	S	M										
CO4		M		M								
CO5					M					S		
CO6										S		

S-Strong; M-Medium; L-Low

THEORY 60 hrs

Unit I 12 h

1. Basic Aspects of Organic Chemistry:
    a) Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications.
    b) Types of reaction mechanisms and methods of determining them,
    c) Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations.
2. Addition reactions
    a) Nucleophilic uni- and bimolecular reactions (SN1 and SN2)
    b) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule)
    c) Rearrangement reaction

Unit II 12 h

Study of mechanism and synthetic applications of following named Reactions:Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Mille Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeyer-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction

Unit III 12 h

Synthetic Reagents & Applications:

Aluminium isopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodiimide, Wilkinson reagent, Witting reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, (Benzotriazol-1-yloxy) tris (dimethylamino) phosphonium hexafluoro-phosphate (BOP).

Protecting groups

a) Role of protection in organic synthesis
b) Protection for the hydroxyl group, including 1,2-and 1,3-diols: ethers, esters, carbonates, cyclic acetals & ketals
c) Protection for the Carbonyl Group: Acetals and Ketals
d) Protection for the Carboxyl Group: amides and hydrazides, esters
e) Protection for the Amino Group and Amino acids: carbamates and amides

Unit IV 12 h

Heterocyclic Chemistry:

Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused heterocyclics such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis, Pinner Pyrimidine Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis.

Synthesis of few representative drugs containing these heterocyclic nuclei such as Ketoconazole,

Metronidazole, Miconazole, celecoxib, antipyrine, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochlorperazine, Promazine, Chlorpromazine, Theophylline, Mercaptopurine and Thioguanine.

Unit V 12 h

Synthon approach and retrosynthesis applications

a) Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconversion and addition (FGI and FGA)
b) C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-,1,4-, 1,5-, 1,6-difunctionalized compounds
c) Strategies for synthesis of three, four, five and six-membered ring.

REFERENCES

1. "Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.
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" Vol I and II. I.L. Finar. ELBS, Pearson Education Lts, Dorling Kindersley (India) Pvt. Ltd.,
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. Carey, Organic Chemistry, 5th Edition (Viva Books Pvt. Ltd.)
9. Organic Synthesis - The Disconnection Approach, S. Warren, Wily India
10. Principles of Organic Synthesis, ROC Norman and JM Coxan, Nelson Thorns.
11. Organic Synthesis - Special Techniques. VK Ahluwalia and R Agarwal, Narosa Publishers.
12. Organic Reaction Mechanisms IVth Edn, VK Ahluwalia and RK Parashar, Narosa Publishers.

24MPC103T SEMESTER I

ADVANCED MEDICINAL CHEMISTRY - THEORY 4H 4C

Instruction hours/ week: L:4 T:0 P:0 Marks: Internal: 25 External: 75 Total: 100

External Semester Exam: 3Hours

SCOPE

The subject is designed to impart knowledge about recent advances in the field of medicinal chemistry at the molecular level including different techniques for the rational drug design.

COURSE OBJECTIVES:

Upon completion of course, the student shall be able to understand

- Different stages of drug discovery
- The drugs classification, uses, SAR and synthesis.
- 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
- Peptidomimetics

COURSE OUTCOMES:

COs	Course Outcomes	Blooms Level
CO1	Understand the stages of drug discovery and receptors, types and drug receptor interaction.	Understand
CO2	Describe prodrug and analog design in drug discovery.	Understand
CO3	Explain the Classification, Synthesis, therapeutic value and Structural activity relationship of selected CNS, CVS, ANS, autocoid and antimicrobial drugs.	Apply
CO4	Discuss the stereochemical aspects of drug design including case studies.	Apply
CO5	Discuss the enzyme kinetics and rational design of enzyme inhibitors	Apply
CO6	Explain the design and therapeutic value of peptidomimetics and chemistry of prostaglandins	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S										
CO3	S	M										
CO4		M		M								
CO5					M					S		
CO6										S		

S-Strong; M-Medium; L-Low

THEORY 60 hrs

Unit I 12 h

Drug discovery: Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets.

Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists, artificial enzymes.

Unit II 12 h

Prodrug Design and Analog design:

1. **Prodrug design:** Basic concept, Carrier linked prodrugs/ Bio precursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design.
2. **Combating drug resistance:** Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance.
3. **Analog Design:** Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.

Unit III 12 h

1. Medicinal chemistry aspects of the following class of drugs

Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs:Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic agents, Antineoplastic and Antiviral agents.

