To,

All Affiliated Pharmacy Colleges.

Subject: Revised syllabi of B. Pharmacy (Sem.-I to VIII) & M. Pharmacy (Sem. I to IV) course under the Faculty of Engineering.

Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi of B. Pharmacy (Sem.-I to VIII) & M. Pharmacy (Sem. I to IV) course under the Faculty of Engineering & Technology. This syllabi will be implemented from the academic year 2009-10 i.e. from June 2009 onwards, gradually. A soft copy (C.D.) containing the said syllabi is enclosed herewith.

Further, it is hereby informed that the question papers on the pre-revised syllabi for repeater candidates, if any will be set as mentioned below:

<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Examinations</th>
<th>Two Chances for the examinations to be held in</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>First year B. Pharmacy Sem.I &amp; II</td>
<td>Oct.-2009 &amp; April -2010</td>
</tr>
<tr>
<td>3</td>
<td>Third Year B. Pharmacy Sem.IV &amp; V</td>
<td>Oct.-2011 &amp; April -2012</td>
</tr>
<tr>
<td>4</td>
<td>Final Year B. Pharmacy Sem.V &amp; VI</td>
<td>Oct.-2012 &amp; April -2013</td>
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<table>
<thead>
<tr>
<th>Sr.No.</th>
<th>Examinations</th>
<th>Two Chances for the examinations to be held in</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>First year M. Pharmacy Sem.I &amp; II</td>
<td>Oct.-2009 &amp; April -2010</td>
</tr>
<tr>
<td>2</td>
<td>Second year M. Pharmacy Sem.III&amp; IV</td>
<td>Oct.-2010 &amp; April -2011</td>
</tr>
</tbody>
</table>

You are therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

Yours faithfully,

Sd/-

Enclosed-: As above

Copy f.w.e.s. to:
1) The Dean, Faculty of Engg. & Tech.
2) The Chairman, B.O.S in Pharmacy.

1) Appointment Section.
2) Other Exam.- 3

Copy for information and necessary action
SHIVAJI UNIVERSITY KOLHAPUR

Rules regulating including scheme and syllabi relating to the Degree of Bachelor of Pharmacy (B. Pharm.) Course.

Course Title : Bachelor of Pharmacy.
Abbreviation : B. Pharm.
Type of Course : A four year degree course divided into eight semesters.
Pattern : Semester.
Number of Years and Semester : Four Years divided into eight semesters with two semesters per year.
Nomenclature of Semesters :
• Semester-I and Semester-II First B. Pharm.
• Semester-III and Semester-IV Second B. Pharm.
• Semester-V and Semester-VI Third B. Pharm.
• Semester-VII and Semester-VIII Final B. Pharm.
Award of the Degree : Degree will be awarded for those passing in all the eight semesters as per the rules and regulations given subsequently.
Duration of Semester : Each Semester will be normally of 15 weeks duration for class room teaching/lecture and examination for that semester will be held during or after the 16th week from the commencement of the semester.
Entry levels into the course, eligibility criteria, admission authority and procedures.

Entry levels into the course will be at the beginning of the Semester- I or at the beginning of the Semester -III.

Eligibility Criteria for Admission at the entry level at Semester -I into the Course.

In order to secure admission to Semester -I of the Four year Degree Course in Pharmacy, the candidate should fulfil the following eligibility criteria;

- Passed the Higher Secondary Certificate (Std. XII) Examination of the Maharashtra State Board of Secondary and Higher Secondary Education, or its equivalent examination with
  - English as one of the subjects.
  - All the subjects mentioned under Group-I and
  - Any one of the subjects from Group-II.

AND

- Secured minimum 50% marks (45% for backward class candidates from Maharashtra) in Physics, Chemistry, and the subject of maximum marks amongst the four subjects of Group-II, added together.

**Group-I : (all subjects from this group are compulsory)**
1. Physics
2. Chemistry

**Group-II : (any one of the subjects from this group)**
1. Mathematics
2. Biology
3. Bio- Technology

OR

Must have passed Diploma in Pharmacy or its equivalent examination by Board of Technical Education or equivalent examination with not less than 50% of marks in the aggregate of all subjects taken together at the Final Year Examination at one and the same sitting.

Eligibility Criteria for Admission at the entry level of Semester-III (i.e. the first semester of Second Year B. Pharm.) into the Course

The candidate who has passed the final examination leading to the Diploma in Pharmacy conducted by the Board of Technical Education, Maharashtra State or equivalent examination from the institute approved by the Pharmacy Council of India And with a minimum First Class (60% i.e.600 out of 1000 at part-II examination for the Diploma in Pharmacy Course) as per ER-91 (i.e. Post H.S.C. two year Diploma Course) be held eligible for admission to Semester-III.

Admission authority and procedure at the entry levels into the course
As per the directions of Government of Maharashtra / Director of Technical Education prevailing at the time of admissions.

R. B. Pharm. – 3  STANDARDS OF PASSING

R. B. Pharm. – 3.1  a) Theory and Practical are to be considered as separate heads for examination and passing.

b) A candidate who fails in not more than one third of total number of subjects including aggregate at Semester I of B. Pharm. Course and Semester II of B. Pharm. Course / Semester III of B. Pharm. Course and Semester IV of B. Pharm. Course / Semester V of B. Pharm. Course and Semester VI of B. Pharm. Course examination will be permitted to keep terms to the higher class namely Semester III of B. Pharm. Course and Semester IV of B. Pharm. Course, Semester V of B. Pharm. Course and Semester VI of B. Pharm. Course, and Semester VII of B. Pharm. Course and Semester VIII of B. Pharm. course Examination respectively.

c) A candidate who fails in more than one third of total number of subjects at Semester I and Semester II/Semester III and Semester IV/Semester V and Semester VI course examination will not be permitted to keep terms in the higher class viz. Semester III and Semester IV/Semester V and Semester VI/Semester VII and Semester VIII of B. Pharm. course examination respectively.

d) Candidate passing in any of the subject heads need not to appear in the same subject head.

R. B. Pharm. – 3.2  a) No candidate will be admitted to the Semester III course unless he/she-

i) Passes his/her Semester I and Semester II examination of B. Pharm.

   OR

ii) Passes in at least two third of total number of subjects at the Semester I and Semester II examination of B. Pharm. in accordance with R. B. Pharm. – 3.1 (b)

b) No candidate will be admitted to the Semester V course unless he/she –

i) passes his/her Semester I and Semester II., Semester III and Semester IV Examinations of B. Pharm.

   OR

ii) passes his/her Semester I and Semester II examination of B. Pharm., and fails in not more than One third of total number of subjects at the Semester III and Semester IV Examinations of B. Pharm. in accordance with R. B. Pharm. – 3.1 (b)

c) No candidate will be admitted to the Semester VII course of B. Pharm. unless he/she -

i) passes his/her Semester I and Semester II., Semester III and Semester IV., Semester V and Semester VI Examinations of B. Pharm. examinations,

   OR

ii) passes his/her Semester I and Semester II., Semester III and Semester IV Examinations of B. Pharm. and fails in not more than one third of total number of subjects at the Semester V and Semester VI Examinations of B. Pharm. in accordance with R. B. Pharm. – 3.1 (b)
R. B. Pharm. – 3.3  Passing criteria for each subject head:

Maximum marks for each subject head and the minimum marks for passing in each of the subject head – See Examination scheme Annexure –I.

Candidate will be considered as passed in the subject heads when the candidate fulfills the following two criteria considered together.

1. Has got Minimum marks prescribed for the semester examination and periodic test

2. Has got Minimum marks prescribed for combined semester of I\textsuperscript{st} & II\textsuperscript{nd} (First B. Pharm.), III\textsuperscript{rd} & IV\textsuperscript{th} (Second B. Pharm.), V\textsuperscript{th} & VI\textsuperscript{th} (Third B. Pharm.) and VII\textsuperscript{th} & VIII\textsuperscript{th} (Final B. Pharm.)

Candidate will be considered as failed in the subject head if the candidate does not fulfil criteria 1 or 2 or both given in. R. B. Pharm. – 3.3 above.

Retest/Examination:

If a candidate’s application form for reappearing in the examination in a subject head is received & approved by the examination committee, the candidate will be allowed to appear in the said examination (Periodic test and Semester examination) fresh marks will be considered and the candidate forfeits the marks obtained in the previous examination/s in that subject head and those marks will not be reconsidered for any purpose again under any circumstances what-so-ever.

Examination of the subject head “Project report” will be conducted by the institute. The criteria for marks distribution are specified in the Annexure-II. The institute must submit the marks awarded in the Project report to the controller of examination along with the periodic test marks. Once the candidate has passed in the subject head “Project report,” the candidate will not be allowed to reappear for examination in this subject head.

R. B. Pharm. – 4  Continuation into the subsequent semesters after the entry level semesters.

The admitting authority will be the individual institutes where the candidate has been admitted into the course, and the continuation will be as per the criteria decided by the University for each semester.

The following criteria are applicable to all the candidates for continuation.

R. B. Pharm. – 4.1  A candidate, to be eligible for the Degree will be required to pass examinations, as under:-

**First B. Pharm.**  
Semester-I and Semester-II

**Second B. Pharm.**  
Semester-III and Semester-IV

**Third B. Pharm.**  
Semester-V and Semester-VI

**Final B. Pharm.**  
Semester-VII and Semester-VIII
No candidate will be admitted to any examination unless he/she keeps term at a college affiliated to the University, and produces, from the Principal of the college, testimonials of:

a) Satisfactory attendance at the theory, Practical and term work classes as prescribed.

b) Satisfactory completion of the Project work prescribed for the Part and passing in the Project work by securing at least 40% marks out of the maximum prescribed for the entire Project work.

a) A Candidate who fails at his/her Semester - I examination of First Year B. Pharm. will be allowed to keep term for his/her Semester - II Examination, of First Year B. Pharm.

b) A Candidate who fails at his/her Semester - III examination of Second Year B. Pharm. will be allowed to keep term for his/her Semester - IV Examination of Second Year B. Pharm.

c) A Candidate who fails at his/her Semester - V examination of Third Year B. Pharm. will be allowed to keep term for his/her Semester - VI Examination of Third Year B. Pharm.

d) A Candidate who fails at his/her Semester - VII examination of Final Year B. Pharm. will be allowed to keep term for his Semester - VIII Examination of Final Year B. Pharm.

Additional Conditions for the Candidates who have entered into the Course at Semester-III level as per R. B. Pharm. - 1.2

The candidates must keep terms for the following subject heads, hence-forth referred as remedial subjects, of Semester - I and Semester - II. Accordingly the institutes must arrange the lecture schedules in the respective Semesters such that these candidates can keep terms for the subject heads. The institute will devise a mechanism to keep records by way of getting form filled by these candidates for attending the theory and practical, etc. as is done to the regular candidates.

Remedial Subjects:

Remedial Biology, Remedial Mathematics. The examination shall be conducted at the institute level and the results of the subject shall be forwarded to the University.

Unless the candidate passes the specified remedial subject heads of the Semester-I, they will not be admitted to the Semester -V and their results of Semester- IV will be with held.

Examinations:

Examination conducting authority: Shivaji University, Kolhapur.

Regular and Supplementary Examinations and time:

<table>
<thead>
<tr>
<th>Semester</th>
<th>Regular Examination</th>
<th>Supplementary Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>I, III, V and VII</td>
<td>(November/December)</td>
<td>(April/May)</td>
</tr>
<tr>
<td>II, IV, VI and VIII</td>
<td>(April/May)</td>
<td>(November/December)</td>
</tr>
</tbody>
</table>
Duration of Examinations, Marks, etc. See examination scheme at Annexure-I

R. B. Pharm. – 6.3 Criteria for admitting the candidate for examinations irrespective of regular or supplementary examinations:
Candidate must have been admitted to the respective Semester as per the criteria for continuation into the respective Semesters given in R. B. Pharm. 4 and has kept the term for the Semester for which he is examined.

The candidate must submit prescribed application form along with fees.

Candidates must appear for the examination in the place and time as decided by the admitting Institute/ the University as the case may be.

Candidate who has failed in a particular Semester or has ATKT will be allowed to appear for the same examination on a new application being forwarded and a fresh fee paid.

R. B. Pharm. – 6.4 Passing of the semester

Candidate will be considered as passed the semester only when the candidate passes in all the subject heads and obtains overall a minimum of 50% of the aggregate marks prescribed for the semester see Annexure-I.

Clarifications:

Candidate who has ATKT will appear for examinations in only those subject heads in which the candidate has failed.

The candidate who has passed in all the subjects but failed due to not getting overall 50% marks will be allowed to appear in four heads the candidate desires except the subject head of Project report.

For all the remaining cases, the candidate has to appear for examination in all those subject heads in which the candidate has failed.

R. B. Pharm. – 6.5 Periodic Tests:

To ensure uniform attention of the students of their work throughout each semester of their study, Periodic tests will be conducted for each semester and;

Conducting authority: shall be the institutes conducting the course.

Number of tests:

One periodic test as per the examination scheme (See Annexure- I), for each semester. The students who are unable to appear for the scheduled periodic test may be permitted for the periodic test in the same semester only if approved by institutional examination committee and paying fees prescribed by the institution.

The institutional examination committee shall consist of Principal (Chairman), and four teachers nominated by the Principal.

Time Schedule:

After completion of at least two thirds of the semester instruction weeks.

The Retest for the periodic tests will be allowed for the failed candidates in the University examination in the respective subject head. The Retest/ Improvement test/ or supplementary test shall be conducted by the
respective institution and the marks obtained by the candidate shall be forwarded to the University.

The institute conducting the course must submit the periodic test marks of the respective semester to the Controller of Examinations before the commencement of theory or practical examination whichever is later.

**R. B. Pharm. – 7 Award of the degree and class.**

Degree will be awarded to the candidates who have passed all the eight semesters.

