Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Proposed Syllabi and Scheme of

Master of Pharmacy

(Semester, Credit & Grade system)

2012-13
FEATURES OF THE CREDIT SYSTEM

• Master's degree would be of 80 credits each.
• One credit course of theory will be of one clock hour per week running for 15 weeks.
• Two credit course of theory will be of two clock hours per week running for 15 weeks.
• Four-credit course of theory will be of four clock hours per week running for 15 weeks.
• One credit course of practical will consist of 2 hours of laboratory exercise for 15 weeks.
• Two credit courses of practical will consist of 4 hours of laboratory exercise for 15 weeks.
• Four credit course of practical will consist of 8 hours of laboratory exercise for 15 weeks.

FIRST TWO SEMESTERS SHALL HAVE 5 THEORY COURSES, 2 PRACTICAL COURSES AND 1 SEMINAR FOR EACH SEMESTER

• 3 Theory courses x 4 credits = 12 credits
• 2 Theory courses x 2 credits = 04 credits
• 2 Laboratory courses x 4 credits = 08 credits
• 1 Seminar x 2 credits = 02 credits

Total = 26 credits

EVERY STUDENT SHALL COMPLETE 80 CREDITS IN A MINIMUM OF FOUR SEMESTERS.
FIRST TWO SEMESTERS WILL HAVE 26 CREDITS EACH, THIRD SEMESTER WILL BE OF 08 CREDITS AND FOURTH SEMESTER WILL BE OF 20 CREDITS.

• Two semesters 2x 26 credits = 52 credits
• Third semester 1x 08 = 08 credits
• Forth semester 1x 20 = 20 credits

Four semesters total credits = 80 credits

SCHEME OF SYLLABUS AND CREDIT SYSTEM

The syllabus for the first semester includes three (03) theory courses common to all M. Pharm. Specializations, one theory course of respective specialization and an elective subject, so consist of total five theory papers and two laboratory courses and one seminar. Two credits have been allocated for seminar. Marks out of 50 will be allotted. Evaluation of seminar shall be done by three internal Examiners appointed by the Head/Principal of the Department/Institute based on scientific contents, communication, representation and skill in oral presentation.

The syllabus for the second semester includes two (02) theory courses common to all M. Pharm. Specializations, two theory course of respective specialization and an elective subject, so consist of total five theory papers and two laboratory courses and one seminar. Two credits have been allocated for seminar. Marks out of 50 will be allotted. Evaluation of seminar shall be done by three internal Examiners appointed by the Head/Principal of the Department/Institute based on scientific contents, communication, representation and skill in oral presentation.

The syllabus for the third semester includes one theory course of respective specialization and an elective subject, so consist of total two theory papers and one seminar. Two credits
have been allocated for seminar. Marks out of 50 will be allotted. Evaluation of seminar shall be done by three internal Examiners appointed by the Head/Principal of the Department/Institute based on scientific contents, communication, representation and skill in oral presentation. The topic for the research envisaged for the dissertation shall be assigned to him/her within one month from the date of commencement of third semester.

One elective subject can be chosen by minimum 8 and maximum 12 students of a particular college/institution during a semester. Each student has to clear three different elective subjects during his/her course of studies from the list given in Annexure-I.

Total four credits have been allocated for the seminar on dissertation on completed research work for dissertation prior to thesis submission in fourth semester.

**Scheme for Marks Distribution of Seminar on Dissertation (Semester IV)**

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>MARKS</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction, justification, scope of dissertation work, organization of materials, methods and references.</td>
<td>25</td>
<td>01</td>
</tr>
<tr>
<td>2. Experimental work, observations, results and conclusion</td>
<td>50</td>
<td>02</td>
</tr>
<tr>
<td>3. Presentation skill, questioning and defending</td>
<td>25</td>
<td>01</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>04</strong></td>
</tr>
</tbody>
</table>

• Twelve credits have been allocated for the dissertation work.

**Scheme for Marks Distribution for Dissertation Work**

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>MARKS</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Introduction, information retrieval system</td>
<td>50</td>
<td>02</td>
</tr>
<tr>
<td>2. Experimental work</td>
<td>100</td>
<td>04</td>
</tr>
<tr>
<td>3. Scientific content</td>
<td>50</td>
<td>02</td>
</tr>
<tr>
<td>4. Results / Conclusion</td>
<td>50</td>
<td>02</td>
</tr>
<tr>
<td>5. Organization of Scientific materials, dissertation thesis and references</td>
<td>50</td>
<td>02</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>300</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

• Four credits each have been allocated for the Viva-voce on dissertation.

**Scheme for Marks Distribution for Viva-voce**

<table>
<thead>
<tr>
<th>CONTENT</th>
<th>MARKS</th>
<th>CREDIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Reading research paper and depth of knowledge on work topic</td>
<td>50</td>
<td>02</td>
</tr>
<tr>
<td>2. Discussion</td>
<td>25</td>
<td>01</td>
</tr>
<tr>
<td>3. Report</td>
<td>25</td>
<td>01</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
<td><strong>04</strong></td>
</tr>
</tbody>
</table>

• One credit = 25 marks; two credits = 50 marks and four credits = 100 marks.
• Four credits (theory) = 100 marks
Internal Examination  External Examination
(20 marks)                        (80 marks)
• Four credits (Practical) = 100 marks

Internal Examination  External Examination
(20 marks)                        (80 marks)

The Internal Assessment marks for theory should be based on Class Test and Attendance as follows:-

a) Class Test - 15
   Marks will be based upon average marks of two Class Tests.
b) Attendance - Marks/s
   

<table>
<thead>
<tr>
<th>Marks Obtained</th>
<th>Grade</th>
<th>Grade Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>100-85</td>
<td>A*</td>
<td>10</td>
</tr>
<tr>
<td>84-75</td>
<td>A</td>
<td>9</td>
</tr>
<tr>
<td>74-65</td>
<td>B*</td>
<td>8</td>
</tr>
<tr>
<td>64-60</td>
<td>B</td>
<td>7</td>
</tr>
<tr>
<td>59-55</td>
<td>C</td>
<td>6</td>
</tr>
<tr>
<td>54-50</td>
<td>D</td>
<td>5</td>
</tr>
<tr>
<td>49 and less (internal)</td>
<td>FR</td>
<td>0-Failed (Clear course)</td>
</tr>
</tbody>
</table>

The computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) of an examinee shall be as given below:-
The marks will be given in all examinations which will include college assessment marks and the total marks for each Theory/Practical shall be converted into Grades as per Table I. SGPA shall be calculated based on Grade Points corresponding to Grade as given in Table I and the Credits allotted to respective Theory/Practical shown in the scheme for respective semester.

SGPA shall be computed for every semester and CGPA shall be computed only in IV semester. The CGPA of IV semester shall be calculated based on SGPA of all four semesters as per following computation:

\[
\text{SGPA} = \frac{C_1 \times G_1 + C_2 \times G_2 + \ldots + C_n \times G_n}{C_1 + C_2 + \ldots + C_n}
\]

Where \(C_1\) = Credit of individual Theory/Practical  
\(G_1\) = Corresponding Grade Point obtained in the Respective Theory/Practical  

\[
\text{CGPA} = \frac{(\text{SGPA})_I \times (\text{Cr})_I + (\text{SGPA})_II \times (\text{Cr})_II + (\text{SGPA})_III \times (\text{Cr})_III + (\text{SGPA})_IV \times (\text{Cr})_IV}{(\text{Cr})_I + (\text{Cr})_II + (\text{Cr})_III + (\text{Cr})_IV}
\]

Where,  
\((\text{SGPA})_I = \text{SGPA of I Semester}\)  
\((\text{Cr})_I = \text{Total Credits for I Semester}\)  
\((\text{SGPA})_II = \text{SGPA of II Semester}\)  
\((\text{Cr})_II = \text{Total Credits for II Semester}\)  
\((\text{SGPA})_III = \text{SGPA of III Semester}\)  
\((\text{Cr})_III = \text{Total Credits for III Semester}\)  
\((\text{SGPA})_IV = \text{SGPA of IV Semester}\)  
\((\text{Cr})_IV = \text{Total Credits for IV Semester}\)

<table>
<thead>
<tr>
<th>CGPA</th>
<th>Final Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.0 – 10</td>
<td>A+</td>
</tr>
<tr>
<td>8.0 – 8.9</td>
<td>A</td>
</tr>
<tr>
<td>7.0 – 7.9</td>
<td>B+</td>
</tr>
<tr>
<td>6.0 – 6.9</td>
<td>B</td>
</tr>
<tr>
<td>5.5 – 5.9</td>
<td>C</td>
</tr>
<tr>
<td>5.0 – 5.4</td>
<td>D</td>
</tr>
<tr>
<td>4.9 and less</td>
<td>FR (Failed)</td>
</tr>
</tbody>
</table>

Final Mark List will only show the grade and grade points and not the marks.

CGPA equal to 6.00 and above shall be considered as equivalent to First Class which shall be mentioned on Grade Card of IV Semester as a foot note.

**ACADEMIC CALENDAR AND TERMS**

The terms and academic activities of the college affiliated to RTM, Nagpur University under CGPA shall be as prescribed by the University for respective academic session.  
Beginning of First Term (Semester I and III) : As per University academic calendar  
Vacation : As per University academic calendar  
Beginning of Second Term (Semester II and IV) : As per University academic calendar
Draft Syllabus Prescribed for Master of Pharmacy

The several courses leading to the Master Degree of Pharmacy covers following subjects namely

1. Pharmaceutics
2. Pharmaceutical Chemistry
3. Pharmacology
4. Pharmacognosy
5. Biotechnology
6. Quality Assurance
7. Industrial Pharmacy
8. Pharmacoinformatics
9. Clinical Pharmacy
10. Natural Products
11. Pharmaceutical Management
## SCHEME OF TEACHING AND EXAMINATION

### APPENDIX – A

### Pharmaceutics

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Hrs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hrs.</td>
<td>Marks</td>
<td>Hrs.</td>
<td>Hrs.</td>
</tr>
<tr>
<td>Semester-I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1/101</td>
<td>MC-S1</td>
<td>Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td>S1/102</td>
<td>MC-S2</td>
<td>Research Methodology &amp; Biostatistics</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S1/103</td>
<td>MC-S3</td>
<td>Drug Regulatory Affairs</td>
<td>4</td>
<td>20</td>
<td>03</td>
<td>80</td>
</tr>
<tr>
<td>S1/104</td>
<td>MPH-S4</td>
<td>Advanced Pharmaceutics</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td>S1/105</td>
<td></td>
<td>Elective-I</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S1/106</td>
<td>MPH-6</td>
<td>Seminar (I)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2/201</td>
<td>MC-S7</td>
<td>Validation &amp; cGMP</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S2/202</td>
<td>MC-S8</td>
<td>Biophysical Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td>S2/203</td>
<td>MPH-S9</td>
<td>Product Development and Formulation</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td>S2/204</td>
<td>MPH-S10</td>
<td>Novel Drug Delivery Systems</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td>S2/205</td>
<td></td>
<td>Elective-II</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S2/206</td>
<td>MPH-12</td>
<td>Seminar (II)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3/301</td>
<td>MPH-S13</td>
<td>Biopharmaceutics and Pharmacokinetics</td>
<td>4</td>
<td>20</td>
<td>03</td>
<td>80</td>
</tr>
<tr>
<td>S3/302</td>
<td></td>
<td>Elective-III</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S3/303</td>
<td>MPH-15</td>
<td>Seminar (Presynopsis presentation)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3/304</td>
<td>MPH-16</td>
<td>Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>06</td>
<td>28</td>
<td>30</td>
<td>05</td>
</tr>
<tr>
<td>Semester-IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4/401</td>
<td>MPH-17</td>
<td>Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4/402</td>
<td>MPH-18</td>
<td>Seminar on Dissertation</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4/403</td>
<td>MPH-19</td>
<td>Viva-voce</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MC-S : Subject common to all branches

MPH-S : Subject specialization in pharmaceutics
<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Hrs.</td>
<td>Marks</td>
</tr>
<tr>
<td>Semester-I</td>
<td></td>
<td>Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>S1/101</td>
<td>MC-S1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1/102</td>
<td>MC-S2</td>
<td>Research Methodology &amp; Biostatistics</td>
<td>2</td>
<td>10</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>S1/103</td>
<td>MC-S3</td>
<td>Drug Regulatory Affairs</td>
<td>4</td>
<td>20</td>
<td>03</td>
<td>80</td>
</tr>
<tr>
<td>S1/104</td>
<td>MPC-S4</td>
<td>Advanced Pharmaceutical Chemistry-I</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>S1/105</td>
<td>MPC-S5</td>
<td>Elective-I</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S1/106</td>
<td>MPC-6</td>
<td>Seminar (I)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-II</td>
<td></td>
<td>Validation &amp; cGMP</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S2/201</td>
<td>MC-S7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2/202</td>
<td>MC-S8</td>
<td>Biological Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td>S2/203</td>
<td>MPC-S9</td>
<td>Advanced Pharmaceutical Chemistry-II</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>S2/204</td>
<td>MPC-S10</td>
<td>Advanced Pharmaceutical Chemistry-III</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>S2/205</td>
<td>MPC-S11</td>
<td>Elective-II</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S2/206</td>
<td>MPC-12</td>
<td>Seminar (II)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-III</td>
<td></td>
<td>Advanced Pharmaceutical Chemistry-IV</td>
<td>4</td>
<td>20</td>
<td>03</td>
<td>80</td>
</tr>
<tr>
<td>S3/301</td>
<td>MPC-S13</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3/302</td>
<td>MPC-S14</td>
<td>Elective-III</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S3/303</td>
<td>MPC-S15</td>
<td>Seminar (Presynopsis presentation)</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S3/304</td>
<td>MPC-S16</td>
<td>Dissertation</td>
<td>24</td>
<td>06</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester-IV</td>
<td></td>
<td>Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4/401</td>
<td>MPC-17</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4/402</td>
<td>MPC-18</td>
<td>Seminar on Dissertation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4/403</td>
<td>MPC-19</td>
<td>Viva-voce</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MC-S : Subject common to all branches
MPC-S : Subject specialization in pharmaceutical chemistry
## Pharmacology

### APPENDIX–C

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td>Semester-I</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S1/101</td>
<td>MC-S1</td>
<td>Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>S1/102</td>
<td>MC-S2</td>
<td>Research Methodology &amp; Biostatistics</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S1/103</td>
<td>MC-S3</td>
<td>Drug Regulatory Affairs</td>
<td>4</td>
<td>20</td>
<td>03</td>
<td>80</td>
</tr>
<tr>
<td>S1/104</td>
<td>MPL-S4</td>
<td>Advanced Physiology &amp; Pathophysiology</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>S1/105</td>
<td>Elective-I</td>
<td></td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S1/106</td>
<td>MPL-6</td>
<td>Seminar (I)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-II</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S2/201</td>
<td>MC-S7</td>
<td>Validation &amp; cGMP</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S2/202</td>
<td>MC-S8</td>
<td>Biological Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>S2/203</td>
<td>MPL-S9</td>
<td>Advanced Systemic Pharmacology</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>S2/204</td>
<td>MPL-S10</td>
<td>Advanced Pharmacology &amp; Pharmacotherapeutics</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>S2/205</td>
<td>Elective-II</td>
<td></td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S2/206</td>
<td>MPL-12</td>
<td>Seminar (II)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-III</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3/301</td>
<td>MPL-S13</td>
<td>Molecular Pharmacology and Toxicology</td>
<td>4</td>
<td>20</td>
<td>03</td>
<td>80</td>
</tr>
<tr>
<td>S3/302</td>
<td>Elective-III</td>
<td></td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td>S3/303</td>
<td>MPL-15</td>
<td>Seminar (Presynopsis Presentation)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S3/304</td>
<td>MPL-16</td>
<td>Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>06</td>
<td>28</td>
<td>30</td>
<td>05</td>
</tr>
<tr>
<td>Semester-IV</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4/401</td>
<td>MPL-17</td>
<td>Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4/402</td>
<td>MPL-18</td>
<td>Seminar on Dissertation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S4/403</td>
<td>MPL-19</td>
<td>Viva-voce</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2000</td>
<td>(80)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MC-S : Subject common to all branches  
MPL-S : Subject specialization in pharmacology
<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td>Semester-I</td>
<td>SI/101</td>
<td>MC-S1</td>
<td>Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>SI/102</td>
<td>MC-S2</td>
<td>Research Methodology &amp; Biostatistics</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>SI/103</td>
<td>MC-S3</td>
<td>Drug Regulatory Affairs</td>
<td>4</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>SI/104</td>
<td>MPG-S4</td>
<td>Advanced Pharmacognosy and Phytochemistry</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>SI/105</td>
<td>Elective-I</td>
<td></td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>SI/106</td>
<td>MPG-6</td>
<td>Seminar (I)</td>
<td>4</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Semester-II</td>
<td>S2/201</td>
<td>MC-S7</td>
<td>Validation &amp; eGMP</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S2/202</td>
<td>MC-S8</td>
<td>Biological Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/203</td>
<td>MPG-S9</td>
<td>Standardization of Natural Products</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/204</td>
<td>MPG-S10</td>
<td>Herbal Drug Formulation and Development</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/205</td>
<td>Elective-II</td>
<td></td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S2/206</td>
<td>MPG-12</td>
<td>Seminar (I)</td>
<td>4</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Semester-III</td>
<td>S3/301</td>
<td>MPG-S13</td>
<td>Selected Topics in Pharmacognosy</td>
<td>4</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S3/302</td>
<td>Elective-III</td>
<td></td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S3/303</td>
<td>MPG-15</td>
<td>Seminar (Presynopsis presentation)</td>
<td>4</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S3/304</td>
<td>MPG-16</td>
<td>Dissertation</td>
<td>24</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>06</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Semester-IV</td>
<td>S4/401</td>
<td>MPG-17</td>
<td>Dissertation</td>
<td>24</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S4/402</td>
<td>MPG-18</td>
<td>Seminar on Dissertation</td>
<td>24</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S4/403</td>
<td>MPG-19</td>
<td>Viva-voce</td>
<td>24</td>
<td>20</td>
<td>03</td>
</tr>
</tbody>
</table>

MC-S : Subject common to all branches  
MPG-S : Subject specialization in pharmacognosy and phytochemistry
# Biotechnology

## APPENDIX – E

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hrs.</td>
<td>Marks</td>
<td>Hrs.</td>
<td>Marks</td>
</tr>
<tr>
<td>Semester-I</td>
<td>S1/101</td>
<td>MC-S1</td>
<td>Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/102</td>
<td>MC-S2</td>
<td>Research Methodology &amp; Biostatistics</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S1/103</td>
<td>MC-S3</td>
<td>Drug Regulatory Affairs</td>
<td>4</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S1/104</td>
<td>MBT-S4</td>
<td>Fundamentals of Biotechnology</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/105</td>
<td>Elective-I</td>
<td></td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S1/106</td>
<td>MBT-6</td>
<td>Seminar (I)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Semester-II</td>
<td>S2/201</td>
<td>MC-S7</td>
<td>Validation &amp; cGMP</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S2/202</td>
<td>MC-S8</td>
<td>Biological Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S2/203</td>
<td>MBT-S9</td>
<td>Molecular Biology</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/204</td>
<td>MBT-S10</td>
<td>Fermentation Technology</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/205</td>
<td>Elective-II</td>
<td></td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>S2/206</td>
<td>MBT-12</td>
<td>Seminar (II)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Semester-III</td>
<td>S3/301</td>
<td>MBT-S13</td>
<td>Advanced Tissue and Cell Culture</td>
<td>4</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S3/302</td>
<td>Elective-III</td>
<td></td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S3/303</td>
<td>MBT-15</td>
<td>Seminar (Presynopsis presentation)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3/304</td>
<td>MBT-16</td>
<td>Dissertation</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>06</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Semester-IV</td>
<td>S4/401</td>
<td>MBT-17</td>
<td>Dissertation</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/402</td>
<td>MBT-18</td>
<td>Seminar on Dissertation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/403</td>
<td>MBT-19</td>
<td>Viva-voce</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**MC-S**: Subject common to all branches

**MBT-S**: Subject specialization in biotechnology
### Quality Assurance

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hrs.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester-I</td>
<td>S1/101</td>
<td>MC-S1 Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/102</td>
<td>MC-S2 Research Methodology &amp; Biostatistics</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>S1/103</td>
<td>MC-S3 Drug Regulatory Affairs</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/104</td>
<td>MQA-S4 Pharmaceutical Validation</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/105</td>
<td>Elective-I</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>S1/106</td>
<td>MQA-6 Seminar (I)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-II</td>
<td>S2/201</td>
<td>MC-S7 Validation &amp; cOMP</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>S2/202</td>
<td>MC-S8 Biological Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S2/203</td>
<td>MQA-S9 Quality Assurance of Cosmeceuticals</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/204</td>
<td>MQA-S10 Novel Drug Delivery Systems</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/205</td>
<td>Elective-II</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>S2/206</td>
<td>MQA-12 Seminar (II)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-III</td>
<td>S3/301</td>
<td>MQA-S13 Quality Management</td>
<td>4</td>
<td>20</td>
<td>03</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>S3/302</td>
<td>Elective-III</td>
<td>2</td>
<td>10</td>
<td>02</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>S3/303</td>
<td>MQA-15 Seminar (Presynopsis presentation)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3/304</td>
<td>MQA-16 Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>06</td>
<td>28</td>
<td>30</td>
<td>05</td>
</tr>
<tr>
<td>Semester-IV</td>
<td>S4/401</td>
<td>MQA-17 Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/402</td>
<td>MQA-18 Seminar on Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/403</td>
<td>MQA-19 Viva-voce</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MC-S : Subject common to all branches  
MQA-S : Subject specialization in quality assurance
### MIP

**Semester-I**
- **S1/101 MC-S1** Advanced Analytical Techniques (Theory: 4 Hrs/week, Practical: 8 Hrs/week)
- **S1/102 MC-S2** Research Methodology & Biostatistics (Theory: 2 Hrs/week, Practical: 10 Hrs/week)
- **S1/103 MC-S3** Drug Regulatory Affairs (Theory: 4 Hrs/week, Practical: 20 Hrs/week)
- **S1/104 MIP-S4** Advanced Industrial Pharmacy-I (Theory: 4 Hrs/week, Practical: 8 Hrs/week)
- **S1/105** Elective-I (Theory: 2 Hrs/week, Practical: 10 Hrs/week)
- **S1/106 MIP-6** Seminar-I (Theory: 2 Hrs/week, Practical: 4 Hrs/week)

**Semester-II**
- **S2/201 MC-S7** Validation & cGMP (Theory: 2 Hrs/week, Practical: 10 Hrs/week)
- **S2/202 MC-S8** Biological Evaluation (Theory: 4 Hrs/week, Practical: 20 Hrs/week)
- **S2/203 MIP-S9** Advanced Industrial Pharmacy-II (Theory: 4 Hrs/week, Practical: 8 Hrs/week)
- **S2/204 MIP-S10** Advances in Drug Delivery Systems (Theory: 4 Hrs/week, Practical: 8 Hrs/week)
- **S2/205** Elective-II (Theory: 2 Hrs/week, Practical: 10 Hrs/week)
- **S2/206 MIP-12** Seminar-II (Theory: 2 Hrs/week, Practical: 4 Hrs/week)

**Semester-III**
- **S3/301 MIP-S13** Industrial Process Validation and Production Management (Theory: 4 Hrs/week, Practical: 20 Hrs/week)
- **S3/302** Elective-III (Theory: 2 Hrs/week, Practical: 10 Hrs/week)
- **S3/303 MIP-15** Seminar (Pre-Dissertation presentation) (Theory: 4 Hrs/week)
- **S3/304 MIP-16** Dissertation (Theory: 4 Hrs/week)