2. **Stereochemistry and Drug action:** Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination.

Unit IV 12 h

Rational Design of Enzyme Inhibitors

Enzyme kinetics & Principles of Enzyme inhibitors, Enzyme inhibitors in medicine, Enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors.

Unit V 12 h

Peptidomimetics

Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally.

Chemistry of prostaglandins, leukotrienes and thromboxones.

REFERENCES

1. Medicinal Chemistry by Burger, Vol I –VI.
2. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, 12th Edition, Lippincott Williams & Wilkins, Wolters Kluwer (India) Pvt. Ltd, New Delhi.
3. Comprehensive Medicinal Chemistry – Corwin and Hansch.
4. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore.
5. Introduction to Quantitative Drug Design by Y.C. Martin.
6. Principles of Medicinal Chemistry by William Foye, 7th Edition, Lippincott Williams & Wilkins, Woltess Kluwer (India) Pvt. Ltd, New Delhi.
7. Drug Design Volumes by Ariens, Academic Press, Elsevier Publishers, Noida, Uttar Pradesh.
8. Principles of Drug Design by Smith.
9. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, II Edition, Elsevier Publishers, New Delhi.
10. An Introduction to Medicinal Chemistry, Graham L. Patrick, III Edition, Oxford University Press, USA.
11. Biopharmaceutics and pharmacokinetics, DM. Brahmankar, Sunil B. Jaiswal II Edition, 2014, Vallabh Prakashan, New Delhi.
12. Peptidomimetics in Organic and Medicinal Chemistry by Antonio Guarna and Andrea Trabocchi, First edition, Wiley publishers.

24MPC104T SEMESTER I

CHEMISTRY OF NATURAL PRODUCTS - THEORY 4H 4C

Instruction hours/ week: L:4 T:0 P:0 Marks: Internal: 25 External:75 Total:100

External Semester Exam: 3Hours

SCOPE

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.

COURSE OBJECTIVES:

Upon completion of course, the student shall be able to understand

- Different types of natural compounds and their chemistry
- The medicinal importance of natural compounds
- 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 OUTCOMES:

On successful completion of the course the student will

COs	Course Outcomes	Blooms Level
CO1	Explain the chemistry and uses of various drugs from natural.	Understand
CO2	Discuss the classification, isolation, purification, modification and activity of alkaloids, flavonoids, steroids.	Understand
CO3	Discuss the classification, isolation, purification, modification and activity of terpenoids and vitamins.	Apply
CO4	Describe the recombinant DNA technology and its application in drug discovery.	Apply
CO5	Elaborate the active constituent of certain crude drugs in indigenous system.	Apply
CO6	Elucidate the structure of some important natural phytoconstituents.	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S										
CO3	S	M										
CO4		M		M								
CO5					M					S		
CO6										S		

S - Strong; M-Medium; L-Low

THEORY 60 hrs

Unit I 12 h

Study of Natural products as leads for new pharmaceuticals for the following class of drugs

a) Drugs Affecting the Central Nervous System: Morphine Alkaloids
b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide
c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol
d) Neuromuscular Blocking Drugs: Curare alkaloids
e) Anti-malarial drugs and Analogues
f) Chemistry of macrolide antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β - Lactam antibiotics (Cephalosporins and Carbapenem)

Unit II 12 h

1. Alkaloids

General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids, general methods of structural determination of alkaloids, structural elucidation and stereochemistry of ephedrine, morphine, ergot, emetine and reserpine.

2. Flavonoids

Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin.

3. Steroids

General introduction, chemistry of sterols, sapogenin and cardiac glycosides. Stereochemistry and nomenclature of steroids, chemistry of contraceptive agents, male & female sex hormones (Testosterone, Estradiol, Progesterone), adrenocorticoids (Cortisone), contraceptive agents and steroids (Vit – D).

Unit III 12 h

1. Terpenoids

Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di (retinol, Phytol, taxol) and tri terpenoids (Squalene, Ginsenoside), carotinoids (β carotene).

2. Vitamins

Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin.

Unit IV 12 h

1. Recombinant DNA technology and drug discovery

RDNA technology, hybridoma technology, new pharmaceuticals derived from biotechnology; Oligonucleotide therapy. Gene therapy: Introduction, Clinical application and recent advances in gene therapy, principles of RNA & DNA estimation

2. Active constituent of certain crude drugs used in Indigenous system; Diabetic therapy – Gymnema sylvestre, Salacia reticulate, Pterocarpus marsupiam, Swertia chirata, Trigonella foenum graccum; Liver dysfunction – Phyllanthus niruri; Antitumor – Curcuma longa Linn.