Class will be awarded to those candidates who have passed the Semester-VII in one and the same sitting and VIII also in one and the same sitting and on the basis of combined marks at the Semester-I to Semester-VIII

| 1. | Those obtaining 50 per cent and above but below 60 per cent of the total marks | Second class |
| 2. | Those obtaining 60 per cent and above but below 70 per cent of the total marks | First Class. |
| 3. | Those obtaining 70 per cent of the total marks and above | First Class with Distinction |

Such candidates who have not passed the Semester-VII and / or VIII in one sitting and desire to get class awarded will be permitted to reappear the examination in all the subject heads on payment of fees with fresh application. Such candidates will be treated at par with fresh candidates and result of this examination will only be considered for all purposes. **However the candidate will forfeit all the previous marks and result of all the subject heads of the semester of which he has reappeared for the examination.**

A student will be allowed to improve his/her class at B. Pharm. by reappearing for all subjects (theory and practical taken together of that examination) of VII or / and VIII Semesters of B. Pharm. Course.

**R. B. Pharm. – 8 Withholding of results.**

A candidate’s result will be withheld under the following situations and of the respective Semester.

Result of Semester IV will be withheld if the candidate has not passed Semester – I and Semester II.

Result of Semester VI will be withheld if the candidate has not passed Semester – III and Semester – IV.

Result of Semester VIII will be withheld if the candidate has not passed Semester – V and Semester – VI.

**R. B. Pharm. – 8.1 Candidate who remains absent for the examination/periodic test.**

If a candidate does not appear for examinations in one or more subject heads in which the candidate’s form is accepted for the examination the candidate will be declared as ATKT or failed considering as if the candidate has appeared for all the subjects. However the candidate has to reappear and pass in the subjects for which the candidate was absent.

**R. B. Pharm. – 8.2 Exemption to appear for the examination:**

If a candidate has got ATKT, the candidate will be exempted for appearing the examination for those subject heads in which the candidate has passed
Any candidate who has passed in any subjects head is exempted for appearing the examination in that subject head.

If a candidate has passed in all the subjects but failed due to not getting 50% of the annual (semester pattern) aggregate marks may appear for the examination in any number of subject heads the candidate desires except the subject head “Project report”, so as to get over all 50% marks. The result of the examination will be declared only if he/she obtains 50% or more of the aggregate marks. The marks obtained by the candidate who fails to obtain 50% of the aggregate marks will be made known to him on request & on the payment of prescribed fees

R. B. Pharm. – 8.3 Every candidate shall be required to work for at least four weeks in a Pharmaceutical Industry or Govt. Hospital after the Semester- VI of the course of study, and shall submit satisfactory report of such work to the head of the institute.

R. B. Pharm. – 8.4 The Detailed Scheme of Examination and Syllabus for each semester
See Annexure - I and II.
### Scheme of Examination

Annexure - I

**Scheme of Examination** for eight semesters of B. Pharm. Course Name and number of heads of passing, number of paper, duration of examination, maximum marks, minimum marks for passing, periodic tests, duration, maximum marks,

<table>
<thead>
<tr>
<th>Semester I</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>THEORY PAPERS</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Sub Code</strong></td>
<td><strong>Subject</strong></td>
</tr>
<tr>
<td>1.1.1</td>
<td>Pharmaceutics</td>
</tr>
<tr>
<td>1.1.2</td>
<td>Dispensing of Medication and Hospital Pharmacy</td>
</tr>
<tr>
<td>1.1.3</td>
<td>Pharmaceutical Inorganic Chemistry</td>
</tr>
<tr>
<td>1.1.4</td>
<td>Pharmaceutical Analysis – I</td>
</tr>
<tr>
<td>1.1.5</td>
<td>Anatomy Physiology &amp; Health Education – I</td>
</tr>
<tr>
<td><strong>PRACTICALS</strong></td>
<td></td>
</tr>
<tr>
<td>1.1.6</td>
<td>Pharmaceutics (Practical)</td>
</tr>
<tr>
<td>1.1.7</td>
<td>Dispensing of Medication and Hospital Pharmacy (Practical)</td>
</tr>
<tr>
<td>1.1.8</td>
<td>Pharmaceutical Inorganic Chemistry (Practical)</td>
</tr>
<tr>
<td>1.1.9</td>
<td>Pharmaceutical Analysis – I (Practical)</td>
</tr>
<tr>
<td>1.1.10</td>
<td>Anatomy Physiology &amp; Health Education – I (Practical)</td>
</tr>
<tr>
<td><strong>Total Marks for the Semester</strong></td>
<td>: 500</td>
</tr>
<tr>
<td><strong>Minimum Marks for passing the Semester</strong></td>
<td>: 200</td>
</tr>
</tbody>
</table>

**Semester II**

| **THEORY PAPERS** |  |
| **Sub Code** | **Subject** | **No. of Papers** | **Semester Examination** | **Periodic tests** | **Total Maxi for Subject** |
| 1.1.1 | Pharmaceutics | 1 | 2 | 40 | 16 | 1 | 10 | 4 | 50 |
| 1.1.2 | Dispensing of Medication and Hospital Pharmacy | 1 | 2 | 40 | 16 | 1 | 10 | 4 | 50 |
| 1.1.3 | Pharmaceutical Inorganic Chemistry | 1 | 2 | 40 | 16 | 1 | 10 | 4 | 50 |
| 1.1.4 | Pharmaceutical Analysis – I | 1 | 2 | 40 | 16 | 1 | 10 | 4 | 50 |
| 1.1.5 | Anatomy Physiology & Health Education – I | 1 | 2 | 40 | 16 | 1 | 10 | 4 | 50 |
### Semester II

#### THEORY PAPERS

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>No. of Papers</th>
<th>Duration (Hours)</th>
<th>Maximum marks</th>
<th>Minimum for passing</th>
<th>Duration (Hours)</th>
<th>Maximum marks</th>
<th>Minimum for passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.1</td>
<td>Pharmaceutical Technology – I</td>
<td>1</td>
<td>2</td>
<td>40</td>
<td>16</td>
<td>1</td>
<td>10</td>
<td>4</td>
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<tr>
<td>1.2.2</td>
<td>Pharmaceutical Organic Chemistry</td>
<td>1</td>
<td>2</td>
<td>40</td>
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<tr>
<td>1.2.3</td>
<td>Pharmaceutical Analysis – II</td>
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<td>40</td>
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<tr>
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<td>Anatomy Physiology &amp; Health Education – II</td>
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<td>2</td>
<td>40</td>
<td>16</td>
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<td>10</td>
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</tr>
<tr>
<td>1.2.5</td>
<td>Pharmacognosy &amp; Phytochemistry – I</td>
<td>1</td>
<td>2</td>
<td>40</td>
<td>16</td>
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<td>Pharmaceutical Technology – I (Practical)</td>
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<td>4</td>
<td>40</td>
<td>16</td>
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<td>1.2.7</td>
<td>Pharmaceutical Organic Chemistry (practical)</td>
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<td>6</td>
<td>40</td>
<td>16</td>
<td>3</td>
<td>10</td>
<td>4</td>
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<tr>
<td>1.2.8</td>
<td>Pharmaceutical Analysis – II (Practical)</td>
<td>1</td>
<td>4</td>
<td>40</td>
<td>16</td>
<td>3</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>1.2.9</td>
<td>Anatomy Physiology &amp; Health Education – II (Practical)</td>
<td>1</td>
<td>4</td>
<td>40</td>
<td>16</td>
<td>3</td>
<td>10</td>
<td>4</td>
</tr>
<tr>
<td>1.2.10</td>
<td>Pharmacognosy &amp; Phytochemistry – I (Practical)</td>
<td>1</td>
<td>4</td>
<td>40</td>
<td>16</td>
<td>3</td>
<td>10</td>
<td>4</td>
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</tbody>
</table>

**Total Marks for the Semester** : 500

Minimum Marks for passing the Semester II : 200

Minimum Marks for passing First B. Pharm. (Sem. I & Sem. II) : 500

### Semester III

#### THEORY PAPERS

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>No. of Papers</th>
<th>Duration (Hours)</th>
<th>Maximum marks</th>
<th>Minimum for passing</th>
<th>Duration (Hours)</th>
<th>Maximum marks</th>
<th>Minimum for passing</th>
<th>Total Maximum for Subject</th>
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<tr>
<td>2.3.1</td>
<td>Physical Pharmacy – I</td>
<td>1</td>
<td>2</td>
<td>40</td>
<td>16</td>
<td>1</td>
<td>10</td>
<td>4</td>
<td>50</td>
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<tr>
<td>2.3.2</td>
<td>Pharmaceutical Microbiology &amp; Immunology</td>
<td>1</td>
<td>2</td>
<td>40</td>
<td>16</td>
<td>1</td>
<td>10</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>2.3.3</td>
<td>Pharmaceutical Biochemistry</td>
<td>1</td>
<td>2</td>
<td>40</td>
<td>16</td>
<td>1</td>
<td>10</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>2.3.4</td>
<td>Pharmacognosy &amp;</td>
<td>1</td>
<td>2</td>
<td>40</td>
<td>16</td>
<td>1</td>
<td>10</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>Sub Code</td>
<td>Subject</td>
<td>No. of Papers</td>
<td>Duration (Hours)</td>
<td>Maximum marks</td>
<td>Minimum for passing</td>
<td>Duration (Hours)</td>
<td>Maximum marks</td>
<td>Minimum for passing</td>
<td>Total Maximum for Subject</td>
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<tr>
<td>2.3.5</td>
<td>Phytochemistry – II</td>
<td>1</td>
<td>2</td>
<td>40</td>
<td>16</td>
<td>1</td>
<td>10</td>
<td>4</td>
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<td><strong>PRACTICALS</strong></td>
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<tr>
<td>2.3.6</td>
<td>Physical Pharmacy – I (Practical)</td>
<td>1</td>
<td>4</td>
<td>40</td>
<td>16</td>
<td>3</td>
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Total Marks for the Semester : 500

Minimum Marks for passing the Semester III : 200

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Minimum Marks for passing the Semester V : 180

Total Marks for the Semester : 450
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Total Marks for the Semester : 550

Minimum Marks for passing the Semester VI : 220

Minimum Marks for passing Second B. Pharm. (Sem. V & Sem. VI) : 500

**Semester VII**

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| 4.7.8 | Medicinal Chemistry – III (Practical) | 1 | 6 | 40 | 16 | 3 | 10 | 4 | 50 |
| 4.7.9 | Pharmaceutical Analysis – IV (Practical) | 1 | 4 | 40 | 16 | 3 | 10 | 4 | 50 |
| 4.7.10 | Pharmacology – IV (Practical) | 1 | 4 | 40 | 16 | 3 | 10 | 4 | 50 |
| 4.7.11 | Pharmacognosy & Phytochemistry – IV (Practical) | 1 | 4 | 40 | 16 | 3 | 10 | 4 | 50 |

Total Marks for the Semester : 550

Minimum Marks for passing the Semester VII : 220

*Elective

1. Pharmaceutical Marketing
2. Medicinal Plant
3. Biotechnology
4. Quality
5. Assurance
6. Drug Design and Lead Identification
7. Bioavailability and TDM
8. Cosmeceutics
9. Packaging Technology
10. Any other emerging area availing local expertise of Pharmaceutical relevance

**Semester VIII**

**THEORY PAPERS**

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Total Marks for the Semester : 450

Minimum Marks for passing the Semester VI : 180

Minimum Marks for passing Second B. Pharm. (Sem. VII & Sem. VIII) : 500

*To be submitted in the institution and college level examination.

Total Marks for Semester I to Semester VIII : 4000

Minimum Marks for passing Semester I to Semester VIII : 2000
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Semester – IV

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<td>Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry</td>
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### Semester – V

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<td>Pharmaceutical Polymer Chemistry</td>
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### Semester – VI

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### Semester – VII

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<td>Pharmaceutical Jurisprudence</td>
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<td>Pharmaceutical Industrial Management</td>
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**Elective subjects**

1. Pharm. Marketing
2. Medicinal Plant Biotechnology
3. Quality Assurance
4. Drug Design and Lead Identification
5. Bioavailability and TDM
6. Cosmeceutics
7. Packaging Technology
8. Any other emerging area availing local expertise of Pharmaceutical relevance.
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<td>Pharmaceutical Inorganic Chemistry</td>
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<td>Anatomy Physiology &amp; Health Education – I</td>
<td>3</td>
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1.1.1 Pharmaceutics Theory (3 Hrs/Wk)

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<td>08</td>
<td>09 – 12</td>
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1. Introduction to pharmaceutics and its scope.

2. Pharmaceutical industry in India.
   - Historical background and development of various dosage forms.

3. History of pharmaceutical education in India.

4. Introduction to dosage forms.
   - Historical background and development of profession of pharmacy.
   - Classification of dosage forms, advantages and disadvantages.

