Rules & Syllabus for
Master of Pharmacy

M. Pharm
(PCI regulations 2014)
AMRITA VISHWA VIDYAPEETHAM is a multi-campus, multi-disciplinary research academia that is accredited ‘A’ by NAAC and is ranked as one of the best research institutions in India. Amrita is spread across five campuses in three states of India - Kerala, Tamil Nadu and Karnataka, with the headquarters at Ettimadai, Coimbatore, Tamil Nadu. Amrita Vishwa Vidyapeetham continuously collaborates with top US universities including Ivy league universities and top European universities for regular student exchange programs, and has emerged as one of the fastest growing institutions of higher learning in India. The institution is managed by the Mata Amritanandamayi Math.

AMRITA SCHOOL OF PHARMACY is a constituent Unit of AMRITA VISHWA VIDYAPEETHAM Deemed University established under Section 3 of UGC Act 1956. It is located in the Health Sciences Campus of the University at Kochi, Kerala, India. Amrita School of Pharmacy offers training for one of the most sought after professions. The School's commitment to excellence in healthcare is in line with the overall objective of the Kochi - based Health Sciences campus of the University. Amrita School of Pharmacy is recognized by Pharmacy Council of India (PCI) and All India Council for Technical Education (AICTE).

The School of Pharmacy strives not only to provide quality education in pharmaceutical sciences but also to establish itself in research and serves as an ideal platform for the overall development of highly competent pharmacy professionals. The School maintains an exemplary clinical practice and conducts community outreach programmes that address the needs of Kochi and the society at large.

VISION

To develop as a center of excellence in Pharmacy education and research and become one among the distinguished pharma institutions in the country. It envisions to establish effective collaborations with Pharma industries and international pharmacy institutions for mutual benefits.

MISSION

To provide high quality value-based education with high emphasis on research and mould competent and socially committed pharmacy professionals capable of practicing and managing the future of pharmacy profession in the country and abroad.
Programmes Offered:

- BPharm (4 years – 8 semesters)
- MPharm (2 years – 4 semesters)
  - Pharmacy Practice
  - Pharmaceutics
  - Pharmaceutical Chemistry
  - Pharmacology
- Pharm D Regular (5 years plus 1 year Internship)
- Pharm D Post Baccalaureate (2 years plus 1 year Internship)
- PhD in Pharmaceutical Sciences

M.PHARM

The rules and syllabus of Master of Pharmacy framed under regulation 6, 7, 8 of the Master of Pharmacy (M.Pharm) course regulations 2014 by Pharmacy Council of India has been adopted for the M.Pharm programme of Amrita Vishwa Vidyapeetham from the academic year 2017 - 18 onwards.
PHARMACY COUNCIL OF INDIA

NOTIFICATION

New Delhi, the 10th December, 2014

The Master of Pharmacy (M.Pharm) Course Regulations, 2014

No. 14-136/2014-PCI.—In exercise of the powers conferred by Sections 10 and 18 of the Pharmacy Act, 1948 (10 of 1948), the Pharmacy Council of India, with the approval of the Central Government hereby makes the following regulations; namely—
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 2016-17. 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.
7.1. Credit assignment

7.1.1. Theory and Laboratory courses

Courses are broadly classified as Theory and Practical. Theory courses consist of lecture (L) and Practical (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.

7.2. 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 14. 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

The specializations in M.Pharm program is given in Table 1.

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Specialization</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Pharmaceutics</td>
<td>MPH</td>
</tr>
<tr>
<td>2.</td>
<td>Industrial Pharmacy</td>
<td>MIP</td>
</tr>
<tr>
<td>3.</td>
<td>Pharmaceutical Chemistry</td>
<td>MPC</td>
</tr>
<tr>
<td>4.</td>
<td>Pharmaceutical Analysis</td>
<td>MPA</td>
</tr>
<tr>
<td>5.</td>
<td>Pharmaceutical Quality Assurance</td>
<td>MQA</td>
</tr>
<tr>
<td>6.</td>
<td>Pharmaceutical Regulatory Affairs</td>
<td>MRA</td>
</tr>
<tr>
<td>7.</td>
<td>Pharmaceutical Biotechnology</td>
<td>MPB</td>
</tr>
<tr>
<td>8.</td>
<td>Pharmacy Practice</td>
<td>MPP</td>
</tr>
<tr>
<td>9.</td>
<td>Pharmacology</td>
<td>MPL</td>
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<tr>
<td>10.</td>
<td>Pharmacognosy</td>
<td>MPG</td>
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</table>

The course of study for M.Pharm specializations shall include Semester wise Theory & Practical as given in Table – 2 to 11. The number of hours to be devoted to each theory and practical course in any semester shall not be less than that shown in Table – 2 to 11.
The Specializations offered by Amrita School of Pharmacy are denoted in bold in Table 1 and the details of the respective Specializations are only included in this book. (Tables 2, 4, 9 & 10 only are shown below)

Table – 2: Course of study for M. Pharm. (Pharmaceutics)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course</th>
<th>Credit Hours</th>
<th>Credit Points</th>
<th>Hrs./wk</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPH101T</td>
<td>Modern Pharmaceutical Analytical Techniques</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>MPH102T</td>
<td>Drug Delivery Systems</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>MPH103T</td>
<td>Modern Pharmaceutics</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>100</td>
</tr>
<tr>
<td>MPH104T</td>
<td>Regulatory Affairs</td>
<td>4</td>
<td>4</td>
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<td>100</td>
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<tr>
<td>MPH105P</td>
<td>Pharmaceutics Practical I</td>
<td>12</td>
<td>6</td>
<td>12</td>
<td>150</td>
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<tr>
<td></td>
<td>Seminar/Assignment</td>
<td>7</td>
<td>4</td>
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<td></td>
<td><strong>Total</strong></td>
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<td><strong>26</strong></td>
<td><strong>35</strong></td>
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<table>
<thead>
<tr>
<th>Course Code</th>
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<th>Credit Hours</th>
<th>Credit Points</th>
<th>Hrs./wk</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPH201T</td>
<td>Molecular Pharmaceutics (Nano Technology and Targeted DDS) (NTDS)</td>
<td>4</td>
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<td>100</td>
</tr>
<tr>
<td>MPH202T</td>
<td>Advanced Biopharmaceutics &amp; Pharmacokinetics</td>
<td>4</td>
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<tr>
<td>MPH203T</td>
<td>Computer Aided Drug Delivery System</td>
<td>4</td>
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<tr>
<td>MPH204T</td>
<td>Cosmetics and Cosmeceuticals</td>
<td>4</td>
<td>4</td>
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<td>100</td>
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<tr>
<td>MPH205P</td>
<td>Pharmaceutics Practical II</td>
<td>12</td>
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<td>Seminar/Assignment</td>
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Table – 4: Course of study for M. Pharm.

(Pharmaceutical Chemistry)

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<thead>
<tr>
<th>Course Code</th>
<th>Course</th>
<th>Credit Hours</th>
<th>Credit Points</th>
<th>Hrs./w k</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPC101T</td>
<td>Modern Pharmaceutical Analytical Techniques</td>
<td>4</td>
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<tr>
<td>MPC102T</td>
<td>Advanced Organic Chemistry –I</td>
<td>4</td>
<td>4</td>
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<tr>
<td>MPC103T</td>
<td>Advanced Medicinal chemistry</td>
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<td>4</td>
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<tr>
<td>MPC104T</td>
<td>Chemistry of Natural Products</td>
<td>4</td>
<td>4</td>
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<td>MPC105P</td>
<td>Pharmaceutical Chemistry Practical I</td>
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<td>6</td>
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<td></td>
<td>Seminar/Assignment</td>
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Semester II

<table>
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<tr>
<th>Course Code</th>
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<th>Marks</th>
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<tr>
<td>MPC201T</td>
<td>Advanced Spectral Analysis</td>
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<td>MPC202T</td>
<td>Advanced Organic Chemistry –II</td>
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<td>Computer Aided Drug Design</td>
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<td>MPC204T</td>
<td>Pharmaceutical Process Chemistry</td>
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<td>MPC205P</td>
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<td>Course Code</td>
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<td>Credit Points</td>
<td>Hrs./wk</td>
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<td>MPP 101T</td>
<td>Clinical Pharmacy Practice</td>
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<td>MPP 102T</td>
<td>Pharmacotherapeutics-I</td>
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<tr>
<td>MPP 103T</td>
<td>Hospital &amp; Community Pharmacy</td>
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<tr>
<td>MPP 104T</td>
<td>Clinical Research</td>
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<tr>
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<td>Pharmacy Practice Practical I</td>
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<td>6</td>
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<td>Seminar/Assignment</td>
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<td>MPP 201T</td>
<td>Principles of Quality Use of Medicines</td>
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<tr>
<td>MPP 202T</td>
<td>Pharmacotherapeutics II</td>
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<td>MPP 203T</td>
<td>Clinical Pharmacokinetics and Therapeutic Drug Monitoring</td>
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<tr>
<td>MPP 204T</td>
<td>Pharmacoepidemiology &amp; Pharmacoeconomics</td>
<td>4</td>
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<td>MPP 205P</td>
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<td>Course Code</td>
<td>Course</td>
<td>Credit Hours</td>
<td>Credit Points</td>
<td>Hrs./wk</td>
<td>Marks</td>
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<td>MPL 101T</td>
<td>Modern Pharmaceutical Analytical Techniques</td>
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<td>100</td>
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<tr>
<td>MPL 102T</td>
<td>Advanced Pharmacology-I</td>
<td>4</td>
<td>4</td>
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<td>100</td>
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<tr>
<td>MPL 103T</td>
<td>Pharmacological and Toxicological Screening Methods-I</td>
<td>4</td>
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<td>MPL 104T</td>
<td>Cellular and Molecular Pharmacology</td>
<td>4</td>
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<tr>
<td>MPL 105P</td>
<td>Pharmacology Practical I</td>
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<td>6</td>
<td>12</td>
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<td>-</td>
<td>Seminar/Assignment</td>
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<tbody>
<tr>
<td>MPL 201T</td>
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<td>MPL 205P</td>
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### Table – 12: Course of study for M. Pharm. III Semester

(Common for All Specializations)

<table>
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<tr>
<th>Course Code</th>
<th>Course</th>
<th>Credit Hours</th>
<th>Credit Points</th>
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<tbody>
<tr>
<td>MRM 301T</td>
<td>Research Methodology and Biostatistics*</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>-</td>
<td>Journal club</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>-</td>
<td>Discussion / Presentation</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>(Proposal Presentation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-</td>
<td>Research Work</td>
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<td>14</td>
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<td>Total</td>
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* Non University Exam

### Table – 13: Course of study for M. Pharm. IV Semester

(Common for All Specializations)

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course</th>
<th>Credit Hours</th>
<th>Credit Points</th>
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<tbody>
<tr>
<td>-</td>
<td>Journal Club</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>-</td>
<td>Research Work</td>
<td>31</td>
<td>16</td>
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<tr>
<td>-</td>
<td>Discussion/Final Presentation</td>
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<td>Total</td>
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### Table – 14: Semester wise credits distribution

<table>
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<th>Semester</th>
<th>Credit Points</th>
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<tbody>
<tr>
<td>I</td>
<td>26</td>
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<tr>
<td>II</td>
<td>26</td>
</tr>
<tr>
<td>III</td>
<td>21</td>
</tr>
<tr>
<td>IV</td>
<td>20</td>
</tr>
<tr>
<td>Co-curricular Activities</td>
<td>Minimum=02</td>
</tr>
<tr>
<td>(Attending Conference, Scientific Presentations and Other Scholarly Activities)</td>
<td>Maximum=07*</td>
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<tr>
<td>Total Credit Points</td>
<td>Minimum=95</td>
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<td></td>
<td>Maximum=100*</td>
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* Credit points for co-curricular activities
<table>
<thead>
<tr>
<th>Name of the Activity</th>
<th>Maximum Credit Points Eligible / Activity</th>
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</thead>
<tbody>
<tr>
<td>Participation in National Level Seminar/Conference/Workshop/Symposium/ Training Programs (related to the specialization of the student)</td>
<td>01</td>
</tr>
<tr>
<td>Participation in international Level Seminar/Conference/Workshop/Symposium/ Training Programs (related to the specialization of the student)</td>
<td>02</td>
</tr>
<tr>
<td>Academic Award/Research Award from State Level/National Agencies</td>
<td>01</td>
</tr>
<tr>
<td>Academic Award/Research Award from International Agencies</td>
<td>02</td>
</tr>
<tr>
<td>Research / Review Publication in National Journals (Indexed in Scopus / Web of Science)</td>
<td>01</td>
</tr>
<tr>
<td>Research / Review Publication in International Journals (Indexed in Scopus / Web of Science)</td>
<td>02</td>
</tr>
</tbody>
</table>

* International conference: Held 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 sessionalexam and before the end semester exam.