Unit V 12 h

Structural Characterization of natural compounds

Structural characterization of natural compounds using IR, 1HNMR, 13CNMR and MS Spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalis glycosides.

REFERENCES

1. Modern Methods of Plant Analysis, Peech and M.V. Tracey, Springer – Verlag, Berlin, Heidelberg.
2. Phytochemistry Vol. I and II by Miller, Jan Nostrant Rein Hld.
3. Recent advances in Phytochemistry Vol. I to IV – Scikel Runeckles, Springer Science & Business Media.
4. Chemistry of natural products Vol I onwards IWPAC.
5. Natural Product Chemistry Nakanishi Gggolo, University Science Books, California.
6. Natural Product Chemistry "A laboratory guide" – Rapheal Khan.
7. The Alkaloid Chemistry and Physiology by RHF Manske, Academic Press.
8. Introduction to molecular Phytochemistry – CHJ Wells, Chapmannstall.
9. Organic Chemistry of Natural Products Vol I and II by Gurdeep and Chatwall, Himalaya Publishing House.
10. Organic Chemistry of Natural Products Vol I and II by O.P. Agarwal, Krishan Prakashan.
11. Organic Chemistry Vol I and II by I.L. Finar, Pearson education.
12. Elements of Biotechnology by P.K. Gupta, Rastogi Publishers.
13. Pharmaceutical Biotechnology by S.P. Vyas and V.K. Dixit, CBS Publishers.
14. Biotechnology by Purohit and Mathur, Agro-Bios, 13th edition.
15. Phytochemical methods of Harborne, Springer, Netherlands.
16. Burger's Medicinal Chemistry.

24MPC105P SEMESTER I

PHARMACEUTICAL CHEMISTRY PRACTICAL-I 6H 3C

Instruction hours/ week: L:0 T:0 P:6 Marks: Internal: 25 External:50 Total:75

External Semester Exam: 3Hours

COURSE OBJECTIVES:

Upon completion of course, the student shall be able to understand

- The analysis of drugs and their formulations
- The working of column, HPLC and gas chromatography
- The estimation technique using fluorimetry and flame photometry.
- The synthesis of compounds using named reactions
- The structural characterization of synthetic compounds
- The various degradation studies.

COURSE OUTCOMES:

On successful completion of the course the student will

COs	Course Outcomes	Blooms Level
CO1	Analyze the drugs and their formulations	Understand
CO2	Perform experiments using column, HPLC and gas chromatography	Understand
CO3	Estimate pharmaceuticals using fluorimetry and flame photometry	Apply
CO4	Synthesize compounds using few important named reactions.	Apply
CO5	Characterize the synthesized compounds using various analytical techniques	Apply
CO6	Perform degradation studies	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S										
CO3	S	M										
CO4		M		M								
CO5					M					S		
CO6										S		

S-Strong; M-Medium; L-Low

COURSE CONTENT

To perform the following reactions of synthetic importance

1. Purification of organic solvents, column chromatography
2. Claisen-schmidt 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.

Some typical degradation reactions to be carried on selected plant constituents

24MPC106P SEMESTER I

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES - PRACTICAL 6H 3C

Instruction hours/ week: L:0 T:0 P: 6 Marks: Internal: 25 External:50 Total:75

External Semester Exam: 3Hours

COURSE OBJECTIVES:

- To estimate the samples using analytical instruments.
- To perform assay of official drug samples using analytical instruments
- To demonstrate Flash Chromatography.
- To demonstrate HPLC.
- To demonstrate LCMS.
- To demonstrate gas chromatography.

COURSE OUTCOMES:

At completion of this course student will

COs	Course Outcomes	Blooms Level
CO1	demonstrate the analysis of pharmacopieal compounds and simultaneous estimation by UV-VIS	Apply
CO2	acquire skills in selecting the suitable techniques for analysis of drugs	Analyze
CO3	demonstrate HPLC & LCMS	Apply
CO4	estimation of pharmaceutical substance by using fluorimetry / flame photometry	Understand
CO5	Compare and contrast various methods of analysis and their outcomes	Analyze
CO6	demonstrate Flash Chromatography	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1				S								
CO2	S											
CO3				S								
CO4	S									S		
CO5	M									S		
CO6	M										S	

Strong; M-Medium; L-Low

CONTENTS:

1.Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer

2. Simultaneous estimation of Multicomponent containing formulations by uv spectrophotometry

2. Experiments based on Column chromatography

3. Experiments based on HPLC

4. Experiments based on Gas Chromatography

5. Estimation of various drugs by Spectrofluorimetry

6. Estimation of sodium/potassium level by flame photometry

7. Experiments Based on Flash Chromatography.(Two Experiments)

8. Experiments Based on LC-MS.

9. Experiments based on IR spectroscopy.

10.Experiments based on HPTLC.(Two Experiments)

11. Interpretation of Any two organic compounds by HNMR

REFERENCE BOOKS (LATEST EDITIONS):

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons,2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5thedition, Eastern press, Bangalore,1998.
3. Instrumental methods of analysis – Willards, 7thedition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4thedition, CBS Publishers, New Delhi,1997.
5. Organic Spectroscopy - William Kemp, 3rdedition, ELBS,1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rdEdition, CBS Publishers, New Delhi,1997.
7. Pharmaceutical Analysis - Modern Methods – Part B - J W Munson, Vol 11, Marcel. DekkerSeries
a. Spectroscopy of Organic Compounds, 2ndedn., P.S/Kalsi, Wiley estern Ltd.,Delhi.

24MPC107S SEMESTER I

SEMINAR/ASSIGNMENT 7H 4C

Instruction hours/ week: L:7 T:0P:0 Marks: Internal :100

Total:100

S. No	COMPONENTS	MARKS
1	ATTENDANCE	08
2	CONTENT RELEVANCE AND DEPTH	20
3	ENGAGEMENT AND INTERACTION	12
4	PRESENTATION SKILLS	60
Total	**PASS MARK (50)**	**100**

24MPC201T SEMESTER II

ADVANCED SPECTRAL ANALYSIS -THEORY **4H 4C**

Instruction hours/ week: L:4 T:0 P:0 Marks: Internal: 25 External:75 Total:100

External Semester Exam: 3Hours

SCOPE

This subject deals with various hyphenated analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are LC-MS, GC-MS, ATR-IR, DSC etc.

COURSE OBJECTIVES:

Upon completion of course, the student shall be able to understand

- The interpretation of the NMR, Mass and IR spectra of various organic compounds
- The theoretical and practical skills required for handling the hyphenated instruments
- The identification methods of organic compounds
- The principle and operations of different spectroscopy, chromatography and thermal techniques
- The applications of different spectroscopy, chromatography and thermal techniques
- The bioassay and immunoassay

COURSE OUTCOMES:

On successful completion of the course the student will

COs	Course Outcomes	Blooms Level
CO1	Explain the various techniques involves in UV, IR, NMR and mass spectroscopy.	Understand
CO2	Understand the interpretation of the various spectra of organic compounds.	Understand
CO3	Discuss the principle, instrumentation and applications of various chromatography techniques	Apply
CO4	Describe the instrumentation and applications of hyphenated instruments	Apply
CO5	Explain the principle, instrumentation and applications of DSC, TGA, DTA and raman spectroscopy	Apply
CO6	Illustrate the biological standardization using bioassay and immunoassay.	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S											
CO2		S										
CO3	S	M										
CO4		M		M								
CO5					M					S		
CO6										S		

S-Strong; M-Medium; L-Low

THEORY 60 hrs

Unit I 12 h

UV and IR spectroscopy:

Woodward – Fieser rule for 1,3-butadienes, cyclic dienes and α,β-carbonyl compounds and interpretation compounds of enones. ATR-IR, IR Interpretation of organic compounds.

Unit II 12 h

NMR spectroscopy:

1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.

Unit III 12 h

Mass Spectroscopy

Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule, Isotopic peaks, Interpretation of organic compounds.

Unit IV 12 h

Chromatography:

Principle, Instrumentation and Applications of the following:

a) GC-MS b) GC-AAS c) LC-MS d) LC-FTIR e) LC-NMR f) CE- MS g) High Performance Thin Layer chromatography h) Super critical fluid chromatography i) Ion Chromatography j) I-EC (Ion- Exclusion Chromatography) k) Flash chromatography

Unit V 12 h

1. Thermal methods of analysis

Introduction, principle, instrumentation and application of DSC, DTA and TGA.

2. Raman Spectroscopy

Introduction, Principle, Instrumentation and Applications.

3. Radio immuno assay

Biological standardization, bioassay, ELISA, Radioimmuno assay of digitalis and insulin.