**Semester-IV**
- **S4/401 MIP-17** Dissertation (Theory: 24 Hrs/week)
- **S4/402 MIP-18** Seminar on Dissertation (Theory: 24 Hrs/week)
- **S4/403 MIP-19** Viva-voce (Theory: 24 Hrs/week)

**Total Marks (Credits):**
- **Industrial Pharmacy**
- **MC-S** : Subject common to all branches
- **MIP-S** : Subject specialization in industrial pharmacy

---

**APPENDIX-G**

<table>
<thead>
<tr>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Minimum Marks (Credit) for Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
</tr>
<tr>
<td>Semester-I</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester-II</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester-III</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester-IV</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Pharmacoinformatics

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hrs.</td>
<td>Hrs.</td>
<td>Marks</td>
<td>Hrs.</td>
</tr>
<tr>
<td>Semester-I</td>
<td>S1/101</td>
<td>MC-S1 Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/102</td>
<td>MC-S2 Research Methodology &amp; Biostatistics</td>
<td>2</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S1/103</td>
<td>MC-S3 Drug Regulatory Affairs</td>
<td>4</td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S1/104</td>
<td>MPI-S4 Information Technology</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/105</td>
<td>Elective-I</td>
<td>2</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S1/106</td>
<td>MPI-6 Seminar (I)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-II</td>
<td>S2/201</td>
<td>MC-S7 Validation &amp; cGMP</td>
<td>2</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S2/202</td>
<td>MC-S8 Biological Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S2/203</td>
<td>MPI-S9 Bioinformatics</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/204</td>
<td>MPI-S10 Molecular Biology</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/205</td>
<td>Elective-II</td>
<td>2</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S2/206</td>
<td>MPI-12 Seminar (II)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-III</td>
<td>S3/301</td>
<td>MPI-S13 Selected Topics in Pharmacoinformatics</td>
<td>4</td>
<td></td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3/302</td>
<td>Elective-III</td>
<td>2</td>
<td></td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3/303</td>
<td>MPI-15 Seminar (Presynopsis presentation)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3/304</td>
<td>MPI-16 Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>06</td>
<td>28</td>
<td>30</td>
<td>05</td>
</tr>
<tr>
<td>Semester-IV</td>
<td>S4/401</td>
<td>MPI-17 Dissertation</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/402</td>
<td>MPI-18 Seminar on Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/403</td>
<td>MPI-19 Viva-voce</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MC-S: Subject common to all branches  
MPI-S: Subject specialization in pharmacoinformatics
## APPENDIX–I

### Clinical Pharmacy

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td>Semester-1</td>
<td>S1/101</td>
<td>MC-S1</td>
<td>Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/102</td>
<td>MC-S2</td>
<td>Research Methodology &amp; Biostatistics</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S1/103</td>
<td>MC-S3</td>
<td>Drug Regulatory Affairs</td>
<td>4</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S1/104</td>
<td>MCP-S4</td>
<td>Advanced Clinical Pharmacy &amp; Pharmacotherapeutics-I</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/105</td>
<td></td>
<td>Elective-I</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S1/106</td>
<td>MCP-6</td>
<td>Seminar (I)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Semester-II</td>
<td>S2/201</td>
<td>MC-S7</td>
<td>Validation &amp; cGMP</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S2/202</td>
<td>MC-S8</td>
<td>Biological Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/203</td>
<td>MCP-S9</td>
<td>Advanced Clinical Pharmacy &amp; Pharmacotherapeutics-II</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/204</td>
<td>MCP-S10</td>
<td>Clinical Research</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/205</td>
<td></td>
<td>Elective-II</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S2/206</td>
<td>MCP-12</td>
<td>Seminar (II)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
</tr>
<tr>
<td>Semester-III</td>
<td>S3/301</td>
<td>MCP-S13</td>
<td>Community &amp; Clinical Pharmacy</td>
<td>4</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S3/302</td>
<td></td>
<td>Elective-III</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S3/303</td>
<td>MCP-15</td>
<td>Seminar (Presynopsis presentation)</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3/304</td>
<td>MCP-16</td>
<td>Dissertation</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>06</td>
<td>28</td>
<td>30</td>
</tr>
<tr>
<td>Semester-IV</td>
<td>S4/401</td>
<td>MCP-17</td>
<td>Dissertation</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/402</td>
<td>MCP-18</td>
<td>Seminar on Dissertation</td>
<td>100(4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/403</td>
<td>MCP-19</td>
<td>Viva-voce</td>
<td>100(4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MC-S : Subject common to all branches
MCP-S : Subject specialization in clinical pharmacy

## APPENDIX–J

14
## Natural Product

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination</th>
<th>Scheme of External Examination</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td>Semester-I</td>
<td>S1/101</td>
<td>MC-S1 Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/102</td>
<td>MC-S2 Research Methodology &amp; Biatistics</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S1/103</td>
<td>MC-S3 Drug Regulatory Affairs</td>
<td>4</td>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S1/104</td>
<td>MNP-S4 Industrial Pharmacognosy</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/105</td>
<td>Elective-I</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S1/106</td>
<td>MNP-6 Seminar (I)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-II</td>
<td>S2/201</td>
<td>MC-S7 Validation &amp; cGMP</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S2/202</td>
<td>MC-S8 Biological Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S2/203</td>
<td>MNP-S9 Natural Products &amp; Bio-organic Chemistry</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/204</td>
<td>MNP-S10 Standardization of Natural Products</td>
<td>4</td>
<td>8</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/205</td>
<td>Elective-II</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S2/206</td>
<td>MNP-12 Seminar (II)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>16</td>
<td>20</td>
<td>80</td>
<td>40</td>
</tr>
<tr>
<td>Semester-III</td>
<td>S3/301</td>
<td>MNP-S13 Selected Topics in Natural Products</td>
<td>4</td>
<td>20</td>
<td></td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S3/302</td>
<td>Elective-III</td>
<td>2</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3/303</td>
<td>MNP-15 Seminar (Presynopsis presentation)</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3/304</td>
<td>MNP-16 Dissertation</td>
<td>24</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>06</td>
<td>28</td>
<td>30</td>
<td>05</td>
</tr>
<tr>
<td>Semester-IV</td>
<td>S4/401</td>
<td>MNP-17 Dissertation</td>
<td>25</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/402</td>
<td>MNP-18 Seminar on Dissertation</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/403</td>
<td>MNP-19 Viva-voce</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

MC-S : Subject common to all branches  
MNP-S : Subject specialization in natural product
## Pharmaceutical Management

### APPENDIX – K

<table>
<thead>
<tr>
<th>Semester</th>
<th>Paper Code</th>
<th>Title of Paper</th>
<th>Scheme of Teaching in Hrs/week</th>
<th>Scheme of Internal Examination in Hrs/week</th>
<th>Scheme of External Examination in Hrs/week</th>
<th>Total Marks (Credits)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lecture</td>
<td>Practical</td>
<td>Theory</td>
<td>Practical</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Hrs.</td>
<td>Marks</td>
<td>Hrs.</td>
<td>Marks</td>
</tr>
<tr>
<td>Semester-I</td>
<td>S1/101</td>
<td>MC-S1</td>
<td>Advanced Analytical Techniques</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/102</td>
<td>MC-S2</td>
<td>Research Methodology &amp; Biostatistics</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S1/103</td>
<td>MC-S3</td>
<td>Drug Regulatory Affairs</td>
<td>4</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S1/104</td>
<td>MPM-S4</td>
<td>Pharmaceutical Management-I (General and Personnel)</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S1/105</td>
<td>MPM-6</td>
<td>Elective-I</td>
<td>2</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>S1/106</td>
<td>MPM-6</td>
<td>Seminar (I)</td>
<td>4</td>
<td>50(2)</td>
<td></td>
</tr>
<tr>
<td>Semester-II</td>
<td>S2/201</td>
<td>MC-S7</td>
<td>Validation &amp; cGMP</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S2/202</td>
<td>MC-S8</td>
<td>Biological Evaluation</td>
<td>4</td>
<td>Demo</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/203</td>
<td>MPM-S9</td>
<td>Pharmaceutical Management II (Production)</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/204</td>
<td>MPM-S10</td>
<td>Pharmaceutical Marketing Management</td>
<td>4</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>S2/205</td>
<td>MPM-12</td>
<td>Elective-II</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S2/206</td>
<td>MPM-12</td>
<td>Seminar (II)</td>
<td>4</td>
<td>50(2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester-III</td>
<td>S3/301</td>
<td>MPM-S13</td>
<td>Pharma Product Management</td>
<td>4</td>
<td>20</td>
<td>03</td>
</tr>
<tr>
<td></td>
<td>S3/302</td>
<td>MPM-S14</td>
<td>Elective-III</td>
<td>2</td>
<td>10</td>
<td>02</td>
</tr>
<tr>
<td></td>
<td>S3/303</td>
<td>MPM-S15</td>
<td>Seminar (Presynopsis presentation)</td>
<td>4</td>
<td>50(2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S3/304</td>
<td>MPM-16</td>
<td>Dissertation</td>
<td>24</td>
<td>120</td>
<td>100(4)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Semester-IV</td>
<td>S4/401</td>
<td>MPM-17</td>
<td>Dissertation</td>
<td>24</td>
<td>30</td>
<td>05</td>
</tr>
<tr>
<td></td>
<td>S4/402</td>
<td>MPM-18</td>
<td>Seminar on Dissertation</td>
<td>24</td>
<td>50(2)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>S4/403</td>
<td>MPM-19</td>
<td>Viva-voce</td>
<td>24</td>
<td>500(20)</td>
<td></td>
</tr>
</tbody>
</table>

MC-S : Subject common to all branches

MPM-S : Subject specialization in pharmaceutical management

16
Syllabus Prescribed for Degree of Master of Pharmacy in Pharmaceutics

Semester-I

Subject code: MC-S1
Subject: ADVANCED ANALYTICAL TECHNIQUES
THEORY: 60 Hours (4 hrs./week)

1. **Chromatographic Techniques:**
   Classification of chromatographic methods based on mechanism of separation and their basic principles.
   - **Gas chromatography:** Instrumentation, column efficiency parameters, derivatisation methods, applications in pharmaceutical analysis.
   - **Liquid chromatography:** Instrumentation in HPLC, normal and reversed phase packing materials, column selection, mobile phase selection, efficiency parameters, applications in pharmaceutical analysis.
   Thin Layer Chromatography overview. Instrumentation and applications of HPTLC giving emphasis to use of TLC- Densitometry in the standardization of some Medicinal Plants.
   Recent advances in Chromatography like LCMS, HPTLC MS, LC MS-MS

2. **UV-Visible Spectroscopy:**

3. **Infra-Red Spectroscopy:**

4. **Nuclear Magnetic Resonance Spectroscopy:**
   Fundamental principles of NMR. Instrumentation. Chemical shift concept, spin-spin coupling and decoupling, shielding and deshielding, solvents. Pascale triangle, signal multiplicity in PMR. Spin-spin and spin-lattice relaxation, Nuclear overhauser effect, Interpretation of PMR, 13 C NMR.

5. **Mass Spectrometry:**
   Basic principles and instrumentation. Ionization techniques, mass spectrum and its characteristics, molecular ion, metastable ions, fragment ions; fragmentation processes, fragmentation patterns and fragment characteristics in relation to parent structure and functional groups. Relative abundances of isotopes and their contribution to characteristic peaks.

6. **Thermal Methods:**
   Thermogravimetry, Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)
RECOMMENDED BOOKS:


Subject code: MC-P1
Subject: ADVANCED ANALYTICAL TECHNIQUES

PRACTICAL: 8 hrs. /week

1. UV/Visible spectrum scanning of a few organic compounds for UV- absorption and correlations of structures and isobestic point in case of mixtures.
2. Estimation of single drug (raw material/ formulation) by colorimetry involving different reagents. (minimum of 4 experiments)
3. Estimation of single drug (raw material/ formulations) by UV spectrophotometry. (minimum of 4 experiments)
4. Estimation of multicomponent formulation by UV- Spectrophotometer in formulations (minimum of 4 experiments)
5. Effect of pH and solvent on UV Spectrum of certain drugs. (Minimum of 2 experiments)
7. Interpretation of structure of drugs by Infra red spectra. (Minimum 4 compounds).
8. Experiments based on the application of derivative spectroscopy. (Minimum of 2 experiments)
9. Standardization and dissolution studies of solid dosage form (Minimum of 5 experiments)
11. Estimation of drugs in biological fluids by HPLC (minimum 2 experiments)
12. Experiments based on application of HPTLC for quantification of Berberin from Berberis aristata and Andrographolide from Andrographis paniculata.
Subject code: MC-S2  
Subject: RESEARCH METHODOLOGY & BIOSTATISTICS  
THEORY: 30 Hours (2 hrs./week)

Research Methodology
1. **Introduction:** Meaning & Objectives of research, types of research: basic, applied action & patent oriented research, approaches to research; research methods, research process; criteria for good research, common problems, nature and significance of research problems, qualitative & quantitative research methods.

2. **Selection of Research Topic:** Selection of research problem, literature review, evaluation of research problem, research design; meaning, concept & features of research design, experimental design, plan of research work.

3. **Methods & tools of research**
   Reliability and validity of research tool, Qualitative and quantitative studies, Primary & secondary data collection method, Preparing questionnaire and opinionnaire, identification of sources of information, searching and classifying information; organization of data collection, processing & analyzing of data & information. Limitations & sources of error.

4. **Preparing a research proposal**
   Format of research proposals: finding related literature, Individual & Institutional research proposals, submitting research proposal to funding agencies.

5. **The Research Report/Report writing**
   Style manuals, format of research report, The thesis or dissertation, style of writing, typing the report, reference form, pagination, tables, figures, evaluating a research report, summary, references.

Biostatistics
1. **Descriptive Statistics:** Classification of variable, Summary of measures of location: median and mean, Properties of the sample mean, Summary measures of dispersion: interquartile range, variance, standard deviation, Properties of sample variance and standard deviation, Graphic representation of data.

2. **Estimation and Hypothesis testing:** Null Hypothesis, confidence level, Point & interval estimation, concept of hypothesis testing & types of error, Student ‘t’ test, Chi-Square test.

3. **Analysis of Variance:** Analysis of variance (one way & two way), Repeated measures designs, factorial designs, univariate ANOVA post hoc tests, analysis of covariance (ANCOVA), repeated measures analysis, multiple regression, and power analysis.

**RECOMMENDED BOOKS:**


Subject code: MC-S3
Subject: DRUG REGULATORY AFFAIRS

THEORY

60 Hours (4 hrs./week)

1. Aims, objects and salient features of following legislations affecting pharmaceutical industry.
   a) Industrial Development and Regulation Act 1951.
   b) Consumer Protection Act
   c) Pollution and Environmental Control Act

2. Legislation
   a. To Regulate the profession of pharmacy – The Pharmacy Act 1948
   c. To control the operations relating to dangerous drugs & opium. Narcotic Drugs & Psychotropic Substance Act 1985.


4. Intellectual Property Rights Law:
   a) Indian Patent Act 1970 and amendments there under,
   b) Copyright (Indian) Act
   c) Guidelines for filing patents in countries like US & UK.
   d) Good Clinical Practice Guideline, Good Laboratory Practice Guidelines, GMP Guidelines


6. Management of Intellectual Property in Drugs & Pharmaceuticals

7. Drug Regulatory Agencies of the following countries with focus on historical perspectives, organization structure activities & responsibilities: India, US, Europe and Japan

11. Material Safety Data Sheet (MSDS) preparation and Industrial Safety & Health

RECOMMENDED BOOKS: -

2. Drugs and Cosmetics Laws by Krishnan Arora, Professional Book Publishers, New Delhi
5. Deshpande S.W., Drugs and Cosmetic Act.1940
6. Bubuarm N.R, Whatever one should know about patent, 2nd Ed., Pharma Book Syndicate
12. Guidelines of various countries like MCA, TGA, ICH.
13. GLP regulation by Alen Hirsch Vol 38 Marcel Decker series.
15. I.P., B.P., U.S.P. International Pharmacopoeia

Subject code: MPH-S4
Subject : ADVANCED PHARMACEUTICALS

THEORY: 60 Hours (4 hrs./week)

1. Preformulation Studies: Timings and goals of Preformulation, Pre-formulation methodology, solid state properties, partition coefficient, solubility, dissolution, crystal form and stability, Thermal Analysis, X-ray diffraction: Techniques to generate & characterize amorphous & crystalline forms, compatibility tests, dissolution of drug substances and dosage.


Study of newer excipients like cyclodextrin, ion exchange resins, film coating materials, superdisintegrants, directly compressible vehicles, surfactants- micelle formation, liquid crystal phase, thickeners. Standardization of excipients.

4. **Polymer Science:** Introduction and classification, preparation methods of synthetic polymers, Molecular weight determination, Thermal characterization and rheology of polymers. Introduction to biodegradable & biodegradable polymers.


6. Optimization Techniques in Pharmaceutics, Formulation and Processing Optimization parameters, statistical design, and other application.

7. **Quality Control:** Process of dosage forms: Process control; Control of quality Validation, Control of manufacturing Process, Statistical quality control, control charts, sampling plans, Automated & process control, Dosage form control, Testing programme & method, Product identification systems, Adulteration, Misbranding, maintenance of records, Bioavailability, Bioequivalence, manufacturer’s reliability, Manufacturer/drug information profile.

**RECOMMENDED BOOKS:**

10. Quality Assurance Guide; By Organization of Pharmaceutical producers of India.
Subject code: MPH-P4
Subject: ADVANCED PHARMACEUTICS
Practical: 8 hrs. /week

1. Preformulation studies on tablets.
2. To study the decomposition kinetics of any three drugs.
3. To study the effect of copper ions on the ascorbic acid stability in solution
4. To determine the aqueous solubility of given drug sample at various temperature and report its thermodynamic parameters.
5. To study the dissolution kinetics of given drug.
6. To study the effect of pH (2, 4, 6 and 8.0) on the apparent partition coefficient of a drug in n-octanol-water buffer system.
7. To study the dissolution kinetics of immediate and extended release dosage form (any five).
8. To study the effect of temperature on rheological behavior of poloxamers.
9. To study the effects of pH on rheological characteristics of carbopol gels using Brookfield viscometer.
10. To determine the best compatible additive for aspirin tablets using at least five known tablet components.
11. To study the diffusion of drug from topical gel using Franz diffusion cell.
Semester-II

Subject code: MC-S7
Subject: VALIDATION and cGMP
THEORY: 30 Hours (2 hrs./week)

Validation
1. Definition, Government regulation, scope and advantage of validation, relationship between validation and qualification, validation master plan, FDA 21 CFR Part 11, qualifications of utilities and process equipments (protocols & reports for DQ, IQ, OQ, PQ).
2. Validation of medical devices, biotechnology processes, pharmaceutical ingredients, air handling and HVAC systems, sterile and non sterile areas, aseptic processes and sterilization methods, purified water system, distilled water and water for injection.

cGMP
1. Concepts and Philosophy of cGMP in manufacturing, processing, packaging, and holding of Drugs.
2. Organization and Personnel: Responsibilities, qualification, experience, training, personal hygiene and clothing.
3. Buildings and Facilities: Location, design, plant layout, maintenance and sanitation, environmental control, utilities and services like gas, water, control of contamination and maintenance of sterile areas.
4. Raw materials: Purchase specifications, selection of vendors, control on raw materials and finished dosage forms.

RECOMMENDED BOOKS:
3. Encyclopedia by pharmaceutical technology edited by James Swarbrick, James C. Boylan, Marcel Dekker Inc. gtg
1. Principles of Pharmacological and Pre-clinical Evaluation of drugs. Commonly used laboratory animals in pharmacological research, limitations of animal tests. Standard techniques used in laboratory animals, euthanasia of experimental animals. Regulations for laboratory animal care and ethical requirements.

2. Bioassays: Basic principles of bioassays, official bioassays, experimental models, design of bioassays.

3. Toxicology: Principles of toxicity evaluations. Safety evaluation of new drugs in animals including acute, sub-acute, sub chronic and chronic toxicity. ED50 and LD50 determination, special toxicity test like teratogenicity and mutagenicity. Various guidelines for toxicity studies. International guidelines and regulatory agencies for toxicity studies like ICH, OECD, FDA, WHO etc.

4. Modern Methods of Pharmacological evaluations: Radioligand binding assay, patch clamp, stereotaxic technique and ELISA. Recent advances in transgenic and genetically modified animals for drug screening and other sophisticated methods.

5. Alternatives to animal screening procedures: Cell line - handling, maintenance and propagation of cell lines, their uses and limitations. In-vitro testing of drugs.

6. Preclinical Evaluation: Preclinical models employed and organization of screening of new drugs of following categories:
   i) Sedatives, hypnotics, anxiolytics, antidepressants, antipsychotics, nootropics, antiparkinsonian agents, analgesics, antipyretics.
   ii) Anti-inflammatory agents, anticonvulsants, local anaesthetics, CNS stimulants.
   iii) Cardiac glycosides, antiarrhythmic, antihypertensive, antianginal, anti-atherosclerotic.
   iv) Antiulcer agents, Laxatives, Bronchodilators, antitussives.
   v) Diuretics.
   vi) Histamine antagonists.
   vii) Muscle relaxants, Anticholinesterases, anticholinergics, adrenolytics.
   viii) Hypoglycemics, antifertility agents, androgens.
   ix) Anti-thyroid agents, Dermatological agents, Antitumor agents.
   x) Anthelmintics, Antimalarials, Antileprotics.
   xi) Drugs used for glaucoma, cataract and eye inflammation.

RECOMMENDED BOOKS:


Subject code: MPH-S9
Subject: PRODUCT DEVELOPMENT AND FORMULATION
THEORY: 60 Hours (4 hrs. /week)

1. **Fundamental Aspects of Product Development**: Studies of wettability, solubility, dissolution, and absorption, surfactant and hydrocolloids and their role in drug delivery and targeting.

2. **Pilot Plant Scale-up Techniques**: Purpose and functions, concepts of pilot plant for development and control. Planning for pilot plant, size of pilot plant. Organization and personnel, basic consideration in developing the process for production of pharmaceutical dosage forms. Pilot plant study design for tablets, tablet coating, capsules, liquid orals and semi-solids.

3. **Designing of Oral Pharmaceuticals**: Formulation, evaluation, stability Studies and recent advances in dosage form; tablet, capsule, suspension, emulsion; microencapsulation, advances in coating techniques. Advances in pelletization techniques.

4. **Development of Parenterals**: Concepts, formulation, evaluation of large and small volume parenterals, environmental control and quality assurance in manufacturing.

5. **Ophthalmic Preparation**: Introduction, Physiology of eye, formulation consideration and evaluation of ophthalmic products (ointments, suspension, eye drops, contact lenses, occuserts etc.), container and closures.

6. **Suppositories**: Selection of suppository bases, characteristics of bases, formulation, preparation, evaluation and packaging of suppositories, stability studies and recent development.

7. **Dermatological Preparations**: Anatomy and physiology of skin, mechanism of absorption through skin including mathematical treatment, formulation and evaluation of ointments, creams, paste, gels including herbal cosmetic creams.

**Note**: The designing and development of dosage form should be covered at advanced level considering recent advances in dosage form technology.
RECOMMENDED BOOKS:
2. Lachman “The Theory and Practice of Industrial Pharmacy” 3rd edition, Varghese Publisher.