5. Drug delivery systems:
   - Detail study of non sterile monophasic liquid - solutions, mixtures, aromatic waters and conc. Aromatic waters, infusions and decoction, glycerites, syrups, elixirs, linctuses, paints, mouth-washes

Reference Books:

1. Pharmaceutical Dosage and Drug Delivery System - Ansel Popovich and Allen (Williams and Wilkins)
2. American Pharmacy - Dittert (J.B. Lipincott)
3. Remington- The Science and practice of Pharmacy (Mack Publishing Co)
4. Bentley's Text Book of Pharmaceutics - Rawlins (ELBS)
5. Banker and Rhodes - Modern Pharmaceutics -(Dekker)
7. Register Pharmacy
8. Indian Pharmacopoeia
9. Tutorial Pharmacy - Cooper and Gunn
10. Practical notebook on Pharmaceutics – A. Gupta and V. K. Jain, CBS Publication
11. Textbook of Professional Pharmacy – Jain and Sharma
### 1.1.2 Dispensing of Medication and Hospital Pharmacy

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<td>Definition and scope of dispensing and compounding of drug.</td>
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<td>General dispensing procedures (to be covered in practical)</td>
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<tr>
<td>3</td>
<td>Imperial system of weights and measures (to be covered in practical)</td>
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<td>02–05</td>
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<tr>
<td>4</td>
<td>Latin terms used in pharmacy (to be covered in practical)</td>
<td>3</td>
<td>03–05</td>
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<tr>
<td>5</td>
<td>Prescription and its parts:</td>
<td>6</td>
<td>05–08</td>
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<tr>
<td></td>
<td>Responding to prescription, calculations for compounding and dispensing, fundamental operations in compounding, containers and closures for dispensed products, labelling of dispensed medicine, compounding accuracy and calibration, latin terms, prescription pricing and record.</td>
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<tr>
<td>6</td>
<td>Pharmaceutical calculations:</td>
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<td>03–06</td>
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<tr>
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<td>Percentage calculations, alligation methods, calculations involving isotonic solutions, proof spirit, posology, calculations of doses for infants and children, weights and measures.</td>
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<tr>
<td>7</td>
<td>Incompatibilities in prescriptions:</td>
<td>8</td>
<td>06–09</td>
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<td>Types of incompatibilities -physical, chemical and therapeutic.</td>
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<td>Study of various prescription examples involving the same.</td>
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<tr>
<td>8</td>
<td>Organization and structure of hospital pharmacy.</td>
<td>2</td>
<td>03–05</td>
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<td>9</td>
<td>Hospitals -classification, functions, organization administration.</td>
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<td>03–05</td>
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<td>Hospital formulary.</td>
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<td>Duties and responsibilities of hospital pharmacist.</td>
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<td>02–03</td>
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<td>12</td>
<td>Drug distribution system.</td>
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<td>03–06</td>
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<td>13</td>
<td>Drug information services.</td>
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<td>14</td>
<td>Records and reports.</td>
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<td>02–03</td>
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Reference Books:

1. Remington's Pharmaceutical Sciences AH. Gennaro (Mack Publishing)
2. Pharmaceutical Practice Collett and Aulton (ELBS)
3. Dispensing of Medications Hoover (Mack Publishing)
4. Prescription Pharmacy Sprowls (Lippincott)
5. Pharmaceutical Calculations Stocklosa
6. USP Vol. I and II
7. IP, BP, USP-NF, NF1 and the Official Pharmacopoeia
8. Martindale Extra Pharmacopoeia Official
10. Hospital Pharmacy, Merchant and Quadry
12. Hospital and Clinical Pharmacy, by A. R. Paradkar and S. A. Chunawala, Nirali Prakashan
13. Hospital and Clinical Pharmacy, by P.C. Dandiya and Mukul Mathur
1.1.3 Pharmaceutical Inorganic Chemistry Theory (4 Hrs/Wk)

1. Acid, Bases, Buffers
   Types & Mechanism, Pharmaceutical buffers, Buffer equation and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurement of tonicity and calculation and methods of adjusting isotonicity.
   Hrs 06  Marks 05 – 08

2. Gastrointestinal Agents
   Acidifying agents, antacids specifically aluminium hydroxide, magnesium hydroxide, sodium bicarbonate, calcium carbonate, magnesium carbonate and polymethyl siloxime, protectives & adsorbents specially activated charcoal, milk of bismuth, bismuth subcarbonate, bismuth subnitrate and kaolin, Cathartics such as sodium phosphate, magnesium sulphate, sulphur containing compounds and calomel.
   Hrs 05  Marks 05 – 07

3. Major Intra & Extra cellular Electrolytes
   Physiological ions, Electrolytes used for replacement therapy, acid base balance, Combination therapy.
   Hrs 08  Marks 05 – 08

4. Essential & Trace elements
   Transition elements & their compounds of Pharmaceutical importance such as iron, copper, iodine and zinc with their official preparations, Haematinics like ferrous sulphate, ferrous gluconate, ferrous fumarate and iron dextran injection.
   Hrs 05  Marks 05 – 08

5. Topical Agents
   Protective, astringents, Anti-infective like talk, zinc oxide, calamine, hydrogen peroxide, potassium permanganate, iodine with their mechanism of action.
   Hrs 04  Marks 03 – 05

6. Gases & Vapors
   Oxygen, anesthetics, respiratory stimulants such as nitrogen oxide, carbon dioxide and helium.
   Hrs 04  Marks 04 – 06

7. Dental Products
   Dentifrices & Anti-carries agent like sodium fluoride, SnF₂, concentrated fluorides and polishing agents, zinc chloride.
   Hrs 03  Marks 03 – 05

8. Complexing & Chelating agents, other antidotes
   Complexing agent – EDTA, penicillamine.
   Antidotes – cyanide poisoning, sodium thiosulphate.
   Precipitation – copper sulphate, sodium phosphate and magnesium sulphate.
9 Sclerosing agents, Expectorants, Emetics such as ammonium chloride and Antioxidants sodium bisulphide, metabisulphide and sulphur dioxide.


Reference Books:

1. Vogel’s Textbooks of qualitative Inorganic Analysis By Denny, Jeffery.
2. Practical Pharmaceutical inorganic chemistry, By Beckett & Stenlake.
3. Inorganic Medicinal & Pharmaceutical Chemistry By Block & Roche.
5. Textbook of Pharmaceutical analysis By Connors K.A.
6. Text book of Pharmaceutical Analysis By Dr. H. N. More
7. Indian Pharmacopoeia
1. Introduction:
Significance of quantitative analysis in quality control, different techniques of analysis, preliminaries and definitions, types of errors, selection of sample, precision and accuracy. Fundamentals of volumetric analysis, methods of expressing concentrations, primary and secondary standards. Calculation of equivalent weight and stoichiometry.

2. Aqueous Acid-Base titrations:
Law of mass action, hydrolysis of salts, neutralization curves, and theory of indicators, choice of indicators, mixed indicator. Application in assay of Benzoic acid, Boric acid, Aspirin.

3. Non-Aqueous titrations:
types of solvents, end point detection, application in assay of Sodium acetate, Sodium benzoate, Norfloxacin tablet.

4. Oxidation-Reduction titrations:
Theory of redox titration, measurement of electrode potential, oxidation-reduction curves, redox Indicators. Titrations involving potassium permanganate, potassium dichromate, potassium bromate, potassium iodate, cerium (IV) sulfate, Iodine (Iodimetry and Iodometry), titanous chloride. Applications in assay of Ferrous sulfate, Ascorbic acid, Isoniazide, Hydrogen peroxide.

5. Complexometric titrations:
Theory, formation of complex and its stability, titration curves, metallochrome indicators (no structures), types of EDTA titrations, application in assay of Magnesium sulfate, Lead nitrate and calcium gluconate.

6. Argentometric titrations:
Theory, factors affecting solubility of a precipitate, titration methods—Mohr’s, Volhard’s, Gay lussac, and Fajan’s method, indicators. Applications in assay of Potassium chloride, Sodium chloride and Ammonium chloride.
7. Miscellaneous methods of analysis:  
Diazotisation titrations, Kjeldahl’s method of nitrogen determination and Oxygen flask combustion method.

8. Gravimetric analysis:  
Precipitation techniques, solubility products, colloidal state, supersaturation, co-precipitation, post precipitation, digestion, filtration, ignition, weighing and calculation. Application in assay of Alum by oxime reagent, Calcium as calcium oxalate and magnesium as magnesium pyrophosphate.

Reference Books:

5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
1. **Scope of Anatomy and Physiology, basic terminology used in this subject.**
   - Hrs: 01  
   - Marks: 01 – 03

2. **Structure of cell – Its components and their functions**
   - Hrs: 01  
   - Marks: 01 – 03

3. **Elementary tissues of the human body:**
   - Epithelial, connective, muscular and Nervous tissues – their subtypes and characteristics.
   - Contraction of skeletal muscle
   - Neuro muscular transmission
   - Contraction of smooth muscle
   - Hrs: 02  
   - Marks: 03 – 05

4. **Haemopoietic system** Composition and functions of blood.
   - Haemopoiesis and disorders of blood & its components, Disorders of Haemopoietic system).
   - RBC metabolism
   - Blood groups.
   - Clotting factors and mechanism. Platelets and disorders of coagulation.
   - Hrs: 07  
   - Marks: 06 – 10

5. **Lymph and Lymphatic system –**
   - Composition, formation and circulation of lymph
   - Disorders of Lymph and lymphatic system (Definitions only)
   - Spleen: Physiology and function.
   - Hrs: 02  
   - Marks: 01 – 03

6. **Cardiovascular system –**
   - Anatomy of heart
   - Physiology of cardiac muscle and heart
   - Conduction system of heart
   - Blood vessels and its disorders
   - Cardiac cycle and Heart Sounds,
   - ECG, Blood pressure and its regulation (short term and long term).
   - Definitions, types, etiology, and pathophysiology of the following disorders- Hypertension, Hypotension, Arteriosclerosis, Angina, Myocardial infarction, Congestive Heart failure and Cardiac arrhythmias.
   - Hrs: 09  
   - Marks: 08 – 10
### Respiratory System
- Anatomy of respiratory organs and functions
- Mechanism and regulation of Respiration
- Physiology of respiration: transport of respiratory gases
- Respiratory volumes and vital capacity
- Disorders of respiratory tract like TB, COPD, asthma

### Digestive System
- Anatomy of Gastro Intestinal Tract (GIT)
- Secretions functions and anatomy of Salivary glands, Pancreas, Stomach, Intestine, Liver
- Physiological and biochemical aspects of digestion and absorption of food
- Disorders of GIT

### Health Education-
Definition of Health (Physical & Mental) and Health Education, objectives of Health Education.

#### Family Planning
Principles underlying various family planning methods.

#### Nutrition:

### Skeletal muscles
1. Histology
2. Physiology of muscle contraction
3. Physiological properties of skeletal muscle performance
(definition of the disorders)
Reference Books:

15. Anatomy and Physiology by Kimber - Grey - Stacktole’s
16. Practical Physiology and Biochemistry by Goel, Shah and Patel
1. Preparation and evaluation of- (at least two preparation from each category)
   - Solutions
   - Mixtures
   - Aromatic waters and concentrated aromatic waters
   - Infusions and Decoction
   - Glycerites

A. Syrups
B. Elixirs
C. Linctuses
D. Paints
E. Mouth washes

Reference Books:

1. Pharmaceutical Dosage and Drug Delivery System -Ansel - Popovich and Allen -(Williams and Wilkins]
2. American Pharmacy -Dittert (J. B. Lipincott)
4. Bentley's Text Book of Pharmaceutics -Rawlins (ELBS)
5. Banker and Rhodes -Modern Pharmaceutics -(Dekker)
6. Register Pharmacy
1.1.7 Dispensing of Medication and Hospital Pharmacy

1. General instructions to be explained and practiced:
   a) Dispensing vs compounding.
   b) Weighing technique for the dispensing balance sensitivity, weight box calibration and accuracy, precision of weighing and error evaluation, devices for accurate dosage measurement
   c) Handling of prescription- reading, checking, labeling and dispensing, with detailing.
   d) General dispensing procedure - different containers for dispensing labeling of dispensed medicines - documentation.
   e) Posology and calculations
   f) Weights and measures
   g) Reducing and enlarging recipes
   h) Percentage calculations
   i) Dilutions and concentration (stock solutions)
   j) Isotonic solutions

2. Incompatibilities in prescription:
   • Incompatibility of Alkaloids
   • Incompatibility of soluble Iodides
   • Incompatibility of soluble salicylates and benzoates
   • Incompatibility causing evolution of CO₂
   • Incompatibility of soluble barbiturates
   • Incompatibility of emulsifying agent

2) Compounding of proprietories for the following preparations:
   • Topicals containing ointment/cream with powders, liquids of antimycotic, antibacterial and anti-inflammatory
   • Anti diarrhoeal powder for paediatric use containing anti bacterial, antispasmodic, antiamoebic with kaolin and pectin.
   • Mouth washes containing thymol, menthol, peppermint oil and an suitable antiseptic.
   • Scalp lotion containing mercuric choride, panthenol and a hair conditioning agent etc.
   • Prepackaging and bulk compounding of paracetamol/trimethoprim/sulpha tablets.
   • Drug information - source - an exercise on drug information.
Reference Books:

1. Prescription pharmacy – sprowls
2. Dispensing for pharmacy students - cooper & gunn - 12th edition
3. Pharmaceutical practice - Collet & Aulton
4. Dispensing of medication – Hoover
5. The extra pharmacopoeia - Martindale
6. Pharmaceutical calculations - stoklosa

1.1.8 Pharmaceutical Inorganic Chemistry

Practical (3 Hrs/Wk)

1. Systematic qualitative analysis of inorganic mixtures containing two anions and two cations. (06)
2. Practicals based on Limit test (04)
3. Preparation of inorganic compounds. (05)

Reference Books:

1. Vogel's Textbooks of qualitative Inorganic Analysis By Denny, Jeffery.
2. Practical Pharmaceutical inorganic chemistry, By Beckett & Stenlake.
3. Inorganic Medicinal & Pharmaceutical Chemistry By Block & Roche.
5. Textbook of Pharmaceutical analysis By Connors K.A.
6. Text book of Pharmaceutical Analysis By Dr. H. N. More
7. Indian Pharmacopoeia
1. The students should be introduced to the main Analytical tools through demonstration. They should have a clear understanding of a typical analytical balance, weights, care and use of balance, methods of weighing and errors of weighing. The students should also be acquainted with the general apparatus required in various analytical procedures.