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
5. Quantitative analysis of pharmaceutical formulations by HPTLC - P D Sethi, CBS Publishers, New Delhi.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series

24MPC202T SEMESTER II

ADVANCED ORGANIC CHEMISTRY II -THEORY 4H 4C

Instruction hours/ week: L:4 T:0 P:0 Marks: Internal: 25 External:75 Total:100

External Semester Exam: 3Hours

SCOPE

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

COURSE OBJECTIVES:

Upon completion of course, the student shall be able to understand

- The principles and applications of green chemistry
- The concept of peptide chemistry.
- The photochemical reactions
- The mechanism and type of pericyclic reactions
- The various catalysts used in organic reactions
- The concept of stereochemistry and asymmetric synthesis.

COURSE OUTCOMES:

At the end of this course students will be able to

COs	Course Outcomes	Blooms Level
CO1	Discuss principle and various techniques of green chemistry	Apply
CO2	Describe the chemistry and synthesis of peptides	Understand
CO3	Understand photochemical reactions and its types	Understand
CO4	Explain the mechanism and types of pericyclic reactions	Apply
CO5	Enumerate different types of catalyst and its applications	Apply
CO6	Explain stereochemistry and asymmetric synthesis and its influence on drug action.	Apply

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1									**S**	**S**		
CO2												
CO3												
CO4				**S**								
CO5				**S**								
CO6	**S**			**S**								

S-Strong; M-Medium; L-Low

THEORY 60 hrs

Unit I 12 h

Green Chemistry:

a. Introduction, principles of green chemistry
b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted

synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis

c. Ultrasound assisted reactions: Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications
d. Continuous flow reactors: Working principle, advantages and synthetic applications.

Unit II 12 h

Chemistry of peptides

a. Coupling reactions in peptide synthesis
b. Principles of solid phase peptide synthesis, t-BOC and FMOC protocols, various solid supports and linkers: Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides
c. Segment and sequential strategies for solution phase peptide synthesis with any two case studies
d. Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, over- activation and side reactions of individual amino acids.

Unit III 12 h

1. Photochemical Reactions

Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation.

2. Pericyclic reactions

Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatrophic rearrangement reactions with examples

Unit IV 12 h

Catalysis:

a. Types of catalysis, heterogeneous and homogenous catalysis, advantages and disadvantages
b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs.
c. Homogenous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogenous

catalysis used in synthesis of drugs

d. Transition-metal and Organo-catalysis in organic synthesis:
e. Metal-catalyzed reactions
f. Biocatalysis: Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction.

Phase transfer catalysis - theory and applications

Unit V 12 h

Stereochemistry & Asymmetric Synthesis

a. Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centers, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z notation.
b. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples.

REFERENCES

1. "Advanced Organic chemistry, Reaction, mechanisms and structure", J March, John Wiley and sons, New York.
2. "Mechanism and structure in organic chemistry", ES Gould, Hold Rinchart and Winston, NewYork.
3. "Organic Chemistry" Clayden, Greeves, Warren and Woihers., Oxford University Press 2001.
4. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Sixth ed., 1995.
5. Carey, Organic chemistry, 5th edition (Viva Books Pvt. Ltd.)
6. Organic synthesis-the disconnection approach, S. Warren, Wily India
7. Principles of organic synthesis, ROC Norman and JM Coxan, Nelson thorns
8. Organic synthesis- Special techniques VK Ahluwalia and R Aggarwal, Narosa Publishers.
9. Organic reaction mechanisms IV edn, VK Ahluwalia and RK Parashar, Narosa Publishers.

24MPC203T SEMESTER II

COMPUTER AIDED DRUG DESIGN - THEORY 4H 4C

Instruction hours/ week: L:4 T:0 P:0 Marks: Internal: 25 External:75 Total:100

External Semester Exam: 3Hours

SCOPE

The subject is designed to impart knowledge on the current state of the art techniques involved in computer assisted drug design.

COURSE OBJECTIVES:

Upon completion of course, the student shall be able 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 softwares to design new drug molecules
- The prediction of ADMET properties
- The *in silico* virtual screening protocols

COURSE OUTCOMES:

On successful completion of the course the student will

COs	Course Outcomes	Blooms Level
CO1	Understand the various parameters in QSAR calculations	Understand
CO2	Discuss the applications of QSAR and 3D QSAR approach including the statistical methods involved.	Understand
CO3	Describe the different methodologies involved in molecular modeling and docking.	Apply
CO4	Predict the ADMET properties of a drug candidate.	Apply
CO5	Discuss the methods of drug design	Apply
CO6	Explain pharmacophore mapping and virtual screening approaches.	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S										
CO2		S									
CO3	S	M									
CO4		M		M							
CO5									S		
CO6									S		

S-Strong; M-Medium; L-Low

THEORY 60 hrs

Unit I 12 h

1. Introduction to Computer Aided Drug Design (CADD)
2. History, different techniques and applications.]
3. Quantitative Structure Activity Relationships: Basics
4. History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters.