Subject code: MPH-S10
Subject: NOVEL DRUG DELIVERY SYSTEMS
THEORY: 60 Hours (4 hrs./week)

1. Fundamentals of controlled release drug delivery systems:
   Fundamentals and Rationale of Sustained / controlled drug delivery, factors influencing the design & performance of sustained/ Controlled release products, Drug Targeting, Use of polymers in controlled release of active agents, Pharmacokinetic / Pharmacodynamic basis of controlled drug delivery systems, regulatory requirements.

2. Oral drug delivery: Formulation, fabrication and evaluation of various oral controlled drug delivery systems including dissolution and diffusion controlled delivery systems, gastro retentive, colon targeted and pulsatile drug delivery. TIMERx, MASSRx & COSRx, Procise technology, RingCap technology, Theriform Technology, Accudep Technology, THREEFORM Technology, DissoCube IDD Technology, Zydis Technology for poorly soluble drugs, Orasolv & Durasolv technology, Egalet Technology, Buccal Mucoadhesives, Periochips.

3. Parenteral controlled release system: Scope, terminology & techniques used, injectable controlled release, formulation. Implantable drug delivery, microspheres, liposomes & their quality control.


5. Transdermal drug delivery system: Permeation through skin including mechanism, permeation enhances, In-vitro skin permeation, technologies for developing transdermal drug delivery system, mechanism of release kinetics, evaluation of transdermal drug delivery systems.

6. Ocular Drug Delivery: Transport of drugs through ocular tissues, approaches to improve ocular drug delivery.

7. Site specific drug delivery system: Active & passive targeting, resealed erythrocyte, monoclonal antibodies, drug targeting by particulate carrier system, drug targeting to brain, lung & colon.

9. **Regulatory consideration in controlled release:** Demonstration of safety, efficiency & controlled release nature. WHO conditions.

**RECOMMENDED BOOKS:**

9. R. Williams, D. Taft and J. McConville, “Advanced formualtion design to optimize therapeutic outcomes” Marcel Dekker, Inc.
Subject code: MC-P8
Subject: BIOLOGICAL EVALUATION
PRACTICAL:

1. Demonstrations will be based on the topics mentioned in Biological Evaluation theory

Subject code: MPH-P9
Subject: PRODUCT DEVELOPMENT AND FORMULATION
PRACTICAL: 8 hrs./week

1. Determination of molecular weight of the given polymer.
2. Enhancement of solubility of the given drug by solid dispersion technique.
3. Performance of water attack on treated soda lime glass container.
4. Formulation and characterization of topical gels of some anti-inflammatory drugs.
5. Comparison of release rate profile of conventional and sustained release tablets.
6. Preparation of microcapsules by different techniques and their evaluation.
7. Formulation and evaluation of ophthalmic dosage forms.
8. Performance of physical stability and dissolution studies of the suspension of given drug.
10. Determination of the effect process variable on physicochemical characteristics and in-vitro release profile of microcapsule.

Subject code: MPH-P10
Subject: NOVEL DRUG DELIVERY SYSTEMS
PRACTICAL: 8 hrs./week

1. Formulation and evaluation of sustained release matrix tablet (of any two drugs).
2. Formulation and evaluation of floating microspheres.
3. Formulation and evaluation of floating tablet.
4. Formulation and in vitro evaluation of transdermal patches.
5. Development and evaluation of ocular inserts of a given drug.
6. Preparation and evaluation of buccal film of any two cardiovascular drugs.
7. Taste masking of some bitter drugs by ion-exchange resins.
Semester-III

Subject code: MPH-S13

Subject: BIOPHARMACEUTICS AND PHARMACOKINETICS

THEORY: 60 Hours (4 hrs. /week)

1. Introduction to biopharmaceutics and clinical pharmacokinetics
   Definition of Biopharmaceutics, Pharmacokinetic, clinical Pharmacokinetic and its importance.

2. Absorption of drugs

3. Distribution of drugs

4. Elimination of drug

5. Bioavailability and bioequivalence
   a) Objective of bioavailability studies, determination bioavailability parameters of bioavailability rate of absorption extent of absorption, relative bioavailability, determination of AUC (using planimeter, counting squares trapezoidal rule and cutting and weighing studies). Study designs of bioavailability and bioequivalence testing. Statistical concept in determination of bioavailability and bioequivalence testing.
   b) Drug dissolution rate and bioavailability
      Theories of dissolution in-vitro drug dissolution testing models
      In-vitro – in-vivo correlation
   c) In-vitro and in-situ absorption studies
      Various In-vitro & in-situ models – selection of animals

6. Pharmacokinetics
   Basic consideration, Pharmacokinetic models, Compartment modeling: One compartment model-IV bolus, IV infusion, Extra-vascular; Multi Compartment models; Two compartment model–IV bolus, IV infusion, Extra-vascular. Application of pharmacokinetics in new drug development and designing of dosage forms and novel drug delivery systems.

7. Non linear pharmacokinetics
   Saturable enzymatic elimination process, drug elimination by capacity limited pharmacokinetics, mixed drug elimination, time dependent pharmacokinetics, bioavailability of drug that follow non linear pharmacokinetics, non linear pharmacokinetics due to protein binding (e.g. phenytoin)
RECOMMENDED BOOKS
Syllabus Prescribed for Degree of Master of Pharmacy in Pharmaceutical Chemistry

Semester-I

| Advanced Analytical Techniques (MC-S1 & MC-P1) | Syllabus is same as prescribed for these papers for M. Pharm semester-I examination in Pharmaceutics |
| Research Methodology and Biostatistics (MC-S2) |
| Drug Regulatory Affairs (MC-S3) |

Subject code: MPC-S4
Subject: ADVANCED PHARMACEUTICAL CHEMISTRY-I
THEORY: 60 Hours (4 hrs./week)

1. Various Reaction Mechanisms:
   a. Substitution Reaction: Nucleophilic substitution reaction in aliphatic systems, SN1, SN2 reactions, Hydride transfer reaction, Cram’s rule, Participation of neighbouring group in nucleophilic substitution reaction and rearrangements. Aromaticity, electrophilic and nucleophilic substitution in aromatic systems, Reactivity, orientation in electrophilic substitution.

   b. Elimination Reaction: Beta Elimination reactions, E1, E2 and E1cb mechanisms, Hoffman and saytzeff’s rule for elimination, stereochemistry of E2 reaction, Elimination from alicyclic compounds.

   c. Addition Reaction: Electrophilic and Nucleophilic additions, Stereochemistry involved, Markonikov’s rule.

   d. Free Radical Reaction: Formation, Detection, Reactions, Homolysis and free radical displacements, addition and rearrangements of free radicals.

2. Esterification reactions and ester hydrolysis.

3. Heterocyclic chemistry:
   Nomenclature, synthesis, physical, chemical and spectroscopic properties of pyrrole, furan, thiophen, pyridine, pyridazine, pyrimidine, pyrazine, quinoline, isoquinoline, indole, oxazole, imidazole and benzimidazole.

4. Oxidation and reduction reactions:
   Oxidation reaction involving use of potassium permanganate, potassium dichromate, chromic acid, selenium dioxide, periodic acid, N-bromo succinimide and oppenaure oxidation. Reduction reactions using metal and acid, metal amine reduction, catalytic reduction, hydrogenation of double bond, triple bond and aromatic rings, birch reduction, Meerwein-Pondroff-Verley reduction.

5. Modern synthetic methods:
   a) Green Synthesis: Introduction; Green reagents; green catalysts; ionic solvents; phase transfer catalysis in green synthesis; application of phase transfer catalysts in green synthesis of heterocyclic compounds: Williamson’s synthesis, Wittig reaction.
b) Microwave assisted synthesis: Introduction; microwave reactions in water (Hofmann elimination, hydrolysis and oxidation); microwave reactions in organic solvents; solid state reactions; advantages of microwave technique.

RECOMMENDED BOOKS:

Subject code: MPC-P4
Subject: ADVANCED PHARMACEUTICAL CHEMISTRY-I
Practical: 8 hrs./week

2. Synthesis, physico-chemical and spectral analysis of some of the following heterocyclic compounds:
   a) Quinoline b) benzimidazole/derivative c) flavone/chromone d) indole/derivative e) phenothiazine f) oxazole/oxazolone g) benzoazole h) 3,5 dimethylisoxazole
3. Synthesis and characterization of at least two organic compounds based on green chemistry approach.
4. Synthesis and characterization of at least two heterocyclic/organic compounds using microwave.
**Semester-II**

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

**Subject code:** MPC-S9  
**Subject:** ADVANCED PHARMACEUTICAL CHEMISTRY-II  
**THEORY:** 60 Hours (4 hrs./week)

**I Stereochemistry:**

1. Stereoechemical nomenclature & terminology.

2. General concepts on: Chirality, Molecular dissymmetry, Elements of symmetry (plane, centre and axis with relevant examples), optical activity and specific rotation, enantiomers distereomers, Sequence rule - Relative and absolute configuration (D, L and R, S nomenclature), Projection formulae (Fischer, Howarth, Newman and Sawhorse).

3. Stereochemistry of compounds with one stereogenic centre, stereochemistry of compounds with two similar and dissimilar stereogenic centres, properties of stereoisomers. Stereochemistry of alkenes. Stereochemistry of allenes, alkylidene cycloalkane, spirans, biphenyls and fused ring.

4. Racemic modification – properties, methods and resolution.

5. Conformational analysis  
Conformation and reactivity in acyclic molecules, Conformation of cyclohexane, monosubstituted cyclohexane, dissubstituted cyclohexane, cyclohexene and their relative stabilities. Reactivity of alicyclic, cyclic, fused and bridge ring systems. Curtin Hammett principle in determining the course of reaction in different compounds.

6. Stereospecific and stereoselective synthesis

**II Reaction Mechanism (Including stereochemistry):**

7. Carbonium ions, carbanions, their generation, stability and fate.


**RECOMMENDED BOOKS:**


Subject code: MPC-S10
Subject: ADVANCED PHARMACEUTICAL CHEMISTRY-III
THEORY: 60 Hours (4 hrs. /week)

1. GENESIS OF NEW DRUGS:
i) A brief review of the following topics: sources of new drugs; leads from natural products; molecular modifications; random screening; high thought put screening; insilico screening; structural features and pharmacological activity; prodrugs; soft drugs; isosterism. selective optimization of side activities (SOSA) approach, , new use for old drugs – An illustrative study with suitable examples
ii) A brief account of drug discovery by recombinant DNA technology.

2. PRINCIPLE OF DRUG DESIGN:
Analogue synthesis versus rational design; discovery of lead compounds, Pharmacophoric identification, Prodrugs and soft drug. Physicochemical properties in relation to drug action; metabolic transformation of drugs and its role in development of new drug molecules.

QSAR in drug design.
a) Physical properties related to potency.
b) Calculation, measurements and significance of various parameter used in QSAR – (Lipophilicity, steric, Electronic effects). c) applications of Hansch Analysis.

Computers in drug design:
Introduction; computer graphics and molecular visualization; computational chemistry overview, force field methods; geometry optimization; conformational searching; molecular dynamics simulations; quantum mechanics; structure based drug design and Pharmacophore perception, predictive ADME.

3. MEDICINAL CHEMISTRY OF
a. Antiviral Agents and agents under development of HIV infection.
b. Immunosuppressant and Immunostimulants.
c. Agents used in Neurodegenerative disease Like Alzheimer’s and Parkinsonism.
d. GABAergic Agonists.
e. Antidiabetic agents like Peroxisome Proliferator Activated Receptors inhibitors, Dipeptidyl Peptidase 4 (DPP 4) Inhibitors like Sitagliptin, Vildagliptin, Protein Tyrosine Phosphatase 1 B (PTP 1 B).
f. Antihypertensives like Direct Renin Inhibitors e.g. Aliskiren

NOTE: “A study of” includes an account of their origin and development, classification, structures, mechanism of action, SAR, uses and toxicity.
4. RECENT ADVANCES IN FOLLOWING CATEGORY:
   a. Cephalosporin
   b. Anticancer agents.
   c. Non-steroidal anti-inflammatory agents
   d. Antihypertensive agents
   
   Synthesis of Following Drugs:
   a. Cefaclor, Cefotaxim, Cefadroxil, Cephalexin
   b. chlorambucil, methotrexate, Trimetrexate, Tamoxifen
   c. paracetamol, ibuprofen, aceclofenac, Allopurinol
   d. Propranolol, Nifedipine, Fosinopril, Candesartan

5. A STUDY OF:
   a) Penicillin
   b) Anthihyperlipidemic agents
   c) Phosphodiesterase inhibitors
   c) Quinolone antibacterial agents

RECOMMENDED BOOKS:

8. Ed. Fennirl Hicham, 2000, Combinatorial Chemistry, Oxford University

Subject code: MPC-P9
Subject: ADVANCED PHARMACEUTICAL CHEMISTRY-II
Practical: 8 hrs. /week

1. Synthesis from some of the following reactions and their characterization:
   1) Beckmann rearrangement 2) Fries rearrangement 3) Benzil benzilic acid rearrangement
   4) Hofmann rearrangement 5) Pinacol pinacolone rearrangement 6) Methylolation
   7) Metal/acid reductions 8) Friedel-Crafts alkylation & Acylation 9) Nitration using different reagents

2. Asymmetric synthesis of some organic/medicinal compounds.
3. Resolution of racemic mixture/modification.
4. Microwave assisted synthesis of any two compounds and their characterization
Subject code: MPC-P10
Subject: ADVANCED PHARMACEUTICAL CHEMISTRY-III
Practical: 8 hrs./week

1. Practical based on some topics covered in the theory part including synthesis of medicinal compounds basic operations like Molecular distillation, fractional crystallization, and purification by column chromatography and preparative TLC

2. Synthetic studies of following drugs with characterization by chemical test, UV and IR method
   - Acetyl Salicylic acid using acetyl chloride (2 Steps)
   - Chloramin –T (3 Steps)
   - Sulphanilamide (3 Steps)
   - 5,5-Diphenyl Hydantoin
   - Dimethyl-p-phenylenediamine (3 steps)
   - Sulfanilic acid
   - Chalcones

3. Microwave assisted synthesis of organic/medicinal compounds and their characterization
Semester-III

Subject code: MPC-S13
Subject: ADVANCED PHARMACEUTICAL CHEMISTRY-IV
THEORY: 60 Hours (4 hrs./week)

The following topics will be discussed keeping in view the recent advances:

1. **Psychopharmacological agents:** Biochemical basis of mental disorders; abnormal protein factors; endogenous amines and related substances; faulty energy metabolism; genetic disorders and nutritional disorders; phenothiazines – chemistry; synthesis. Screening methods; pharmacological actions; SAR; mechanism of action; uses; toxicity; ring analogues of phenothiazines; fluorobutyrophenones; Development of atypical antipsychotics clozapine synthesis of chlordiazepoxide, prochlorperazine, fluphenazine, haloperidol.

2. **Anxiolytics, sedatives and hypnotics:** Benzodiazepines and related compounds; barbiturates; other classes; mechanism of action, SAR; uses and toxicity. Synthesis of Chlordiazepoxide, diazepam, alprazolam, Phenobarbital, meprobamate.

3. **Antidepressants:** MAO inhibitors; tricyclic antidepressants; SAR; mechanism of action; uses; toxicity other classes like: selective serotonin reuptake inhibitors, selective 5-HT and NE reuptake inhibitors; selective serotoninergic reuptake inhibitors and 5-HT antagonists; 5-HT agonists and partial agonists and α2-agonists. Synthesis of tranylcypromine, amitriptyline, fluoxetine, buspirone.

4. **Antiepileptics & CNS stimulants:**
   a) Antiepileptics: Screening methods; classification of epilepsies; symptoms; drugs used; classification; structural features common to drugs; SAR; mechanism of action; toxicity and uses; synthesis of diphenylhydantion, carbamazepine, sodium valproate.
   b) CNS stimulants: an account of the drugs with CNS stimulant activity; structures and uses.

5. **Diuretics:** anatomy and physiology of nephron; classification of diuretics based on site of action; carbonic anhydrase inhibitors; thiazide and thiazide like diuretics; loop and potassium sparing diuretics; miscellaneous diuretics emerging developments in the use of diuretics to treat hypertension and congestive heart failure.

6. **Microorganism in drug development:** Microbial conversions of drugs like steroids, prostaglandins and antibiotics. These should include some biotechnology-oriented chapters like enzymes immobilization techniques.

7. **Classification of colors, preservatives and artificial sweetening agents** in food, food product, drugs and cosmetics. Detection and determination of colors, preservatives and artificial sweetening agents.

9. Radioprotective drugs

10. Synthon approach
    a. Definition of terms - disconnection, synthon, functional group interconversion (FGI).
    b. Basic rules in Disconnection.
    c. Use of synthon approach in synthesis of some medicinal/organic compounds

11. Principal of toxicology and treatment of intoxication.

RECOMMENDED BOOKS:

2. Wilson and Gisvold’s Text Book of Medicinal Chemistry, Lippincott Williams and Wilkins.
Syllabus prescribed for Degree of Master of Pharmacy in Pharmacology

Semester-I

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Theory:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPL-S4</td>
<td>ADVANCED PHYSIOLOGY AND PATHOPHYSIOLOGY</td>
<td>60 Hours (4 hrs./week)</td>
</tr>
</tbody>
</table>

1. Membrane Physiology, Nerve and Muscle

2. Blood

3. Cardiovascular System

4. Respiratory System

5. Gastrointestinal System

6. Endocrine System
Various endocrine glands and their related disorders.

7. Reproduction
8. Renal System

9. Neurophysiology
i) General
Introduction to neurophysiology. Properties of synaptic transmission. Neurotransmitters

ii) Sensory system

iii) Motor system

iv) Visceral and motivational system
Autonomic nervous system. Hypothalamus. Limbic system and emotions

v) EEG, sleep and higher nervous functions
Electroencephalography. Sleep and wakefulness. Learning and memory. Speech. Pathophysiology of Epilepsy, Dementia, Psychosis Schizophrenia and Alzheimer’s disease.

vi) Special Senses

RECOMMENDED BOOKS:
1. Introduction to use of Physiographs in experimental Pharmacology, Demonstration of invasive / non invasive rat blood pressure experiment, ECG, EEG etc
3. Identification of phases of estrous cycle in rats.
4. Study of different tissue section of animals.
5. Use and interpretation of biochemical data viz: (Significance of screening the parameter)
   Diagnostic prognostic screening tests like (rationale behind performing following tests)
   a) Blood sugar : by O-toludine, glucose oxidase
   b) Blood protein by Biuret, Lowery’s method
   c) Blood urea
   d) Serum uric acid
   e) Urine calcium
   f) Serum cholesterol
   g) Serum bilirubin
   h) Blood creatinine
   i) Blood chlorides
   j) SGPT
   k) SGOT
   l) Urine amylase
   m) LDH
6. Pregnancy test in rats
7. Measurement of Glucose by glucometer
8. Qualitative tests for identification of given protein sample
9. Preparation of plasma (using diff.anti-coagulants), serum
10. Widal test
11. Rheumatoid Arthritis factor test
Semester-II

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MPL-S9
Subject: ADVANCED SYSTEMIC PHARMACOLOGY
THEORY: 60 Hours (4 hrs./week)


2. Pharmacology of the Autonomic Nervous System:
Physiology of autonomic nervous system, Muscarinic receptor agonists and antagonists, Anticholinesterase agents, Agents acting at neuromuscular junction and autonomic ganglia, Adrenergic agonists and antagonists, 5-Hydroxytryptamine receptor agonists and antagonists.

3. Pharmacology of Autocoids:
Histamine, bradykinin, and their antagonists, Lipid derived autocoids: Eicosanoids and platelet activating factor.

4. Drugs Acting on the Central Nervous System:
Neurotransmission in central nervous system, General anesthetics, Local anesthetics, Hypnotics and sedatives, Opioid analgesics, Pharmacology of ethanol, Drug addiction and drug abuse.

5. Analgesic, Antipyretic, and Anti-inflammatory Agents

6. Drugs Affecting Renal and Cardiovascular Function:
Diuretics, Vasopressin and other agents affecting the renal conservation of water, Renin, angiotensin, and their modulators, Calcium channel blockers.

7. Immunosuppressants and Immunostimulants

8. Hormones and Their Antagonists:
Pituitary hormones and their hypothalamic releasing factors, Thyroid and antithyroid drugs, Estrogens and progestins, Androgens, Adrenocortical steroids and their synthetic analogs, inhibitors of synthesis and actions of adrenocortical hormones, Agents affecting mineral ion homeostasis and bone turnover.

9. Drugs Acting on the Blood and Blood-Forming Organs:
Hematopoietic agents: Growth factors, minerals, and vitamins, Blood coagulation and anticoagulant, thrombolytic, and antiplatelet drugs.

10. Pharmacology of Dermatological Agents

11. Ocular Pharmacology
RECOMMENDED BOOKS:
12. Review articles and Research articles from Medical and Pharmacological Journals

Subject code: MPL-S10
Subject: ADVANCED PHARMACOLOGY AND PHARMACOTHERAPEUTICS
THEORY: 60 Hours (4 hrs./week)

1. Basic Principles of Clinical Pharmacology:
Monitoring of drug therapy, patient compliance, principles of pediatric and geriatric pharmacology, drug therapy in pregnant and lactating mothers.

2. Drug Therapy of Cardiovascular Disorders:
Pathophysiology and drug therapy of congestive cardiac failure, hypertension, cardiac arrhythmias, ischemic heart disease, hyperlipidemia, and atherosclerosis.

3. Drug Therapy of Neurological Disorders:
Pathophysiology and drug therapy of epilepsy, Parkinson's disease, migraine, and myasthenia gravis.
4. Drug Therapy of Psychiatric Disorders:
Pathophysiology and drug therapy of anxiety, schizophrenia, Alzheimer’s disease, mood and sleep disorders, and memory.

5. Drug Therapy of Endocrine Disorders:
Pathophysiology and drug therapy of diabetes mellitus, contraception, and infertility.

6. Drug Therapy of Inflammatory Disorders:
Biology of inflammation, pathophysiology and drug therapy of osteoarthritis, rheumatoid arthritis, and gout.

7. Drug Therapy of Respiratory Diseases:
Pathophysiology and drug therapy of asthma.

8. Drug Therapy of Gastrointestinal Diseases:
Pathophysiology and drug therapy of peptic ulcers, emesis, irritable bowel syndrome, and inflammatory bowel disease.

9. Drug Therapy of Metabolic and Sexual Disorders:
Pathophysiology and drug therapy of obesity and erectile dysfunction.

10. Pharmacology of Chemotherapeutic and Antimicrobial Agents:
General considerations of antimicrobial therapy, Sulfonamides, trimethoprin, quinolones, other related agents, Penicillins, cephalosporins, and other beta-lactam antibiotics, Aminoglycosides, Protein synthesis inhibitors and miscellaneous antibacterial agents, Antifungal agents, Antiviral agents (Non-retroviral).

11. Pathophysiology of cancer and Antineoplastic Agents

12. Drug Therapy of Infectious Diseases:
Pathophysiology and drug therapy of tuberculosis, leprosy, HIV and related opportunistic infections, malaria, amoebiasis, and helminth infections.

RECOMMENDED BOOKS:
Subject code: MPL-P9
Subject: ADVANCED SYSTEMIC PHARMACOLOGY
Practical: 8 hrs./week

1. **Bioassays:**
   
a) Estimation of potency of test substance by three point and four point bioassay method using different isolated tissues.
   
b) To determine the PA2 value using different isolated tissues.

2. **In-vivo experiments:**
   
a) To study antisecretory and ulcer protective effect of Cimetidine in pylorus ligated rats.
   
b) To study Diuretic effect of any one marketed preparation in rats.