2. Standardization of analytical weights and calibration of balances and volumetric apparatus.

3. Perform following assays as per IP including preparation and standardization of titrants.
   - Acid-base titrations: Benzoic acid, Boric acid, Aspirin
   - Non-Aqueous titrations: Sodium acetate, Sodium benzoate, Norfloxacin tablet.
   - Complexometric titrations: Magnesium sulfate, Lead nitrate, calcium gluconate
   - Argentometric titrations: Potassium chloride, Sodium chloride and Ammonium chloride.
   - Gravimetric analysis: Alum by oxime reagent, Calcium as calcium oxalate and magnesium as magnesium pyrophosphate (Demonstration of any one).

Reference Books:

5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
1. **Haematology**
   - Determination of Total Leukocyte Count
   - Determination of RBC Count
   - Estimation of hemoglobin content
   - Determination of bleeding time
   - Determination of Clotting time
   - Determination of Blood Group

2. **Study of Models**
   Different models covering, Heart, Respiratory system, Digestive system

3. **Study of Histological Slides**
   Different histological slides based on chapters covered in theory to be studied

4. **Study of family planning devices**
   Like condoms, copper ‘T’, foam tablets, contraceptive pills, etc.
Reference Books:

15. Anatomy and Physiology by Kimber - Grey - Stacktole’s
16. Practical Physiology and Biochemistry by Goel, Shah and Patel
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<td><strong>Pharmaceutical Organic Chemistry</strong></td>
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<td><strong>Pharmaceutical Analysis – II</strong></td>
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<td>1.2.4</td>
<td><strong>Anatomy Physiology &amp; Health Education – II</strong></td>
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<td><strong>Pharmacognosy &amp; Phytochemistry – I</strong></td>
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**Practical**

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<td><strong>Pharmaceutical Organic Chemistry (practical)</strong></td>
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<td>1.2.9</td>
<td><strong>Anatomy Physiology &amp; Health Education – II (Practical)</strong></td>
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1.2.1 Pharmaceutical Technology - I Theory (3 hr./wk)

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<td>07</td>
<td>08 - 12</td>
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<tr>
<td>11</td>
<td>14 - 20</td>
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1. Design and development of pharmaceuticals, general considerations:
   Preformulation and formulation of dosage forms, general principles

2. Evaluation of active ingredients [Brief introduction]:
   Content, uniformity, physical and chemical stability, safety and efficacy considerations, quality control, manufacturer’s reliability, manufacturer’s drug information profile.

3. Excipients used in pharmacy
   Thickening agents, surfactants, sweetening agents, antioxidants, preservatives.

4. Suspensions:
   Flocculated and deflocculated systems, structured vehicle, particle, size and charge, caking in suspension, suspending agents, wetting agents, deflocculating and flocculating agents, formulation development, manufacturing and packaging equipments, stability of suspension, evaluation, preservation and storage, pharmaceutical applications.

5. Emulsions:
   Physical properties, creaming, coalescence, cracking, destabilization kinetics, multiple emulsion emulsifier and choice of emulgent, HLB, phase inversion temperature Formulation, manufacturing equipments stability and evaluation, packaging and storage.

6. Semisolid dosage forms:
   Classification, Structure of skin, penetration, absorption and bioavailability of drugs.
   a. Ointments:
      Ointment bases and their selection, properties of the drug and the base governing drug release from ointments, manufacturing processes and equipments, packaging and evaluation.
   b. Creams:
      Definition, advantages and disadvantages, types, ingredients, processing environmental controls, in-process and finished product controls, stability of creams and evaluation.
   c. Gels and jellies:
      Definition, natural and synthetic gelling materials, types of gels, formulation and components, packaging, stability and evaluation.
   d. Suppositories:
Reference Books:

11. Pharmaceutical process validation, by Nash Wachler, Marcel Dekker
1.2.2 Pharmaceutical Organic Chemistry

Theory 4 hrs/wk.

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<th>Hrs</th>
<th>Marks</th>
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<tr>
<td>7</td>
<td>08-12</td>
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</table>

1. Factors affecting electron availability in bonds and at individual atoms:
   Electronegativity, inductive effect, Resonance including rules of the Resonance, Concept and types of Tautomerism.

2. Classes of reactions and reagents:
   Including electrophiles, nucleophiles and radicals, transition reaction intermediates, Carbocations, Carbanions, Carbenes and Nitrenes, Kinetics and thermodynamic control of reactions.

3. Theories of acidity and basicity with respect to organic compounds:
   Factors effecting acidity and basicity – Resonance, Inductive effect, steric parameters and hydrogen bonding.

4. Structure, Nomenclature [multifunctional groups also], preparation and reactions of:
   cycloalkanes, alkenes, dienes, alkynes, alcohol, alkyl halides, amines, phenols, aldehydes & ketones, carboxylic acids and functional derivatives of carboxylic acids including beta keto esters [Mechanisms of reactions to be covered].

5. Benzene and Aromaticity:
Reference Books:

1. Advanced Organic Chemistry, Ed. 4 -Jerry March.
3. Organic Chemistry by Pine
4. Advanced Organic Chemistry by Solomans
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry: Peter Sykes
8. Organic Chemistry by Jain M.K.
10. Vogel’s Textbook of practical organic chemistry
11. Practical Organic Chemistry –Mann and Saunders
12. Qualitative Analysis in Organic Chemistry-Nadkarni V.V. and Fernades P.S.
13. A Laboratory handbook of Organic qualitative analysis and separations-Kulkarni V.S. and Pathak S.P.
1.2.3 Pharmaceutical Analysis - II Theory 4 hrs/wk.

1. **Polarimetry:**
   - Introduction, Instrumentation and Applications.
   - Hrs: 04  Marks: 03 - 05

2. **Refractometry:**
   - Introduction, Instrumentation (Abbey’s, Dipping/Immersion, Pulfrich and Image displacement refractometer), Applications.
   - Hrs: 04  Marks: 03 - 05

3. **Electrochemical Analysis:**
   - Definition of all types of electrochemical analysis.
     a. **Conductometry:**
        - Principle, instrumentation, Applications including conductometric titrations. High frequency method.
        - Hrs: 04  Marks: 03 - 05
     b. **Potentiometry:**
        - Introduction, Different types of electrodes, measurement of electrode potential and pH, Applications including potentiometric titrations.
        - Hrs: 06  Marks: 05 - 08
     c. **Polarography:**
        - Introduction, Instrumentation and Applications.
        - Hrs: 07  Marks: 05 - 08
     d. **Amperometry:**
        - Introduction, Instrumentation and Applications including amperometric titrations.
        - Hrs: 04  Marks: 03 - 05

4. **Karl-Fischer titrations:**
   - Introduction, Instrumentation, and Applications.
   - Hrs: 03  Marks: 03 - 05

5. **Thermal Analysis:**
   - Introduction, Principle, Methods, Instrumentation, and Factors affecting results, Applications of TG, DSC and DTA.
   - Hrs: 09  Marks: 06 - 08

6. **X-ray diffraction:**
   - i. Laue photographic method.
   - ii. Bragg X-ray spectrophotometry.
   - iii. Rotating crystal method.
   - Hrs: 06  Marks: 06 - 08
Reference Books:

5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
1.2.4  Anatomy Physiology & Health Education – II  Theory  (3 hr./wk)

1  **Nervous systems:**

Definitions and classification of nervous system

- anatomy and physiology of neurons, initiation and conduction of nerve impulses, CNS synapses
- definition, types and functions of central and peripheral neurotransmitters and its receptors
- Functional areas and functions of cerebrum
- Cerebellum, basal ganglia and motor control
- Pons and medulla
- Thalamus and hypothalamus
- Spinal cord: structure and functions
- Cranial nerves-names and functions
- ANS-anatomy and functions of sympathetic and parasympathetic nervous system.

2  **Urinary system**

- Parts of urinary system and gross structure of the kidney.
- Structure of nephron.
- Formation of urine.
- Renin angiotensin system, juxta -glomerular apparatus. Acid base balance,
- Disorders of renal function
- Renal function test.

3  **Endocrine system**

Endocrine glands

- Pituitary gland and its hormones
- Adrenal gland and adrenocortical hormones
- Thyroid and parathyroid gland and metabolic hormones
- Pancreas and gonads and their secretions.
- Endocrine disorders

4  **Reproductive system**
1. Male and female reproductive systems
2. Their hormones – physiology of menstruation
3. Spermatogenesis and oogenesis
4. Sex determination (genetic basis)
5. Early pregnancy tests and changes during pregnancy, its maintenance and parturition

5 Sense organ-structure and functioning of eye, ear, skin, nose, tongue.

6. Communicable and non communicable diseases:-
Causative agents modes of transmission, symptoms, treatment and prevention of chicken pox, small pox, measles, mumps, rubella, influenza, diphtheria, whooping cough and tuberculosis, tetanus, hepatitis, cholera, typhoid, malaria, filariasis, kala azar, syphilis, gonorrhea, AIDS.

Reference Books:
1.2.5 Pharmacognosy & Phytochemistry - I | Theory (3 Hrs/Wk)

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<th>Hrs</th>
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<tbody>
<tr>
<td>02</td>
<td>02 – 03</td>
<td>Definition, history, scope and development of pharmacognosy</td>
</tr>
<tr>
<td>01</td>
<td>01 – 03</td>
<td>Sources of crude drugs: biological, marine, microbes, mineral, animal and plant tissue culture as sources of drugs.</td>
</tr>
<tr>
<td>03</td>
<td>03 – 05</td>
<td>Classification of crude drugs (organized &amp; unorganized): alphabetical, morphological, taxonomical, chemical, pharmacological and chemotaxonomical classification of crude drugs</td>
</tr>
<tr>
<td>04</td>
<td>05 – 08</td>
<td>Plant taxonomy: study of following families with special reference to medicinal important plants of apocynaceae, solanaceae, rutaceae, umbelliferae, leguminosae and liliaceae</td>
</tr>
<tr>
<td>05</td>
<td>05 – 08</td>
<td>Cultivation, collection, processing and storage of crude drugs: factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation, hybridization with reference to medicinal plants.</td>
</tr>
<tr>
<td>04</td>
<td>05 – 08</td>
<td>Quality control of crude drugs: adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation</td>
</tr>
<tr>
<td>03</td>
<td>03 – 05</td>
<td>An introduction to active constituents of crude drugs, their general isolation and classification</td>
</tr>
<tr>
<td>07</td>
<td>08 - 10</td>
<td>Systematic pharmacognostic study of following: Carbohydrates and derived products: agar, guar gum, acacia, honey, isabgol, pectin, tragacanth, starch, modified starches and inulin</td>
</tr>
<tr>
<td>07</td>
<td>08 - 10</td>
<td>Lipids: bees wax, castor oil, coca butter, cod liver oil, linseed oil, rice bran oil, shark liver oil and wool fat</td>
</tr>
</tbody>
</table>
Reference Books:

2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
19. Export potential of selected medicinal plants, prepared by basic chemicals, pharmaceuticals and cosmeticexport promotion council, Bombay, and other reports.
22. Kokate C. K., Cultivation of Medicinal Plants.
23. Pulok Mukharji, Quality control of Herbal drugs.
1. Evaluation of excipients used in the formulations mentioned in theory (one each)
2. Preparation and evaluation of
   -Suspensions for internal and external use – 04
   -Emulsions for internal and external use – 04
   -Ointments using different bases – 04
   -Creams using different bases – 02
   -Gels using different gelling agents – 02
   -Suppositories – 04

Reference Books:

1.2.7 Pharmaceutical Organic Chemistry Practical 3 hrs/wk.

1. Synthesis of organic compounds
   - p-Bromoacetanilide
   - m-Dinitrobenzene/p-Nitroacetanilide
   - Anthraquinone from anthracene
   - Aniline/N-Phenylhyroxylamine from Nitrobenzene by Reduction.

2. Qualitative analysis of Organic compounds [at least 3 single compounds] and Binary mixtures [at least 6 Mixtures] Only water insoluble solid mixtures.

Reference:

1. Advanced Organic Chemistry, Ed. 4 -Jerry March
3. Organic Chemistry: Pine
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry : Peter Sykes
8. Organic Chemistry : Jain M.K.
10. Vogel’s Textbook of practical organic chemistry
11. Practical Organic Chemistry : Mann and Saunders
12. Stereochemistry of Organic Compounds : Nasipuri D.
1. Exercises involving Polarimetry.
2. Calibration of Refractometer and measurement of RI of glycerine, nitrobenzene, specific and molar refraction.
3. Calibration of conductometer and conductance of distilled water.
4. Conductometric titration (SA Vs SB and WA Vs SB).
5. Determination of cell constant.
7. Potentiometric analysis: - pKa determination of phosphoric acid / boric acid.
8. Potentiometric titration of Acid Vs Base.

Reference Books:
5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
1. **Study of the Physiology**  
   Normal & Abnormal Constituents of urine

2. **Study of Models**  
   Different models covering, Brain, Urinary system, Reproductive system, Eye, Ear, Skin, Nose, Tongue

3. **Study of Histological Slides**  
   Different histological slides based on chapters covered in theory to be studied

4. **Study of human skeleton. (Osseous system)**  
   - Structure, Classification of Bones, composition of Bones  
   - Functions of the skeleton. Classification of joints, types of movements of joints and Disorders of joints.

5. Recording of body temperature, pulse rate and blood pressure, recording and understanding of Electrocardiogram-PQRST waves and their significance.