Unit II 12 h

1. Quantitative Structure Activity Relationships: Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations.
2. 3D-QSAR approaches and contour map analysis.
3. Statistical methods used in QSAR analysis and importance of statistical parameters.

Unit III 12 h

Molecular Modeling and Docking

a. Molecular and Quantum Mechanics in drug design.
b. Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation
c. Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra-precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AchE & BchE)

Unit IV 12 h

Molecular Properties and Drug Design

a. Prediction and analysis of ADMET properties of new molecules and its importance in drug design.
b. De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design.
c. Homology modeling and generation of 3D-structure of protein.
d.

Unit V 12h

Pharmacophore Mapping and Virtual Screening

a. Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping.
b. In Silico Drug Design and Virtual Screening Techniques
c. Similarity based methods and Pharmacophore based screening, structure based In-silico virtual Screening protocols.

REFERENCES

1. Computational and structural approaches to drug discovery, Robert M Stroud and Janet. F Moore, RCS Publishers.
2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor & Francis group.
3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers.
4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor & Francis.
5. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.
6. Medicinal Chemistry by Burger, Wiley Publishing Co.
7. An Introduction to Medicinal Chemistry –Graham L. Patrick, Oxford University Press.
8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Lippincott Williams & Wilkins.
9. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers.
10. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore

24MPC204T SEMESTER II

PHARMACEUTICAL PROCESS CHEMISTRY - THEORY 4H 4C

Instruction hours/ week: L:4 T:0 P:0 Marks: Internal: 25 External:75 Total:100
External Semester Exam: 3Hours

SCOPE

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. The goal of a process chemist 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 for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

COURSE OBJECTIVES:

Upon completion of course, the student shall be able to understand

- The strategies of scale up process of APIs and intermediates
- The various unit operations in process chemistry
- The various reactions in process chemistry
- The fermentation and process of production of antibiotics
- The methods to characterize the reaction progress kinetics
- The industrial safety procedures to be followed.

COURSE OUTCOMES:

On successful completion of the course the student will

COs	Course Outcomes	Blooms Level
CO1	Explain the strategies of scale up process of APIs and intermediates	Understand
CO2	Discuss the various unit operations in process chemistry	Understand
CO3	Describe nitration, halogenation, oxidation and reduction reactions	Apply
CO4	Elaborate the fermentation process with example of production of antibiotics	Apply
CO5	Characterization of reaction progress and kinetics	Apply
CO6	Understand industrial safety methods and procedures	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S										
CO2		S									
CO3	S	M									
CO4		M		M							
CO5									S		
CO6									S		

S-Strong; M-Medium; L-Low

THEORY 60 hrs

Unit I 12 h

Process chemistry

a. Introduction, Synthetic strategy
b. Stages of scale up process: Bench, pilot and large-scale process. In-process control and validation of large-scale process.
c. Case studies of some scale up process of APIs.
d. Impurities in API, types and their sources including genotoxic impurities

Unit II 12 h

Unit operations

a. Extraction: Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction.
b. Filtration: Theory of filtration, pressure and vacuum filtration, centrifugal filtration,
c. Distillation: azeotropic and steam distillation
d. Evaporation: Types of evaporators, factors affecting evaporation.
e. Crystallization: Crystallization from aqueous, non- aqueous solutions factors affecting crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs.

Unit III 12 h

Unit Processes - I

a. **Nitration:** Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration,
b. **Halogenation:** Kinetics of halogenations, types of halogenations, catalytic
c. halogenations. Case study on industrial halogenation process.
d. **Oxidation:** Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H_2O_2, sodium hypochlorite, Oxygen gas, ozonolysis.

Unit IV 12 h

Unit Processes - II

a. **Reduction:** Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.
b. **Fermentation:** Aerobic and anaerobic fermentation.

Production of

i) Antibiotics; Penicillin and Streptomycin,
ii) Vitamins: B2 and B12
iii) Statins: Lovastatin, Simvastatin

c. Reaction progress kinetic analysis

i) Streamlining reaction steps, route selection,
ii) Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.