3. **Clinical:**
   
In this module, it is expected a student should collect data from field targeted as disease oriented, drug use oriented, adverse events oriented, biochemical oriented etc and compile it with conclusive output.

4. **Statistical:**
   
a) Statistical evaluation of data and finding level of significance.
   
b) Hand on experience on online, offline, open source statistical software’s.

5. **Demonstration:**
   
To demonstrate different experiments using simulated computer softwares.
1. Prerequisite for Pharmacology Practicals:
In this module it is expected student should know general principles, techniques and strategies for pharmacological screening of drugs, animal care, handling, ethical requirements and regulations therein.

2. Basic Experimental Techniques:
1. Standard techniques collection of blood samples and feeding of animals
2. Administration of drugs by different routes in mice
3. Use of anaesthetics and cannulation of veins, arteries, trachea

3. Experiments on intact animals:
1. To study locomotor activity by using Actophotometer.
2. To evaluate analgesic activity of drug using tail flick latency test.
3. To determine the effect of carrageen induced edema in rats by using digital Plethysmometer.
4. To study the anticonvulsant effect of Phenobarbitone against MES induced convulsions in rats.
5. To determine the analgesic effect by using Eddy’s hot plate.
6. To study effect of pentabarbitone sodium on righting reflex (hypnosis) in mice.
7. To study Anti-anxiety effect of diazepam in mice using elevated plus maze apparatus.
8. To study the Apomorphine induced compulsive behaviour (Stereotype) in mice.
9. To study the muscle relaxant property of Diazepam in mice using rotarod.
10. To study amnesic (loss of memory) effect of drug using passive avoidance step-down task paradigm in mice.
11. To study the antidepressant effect of drug using forced swimming test apparatus.

4. Toxicity Studies:
1. Regulations and guidelines of toxicity studies
2. Method of calculation of ED50 and LD50
3. Observation of behavioral changes in animals during acute and sub acute toxicity study of test drug.

5. Practicals using computer software’s:
In this module it is expected student should know working of software and setting of physiologic and animal experimentation and perform at least four experiments from following or others-
1. To record temperature using thermal transducer
2. To measure blood pressure using Blood pressure transducer
3. To measure drug response curve using isotonic transducer
5. To measure a change in volume using volume transducer
6. To measure a respiration using a respiratory transducer
7. To study various transducers and couplers
8. To study ECG using ECG coupler with BioPac
9. To measure vital capacity, forced expiratory volume etc., using isotonic transducer and Spirometer.
Semester-III

Subject code: MPL-S13
Subject: MOLECULAR PHARMACOLOGY AND TOXICOLOGY
THEORY: 60 Hours (4 hrs./week)

1. **Molecular mechanism of drug action**: Receptor occupancy and cellular signaling systems such as G-proteins, cyclic nucleotides, calcium and phosphatidyl inositol. Ionic channels and their modulators.

2. **Endogenous bioactive molecules** such as cytokines, neuropeptides and their modulators, neurosteroids, nitric oxide, phosphodiesterase enzyme and protein kinase C, arachidonic acid metabolites.

3. **Recent trends on different classes of receptors and drugs acting on them**
   Angiotensin receptors, Excitatory amino acid receptors, Kinin receptors, Adrenoceptors, Low molecular weight heparins, Imidazole receptors, Cholinergic receptors, Dopamine receptors, Serotonin receptors, Hormone receptors, GABA receptors, Purinergic receptors, Glutamate receptors.

4. **Ion channel and their modulators**: calcium, potassium, sodium and chloride channels

5. **Basic Concepts of Chronopharmacology** and their implications to Drug Therapy.


7. **Toxicology**: Principles of toxicology, elementary knowledge of systemic toxicology, manifestation of toxicology, Management and treatment of poisoning, immunotoxicity, toxic effect on genetic material and cell proliferation, non therapeutic toxicants, air pollutants, solvents, vapour and pesticides toxicity, food additives and contaminant toxicity, heavy metal toxicity, toxins of animal origin, radiations and radioactive material toxicity, adverse drug reactions, toxicity of drug overdosing and its management.

**RECOMMENDED BOOKS:**


12. Recent review articles in different international journals of repute.
Syllabus Prescribed for Degree of Master of Pharmacy in Pharmacognosy

Semester-I

| Advanced Analytical Techniques (MC-S1 & MC-P1) | Syllabus is same as prescribed for these papers for M. Pharm semester-I examination in Pharmaceutics |
| Research Methodology and Biostatistics (MC-S2) |
| Drug Regulatory Affairs (MC-S3) |

Subject code: MPG-S4

Subject: ADVANCED PHARMACOGNOSY AND PHYTOCHEMISTRY

THEORY: 60 Hours (4 hrs. /week)

1. **Neutraceuticals:** Introduction, probiotics & Prebiotics, Study of some plant constituents and their products in international market, study of lycopene, proanthocyanidin and grape products, ornithine, flax seed and flax oil, melatonin and ornithine.

2. **Study of herbal extracts:** General methods for the extraction of herbal drugs, processing and analytical profile, stability, preservation and evaluation of extracts. Effect of solvent, solvent mixtures and solution on extraction.

3. **Extraction, isolation, purification and estimation of following phytoconstituents:**
   - Alkaloids: Caffeine, Atropine, Berberine, Piperine
   - Glycosides: Sennosides, Digoxin
   - Flavonoids: Rutin, Hesperidin
   - Terpenoids: Taxol, Andrographolide
   - Saponins: Diosgenin, Glycyrrhizin


6. **Drug discovery from Natural Products.**

7. **Ethnobotany in Herbal Drug Evaluation.**

8. **Adverse reactions and safety in herbal medicine**

RECOMMENDED BOOKS:

1. Mukherjee Pulok, Quality Control of Herbal Drugs, Business Horizons Limited, New Delhi.

2. Advances in Natural Product Chemistry, extraction and isolation of biologically active compounds. S. Natori et al., Wiley, New York.


Subject code: MPG-P4
Subject: ADVANCED PHARMACOGNOSY AND PHYTOCHEMISTRY
Practical: 8 hrs./week

1. Extraction of active principles i.e. alkaloids, glycosides, resins, essential oils, terpenoids, fixed oils, carbohydrates, fats, tannins, steroids, pectins, etc. from natural drugs.

2. Preliminary phytochemical screening of the plant extracts.

3. Extraction, isolation, purification and identification of important phytoconstituents as follows:
   a. Sennosides from Senna leaves
   b. Curcumin from Turmeric
   c. Glycyrrhizin from Liquorice
   d. Hesperidin from Orange peels
   e. Caffeine from Tea
   f. Rutin from Ruta graveolens
   g. Aloin from Aloes
   h. Piperine from Pepper
   i. Quinine from cinchona bark
   j. Berberine from Berberis aristata
   k. Diosgenin from Dioscorea

4. Evaluation of crude drugs by different WHO Standards.
Semester-II

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MPG-S9
Subject: STANDARDIZATION OF NATURAL PRODUCTS

THEORY: 60 Hours (4 hrs./week)

1. Introduction: Need of standardization, limitations of herbal medicines, current regulation of standardization of natural products, their quality, safety and efficacy assessment.

2. Application of various chromatographic techniques i.e. Paper chromatography, TLC, HPTLC, HPLC, GLC, GC-MS for the standardization of plant extracts.

3. Application of UV, FTIR, NMR (\(^{1}\text{H}\) and \(^{13}\text{C}\)-NMR) and Mass spectroscopy for structural elucidation of flavonoids (Rutin, Hesperidin, Kaempferol), Terpenoids (Camphor, Menthol, Eugenol, Citral) and phytosterols (B-sitosterol, stigmasterol).

4. WHO guidelines for the quality control of herbal plant materials.

RECOMMENDED BOOKS:

2. WHO guide lines for the quality control of Herbal plant materials.
6. Biological Standardization by JN Barn, DJ Finley and LG Goodwin.
10. Textbook of Industrial Pharmacognosy by AN Kalia, CBS publishers and Distributors, New Delhi.
1. Herbal based Industry: Scope, study of infrastructure, staff requirement, project profiles, plant and equipment, processing, research and development, regulatory requirement. Pilot plant scale up techniques.


3. Standardization of polyherbal formulations: syrups, powders, ointments and other semisolid preparations, tablets and capsules.

4. Evaluation aspects of Herbal products containing Ashwagandha, Kalmegh, Shatavari, Phyllanthus, Guduchi and Shilajeet by study of HPTLC and HPLC fingerprints.

5. WHO and Indian regulatory requirements of Clinical trials for herbal formulations.


RECOMMENDED BOOKS:

5. Mukherjee Pulok, Quality Control of Herbal Drugs, Business Horizons Limited, New Delhi.
Subject code: MPG-P9
Subject: STANDARDIZATION OF NATURAL PRODUCTS
Practical: 8 hrs. /week

1. Determination of Anthracene derivatives in senna by spectrophotometric method, Reserpine in Rauwolfia, Carvone content of Caraway fruits, Citral content in Lemon oil.
2. Determination of ascorbic acid by UV spectroscopic method in some crude drugs.
3. Paper chromatography and TLC of active principles of natural products.
4. Study of UV and FTIR spectral data of some marker compounds.
5. Separation of Solanaceous alkaloids from Belladona leaves by TLC using hyoscine and hyoscyamine as reference compounds.
6. Quantitative estimation of Ephedrine in Ephedra extracts by HPTLC method (demonstration only).
7. Quantitative estimation of Reserpine in Rauwolfia extracts by HPLC method (demonstration only).
8. Study of HPTLC and HPLC fingerprinting of some important phytoconstituents (demonstration only).

Subject code: MPG-P10
Subject: HERBAL DRUG FORMULATION AND DEVELOPMENT
Practical: 8 Hours / week

1. Formulation and evaluation of different polyherbal formulations.
2. Stress induced stability evaluation of different polyherbal formulations.
3. Quantitation of some therapeutically important phytoconstituents from herbal drug formulations by HPTLC.
4. Identification of some phytoconstituents from herbal drug formulations by TLC.
5. Evaluation of some marketed Ayurvedic formulations like Asavas and Aristas, Avalehas, Churnas, Ghritas and Vatika.
Semester-III

Subject code: MPG-S13
Subject: Selected Topics in Pharmacognosy

THEORY: 60 Hours (4 hrs./week)

1. Problems and Prospects of discovering new drugs from higher plants. Natural products: its impact on industry and medicine.
2. Phytosomes
3. Anticancer and Psychosomatic drugs of plant origin
4. Marine drugs of medicinal importance.
5. Antimicrobials from higher plants.
6. Pharmacological screening methods of natural products for their a. Hepatoprotective; b. antidiabetics; c. antioxidants; d. analgesic and anti-inflammatory; e. Antihyperlipidemic; f. antimicrobials; antiepileptics activities.
7. Bioassay Guided Isolation, Separation and Structural Characterization
8. Recent advances in alkaloids: Chemistry, isolation, purification, identification and estimation by physical and chemical methods of following alkaloids: Atropine, Ephedrine, Reserpine, Ergometrine, Vinblastine, Quinine.
9. Recent advances in glycosides: Chemistry, isolation, purification, identification and estimation by physical and chemical methods of following glycosides: Rutin, Glycyrrhizin, Picrosides, Kutkosides, Diosgenin, Hesperidin.
10. Recent advances in terpenoids: Chemistry, isolation, purification, identification and estimation by physical and chemical methods of following terpenoids: Menthol, Carvone, Citral, Eugenol and Cineol.

RECOMMENDED BOOKS:

8. Agrawal OP, Chemistry of Organic Natural Product, Goel Publication House, UP.
11. Mukherjee Pulok, Quality Control of Herbal Drugs, Business Horizons Limited, New Delhi.
Syllabus Prescribed for Degree of Master of Pharmacy in Biotechnology

Semester-I

<table>
<thead>
<tr>
<th>Subject code: MBT-S4</th>
<th>Subject: FUNDAMENTALS OF BIOTECHNOLOGY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advanced Analytical Techniques (MC-S1 &amp; MC-P1)</td>
<td>Syllabus is same as prescribed for these papers for M. Pharm semester-I examination in Pharmaceutics</td>
</tr>
<tr>
<td>Research Methodology and Biostatistics (MC-S2)</td>
<td></td>
</tr>
<tr>
<td>Drug Regulatory Affairs (MC-S3)</td>
<td></td>
</tr>
</tbody>
</table>

THEORY: 60 Hours (4 hrs /week)

1. **Microbial biotechnology**: Bacteria, actinomycetes, fungi, algae and viruses: structure, chemistry, morphology, nomenclature, general classification, molecular & genotypic taxonomy, cultural, physiological and reproductive features, methods of isolation, cultivation, and maintenance of pure cultures. Industrially important microorganisms: examples and applications.

2. **Microbial pathology**: identifying features of pathogenic bacteria, fungi and viruses, mechanism of microbial pathogenicity, etiology and pathology of common microbial diseases and currently recommended therapies for common bacterial, fungal & viral infections.

3. **Cellular Biology**: Cell structure & function: cell organelles, cytoskeleton & cell movements, basic aspects of cell regulation, bioenergetics and fuelling reactions of aerobics and anaerobics, secondary metabolism & its applications. Intracellular vesicular traffic, cell communication, cell cycle and apoptosis, mechanism of cell division. Cell junctions/adhesion and extra cellular matrix, germ cells and fertilization, histology- the life and death of cells in tissues.


5. **Apoptosis and Oncogenes**: Programmed Cell Death, Tumor cells, Proto-oncogenes, oncogenic mutations, cell cycle & controls, carcinogens & repair.


**RECOMMENDED BOOKS:**

Subject code: MBT-S4
Subject: FUNDAMENTALS OF BIOTECHNOLOGY
Practical: (8 hrs /week)

1. Basic Laboratory Procedure – Instrument Introduction and Handling, Maintenance, Aseptic condition maintenance, Sterilization, Microscopy, etc.

2. Basic Microbiology Practicals: Preparations of various important media, Culturing and harvesting of microbes. Staining and identification. Maintenance.

3. To study several kinds of bacteria, yeast, moulds, actiomycets, fungi etc. by morphological and cultural techniques. Counting of micro-organisms. Total and Hable count (air, water, soil etc.).

4. Isolation of a pure culture from different samples and its identification in the Laboratory.

5. Effects of temperature on the growth of micro-organisms. To find out the normal death rate of different micro-organisms.

6. To find out the drug resistance in bacteria by testing the sensitivity of bacteria to antimicrobial agents, using filter paper discs.

7. Evaluation of potency of antibiotics by different methods.
Semester-II

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MBT-S9
Subject: MOLECULAR BIOLOGY

THEORY: 60 Hours (4 hrs/week)

1. **Recombinant DNA Technology**: DNA structure and functions, restriction endonucleases, plasmid cloning, methods of creating and screening gene library, cloning DNA sequences that encode eukaryotic proteins, vectors for cloning large pieces of DNA, genetic transformation, and selection of prokaryotes.

2. **Molecular Diagnostics**: DNA diagnostic systems, hybridization probes, diagnosis of malaria, fluorescent in situ hybridization procedure, molecular diagnosis of genetic diseases – PCR/OLA procedures, ligase chain reaction (LCR).


4. **Biopharmaceuticals**: Basic principles of development of protein pharmaceuticals with special reference to human insulin, human interferons, human growth hormone, erythropoietin, variants of t-PA, immunoadhesions, and chimeric proteins.

**RECOMMENDED BOOKS:**

1. Production and Analysis of different products from microorganisms by fermentation technology: Production of culture. Production and mechanisms of ethanol fermentation. Production of alcoholic beverages, wines, alcohols, beers, brandies, rum etc.

2. Glycerol fermentation: Organic acids-citric, lactic, gallic, fumaric, gibberillic etc. Antibiotics-chloramphenicol, novobiocin, griseofulvin, erythromycin and other commonly used therapeutic agents.
   An outline of production of solvents and amino acids like alanine, methionine as well as fermented Ayurvedic preparations, Biofertilizers, Biogas.


4. Production of Vaccine and Sera: Study of Enzymes-chemistry, structure, function, requirements, mechanism of action, regulation, synthetic and artificial enzymes, Use of enzymes in biotechnology and engineered alteration of enzyme activity, specificity and stability. Mechanisms based in activation of enzymes, active site directed reagents and transition state analogues in relation to enzyme and drug development, selected aspects of immobilization of enzymes and cells, kinetics of free enzyme and immobilized enzyme and cells. Site directed mutagenesis, protein engineering and synthetic enzymes.

RECOMMENDED BOOKS:
5. Scragg, Biotechnology for Engineers: Biological System in Technological Processes, Ellis Horwood Ltd.
Subject code: MBT-P9
Subject: MOLECULAR BIOLOGY
Practical: (8 hrs. /week)

1. Isolation of human DNA.
2. Quality assessment DNA by spectrophotometer and gel electrophoresis
3. Restriction digestion of DNA
4. Separation of DNA fragments by gel electrophoresis
5. Staining of DNA bands with ETH-Br, DNA visualization.
6. Isolation of RNA from microbial sources and estimation.

Subject code: MBT-P10
Subject: FERMENTATION TECHNOLOGY
Practical: (8 hrs /week)

1. Preparation of some biochemical products in laboratory using fermentation technology:
   (a) Preparation of bacterial yeast, (b) Preparation of citric acid, (c) Preparation of alcohol, (d) Preparation of antibiotics.
2. Biological assays of various fermented products.
3. Chemical analysis of various fermented products.
4. Tests for sterility of various products.
5. Standardisation of vaccine and sera.
6. Standardisation of antisera using animals.
7. Demonstration of Ab by (1) Precipitation test, (2) Immuno diffusion test, (3) Immunelectrophoresis.
8. Phagocytosis staining after engulfment of Ab coated SRBC.
Semester-III

Subject code: MBT-S13
Subject: ADVANCED TISSUE AND CELL CULTURE TECHNIQUES

THEORY: 60 Hours (4 hrs./week)


2. A review with useful recent advances of plant growth: Troposm, photomorphogenesis, photoperiodism and plant growth regulations, Biosynthesis, chemical properties, distributions, classification and function (s) of : Glycosides, alkaloids, terpenoids, steroids, production of secondary metabolites, culture systems, selection of nutritional factors and other physical parameters for optimal products on applications of plant cell tissue culture: Agriculture crops, forest trees, ornamental plants, medicinal plants.

3. Short outline of special techniques in animal cell tissue culture: Aminocentesis, Enucleation, in-vitro mutagenesis, carcinogenesis, crypotoxicity, cell fusion of hybridoma technique, actions of hormone on cell and organ cultures etc.


RECOMMENDED BOOKS:

Syllabus Prescribed for Degree of Master of Pharmacy in Quality Assurance

Semester-I

| Advanced Analytical Techniques (MC-S1 & MC-P1) | Syllabus is same as prescribed for these papers for M. Pharm semester-I examination in Pharmaceutics |
| Research Methodology and Biostatistics (MC-S2) |
| Drug Regulatory Affairs (MC-S3) |

Subject code: MQA-S4
Subject: PHARMACEUTICAL VALIDATION

THEORY: 60 Hours (4 hrs. /week)

1. **Introduction:** Introduction to Pharmaceutical validation, the validation committee, validation protocol and report, pre-approval inspection, pilot plant scale up and technical transfer, stages of validation.

2. **Equipment validation:** Installation and validation of typical equipments such as dry powder mixers, fluid bed and tray dryers, tablet compression machine, capsule filling machine, autoclaves.

3. **Analytical method validation:** General principles of analytical method validation, sampling and sample handling, validation of analytical instruments i.e. UV / VIS spectrophotometers, HPLC, dissolution test apparatus.

4. **Process validation:** Regulatory basis for process validation, prospective process validation and retrospective validation. Manufacturing and process validation of sterile and non-sterile products i.e. coated tablets, capsules, ampoules and vials, ointments and creams, liquid orals and parenterals. Validation of processes like mixing, granulation, drying, compression, filtration, filling etc.

5. **Validation of solid dosage forms:** Introduction, validation of raw materials, definition and control of process variables, in-process tests, finished products tests, guidelines for process validation of solid dosage forms, tablets, tablet composition, process evaluation and selection, equipment evaluation, capsules, capsule composition, process evaluation and selection, encapsulation equipment evaluation.

6. **Validation of Stability studies:** ICH guidelines and stability protocols for different Pharmaceutical dosage forms.

RECOMMENDED BOOKS:

3. Automation and validation of information in pharmaceutical processing by Despautz JF, Marcel Decker Inc.
Subject code: MQA-P4
Subject: PHARMACEUTICAL VALIDATION
Practical: 8 hrs. /week

1. Validation of analytical method (minimum four experiments)
2. Validation of following equipments:
   a. Autoclave
   b. Hot air oven
   c. Powder Mixer (Dry)
   d. Tablet compression machine
   e. Dryers
3. Validation of at least two analytical instruments.
4. Cleaning validation of one equipment.
5. Stability study of active pharmaceutical ingredients and finished products (minimum two).
6. Validation of granulation process.
7. In-process testing of solid dosage forms.
Semester-II

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MQA-S9
Subject: QUALITY ASSURANCE OF COSMECEUTICALS

THEORY: 60 Hours (4 hrs./week)

1. Factors to be considered in designing of cosmetic products: Regulatory requirements of cosmetic products, consumer safety consideration with microbiological preservation of cosmetic, intellectual property issue: patents of trade secrets.

2. Quality Management of cosmetics:
   i) Manufacturing techniques and evaluation of the cosmetic finished products,
      a) The skin
         Irritation and sensitization of the skin
         Nutrition and hormonal control of the skin
         Preparation for the facial skin: Vanishing cream, cold and moisturizing cream, makeup preparations and face powder.
      ii) Preparation for oral hygiene: Dentifrices, mouthwashes.
         Preparation for hands and feet
      iii) Body cosmetics: Antiperspirant and deodorant, talcum powder, sun-screen, sun tan, and anti sun burn preparation.
      iv) Preparation for hair: Shampoos, anti-dandruff preparations, hair dyes and conditioners, hair oil, depilatories, and hair grooming aids.
      v) Preparation for nails
      vi) Cosmetics for Men: shaving preparation, pre shave and after shave lotion
      vii) Baby cosmetics
      viii) Perfumes used in cosmetics

3. Toxicity testing methods, special toxicity testing like teratogenicity, and skin sensitivity testing.

4. General principle of quality control of cosmetic product

5. Stability evaluation of cosmetics

RECOMMENDED BOOKS:
Subject code: MQA-S10
Subject: NOVEL DRUG DELIVERY SYSTEMS
THEORY: 60 Hours (4 hrs. /week)

1. Fundamentals of controlled release drug delivery systems:
Fundamentals and Rationale of Sustained / controlled drug delivery, factors influencing the design & performance of sustained/controlled release products, Drug Targeting, Use of polymers in controlled release of active agents, Pharmacokinetic / Pharmacodynamic basis of controlled drug delivery systems, regulatory requirements.

2. Oral drug delivery:
Formulation, fabrication and evaluation of various oral controlled drug delivery systems including dissolution and diffusion controlled delivery systems, gastro retentive, colon targeted and pulsatile drug delivery. TIMERx, MASSRx & COSRx, Procise technology, RingCap technology, Theriform Technology, Accudep Technology, THREEFORM Technology, DissoCube IDD Technology, Zydis Technology for poorly soluble drugs, Orasolv & Durasolv technology, Egalet Technology, Buccal Mucoadhesives, Periochips.

3. Parenteral controlled release system:
Scope, terminology & techniques used, injectable controlled release, formulation. Implantable drug delivery, microspheres, liposomes & their quality control.