6. **Differential leukocyte count**

7. **E.S.R.**

**Reference Books:**


1.2.10 Pharmacognosy & Phytochemistry – I Practical (3 Hrs/Wk)

1. Morphological characteristics of plant families mentioned in theory
2. Microscopic measurement of cell and cell contents: Starch grains, Calcium oxalate crystals and phloem fibres.
3. Determination of leaf constants such as stomatal index, stomatal number, vein-islet number, Vein-termination number, palisade ratio and lycopodium method (Any four)
4. Identification of crude drugs belonging to carbohydrates and lipids (chemical evaluation)
5. Preparation of herbarium sheets

Reference Books:

2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
19. Export potential of selected medicinal plants, prepared by basic chemicals, pharmaceuticals and cosmeticexport promotion council, Bombay, and other reports.
22. Kokate C. K., Cultivation of Medicinal Plants.
23. Pulok Mukharji, Quality control of Herbal drugs.
### Semester – III

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<td>Physical Pharmacy – I</td>
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<td>Pharmaceutical Microbiology &amp; Immunology</td>
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<td>2.3.3</td>
<td>Pharmaceutical Biochemistry</td>
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<td>2.3.5</td>
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<td>2.3.8</td>
<td>Pharmaceutical Biochemistry (Practical)</td>
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<td>2.3.10</td>
<td>Biostatistics and Computer applications (Practical)</td>
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</table>
2.3.1 Physical Pharmacy – I

Theory 3 hrs/wk.

1. Behaviour of gases:
   Kinetic theory of gases, derivation from behaviours and explanation.
   Hrs Marks 03 05 – 08

2. The liquid state:
   Physical properties such as surface tension, parachor, viscosity, refractive index, optical rotation and dipole moment
   Hrs Marks 04 05 – 10

3. Solubility and Solutions:
   Types of solutions, solubility expressions, factors affecting solubility, methods of solubility determination, heat of solution, Ideal and real solution, colligative properties, specific and equivalent conductance, dielectric constant, partition coefficient and its determination, Phase rule; upper and lower consolute temperatures, one, two and three component systems, Debye Huckel theory; applications of solubility in pharmacy
   Hrs Marks 06 06 – 10

4. Thermodynamics:
   First law, second law, third law of thermodynamics, zeroth law, absolute temperature scale.
   Hrs Marks 03 03 – 05

5. Ionic Equilibria
   Arrhenious, Bronsted-Lowry and Lewis acid-base theory, pH Scale, Pharmaceutical Buffers, buffer capacity, buffer action, buffers in pharmaceutical preparations, isotonic solutions and buffered isotonic solutions, tonicity adjustments and measurements.
   Hrs Marks 05 05 – 08

6. Adsorption:
   Types, factors affecting, Freundlich and Gibbs adsorption isotherm, Langmuir theory of adsorption, adsorption on solid interface, solid-gas and solid-liquid interfaces, applications in pharmacy
   Hrs Marks 04 03 – 07

7. Chemical kinetics:
   Zero, first, and second order reactions, complex reactions, theories of reaction kinetics, biological half life, types and characteristics of catalysis, applications of kinetics in pharmacy.
   Hrs Marks 06 06 – 10

8. Numerical problems:
   Problems based on all above chapters
   Hrs Marks 05 07 – 12
Reference Books:-

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone & Lewis
3. Practical Pharmaceutics (Physical Pharmacy) – H. N. More, Ashok Hajare
4. Physical Chemistry – Maron S. & Pruton
5. Remington’s Pharmaceutical Sciences
6. Theory & Practice of Industrial Pharmacy – Lachman Liebermann & Kanig
7. Physical Chemistry – Bahl and Tuli
8. Pharmaceutical Technology – Eugene Parrott
9. Physical Pharmacy – Martin, Swarbrick and Commarata
10. Practical Pharmaceutical Technology - Eugene Parrot
### 2.3.2 Pharmaceutical Microbiology & Immunology

<table>
<thead>
<tr>
<th>Hrs</th>
<th>Marks</th>
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<tbody>
<tr>
<td>02</td>
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<td>12 – 17</td>
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### 1. Scope of Microbiology:
Historical development (Antony Van Leuenhook, Koch’s postulates, Pasteur’s contribution) applications of microbiology to pharmaceuticals.

### 2. Classification of microorganisms and their taxonomy:
Whittker’s five kingdom concept, Classification of microorganisms into bacteria, actinomycetes, yeast and fungi, rickettsia and viruses. (General features and Applications) Introduction to microscopy (optical, electron, phase contrast, etc.)

### 3. Study of Bacteria:
Structure, locomotion, reproduction, genetic exchange isolation, nutritional requirements, culture media, growth curve, and mean generation time, counting methods, identification procedure & characteristics of pathogens (Staphylococcus, Clostridium, Vibrio, Mycobacterium, Corynebacterium).

### 4. Study of Yeasts, Fungi & Rickettsia:
Introduction, characteristics, clinical significance & applications in Pharmacy

### 5. Study of Viruses:
Introduction - General properties (size, nucleic acid content, metabolism) - structure of viruses (helical symmetry and icosahedral symmetry) - effect of chemical and physical agents on viruses - virus-host cell interactions - bacteriophage and its epidemiological uses (lytic growth cycle and lysogeny) - human viruses and their cultivation in cell culture, chick embryo and animal inoculation - multiplication of human viruses - interferon’s HIV.

### 6. Sterilization, Disinfection and Infection control:
Sterilization - Definition - classification into thermal and non-thermal methods - details of hot air sterilization, autoclaving, gaseous, radiation, sterile filtration (method of packaging and equipment to be used should also be covered)

Bioburden determination - sterilization monitors (physical, chemical and biological indicators) - sensitivity of microorganisms, survivor curves, expression of resistance (D-values and z-values), sterility assurance

Disinfection: Definition (antiseptics, preservatives and sanitizing agents) chemical classification (acids and esters, alcohols etc.) - factors affecting choice of antimicrobial agent (properties of chemical agent and microbiological challenge, environmental factors and toxicity of agent) - factors affecting disinfection process - evaluation of disinfectant (RW coefficient, Kelsey-Sykes test).
7. Fundamentals of Immunology -
Definitions of pathogen, virulence, attenuation, exaltation, antigens, antibodies and antisera - defense mechanisms of host - non-specific (skin and mucous membranes, phagocytosis, complement system, inflammation, host damage with exotoxins and endotoxins) - specific defense mechanisms - cellular immunity - humoral immunity - Immunity - types of immunity (natural, naturally acquired, acquired (active and passive) Types and Structure of immunoglobulins.

Reference Books:

2. Tutorial Pharmacy - Cooper and Gunn
4. General Microbiology by Pelczar & Rid
5. General Microbiology by Powar & Daginawala
6. Text book of microbiology by Ananthnarayanan, Jarayam Panikar
2.3.3 Pharmaceutical Biochemistry

1. Enzymes and co-enzymes:
   Nomenclature, enzyme kinetics and its mechanism of kinetics, types of inhibition, drugs used as enzyme inhibitor, resistance related to drugs, enzymes and isoenzymes used in clinical diagnosis. 06 05 – 08

2. Co-enzyme:
   Biochemical role of vitamins and metals as co-enzymes.
   Significance of SGOT, SGPT, LDL, alkaline and acid phosphatases, serum amylase and serum lipase 06 04 – 07

3. Brief introduction to carbohydrate metabolism and diseases related to carbohydrate metabolism:
   Diabetes mellitus, methyl keto urea, galactosemia glycogen storage disease, lactose intolerance and glucose tolerance test. 02 05 – 08

4. Lipid metabolism:
   Oxidation of fatty acid, beta oxidation and energetics, control of metabolism, with reference to physiological and pathophysiological significance essential fatty acids and eicosinoids, (prostaglandins, thromboxanes and leukotriene) phospholipids, sphingolipids clinical orientation of lipid metabolism.
   Disease related to lipid metabolism. Hyper lipidemia, cholesterol metabolism, fatty liver and lipotropic factors, hypolipoproteinous atherosclerosis. 05 04 – 06

5. Biological oxidation:
   Redox potential, energy rich compounds. The respiratory chain, mechanism and energetics of oxidative phosphorylation, study of cytochromes, bioenergetics, production of atp and its biological significance. 03 07 – 09

6. Metabolism of ammonia and nitrogen containing monomers:
   Nitrogen balance, essential amino acid, transamination, deamination, conversion of amino acids to specialized product assimilation of ammonia urea cycle, metabolic disorders, formation of bile salts and pigment and clinical significance. 03 04 – 08

7. Nucleic acid biosynthesis:
   Biosynthesis of dna and its replication, mutation, physical and chemical mutagenesis/ carcinogenesis, dna repair mechanism, biosynthesis of rna and its types 05 05 – 10

8. Genetic code and Protein Synthesis:
   Genetic code, components of protein synthesis, Inhibition of protein synthesis, Brief account of genetic engineering. 06 06 – 08
Reference Books:

1. Textbook of Medical biochemistry, By Dr. Rana Shinde.
2. Outlines of Biochemistry, E. E. Cohn and P. K. Stumpf
3. Biochemistry by Albert Lehninger
5. Practical Biochemistry By David T. Plummer

### 2.3.4 Pharmacognosy & Phytochemistry - II

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<tr>
<th>Theory</th>
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1. **Volatile oils:**
   General methods of obtaining volatile oils from plants, study of volatile oils of mentha, coriander, cinnamon, cassia, lemon peel, orange peel, lemon grass, citronella, dill, clove, fennel, nutmeg, eucalyptus, musk, chenopodium, cardamom, valerian, palmarosa, gaultheria, sandalwood, patchouli

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<tr>
<th>Hrs</th>
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2. **Resins:**
   Study of drugs containing resin combination like colophony, podophyllum, jalap, cannabis, capsicum, myrrh, asafoetida, balsam of tolu, balsam of peru, benzoin, turmeric, storax and ginger.

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3. **Tannins:**
   Study of tannins and tannin containing drugs like gambir, black catechu, myrobalan, behera.

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4. **Phytochemical screening:**
   a. Preparation of extracts.
   b. Screening of alkaloids, glycosides (Cardiac, saponins, anthraquinones, flavonoids, coumarins and cynogenetic glycosides), Tannins, steroids, carbohydrates, proteins and amino acids.

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5. **Fibres:**
   Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass wool, polyester and asbestos

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6. **Pharmaceutical aids & technical products:**
   Study of pharmaceutical aids like talc, Diatomite, kaolin, bentonite, gelatin

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<th>Hrs</th>
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<tr>
<td>04</td>
<td>04 - 06</td>
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</table>
Reference Books:

2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.


### Biostatistics and Computer applications

<table>
<thead>
<tr>
<th>Theory</th>
<th>2 hrs/wk.</th>
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<tr>
<td>Hrs</td>
<td>Marks</td>
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1. **Basic Concepts of Statistics**
   - Introduction and Meaning of statistics, statistical data and Data graphics, collection and Classification of data, frequency distribution, mean, mode, median, types of measures, absolute and standard deviation and Coefficient of variance
   - Hrs: 02, Marks: 03 - 05

2. **Probability and Probability distribution**
   - Terminology, theoretical, binomial, normal probability distribution
   - Hrs: 01, Marks: 03 - 05

3. **Sample, Sampling Methods and Statistical Inferences**
   - Methods of sampling, statistical tests for rejection, testing procedures, t-test, chi square test, confidence intervals in biological assays.
   - Hrs: 02, Marks: 04 – 06

4. **Correlation and Regression analysis**
   - Methods of studying correlation, spearman’s rank correlation and Significance, methods to find regression line, properties of regression coefficient
   - Hrs: 03, Marks: 04 – 06

5. **Analysis of Variance and Experimental Design**
   - Meaning and the Technique of ANOVA
   - Hrs: 01, Marks: 03 – 05

6. **History and Generation of Computers**
   - Fundamentals, evolution and generation, types of computers
   - Hrs: 01, Marks: 03 – 05

7. **Anatomy and Computer Peripherals**
   - CPU, Input and Output devices, Ancillary machines, characteristics of computers, memories and storage devices
   - Hrs: 02, Marks: 03 – 05

8. **Operating systems**
   - Terminology MS-DOS, MS Windows, Introduction to other operating systems.
   - Hrs: 04, Marks: 06 – 10

9. **Microsoft office**
   - MS Word, MS Excel, MS PowerPoint
   - Hrs: 05, Marks: 08 – 10

10. **Introduction to internet basics and networking**
    - Internet browsing, search engines, e-mail networking concepts, LAN, WAN.
    - Hrs: 02, Marks: 03 - 05

11. **Computer applications in pharmacy**
    - Applications to pharmacokinetics, drug design, hospital and clinical pharmacy, pharmaceutical analysis, crude drug identification, diagnosis and data analysis, bulk drug and pharmaceutical manufacturing, sales and marketing
    - Hrs: 01, Marks: 03 - 05
Reference Books:

1. Introduction to Biostatics and Computer science by Y. I. Shah, Dr. A. R. Paradkar, and M. G. Dhaygude, Nirali Prakashan, Pune – 02
2. Methods of Biostatics for Medical and Research students by B. K. Mahajan, Jaypee brothers medical publishers (P) Ltd., New Delhi – 02
4. Statistical methods for cost accountants by S. P. Gupta, Sultan Chand and Sons Publishers, New Delhi - 02
6. William and Fassett - Computer Applications in Pharmacy.
9. Computer Programming - I by Sneha Phadke, Publisher: Technova Publication
11. The ABC’s of the Internet by Cristain Crumlish, BPB Publications, N. Delhi – 01
1. Physical Properties of Drug Molecules
   - Determination of Density / Specific gravity of given liquids
   - Determination of Refractive index of given liquids
   - Determination of Molecular weight by Freezing Point Depression Method (Rast camphor method)
   - Determination of viscosity of given liquids by Ostwald, Suspended and Rotary viscometer

2. Solubility and distribution co-efficient:
   - Determination of partition coefficient of iodine between carbon tetrachloride and water.
   - Determination of partition coefficient of benzoic acid between water and benzene.
   - Determination of critical solution temperature of phenol water system.
   - Study of the effect of third component on CST
   - To study phase behaviour of 3 component system and construct ternary phase diagram.
   - Determination of heat of solution by solubility method.
   - Determination of solubility of drugs.
   - Conductivity: Verification of Ostwald's dilution law by conductometry.