11. Examinations/Assessments

The schemes for internal assessment and end semester examinations are given in Table (16-25)

*Note: Tables relevant to the available specializations 16, 18, 23 & 24 are only included*

11.1. 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.
### Tables – 16: Schemes for internal assessments and end semester examinations

**Pharmaceutics- MPH**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course</th>
<th>Internal Assessment</th>
<th>End Semester Exams</th>
<th>Total Marks</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
<td>Continuous Mode</td>
<td>Sessional Exams</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marks</td>
<td>Duration</td>
<td>Total Marks</td>
</tr>
<tr>
<td>MPH 101T</td>
<td>Modern Pharmaceutical Techniques</td>
<td>10</td>
<td>15</td>
<td>1 Hr</td>
</tr>
<tr>
<td>MPH 102T</td>
<td>Drug Delivery Systems</td>
<td>10</td>
<td>15</td>
<td>1 Hr</td>
</tr>
<tr>
<td>MPH 103T</td>
<td>Modern Pharmaceutics</td>
<td>10</td>
<td>15</td>
<td>1 Hr</td>
</tr>
<tr>
<td>MPH 104T</td>
<td>Regulatory Affairs</td>
<td>10</td>
<td>15</td>
<td>1 Hr</td>
</tr>
<tr>
<td>MPH 105P</td>
<td>Pharmaceutics Practical-I</td>
<td>20</td>
<td>30</td>
<td>6 Hrs</td>
</tr>
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<td>-</td>
<td>Seminar/Assignment</td>
<td>-</td>
<td>-</td>
<td>-</td>
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**SEMESTER II**

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</tr>
</thead>
<tbody>
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<td>Sessional Exams</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marks</td>
<td>Duration</td>
<td>Total Marks</td>
</tr>
<tr>
<td>MPH 201T</td>
<td>Molecular Pharmaceutics (Nano Technology &amp; Targeted DDS) (NTDS)</td>
<td>10</td>
<td>15</td>
<td>1 Hr</td>
</tr>
<tr>
<td>MPH 202T</td>
<td>Advanced Biopharmaceutics &amp; Pharmacokinetics</td>
<td>10</td>
<td>15</td>
<td>1 Hr</td>
</tr>
<tr>
<td>MPH 203T</td>
<td>Computer Aided Drug Delivery Systems</td>
<td>10</td>
<td>15</td>
<td>1 Hr</td>
</tr>
<tr>
<td>MPH 204T</td>
<td>Cosmetics and Cosmeceuticals</td>
<td>10</td>
<td>15</td>
<td>1 Hr</td>
</tr>
<tr>
<td>MPH 205P</td>
<td>Pharmaceutics Practical II</td>
<td>20</td>
<td>30</td>
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<td>Seminar/Assignment</td>
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<td>-</td>
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### Tables – 18: Schemes for internal assessments and end semester examinations

*(Pharmaceutical Chemistry-MPC)*

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>End Semester Exams</th>
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</thead>
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<td></td>
<td>Sessional Exams</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marks</td>
<td>Duration</td>
</tr>
<tr>
<td>MPC101T</td>
<td>Modern Pharmaceutical Analytical Techniques</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>MPC102T</td>
<td>Advanced Organic Chemistry -I</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>MPC103T</td>
<td>Advanced Medicinal chemistry</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>MPC104T</td>
<td>Chemistry of Natural Products</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>MPC105P</td>
<td>Pharmaceutical Chemistry Practical I</td>
<td>20</td>
<td>30</td>
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<td>Seminar / Assignment</td>
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**Total**

<table>
<thead>
<tr>
<th></th>
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<td>Course Code</td>
<td>Course Title</td>
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<tr>
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<td>------------------------------------</td>
</tr>
<tr>
<td>MPC201T</td>
<td>Advanced Spectral Analysis</td>
</tr>
<tr>
<td>MPC202T</td>
<td>Advanced Organic Chemistry -II</td>
</tr>
<tr>
<td>MPC203T</td>
<td>Computer Aided Drug Design</td>
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<tr>
<td>MPC204T</td>
<td>Pharmaceutical Process Chemistry</td>
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<tr>
<td>MPC205P</td>
<td>Pharmaceutical Chemistry Practical II</td>
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<td>Course Code</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>SEMESTER I</td>
<td></td>
</tr>
<tr>
<td>MPP10 1T</td>
<td>Clinical Pharmacy Practice</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>MPP10 2T</td>
<td>Pharmacotherapeutics I</td>
</tr>
<tr>
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<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>MPP10 3T</td>
<td>Hospital &amp; Community Pharmacy</td>
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<td>MPP10 4T</td>
<td>Clinical Research</td>
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<td>MPP10 5P</td>
<td>Pharmacy Practice Practical I</td>
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<td>SEMESTER II</td>
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</tr>
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<td>MPP20 1T</td>
<td>Principles of Quality Use of Medicines</td>
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<tr>
<td>MPP10 2T</td>
<td>Pharmacotherapeutics II</td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>MPP20 3T</td>
<td>Clinical Pharmacokinetics and Therapeutic Drug Monitoring</td>
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<tr>
<td>MPP20 4T</td>
<td>Pharmacoepidemiology &amp; Pharmacoeconomics</td>
</tr>
<tr>
<td>MPP20 5P</td>
<td>Pharmacy Practice Practical II</td>
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### Tables – 24: Schemes for internal assessments and end semester examinations (Pharmacology-MPL)

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<th>Course Code</th>
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<tr>
<td>MPL10 1T</td>
<td>Modern Pharmaceutical Analytical Techniques</td>
<td>10 15</td>
<td>1Hr 25</td>
</tr>
<tr>
<td>MPL10 2T</td>
<td>Advanced Pharmacology–I</td>
<td>10 15</td>
<td>1Hr 25</td>
</tr>
<tr>
<td>MPL10 3T</td>
<td>Pharmacological and Toxicological Screening Methods–I</td>
<td>10 15</td>
<td>1Hr 25</td>
</tr>
<tr>
<td>MPL10 4T</td>
<td>Cellular and Molecular Pharmacology</td>
<td>10 15</td>
<td>1Hr 25</td>
</tr>
<tr>
<td>MPL10 5P</td>
<td>Pharmacology Practical – I</td>
<td>20 30</td>
<td>6Hrs 50</td>
</tr>
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<td>Seminar /Assignment</td>
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<td>– – –</td>
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### SEMESTER II

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<td></td>
<td>Duration</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Duration</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>MPL20 1T</td>
<td>Advanced Pharmacology II</td>
<td>10 15</td>
<td>1Hr 25</td>
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<tr>
<td>MPL20 2T</td>
<td>Pharmacological and Toxicological Screening Methods–II</td>
<td>10 15</td>
<td>1Hr 25</td>
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<tr>
<td>MPL20 3T</td>
<td>Principles of Drug Discovery</td>
<td>10 15</td>
<td>1Hr 25</td>
</tr>
<tr>
<td>MPL20 4T</td>
<td>Clinical research and pharmacovigilance</td>
<td>10 15</td>
<td>1Hr 25</td>
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<td></td>
<td>Seminar /Assignment</td>
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<td>– – –</td>
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<td>Total</td>
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</table>
11.2. Internal assessment: Continuous mode

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

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<thead>
<tr>
<th>Course Code</th>
<th>Course</th>
<th>Internal Assessment</th>
<th>End Semester Exams</th>
</tr>
</thead>
<tbody>
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<td></td>
<td></td>
<td>Continuous Mode</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sessional Exams</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mark</td>
<td>Duration</td>
</tr>
<tr>
<td>MRM301T</td>
<td>Research Methodology and Biostatistics*</td>
<td>10</td>
<td>15</td>
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<td></td>
<td>Journal club</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Discussion / Presentation (Proposal Presentation)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Research work*</td>
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</tr>
<tr>
<td></td>
<td>Journal club</td>
<td>-</td>
<td>-</td>
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<tr>
<td></td>
<td>Discussion / Presentation (Proposal Presentation)</td>
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<td>-</td>
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<td></td>
<td>Research work and Colloquium</td>
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</table>

* Non University Exam
Table – 27: Scheme for awarding internal assessment: Continuous mode

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Theory</th>
<th>Maximum Marks</th>
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<tr>
<td>Attendance (Refer Table – 28)</td>
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<tr>
<td>Student – Teacher interaction</td>
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<table>
<thead>
<tr>
<th>Practical</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Attendance (Refer Table – 28)</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Based on Practical Records, Regular viva voce, etc.</td>
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<td>10</td>
</tr>
<tr>
<td>Total</td>
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<td>20</td>
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</table>

Table – 28: Guidelines for the allotment of marks for attendance

<table>
<thead>
<tr>
<th>Percentage of Attendance</th>
<th>Theory</th>
<th>Practical</th>
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<tbody>
<tr>
<td>95 – 100</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>90 – 94</td>
<td>6</td>
<td>7.5</td>
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<tr>
<td>85 – 89</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>80 – 84</td>
<td>2</td>
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</tr>
<tr>
<td>Less than 80</td>
<td>0</td>
<td>0</td>
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</tbody>
</table>

11.2.1. 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 theoretical and practical sessional examinations is given in the table. The average marks of two sessional exams shall be computed for internal assessment as per the requirements given in tables.

12. Promotion and award of grades

A student shall be declared PASS and eligible for getting grade in a course of M.Pharm. programme if 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 obtained by 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. Reexamination of end semester examinations

Reexamination of end semester examination shall be conducted as per the schedule given in table 29. The exact dates of examinations shall be notified from time to time.
16. Allowed to keep terms (ATKT):

No student shall be admitted to any examination unless he/she fulfills the norms given in 6. ATKT rules 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 the courses 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 IV semesters 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. Such rules 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 the semester for each course. The letter grades and their corresponding grade points are given in Table – 30.

Table – 30: Letter grades and grade points equivalent to Percentage of marks and performances

<table>
<thead>
<tr>
<th>Percentage of Marks Obtained</th>
<th>Letter Grade</th>
<th>Grade Point</th>
<th>Performance</th>
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</thead>
<tbody>
<tr>
<td>90.00 – 100</td>
<td>O</td>
<td>10</td>
<td>Outstanding</td>
</tr>
<tr>
<td>80.00 – 89.99</td>
<td>A</td>
<td>9</td>
<td>Excellent</td>
</tr>
<tr>
<td>70.00 – 79.99</td>
<td>B</td>
<td>8</td>
<td>Good</td>
</tr>
<tr>
<td>60.00 – 69.99</td>
<td>C</td>
<td>7</td>
<td>Fair</td>
</tr>
<tr>
<td>50.00 – 59.99</td>
<td>D</td>
<td>6</td>
<td>Average</td>
</tr>
<tr>
<td>Less than 50</td>
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<td>Fail</td>
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<td>Absent</td>
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</tbody>
</table>

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 courses by the student during the semester. For example, if a student takes five courses (Theory/Practical) in a semester 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:

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

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

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

\[
CGPA = \frac{C_1S_1 + C_2S_2 + C_3S_3 + C_4S_4}{C_1 + C_2 + C_3 + C_4}
\]

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

20. Declaration of class

The class shall be awarded on the basis of CGPA as follows:

- First Class with Distinction = CGPA of 7.50 and above
- First Class = CGPA of 6.00 to 7.49
- Second Class = CGPA of 5.00 to 5.99

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 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 = 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 / 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.
Programme Educational Objectives

1. To develop competent pharmacy graduates by structured teaching learning process through dedicated and devoted faculty.

2. To mould professionals with technical skills and inculcate high level of understanding in the area of manufacturing of drugs and pharmaceuticals.

3. To master the students to use modern tools, equipments and softwares necessary to design and develop advanced pharmaceutical formulations.

4. To provide interdisciplinary research and educational opportunities to solve problems that will improve the quality of life for those suffering from health-related diseases and disorders.

5. To inspire the graduates for higher education, research or entrepreneurship and life-long learning in the context of technological advancement.
SEMESTER I

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPH 101T)

SCOPE

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

OBJECTIVES

After completion of course student is able to know,

• Chemicals and Excipients
• The analysis of various drugs in single and combination dosage forms
• Theoretical and practical skills of the instruments

THEORY


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


5. 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.


7. Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following:
   a) Paper chromatography b) Thin Layer chromatography
   c) Ion exchange chromatography d) Column chromatography
   e) Gas chromatography f) High Performance Liquid chromatography
   g) Affinity chromatography

5. 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
b. X ray Crystallography: Production of X rays, Different X ray diffraction methods, Bragg’s law, Rotating crystal technique, X ray powder technique, Types of crystals and applications of X-ray diffraction.