4. Mucosal drug delivery models:

5. Transdermal drug delivery system:
Permeation through skin including mechanism, permeation enhances, In-vitro skin permeation, technologies for developing transdermal drug delivery system, mechanism of release kinetics, evaluation of transdermal drug delivery systems.

6. Ocular Drug Delivery:
Transport of drugs through ocular tissues, approaches to improve ocular drug delivery.

7. Site specific drug delivery system:
Active & passive targeting, resealed erythrocyte, monoclonal antibodies, drug targeting by particulate carrier system, drug targeting to brain, lung & colon.

8. Protein & peptide drug delivery system:

RECOMMENDED BOOKS:
9. R. Williams, D. Taft and J. McConville, “Advanced formulaition design to optimize therapeutic outcomes” Marcel Dekker, Inc.

Subject code: MQA-P9
Subject: QUALITY ASSURANCE OF COSMECEUTICALS
Practical: 8 hrs./week
1. Evaluation of cosmetic raw materials (Minimum of 5 experiments).
2. Formulation and evaluation of various types of cosmetic preparations (Minimum of 5 experiments).
3. Evaluation of some marketed brands of cosmetic preparations (Minimum of 5 experiments).
5. Determination of microbial load of cosmetic preparation (Minimum of 2 experiments).

Subject code: MQA-P10
Subject: NOVEL DRUG DELIVERY SYSTEMS
Practical: 8 hrs./week
1. Formulation and evaluation of sustained release matrix tablet (of any two drugs).
2. Formulation and evaluation of floating microspheres.
3. Formulation and evaluation of floating tablet.
4. Formulation and in vitro evaluation of transdermal patches.
5. Development and evaluation of ocular inserts of a given drug.
6. Preparation and evaluation of buccal film of any two cardiovascular drugs.
7. Taste masking of some bitter drugs by ion-exchange resins.
Semester-III

Subject code: MQA-S13
Subject: QUALITY MANAGEMENT

THEORY: 60 Hours (4 hrs./week)


2. Documentation requirements in pharmaceutical industry for GMP compliance:
   a. Equipment, selection, purchase specifications, maintenance clean in place and sterilize in place.
   c. In process quality control on sterile and non-sterile dosage forms. Standard Operating Procedures for various operations like cleaning, filling, drying compression, coating, disinfection, fumigation, sterilization, membrane filtration etc.
   d. Packaging and labeling controls, line clearance and other packaging material.


4. Quality control laboratory responsibilities and good laboratory practices.

5. Finished product release, quality audits, batch release documents.

6. Good warehousing practices and materials management.

7. Distribution records, handling of returned goods, recovered materials and processing.


9. Waste and scrap disposal procedures and records.

10. Good Manufacturing Practices according to Schedule M of D & C Act


RECOMMENDED BOOKS:


2. Encyclopedia by pharmaceutical technology edited by James Swarbrick, James C. Boylan, Marcel Dekker Inc.


4. Drug and Cosmetic Act and Rules (Government of India)


7. Girmaldi, Monica and Gough, Janet, The internal quality audit, Davis Harwood International Publishing.

8. Singer, Guidelines for laboratory quality auditing, Marcel Dekker

9. Lewis, Pharmaceutical experimental design, Marcel Dekker.


Syllabus Prescribed for Degree of Master of Pharmacy in Industrial Pharmacy

Semester-I

| Subject Code | Subject | Syllabus
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MC-S1 &amp; MC-P1</td>
<td>Advanced Analytical Techniques</td>
<td>Syllabus is same as prescribed for these papers for M. Pharm semester-I examination in Pharmaceutics</td>
</tr>
<tr>
<td>MC-S2</td>
<td>Research Methodology and Biostatistics</td>
<td></td>
</tr>
<tr>
<td>MC-S3</td>
<td>Drug Regulatory Affairs</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MIP-S4
Subject: ADVANCED INDUSTRIAL PHARMACY-I

THEORY: 60 Hours (4 hrs./week)

1. **Principles of improved Tablet Production system design**: introduction, Benefits of improved Tablet production system, Material Handling, processing step combination or elimination, Unit operation improvements, Role of Computer process Control.
3. **Pelletization technology**: Introduction, Pelletization process and formulation, Requirements for pelletization.
4. **Sterile Dosage forms**: Formulation and Processing of large volume parenterals, Small volume Parenterals and Related parenteral products, Parenteral devices.
6. **Evaporation and Evaporators**: Introduction, Types of Evaporators, Design of Evaporators, operation of Evaporators.
7. **Pilot plant Scale Up Techniques**: General Consideration, Purpose and functions concepts of pilot plant for Development and control, Planning for pilot plant, Size of pilot plant. Organisation and Personnel, Basic Consideration in Developing the process for Production of dosage forms, GMP consideration. Transfer of Analytical methods to Quality assurance, Product consideration, Pilot plant study design for solid dosage forms, Liquid orals and semi-solids.

REFERENCE BOOKS:
1. B.S. Banker. Modern Pharmaceutics, Marcel Dekker.
3. Lachman, Theory and Practice of Industrial Pharmacy, Lea and Febiger.
7. Ghebre, sellasie, Pharmaceutical Polletization technology, Marcel Dekker.

Subject code: MIP-P4
Subject : ADVANCED INDUSTRIAL PHARMACY-I
Practical: 8 hrs. /week

1. To study the effect of particle size, moisture content and lubricant on flowability and compressibility of powders.
2. To prepare and evaluate antibiotic dispersible tablet.
3. To prepare and evaluate chewable tablet.
4. To prepare and evaluate medicated logenzes.
5. Development and evaluation of compression coated tablet of some drugs.
6. Design and characterization of drug loaded pellets by different techniques.
7. To prepare and evaluate parenteral suspension
8. To prepare and evaluate parenteral solution
9. To prepare and evaluate parenteral emulsion
10. To prepare and evaluate sterile reconstituted powder.
11. To prepare and evaluate microsphere prepared by spray drying technique
Semester-II

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MIP-S9
Subject: ADVANCED INDUSTRIAL PHARMACY-II

THEORY: 60 Hours (4 hrs. /week)

1. **Optimization techniques in pharmaceutical formulation and processing**
   - Concept of optimization, Optimization parameters, Classical optimization, Statistical design, and Optimization methods.

2. **Stability testing**
   - Physicochemical and biological factors affecting stability of drugs, Methods to find out degradation pathways, Determination of shelf life by accelerated stability testing, Overages.

3. **Bioavailability and bioequivalence studies**

4. **Methods of enhancing bioavailability**
   - Solubilization, Prodrugs, and enhancement of dissolution characteristics, cyclodextrin, permeation enhancer, solid dispersion, surfactant, bioavailability enhancers.

5. **Biochemical and molecular biology approaches to controlled drug delivery:**

6. **Engineering**
   - Adequate knowledge of mechanical, electrical and electronic parts of pharmaceutical machinery and equipment, preventive maintenance, assessing plant and machinery efficiency and life. Material handling, transfer, transport and conveyance of bulk material.

7. **Packaging Material Science:** Packing design and specification, packaging validation trials, materials of construction. Component product validation, regulatory requirements, quality control testing and standards, GMP requirements and its deficiencies. In processes control during component manufacture, documentation sterilization of packing component, packaging and filling equipment, pharmaceutical packaging including sterile area.

RECOMMENDED BOOKS:
8. Quality Assurance Guide; By Organization of Pharmaceutical producers of India.

Subject code: MIP-S10
Subject: ADVANCES IN DRUG DELIVERY SYSTEMS
THEORY: 60 Hours (4 hrs./week)

2. Sustained release formulations: Introduction, concept, advantages and disadvantages. Physicochemical and biological properties of drugs relevant to sustained release formulations, evaluation of SRDFs.
3. Concept and system design for rate-controlled drug delivery: Classification of controlled drug delivery systems, rate-programmed release, activation modulated and feedback-regulated drug delivery systems, effect of system parameters on controlled release drug delivery.
4. Controlled release oral drug delivery systems: Dissolution, Diffusion, Combination of dissolution and diffusion controlled systems, osmotic pressure controlled release systems, floating drug delivery systems, pH dependent systems, ion exchange controlled systems.
7. Transdermal drug delivery systems: Anatomy and physiology of skin, permeation through skin, factors affecting permeation, basic components of TDDS, formulation approaches used in development of TDDS and their evaluation, permeation enhancers, penetration enhancement techniques, iontophoresis, sonophoresis, transfersomes, ethosomes
9. **Intrauterine drug delivery systems**: Anatomy & physiology of vagina, development of intrauterine devices (IUDs), copper IUDs, hormone-releasing IUDs, and vaginal rings.

10. **Targeted drug delivery systems**: Principles of targeting, classification, advantages and disadvantages, biological processes and event involved in drug targeting, microspheres, magnetic microspheres, nanoparticles, liposomes, niosomes, dendrimers, resealed erythrocytes, and monoclonal antibodies.

11. **Protein and peptide drug delivery**: Introduction, classification and structure of protein, drug delivery systems for proteins and peptides, manifestation of protein instability and stability.

12. **Vaccine delivery**: Novel vaccination strategies, microparticles as vaccine adjuvants and delivery systems, liposomes and ISCOMs in vaccine delivery, virosomal technology, vaccines for specific targets, nanotechnology for vaccine delivery

**RECOMMENDED BOOKS**

3. Lliun Lisbeth, Davis Stanley S. Polymers in Controlled Drug Delivery. Wright Bristol.
Subject code: MIP-P9
Subject: ADVANCED INDUSTRIAL PHARMACY II
Practical: 8 hrs. /week

1. Optimization of formulations by factorial design.
2. Preformulation studies on tablets.
3. To study the decomposition kinetics of any three drugs.
4. To study the effect of copper ions on the ascorbic acid stability in solution.
5. To determine the aqueous solubility of given drug sample at various temperature and report its thermodynamic parameters.
6. To study the dissolution kinetics of given drug.
7. To study the effect of pH (2, 4, 6 and 8.0) on the apparent partition coefficient of a drug in n-octanol-water buffer system.
8. To perform powdered glass test and whole container test as per USP on given glass containers.
10. To determine water absorption capacity of different packaging materials.

Subject code: MIP-P10
Subject: ADVANCES IN DRUG DELIVERY SYSTEMS
Practical: 8 hrs. /week

1. Formulation and evaluation of sustained release matrix tablet (of any two drugs).
2. Formulation and evaluation of floating microspheres.
3. Formulation and evaluation of floating tablet.
4. Formulation and in vitro evaluation of transdermal patches.
5. Development and evaluation of ocular inserts of a given drug.
6. Preparation and evaluation of buccal film of any two cardiovascular drugs.
7. Taste masking of some bitter drugs by ion-exchange resins.
Semester-III

Subject code: MIP-S13
Subject: INDUSTRIAL PROCESS VALIDATION AND PRODUCTION MANAGEMENT

THEORY:  60 Hours (4 hrs. /week)

1) **Definition.** regulatory history of process validation, regulatory basis of process validation.
2) **Organisation :** Structure, corresponding departments, scope of validation work, protocol and documentation.
3) **Validation of Sterile dosage form :** Theoretical approaches, validation of steam, dry heat and ethylene oxide. Sterilization cycle. Validation of radiation and sterilising filters.
4) **Validation of solid dosage form :** Definition and control of process variables, guidelines for process validation of solid dosage form, validation of raw material and analytical methods.
5) **Prospective process validation :** Introduction, Organisation and documentation. Formulation development and development of manufacturing capability Scale up studies, qualification trials master product documents. Experimental design and analysis.
6) **Retrospective process validation :** Process validation strategies. Selection and evaluation of historical data.
7) **Process of raw material :** Cost verses risk analysis. Establishment of specifications, test procedure for sampling. Establishment of optimum storage conditions.
8) **Analytical methods validation :** Assay validation during development phase. Retrospective and prospective analytical methods validation.
9) **Production and planning management :** Space allocation, environment factors, manufacturing, materials management. Forecasting cost control. Industrial relation. Entreprenuership development.
10) **Safety management:** Industrial hazards due to fire, accident, mechanical and electrical equipment, chemicals and pharmaceutical safety measures.

**RECOMMENDED BOOKS :**

Syllabus Prescribed for Degree of Master of Pharmacy in Pharmacoinformatics

Semester-I

<table>
<thead>
<tr>
<th>Advanced Analytical Techniques (MC-S1 &amp; MC-P1)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-I examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Methodology and Biostatistics (MC-S2)</td>
<td></td>
</tr>
<tr>
<td>Drug Regulatory Affairs (MC-S3)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MPI-S4
Subject: INFORMATION TECHNOLOGY

THEORY: 60 Hours (4 hrs./week)

1. Chemoinformatics: Introduction, molecular structures, representation and manipulation of 2D and 3D structures, generation of 3D structures visualization techniques, molecular databases, virtual screening, chemical libraries, molecular descriptors, calculation of descriptors reflecting physical and chemical properties of molecules, molecular similarities and complementarities, selection of structurally diverse and representative sets, molecular properties, solubility partition coefficient, drug like properties, data analysis, quantitative and qualitative structure activity relationship, prediction of ADME properties, application of chemoinformatics in drug research.


3. Programming in database environment, development of databases, relational databases, information retrieval systems, general search methods, Means-ends analysis, depth first search, breath first search, optimal search, branch and bound etc. Oracle database environment.

4. Web based search engines and the details of their search algorithms especially pertaining to bio-computing.

5. Molecular modeling: Energy minimization, geometry optimization, conformational analysis, global conformational minima determination, approaches and problems, bioactive vs. global minimum conformations, automated methods of conformational search, advantages and limitations of available software, molecular graphics, computer methodologies behind molecular modeling including artificial intelligence methods.

6. Structure activity relationships in drug design: qualitative vs. quantitative approaches, advantages and disadvantages, random screening, nonrandom screening, drug metabolism studies, clinical observations, rational approaches to lead discovery, homologation, chain
branching, ring chain transformations, bio-isosterism, insights into molecular recognition phenomenon, structure based drug design, ligand based drug design.

7. QSAR: Electronic effects, Hammett equations, lipophilicity effects, Hansch equation, steric effects, Taft equation, experimental and theoretical approaches for determination of physicochemical parameters, parameter inter-dependence, case studies, regression analysis, extrapolation vs. interpolation, linearity vs. non linearity, importance of biological data in the correct form, 3D-QSAR – example CoMFA and CoMSIA.

RECOMMENDED BOOKS:

Subject code: MPI-P4
Subject: INFORMATION TECHNOLOGY
Practical: 8 hrs. /week

1. Windows Operating system basic commands and utility software exposures
2. Basic operations on MS-office and Foxpro software.
3. Statistical operations using SPSS packages
4. C- language fundamentals and programming
5. Sequence data retrieval using SRS and Entrez
6. Sequence similarity search using BLAST and FASTA tools
7. Sequence and Structure Analysis using EMBOSS Package.
9. Protein Target Identification.
10. Selection of Template structures.
Semester-II

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MPI-S9
Subject: BIOINFORMATICS

THEORY: 60 Hours (4 hrs./week)

1. Bioinformatics basic: Computers, biology and medicine, importance of Unix and Linux systems and its basic commands, data base concepts, protein and nucleic acid database concepts, protein bases, Biological XML DTD’s; pattern matching algorithm basics.

2. Computational tools for DNA sequence analysis: GCG: The Wisconsin package of analysis program, web bases interfaces for GCG sequence analysis program.

3. Database and search tools: biological background for sequence analysis. Identification of protein sequence from DNA sequence, searching of database similar sequence. The NCBI; Publicly available tool resources at EBI, resources on the web data base mining tools.

4. DNA sequence analysis: The gene bank sequence data base; submitting DNA sequence to the data base and data base searching, sequence alignment, pairwise alignment, techniques, multiple sequence analysis, multiple sequence alignment, flexible sequence similarity searching with the FAST3 program package, the use of CLUSTALX for the multiple sequence alignment.

5. Submitting DNA protein sequence database: Where and how to submit SEQUIN, genomemcentres; submitting aligned set of sequence updates and internet resources.

6. Protein modeling: Introduction; forcefield methods; energy, buried and exposed residue, side chain and neighbours; fix region, hydrogen bonds, mapping properties onto surfaces; fitting monomers, rms fits of confirms, assigning secondary structures: sequence alignment methods, evaluation, scoring, protein completion, backbone construction and side chain addition, small peptide, methodology, software accessibility, building peptides, protein displayed; substructure manipulation, anneling.

7. Pepdidomimetics: Introduction, classification; conformationally restricted peptides, design pseudopeptides, peptidomimetics and transition state analogs; biologically active template; amino acid replacement; peptidomimetics and rational drug design; CADD techniques in peptidomimetics; development of nonpeptide peptidomimetics.

8. Protein structure prediction: Protein folding and model generation; secondary structure; protein loop searching, loop generating methods, loop analysis; homology modeling.
concept of homology modeling potential application, description methodology, homologous sequence identification; align structure, align model sequence; construction of variables and conserved region, threading technique, topology fingerprint approach for prediction, evaluation of alternate models; structure prediction on a mystery sequence, structure aided sequence technique of structure prediction, structure profiles, alignment algorithms, mutation tables, prediction, validation, sequence based methods of structure prediction, prediction using inverse folding, fold prediction; significant ability; flexy dock, creatine analysis, scoring technique, sequence-sequence scoring.

9. Protein-ligand docking: Introduction; docking problems, methods for protein ligand docking, validation studies and application; screening small molecule database, docking of combinatorial libraries input data, input data, analysis docking results, software accessibility; flexy dock, creating input structures, ligand prepositioning, binding pockets, flexible bonds, torsional space, genetic algorithm, scoring.

10. The virtual library: searching MEDLINE, PubMed, current content, science citation index and current awareness services, electronic journals, grant and finding information.

REFERENCE BOOKS:

1. John, S. and Haywell, W., A guide to chemical basis of drug design, Introduction to the principles of drug design, Wright PSG.
10. Christine oreno, Bioinformatics genes, protein and computer.
1. System and methods of molecular biology: Introduction to genetics engineering and biotechnology, genes and gene expression, bacteria, bacteriophage, yeasts, animal cells; use of mutants, genetics analysis of mutants, genetics of recombination, complementation.

2. DNA replication, transcription and translation: Enzymology of replication, initiation of replication, reverse transcriptase, bidirectional replication; transcription signals, promoter sites, rho and sigma factor, RNA processing; the genetic code, the wobble hypothesis, polycistronic mRNA, overlapping genes, polypeptide synthesis.


5. Gene cloning: nucleic acid isolation, cloning vectors, salient features and types, biology of bacteriophage lambda, cosmid vectors and their use, cloning methods.


7. DNA–protein interaction: single protein binding to a regulatory DNA site, levels of specificity, single stranded DNA binding protein in E. coli, protein-DNA binding in tobacco mosaic virus, structural and functional studies of ribonuclease T1, Tet repressor, Tet operator, condensation of chromatin.


**RECOMMENDED BOOKS:**


Subject code: MPI-P9
Subject: BIOINFORMATICS
Practical: 8 hrs./week

1. Validation and active site prediction of the modeled target structure using SAVS, CASTp and PASS.
2. Identification and generation of ligand molecule from Chemical structure database.
3. Docking the ligand molecule with the protein target using AUTODOCK
4. Creating Databases like SARS PROTEIN, Amino acid and querying using MYSQL
5. Usage of String, Mathematical & Date Functions on MYSQL
6. Understanding the KEYS and references in MYSQL

Subject code: MPI-P10
Subject: MOLECULAR BIOLOGY
Practical: 8 hrs./week

2. Applications of Chromatographic techniques – Column chromatography, TLC, - HPTLC, HPLC and GC-MS.
3. Identification of chemical compounds by Nuclear Magnetic Resonance (NMR) - spectroscopy.
4. Determination of metals by Flame photometry and Absorption spectrometry.
5. Separation of proteins by Gel – Electrophoresis.
Semester-III

Subject code: MPI-S13
 Subject: SELECTED TOPICS IN PHARMACOINFORMATICS
 THEORY: 60 Hours (4 hrs./week)

1. Drug metabolism and toxicity and metabolic disorder:
Introduction to metabolic errors and metabolic diseases, metabolism in health and diseases, regulatory enzymes for metabolic pathways, metabolic problems as diagnostic criteria, advanced concept in the organization and control of carbohydrates, lipid and nitrogen metabolism in eukaryotes, regulation at cellular levels via metabolite trafficking and control of enzyme activity, integration of metabolism at the whole body level by hormonal signaling, the molecular basis of inherited metabolic diseases, use of anti metabolites in the chemotherapy molecular graphics and modeling of metabolites and biomolecules, resource for macromolecular modeling and pharmacoinformatics, pharmacogenetic variations influencing metabolism and its clinical relevance, toxicogenomics, toxicogenetics, microarray expression profiles, gene expression and databases of microarray expression profiles, gene expression biomarkers, toxicology informatics.

2. Pharmacoinformatics – The tools
Patterns recognition techniques with examples from spectral patterns and biological sequence patterns, artificial intelligence, logical programming, experts systems, artificial neural network(ANN), genetic algorithms.

Pharmacoinformatics- The methodology
a) Pharmacoinformatics: Integration of bioinformatics, chemoinformatics, genomics and proteomics; in silico identification and validation of novel therapeutic targets, 3D database search method, artificial neural network methods, genetic algorithm methods in chemoinformatics, evaluation of diverse compounds subsets from chemical structures databases, recognition of hypothesis, validation of hypothesis using pharmacophore pattern searching methods in chemoinformatics, spectral and crystallographic databases, ab initiogene prediction technique to predict novel gene targets, case studies.

b) In silico combinatorial and high throughput methods: computational methods of library design.

c) Virtual screenings, Lead compounds selection and lead optimization using virtual screening, filtering methods, rapid QSAR methods for virtual screening rapid molecular docking methods for virtual screening; receptor selectivity mapping; testing the lead drug candidates (from chemoinformatics method) for their selectivity across a broad panel of
targets (from bioinformatics methods), scoring function and their importance in virtual screening, case studies internet computing in drug discovery.

**Pharmacy informatics**

Introduction to pharmacy informatics, role of informatics to enhance the services provided by pharmaceutical care gives health information system architecture, health data management, medical coding and classification, medical databases, clinical data collection and acquisition and evaluation methods; privacy and security of clinical data, clinically relevant drug-drug interaction and databases, telemedicine and telehealth, ethics in medical informatics, pharmacy system and automation, drug information systems, electronic records, informatics application in pharmacy, survey and evaluation of online resources.

**RECOMMENDED BOOKS:**

Syllabus Prescribed for Degree of Master of Pharmacy in Clinical Pharmacy

Semester-I

<table>
<thead>
<tr>
<th>Subject Code</th>
<th>Subject</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-I examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCP-S1 &amp; PC-P1</td>
<td>Advanced Analytical Techniques</td>
<td></td>
</tr>
<tr>
<td>MCP-S2</td>
<td>Research Methodology and Biostatistics</td>
<td></td>
</tr>
<tr>
<td>MCP-S3</td>
<td>Drug Regulatory Affairs</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MCP-S4
Subject: ADVANCED CLINICAL PHARMACY AND PHARMACOTHERAPEUTICS–I

THEORY: 60 Hours (4 hrs. /week)

Pathophysiology and clinical pharmacotherapy of diseases associated with following system:

1. **Cardiovascular system**
   - Hypertension, congestive cardiac failure, ischemic heart disease, myocardial infarction, arrhythmias, hyperlipidemias.

2. **Respiratory system**
   - Asthma, chronic obstructive airways diseases, drug acting on pulmonary diseases.

3. **Hematological diseases**
   - Anemia’s deep vein thrombosis, drug induced hematological diseases.