3. Ionic Equilibria
   Determination of buffer capacity at various stages of titration of weak acid against strong base thus determining pKa of the acid

4. Adsorption
   Determination of specific surface area by adsorption method

5. Chemical Kinetics:
   First order kinetics. (any one)
   Determination of degree of hydrolysis of given ester.
   Determination of relative strengths of 2 acids.
   Second order reaction (any two)
   To find the degree of hydrolysis of a second order reaction when a=b.
   To verify Ostwald’s dilution law for a second order reaction.
   Determination of energy of activation of acid hydrolysis of methyl acetate.
   Kinetics of Inversion of Cane Sugar
Reference Books:-

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone & Lewis
3. Practical Pharmaceutics (Physical Pharmacy) - H. N. More, Ashok Hajare
4. Physical Chemistry – Maron S. & Pruton
5. Remington’s Pharmaceutical Sciences
6. Theory & Practice of Industrial Pharmacy – Lachman Liebermann & Kanig
7. Physical Chemistry – Bahl and Tuli
8. Pharmaceutical Technology – Eugene Parrott
9. Physical Pharmacy – Martin, Swarbrick and Commarata
10. Practical Pharmaceutical Technology - Eugene Parrot
1. Study of microscope and other lab equipments
2. Identification of morphology of bacteria by
   - Monochrome staining
   - Negative staining
   - Gram staining
   - Cell wall staining
   - Spore staining
   - Capsule staining
   - Acid fast staining
   - Motility by Hanging drop technique
3. Preparation and standardization of nutrient broth, agar slants, stabs, plates.
4. Techniques of inoculation on different types of media, (coccis and bacilli)
5. Inoculation, isolation and study of growth pattern of micro organism (Colony Characteristics) on selective media.
   Escherichia coli - MacConkey’s agar.  
   Pseudomonas - Cetrimide agar.
   Salmonella - Xylose - lysine medium or Staphylococcus aureus - Vogel Johnson’s suitable selective medium.
7. Sterility testing.
8. Study of air and water microbiology.
10. Serological diagnosis of Typhoid.

Reference Books:

2. Tutorial Pharmacy - Cooper and Gunn
4. General Microbiology by Pelczar & Rid
5. General Microbiology by Powar & Daginawala
6. Microbiological methods by Collins & Lyne
2.3.8 Pharmaceutical Biochemistry Practical (3 hr./wk)

1. **Titration curves for amino acids:**
   Potentiometric / conductometric titration of sample of amino acids (at least two).

2. **Quantitative estimation of**
   - Amino acids by ninhydrin, biuret assay
   - Protein by folin-lowery method
   - Carbohydrate by folin-wu method, benedict’s quantitative reagent method

3. **Electrophoresis:**
   - Separation of serum protein
   - Separation of amino acid

4. Determination of abnormal constituents of urine.
   Demonstrations...

5. Enzymatic hydrolysis of glycogen by \(\alpha\) amylase
6. Effect of temperature on activity of salivary \(\alpha\) amylase.
7. Enzymatic determination of Glucose.

**Reference Books:**

1. Textbook of Medical biochemistry, By Dr. Rana Shinde.
2. Outlines of Biochemistry , E.E.Cohn and P. K. Stumpf
3. Biochemistry by Albert Lehninger
5. Practical Biochemistry By David T. Plummer
2.3.9 Pharmacognosy & Phytochemistry - II

1. Identification of crude drugs mentioned in theory
2. Study of fibres and pharmaceutical aids
3. Microscopic studies of seven selected crude drugs and their powder characters mentioned under the category of vol. oils and their chemical tests (Fennel, Cassia, Clove, Cardamom, Coriander, Ginger, Eucalyptus)
4. General chemical tests for alkaloids, glycosides, steroids, flavonoids and tannins.

Reference Books:
2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
2.3.10 Biostatistics and Computer applications Practical 3 hrs/wk.

1. Fundamentals:
The basic anatomy of Computers, Components of Computer system Viz. memory, CPU, various input-output units, Low and High level languages, units of size(Capacity), System software, Application software, Utility Software, IBM compatible personal computer and its components.

2. Anatomy and Computer Peripherals
CPU, Input and Output devices, Ancillary machines, characteristics of computers, memories and storage devices

3. Introduction to Operating systems
Terminology MS-DOS, Introduction and need, MS-DOS operating system Internal Commands, External Commands, batch files, MS Windows, Introduction to other operating systems.

4. Microsoft office
MS Word, MS Excel, MS PowerPoint

5. Introduction to internet basics and networking
Internet browsing, search engines, e-mail networking concepts, LAN, WAN.

6. Computer applications in pharmacy
Applications to pharmacokinetics, drug design, hospital and clinical pharmacy, pharmaceutical analysis, crude drug identification, diagnosis and data analysis, bulk drug and pharmaceutical manufacturing, sales and marketing

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2. Methods of Biostatics for Medical and Research students by B. K. Mahajan, Jaypee brothers medical publishers (P) Ltd., New Delhi – 02
4. Statistical methods for cost accountants by S. P. Gupta, Sultan Chand and Sons Publishers, New Delhi - 02
6. William and Fassett - Computer Applications in Pharmacy.
9. Computer Programming - I by Sneha Phadke, Publisher: Technova Publication
11. The ABC’s of the Internet by Cristain Crumlish, BPB Publications, N. Delhi – 01
### Semester – IV

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
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<tr>
<td>2.4.1</td>
<td>Physical Pharmacy – II</td>
<td>3</td>
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<tr>
<td>2.4.2</td>
<td>Pharmaceutical Biotechnology</td>
<td>3</td>
<td>50</td>
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<tr>
<td>2.4.3</td>
<td>Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry</td>
<td>4</td>
<td>50</td>
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<tr>
<td>2.4.4</td>
<td>Pharmaceutical Chemistry</td>
<td>3</td>
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<td>2.4.5</td>
<td>Pharmacology – I</td>
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<td><strong>Total</strong></td>
<td><strong>17</strong></td>
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#### Practical

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<tr>
<td>2.4.6</td>
<td>Physical Pharmacy – II (practical)</td>
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<tr>
<td>2.4.7</td>
<td>Pharmaceutical Biotechnology (practical)</td>
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<td>2.4.8</td>
<td>Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry (practical)</td>
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<td>Pharmaceutical Chemistry (practical)</td>
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<td>2.4.10</td>
<td>Pharmacology – I (practical)</td>
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<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>250</strong></td>
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2.4.1 Physical Pharmacy - II Theory 3 hrs/wk.

1. Matter and its properties:
   Introduction to state of matter, change in the state of matter, latent heat, sublimation, critical point, eutectic mixture, relative humidity, liquid complexes, liquid crystals, glassy state, solid-crystalline, amorphous and polymorphism.

2. Surface tension and interfacial phenomenon:
   Liquid interfaces, surface tension and surface free energy, measurement of surface and interfacial tension, spreading coefficient; surfactants, their classification, HLB, complex films, zeta and Nernst potential, applications in pharmacy.

3. Micromeritics:
   Particle size and size distribution, average particle size, number and weight distribution, particle number, methods to determine particle size; optical microscopy, sieving, sedimentation measurement, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties, compressibility index.

4. Rheology:
   Newtonian systems: Newton’s law of flow; types of viscosities, factors affecting viscosity, non newtonian system: plastic flow, pseudo plastic flow, dilatent flow; thixotropy, thixotropy in formulation, viscosity measurements, and applications in pharmacy.

5. Dispersed systems:
   A) Colloidal dispersion: definition, types, properties of colloids: protective colloids, applications of colloids in pharmacy.

6. Drug stability:
   General considerations and concepts, Mechanisms of drug instability: Interactions with containers and closures and their evaluation - compatibility testing. Half life determinations, factors affecting drug stability, Q10 value, accelerated stability study, expiration dating.
Reference Books:-

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone and Lewis
3. Physical Chemistry – Maron S. and Pruton
5. Theory & Practice of Industrial Pharmacy – Lachman Liebermann and Kanig
6. Physical Chemistry – Bahl and Tuli
7. Pharmaceutical Technology – Eugene Parrott
### 2.4.2 Pharmaceutical Biotechnology Theory (3 hrs/wk.)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hrs</th>
<th>Marks</th>
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<tbody>
<tr>
<td>1. Definition and scope - potential and achievements</td>
<td>02</td>
<td>03 – 05</td>
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<tr>
<td>2. Fermentation technology and industrial microbiology</td>
<td>13</td>
<td>15 – 18</td>
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<tr>
<td>3. Animal cell culture and genetic engineering</td>
<td>07</td>
<td>06 – 10</td>
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<tr>
<td>4. Preparation and characterization of immunologicals</td>
<td>06</td>
<td>05 – 08</td>
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<tr>
<td>5. Biotechnology derived products (therapeutic proteins)</td>
<td>04</td>
<td>03 – 05</td>
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<tr>
<td>6. Characterization and quality control of biotech derived products:</td>
<td>10</td>
<td>08 – 12</td>
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</table>

- **Fermentation** as a biochemical process, bioconversion and biotransformation, fermenter construction and working, downstream processing, fermentation monitoring, in-situ recovery of fermentation products, waste discharge and effluent treatment, definition of BOD and COD, safety and proof of efficacy of biotech products, general applications of fermentation in the manufacturing of antibiotics (Penicillin, streptomycin, tetracycline) dextran, vitamins (Vit.B2 and Vit.B12), microbial enzymes, microbial limit tests and assays (antibiotics, vitamins, amino acids etc.), standards of water used in fermentation, pharmaceutical and cosmetic industry.

- **Introduction** to mammalian genome, genetic recombination of animal cells, purified DNA, vectors probing and cloning, strain and restrictional enzymes, gene machine, DNA hybridization, molecular engineering, polymerase chain reaction, genetic diseases, human gene therapy, tissue engineering.

- Preparation and standardization of vaccines, sera, allergenic extracts, diagnostics, biologicals, Introduction to veterinary vaccines, immunomodulating substances, lymphokines, preparation of monoclonal antibodies, applications of monoclonal antibodies.

- Examples of biotechnology derived therapeutics products, production of human Insulin, interferon, somatostatin, somatotropin.

- Purification, characterization and analysis, establishing safety and efficacy, impurities presents in biotechnology derived products, foreign contaminants (e.g. host cells, proteins, DNA/RNA and pyrogens) and related substances (e.g. clips i.e. aggregates of desired protein derived from isolation and purification), heterogeneity of desired protein-analytic technique (gel electrophoresis, HPLC/FPLC, trypic mapping, N-terminal sequencing, light scattering, circular dichroism and ultracentrifugation), immunoassay and ELISA, enzyme substrate assays and bioassays, degradation pathways and stability, regulatory requirements governing marketing.
Reference Books:

2.4.3 Pharmaceutical Heterocyclic & Polycyclic Chemistry  
Theory  4 hrs/wk.

1. Stereochemistry:
   - Isomerism and its types - Optical isomerism-nomenclatures [including D/L & R/S] and projection formulas, enantiomers, distereoisomers, chirality, racemic mixtures, resolution of racemic mixtures.
   - Geometrical isomerism-Z & E, cis-trans isomerisms.
   - Methods of determination of configurations.
   - iv. Conformational isomerism: Conformations of n-butane & cyclohexane and disubstituted cyclohexanes, locking of conformation with respect to t-butyl cyclohexane, Conformational analysis.

2. Heterocyclic Compounds:
   Introduction & Nomenclature of all heterocyclic compounds, Preparation, reactivity and Chemical reactions of Aziridines, Furan, Pyrrole, Pyridine, other fused pyridines, purines, diazines, triazines & tetrazines, oxazines, thiazines, pyrazoles, tetrazoles, oxadiazoles, thiadiazoles, isoxazoles, isothiazoles & there benzo dervs, Pyrimidine, Thiophene, Indole, Quinoline, Imidazole, Thiazole, Oxazole, Triazole, azepines, diazepines & benzodiazepines.

3. Molecular Rearrangements:
   General considerations, types of rearrangement Nucleophilic, electrophilic, free radical), Principle, reaction mechanism and stereochemistry of...
   - Electron rich Rearrangements: Stevans rearrangement, Wittig rearrangement, Neber rearrangement, Sommelet rearrangements, Favourskii rearrangement.
   - Rearrangements involving migration of Aromatic ring-Fries rearrangement, Claisen rearrangement.

4. Fused polynuclear Compound: Preparation, reactivity and chemical properties of Naphthalene, Anthracene and Phenanthrene.

5 Oxidation & reduction reactions: General consideration of mechanisms, elimination of hydrogen, oxidation involving cleavage of carbon-carbon bonds, replacement of hydrogen by oxygen, oxygen is added to the substrate, oxidative coupling, reduction involving replacement of oxygen by hydrogen, oxygen is removed from the substrate.
**Reference Books:**

3. Organic Chemistry by Pine
4. Advanced Organic Chemistry by Solomans
5. Organic Chemistry: Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry: Peter Sykes
8. Organic Chemistry by Jain M.K.
10. Vogel’s Textbook of practical organic chemistry
11. Practical Organic Chemistry – Mann and Saunders
12. Qualitative Analysis in Organic Chemistry-Nadkarni V.V. and Fernades P.S.
13. A Laboratory handbook of Organic qualitative analysis and separations-Kulkarni V.S. and Pathak S.P.
2.4.4 Pharmaceutical Chemistry Theory 3 hrs/wk.