6. Immunological assays: RIA (Radio immuno assay), ELISA, Bioluminescence assays.

REFERENCES

DRUG DELIVERY SYSTEMS (MPH 102T)

SCOPE
This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

OBJECTIVES
Upon completion of the course, student shall be able to understand
- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of delivering system
- The formulation and evaluation of Novel drug delivery systems.

THEORY 60 HOURS


4. **Ocular Drug Delivery Systems**: Barriers of drug permeation, Methods to overcome barriers.


6. **Protein and Peptide Delivery**: Barriers for protein delivery. Formulation and Evaluation of delivery systems of proteins and other macromolecules.

7. **Vaccine delivery systems**: Vaccines, uptake of antigens, single shot vaccines, mucosal and transdermal delivery of vaccines.

**REFERENCES**


3. Encyclopedia of controlled delivery, Editor- Edith Mathiowitz, Published by WileyInterscience Publication, John Wiley and Sons, Inc, New York! Chichester/Weinheim


**JOURNALS**

1. Indian Journal of Pharmaceutical Sciences (IPA)

2. Indian drugs (IDMA)

3. Journal of controlled release (Elsevier Sciences) desirable

4. Drug Development and Industrial Pharmacy (Marcel & Decker) desirable
MODERN PHARMACEUTICS (MPH 103T)

SCOPE

Course designed to impart advanced knowledge and skills required to learn various aspects and concepts at pharmaceutical industries

OBJECTIVES

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

- The elements of preformulation studies.
- The Active Pharmaceutical Ingredients and Generic drug Product development
- Industrial Management and GMP Considerations.
- Optimization Techniques & Pilot Plant Scale Up Techniques
- Stability Testing, sterilization process & packaging of dosage forms.

THEORY 60 HOURS


   b. **Optimization techniques in Pharmaceutical Formulation**: Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation

2. **Validation**: Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, ICH & WHO guidelines for calibration and validation of equipments, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities.

3. **cGMP & Industrial Management**: Objectives and policies of current good manufacturing practices, layout of buildings, services, equipments and their maintenance Production management: Production organization, materials management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship. Concept of Total Quality Management.

4. **Compression and compaction**: Physics of tablet compression, compression, consolidation, effect of friction, distribution of forces, compaction profiles. Solubility.

5. **Study of consolidation parameters**: Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters, Heckel plots, Similarity factors – f2 and f1, Higuchi and Peppas plot, Linearity Concept of significance, Standard deviation, Chi square test, students T-test, ANOVA test.

REFERENCES

1. Theory and Practice of Industrial Pharmacy By Lachmann and Libermann
4. Pharmaceutical Dosage forms: Parenteral medications Vol. 1-2; By Leon Lachmann.
5. Modern Pharmaceutics; By Gillbert and S. Banker.
8. Physical Pharmacy; By Alfred martin
11. Quality Assurance Guide; By Organization of Pharmaceutical producers of India.
13. How to practice GMPs; By P.P.Sharma. Vandhana Publications, Agra.
15. Pharmaceutical Preformulations; By J.J. Wells.
16. Applied production and operations management; By Evans, Anderson, Sweeney and Williams.
17. Encyclopaedia of Pharmaceutical technology, Vol I – III.

REGULATORY AFFAIRS (MPH 104T)

SCOPE

Course designed to impart advanced knowledge and skills required to learn the concept of generic drug and their development, various regulatory filings in different countries, different phases of clinical trials and submitting regulatory documents: filing process of IND, NDA and ANDA

• To know the approval process of
• To know the chemistry, manufacturing controls and their regulatory importance
• To learn the documentation requirements for
• To learn the importance and

OBJECTIVES:

Upon completion of the course, it is expected that the students will be able to understand

• The Concepts of innovator and generic drugs, drug development process
• The Regulatory guidance’s and guidelines for filing and approval process
• Preparation of Dossiers and their submission to regulatory agencies in different countries
• Post approval regulatory requirements for actives and drug products
• Submission of global documents in CTD/ eCTD formats
• Clinical trials requirements for approvals for conducting clinical trials
• Pharmacovigilance and process of monitoring in clinical trials.

THEORY 60 HOURS

1. a. **Documentation in Pharmaceutical Industry:** Master formula record, DMF (Drug Master File), distribution records. Generic drugs product development Introduction, Hatch-Waxman act and amendments, CFR (CODE OF FEDERAL REGULATION), drug product performance, in-vitro, ANDA regulatory approval process, NDA approval process, BE and drug product assessment, in-vivo, scale up process approval changes, post marketing surveillance, outsourcing BA and BE to CRO.

18Hrs

b. **Regulatory requirement for product approval:** API, biologics, novel, therapies obtaining NDA, ANDA for generic drugs ways and means of US registration for foreign drugs

6Hrs

2. **CMC, post approval regulatory affairs:** Regulation for combination products and medical devices.CTD and ECTD format, industry and FDA liaison. ICH - Guidelines of ICH-Q, S E, M. Regulatory requirements of EU, MHRA, TGA and ROW countries.

12Hrs

3. **Non clinical drug development:** Global submission of IND, NDA, ANDA. Investigation of medicinal products dossier, dossier (IMPD) and investigator brochure (IB).

12Hrs

4. **Clinical trials:** Developing clinical trial protocols. Institutional review board / independent ethics committee Formulation and working procedures informed Consent process and procedures. HIPAA-new, requirement to clinical study process, pharmacovigilance safety monitoring in clinical trials.

12Hrs

REFERENCES


7. www.ich.org/

8. www.fda.gov/

9. europa.eu/index_en.htm

1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on HPLC
4. Experiments based on Gas Chromatography
5. Estimation of riboflavin/quinine sulphate by fluorimetry
6. Estimation of sodium/potassium by flame photometry
7. To perform In-vitro dissolution profile of CR/ SR marketed formulation
8. Formulation and evaluation of sustained release matrix tablets
9. Formulation and evaluation osmotically controlled DDS
10. Preparation and evaluation of Floating DDS- hydro dynamically balanced DDS
11. Formulation and evaluation of Muco adhesive tablets.
12. Formulation and evaluation of trans dermal patches.
13. To carry out preformulation studies of tablets.
14. To study the effect of compressional force on tablets disintegration time.
15. To study Micromeritic properties of powders and granulation.
16. To study the effect of particle size on dissolution of a tablet.
17. To study the effect of binders on dissolution of a tablet.
18. To plot Heckal plot, Higuchi and peppas plot and determine similarity factors.
SEMESTER II

MOLECULAR PHARMACEUTICS (NANO TECHNOLOGY & TARGETED DDS) (NTDS) (MPH 201T)

SCOPE

This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

OBJECTIVES

Upon completion of the course student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of NTDS
- The formulation and evaluation of novel drug delivery systems.

THEORY


3. **Micro Capsules / Micro Spheres**: Types, preparation and evaluation, Monoclonal Antibodies; preparation and application of Niosomes, Aquasomes, Phyto-somes, Electrosomes.

4. **Pulmonary Drug Delivery Systems**: Aerosols, propellents, Containers Types, preparation and evaluation, Intra Nasal Route Delivery systems; Types, preparation and evaluation.


REFERENCES


ADVANCED BIOPHARMACEUTICS & PHARMACOKINETICS (MPH 202T)

SCOPE

This course is designed to impart knowledge and skills necessary for dose calculations, dose adjustments and to apply biopharmaceutics theories in practical problem solving. Basic theoretical discussions of the principles of biopharmaceutics and pharmacokinetics are provided to help the students’ to clarify the concepts.
OBJECTIVES

Upon completion of this course it is expected that students will be able understand,

- The basic concepts in biopharmaceutics and pharmacokinetics.
- The use raw data and derive the pharmacokinetic models and parameters the best describe the process of drug absorption, distribution, metabolism and elimination.
- The critical evaluation of biopharmaceutic studies involving drug product equivalency.
- The design and evaluation of dosage regimens of the drugs using pharmacokinetic and biopharmaceutical parameters.
- The potential clinical pharmacokinetic problems and application of basics of pharmacokinetics.

THEORY  60 HOURS


3. **Pharmacokinetics:** Basic considerations, pharmacokinetic models, compartment modeling: one compartment model- IV bolus, IV infusion, extra-vascular. Multi compartment model: two compartment - model in brief, non-linear pharmacokinetics: cause of non-linearity, Michaelis – Menten equation, estimation of kmax and vmax. Drug interactions: introduction, the effect of protein-binding interactions, the effect of tissue-binding interactions, cytochrome p 4 5 0 -based drug interactions, drug interactions linked to transporters.

4. **Drug Product Performance, In Vivo: Bioavailability and Bioequivalence:** drug product performance, purpose of bioavailability studies, relative and absolute availability, methods for assessing bioavailability, bioequivalence studies, design and evaluation of bioequivalence studies, study designs, crossover study designs, evaluation of the data, bioequivalence example, study submission and drug review process. biopharmaceutics classification system, methods. Permeability: In-vitro, in-situ and In-vivo methods. generic biologics (biosimilar drug products), clinical significance of bioequivalence studies, special concerns in bioavailability and bioequivalence studies, generic substitution.

5. **Application of Pharmacokinetics:** Modified-Release Drug Products, Targeted Drug Delivery Systems and Biotechnological Products. Introduction to Pharmacokinetics and pharmacody-
namic, drug interactions. Pharmacokinetics and pharmacodynamics of biotechnology drugs. Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies.

REFERENCES

2. Biopharmaceutics and Pharmacokinetics, A. Treatise, D.M. Brahmankar and Sunil B. Jaiswal, Vallab-Prakashan, Pitampura, Delhi
4. Textbook of Biopharmaceutics and Pharmacokinetics, Dr. Shobha Rani R. Hiremath,Prism Book

COMPUTER AIDED DRUG DELIVERY SYSTEM (MPH 203T)

SCOPE
This course is designed to impart knowledge and skills necessary for computer Applications in pharmaceutical research and development who want to understand the application of computers across the entire drug research and development process. Basic theoretical discussions of the principles of more integrated and coherent use of computerized information (informatics) in the drug development process are provided to help the students to clarify the concepts.

OBJECTIVES
Upon completion of this course it is expected that students will be able to understand,

- History of Computers in Pharmaceutical Research and Development
- Computational Modeling of Drug Disposition
• Computers in Preclinical Development
• Optimization Techniques in Pharmaceutical Formulation
• Computers in Market Analysis
• Computers in Clinical Development
• Artificial Intelligence (AI) and Robotics
• Computational fluid dynamics (CFD)

THEORY  60 HOURS


2. **Computational Modeling of Drug Disposition:** Introduction, Modeling Techniques: Drug Absorption, Solubility, Intestinal Permeation, Drug Distribution, Drug Excretion, Active Transport; P-gp, BCRP, Nucleoside Transporters, hPEPT1, ASBT, OCT, OATP, BBB-Choline Transporter. 12Hrs


   b. **Computer Simulations in Pharmacokinetics and Pharmacodynamics:** Introduction, Computer Simulation: Whole Organism, Isolated Tissues, Organs, Cell, Proteins and Genes.

   c. **Computers in Clinical Development:** Clinical Data Collection and Management, Regulation of Computer Systems

5. **Artificial Intelligence (AI), Robotics and Computational fluid dynamics:** General overview, Pharmaceutical Automation, Pharmaceutical applications, Advantages and Disadvantages. Current Challenges and Future Directions.

REFERENCES


COSMETICS AND COSMECEUTICALS (MPH 204T)

SCOPE

This course is designed to impart knowledge and skills necessary for the fundamental need for cosmetic and cosmeceutical products.

OBJECTIVES

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

- Key ingredients used in cosmetics and cosmeceuticals.
- Key building blocks for various formulations.
- Current technologies in the market
- Various key ingredients and basic science to develop cosmetics and cosmeceuticals
- Scientific knowledge to develop cosmetics and cosmeceuticals with desired safety, stability, and efficacy.

THEORY 60 HOURS

1. **Cosmetics – Regulatory**: Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labeling of cosmetics. Regulatory provisions relating to import of cosmetics, Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics – Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties. 12Hrs

2. **Cosmetics - Biological aspects**: Structure of skin relating to problems like dry skin, acne, pigmentation, prickly heat, wrinkles and body odor. Structure of hair and hair growth cycle. Common problems associated with oral cavity. Cleansing and care needs for face, eye lids, lips, hands, feet, nail, scalp, neck, body and under-arm. 12Hrs

3. **Formulation Building blocks**: Building blocks for different product formulations of cosmetics/cosmeceuticals. Surfactants – Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste. Soaps and syndet bars. 12Hrs

    **Perfumes**: Classification of perfumes. Perfume ingredients listed as allergens in EU regulation. Controversial ingredients: Parabens, formaldehyde liberators, dioxane.