4. **Arthritic diseases**
   - Rheumatoid arthritis, osteoarthritis, gout, systemic lupus erythematos.

5. **Gastrointestinal system**
   - Peptic ulcer diseases, reflux esophagitis, inflammatory bowel diseases, Hepatitis, jaundice, cirrhosis, diarrhea and constipation, drug induced liver diseases.

6. **Pain management**
   - Pain pathways, Analgesics and NSAID’S, neuralgias including herpetic, trigeminal and glossopharyngeal neuralgia.

7. **Immunology**
   - Autoimmunity – Definition, classification, mechanism of autoimmune disease, pathogenesis of autoimmunity, immunoglobulin.

8. **Prescribing guidelines for**
   - Pediatric patients, geriatric patients, pregnancy and breast feeding.

**RECOMMENDED BOOKS :**

4. Green & Harris, Pathology & Therapeutics for Pharmacist: A Basis for Clinical Pharmacy Practice, Chapman & Hall Publication.
5. Hefindal E.T., Clinical Pharmacy & Therapeutics, Williams & Wilkins Publication.
Following aspect should be studied in detail in each ward round. Patient medication history in the review, answering drug information questions, patient medication counseling, in ward round. Case presentation should be done in the department. The cases being studied and the follow up studies should be recorded in the practical record books.

1. Answering drug information related questions (Queries related to dosage, administration, contraindication, adverse drug reactions, drug interaction, drug used in pregnancy & lactation, drug profile, efficacy & safety)
2. Patient Medication counseling (common diseases like diabetes, asthma, Hypertension, TB, COPD)
3. Case studies related to laboratory investigation (Hematology, thyroid, renal, cardiac enzymes) Patient medication interview, medication review, detection & assessment of adverse reactions & their documentation.
4. The case presentation in the department should include cases of the following diseases.

<table>
<thead>
<tr>
<th>Diabetes Type I</th>
<th>Schizophrenia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diabetes Type II</td>
<td>Depression</td>
</tr>
<tr>
<td>Hyperthyroidism</td>
<td>Anxiety</td>
</tr>
<tr>
<td>Hypothyroidism</td>
<td>Epilepsy</td>
</tr>
<tr>
<td>Acute Renal Failure</td>
<td>Parkinsonism</td>
</tr>
<tr>
<td>Chronic Renal Failure</td>
<td></td>
</tr>
</tbody>
</table>

The students should be trained in the following aspects of services provided at the hospitals and should be assessed for their performance on the same. The students are required to submit a record of activities performed which includes the strategies used.

- Patient medication interviews
- Answering drug information queries
- Patient medication counseling
- Literature evaluation
- Therapeutic drug monitoring
- Problem solving in clinical pharmacokinetics
- Ward round participation
- Medication order review
- Detection & Assessment of adverse reactions & their documentation
Semester-II

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MCP-S9
Subject: ADVANCE CLINICAL PHARMACY AND PHARMACOTHERAPEUTICS – II

THEORY: 60 Hours (4 hrs./week)

Pathophysiology and clinical pharmacotherapy of diseases associated with following system;

1. Renal System: Acute/ chronic renal failure, renal dialysis & transplantation, drug induced renal diseases
3. Endocrine System: Thyroid disease, oral contraceptives, hormone replacement therapy, osteoporosis.
4. Psychiatric diseases: Schizophrenia, depression ,anxiety, sleep disorder, drug induced psychosis
5. Infectious diseases: General guidelines for the rational use of antibiotics, meningitis, respiratory tract infections ,gastroenteritis, bacterial endocarditis septicemia, otitis media, urinary tract infection, tuberculosis, leprosy, malaria, helmenthiasis, HIV and opportunistic infections, fungal infection ,rheumatic fever
7. Drug and poison information

Introduction to information resources available
1. Systematic approach in answering drug information queries.
2. Critical evaluation of drug information and literature
3. Preparation of written and verbal reports.
4. Establishing a drug information center.
5. Poison information organization and information resources.
6. Poison management in drug dependence and drug abuse(opiates, cocaine, amphetamines, alcohol, benzodiapines, barbiturates, tobacco) Role of emetics, anti-emetics and respiratory stimulants
8. Clinical Pharmacokinetics: Clinical pharmacokinetics models, physiological determination of drug clearance and volume of distribution, renal and non-renal clearance, organ extraction and models of hepatic clearance ,estimation and determination of bioavailability, multiple dosing, calculation of loading and maintenance dose, dose adjustment in renal failure, hepatic dysfunction, gastric and pediatric patient, therapeutic drug monitoring ( general aspects ).
9. Research design and conduct of clinical trials: research support including planning and execution of clinical trials, guidelines for good clinical research practice and ethical requirement, various phases of clinical trials, categories of phase IV studies, monitoring and auditing of clinical trials.
RECOMMENDED BOOKS:
4. Green & Harris, Pathology & Therapeutics for Pharmacist: A Basis for Clinical Pharmacy Practice, Chapman & Hall Publication.
5. Hefindal E.T., Clinical Pharmacy & Therapeutics, Williams & Wilkins Publication.
8. Scott L. T., Basic Skills In Interpreting Laboratory Data, American Society of Health System Pharmacist.
10. Rowland & Tozer, Clinical Pharmacokinetics, Williams & Wilkins Publications.
12. Relevant Review Article from Recent Medical & pharmaceutical Journals.

Subject code: MCP-S10
Subject: CLINICAL RESEARCH THEOR Y: 60 Hours (4 hrs. /week)

1. Overview of clinical research
   Clinical research, the drug development process, phases of clinical research, elements of clinical research and the role of clinical research coordinator in clinical research, the study work area and resources.

2. FDA regulations and good clinical practice guidelines
   Code of federal regulations (CFR), ICH GCP guideline, responsibilities of investigators, responsibilities of sponsor, financial disclosure by clinical investigators, electronic signature, the institutional review board, subjects informed consent, regulatory references.

3. The study: Planning stages and commencement
   Protocol development, the planning stages of a study, study commencement, keeping up with the study, study termination.

4. Interactions with the sponsor
   Sight monitoring visits, resolution of problems identified at site visits, grant – sponsored visits (audits and inspections), telephone monitoring, written correspondence, investigator’s meetings, study procedures manual.

5. Interactions with the institution
   The principle investigator and subinvestigators, the institutional review board, study logistics, preparing hospital staff.

6. The role of the study subject
   The subject, study subject recruitment, obtaining informed consent, assessing subjects for study participation, keeping the subject on the study/ facilitating compliance.
determining noncompliance, subject leaving the study, what is an evaluable subject?,
subject compensation, subject and medical team relationship.

7. **Data management**
   General issues in developing forms for data collection, recording data and completing
case report forms, source documents, analyzing the data, reporting the data.

8. **Adverse events**
   Adverse events, assessment of adverse events, recording adverse event data, medical
management of adverse events, unblinding the study because of an adverse event,
serious adverse events.

9. **Investigational agent management**
   Investigational drug agents in a clinical trial, code breakers, study drug labels, receiving
and storing the investigational agent, dispensing the investigational drug agent,
instructions to study subjects, study drug accountability, destruction of the
investigational drug agent, final disposition.

10. **Inspection of clinical research sites**
    Preparing for an inspection, the data audit, end of the inspection.

**RECOMMENDED BOOKS:**
2. Scott L. T., Basic Skills In Interpreting Laboratory Data, American Society of Health
   System Pharmacist
3. Practice Standards & Definitions- The Society Of Hospital Pharmacist Australia 1997
4. Rowland & Tozer, Clinical Pharmacokinetics, Williams & Wilkins Publications
5. Shargel L., Biopharmaceutics & Applied Pharmacokinetics, Printice & Hall
   Publications
6. Relevant Review Article from Recent Medical & pharmaceutical Journals.

**Subject code: MCP-P9**
**Subject: ADVANCED CLINICAL PHARMACY AND**
**PHARMACOTHERAPEUTICS–II**

**Practical:** 8 hrs./week

Hospital postings in various departments designed to complement the lectures by providing
practical clinical discussion; attending ward rounds; follow up the progress and changes
made in drug therapy in allotted patients; case presentation upon discharge. Students are
required to maintain a record of cases presented and the same should be submitted at the
end of the course for evaluation. A minimum of 20 cases should be presented and recorded
covering most common diseases.

**Assignments:**
Students are required to submit written assignments on the topics given to them. Topics
allotted should cover recent developments in drug therapy of various diseases. A minimum
of THREE assignments [1500 – 2000 words] should be submitted for evaluation.

**Format of the assignment:**
1. Minimum & Maximum number of pages.
2. Reference(s) shall be included at the end.
3. Assignment can be a combined presentation at the end of the academic year.
4. It shall be computer draft copy.
5. Name and signature of the student.
6. Time allocated for presentation may be 8+2 Min.
Subject code: MCP-P10  
Subject: CLINICAL RESEARCH  
Practical:  

8 hrs. /week

Hospital postings in various departments designed to complement the lectures by providing practical clinical discussion; attending ward rounds; follow up the progress and changes made in drug therapy in allotted patients; case presentation upon discharge. Students are required to maintain a record of cases presented and the same should be submitted at the end of the course for evaluation.

The student shall be trained to understand the principle and practice involved in selection of drug therapy including clinical discussion.

A minimum of 20 cases should be presented and recorded covering most common diseases.

Assignments:
Students are required to submit written assignments on the topics given to them. Topics allotted should cover recent developments in drug therapy of various diseases. A minimum of THREE assignments [1500 – 2000 words] should be submitted for evaluation.

Format of the assignment:
1. Minimum & Maximum number of pages.
2. Reference(s) shall be included at the end.
3. Assignment can be a combined presentation at the end of the academic year.
4. It shall be computer draft copy.
5. Name and signature of the student.
6. Time allocated for presentation may be 8+2 Min.
Semester-III

Subject code: MCP-S13
Subject: COMMUNITY AND CLINICAL PHARMACY
THEORY: 60 Hours (4 hrs./week)

Community Pharmacy:
1. The role of community pharmacy and its relationship to other local health care providers
2. Prescribed medication order – Interpretation & legal requirements communication skills-communications with prescriber and patients, over the counter (OTC) sales.
3. Primary health care on Hospital Pharmacy – Family planning, first aid, participation in primary health care programs, smoking cessation, screening programs.
5. Code of ethics for community pharmacist
7. Pharmacoeconomics: Definition & scope, types of economic evaluation, cost models & cost effectiveness analysis.
9. Introduction to clinical pharmacy – Definition, development & scope, introduction to pharmaceutical medicine, the drug development process, new drug discovery, clinical development of drugs, essential clinical trial documents.
10. Introduction to daily activities of a clinical Pharmacist – Drug therapy monitoring (medication chart review, clinical review, pharmacist intervention), ward round participation, adverse drug reaction management & pharmacovigilance, drug information & poison information, medication history, patient counseling, pharmaceutical care, drug utilization (DUE) & review (DUR), Quality assurance of clinical pharmacy services.
11. Patient data analysis – Patient case history, its structure and use in evaluation of drug therapy and understanding, common medical abbreviations & terminologies used in clinical pharmacy, communication skills including patient counseling techniques, medication history, interview presentation of cases, teaching skill, clinical laboratory test used in evaluation of disease state & interpretation of test results like: Hematological, liver function, renal function, thyroid function test associated to cardiac disorder, fluid & electrolyte balance, microbial culture sensitivity test, pulmonary function test.

RECOMMENDED BOOKS:
1. Hassen W.E., Hospital pharmacy, Lec & Febiger Publications.
2. Textbook of Hospital Pharmacy, Allwood M C & Blackwell.
4. Scott L. T., Basic Skills in Interpreting Laboratory Data, American Society of Health System Pharmacist.
6. Rowland & Tozer, Clinical Pharmacokinetics, Williams & Wilkins Publications.
8. Relevant Review Article from Recent Medical & pharmaceutical Journals.
Syllabus Prescribed for Degree of Master of Pharmacy in Natural Product

Semester-I

<table>
<thead>
<tr>
<th>Subject code: MNP-S4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subject: INDUSTRIAL PHARMACOGNOSY</td>
</tr>
<tr>
<td>THEOREY: 60 Hours (4 hrs./week)</td>
</tr>
</tbody>
</table>

1. Factors influencing production of crude drugs. Plant growth regulators, Disease management of medicinal and aromatic plants.
Commercial scale cultivation and processing of following aromatic plants-Lemon grass, Geranium, Basil, Palmarosa, Vetiver, Patchouli, Japanese Mint, Rose, Hops, Jasmine, Sandal, Dill, Celery, Anise, Artemisia.
3. Extraction and Utilization of Biomedicinals:
Occurrence, Methodology for extraction and Chemistry of following-
Sennosides, Digoxin, Ginsenosides, Solasodine, Berberine, Quinine, Scopolamine, Atropine, Emetine, Ergot alkaloid, Caffeine, Taxol, Withanolides, Podophyllotoxin, Rutin, Hesperidin, Andrographolide, Glycyrrhizin, Cod-liver oil and Shark-liver oil
4. Pharmaceutical aids: Profile for manufacture and commerce of papain, pectin, pharmaceutical gums, starch, absorbent cotton and gelatin.
Preparation of standardized extracts suitable for incorporation in solid dosage forms like tablets, capsules, etc.

RECOMMENDED BOOKS:
1. Mukherjee Pulok, Quality Control of Herbal Drugs, Business Horizons Limited, New Delhi.
2. Advances in Natural Product Chemistry, extraction and isolation of biologically active compounds. S. Natori et al., Wiley, New York.
Subject code: MNP-P4

Subject: INDUSTRIAL PHARMACOGNOSY

Practical: 8 hrs./week

1. Preliminary phytochemical screening of the plant constituents.
2. Extraction of active principles such as alkaloids, glycosides, resins, essential oils, terpenoids, fixed oils, carbohydrates, fats, tannins, steroids, pectins, etc. from natural drugs.
3. Extraction, isolation, purification and identification of important phytoconstituents as follows:
   a. Eugenol from clove oil
   b. Sennosides from Senna leaves
   c. Curcumin from Turmeric
   d. Glycyrrhizin from Liquorice
   e. Hesperidine from Orange peels
   f. Caffeine from Tea
   g. Strychnine and Brucine from Nux-Vomica
   h. Rutin from Ruta graveolens
   i. Aloin from Aloes
   j. Piperine from Pepper
   k. Quinine from cinchona bark
   l. Berberine from Berberis aristata
   m. Diosgenin from Dioscorea
4. Determination of lead, arsenic, copper, mercury, etc. from natural drugs or their preparations.
Semester-II

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MNP-S9

Subject: NATURAL PRODUCTS & BIO-ORGANIC CHEMISTRY

THEORY: 60 Hours (4 hrs./week)


2. Carbohydrates: Mono, di, oligo- and polysaccharides, separation and isolation, purification, structure determination, linkage stereochemistry, biological activity.

3. Glycoproteins, lipoproteins and glycopeptidolipids; Structure and biological activity, isolation, purification, degradation, structure determination.

4. Glycosides and saponins: Classification, separation and isolation, linkages stereochemistry, structure determination, biological activity, study of examples.

5. Alkaloids, steroids and triterpenoids: Classification, methods of isolation, stereochemistry, biological activity, general theory of biogenesis.

6. Coumarins, lignans and flavonoids classification, isolation, stereochemistry, biological activity, biosynthesis.

7. Lipids and autocoids: Classification, identification, biological activity, study examples.

RECOMMENDED BOOKS:

1. Vardemme, E., Biotechnology of Industrial antibiotics.
2. Vapporte and Swendsen, Chromatography of Alkaloids.
3. Lala, P.K., Elements of Chromatography.
7. Finar, H., Organic chemistry, Vol II.
10. Creger, W., Techniques in Organic Chemistry.
12. Kanfinan, P. B., Natural Products from Plants.
15. Fransworth, N. It S., Some Hallucinogenic and Related Plants.
17. Harborne J.B., Phytochemical methods, Chapman and Hall.
18. Asolkar, Diosgenin and Other Steroidal Drug Precursors.
22. Feiry & Feisher, Steroids.
23. Pelletier, S.W., Alkaloids Chemical & Biological.

Subject code: MNP-S10
Subject: STANDARDIZATION OF NATURAL PRODUCTS
THEORY: 60 Hours (4 hrs./week)

1. Stability testing of natural products, procedures, predictable chemical and galenic changes, technical limitations, testing methods and combination products.
2. Bioavailability and pharmacokinetics aspects for herbal drugs with examples of well known documented clinically used herbal drugs. Phytoequivalence, pharmaceutical equivalence.
5. Emerging plant drugs- Anti-hepatotoxic, anti-fertility, antimalarial, anti-hypertensive and antibiotic plants.
7. Saponins and Terpenoids with biological activity of pharmaceutical significance. Recent trends in utilization of vegetable laxatives and vegetable bitters.
8. Natural coloring and sweetening agents.
9. Hallucinogenic, allergic, teratogenic and other toxic plants.
10. Endangered species of medicinal plants.
RECOMMENDED BOOKS:

1. Wagner and Black, Plant Drug Analysis.
2. Barn, J. N., Finley, D. J. and Goodwin, R. G., Biological Standardization.
3. Trease and Evans, Pharmacognosy.
4. Tyler, Bready and Robbers, Pharmacognosy.
5. Ramstad, Modern Pharmacognosy.
10. WHO Guidelines for Quality Control of Herbal Plant Material.
11. Indian Pharmacopoeia, 2010
12. Ayurvedic Formulary of India,
15. Turner, R., Screening Methods of pharmacology.

Subject code: MNP-P9
Subject: NATURAL PRODUCTS & BIO-ORGANIC CHEMISTRY
Practical: 8 hrs./week

1. Determination of leaf surface data such as stomatal number, stomatal index, palisade ratio, vein-islet number and vein-islet termination number.
2. Experiments based on WHO guidelines for quality control of medicinal plants.
3. Preparation of permanent slides of important medicinal plants.
4. Study of spectroscopy and degradative methods for alkaloids, flavonoids, triterpenoids, sterols, coumarin (2-3 examples)
Subject code: MNP-P10
Subject: STANDARDIZATION OF NATURAL PRODUCTS
Practical: 8 hrs./week

1. Determination of Anthracene derivatives in senna by spectrophotometric method, Reserpine in Rauwolfia by Photometric method, Carvone content of Umbeliferous fruits, Citral content in Lemongrass oil.
2. Determination of ascorbic acid by UV spectroscopic method in some crude drugs.
3. Paper chromatography and TLC of active principles of natural products.
4. Study of UV and FTIR spectral data of some phytoconstituents.
5. Separation of Solanaceous alkaloids from Belladona leaf by TLC using hyoscine and hyoscyamine as reference compounds.
6. Quantitative estimation of Ephedrine in Ephedra extracts by HPTLC method (only demonstration).
7. Quantitative estimation of Reserpine in Rauwolfia extracts by HPLC method (only demonstration).
8. Study of HPTLC and HPLC fingerprinting of some important phytoconstituents (only demonstration).
Semester-III

Subject code: MNP-S13
Subject: SELECTED TOPICS IN NATURAL PRODUCTS

THEORY: 60 Hours (4 hrs./week)

1. Herbal formulations (general considerations); Single and composite drug formulation of various types; Ayurvedic formulations (Churn, Avaleh, Satwa, Asawa, Aristha etc); Formulations using herbal extracts/pure phytopharmaceuticals. Study of herbal extracts, Processing, Plant and equipment, Project profile, Standardization of herbal formulations.

2. Study of following pharmacognostic parameters -
   Lycopodium spore analysis involving quantitation of discrete structures (starch, stone-cells), linear structures (fibers) and spread out tissues (epidermal area) and fluorescence analysis.

3. Study of following analytical methods (with the sole objective of quantitative analysis of active constituents and if needed, comparison with reference compounds)
   i) Chromatographic methods of analysis (PC, TLC, HPTLC, HPLC & GLC)
   ii) Colorimetric and fluorimetric methods
   iii) Spectral methods (UV, Visible, IR, H-NMR and Mass)

4. Pesticide residues, heavy metal content and microbial contamination in the formulations.
   Preparation and standardization of herbal cosmetics. Shampoo, Hair conditioners, Hair dye, Skin care products.

RECOMMENDED BOOKS:
7. Indian Herbal Pharmacopoeia, Vol I & II , RRI, IDMA.
10. Wanger and Bladt, Plant Drug Analysis, 2nd Ed.
13. Herbal Pharmacopoeia, Vol I & II , RRI, IDMA.
Syllabus prescribed for Degree of Master of Pharmacy in Pharmaceutical Management

Semester-I

<table>
<thead>
<tr>
<th>Advanced Analytical Techniques (MC-S1 &amp; MC-P1)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-I examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research Methodology and Biostatistics (MC-S2)</td>
<td></td>
</tr>
<tr>
<td>Drug Regulatory Affairs (MC-S3)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MPM-S4

Subject: PHARMACEUTICAL MANAGEMENT-I (GENERAL AND PERSONNEL)

THEORY: 60 Hours (4 hrs./week)


2. **Fundamental concepts** of production, financial, personal, legal and marketing functions with special reference to Pharmaceutical Management. Introduction to budgeting, costing, accounting, auditing and budgetary control. Entrepreneurship development.

3. **Understanding organizations:** Meaning, process, types of organization structures & departmentation, line/staff authority, promoting organizational culture. Organizations, pharmaceutical services and functioning of hospital pharmacy, bulk drug unit, formulation unit, Ayurvedic and Unani manufacturing units and testing labs.

4. **Professional Managers:** Tasks, responsibilities and skills needed. Leadership; Styles and managing change. Decision Making: Types, procedures, evaluation and selection of alternatives, decision making under various situations. Management information and decision support systems and time management.

5. **Personnel Management:** Job Analysis, recruitment, selection, orientation and training, performance appraisal and compensation. Retrenchment, lay off and discharge.

6. **Management of Industrial Relations:** Industrial disputes, settlement of disputes through various routes such as bargaining, etc.

7. **Motivational aspects:** theories of motivation, group dynamics, rewards and incentives, interpersonal skills, significance of communication, its processes, measures for effective communication, conflict management. Stress management.

RECOMMENDED BOOKS:

5. Management by Stoner and Freeman; Prentice Hall, New Delhi.
7. Paul and Blanchard Kenneth, Management of Organizational Behavior, Utilizing the Human Resources by Harcey, Prentice Hall of India, New Delhi
9. Harry A. Smith ,Principles and Methods of Pharmacy Management III rd Edition
Subject code: MPM-P4
Subject: PHARMACEUTICAL MANAGEMENT-I (GENERAL AND PERSONNEL)
Practical: 8 hrs./week

1. Case studies based on the topics mention in theory
Semester-II

<table>
<thead>
<tr>
<th>Validation &amp; CGMP (MC-S7)</th>
<th>Syllabus is same as prescribed for these papers for M. Pharm semester-II examination in Pharmaceutics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological Evaluation (MC-S8 &amp; MC-P8)</td>
<td></td>
</tr>
</tbody>
</table>

Subject code: MPM-S9
Subject: PHARMACEUTICAL MANAGEMENT-II (PRODUCTION)

THEORY: 60 Hours (4 hrs./week)

1. Production Management: Fundamentals of production, organization, economic policy, manufacturing economics, production capacities, production lines and job balancing, visible and invisible inputs, methodology of activities. Development of efficient work methods, quality control and management of R&D.

2. Production planning and control, production processes - mass, job and project; plant location and layout; work study (preliminary idea only), materials management - purchase, inventory control and store keeping.