Unit V 12 h

Industrial Safety

a. MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment (PPE)
b. Fire hazards, types of fire & fire extinguishers
c. Occupational Health & Safety Assessment Series 1800 (OHSAS-1800) and ISO-14001 (Environmental Management System), Effluents and its management
d.

REFERENCES

1. Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever- Changing Climate-An Overview; K. Gadamasetti, CRC Press.
2. Pharmaceutical Manufacturing Encyclopedia, 3rd edition, Volume 2.
3. Medicinal Chemistry by Burger, 6th edition, Volume 1-8.
4. W.L. McCabe, J.C Smith, Peter Harriott. Unit operations of chemical engineering, 7th edition, McGraw Hill
5. Polymorphism in Pharmaceutical Solids. Dekker Series Volume 95 Ed: H G Brittain (1999)
6. Regina M. Murphy: Introduction to Chemical Processes: Principles, Analysis, Synthesis
7. Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up
8. P.H. Groggins: Unit processes in organic synthesis (MGH)
9. F.A. Henglein: Chemical Technology (Pergamon)
10. M. Gopal: Dryden's Outlines of Chemical Technology, WEP East-West Press
11. Clausen, Mattson: Principle of Industrial Chemistry, Wiley Publishing Co.,
12. Lowenheim & M.K. Moran: Industrial Chemicals
13. S.D. Shukla & G.N. Pandey: A text book of Chemical Technology Vol. II, Vikas Publishing House
14. J.K. Stille: Industrial Organic Chemistry (PH)
15. Shreve: Chemical Process, Mc Grawhill.
16. B.K. Sharma: Industrial Chemistry, Goel Publishing House
17. ICH Guidelines
18. United States Food and Drug Administration official website www.fda.gov

24MPC205P SEMESTER II

PHARMACEUTICAL CHEMISTRY PRACTICAL -II 12H 6C

Instruction hours/ week: L:0 T:0 P:12 Marks: Internal: 50 External:100 Total:150

External Semester Exam: 3Hours

COURSE OBJECTIVES:

Upon completion of course, the student shall be able to understand

- The synthesis of organic compounds using various approaches
- The synthetic procedure for API and intermediate preparation
- The interpretation of spectra and identify the organic compounds
- The methods to determine the purity of pharmaceuticals
- The various computational approaches in drug design
- The importance of 2D/3D QSAR in drug design.

COURSE OUTCOMES:

On successful completion of the course the student will

COs	Course Outcomes	Blooms Level
CO1	Synthesis organic compounds using different approaches	Understand
CO2	Compare the synthesis if APIs/intermediates by different synthetic routes	Understand
CO3	Compare, interpret different spectra and identify the organic compounds	Apply
CO4	Determine the purity of pharmaceuticals	Apply
CO5	Apply different computational approaches to determine physicochemical properties and perform ADMET, pharmacophore modeling, molecular modeling and docking.	Apply
CO6	Determine 2D/3D QSAR for the therapeutic class of drugs	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	S										
CO2		S									
CO3	S	M									
CO4		M		M							
CO5									S		
CO6									S		

S-Strong; M-Medium; L-Low

COURSE CONTENT

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
19. Pharmacophore modeling
20. 2D-QSAR based experiments
21. 3D-QSAR based experiments
22. Docking study-based experiment
23. Virtual screening-based experiment

24MPC206S SEMESTER II

SEMINAR/ASSIGNMENT **7H 4C**

Instruction hours/ week: L: 7 T: 0 P: 0 Marks: Internal :100 Total:100

S. No	COMPONENTS	MARKS
1	ATTENDANCE	08
2	CONTENT RELEVANCE AND DEPTH	20
3	ENGAGEMENT AND INTERACTION	12
4	PRESENTATION SKILLS	60
Total	**PASS MARK (50)**	**100**

24MPC301T /24MPA301T/24MPA301T SEMESTER III

RESEARCH METHODOLOGY AND BIOSTATISTICS - THEORY 4H 4C

Instruction hours/ week: L:4 T:0 P:0 Marks: Internal: 25 External:75 Total:100
External Semester Exam: 3Hours

COURSE OBJECTIVES:
Upon completion of course, the student shall be able to understand

- The general research methodology
- The importance and methods of literature review
- The application of biostatics methods to various data
- The different medical research methodologies
- The guidelines for animal handling and experimentation
- The basic principles of research