4. **Design of cosmeceutical products**: Sun protection, sunscreens classification and regulatory aspects. Addressing dry skin, acne, sun-protection, pigmentation, prickly heat, wrinkles, body odor, dandruff, dental cavities, bleeding gums, mouth odor and sensitive teeth through cosmeceutical formulations. 12Hrs

5. **Herbal Cosmetics**: Herbal ingredients used in Hair care, skin care and oral care. Review of guidelines for herbal cosmetics by private bodies like cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics. 12Hrs
REFERENCES
3. Cosmetics - Formulation, Manufacture and quality control, PP. Sharma, 4th edition
4. Handbook of cosmetic science and Technology A.O.Barel, M.Paye and H.I. Maibach. 3rd edition
5. Cosmetic and Toiletries recent suppliers catalogue.
6. CTFA directory.

PHARMACEUTICS PRACTICAL - II (MPH 205P)
1. To study the effect of temperature change, non solvent addition, incompatible polymer addition in microcapsules preparation
2. Preparation and evaluation of Alginate beads
3. Formulation and evaluation of gelatin /albumin microspheres
4. Formulation and evaluation of liposomes/niosomes
5. Formulation and evaluation of spherules
6. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique.
7. Comparison of dissolution of two different marketed products /brands
8. Protein binding studies of a highly protein bound drug & poorly protein bound drug
9. Bioavailability studies of Paracetamol in animals.
10. Pharmacokinetic and IVIVC data analysis by WinnolineR software
11. In vitro cell studies for permeability and metabolism
12. DoE Using Design Expert® Software
13. Formulation data analysis Using Design Expert® Software
14. Quality-by-Design in Pharmaceutical Development
15. Computer Simulations in Pharmacokinetics and Pharmacodynamics
16. Computational Modeling Of Drug Disposition
17. To develop Clinical Data Collection manual
19. Development and evaluation of Creams
20. Development and evaluation of Shampoo and Toothpaste base
21. To incorporate herbal and chemical actives to develop products
22. To address Dry skin, acne, blemish, Wrinkles, bleeding gums and dandruff
PHARMACEUTICAL CHEMISTRY (MPC)

Programme Educational Objectives

1. To develop competent pharmacy graduates by structured teaching learning process through dedicated and devoted faculty.

2. To integrate theoretical knowledge and practical skills of synthetic and analytical chemistry to meet the challenges in drug discovery.

3. To develop skills in Computer Aided Drug Design to facilitate outcome oriented research in drug discovery.

4. To provide interdisciplinary research and educational opportunities to solve problems that will improve the quality of life for those suffering from health-related diseases and disorders.

5. To inspire the graduates for higher education, research or entrepreneurship and life-long learning in the context of technological advancement.
SEMESTER I
MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES
(MPC 101T)

SCOPE
This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

OBJECTIVES
After completion of course student is able to know about chemicals and excipients

• The analysis of various drugs in single and combination dosage forms

• Theoretical and practical skills of the instruments

THEORY 60 HOURS


2. **b. 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. **c. Spectroflourimetry:** Theory of Fluorescence, Factors affecting fluorescence (Characteristics of drugs that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence spectrophotometer.

4. **d. Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, Interferences and Applications.

5. **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.


7. **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  

5. **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  

b. **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.


b. **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.

REFERENCES


ADVANCED ORGANIC CHEMISTRY - I  
(MPC 102T)

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.

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

- The principles and applications of retrosynthesis
- 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

THEORY 60 Hrs

1. Basic Aspects of Organic Chemistry: 12 Hrs


2. Types of reaction mechanisms and methods of determining them

3. Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations.

Addition reactions

a) Nucleophilic uni- and bimolecular reactions (SN1 and SN2)

b) Elimination reactions (E1 & E2; Hoffman & Saytzeff’s rule)

c) Rearrangement reaction

2. Study of mechanism and synthetic applications of following named Reactions: 12 Hrs

Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeeyer-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction

3. Synthetic Reagents & Applications: 12 Hrs

Aluminiumisopropoxide, N-bromosuccinamide, diazo methane, dicyclohexylcarbodiimide, Wilkinson reagent, Witting reagent. Osmium tetroxide, titanium chloride, diazopropane, 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

4. **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 nucleus such as Ketoconazole, Metronidazole, Miconazole, celecoxib, antipyrin, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochloropherazine, Promazine, Chlorpromazine, Theophylline, Mercaptopurine and Thioguanine.

5. **Synthon approach and retrosynthesis applications:**

   i. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconversion and addition (FGI and FGA)

   ii. C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-,1,4-, 1,5-, 1,6-difunctionalized compounds

   iii. Strategies for synthesis of three, four, five and six-membered ring.

**REFERENCES**


ADVANCED MEDICINAL CHEMISTRY  
(MPC 103T)

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.

OBJECTIVES

At completion of this course it is expected that students will be able 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
- Peptidomimetics

THEORY

60 Hrs

1. 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.

2. Prodrug Design and Analog design:

   a) Prodrug design: Basic concept, Carrier linked prodrugs/ Bioprecursors, 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.

   b) Combating drug resistance: Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance.

   c) 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 interatomic distance.

3. a. 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:

   a) Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic agents, Antineoplastic and Antiviral agents.

   b. 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.
4. **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.

5. **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 thromboxanes.

REFERENCES

1. Medicinal Chemistry by Burger, Vol I –VI.


3. Comprehensive Medicinal Chemistry – Corwin and Hansch.

4. Computational and structural approaches to drug design edited by Robert M Stroud & Janet. F Moore

5. Introduction to Quantitative Drug Design by Y.C. Martin.


CHEMISTRY OF NATURAL PRODUCTS  
(MPC 104T)

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.

OBJECTIVES

At completion of this course it is expected that students will be able 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

THEORY

60 Hrs

1. Study of Natural products as leads for new pharmaceuticals for the following class of drugs  12 Hrs
   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 macrolid antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β-Lactam antibiotics (Cephalosporins and Carbapenem)

2. a) Alkaloids:  12 Hrs
   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.

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

   c) 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).

3. a) Terpenoids:  12 Hrs
   Classification, isolation, isoprene rule and general methods of structural elucidation of Ter-
penoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di (retinol, Phytol, taxol) and tri terpenoids (Squalene, Ginsenoside) carotinoids (B carotene).

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

4. 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

b) 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.

5. 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
4. Chemistry of natural products Vol I onwards IWPAC.
8. Introduction to molecular Phytochemistry – CHJ Wells, Chapmannstall.
16. Burger’s Medicinal Chemistry.
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 chromatography
2. Claisen-schimidt reaction
3. Benzylic 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
SEMESTER I
ADVANCED SPECTRAL ANALYSIS
(MPC 201T)

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.

OBJECTIVES
At completion of this course it is expected that students will be able to understand:

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

THEORY 60Hrs

1. 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.

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

3. 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.

4. 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

5. a) Thermal methods of analysis Introduction, principle, instrumentation and application of DSC, DTA and TGA.
   c) Radio immuno assay Biological standardization, bioassay, ELISA, Radioimmuno assay of digitalis and insulin.

REFERENCES
2. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman, 5th ed-


ADVANCED ORGANIC CHEMISTRY - II
(MPC 202T)

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.

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.

THEORY

1. 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.

2. 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.


   Pericyclic reactions

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

4. Catalysis: 12 Hrs

   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: Metal-catalyzed reactions


   f. Phase transfer catalysis - theory and applications

5. Stereochemistry & Asymmetric Synthesis 12 Hrs

   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 centres, 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


6. Organic synthesis-the disconnection approach, S. Warren, Wily India

7. Principles of organic synthesis, ROC Norman and JMCoxan, Nelson thorns
SCOPE

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

OBJECTIVES

At completion of this course it is expected that students will 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 *in silico* virtual screening protocols

**Theory**

| 60 Hrs |

1. **Introduction to Computer Aided Drug Design (CADD):**

   History, different techniques and applications.

   **Quantitative Structure Activity Relationships:**

   Basics 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.

2. **Quantitative Structure Activity Relationships: Applications**

   Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D-QSAR equations.

   3D-QSAR approaches and contour map analysis.

   Statistical methods used in QSAR analysis and importance of statistical parameters.

3. **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)
4. 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.

5. Pharmacophore Mapping and Virtual Screening:

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

REFERENCES


10. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore
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.

OBJECTIVES

At completion of this course it is expected that students will be able to understand

- The strategies of scale up process of APIs and intermediates
- The various unit operations and various reactions in process chemistry

THEORY

1. Process chemistry: Introduction, Synthetic strategy

   Stages of scale up process: Bench, pilot and large scale process.

   In-process control and validation of large scale process. Case studies of some scale up process of APIs.

   Impurities in API, types and their sources including genotoxic impurities

2. 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.

3. 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 halogenations. Case study on industrial halogenation process.

   c) Oxidation: Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H2O2, sodium hypochlorite, Oxygen gas, ozone-lysis.
4. **Unit Processes - II**

   12 Hrs

   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.

5. **Industrial Safety**

   12 Hrs

   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

**REFERENCES**


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


12. Lowenheim & M.K. Moran: Industrial Chemicals

17. ICH Guidelines
18. United States Food and Drug Administration official website www.fda.gov
PHARMACEUTICAL CHEMISTRY PRACTICALS – II
(MPC 205P)

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


12. Preparation of 4-iodotolene from p-toluidine.

13. NaBH4 reduction of vanillin to vanillyl alcohol

14. Preparation of umbelliferone by Pechmann 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
**PHARMACY PRACTICE**  
** (MPP)**

**Programme Educational Objectives**

1. To develop competent pharmacy graduates by structured teaching learning process through dedicated and devoted faculty.
2. To enable the graduates in practicing patient centered care and involve in the development of practice guidelines and evidence-based practices.
3. To develop responsible clinical pharmacy professionals to practice in collaboration with other healthcare practitioners for the purpose of improving patient care.
4. To develop skills in identifying rational, reasonable and practical solutions to drug related problems for the wellbeing of the patients.
5. To inspire the graduates for higher education, research or entrepreneurship and life long learning in the context of technological advancement.
SEMESTER I

CLINICAL PHARMACY PRACTICE (MPP 101T)

SCOPE
This course is designed to impart the basic knowledge and skills that are required to practice pharmacy including the provision of pharmaceutical care services to both healthcare professionals and patients in clinical settings.

OBJECTIVES
Upon completion of this course it is expected that students shall be able to:
• Understand the elements of pharmaceutical care and provide comprehensive patient care services
• Interpret the laboratory results to aid the clinical diagnosis of various disorders
• Provide integrated, critically analyzed medicine and poison information to enable healthcare professionals in the efficient patient management

THEORY   60 Hrs
1. Introduction to Clinical Pharmacy: Definition, evolution and scope of clinical pharmacy, International and national scenario of clinical pharmacy practice, Pharmaceutical care
Clinical Pharmacy Services: Ward round participation, Drug therapy review (Drug therapy monitoring including medication order review, chart endorsement, clinical review and pharmacist interventions)

2. Clinical Pharmacy Services: Patient medication history interview, Basic concept of medicine and poison information services, Basic concept of pharmacovigilance, Hemovigilance, Materiovigilance and AEFI, Patient medication counselling, Drug utilisation evaluation, Documentation of clinical pharmacy services, Quality assurance of clinical pharmacy services.

3. Patient Data Analysis:
Patient Data & Practice Skills: Patient’s case history - its structure and significances in drug therapy management, Common medical abbreviations and terminologies used in clinical practice.
Communication skills: verbal and non-verbal communications, its applications in patient care services.
Lab Data Interpretation: Hematological tests, Renal function tests, Liver function tests

4. Lab Data Interpretation: Tests associated with cardiac disorders, Pulmonary function tests, Thyroid function tests, Fluid and electrolyte balance, Microbiological culture sensitivity tests

5. Medicines & Poison Information Services Medicine Information Service: Definition and need for medicine information service, Medicine information resources, Systematic approach in answering medicine information queries, Preparation of verbal and written response, Establishing a drug information centre.
Poison Information Service: Definition, need, organization and functions of poison information centre.

REFERENCES
2. Practice Standards and Definitions - The Society of Hospital Pharmacists of Australia
3. Basic skills in interpreting laboratory data - Scott LT, American Society of Health System Pharmacists Inc
4. Relevant review articles from recent medical and pharmaceutical literature.
PHARMACOTHERAPEUTICS-I (MPP 102T)

SCOPE
This course aims to enable the students to understand the different treatment approaches in managing various disease conditions. Also, it imparts knowledge and skills in optimizing drug therapy of a patient by individualizing the treatment plan through evidence-based medicines.