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<th>Hrs.</th>
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1. **Amino-acids, Peptides, and Proteins:**
   Introduction to amino acids, proteins and peptides, Classification of amino acids, General Synthetic methods for amino acids, General principle of Polypeptide synthesis, Isolation and analysis of amino acids from proteins, Determination of C-terminal, N-terminal and the sequence of amino acids in peptides, Classification of Proteins, Protein organization and structure, Characteristics of proteins with details of peptide bond geometry, Quartenary structure of Insulin and Oxytocin. Peptides and drug action.

2. **Vitamins:**
   Chronological development of vitamins, General structure of vitamins- Structural elucidation of Vitamin A (Retinol), Vitamin B₁ (Thiamine), Vitamin D₂ and α-Tocopherol.

3. **Glycosides:**
   General Chemistry of Glycosides, Determination of structure, Methods in determination of constitution of Arbutin, Amygdalin and Salicin.

4. **Alkaloids:**
   General Chemistry of Alkaloids, General methods of determination of molecular structure, Methods in determination of constitution of Ephedrine, Nicotine, Atropine and Quinine.

5. **Chiral Technology:** Introduction, chirality, Resolution, asymmetric synthesis, chiral pool, chiral reagents, chiral auxillary & chiral catalyst.

6. **Medicinal dyes and pigments:**
   Introduction to synthetic and natural dyes, Chemical classification of synthetic dyes, Constitution, synthesis and properties of Indigotin and Alizarin. Structure and uses of dyes/colors/pigments official in IP. Medicinal uses of dyes.
Reference Books:

1. Chemistry of Natural Products by O. P. Agrawal vol. I and II.
2. Organic chemistry of natural product by Gurdeep Chatwal vol. I and II.
7. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
2.4.5 Pharmacology – I  

1. **General Pharmacology**
   - Introduction and definitions- Sources and active ingredients of drugs.  
     Hrs: 02
   - Various drug discovery and development stages (preclinical and clinical).  
     Hrs: 02
   - Routes of administration of drugs.  
     Hrs: 02
   - Basic pharmacokinetics: absorption, distribution, metabolism and excretion. Basic pharmacokinetic parameters, Biopharmaceutical factors influencing bioavailability  
     Hrs: 01
   - Absorption kinetics, factors influencing absorption, cell membrane, transport of drug across the biological barriers, presystemic metabolism  
     Hrs: 03
   - Drug distribution - tissue distribution, plasma protein binding, blood brain barrier, placental barrier.  
     Hrs: 03
   - Biotransformation – phase-I, phase-II, enzyme induction, enzyme inhibition, First pass effect.  
     Hrs: 03
   - Excretion, Half life.  
     Hrs: 02
     Hrs: 05
   - Dose response relationship, structure activity relationship  
     Hrs: 02
   - Adverse drug reactions.  
     Hrs: 02

2. **Drugs acting on Autonomic Nervous System**  
   Introduction to Autonomic Nervous System: Cholinergic, adrenergic transmission & other peripheral transmitters  
   Hrs: 02
   - Cholinergic & anticholinergic drugs  
     Hrs: 05
   - Sympathomimetic & Sympatholytic drugs : adrenoceptor agonist and antagonists  
     Hrs: 06
   - Skeletal muscle relaxants  
     Hrs: 02
   - Ganglion transmission, Ganglion Stimulants & Blocking drug  
     Hrs: 02
   - Drugs used in the treatment of eye disorders  
     Hrs: 01
Management of atropine, muscarine, scorpion poisoning

Reference Books:

2. Essential Pathology – Emanuel Rubin, John L., Farber J.B. Lippancot company.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
2.4.6  Physical Pharmacy – II

1. Surface Tension and Interfacial Phenomenon:
   - Determination of surface tension of given liquid – 02
   - Determination of Interfacial tension of given liquid – 02
   - Determination of HLB of surfactant – 02

2. Micromeritics:
   - Determination of particle size and size distribution of any material by
     Sieve Analysis
     Microscopy
   - Determination of derived properties of powders or granules

3. Rheology:
   - Determination of Viscosity of given liquids
   - Determination of composition of a binary mixture by viscosity method.
   - Demonstration of Brookfield viscometer

4. Dispersed systems:
   - Determination of critical micelle concentration of a surfactant with stalagmometer.
   - Determination of mol. wt. of polymer by viscosity method
   - Determination of sedimentation volume of suspension prepared by different suspending agents.
   - Identification of type of emulsion by different methods

Reference Books:-

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone & Lewis
3. Physical Chemistry – Maron S. & Pruton
4. Remington’s Pharmaceutical Sciences
5. Theory and Practice of Industrial Pharmacy – Lachman Liebermann & Kanig
6. Pharmaceutical Technology – Eugene Parrott
7. Physical Pharmacy – Martin, Swarbrick and Commarata
8. Practical Pharmaceutics (Physical Pharmacy) - H. N. More, Ashok Hajare
9. Practical Physical Pharmacy - U. B. Hadkar, T.N. Vasudevan, K. S. Laddha
2.4.7 Pharmaceutical Biotechnology

1. Standardization of water used in fermentation and pharmaceutical industry by MPN and IMViC
2. Microbial limit tests
3. Microbial assays
4. Preparation of plant cell culture media
5. Measurement of plant cell growth
6. Development of callus culture
7. Development of embryo culture
8. Isolation of DNA
9. Isolation of RNA
10. SDS polyacrylamide gel electrophoresis of seed proteins
11. Production of secondary metabolites using any available plant cell
12. Isolation of enzyme by adsorption
13. Isolation of enzyme by entrapment in carrageenan / calcium alginate
14. Fermentative production of antibiotics (penicillin) / Vitamins (Vit B₁₂)
Reference Books:
15. Pharmacopoeia of India, 1985, Govt. of India, Ministry of Health and Family Welfare.
2.4.8 Pharmaceutical Heterocyclic & Polycyclic Chemistry Practical 3 hrs/wk.

1. **Synthesis of organic compounds**
   - Benzillic acid [Benzillic acid Rearrangement]
   - Antranillic acid [Hoffmann Rearrangement]
   - Benzanilide from benzophenone [Beckmann Rearrangement]
   - Benzylidene acetophenone [Claisen Schmidt reaction ]
   - Benzimidazole
   - Benzotriazole
   - 1, 2, 3, 4 Tetrahydrocarbazole

2. **Estimation of functional groups**
   Phenols, Amines, Nitro groups

3. **Analysis of oils**
   Acid and, Iodine Value, Sap Value

4. One practical workshop on Molecular Models with the help of ball and stick Model.

**Reference Books:**

1. Advanced Organic Chemistry, Ed. 4 –Jerry March
3. Organic Chemistry : Pine
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry: Peter Sykes
8. Organic Chemistry-------Jain M.K.
10. Vogel’s Textbook of practical organic chemistry
11. Stereochemistry of Organic Compounds—Nasipuri D.
2.4.9 Pharmaceutical Chemistry  

Practical 3 hrs/wk.

1. Extraction of strychnine and brucine from nuxvomica, ammonium glycirrhizinate from liquorice, aloin from aloe and nicotine picrate from tobacco leaves.
2. Estimation of simple functional groups like alcoholic, methoxy and amino groups of biomolecules stated under theory.
3. Identification tests of Alkaloids, Glycosides and carbohydrates.
4. Titrimetric analysis of any two antibiotics.

Reference Books:

1. Chemistry of Natural Products by O. P. Agrawal.
6. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
9. Practical Pharmacognosy by Dr. C.K. Kokate, Vallabh Prakashan, Delhi.
2.4.10 Pharmacology - I

1. Study of laboratory animals and their handling (a. Frogs, b. Mice, c. Rats, d. Guinea pigs and Rabbits)
2. Study of laboratory appliances used in experimental pharmacology
3. Study of use of anesthetics in lab animals (open method and closed method).
4. Study of routes of administration (mice/rats/rabbits).
5. Different modes of collection blood from animal like mice, rat, rabbit and guinea pig.
6. Study of route of administration as a factor modifying drug action (Mg SO₄)
7. Study of effect of autonomic drugs on rabbit’s eye.
8. Effect of drugs on ciliary motility of frog’s esophagus
9. Study the effect of skeletal muscle relaxants using rota rod apparatus.
10. Study the effect of acetylcholine on frog rectus abdominus muscle.

Note: Wherever possible the simulated experiments may be done
CPCSEA approval to be obtained for experiments on animals.

Reference Books:

### Semester – V

<table>
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<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
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<tr>
<td>3.5.1</td>
<td>Cosmeticology</td>
<td>3</td>
<td>50</td>
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<td>3.5.2</td>
<td>Pharmaceutical Engineering</td>
<td>3</td>
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<td>3.5.3</td>
<td>Medicinal Chemistry – I</td>
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<td>50</td>
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<td>3.5.4</td>
<td>Pharmaceutical Polymer Chemistry</td>
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<td>50</td>
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<td>3.5.5</td>
<td>Pharmacology – II</td>
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<td>50</td>
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### Practical

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<th>Hours / Week</th>
<th>Maximum marks</th>
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<td>3.5.6</td>
<td>Cosmeticology (Practical)</td>
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<tr>
<td>3.5.7</td>
<td>Medicinal Chemistry – I (Practical)</td>
<td>3+3</td>
<td>50</td>
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<td>3.5.8</td>
<td>Pharmaceutical Polymer Chemistry (Practical)</td>
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<td>50</td>
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<tr>
<td>3.5.9</td>
<td>Pharmacology – II (Practical)</td>
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<td>50</td>
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<td><strong>Total</strong></td>
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<td><strong>200</strong></td>
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<td>3.5.1 Cosmeticology</td>
<td>Theory</td>
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1. **Physiological Consideration:**
   Skin, hair, nail and eye- in relation to cosmetic application.

2. **Properties, significance & applications of**
   a. Excipients used in various cosmetic formulations
   b. sensitivity & irritation tests for colours

3. **Formulation, Manufacturing & evaluation of cosmetics for**
   a. **Skin:**
      Powders, creams, lotions, deodorants, antiperspirants, suntan preparations, bathing preparations
      Make up preparations - Rouge, Lipsticks
   b. **Hair:**
      Shampoos, hair grooming preparations, preshave & after shave preparations, shaving preparations, depilatories & dyes.
   c. **Nail:**
      Nail lacquers, removers, nail bleach.
   d. **Eye:**
      Eye shadow, mascara, eyebrow pencil, eye make-up remover, eyeliners, eye cover-up makeup.

4. **Aerosols:**
   Definition, advantages, disadvantages. Components, propellants, General formulation, Manufacturing, Evaluation & Pharmaceutical applications,
References:

1. J. Knowlton and S. Rearce; Handbook of cosmetic sciences and technology Elsevier science publisher.
3. E. G. Thomssen; Modern cosmetics; Universal Publishing Corporation.
4. M. S. Balsam and E. Sagarin; Cosmetics, science and technology; John Wiley and Sons.
5. R. L. Elder; Cosmetic Ingredients, their safety assessment; Pathotox.
6. H. R. Moskowitz; Cosmetic Product Testing; Marcel Dekker.
7. W. C. Waggoner; Clinical safety and efficacy testing of cosmetics; Marcel Dekker.
8. C. G. Gebelein, T. C. Cheng and V. C. Yang; Cosmetic and pharmaceutical applications of polymers; Plenum.
9. L. Appell; The formulation and preparation of cosmetics, fragrances and flavours; Micelle Press.
10. W. A. Poucher; Poucher’s Perfumes, cosmetics and soaps; vol.3 Chapman and Hall
11. Dr. Laba; ‘Rheological properties of cosmetics and toiletries; Marcel Dekker.
3.5.2 Pharmaceutical Engineering Theory (3 hrs/wk.)

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<td>08 – 12</td>
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1. Fluid flow:
   Fluid statics, mechanism of fluid flow, Bernoulli’s theorem, fluid heads, fluid handling (liquid and air)

2. Handling and conveying:
   Solids: portable power driven machines, trucks, trailers, power shovels, gantry cranes. Permanent installations for handling solids, conveyors-belt, chain, screw and pneumatic conveyors.
   Fluids: pumps, pipes and fittings, valves, plug, globe, gate and check valves, pipe connections. Application in pharmacy e.g. in water management and handling of liquid dosage forms.

3. Environmental control:
   Air handling, air conditioning, refrigeration - water vapour - air mixture, humidity and particulates in air refrigeration. Application of environmental control in pharma departments like powder, tablets, capsules.

4. Boilers:
   Main parts, mountings and accessories-industrial boilers including cochron, babcock wilcox and lancashire.

5. Measurements:
   Flow: classification and description of various fluid flow measuring devices like orifice, venturi, pilot tube, rotameter and current meters.
   Pressure: classification and description of various pressure measuring devices.
   Temperature: various direct and indirect (remote) methods using mechanical and electrical principles.

6. Material technology:
   Corrosion – Mechanism of corrosion, types of corrosion and ageing, factors influencing corrosion and methods of combating corrosion.
   Materials of construction:
   Classification into metals and non-metals. Ferrous and non-ferrous metals.
   Ferrous - cast iron, mild steel, stainless steel.
   Non ferrous - copper and alloys, nickel alloys, aluminium.
   Non metals - glass and plastics, types of plastics.
   Poly vinyl chloride, polystyrene, polyethylene, polypropylene, nylon, polyester, epoxy, polytetrafluoroethylene, polycarbonate, abs, phenolic plastics, fibre reinforced plastics and laminates, uses of materials of
construction in the design of pharma packaging.

7. Maintenance:

Objective, preventive and corrective maintenance, maintenance record keeping, maintenance of machineries and equipments in pharmaceutical departments like - mills, micropulverizer, sifters, mixers, homogenizers, granulators, compression equipments, coating equipments, packaging equipments, balances, ph meter, polarimeter, refractometer, microscope, colorimeter and flame photometer.

8. Safety:

Hazards and their classification - mechanical, fire, chemical and occupational, their types and prevention.

Fire and explosion - chemistry of fire, classification of fires, methods of extinguishing.