COURSE OUTCOMES:
At the end of this course, students will be able to

COs	Course Outcomes	Blooms Level
CO1	Understand the general research methodology	Understand
CO2	Explain the importance and methods of literature review	Understand
CO3	Apply biostatistics to the given data sample	Apply
CO4	Discuss the different medical research methodologies	Apply
CO5	Explain the guidelines for animal handling and experimentation	Apply
CO6	Describe the basic principles of research	Understand

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1		**M**	**S**									
CO2												
CO3				**S**								
CO4		**M**	**S**	**S**								
CO5									**M**			
CO6				**S**						**S**		

S-Strong; M-Medium; L-Low

Course Content

UNIT – I

General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests (students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxan rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

REFERENCE BOOKS

1. Hubbuch, Susan M., (2005), Writing Research Papers Across the Curriculum, 5th Edition, Thompson.
2. Vedanayagam.E.G (1989), Teaching technology for college teachers New Delhi - Sterling publishers (Pvt) Ltd.
3. Kumar.K.H.(1997), Educational technology, New Delhi- New age international (Pvt) Ltd.
4. Tony Bates.A.N,(2005) Technology, e-learning and distance education, New York, Rout ledge.
5. Aggarwal. J.C. (1995), Essential of educational technology; Teaching Learning innovations in education-New Delhi- Vikas publishing house (p) Ltd.,.
6. Crow & Crow. (1998), Educational Psychology", Erusia Publishing House New Delhi.

M. Ashraf Rizvi.(2005),Effective technical communication, TataMcGraw Hill Co.Ltd.

24MPC302J SEMESTER III

JOURNAL CLUB **1H 1C**

Instruction hours/ week: L:1 T:0 P:0 Marks: Internal :25 Total:25

S. No	COMPONENTS	MARKS
1	ATTENDANCE	4
2	SLIDES PREPARATION	6
3	RESEARCH GAP IDENTIFICATION	8
4	NARRATION OF ARTICLE	7
Total	**PASS MARK (13)**	**25**

24MPC303D SEMESTER III

DISCUSSION / PRESENTATION (PROPOSAL PRESENTATION) 2H 2C

Instruction hours/ week: L:2 T:0 P:0 Marks: Internal :50 Total:50

S. No	COMPONENTS	MARKS
1	ATTENDANCE	08
2	SLIDES PREPARATION	12
3	RESEARCH GAP IDENTIFICATION	5
4	PRESENTATION SKILL	5
5	DEFENCE OF VIVA VOCE	20
Total	**PASS MARK (25)**	**50**

24MPC304RW SEMESTER III

RESEARCH WORK **28H 14C**

Instruction hours/ week: L:0 T:0 P:28 Marks: External :350 Total:350

S. No	COMPONENTS	MARKS
1	ATTENDANCE	8
2	SLIDES PREPARATION	42
3	RESEARCH GAP IDENTIFICATION	50
4	PRESENTATION SKILL	50
5	DEFENCE OF VIVA VOCE	200
Total	**PASS MARK (175)**	**350**

24MPC401J SEMESTER IV

JOURNAL CLUB **1H 1C**

Instruction hours/ week: L:1 T:0 P:0 Marks: Internal :25 Total:25

S. No	COMPONENTS	MARKS
1	ATTENDANCE	4
2	SLIDES PREPARATION	6
3	RESEARCH GAP IDENTIFICATION	8
4	NARRATION OF ARTICLE	7
Total	**PASS MARK (13)**	**25**

24MPC402RW SEMESTER IV

RESEARCH WORK **31H 16C**

Instruction hours/ week: L:0 T:0 P:31 Marks: Internal :75Total:75

S.No	COMPONENTS	MARKS
1	ATTENDANCE	08
2	SLIDES PREPARATION	12
3	RESEARCH GAP IDENTIFICATION	10
4	PRESENTATION SKILL	10
5	DEFENCE OF VIVA VOCE	35
Total	**PASS MARK (38)**	**75**

24MPC403D SEMESTER IV

DISCUSSION / FINAL PRESENTATION **3H 3C**

Instruction hours/ week: L:3 T:0 P:0 Marks: External :400 Total:400

S.No	COMPONENTS	MARKS
1	ATTENDANCE	8
2	SLIDES PREPARATION	42
3	RESEARCH GAP IDENTIFICATION	50
4	PRESENTATION SKILL	50
5	DEFENCE OF VIVA VOCE	250
Total	**PASS MARK (200)**	**400**