OBJECTIVES
Upon completion of this course it is expected that students shall be able to:
• Describe and explain the rationale for drug therapy
• Summarize the therapeutic approach for management of various disease conditions including reference to the latest available evidence
• Discuss the clinical controversies in drug therapy and evidence-based medicine
• Prepare individualized therapeutic plans based on diagnosis
• Identify the patient specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effect/s)

THEORY
Etiopathogenesis and pharmacotherapy of diseases associated with following systems

1. Cardiovascular system: Hypertension, Congestive cardiac failure, Acute coronary syndrome, Arrhythmias, Hyperlipidemias. 12 Hrs
2. Respiratory system: Asthma, Chronic obstructive airways disease, Drug induced pulmonary diseases 12 Hrs
Endocrine system: Diabetes, Thyroid diseases
3. Gastrointestinal system: Peptic ulcer diseases, Reflux esophagitis, Inflammatory bowel diseases, Jaundice & hepatitis 12 Hrs
4. Gastrointestinal system: Cirrhosis, Diarrhea and Constipation, Drug-induced liver disease 12 Hrs
Hematological diseases: Anemia, Deep vein thrombosis, Drug induced hematological disorders
5. Bone and joint disorders: Rheumatoid arthritis, Osteoarthritis, Gout, Osteoporosis 12 Hrs
Dermatological Diseases: Psoriasis, Eczema and scabies, impetigo, drug induced skin disorders
Ophthalmology: Conjunctivitis, Glaucoma

REFERENCES
1. Roger and Walker. Clinical Pharmacy and Therapeutics - Churchill Livingstone publication
3. Robins SL. Pathologic basis of disease -W.B. Saunders publication
4. Eric T. Herfindal. Clinical Pharmacy and Therapeutics- Williams and Wilkins Publication
5. Lloyd Young and Koda-Kimble MA Applied Therapeutics: The clinical Use of Drugs- Lippincott Williams and Wilkins
7. Carol Mattson Porth. Principles of Pathophysiology- Lippincott Williams and Wilkins
9. Relevant review articles from recent medical and pharmaceutical literature
HOSPITAL & COMMUNITY PHARMACY (MPP 103T)

SCOPE
This course is designed to impart basic knowledge and skills that are required to practice pharmacy in both hospital and community settings.

OBJECTIVES
Upon completion of this course it is expected that students shall be able to:
• Understand the organizational structure of hospital pharmacy
• Understand drug policy and drug committees
• Know about procurement & drug distribution practices
• Know the admixtures of radiopharmaceuticals
• Understand the community pharmacy management
• Know about value added services in community pharmacies

THEORY

1. Introduction to Hospitals – Definition, classification, organizational structure 12 Hrs
Hospital Pharmacy: Definition, Relationship of hospital pharmacy department with other departments, Organizational structure, legal requirements, work load statistics, Infrastructural requirements, Hospital Pharmacy Budget and Hospital Pharmacy management
Hospital Drug Policy: Pharmacy & Therapeutics Committee, Infection Control committee, Research & Ethics Committee, Management of Medicines as per NABH

2. Hospital Formulary Guidelines and its development, Developing Therapeutic guidelines, Drug procurement process, and methods of Inventory control, Methods of Drug distribution, Intravenous admixtures, Hospital Waste Management 12 Hrs

3. Education and training: Training of technical staff, training and continuing education for pharmacists, Pharmacy students, Medical staff and students, Nursing staff and students, Formal and informal meetings and lectures, Drug and therapeutics newsletter.
Community Pharmacy Practice: Definition, roles & responsibilities of community pharmacists, and their relationship with other health care providers.
Community Pharmacy management: Legal requirements to start community pharmacy, site selection, lay out & design, drug display, super drug store model, accounts and audits, Good dispensing practices, Different softwares & databases used in community pharmacies. Entrepreneurship in community pharmacy.

4. Prescription – Legal requirements & interpretation, prescription related problems 12 Hrs
Responding to symptoms of minor ailments: Head ache, pyrexia, menstrual pains, food and drug allergy,
OTC medication: Rational use of over the counter medications, Medication counseling and use of patient information leaflets.
Medication adherence – Definition, factors influencing adherence behavior, strategies to improve medication adherence Patient referrals to the doctors
ADR monitoring in community pharmacies

5. Health Promotion – Definition and health promotion activities, family planning, Health screening services, first aid, prevention of communicable and non-communicable diseases, smoking cessation, Child & mother care
National Health Programs- Role of Community Pharmacist in Malaria and TB control programs
Home Medicines review program – Definition, objectives, Guidelines, method and outcomes
Research in community pharmacy Practice
REFERENCES
1. Hospital Pharmacy - Hassan WE. Lea and Febiger publication.
3. Avery’s Drug Treatment, Adis International Limited.
5. Remington Pharmaceutical Sciences.
6. Relevant review articles from recent medical and pharmaceutical literature

CLINICAL RESEARCH (MPP 104T)

SCOPE
This course aims to provide the students an opportunity to learn drug development process especially the phases of clinical trials and also the ethical issues involved in the conduct of clinical research. Also, it aims to impart knowledge and develop skills on conceptualizing, designing, conducting and managing clinical trials.

OBJECTIVES
Upon completion of this course it is expected that students shall be able to:

• Know the new drug development process.
• Understand the regulatory and ethical requirements.
• Appreciate and conduct the clinical trials activities
• Know safety monitoring and reporting in clinical trials
• Manage the trial coordination process

THEORY 60 Hrs

1. Drug development process: Introduction, various approaches to drug discovery, Investigational new drug application submission. 12 Hrs

Ethics in Biomedical Research: Ethical Issues in Biomedical Research – Principles of ethics in biomedical research, Ethical committee [institutional review board] - its constitution and functions, Challenges in implementation of ethical guidelines, ICH GCP guidelines and ICMR guidelines in conduct of Clinical trials, Drug Safety Reporting.

2. Types and Designs used in Clinical Research: Planning and execution of clinical trials, Various Phases of clinical trials, Bioavailability and Bioequivalence studies, Randomization techniques (Simple randomization, restricted randomization, blocking method and stratification), Types of research designs based on Controlling Method (Experimental, Quasi experimental, and Observational methods) Time Sequences (Prospective and Retrospective), Sampling methods (Cohort study, case Control study and cross sectional study), Health outcome measures (Clinical & Physiological, Humanistic and economic)

Clinical Trial Study team: Roles and responsibilities of: Investigator, Study Coordinator, Sponsor, Monitor, Contract Research Organization.


Clinical Trial Start up activities: Site Feasibility Studies, Site/Investigator selection, Pre-study visit, Investigator meeting, Clinical trial agreement execution, Ethics committee document preparation and submission

4. Investigational Product: Procurement and Storage of investigation product. 12 Hrs

5. **Quality Assurance and Quality Control in Clinical Trials**: Types of audits, Audit criteria, Audit process, Responsibilities of stakeholders in audit process, Audit follow-up and documentation, Audit resolution and Preparing for FDA inspections, Fraud and misconduct management Data Management Infrastructure and System Requirement for Data Management: Electronic data capture systems, Selection and implementation of new systems, System validation and test procedures, Coding dictionaries, Data migration and archival. 

Clinical Trial Data Management: Standard Operating Procedures, Data management plan, CRF & Data base design considerations, Study set-up, Data entry, CRF tracking and corrections, Data cleaning, Managing laboratory and ADR data, Data transfer and database lock, Quality Control and Quality Assurance in CDM, Data mining and warehousing.

**REFERENCES**

10. Relevant review articles from recent medical and pharmaceutical literature.

**PHARMACY PRACTICE PRACTICAL – I (MPP 105P)**

Pharmacy Practice practical component includes experiments covering important topics of the courses Clinical Pharmacy Practice, Pharmacotherapeutics-I, Hospital & Community Pharmacy and Clinical Research.

List of Experiments (24)

1. Treatment Chart Review (one)
2. Medication History Interview (one)
3. Patient Medication Counseling (two)
4. Drug Information Query (two)
5. Poison Information Query (one)
6. Lab Data Interpretation (two)
7. Presentation of clinical cases of various disease conditions adopting Pharmaceutical Care Plan Model (eight)
8. ABC Analysis of a given list of medications (one)
9. Preparation of content of a medicine, with proper justification, for the inclusion in the hospital formulary (one)
10. Formulation and dispensing of a given IV admixtures (one)
11. Preparation of a patient information leaflet (two)
12. Preparation of Study Protocol (one)
13. Preparation of Informed Consent Form (one)
PRINCIPLES OF QUALITY USE OF MEDICINES (MPP 201T)

SCOPE:
This course is designed to impart basic knowledge and skills that are required to practice quality use of medicines (QUM) in different healthcare settings and also to promote quality use of medicines, in clinical practice, through evidence-based medicine approach.

OBJECTIVES:
Upon completion of this course it is expected that students shall be able to:
• Understand the principles of quality use of medicines
• Know the benefits and risks associated with use of medicines
• Understand regulatory aspects of quality use of medicines
• Identify and resolve medication related problems
• Promote quality use of medicines
• Practice evidence-based medicines

THEORY 60 Hrs
1. Introduction to Quality use of medicines (QUM): Definition and Principles of QUM, Key partners and responsibilities of the partners, Building blocks in QMC, Evaluation process in QMC, Communication in QUM, Cost effective prescribing.
2 Concepts in QUM: Evidence based medicine: Definition, concept of evidence based medicine, Approaches and practice of evidence based medicine in clinical settings
Essential drugs: Definition, need, concept of essential drug, National essential drug policy and list.
Rational drug use: Definition, concept and need for rational drug use, Rational drug prescribing, Role of pharmacist in rational drug use.
3 QUM in various settings: Hospital settings, Ambulatory care/Residential care, Role of health care professionals in promoting the QUM, Strategies to promote the QUM, Impact of QUM on E-health, integrative medicine and multidisciplinary care. QUM in special population: Pediatric prescribing, Geriatric prescribing, Prescribing in pregnancy and lactation, Prescribing in immune compromised and organ failure patients.
4 Regulatory aspects of QUM in India: Regulation including scheduling, Regulation of complementary medicines, Regulation of OTC medicines, Professional responsibility of pharmacist, Role of industry in QUM in medicine development.
5 Medication errors: Definition, categorization and causes of medication errors, Detection and prevention of medication errors, Role of pharmacist in monitoring and management of medication errors.
Pharmacovigilance: Definition, aims and need for pharmacovigilance, Types, predisposing factors and mechanism of adverse drug reactions (ADRs), Detection, reporting and monitoring of ADRs, Causality assessment of ADRs, Management of ADRs, Role of pharmacist in pharmacovigilance.

REFERENCES:
2. Andrews EB, Moore N. Mann’s Pharmacovigilance
3. Dipiro JT, Talbert RL, Yee GC. Pharmacotherapy: A Pathophysiologic Approach
4. Straus SE, Richardson WS, Glasziou P, Haynes RB. Evidence-Based Medicine: How to practice and teach it
5. Cohen MR. Medication Errors
PHARMACOTHERAPEUTICS - II (MPP 202T)

SCOPE
This course aims to enable the students to understand the different treatment approaches in managing various disease conditions. Also, it imparts knowledge and skills in optimizing drug therapy of a patient by individualizing the treatment plan through evidence-based medicines.

OBJECTIVES
Upon completion of this course it is expected that students shall be able to:
• Describe and explain the rationale for drug therapy
• Summarize the therapeutic approach for management of various disease conditions including reference to the latest available evidence
• Discuss the clinical controversies in drug therapy and evidence based medicine
• Prepare individualized therapeutic plans based on diagnosis
• Identify the patient specific parameters relevant in initiating drug therapy and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effect/s)

THEORY
60 Hrs

1. Nervous system: Epilepsy, Parkinson’s disease, Stroke, Headache, Alzheimer’s disease, 12 Hrs
   Neuralgias and Pain pathways and Pain management.
3. Infectious diseases: General guidelines for the rational use of antibiotics and surgical 12 Hrs
   prophylaxis, Urinary tract infections, Respiratory tract infections, Gastroenteritis, Tuberculosis,
   Malaria, Bacterial endocarditis, Septicemia.
4. Infectious diseases: Meningitis, HIV and opportunistic infections, Rheumatic fever, Dengue 12 Hrs
   fever, H1N1, Helmenthiasis, Fungal infections
5. Oncology: General principles of cancer chemotherapy, pharmacotherapy of breast 12 Hrs
   cancer, lung cancer, head & neck cancer, hematological malignancies, Management of nausea and
   vomiting, Palliative care

REFERENCES
3. Robins SL. Pathologic basis of disease -W.B. Saunders publication
4. Eric T. Herfindal. Clinical Pharmacy and Therapeutics- Williams and Wilkins Publication
5. Lloyd Young and Koda-Kimble MA Applied Therapeutics: The clinical Use of Drugs- Lippincott
   Williams and Wilkins
   Principles and practice— McGraw Hill Publication
7. Carol Mattson Porth. Principles of Pathophysiology- Lippincott Williams and Wilkins
9. Relevant review articles from recent medical and pharmaceutical literature
CLINICAL PHARMACOKINETICS AND THERAPEUTIC DRUG MONITORING
(MPP 203T)

SCOPE
This course is designed to enable students to understand the basics principles and applications of pharmacokinetics in designing the individualized dosage regimen, to interpret the plasma drug concentration profile in altered pharmacokinetics, drug interactions and in therapeutic drug monitoring processes to optimize the drug dosage regimen. Also, it enables students to understand the basic concepts of pharmacogenetics, pharmacometrics for modeling and simulation of pharmacokinetic data.