3. Productivity management: Concepts, problems, tools and techniques for improvement. Operation research techniques by PERT and CPM. Considerations for design of large scale manufacturing units including intricate design criteria for units to manufacture sterile and non-sterile products with special reference to tablets, capsules, and injections. Design and development of packaging units including recent advances in packaging techniques for various types of sterile and non-sterile dosage forms. Warehousing design, construction, maintenance and sanitation; good warehousing practice, materials management.

4. Product Planning: Selection of product, new product development and product differentiation, pricing, promotion – personal selling; salesmanship, qualities of salesman, management of sales force, advertising, publicity and window display, channels of distribution.

5. Plant Maintenance Management: Importance of maintenance, objective, classification - corrective, scheduled, preventive, and predictive. Replacement analysis.


RECOMMENDED BOOKS:
8. Production and Operations Management by S.N.Chary
Subject code: MPM-S10  
Subject: PHARMACEUTICAL MARKETING MANAGEMENT  
THEORY: 60 Hours (4 hrs. /week)

1. Marketing: Meaning, concepts, importance and emerging trends; Marketing environment; Industry and competitive analysis, Indian Pharmaceutical Industry; Analysing consumer buying behaviour; Industrial buying behaviour, Pharmaceutical market segmentation & targeting. Mix Role of 7 P’s (Product, Price, Promotion, Place, Physical Evidence, Process, People) in Pharmaceutical Marketing Management.

2. Product Decision: Meaning, Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.

3. Pricing: Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).

4. Pharmaceutical marketing channels: Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.

5. Promotion: Meaning, methods, determinants of promotional mix, promotional budget; overview-personal selling, advertising, sales promotion and public relations.

6. Strategic marketing planning: Marketing implementation and evaluation.

7. E-Pharma Marketing.

8. Marketing Research: Definition and importance, Pharmaceutical Marketing Research techniques, marketing information system, pharmaceutical marketing research area.

9. Market Demands and Sales Forecasting: Major concepts in the demand measurement, estimating current demands, geo-demographic analysis, estimating industry sales, market share and future demand, sales, forcasting.

RECOMMENDED BOOKS:
1) Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi
3) Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill
4) Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India
7) Shanker, Ravi: Service Marketing, Excell Books, New Delhi
9. Principle and Practice of Marketing in India by Memoria C. B.
Subject code: MPM-P9
Subject: PHARMACEUTICAL MANAGEMENT II (PRODUCTION)
Practical: 8 hrs. /week

1. Case studies based on the topics mention in theory

Subject code: MPM-P10
Subject: PHARMACEUTICAL MARKETING MANAGEMENT
Practical: 8 hrs. /week

1. Case studies based on the topics mention in theory
Semester-III

Subject code: MPM-S13
Subject: PHARMA PRODUCT MANAGEMENT

THEORY: 60 Hours (4 hrs./week)

1. **Introduction to product management**: Definition, role of management and scope of product management.

2. **Product planning and development**: Meaning of product, classification of pharma products, strategic planning for segmenting, targeting and positioning pharma product, product research and need gap analysis and health services. Operational pharma product planning including pharma sales program and budgeting, organizing and controlling for pharma product management.

3. **New product development process and methods**: Types of new pharma products, complete product development process, product innovation, new product adoption and diffusion process, opinion leadership.


5. **Brand, packaging, and other pharma product feature**: Pharma branding process and strategy, OTC generic and prescription product branding. Packaging and labeling, legal and social consumer reports for different kind of packaging and labeling design control of spurious products.

6. **Pharma product pricing issues**: Social, economic, legal, ethical issues for pharma product pricing in India. Pricing methods and techniques. Other factors influencing pharma product pricing.

7. **Pharma product distribution management**: Pharma product channel design, single channel vs multiple channel strategies, roles, and responsibilities of chemist for product promotion and distribution.

8. **Pharma product promotion**: Issues in pharma product promotion, approaches for pharma product promotion, DTC, E-detailing, physician related promotion programmers for increasing acceptance and sales of pharma products.

9. **Pharmaceutical Brand Management**: Branding and it's potential within pharmaceutical industry: history, meaning, need, importance, branding in pharmaceutical industry, building brand values and brand strategy, timing, patient power, strategic brand management process. The role of advertising in branding pharmaceuticals.

**RECOMMENDED BOOKS**:

Annexure-I

Elective Subjects:

Group A: Pharmaceutics, Industrial Pharmacy, Biotechnology
1. Advanced biotechnology
2. Advances in Fermentation Technology
3. Hospital and Clinical pharmacy
4. Nanotechnology and Biotechnology
5. Pharmaceutical Plant Design and Operations
6. Sterile Product Formulation and Technology

Group B: Pharmaceutical Chemistry
1. Chemistry of Natural Products
2. Chemoinformatics
3. Combinatorial Chemistry
4. Green Chemistry
5. Organic Drug Synthesis
6. Rational Drug Design

Group C: Pharmacology, Clinical Pharmacy
1. Advance Molecular Biology
2. Clinical Research and Development
3. Immunopharmacology
4. Neurobiology
5. Pharmacoepidemiology
6. Safety Pharmacology

Group D: Pharmacognosy, Natural Products
1. Advances in Phytochemistry
2. Herbal Cosmetics
3. Herbal Drug Technology
4. Medicinal Plant Biotechnology
5. Natural Product Management
6. Plant Tissue Culture Techniques

Group E: Quality Assurance, Pharmaceutical Management, Pharmacoinformatics
1. Active Pharmaceutical Ingredients (APIs) Management Technology
2. Human Behaviour in Organization
3. Material Management and Inventory Control
4. Packaging Technology
5. Pharmaceutical Marketing and Market Research
6. Quality Planning and Analysis
Draft Syllabus Prescribed for M. Pharm. (Credit System) - Elective Subjects

GROUP A: PHARMACEUTICS, INDUSTRIAL PHARMACY, BIOTECHNOLOGY

Subject code: MPHE1
Subject: ADVANCED BIOTECHNOLOGY
Theory: 30 Hours (2 hrs./week)


RECOMMENDED BOOKS:
1. Reddish, Antiseptics, Disinfectants, Fungicides and Chemical and Physical Sterilisation, Lea and Febiger.
Subject code: MPHE2
Subject: FERMENTATION TECHNOLOGY
Theory: 30 Hours (2 hrs./week)

1. **Introduction**: General review of microbial products and processes. Bacterial starter cultures, different types of microorganisms used in the industries for the production of various microbial products e.g. bacteria, actinomycetes, fungi, yeast etc.

2. **Screening of Cultures**: Isolation, identification and preservation of culture, Development of strain: introduction, cell division (mitosis/meiosis), Mendelian genetics metabolic controls, mutational selection and classes of mutants, protoplast fusion, Recombination DNA technology.

3. **Theory and design of aerobic fermentation**: Operations involved, importance of each process, value of the products, degree of asepsis required, nature of organism used, choice of equipment and its design, biochemical engineering problems in fermentation technology.

4. **Bioreactors**: Introduction, oxygen transfer, gas liquid mass transfer in microbial growth and effect of mixing and non-mixing on O2 uptake rate, effect of substance concentration, accumulation of product and temperature on growth and respiration rate, effect of temperature on specific death rate and its determination, various types of bioreactors-stirred tank, airlift, fluidized, microcarrier, membrane bioreactor, fluid bed and film bed bioreactor, monochemostat model and effect of recycle concept pf nonideal bioreactor. Design of steriliser, bath sterilisation of media, temperature-time profile and design calculation continuous, sterilisation of media, residence time concept. Types of cultures of micro-organism-batch continuous, semibatch, recycle reactor. Enzyme reactors-theory and limitation, film and floes, immobilised enzymes and cell reactors.

5. **Downstream processing**: physical separation processes-solid-liquid systems, flocculation, coagulations, centrifugation, Equilibrium processes-distillation, drying and crystallisation. Rate processes-chromatography, membrane separation, reverse osmosis.

**RECOMMENDED BOOKS:**
6. Asenjo, Separation Processes in Biotechnology, Marcel Dekker. Inc.
7. Fermentation Technology in Industries, B. V. Patel Education Trust.
1. **Pharmacoepidemiology**
   Definition, Origin and evaluation of pharmacoepidemiology, aims and applications, need for pharmacoepidemiology. Prevalence, incidence and incidence rate. Monetary units, number of prescriptions, units of drugs dispensed, defined daily doses and prescribed daily doses, medication adherence measurement.

   Drug utilization review, surveys of drug use, case reports, case series, cross-sectional studies, cohort studies, case control studies, meta-analysis studies, spontaneous reporting, prescription event monitoring and record linkage system.

2. **Clinical Pharmacokinetics and therapeutic drug monitoring**
   
   i) **Clinical Pharmacokinetics**
   Introduction to clinical pharmacokinetics Nomograms and tabulations in designing dosage regimen, conversion from intravenous to oral dosing, determination of dose and dosing interval, drug dosing in the elderly and pediatrics and obese patients. Pharmacokinetic drug interactions, Inhibition and induction of drug metabolism, Inhibition of biliary excretion.

   ii) **Therapeutic drug monitoring**
   Introduction

   iii) **Dosage adjustment in renal and hepatic disease**

3. **Clinical Toxicology**
   General principles involved in the management of poisoning Antidotes and their clinical applications. Supportive care in clinical toxicology Gut decontamination. Elimination enhancement. Toxicokinetics

4. **Clinical symptoms and management of acute poisoning with the following agents:**
   Pesticide poisoning: organophosphorus compounds, carbamates, organochlorines, pyrethroids Opiate overdose, Antidepressants, Barbiturates and benzodiazepines, Alcohol: ethanol, methanol, Paracetamol and salicylates, Non-steroidal anti-inflammatory drugs, Radiation poisoning

5. **Clinical symptoms and management of chronic poisoning with the following agents:**
   Heavy metals: Arsenic, lead, mercury, iron, copper. Food poisoning

6. **Hospital pharmacy – organization and management**

**The budget** – Preparation and implementation
7. **Hospital drug policy**
   Pharmacy and therapeutic committee (PTC); Hospital formulary; Hospital committees: Infection committee, Research and Ethical committee

8. **Hospital pharmacy services**
   Procurement & warehousing of drugs and pharmaceuticals
   Inventory control: definition, methods of inventory control, ABC, VED, EOQ, lead time, safety stock.

9. **Drug distribution in the hospital**

**RECOMMENDED BOOKS:**

3. Hospital Pharmacy by William E. Hassan
5. Toxicology - The basic science of poisons, international edition, Curtis D.Klaassen, 6th edition

**Subject code: MPHE4**

**Subject: NANOTECHNOLOGY AND BIOTECHNOLOGY**

**Theory:** 30 Hours (2 hrs./week)

1. **Bionanotechnology:** History, opportunities and challenges of bionanotechnology, growth potential of bionanotechnology, significance of nanosize in biotechnology and medicine.


3. **Bionanocarriers:** Design and fabrications of nanocapsules, nanoliposomes, nanoparticles, nanoemulsion, Nanopore technology, Nano-self assembling systems, Bionanoarrays, Dendrimers, Carbon nanotubes, Nanosomes and Polymersomes, Inorganic nanoparticles (Gold-gold colloids, gold nanofilm, gold nanorods, Titanium and Zinc oxide), structured DNA nanotechnology.

4. **Nanomedicine Nanobiology and Nanobiotechnology:** Synthesis and assembling of nanoparticles/nanostructures using bio-derived templates, Proteins and nanoparticles,

5. **Bionanoimaging:** Quantum dots-luminescent semiconductor QD in cell and tissue imaging, Fluorimmunoassay using QD. Ultrasound contrast agents, Magnetic nanoparticles, Nanoparticles in molecular imaging, Nanoforce and imaging-AFM, Molecules, cells, materials and systems design based on nanobiotechnology for use in bioanalytical technology.

6. **Instrumentation and Principles:** Electrophoresis techniques, Laser confocal microscopy, Digital image analysis, Biosensors in diagnostics, Enzyme purification and assay techniques, techniques in cytogenetics: DNA sequencing, DNA microarray, Spectral analysis techniques: Introduction, estimation of proteins, DNA and RNA.

7. **Safety Concern of Bionanotechnologicals:** Inhalation, Contact/dermal delivery, Environmental impact, Explosion hazards.

**RECOMMENDED BOOKS:**

**Subject code: MPHE5**  
**Subject:** PHARMACEUTICAL PLANT DESIGN AND OPERATIONS  
**Theory:** 30 Hours (2 hrs./week)


2. **Good Manufacturing Practice:** Introduction, GMP Design Requirement, GMP Reviews of Design.

3. **Validation:** Introduction, Preliminary Activities, Validation Master Planning (VMP), Development of Qualification Protocols and Reports, Design Qualification (DQ), Installation Qualification (IQ), Operational Qualification (OQ), Handover and Process Optimization, Performance Qualification, (PQ), Process Validation (PV), Cleaning
Validation, Computer System Validation, Analytical Method Validation, Change Control and Revalidation.

4. **Primary Production:** Reaction, Key Unit Operation, Production Methods and Considerations, Principles for layout of Bulk Production Facilities, GMP.


**RECOMMENDED BOOKS:**

5. Modern pharmaceutical industry, Thomas Jacobson, Albert Wertheimer, Jones and Barlett publishers, LONDON , UK.
1. **Biopharmaceutical Factors Influencing Bioavailability:** Physicochemical influences on bioavailability, Physiologic factors influencing drug absorption, Dosage form considerations, Drug absorption and bioavailability from intramuscular injection. Drug absorption from subcutaneous injection, Biopharmaceutics of intrathecal injections, Parenteral administration of peptides and proteins, Parenteral drug delivery systems.

2. **Preformulation Research:** Introduction, Drug substance physicochemical properties, General modes of drug degradation, Preformulation studies for proteins and peptides, Preformulation screening of parenteral packaging components.

3. **SVP and LVP:** Introduction to SVP, Formulation principle, Special types of parenterals (Suspension, Emulsion, Dried Forms), Container effect on formulation, Stability evaluation. Introduction to LVP, Concept of formulation, Formulation development, Solution Quality.


5. **Design Consideration For Parenteral Production Facility:** Introduction, Site selection, Facility area use planning, Design concepts.

6. **Environmental control:** Introduction, Control of contamination, Environmental contamination control system design, Clean rooms, Personnel contamination control.

7. **Quality Control:** Sterility testing, FDA guidelines on sterility testing, Pyrogen testing, Particulate matter testing, Package integrity testing.

**RECOMMENDED BOOKS:**
1. K. E. Avis, H. A. Liebermann and Lachman; Pharmaceutical dosage forms: Parenteral Medications: VoL1, 2, 3, Marcel Dekker.
3. N. K. Jain; Controlled and Novel drug delivery: CBS Publication.
4. J. R. Robinson and H. L. Lee; Controlled drugs delivery: Fundamentals and Applications; Marcel Dekker.
5. S.P. Vyas and R. K. Khar, Controlled drug delivery: concepts and advances; Vallabh Prakashan.
GROUP B: PHARMACEUTICAL CHEMISTRY

Subject code: MPCE7
Subject: CHEMISTRY OF NATURAL PRODUCTS
Theory: 30 Hours (2 hrs./week)

1. **Alkaloids**: General introduction, classification, isolation and purification methods, general methods employed for determining the structure of alkaloids, constitution of morphine, reserpine, atropine and quinine.

2. **Steroids**: Introduction, stereochemistry, nomenclature and structure elucidation of cholesterol, sapogenin and cardiac glycosides.


4. **Carbohydrates**: Brief introduction, Configuration of monosaccharides, ring structure of monosaccharides, disaccharides – determination of structures of sucrose, maltose and lactose, Polysaccharides – cellulose and starch.

5. **Flavonoids**: Detailed chemical account of rutin and quercetin.

6. **Coumarins**: General methods of isolation and purification and structural determination of Xanthotoxin and psoralene.

7. **Structure elucidation**: Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, MS, NMR ($^1$H, $^{13}$C).

   i) Carvone, citral; menthol  
   ii) Luteolin; kaempferol  
   iii) Luteolin-7-O-glucoside  
   iv) Nicotine; papaverine  
   v) Estrone; progesterone

Note: In teaching unit – 7 the exact shift values need not be given. It is sufficient if the student is taught how many peaks appear for the compound in the NMR and approximately, in which region.

**RECOMMENDED BOOKS:**

Subject code: MPCE2
Subject: Chemoinformatics
Theory: 30 Hours (2 hrs./week)

1. **Representation of chemical compounds**
   Chemical nomenclature, line notations, coding the constitution, processing constitutional information, different ways to represent molecular structure, representation of stereochemistry, representation of 3D structures, molecular surfaces, visualization of molecular models, molecular structure drawing softwares.

2. **Representation of chemical reactions**
   Reaction types, reaction center, chemical reactivity, reaction classification, stereochemistry of reactions.

3. **The data**
   Data acquisition, data preprocessing, preparation of data sets for validation of the model quality, training and test data sets, compilation of test sets.

4. **Databases and data sources in chemistry**
   Basic database theory, search engine, classification of databases, literature databases, tutorial using chemical abstract system, property (numeric) databases, crystallographic databases, structure databases, chemical reaction database, patent databases, chemical information on the internet.

5. **Calculation of physical and chemical data**
   Empirical approaches to the calculation of properties, molecular mechanics, molecular dynamics, quantum mechanics.

6. **Calculation of structure descriptors**
   Structure descriptors and their classification, topological descriptors, 3D descriptors, chirality descriptors, chirality codes, comparative molecular field analysis.

7. **Methods for data analysis**
   Machine learning techniques, Decision tree, chemometrics, neural networks, fuzzy steps and fuzzy logic, genetic algorithms, data mining, visual data mining, expert systems.

8. **Applications**
   Prediction of properties of compounds, LFER, QSPR, structure spectra correlation, chemical reactions and synthesis design, drug design.

**RECOMMENDED BOOKS:**
4. http://franklin.chm.colostate.edu/mmac
Subject code: MPCE3  
Subject: COMBINATORIAL CHEMISTRY  
Theory: 30 Hours (2 hrs./week)

1. Combinatorial chemistry – principles, methods, drug design and combinatorial methodology, possible limitations of combinatorial chemistry.

2. Organic reactions popular in combinatorial chemistry. This includes amide bond formation, amine alkylation, crosscoupling reactions, alkene metathesis, multicomponent reactions and heterocycle synthesis.


4. Solution-phase parallel synthesis. Methods employing phase switching such as fluorous tags. The applications of resin-bound reagents and scavengers for simplifying reaction workup.

5. Mixture-based compound libraries. Techniques for extracting information from highly pooled samples, including iterative deconvolution, positional scanning and bead-based screening. Methods for bead encoding.


7. Natural product and natural product-like libraries. The differences between synthetic compounds and natural products, and methods for exploiting the latter as a source of molecular diversity.

RECOMMENDED BOOKS:


1. **Introduction**
   The costs of waste, the greening of chemistry and its need, specific health and environmental requirements,

2. **Principles of sustainable and green chemistry**
   Green chemistry and industry, Waste minimization and atom economy, reduction of materials use, reduction of energy requirement, reduction of risk and hazard

3. **Waste minimization in pharmaceutical process development**
   Principles, practice and challenges, focus of process chemistry, safety, increasing complexity, means of purification, choice of starting material, number and order of steps, solvents, reagents, reaction temperature, heavy metals.

4. **Green solvents for chemistry**

5. **Extraction of Natural Products with Superheated Water**
   Properties of superheated water, extraction of other plant materials, chromatography with superheated water, process development, extraction with reaction.

6. **Sonochemistry**
   Power ultrasound, apparatus available for sonochemistry, sonochemistry in chemical synthesis, ultrasound in electrochemistry, ultrasound in environmental protection and waste control, enhanced extraction of raw materials from plants, large-scale sonochemistry

**RECOMMENDED BOOKS:**

1. James Clark & Duncan Macquarie, Handbook of Green Chemistry and Technology, Blackwell Publishing
Subject code: MPCE5
Subject: ORGANIC DRUG SYNTHESIS
Theory: 30 Hours (2 hrs./week)

1. High Throughput Synthesis
   synthesis strategies; combinatorial synthesis techniques; library design; combinatorial
   approaches for reaction optimization, assays and screening of libraries.

2. Chiral Technology
   Introduction to Chirality and Techniques used in asymmetric synthesis of Diltiazem,
   Timolol, Ampicillin, Dextrapropoxyphen, Citrenanol, Propranolol, Atenolol, and
   Naproxen.

3. Microorganisms in Drug Synthesis and Development
   Microbial conversions of drugs like steroids, prostaglandin, antibiotics, enzyme
   immobilization Techniques.

4. Synthesis of agents used in neurodegenerative diseases: like Alzheimer’s and Parkinsonism

5. Synthesis of agents used in treatment of AIDS: Life cycle of HIV and Drugs used.

6. Proteins and Peptide drugs:
   Chemistry, structure, stability and reactivity of proteins and peptides. Different ways
   to synthesize proteins and peptides - study of Insulin, Relaxin, Somatostatin,
   DNAse Interferon

7. Structure based drug design and synthesis

RECOMMENDED BOOKS:
1. Burger’s Medicinal Chemistry and Drug Discovery, Vol. 1. Principle and Practice,
2. Wilson and Gisvold’s Text Book of Organic Medicinal and Pharmaceutical
   Chemistry, Lippincott Williams and Wilkins.
3. T.L. Lemke, D.A. Williams, V.F. Roche and S.W. Zfto, Foye’s Principles of
   Wiley & Sons New York.
   & Sons, Ltd.

Subject code: MPCE6
Subject: RATIONAL DRUG DESIGN
Theory: 30 Hours (2 hrs./week)

1. DRUG DISCOVERY
   a. Historical Perspective
   b. Drug Discovery studies in Direct Drug Design (Structure based) ND Indirect
      Drug Design
   c. Target Selection and Lead Identification
      Natural Product Sources
      Fermentation/ microbialial sources
Synthetic

d. Introduction to Pharmacogenomics.


3. An overall treatment of various approaches to drug design including the method of variation, e.g. – Fibonacci search, Topliss tree, Craigs plot, Simplex methods, and Cluster analysis.


5. Drug design based on antagonism and enzyme inhibition.


8. Introduction to recent advances in drug design

9. Quantitative structure pharmacokinetic relationship (QSPR), Bioinformatics, Genomic & Proteomics.

RECOMMENDED BOOKS:

1. John Smith & Hywel Williams, Introduction to the Principles of Drug Design, Wright PSG.
1. Introduction to molecular biology.

2. Background: Mendel and genes; genetic terminology; genetic mapping. Cells and chromosomes. Discovery of the role of DNA; overview of how it fills that role. DNA structures. Protein structure; role of weak bonds. Mutations, an introduction.

3. Transcription. How RNA polymerase recognizes (and distinguishes) genes; promoters, σ (sigma) factors. Interaction of transcription and DNA supercoiling. Elongation and termination.

4. Gene regulation; DNA-protein interactions. Proteins interact with DNA and modulate its structure and function. The Lac operon paradigm, plus a sampling of other regulatory systems. Types of DNA-binding proteins; sequence recognition; DNA-bending.

5. Transcription in eukaryotes. An introduction to the complexity of the transcriptional apparatus in higher organisms.


7. DNA replication, DNA polymerases. Issues of the replication process: getting started, priming, unwinding the template, working accurately, hanging on, finishing and untangling. The replication apparatus, or replisome. Repair processes; topoisomerases.