OBJECTIVES
Upon completion of this course it is expected that students shall be able to:
• Design the drug dosage regimen for individual patients
• Interpret and correlate the plasma drug concentrations with patients’ therapeutic outcomes
• Recommend dosage adjustment for patients with renal/hepatic impairment
• Recommend dosage adjustment for paediatrics and geriatrics
• Manage pharmacokinetic drug interactions
• Apply pharmacokinetic parameters in clinical settings
• Interpret the impact of genetic polymorphisms of individuals on pharmacokinetics and pharmacodynamics of drugs
• Do pharmacokinetic modeling for the given data using the principles of pharmacometrics

THEORY 60 Hrs
1. Introduction to Clinical pharmacokinetics: Compartmental and Non compartmental 12 Hrs models, Renal and non-renal clearance, Organ extraction and models of hepatic clearance, Estimation and determinants of bioavailability, Multiple dosing, Calculation of loading and maintenance doses.
Designing of dosage regimens: Determination of dose and dosing intervals, Conversion from intravenous to oral dosing, Nomograms and Tabulations in designing dosage regimen.
2. Pharmacokinetics of Drug Interaction: Pharmacokinetic drug interactions, Inhibition 12 Hrs and Induction of Drug metabolism, Inhibition of Biliary Excretion.
Pharmacogenetics: Genetic polymorphism in Drug metabolism: Cytochrome P-450 Isoenzymes, Genetic Polymorphism in Drug Transport and Drug Targets, Pharmacogenetics and Pharmacokinetic / Pharmacodynamic considerations.
Introduction to Pharmacometrics: Introduction to Bayesian Theory, Adaptive method or Dosing with feedback, Analysis of Population pharmacokinetic Data.
3. Non Linear Mixed Effects Modelling: The Structural or Base Model, Modeling 12 Hrs Random Effects, Modeling Covariate Relationships, Mixture Model, Estimation Methods, Model Building Techniques, Covariate Screening Methods, Testing the model assumptions, Precision of the parameter estimates and confidence intervals, Model misspecification and violation of the model assumptions, Model Validation, Simulation of dosing regimens and dosing recommendations, Pharmacometrics software.
5. **Therapeutic Drug monitoring**: Introduction, Individualization of drug dosage regimen (Variability – Genetic, age, weight, disease and Interacting drugs), Indications for TDM, Protocol for TDM, Pharmacokinetic/Pharmacodynamic Correlation in drug therapy.

**TDM of drugs used in the following conditions**: Cardiovascular disease: Digoxin, Lidocaine, Amiodarone; Seizure disorders: Phenytoin, Carbamazepine, Sodium Valproate; Psychiatric conditions: Lithium, Fluoxetine, Amitriptyline; Organ transplantations: Cyclosporine; Cytotoxic Agents: Methotrexate, 5-FU, Cisplatin; Antibiotics: Vancomycin, Gentamicin, Meropenem.

**REFERENCES**

4. Steven How-Yan Wong, Irving Sunshine. Handbook of Analytical Therapeutic Drug Monitoring and Toxicology. CRC Press, USA.
7. Malcolm Rowland, Thomas N. Tozer. Clinical Pharmacokinetics and pharmacodynamics: concepts and applications. lippincott Williams & Wilkins, USA.
9. Michael E. Winter. Basic Clinical Pharmacokinetics. lippincott Williams & Wilkins, USA.
13. Relevant review articles from recent medical and pharmaceutical literature.
PHARMOCOEPIDEMIOLOGY & PHARMACOECONOMICS (MPP 204T)

SCOPE
This course enables students to understand various pharmacoepidemiological methods and their clinical applications. Also, it aims to impart knowledge on basic concepts, assumptions, terminology and methods associated with Pharmacoeconomics and health related outcomes, and when should be appropriate Pharmacoeconomic model should be applied for a health care regimen.

OBJECTIVES
Upon completion of this course it is expected that students shall be able to:
• Understand the various epidemiological methods and their applications
• Understand the fundamental principles of Pharmacoeconomics.
• Identify and determine relevant cost and consequences associated with pharmacy products and services.
• Perform the key Pharmacoeconomics analysis methods
• Understand the Pharmacoeconomic decision analysis methods and its applications.
• Describe current Pharmacoeconomic methods and issues.
• Understand the applications of Pharmacoeconomics to various pharmacy settings.

THEORY

1. Introduction to Pharmacoepidemiology: Definition, Scope, Need, Aims & Applications; 12 Hrs
   Outcome measurement: Outcome measures, Drug use measures: Monetary units, Number of prescriptions, units of drug dispensed, defined daily doses, prescribed daily doses, Diagnosis and Therapy surveys, Prevalence, Incidence rate, Monetary units, number of prescriptions, unit of drugs dispensed, defined daily doses and prescribed daily doses, medications adherence measurements. Concept of risk: Measurement of risk, Attributable risk and relative risk, Time- risk relationship and odds ratio

2. Pharmacoepidemiological Methods: Qualitative models: Drug Utilization Review; Quantitative models: case reports, case series, Cross sectional studies, Cohort and case control studies, Calculation of Odds’ ratio, Meta analysis models, Drug effects study in populations: Spontaneous reporting, Prescription event monitoring, Post marketing surveillance, Record linkage systems, Applications of Pharmacoepidemiology

3. Introduction to Pharmacoeconomics: Definition, history of Pharmacoeconomics, Need of Pharmacoeconomic studies in Indian healthcare system. 12 Hrs
   Cost categorization and resources for cost estimation: Direct costs. Indirect costs. Intangible costs.
   Outcomes and Measurements of Pharmacoeconomics: Types of outcomes: Clinical outcome, Economic outcomes, Humanistic outcomes; Quality Adjusted Life Years, Disability Adjusted Life Years Incremental Cost Effective Ratio, Average Cost Effective Ratio. Person Time, Willingness To Pay, Time Trade Off and Discounting.

4. Pharmacoeconomic evaluations: Definition, Steps involved, Applications, Advantages and disadvantages of the following Pharmacoeconomic models: Cost Minimization 12 Hrs Analysis (CMA), Cost Benefit Analysis (CBA), Cost Effective Analysis (CEA), Cost Utility Analysis (CUA), Cost of Illness (COI), Cost Consequences Analysis (COA).

REFERENCES
5. George E Mackinnon III. Understanding health outcomes and pharmacoeconomics.
7. Walley, Pharmacoeconomics.
8. Pharmacoeconomic – ed. by Nowakowska – University of Medical Sciences, Poznan.
9. Relevant review articles from recent medical and pharmaceutical literature

PHARMACY PRACTICE PRACTICAL - II (MPP 205P)
Pharmacy Practice practical component includes experiments covering important topics of the courses Principles of Quality Use of Medicines, Pharmacotherapeutics-II, Clinical Pharmacokinetics & Therapeutic Drug Monitoring and Pharmacoepidemiology and Pharmacoeconomics.

List of Experiments (24)
1. Causality assessment of adverse drug reactions (three)
2. Detection and management of medication errors (three)
3. Rational use of medicines in special population (three)
4. Presentation of clinical cases of various disease conditions adopting Pharmaceutical Care Plan Model (eight)
5. Calculation of Bioavailability and Bioequivalence from the given data (two)
6. Interpretation of Therapeutic Drug Monitoring reports of a given patient (three)
7. Calculation of various Pharmacoeconomic outcome analysis for the given data (two)
Pharmacology (MPL)

Programme Educational Objectives

1. To develop competent pharmacy graduates by structured teaching learning process through dedicated and devoted faculty.

2. To prepare students for careers of constructive service to society in academia, government, industry and health related fields.

3. To orient students to conduct translational research, from conceptual design through \textit{in vivo} testing with an eye towards clinical implementation.

4. To provide interdisciplinary research and educational opportunities to solve problems that will improve the quality of life for those suffering from health-related diseases and disorders.

5. To inspire the graduates for higher education, research or entrepreneurship and life-long learning in the context of technological advancement.
SEMESTER I
MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (MPL 101T)

SCOPE

This subject deals with various advanced analytical instrumental techniques for identification, characteriza-
tion and quantification of drugs. Instruments dealt are NMR, Mass spectrometer, IR, HPLC, GC etc.

OBJECTIVES

After completion of course student is able to know about,
• Chemicals and excipients
• The analysis of various drugs in single and combination dosage forms
• Theoretical and practical skills of the instruments

THEORY 60 Hrs


**IR spectroscopy:** Theory, Modes of Molecular vibrations, Sample handling, Instrumentation of Dis-
persive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and
Applications of IR spectroscopy, Data Interpretation.

**Spectrofluorimetry:** Theory of Fluorescence, Factors affecting fluorescence (Characterestics of drugs
that can be analysed by flourimetry), Quenchers, Instrumentation and Applications of fluorescence
spectrophotometer. 10 Hrs

**Flame emission spectroscopy and Atomic absorption spectroscopy:** Principle, Instrumentation, In-
terferences and Applications.

2 **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. 10 Hrs

3 **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. 10 Hrs

4 **Chromatography:** Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution, isolation of drug from excipients, data interpretation and applications of the following: 10 Hrs

- 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
5  **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

**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.  10 Hrs

6  **Potentiometry**: Principle, working, Ion selective Electrodes and Application of potentiometry.

**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.  10 Hrs

**REFERENCES**

ADVANCED PHARMACOLOGY - I (MPL 102T)

SCOPE

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, this subject helps the students to understand the concepts of drug action and mechanisms involved.

OBJECTIVES

Upon completion of the course the student shall be able to:

- Discuss the pathophysiology and pharmacotherapy of certain diseases
- Explain the mechanism of drug actions at cellular and molecular level
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

THEORY 60 Hrs

1. General Pharmacology
   b. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors, quantitation of drug receptors interaction and elicited effects.

2a. Neurotransmission
   a. General aspects and steps involved in neurotransmission.
   b. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetyl choline).
   c. Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine).
   d. Non adrenergic non cholinergic transmission (NANC). Co- transmission

2b. Systemic Pharmacology

   A detailed study on pathophysiology of diseases, mechanism of action, pharmacology and toxicology of existing as well as novel drugs used in the following systems

Autonomic Pharmacology

Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting neuromuscular junction

3 Central nervous system: Pharmacology General and local anesthetics Sedatives and hypnotics, drugs used to treat anxiety. Depression, psychosis, mania, epilepsy, neurodegenerative diseases. Narcotic and non-narcotic analgesics.

4 Cardiovascular Pharmacology: Diuretics, antihypertensives, antiischemics, anti- arrhythmics, drugs for heart failure and hyperlipidemia. Hematinics, coagulants, anticoagulants, fibrinolytics and anti-platelet drugs

REFERENCES

1. The Pharmacological Basis of Therapeutics, Goodman and Gillman’s
3. Basic and Clinical Pharmacology by B.G Katzung
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
7. Avery Drug Treatment
10. Robbins & Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology)
PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS - I (MPL 103T)

SCOPE

This subject is designed to impart the knowledge on preclinical evaluation of drugs and recent experimental techniques in the drug discovery and development. The subject content helps the student to understand the maintenance of laboratory animals as per the guidelines, basic knowledge of various in-vitro and in-vivo preclinical evaluation processes.

OBJECTIVES

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

- Appraise the regulations and ethical requirement for the usage of experimental animals.
- Describe the various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experimental animals.
- Describe the various newer screening methods involved in the drug discovery process.
- Appreciate and correlate the preclinical data to humans.

THEORY 60 Hrs

1. Laboratory Animals
   - Common laboratory animals: Description, handling and applications of different species and strains of animals.
   - Transgenic animals: Production, maintenance and applications. Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals.
   - CPCSEA guidelines to conduct experiments on animals.
   - Good laboratory practice.
   - Bioassay-Principle, scope and limitations and methods

2. Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.
   - General principles of preclinical screening.

   - Reproductive Pharmacology: Aphrodisiacs and antifertility agents.
   - Analgesics, anti-inflammatory and antipyretic agents.
   - Gastrointestinal drugs: anti-ulcer, anti-emetic, anti-diarrheal and laxatives.


5. Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models.
   - Immunomodulators, Immunosuppressants and immunostimulants.
   - General principles of immunoassay: theoretical basis and optimization of immunoassay, heterogeneous and homogenous immunoassay systems. Immunoassay methods evaluation; protocol outline, objectives and preparation. Immunoassay for digoxin and insulin. Limitations of animal experimentation and alternate animal experiments.

Extrapolation of in vitro data to preclinical and preclinical to humans.
REFERENCES

1. Biological standardization by J.H. Burn D.J. Finney and I.G. Goodwin
2. Screening methods in Pharmacology by Robert Turner. A
3. Evaluation of drugs activities by Laurence and Bachrach
5. Fundamentals of experimental Pharmacology by M.N.Ghosh
6. Pharmacological experiment on intact preparations by Churchill Livingstone
7. Drug discovery and Evaluation by Vogel H.G.
9. Preclinical evaluation of new drugs by S.K. Guta
10. Handbook of Experimental Pharmacology, SK.Kulkarni
13. Rodents for Pharmacological Experiments, Dr.Tapan Kumar chatterjee.

CELLULAR AND MOLECULAR PHARMACOLOGY (MPL 104T)

SCOPE

The subject imparts a fundamental knowledge on the structure and functions of cellular components and help to understand the interaction of these components with drugs. This information will further help the student to apply the knowledge in drug discovery process.

OBJECTIVES

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

• Explain the receptor signal transduction processes.
• Explain the molecular pathways affected by drugs.
• Appreciate the applicability of molecular pharmacology and biomarkers in drug discovery process.
• Demonstrate molecular biology techniques as applicable for pharmacology

THEORY 60 Hrs

1. Cell biology
   Structure and functions of cell and its organelles
   Genome organization. Gene expression and its regulation, importance of siRNA and micro RNA, gene mapping and gene sequencing
   Cell cycles and its regulation.
   Cell death—events, regulators, intrinsic and extrinsic pathways of apoptosis.
   Necrosis and autophagy. 12 Hrs
2  **Cell signaling**

Intercellular and intracellular signaling pathways.

Classification of receptor family and molecular structure ligand gated ion channels; G-protein coupled receptors, tyrosine kinase receptors and nuclear receptors.

Secondary messengers: cyclic AMP, cyclic GMP, calcium ion, inositol 1,4,5-trisphosphate, (IP3), NO, and diacylglycerol.

**Detailed study of following intracellular signaling pathways:** cyclic AMP signaling pathway, mitogen-activated protein kinase (MAPK) signaling, Janus kinase (JAK)/signal transducer and activator of transcription (STAT) signaling pathway.

3  **Principles and applications of genomic and proteomic tools:** DNA electrophoresis, PCR (reverse transcription and real time), Gene sequencing, micro array technique, SDS page, ELISA and western blotting, Recombinant DNA technology and gene therapy

Basic principles of recombinant DNA technology-Restriction enzymes, various types of vectors. Applications of recombinant DNA technology.

Gene therapy- Various types of gene transfer techniques, clinical applications and recent advances in gene therapy.

4  **Pharmacogenomics**

Gene mapping and cloning of disease gene.

Genetic variation and its role in health/ pharmacology Polymorphisms affecting drug metabolism

Genetic variation in drug transporters Genetic variation in G protein coupled receptors

**Applications of proteomics science:** Genomics, proteomics, metabolomics, functionomics, nutrigenomics

Immunotherapeutics

Types of immunotherapeutics, humanisation antibody therapy, Immunotherapeutics in clinical practice

5  **a. Cell culture techniques**

Basic equipments used in cell culture lab. Cell culture media, various types of cell culture, general procedure for cell cultures; isolation of cells, subculture, cryopreservation, characterization of cells and their application.

Principles and applications of cell viability assays, glucose uptake assay, Calcium influx assays

Principles and applications of flow cytometry

**b. Biosimilars**

REFERENCES:


2. Pharmacogenomics: The Search for Individualized Therapies. Edited by J. Licinio and M.-L. Wong

3. Handbook of Cell Signaling (Second Edition) Edited by Ralph A. et.al
5. Basic Cell Culture protocols by Cheril D. Helgason and Cindy L. Miller
6. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor)
7. Animal Cell Culture: A Practical Approach by John R. Masters (Editor)

**PHARMACOLOGY PRACTICAL - I (MPL 105P)**

1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer
2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry
3. Experiments based on HPLC
4. Experiments based on Gas Chromatography
5. Estimation of riboflavin/quinine sulphate by fluorimetry
6. Estimation of sodium/potassium by flame photometry

**Handling of laboratory animals.**

1. Various routes of drug administration.
2. Techniques of blood sampling, anesthesia and euthanasia of experimental animals.
3. Functional observation battery tests (modified Irwin test)
4. Evaluation of CNS stimulant, depressant, anxiogenics and anxiolytic, anticonvulsant activity.
5. Evaluation of analgesic, anti-inflammatory, local anesthetic, mydriatic and miotic activity.
8. Oral glucose tolerance test.
9. Isolation and identification of DNA from various sources (Bacteria, Cauliflower, onion, Goat liver).
10. Isolation of RNA from yeast
11. Estimation of proteins by Braford/Lowry’s in biological samples.
12. Estimation of RNA/DNA by UV Spectroscopy
13. Gene amplification by PCR.
14. Protein quantification Western Blotting.
15. Enzyme based in-vitro assays (MPO, AChEs, α amylase, α glucosidase).
17. DNA fragmentation assay by agarose gel electrophoresis.
18. DNA damage study by Comet assay.
19. Apoptosis determination by fluorescent imaging studies.
20. Pharmacokinetic studies and data analysis of drugs given by different routes of administration using softwares.
21. Enzyme inhibition and induction activity

22. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (UV)

23. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (HPLC)

REFERENCES

1. CPCSEA, OECD, ICH, USFDA, Schedule Y, EPA guidelines,
2. Fundamentals of experimental Pharmacology by M.N.Ghosh
4. Drug discovery and Evaluation by Vogel H.G.
5. Spectrometric Identification of Organic compounds - Robert M Silverstein,
6. Principles of Instrumental Analysis - Doglas A Skoog, F. James Holler, Timothy A. Nieman,
7. Vogel’s Text book of quantitative chemical analysis -Jeffery, Basset, Mendham, Denney,
8. Basic Cell Culture protocols by Cheril D. Helgason and Cindy L.Mille
9. Basic Cell Culture (Practical Approach ) by J. M. Davis (Editor)
10. Animal Cell Culture: A Practical Approach by John R. Masters (Editor)
SEMESTER II
ADVANCED PHARMACOLOGY - II (MPL 201T)

SCOPE

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, the subject helps the student to understand the concepts of drug action and mechanism involved.

OBJECTIVES

Upon completion of the course the student shall be able to:

- Explain the mechanism of drug actions at cellular and molecular level
- Discuss the Pathophysiology and pharmacotherapy of certain diseases
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

THEORY 60 Hrs

1. Endocrine Pharmacology

Molecular and cellular mechanism of action of hormones such as growth hormone, prolactin, thyroid, insulin and sex hormones Anti-thyroid Drugs, Oral hypoglycemic agents, Oral contraceptives, Corticosteroids. 12 Hrs

Drugs affecting calcium regulation

2. Chemotherapy

Cellular and molecular mechanism of actions and resistance of antimicrobial agents such as ß-lactams, aminoglycosides, quinolones, Macrolide antibiotics. Antifungal, antiviral, and anti-TB drugs. 12 Hrs

3. Chemotherapy

Drugs used in Protozoal Infections

Drugs used in the treatment of Helminthiasis

Chemotherapy of cancer

Immunopharmacology

Cellular and biochemical mediators of inflammation and immune response. Allergic or hypersensitivity reactions. Pharmacotherapy of asthma and COPD. 12 Hrs

Immunosuppressants and Immunostimulants

4. GIT Pharmacology

Antiulcer drugs, Prokinetics, antiemetics, anti-diarrheals and drugs for constipation and irritable bowel syndrome.

Chronopharmacology

Biological and circadian rhythms, applications of chronotherapy in various diseases like cardiovascular disease, diabetes, asthma and peptic ulcer 12 Hrs
5 Free radicals Pharmacology

Generation of free radicals, role of free radicals in etiopathology of various diseases such as diabetes, neurodegenerative diseases and cancer.

Protective activity of certain important antioxidant

Recent Advances in Treatment: Alzheimer’s disease, Parkinson’s disease, Cancer, Diabetes mellitus

REFERENCES

1. The Pharmacological basis of therapeutics- Goodman and Gill man’s
3. Basic and Clinical Pharmacology by B.G. Katzung
7. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
8. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Industrial Scientists
9. Robbins & Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology)
11. KD.Tripathi. Essentials of Medical Pharmacology

PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS-II (MPL 202T)

SCOPE

This subject imparts knowledge on the preclinical safety and toxicological evaluation of drug & new chemical entity. This knowledge will make the student competent in regulatory toxicological evaluation.

OBJECTIVES

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

- Explain the various types of toxicity studies.
- Appreciate the importance of ethical and regulatory requirements for toxicity studies.
- Demonstrate the practical skills required to conduct the preclinical toxicity studies.

THEORY

1. Basic definition and types of toxicology (general, mechanistic, regulatory and descriptive) Regulatory guidelines for conducting toxicity studies OECD, ICH, EPA and Schedule Y OECD principles of Good laboratory practice (GLP) History, concept and its importance in drug development 12 Hrs
2. Acute, sub-acute and chronic- oral, dermal and inhalational studies as per OECD guidelines.
   Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies. 12 Hrs
   Test item characterization- importance and methods in regulatory toxicology studies
3 Reproductive toxicology studies, Male reproductive toxicity studies, female reproductive studies (segment I and segment III), teratogenecity studies (segment II) 12 Hrs
Genotoxicity studies (Ames Test, in vitro and in vivo Micronucleus and Chromosomal aberrations studies) In vivo carcinogenicity studies
4 IND enabling studies (IND studies)- Definition of IND, importance of IND, industry perspective, list of studies needed for IND submission. 12 Hrs
Safety pharmacology studies- origin, concepts and importance of safety pharmacology.
Tier1- CVS, CNS and respiratory safety pharmacology, HERG assay. Tier2- GI, renal and other studies
5 Toxicokinetics- Toxicokinetic evaluation in preclinical studies, saturation kinetics Importance and applications of toxicokinetic studies.
Alternative methods to animal toxicity testing. 12 Hrs
REFERENCES
3. Drugs from discovery to approval by Rick NG.
5. OECD test guidelines.

PRINCIPLES OF DRUG DISCOVERY (MPL 203T)

SCOPE
The subject imparts basic knowledge of drug discovery process. This information will make the student competent in drug discovery process

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

• Explain the various stages of drug discovery.
• Appreciate the importance of the role of genomics, proteomics and bioinformatics in drug discovery
• Explain various targets for drug discovery.
• Explain various lead seeking method and lead optimization
• Appreciate the importance of the role of computer aided drug design in drug discovery
1. **An overview of modern drug discovery process**: Target identification, target validation, lead identification and lead Optimization. Economics of drug discovery.

   Target Discovery and validation-Role of Genomics, Proteomics and Bioinformatics. Role of Nucleic acid microarrays, Protein microarrays, Antisense technologies, siRNAs, antisense oligonucleotides, Zinc finger proteins. Role of transgenic animals in target validation. 12 Hrs

2. Lead Identification- combinatorial chemistry & high throughput screening, in silico lead discovery techniques, Assay development for hit identification.

   Protein structure Levels of protein structure,Domains, motifs, and folds in protein structure.

   **Computational prediction of protein structure**: Threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction 12 Hrs


   **Rational Drug Design Methods**: Structure and Pharmacophore based approaches

   Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening 12 Hrs

4. **Molecular docking**: Rigid docking, flexible docking, manual docking; Docking based screening. De novo drug design. Quantitative analysis of Structure Activity Relationship History and development of QSAR, SAR versus QSAR, Physicochemical parameters, Hansch analysis, Fee Wilson analysis and relationship between them. 12 Hrs

5. **QSAR Statistical methods**: regression analysis, partial least square analysis (PLS) and other multivariate statistical methods.

   3D-QSAR approaches like COMFA and COMSIA

   **Prodrug design**: Basic concept, 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 12 Hrs

**REFERENCES**


2. Darryl León. Scott Markelln. Silico Technologies in Drug Target Identification and Validation. 2006 by Taylor and Francis Group, LLC.


CLINICAL RESEARCH AND PHARMACOVIGILANCE (MPL 204T)

SCOPE

This subject will provide a value addition and current requirement for the students in clinical research and pharmacovigilance. It will teach the students on conceptualizing, designing, conducting, managing and reporting of clinical trials. This subject also focuses on global scenario of Pharmacovigilance in different methods that can be used to generate safety data. It will teach the students in developing drug safety data in Pre-clinical, Clinical phases of Drug development and post market surveillance.

OBJECTIVES

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

- Explain the regulatory requirements for conducting clinical trial
- Demonstrate the types of clinical trial designs
- Explain the responsibilities of key players involved in clinical trials
- Execute safety monitoring, reporting and close-out activities
- Explain the principles of Pharmacovigilance
- Detect new adverse drug reactions and their assessment
- Perform the adverse drug reaction reporting systems and communication in Pharmacovigilance

THEORY

1. **Regulatory Perspectives of Clinical Trials:** Origin and Principles of International Conference on Harmonization - Good Clinical Practice (ICH-GCP) guidelines Ethical Committee: Institutional Review Board, Ethical Guidelines for Biomedical Research and Human Participant- Schedule Y, ICMR Informed Consent Process: Structure and content of an Informed Consent Process Ethical principles governing informed consent process 12 Hrs

2. Clinical Trials: Types and Design Experimental Study- RCT and Non RCT, Observation Study: Cohort, Case Control, Cross sectional Clinical Trial Study Team

   **Roles and responsibilities of Clinical Trial Personnel:** Investigator, Study Coordinator, Sponsor, Contract Research Organization and its management 12 Hrs

3. Clinical Trial Documentation- Guidelines to the preparation of documents, Preparation of protocol, Investigator Brochure, Case Report Forms, Clinical Study Report Clinical Trial Monitoring- Safety Monitoring in CT

   Adverse Drug Reactions: Definition and types. Detection and reporting methods. Severity and seriousness assessment. Predictability and preventability assessment, Management of adverse drug reactions; Terminologies of ADR. 12 Hrs

4. Basic aspects, terminologies and establishment of pharmacovigilance

   History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring programme, WHO and Regulatory terminologies of ADR, evaluation of medication safety, Establishing pharmacovigilance centres in Hospitals, Industry and National programmes related to pharmacovigilance. Roles and responsibilities in Pharmacovigilance
5 Methods, ADR reporting and tools used in Pharmacovigilance

6 Pharmacoepidemiology, pharmacoconomics, safety pharmacology

REFERENCES

PHARMACOLOGY PRACTICAL - II (MPL 205P)
1. To record the DRC of agonist using suitable isolated tissues preparation.
2. To study the effects of antagonist/potentiating agents on DRC of agonist using suitable isolated tissue preparation.
3. To determine to the strength of unknown sample by matching bioassay by using suitable tissue preparation.
4. To determine to the strength of unknown sample by interpolation bioassay by using suitable tissue preparation.
5. To determine to the strength of unknown sample by bracketing bioassay by using suitable tissue preparation.
6. To determine to the strength of unknown sample by multiple point bioassay by using suitable tissue preparation.
7. Estimation of pA2 values of various antagonists using suitable isolated tissue preparations.
8. To study the effects of various drugs on isolated heart preparations.
9. Recording of rat BP, heart rate and ECG.
10. Recording of rat ECG
11. Drug absorption studies by averted rat ileum preparation.
12. Acute oral toxicity studies as per OECD guidelines.
13. Acute dermal toxicity studies as per OECD guidelines.
15. Drug mutagenicity study using mice bone-marrow chromosomal aberration test.
16. Protocol design for clinical trial.(3 Nos.)
17. Design of ADR monitoring protocol.
18. In-silico docking studies. (2 Nos.)
19. In-silico pharmacophore based screening.
20. In-silico QSAR studies.
21. ADR reporting

REFERENCES
1. Fundamentals of experimental Pharmacology-by M.N.Ghosh
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
6. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Industrial Scientists.
SEMESTER III
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 (wilcoxon 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.
ADDITIONAL GUIDELINES FOR M.PHARM

The M.Pharm programmes follow the syllabus and course regulations 2014 notified by Pharmacy Council of India. The following shall serve as additional guidelines for M.Pharm of Amrita Vishwa Vidyapeetham.

1. **Modern Pharmaceutical Analytical Techniques**

   The course on Modern Pharmaceutical Analytical Techniques in the 1st sem of M.Pharm for different specializations of M.Pharm have different course codes and there is slight difference in course contents too as per PCI syllabus. Hence, it shall be considered as different courses for evaluation and there shall be different question paper for each specialization. All the common topics shall be handled as combined classes for the different specializations.

2. **Practical Examination**

   As per the PCI regulations, the duration of end semester practical exam is 6 hours, which shall be considered as a full day exam of maximum duration of 7 hours. In both the 1st and 2nd semesters there is only one Practical exam which includes experiments from different courses of that semester. The end semester practical exam shall include all the experiments mentioned under the Practical syllabus for that semester and a student shall be prepared to perform any of these experiments.

3. **Seminar/Assignment**

   As per the PCI regulations, the number of hours allotted to seminar/assignment in the 1st and 2nd semester is 7 hours each. However, each semester has 4 theory courses and so 8 hours for seminar/assignment in the time-table (2 hours for each course) will be noted.

   The marks allotted for Seminar/Assignment is 100 per semester. As there are 4 theory courses in each semester (1st and 2nd) each course shall carry 25 marks for seminar/assignment.

   The Course codes for Seminar/assignment in the 1st & 2nd sem of various specializations of M. Pharm are as follows.

<table>
<thead>
<tr>
<th>Specialization</th>
<th>Course code for Seminar/assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1st Sem</td>
</tr>
<tr>
<td>Pharmaceutics</td>
<td>MPH 106S</td>
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<tr>
<td>Pharm. Chemistry</td>
<td>MPC 106S</td>
</tr>
<tr>
<td>Pharmacology</td>
<td>MPL 106S</td>
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<tr>
<td>Pharmacy Practice</td>
<td>MPP 106S</td>
</tr>
</tbody>
</table>
Course codes for 3rd and 4th semesters

As per PCI regulations 2014, the course “Research Methodology and Biostatistics” in 3rd semester is common for all specializations and hence has the same course code (MRM310T). The course code for the other courses in the third semester for the various specializations shall be as follows.

M.Pharm III Semester Scheme

<table>
<thead>
<tr>
<th>Name of the course</th>
<th>Pharmaceutics</th>
<th>Pharmaceutical Chemistry</th>
<th>Pharmacology</th>
<th>Pharmacy Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal Club</td>
<td>MPH302J</td>
<td>MPC302J</td>
<td>MPL302J</td>
<td>MPP302J</td>
</tr>
<tr>
<td>Discussion/Presentation</td>
<td>MPH303D</td>
<td>MPC303D</td>
<td>MPL303D</td>
<td>MPP303D</td>
</tr>
<tr>
<td>Research Work</td>
<td>MPH304R</td>
<td>MPC304R</td>
<td>MPL304R</td>
<td>MPP304R</td>
</tr>
</tbody>
</table>

M.Pharm IV Semester Scheme

<table>
<thead>
<tr>
<th>Name of the course</th>
<th>Pharmaceutics</th>
<th>Pharmaceutical Chemistry</th>
<th>Pharmacology</th>
<th>Pharmacy Practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Journal Club</td>
<td>MPH401J</td>
<td>MPC401J</td>
<td>MPL401J</td>
<td>MPP401J</td>
</tr>
<tr>
<td>Research Work</td>
<td>MPH402R</td>
<td>MPC402R</td>
<td>MPL402R</td>
<td>MPP402R</td>
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<tr>
<td>Discussion/Final Presentation</td>
<td>MPH403D</td>
<td>MPC403D</td>
<td>MPL403D</td>
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</tbody>
</table>

Guidelines for awarding credit points for co-curricular activities

As per the requirements of Amrita Vishwa Vidyapeetham, all M. Pharm students are required to publish a paper in a Scopus indexed journal in order to be eligible for the award of the degree. The award of the credit points for co-curricular activities shall be done at the end of the 4th Semester based on the details and documentary evidences submitted by the students and this shall appear as “Additional credits earned for co-curricular activities “in the final marklist or transcript.

A per PCI guidelines there shall be minimum of 2 credits and maximum of 7 credits earned from cocurricular activities (attending conferences/workshops etc).
6. Scheme for internal assessment and end semester examinations of Sem III & IV

As per PCI regulations the mark distribution for 3rd & 4th Semester of M.Pharm is as follows:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course</th>
<th>Internal Assessment</th>
<th>End Semester Exams</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Continuous Mode</td>
<td>Sessional Exam</td>
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<td></td>
<td>Marks</td>
<td>Duration</td>
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<td>Total Marks</td>
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<tr>
<td>SEMESTER III</td>
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</tr>
<tr>
<td>MRM30IT</td>
<td>Research Methodology and Biostastics*</td>
<td>10</td>
<td>15</td>
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<tr>
<td>SEMESTER IV</td>
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</tbody>
</table>
“The 400 marks for Research Work and Colloquium (Semester IV)” shall have the following split up.

1. Evaluation by Guide 100 marks
2. Dissertation Book 200 marks
3. Evaluation of Presentation 100 marks

Total for Research Work and Colloquium 400 marks

Evaluation of Dissertation Book
Objective (s) of the work done 25 marks
Methodology adopted 75 marks
Results and Discussion 75 marks
Conclusions and Outcomes 25 marks
Total 200 marks

Evaluation of Presentation
Presentation & Communication skills 50 marks
Question and answer skills 50 marks
Total 100 marks

The 75 marks assigned for Discussion/Presentation (Proposal Presentation) shall be allotted by the Internal examiner.

7. M.Pharm Thesis submission & evaluation

The M.Pharm project report in the form of thesis shall be submitted as per guidelines.

- Students shall submit one hard copy of the thesis in soft binding on or before the last date notified in the academic calendar.
- Soft bound copy of thesis can be sent to the external examiner before thesis evaluation date
- The page “Evaluated & Approved” can be submitted on the day of thesis evaluation so that it can be signed by the committee
- The final thesis can be submitted after one week of evaluation incorporating the corrections suggested by the panel.

8. Improvement of internal assessments

A student who fails in university exam in the 1st attempt can apply for improvement sessional exam by submitting the duly filled application form when notified by the Principal.

9. Condonation under exceptional cases:

If the attendance of student falls short of 80% in any course, due to continuous absence caused by accident, prolonged illness, or unforeseen circumstances, such case may be considered by the Principal for condonation of absence based on the request of the student supported by recommendation of the respective faculty advisor. However in such cases, the student must have duly applied for leave in time. **The overall attendance of a student in such a case shall not fall below 70%**. Condonation will be considered only in the case of those students who have proved themselves to be otherwise regular, by attending at least 80% of the classes during the semester, excluding the period of long leave. At least 70% physical presence is mandatory in every course even in such exceptional cases and this provision can be exercised by a student, only once in the programme.
Condonation cannot be claimed as a matter of right. It shall be granted at the discretion of the authorities, based on the genuineness and validity of the reasons cited for the absence. A student is not eligible for condonation, if he had any unauthorized absence during the year.

10. **Revaluation**

A failed student shall have the right to apply for revaluation of the theory paper by filling the application form along with the required fees within the stipulated time after the publication of the result.

11. **Question paper pattern for sessional and end semester exams**

There shall be no choice of questions for sessional as well as semester examination of M.Pharm

**Sessional (30 marks)**

- Objective type: \( 5 \times 2 \text{ marks} = 10 \text{ marks} \)
- Long answer type: \( 1 \times 10 \text{ marks} = 10 \text{ marks} \)
- Short answer type: \( 2 \times 5 \text{ marks} = 10 \text{ marks} \)

**End Semester Examination (75 marks)**

- Objective type: \( 10 \times 2 \text{ marks} = 20 \text{ marks} \)
- Long answer type: \( 2 \times 10 \text{ marks} = 20 \text{ marks} \)
- Short answer type: \( 7 \times 5 \text{ marks} = 35 \text{ marks} \)

12. **Eligibility of Examiners & Q.P Setters**

i) **Internal Examiners:**

Teachers of the Amrita School of Pharmacy who are handling the respective courses and are having a minimum of 5 years of teaching experience are eligible to be appointed as internal examiners.

ii) **External Examiners:**

Teachers having a minimum of 10 years experience (or having Ph D with 5 years experience )in PCI/AICTE approved Pharmacy institutions are eligible to be appointed as external examiners for 1st and 2nd Semester theory and practical examinations. Teachers having PhD with 10 years of experience in pharmacy/research institutions are eligible to be appointed as external examiners in the panel for thesis evaluation.

iii) **Q.P. Setter**

Faculty who are eligible to be internal & external examiners as per the above criteria are eligible to be Q.P setters too.

13. **Every M.Pharm student is required to publish a Scopus indexed paper as mandated by Amrita Vishwa Vidyapeetham in order to be eligible for award of degree.**

14. **The declaration of class mentioned as point 20 (page no : 24) under PCI regulations require further clarifications from PCI and shall be modified accordingly.**