RECOMMENDED BOOKS:
Subject code: MPLE2
Subject: CLINICAL RESEARCH AND DEVELOPMENT

Theory: 30 Hours (2 hrs./week)

1. **Introduction to clinical Trial**
   History, terminologies, types of clinical research, phases of clinical research, role of clinical trial in new drug developments

2. **Regulatory affairs in clinical trials**
   IND, NDA, ANDA- Parts and contents, Safety monitory boards, FDA in various countries including India

3. **Ethical issues in clinical trials**

4. **Clinical trial design**
   Designs used in clinical trials with their advantages and disadvantages, hypothesis, risks and benefits, subject selection, inclusion and exclusion criteria, randomization, blinding and controls

5. **Clinical trial protocol Development**
   Required Documentation including Investigator's Brochure, Case Report Forms, Serious Adverse Event (SAE) Reports, Laboratory Certification, data collection and quality control of data, closing out of clinical trial

6. **Good Clinical Practice**
   Concept, importance, and GCP guidelines including ICH guidelines

7. **Management of Clinical trials**
   Role and responsibilities of Stakeholders of clinical trials (FDA, CRO, Sponsor, Physicians, Nurses, Health professionals, Hospitals, Patient), monitoring of clinical trials, Publications of clinical trials

8. **Bioavailability, bioequivalence and Therapeutic Drug Monitoring**
   Concept, organization, advantages, special issues, applications, bioequivalence

9. **Data analysis issues in Clinical Trials**
   Monitoring of data, computer applications, statistical tests used, interpretation, survival analysis, sub-group analysis, Quality control of clinical trials

**RECOMMENDED BOOKS:**
1. Dipiro, Joseph L.; Pharmacotherapy: A Pathophysiological Approach, Elsevier
4. Roger and Walker; Clinical Pharmacy and Therapeutics, Churchill, Livingston, London
INTRODUCTION
Definition, Classification, General principles of natural immunity, Phagocytosis, acquired immunity (active and passive). Concept of immunopharmacology and pharmacotheraputics.

A) IMMUNITY

Hematopoiesis and lymphocyte development: an introduction: Introduction: Blood cell development and immunity, Hematopoietic stem cells, lymphocyte development, T cell development, B cell development, NK cell development.


Antibody diversity and B lymphocyte-mediated immunity: Antibodies and immunoglobulins, Structure of immunoglobulins, T cell-independent B lymphocyte activation.

Cytokines: Introduction, Differentiation factors, Activation and growth factors of lymphocytes, Mediators of inflammation, Chemokines, Inhibition of cytokines.

Inflammatory mediators and intracellular signaling: Introduction, Eicosanoids, Platelet-activating factor, Innate immune signalling receptors, Cytokines, Chemokines and their intracellular signalling, Kinins, Reactive oxygen species, Amines.


B) IMMUNODIAGNOSIS


Immunoaassays: Introduction, Basic principles of assay design, Components of immunoassays.

C) IMMUNOTHERAPEUTICS

Vaccines: Introduction, vaccine categories, Pharmacological effects of vaccination new developments.

Anti-allergic drugs: Introduction, Disodium cromoglycate and nedocromil sodium (cromones), Histamine receptor antagonists, Anti-leukotrienes, Anti-IgE.

Cytotoxic drugs: Background, Azathioprine, Cyclophosphamide, Fludarabine, Methotrexate, Mycophenolic acid

Immunostimulants and Immunosuppressant's.

RECOMMENDED BOOKS:
3. Roger Walker, Clinical Pharmacy and Therapeutics; Second edition, Churchill Livingstone publication

Subject code: MPL4
Subject: NEUROBIOLOGY
Theory: 30 Hours (2 hrs. /week)

1. Organization of the nervous system.
2. Introduction to the neurons, the neuron doctrine, components of neurons, types, organization of a neuron, and functions.
3. Developmental Neurobiology.
4. Glial cells : structure and function, types, glial neuronal relationship, importance of astrocytes in glutamate uptake and blood- brain barrier, role of tanycytes in the hypothalamus.
5. Membrane channels, ionic basis of resting potential and action potential, synaptic plasticity.
6. Neurotransmitters, neurotransmitter receptors, chemical transmission, electrical synapses.
9. Learning and memory.
10. Neurological disorders.
11. Techniques in neuroscience.

RECOMMENDED BOOKS:

Subject code: MPLE5
Subject: PHARMACOEPIDEMIOLOGY

Theory: 30 Hours (2 hrs./week)

1. Definition and scope: Origin and evaluation of Pharmacoepidemiology need for Pharmacoepidemiology, aims and applications.

2. Measurement of outcomes in Pharmacoepidemiology: Outcome measure and drug use measures Prevalence, incidence and incidence rate. Monetary units, number of prescriptions, units of drugs dispensed, defined daily doses and prescribed daily doses, medication adherence measurement.


4. Research methods in Pharmacoepidemiology: Includes theoretical aspects of various methods and practical study of various methods with the help of case studies for individual methods Drug utilization review, case reports, case series, surveys of drug use, cross-sectional studies, cohort studies, case control studies, case-cohort studies, meta-analysis studies, spontaneous reporting, prescription event monitoring and record linkage system.

5. Sources of data for pharmacoepidemiological studies: Ad Hoc data sources and automated data systems.

6. Selected special applications of pharmacoepidemiology: Studies of vaccine safety, hospital pharmacoepidemiology, pharmacoepidemiology and risk management, drug induced birth defects.

RECOMMENDED BOOKS:
Subject code: MPLE6  
Subject: SAFETY PHARMACOLOGY  
Theory:  
30 Hours (2 hrs./week)  

1. Definition and scope of safety pharmacology.  
3. Principles and study design of safety evaluation.  
   a. Acute toxicity - rodent and non-rodent  
   b. Repeated dose studies (sub acute and chronic)  
   c. Analysis of safety pharmacological data.  
4. Preclinical safety pharmacology: In vitro and in vivo studies including genotoxicity, mutagenicity, carcinogenicity, reproductive and ocular toxicity, Safety testing for dermatological product.  
5. Clinical Safety pharmacology: definition, data collection, reporting methods and assessment and analysis of adverse event (AE) monitoring during clinical trials.  
7. Safety pharmacology of different body organs and systems  

RECOMMENDED BOOKS:  
11 Casarett and Doull’s Toxicology: The basic science of poisons 6th edition McGra Hill, Newyork.  
12 Helmial Graim and Robert Snyder, Toxicology and risk assessment, a comprehensive introduction. Wiley.
GROUP D: PHARMACOGNOSY, NATURAL PRODUCTS

Subject code: MPGE1
Subject: ADVANCES IN PHYTOCHEMISTRY
Theory: 30 Hours (2 hrs./week)

1. **Natural products as leads for new drugs:** Approaches to discovery and development of natural products as potential new drugs, selection and optimization of lead compounds for further development with suitable examples from CNS, anticancer, antibiotics and Cardiovascular drugs.

2. **Steroids:** Stereochemistry, SAR, structural modifications and pharmacokinetic properties, Source and structure elucidation of Beta-sitosterol, stigmasterol and diosgenin.


4. **Biogenesis of Alkaloids:** Pyridine, Piperidine, Tropane, Quinoline, Isoquinoline, Indole, Phenanthrene types of alkaloids.

5. **Polypeptides and Proteins:** General methods of separation, general methods of degradation and end group analysis, general methods of synthesis of peptides. Sequence analysis, secondary and tertiary structure of proteins; chemistry of Insulin.

RECOMMENDED BOOKS:

2. Introduction to Molecular Phytochemistry by CHJ Wells (Chapman and Hall).
10. The essential oils by Ernest Guenther and Robert E. Kreiger
Subject code: MPGE2
Subject: HERBAL COSMETICS
Theory: 30 Hours (2 hrs./week)


2. **Herbal cosmetics for skin:** Manufacturing and formulations aspects of herbal cosmetics for Skin: Powders, creams, lotions, deodorants, suntan preparations and makeup preparations

3. **Herbal cosmetics for Hair:** Manufacturing and formulations aspects for Hair preparations, shampoos, rinses and conditioners, oily scalp hair tonics, hair dressings and depilatories preparations.

4. **Herbal cosmetics for Nail:** Manufacturing and formulations aspects of nail preparations

5. **Analysis of cosmetics:** Nail enamel, shampoos, hair dyes and aerosol preparations

6. **Toxicity methods for cosmetics**

**RECOMMENDED BOOKS:**


Subject code: MPGE3
Subject: HERBAL DRUG TECHNOLOGY
Theory: 30 Hours (2 hrs./week)


2. Natural products used as coloring pigments, excipients, biopolymers, photosensitizing agents, flavors and biofuels.
3. Profiles for commercial cultivation technology/ and post-harvest care of following medicinal plants- Cinchona, Rauwolfia, Pyrethrum, Belladona, Dioscorea, Vinca.


5. Reverse pharmacology approach to develop herbal drugs/ phytopharmaceuticals from herbs known in Traditional knowledge like Ayurveda / TCM etc. Examples of successful drugs developed in India and abroad, case studies. Emerging regulations like USFDA Guide to Industry for Botanical drugs and how to comply with them.

6. Phytography and phytogeographical distribution of medicinal plants with special reference to India.

RECOMMENDED BOOKS:
1. Mukherjee Pulok, Quality Control of Herbal Drugs, Business Horizons Limited, New Delhi.
6. Herbal Drug technology by SS Agrawal and M Paridhavi, Orient Longman

Subject code: MPGE4
Subject: MEDICINAL PLANT BIOTECHNOLOGY
Theory: 30 Hours (2 hrs./week)


5. **DNA bar code development** adopting various techniques and their application to differentiate authentic herb from their other species, and substitutes and adulterants. Applications with examples, limitations of technique, and emerging scenario.

**RECOMMENDED BOOKS:**

7. Medicinal Plant Biotechnology by C.D. Veeresham, C.B.S. Publisher.

**Subject code:** MPGE5  
**Subject:** Natural Product Management  
**Theory:** 30 Hours (2 hrs./week)


3. **Indian trade in medicinal and aromatic plants:** Export potential of Indian medicinal herbs. Indian medicinal plants used in cosmetics and aromatherapy. Spices and their exports.

4. **Study of infrastructure:** For different types of industries involved in making standardized extracts and various dosage forms including traditional Ayurvedic dosage forms and modern dosage forms.

5. **Global regulatory status of herbal medicines: Patents:** Indian and international patent laws. Recent amendments as applicable to herbal/natural products and processes. Plant breeders right.

6. **Management of natural sources**
RECOMMENDED BOOKS:


Subject code: MPGE6
Subject: Plant Tissue Culture Techniques
Theory: 30 Hours (2 hrs. /week)


2. The nutrition and Metabolism of plant tissue and organ culture. Growth differentiation and organogenesis in plant tissue and organ culture. Cytogenetics of differentiation in tissue and cell culture. Different parameters used to measure the growth of cultures.

3. DNA amplification and Tissue culture protoplast: Somatic hybridization and engineering, Protoplast isolation, protoplast culture and somatic hybridization.

4. Gene mapping and molecular maps of plant genomes: Plant chromosome analysis, use of PCR in gene mapping, molecular maps- RFLP, RAPD.

5. Application of tissue culture in improvement of medicinal plants: Yield improvement, stress tolerant plants, disease resistant plants, pesticide tolerant plants, synthetic seed production, germplasm storage and cryopreservation for conservation of plants.


RECOMMENDED BOOKS:

5. A handbook of plant culture, 1943, White P.R., Cattell and Co.
GROUP E: QUALITY ASSURANCE, PHARMACEUTICAL MANAGEMENT,
PHARMACOINFORMATICS

Subject code: MQAE1
Subject: ACTIVE PHARMACEUTICAL INGREDIENTS (APIS): MANAGEMENT
TECHNOLOGY

Theory: 30 Hours (2 hrs./week)

1. **Introduction to basic pharmaceutical and fine chemical chemistry**: Definitions of basic pharmaceuticals, intermediates, fine chemicals, heavy chemicals. Technology involved in manufacturing of pharmaceuticals. Unit processes in synthesis, biochemical processes in synthesis.

2. **Unit processes**: Study of the following chemical processes (with references to reagents, mechanisms, equipments and manufacture of drugs given below): Acylation, esterification, alkylation, amination, halogenation, hydrolysis, nitration, oxidation and reduction.

3. **Industrial processes & scale up techniques**
   - The process design, technology transfer and first manufacture. Industrial manufacturing methods and flow charts of Sulphamethoxazole, Ciprofloxacin, Benzocaine, Adrenaline, Rifampicin, Aspirin and Pentothal sodium.

4. **Bioethics and Bio-Safety**
   - Health hazards in manufacturing facility. The forms of Atmospheric contaminants, Chemical mixtures, Detection and sampling, Atmospheric contamination, industrial noise, criteria for hearing damage, Noise measuring instruments, effects of sound and ultrasound, the control of noise, vibration, Radiation Hazards, Radiation detection and measurement, personal protection, eye protection, Types of eye protection equipment, Finger & Arm protection, Foot & leg protection. Environmental protection laws related to industry.

**RECOMMENDED BOOKS:**
Subject code: MQAE2
Subject: HUMAN BEHAVIOR IN ORGANIZATION
Theory: 30 Hours (2 hrs./week)

1. **Foundations of organizational behavior**: Understanding behavior in organizations, OB model.
2. **Introduction to Individual Motivation Needs, contents and processes**: Maslow's hierarchy of human needs, Herzberg's two factor theory of motivation, Vroom's expectancy theory.
3. **Group processes**:
   - **Importance of values**: Types of values, attitudes and consistency (cognitive dissonance theory)
   - **Group dynamics and teams**.
   - **Leadership**: Trait theories, behavioural theories, Ohio state studies, university of Michigan studies, the managerial grid, contingency theories; Hersey and Blanchard's situational theory and path goal theory.
4. **Transaction analysis**.
5. **Organizational culture**: What is organizational culture, what does cultures do, creating, and sustaining culture, how employees learn culture.
6. **Organizational change**: Forces of change, resistance to change, and approaches to managing organizational change.
7. **Conflict management**: Transitions in conflict thought, functional Vs dysfunctional conflict, the conflict process.

**RECOMMENDED BOOKS**:

Subject code: MQAE3
Subject: MATERIAL MANAGEMENT AND INVENTORY CONTROL
Theory: 30 Hours (2 hrs./week)

1. **Purchasing**: Introduction, purchasing activities, purchasing policies, value analysis, procurement by manufacture, discount and terms of payment, hedging, evaluating purchasing performance.
2. **Materials handling**: Introduction, objectives of material handling, materials handling analysis, guiding principles of material handling, small part handling, packing, transportation, materials handling equipments.

3. **Inventory planning and control**: Introduction, lead time, inventory cushions, recorder point, order quantity, quantity discount, Fifo and Lifo system, materials identification, storage facilities, purging inventories, pilferage protection, symptoms of mismanaged inventories, basic inventory model, inventory model with uncertain demand, inventory control systems, ABC classification of inventory items.

4. **Statistical quality control**: Introduction, frequency distribution, statistical measures, normal distribution, process control, establishing control charts, control charts in use, use of samples, relation of control limits to tolerance limits, control charts computations, control charts of attributes, accepting sampling, operative characteristics curve, average outgoing quality, double and multiple sampling plans, diversified applications of statistical techniques.

5. **Storage**: Storage room management, Shelf stripping and floor marking, marking of merchandise, storage of pharmaceuticals.

**RECOMMENDED BOOKS:**

1. Effective Industrial Management, J.L. Lundy, Eurasia Publishing House, ND.

**Subject code**: MQAE4  
**Subject**: PACKAGING TECHNOLOGY  
**Theory**: 30 Hours (2 hrs./week)

1. **Introduction to pharmaceutical packaging**: Introduction, Some factors influencing pharmaceutical packaging, protection, sterilization.

2. **The packaging function**: Management, development and product shelf life, packaging management, product and pack development, drug substance, shelf life, packaging specifications.

3. **Regulatory aspects of pharmaceutical packaging**: Definition of the pack, product license specifications, data requirements on the package.
4. Specifications and quality: material specifications and quality standards, sampling, supplier evaluation, manufacture and qualification controls.

5. Glass containers: composition of glass and types, manufacturing process, quality control and quality assurance, bottles and production lines, special pharmaceutical containers.


7. Films, foils and laminations: shrink wrapping, stretch wrapping, combination materials covering flexible and rigid applications, paper, coatings, aluminum foils, lamination and lamination processes, decoration and printing.

8. Metal containers: modern packaging metals, types of metal containers, built up containers, aerosols.

9. Closure and closure systems: basis of closure system, closure evaluation, assessment and control, prethreaded screw caps, specific closures for containers, non-reclosables, adhesive sealings, closure evaluation.

10. Sterile products: sterilization of parenteral products, rubber and elastomers, ampoules and vials, prefilled syringes, auto-injectors, selection of rubber formulation and component design.


12. The packaging line: materials in packaging line, common filling methods, container based filling, labeling and other requirements.

13. Warehousing, handling and distribution: hazards in warehousing, handling and distribution, handling, moving and storage methods, load stability, modes of distribution and transport.


RECOMMENDED BOOKS:
Subject code: MQAE5
Subject: PHARMACEUTICAL MARKETING AND MARKET RESEARCH
Theory: 30 Hours (2 hrs. /week)

1. Indian Pharmaceutical Industry- An overview
2. The Pharmaceutical Market
3. Nine P’s
4. Marketing New Products
5. Marketing Planning
6. Modern Marketing
   a. The field of marketing
   b. Career in Marketing
   c. The changing marketing environment
   d. Strategic planning and forecasting
   e. Marketing research and Information
7. Marketing in Special Field
   a. Services marketing by For-Profit and Nonprofit Organization
   b. International Marketing
8. Managing the sales force

RECOMMENDED BOOKS:
1. Subba Rao, Pharmaceutical Marketing in India, Published by Asian Institute of Pharmaceutical Marketing, Hyderabad.
3. Philip Kotler, Marketing Management, Prentice-Hall of India Private Limited, New Delhi
6. Arun Kumar and N Menakshi, Marketing Management, Vikas Publishing, India
7. Shanker, Ravi, Service Marketing, Excell Books, New Delhi
8. Memoria C. B., Principle and Practice of Marketing in India

Subject code: MQAE6
Subject: QUALITY PLANNING AND ANALYSIS
Theory: 30 Hours (2 hrs. /week)

1. Basic concepts of Quality
   Definition of Quality, The Quality function, Managing for Quality, Perspective on Quality- Internal versus External

2. Quality Improvement and Cost Reduction
   Sporadic and chronic quality problems, Need for quality improvement & cost reduction, Causes of poor quality and high cost, Remedy to prove effectiveness for improving quality, Resistance to change.

3. Control of Quality
   Definition of Control, Self control, The control subject for Quality, Units of measure
Setting a goal for the control subject, The sensor, Measuring actual performance, Interpreting the difference between actual performance and goal, Taking action on the difference, Continuous process regulation.

4. Developing Quality culture
   Technology and cultures, Theories of motivation, Create and maintain awareness of Quality, Provide evidence of management and empowerment, Time to change the culture.

5. Manufacturing
   Importance of manufacturing planning for quality, Initial planning for Quality, Concept of controllability, self control, Defining quality responsibilities, Self inspection, Automated manufacturing, Overall review of manufacturing planning, Process quality audits, Quality and production floor culture

6. Statistical Process control
   Definition and importance of SPC, Quality measurement in manufacturing, Statistical control charts-general, Advantages of statistical control, Process capability, Estimating inherent or potential capability from a control chart analysis, Measuring process control and Quality improvement

7. Inspection, test and Measurement
   The terminology of inspection, Conformance to specification and fitness for use, Disposition of non conforming product, Inspection planning, Automated inspection, How much inspection is necessary?, Inspection accuracy, Errors of measurement, Economics of Inspection.

8. Quality assurance general concepts
   Definition of Quality Assurance, Concept of Quality Assurance, Quality Audit- The concept, Structuring the audit programme, Planning and performance of audit, Human relations in auditing, Audit reporting, Essential elements of quality audit programme, Quality surveys, Product audit, Sampling for audit, Reporting the results of audit

RECOMMENDED BOOKS:
2. Improving Quality through planned experimentation by Meen, Tata Mc-Graw Hill, India
3. Statistical Quality control by Grant, Tata Mc-Graw Hill, India
## Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

### M. Pharm. Syllabus

**Credit-grade based performance and assessment system (CGPA)**

**Features of the Credit System**

With effect from Academic Session 2012-2013

### Scheme of Absorption & Matchable Subjects

<table>
<thead>
<tr>
<th>OLD SYLLABUS</th>
<th>NEW SYLLABUS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subject Code</strong></td>
<td><strong>Name of Subject</strong></td>
</tr>
<tr>
<td>CP-1</td>
<td>Biostatistics</td>
</tr>
<tr>
<td>CP-2</td>
<td>Product Development and Formulation</td>
</tr>
<tr>
<td><strong>Pharmaceutics</strong></td>
<td></td>
</tr>
<tr>
<td>PH-1</td>
<td>Advanced Physical Pharmacy</td>
</tr>
<tr>
<td>PH-2</td>
<td>Biopharmaceutics and Pharmacokinetics</td>
</tr>
<tr>
<td>PH-3</td>
<td>Pharmaceutical Dosage Form Technology</td>
</tr>
<tr>
<td>PH-4</td>
<td>Selected Topics in Pharmaceutics</td>
</tr>
<tr>
<td>PH-5</td>
<td>Practicals In Pharmaceutics</td>
</tr>
<tr>
<td><strong>Pharmaceutical Chemistry</strong></td>
<td></td>
</tr>
<tr>
<td>PC-1</td>
<td>Advanced Pharmaceutical Chemistry-I</td>
</tr>
<tr>
<td>PC-2</td>
<td>Advanced Pharmaceutical Chemistry-II</td>
</tr>
<tr>
<td>PC-3</td>
<td>Advanced Pharmaceutical Chemistry-III</td>
</tr>
<tr>
<td>PC-4</td>
<td>Selected Topics in Pharmaceutical Chemistry</td>
</tr>
<tr>
<td>PC-5</td>
<td>Practicals in Pharmaceutical Chemistry</td>
</tr>
<tr>
<td><strong>Pharmacology</strong></td>
<td></td>
</tr>
<tr>
<td>PL-1</td>
<td>Advanced Physiology and Pathophysiology</td>
</tr>
<tr>
<td>PL-2</td>
<td>Advanced Systemic Pharmacology</td>
</tr>
<tr>
<td>PL-3</td>
<td>Biological Evaluation Methods and Toxicology</td>
</tr>
<tr>
<td>PL-4</td>
<td>Selected Topics in Pharmacology</td>
</tr>
<tr>
<td>PL-5</td>
<td>Practicals in Pharmacology</td>
</tr>
<tr>
<td><strong>Pharmacognosy</strong></td>
<td></td>
</tr>
<tr>
<td>PG-1</td>
<td>Advance Pharmacognosy and Tissue Culture</td>
</tr>
<tr>
<td>PG-2</td>
<td>Plant Biochemistry and Biogenesis</td>
</tr>
<tr>
<td>PG-3</td>
<td>Comparative Phytochemistry and Taxonomy</td>
</tr>
<tr>
<td>PG-4</td>
<td>Selected Topics in Pharmacognosy</td>
</tr>
<tr>
<td>PG-5</td>
<td>Practicals in Pharmacognosy</td>
</tr>
<tr>
<td><strong>Quality Assurance</strong></td>
<td></td>
</tr>
<tr>
<td>QA-1</td>
<td>Cosmetic Preparation &amp; Evaluation</td>
</tr>
<tr>
<td>QA-2</td>
<td>Quality Management</td>
</tr>
<tr>
<td>QA-3</td>
<td>Modern Analytical Techniques</td>
</tr>
<tr>
<td>QA-4</td>
<td>New Drug Delivery System</td>
</tr>
<tr>
<td>QA-5</td>
<td>Practicals in Quality Assurance</td>
</tr>
</tbody>
</table>