Accidents - unsafe actions, unsafe conditions, financial losses, costs prevention.

Accident safety training and education

Reference Books:


8. Industrial Instrumentation, Donald P. Eckman,Seventh Wiley Eastern, Reprint, 1983,Wiley Eastern Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002
### 3.5.3 Medicinal Chemistry – I Theory (3 hrs/wk.)

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### 1. Introduction:
Sources of Drugs- Serendipity, Random Screening, Extraction from Natural Sources, Molecular Modification.

### 2. Theoretical Aspects of Drug Action
The Ferguson's Principle
Physicochemical Parameters and Pharmacological Activity- Solubility, Partition Coefficient, Surface Activity, pKa, Ionisation, Stereochemical Factors, Bio-isosterism.

### 3. Metabolism
Routes of Elimination
Factors Affecting Metabolism – Genetic Factors, Physiological Factors, Pharmaceutical Factors, Drug Interactions.
Metabolic Process- Phase I (Oxidation, Reduction & Hydrolysis) and Phase II (Glucuronide Conjugation, Acetylation, Methylation, Sulphate Conjugation, Conjugation with amino acids and Mercapturic acid formation.)

### 4. Introduction to Receptor Concept
History, affinity, receptor & biological response, drug-receptor interaction, forces involved in drug-receptor interaction, receptor theories, conformational flexibility and multiple modes of action.

### 5. The following classes of drugs should be discussed in relation to:
- Introduction to the rational development (if any)
- Detailed Classification of each class
- Mechanism of action
- Synthesis of compounds with asterisk
- Structure-activity relationship
- Generic names / Trade names
- Chemical nomenclature
- Metabolism
- Uses

### 6. Drugs Acting on ANS

#### a. Drugs Acting on Cholinergic Nervous System:

#### b. Drugs Acting on Adrenergic Nervous System:
c. Local Anaesthetics:
Lignocaine, Benzocaine, Lidocaine, Procaine, Bupivacaine.

7. Drugs Acting on Cardio Vascular System:

Anti Hypertensives & Anti Arrythmic Agents:
Calcium channel blockers lanatosides A,B,C, Digoxin, Quinidine, Procainamide*, Nifedipine*, Amlodipine, Verapamil, Hydralazine, ACE Inhibitors, Enalapril and related drugs, Vasodilators such as Amyl nitrite, Nitroglycerin, Isoxsuprine, Sodium Nitroprusside.

8. Antilipedemic Agents (Lipid lowering agents):
Lipoproteins: Classes & Metabolism, Hyperlipoproteineamias, Types and therapy, Clofibrate*, HMG-COA reductase inhibitors. (Provastatin*, Lovastatin, Simvastatin, Atorvastatin).

9. Diuretics:

10 Hypotensive agents acting on vascular smooth muscle: Nitrites, amyl nitrite, glyceryl trinitrate, sodium nitrite, tetryanitrate, mannitol, penetrythritol tetryanitrate, Isosorbide mononitrate, Isosorbide dinitrate.

Reference Books:

6. Profiles in Drug Synthesis : V.N. Gogte
9. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
11. Practical Organic Chemistry – Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson
3.5.4 Pharmaceutical Polymer Chemistry Theory (3 hrs/wk.)
1. **Introduction to Polymer Chemistry and its pharmaceutical applications:**

   **Introduction:**

   Monomers, Polymers, backbone and side chains of polymers.

   Tacticity of Polymers: Stereochemistry of substituents, Relative and absolute configuration, Syndiotactic (R,S alternating), Isotactic (all R or all S), Atactic (R and S random), Illustration of tacticity with polyethylene polymers (no tacticity) and polypropylene polymers.

   Classification of Polymers

   a) Addition Polymers: Addition to pi bonds- PVC, Teflon, polystyrene, polymethacrylate.

   Macroscopic properties of these polymers- Crystalline (HDPE), Amorphous, Random conformation.

   b) Condensation Polymers/Co-polymers: Formation of condensation polymers- PET (polyethyleneterephthalate) and Nylon (6, 6).

   Pharmaceutical uses of polymers.

2. **Purines, Pyrimidines and nucleic acids:**

   General knowledge of Nitrogeneous Bases in Nucleic Acids, Chemistry, structure and functions of nucleic acids, nucleosides and Nucleotides, Introduction to purines and pyrimidines, Synthesis of adenine, guanine, uracil, thiamine and cytosine. Examples of Nucleic acid analogues used as drugs.

3. **Introduction to chemistry of Pharmaceutical Excipients**

   General Chemistry and Structure Property Relationship of

   1.1-**Cellulose derivatives**-

   Ethyl Cellulose, Hydroxy propyl methyl cellulose, Hydroxy propyl cellulose, Microcrystalline cellulose and Sodium carboxy methyl cellulose.

   1.2-**Carbopols**-

   1.3-**PEG Derivatives**- Polyvinyl Alcohol, Polyvinyl Phthalate

   1.4-**Plasticizers**- Triethyl citrate, Tri acetin, Propylene Glycol, and Glycerin.

   1.5-**pH sensitive polymers**-

   (a) **Acrylic acid derivatives**- Solid and liquid eudragits.

   (b) **Cellulose derivatives**- Cellulose acetate phthalate, hydroxyl propyl cellulose phthalate.

   1.6-**Binders, Disintegrants and Super disintegrants**-

   (a) **Polysaccharides**- Gums and mucilages of starch, acacia and tragacanth.

   (b) **Resins**- Indion-414 (Vinyl and divinyl benzene copolymers), Pyrillidones, cross-povidone/ acdisol/ polyplasdone.

   1.7-**Solubility enhancers/ Emulsifiers**- Tweens and Spans.
4. **Lipids:**

Classification of lipids- Fats and oils, Phospholipids (Cephalins, Lecithins, Phosphatidyl serine & Phosphatidyl choline), Glycolipids, Steroids (cortisone, lanosterol), Terpenes (Vitamin-A) and prostaglandins (along with formation from arachidonic acid). Structure and chemistry of all classes. Nutritional facts about fatty acids, triacylglycerides and cholesterol. Chemistry of the lipoidal barriers to drug absorption and distribution.

5. **Carbohydrates:**

General Chemistry of carbohydrates, classification, General methods of determination of molecular structure, Methods in determination of constitution of


**Reference Books:**

1. An Introduction to Physical Chemistry, Das Ishwar, Sharma Archana, New Age International (P), Limited, New Delhi
3. Chemistry of Natural Products by O. P. Agrawal vol. I and II.
5. Introduction to Polymers, By Robert J. Young, Amazon, UK.
10. Organic chemistry of natural product by Gurdeep chatwal vol. I and II.
12. Polymer Chemistry: An Introduction, By Malcolm P. Stevens, Amazon, UK.
13. Polymer Composite. M. C. Gupta and A. P. Gupta. New Age International (P), Limited, New Delhi
17. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
3.5.5 **Pharmacology – II**  

<table>
<thead>
<tr>
<th></th>
<th><strong>Theory</strong> (4 hrs/wk.)</th>
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<td></td>
<td><strong>Hrs</strong></td>
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<tr>
<td>1</td>
<td>Introduction to Pathophysiology</td>
<td>02</td>
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<tr>
<td>2.</td>
<td>Basic principles of cell injury and adaptations.</td>
<td>03</td>
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<tr>
<td></td>
<td>a. Causes, pathogenesis and morphology of cell injury.</td>
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<td>b. Abnormalities in lipoproteinaemia, glycogen infiltration and glycogen storage disease.</td>
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<td>3.</td>
<td>Basics mechanisms involved in the process of inflammation and repair.</td>
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<tr>
<td></td>
<td>a. Pathogenesis of acute inflammation.</td>
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<td>b. Chemical mediators in inflammation.</td>
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<td></td>
<td>c. Pathogenesis of chronic inflammation.</td>
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<td></td>
<td>d. Repair of wounds in the skin. Factors influencing healing of wound.</td>
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<td>Diuretics-</td>
<td>02</td>
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<td>Role of nephron segments</td>
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<td></td>
<td>Basic and clinical pharmacology of diuretics</td>
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<td>Oedematous states and nonoedematous state</td>
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<td>5.</td>
<td>Pathology, pharmacology and pharmacotherapy of</td>
<td>13 – 21</td>
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<td>CCF</td>
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<tr>
<td></td>
<td>Arrhythmia</td>
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<td>Ischemic heart diseases: angina pectoris and myocardial infarction.</td>
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<td>Hypertension</td>
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<td>Hyperlipidemia</td>
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<td>Kidney and urinary tract disease</td>
<td>02</td>
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<tr>
<td></td>
<td>(terminological introduction to various disorders-</td>
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<td>Glomerulonephritis, nephrotic syndrome, acute &amp; chronic renal failure, pylonephritis.)</td>
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<td>4.</td>
<td>Autocoids</td>
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<td>Kinins, prostaglandins, Leukotrienes and cytokines</td>
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<td></td>
<td>Thromboxane- biosynthesis and pharmacology</td>
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<td>Histamines- release, immunological and non-immunological release and its pharmacology</td>
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<td></td>
<td>Antihistaminics – H1 and H2 antagonists</td>
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</tr>
<tr>
<td></td>
<td>Platelet activating factor.</td>
<td></td>
</tr>
</tbody>
</table>
Reference Books:

1. Goodman & Gillman - Pharmacological basis of Therapeutics Vol 1 & 2 (Pergamon Press)
2. Satoskar RS & Bhandarkar - Pharmacology & Therapeutics pt. I & II (Popular Prakashan)
3. Lewis Pharmacology - by Crossland (Churchill Livingston)
4. Laurence DR & Bennett - Chemical Pharmacology (ELBS)
5. Rang & Dale - Pharmacology (ELBS)
6. Sheth & Others - Selected topics in experimental Pharmacology (Kothari Book Dept).
7. Perry - Pharmacological experiments on Isolated preparations (E & S Livingston)
8. McLeod LJ - Pharmacological experiments on intact preparation (E & S Livingston)

3.5.6 Cosmeticology

Practical 3 hrs/wk.

1. Preparation and evaluation of following cosmetic formulations
   - Skin cosmetics
   - Hair cosmetics
   - Eye cosmetics
   - Nail cosmetics

Reference Books:

2. Modern Cosmetics : Thomson
3. Harry’s Cosmeticology
4. Perry’s Book of Cosmetics
5. Cosmetics Science & Technology : Edward Saggarin
1. Laboratory scale preparation of the following compounds
   - p-Bromothiophenol
   - Ortho-Iodo benzoic acid and Ortho-chlorobenzoic acid (Sandmeyer reaction)
   - Benzillic acid (Benzillic acid rearrangement)
   - Phenyl Toluene-p-Sulphonate
   - Acetanilide from Acetophenone (Beckmann Rearrangement)
   - Benzanilide from Benzophenone.
   - o-Thiocresol
   - Benzoic acid
   - Dibenzylacetone

Reference Books:

5. Profiles in Drug Synthesis : V.N. Gogte
8. Principle of Medicinal Chemistry (Volume I & II ) by Kadam, Mahadik and Bothara
10. Practical Organic Chemistry - Mann and Sanders
11. Systematic Identification of Organic Composition, Shriner and Fuson
3.5.8 Pharmaceutical Polymer Chemistry Practical (3 hrs/wk.)

1. Determination of Ester value and Acetyl value of Oils.
2. Simple identification tests of Proteins and Amino acids.
4. Extraction of lycopene from tomato, caseine from milk, caffeine from tea leaves and solanine from potato.
5. Demonstration of cyclodextrin biosynthesis.

Reference Books:

1. Chemistry of Natural Products by O. P. Agrawal.
6. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
9. Practical Pharmacognosy by Dr. C.K. Kokate, Vallabh Prakashan, Delhi.
3.5.9 Pharmacology – II

1. To study the physiological salt solution
2. To study the appliances
3. To study the isolated frog heart perfusion tech.
4. To study the effects of ions on isolated heart of frog. (KCl, CaCl$_2$)
5. To study the effects of Ach & Adrenaline on isolated heart of frog.
6. To study the effects of antagonists on isolated heart of frog.
7. To identify the unknown drug acting on isolated heart of frog.
8. To study the Cardiotonic activity of drugs using isolated frog heart and mammalian heart preparations. (Digitalis)
9. To study the effect of diuretics in rats/rabbits.
10. To prove the formula for ringer solution on frog heart.
11. To demonstrate the Anti-inflammatory effect of drugs using rat-paw edema method
12. To study the effect of drugs on blood vessels by using hindlimb perfusion tech.

Reference Books:

<table>
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<th>Hours / Week</th>
<th>Maximum marks</th>
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<td>3</td>
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<td>3.6.2</td>
<td>Pharmaceutical Unit Operations</td>
<td>3</td>
<td>50</td>
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<td>3.6.3</td>
<td>Medicinal Chemistry – II</td>
<td>3</td>
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<td>3.6.4</td>
<td>Pharmaceutical Analysis – III</td>
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<td>3.6.5</td>
<td>Pharmacology – III</td>
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<td>Pharmacognosy &amp; Phytochemistry - III</td>
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**Practical**

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<td>Pharmaceutical Technology – II (Practical)</td>
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<td>3.6.8</td>
<td>Pharmaceutical Unit Operations (Practical)</td>
<td>3</td>
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<td>3.6.9</td>
<td>Medicinal Chemistry – II (Practical)</td>
<td>3</td>
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<td>3.6.10</td>
<td>Pharmaceutical Analysis – III (Practical)</td>
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<td>3.6.11</td>
<td>Pharmacognosy &amp; Phytochemistry - III (Practical)</td>
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### 3.6.1 Pharmaceutical Technology - II Theory (3 hrs/wk.)

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**1. Tablets:**

Introduction, definition, advantages, disadvantages, preformulation, tablet excipients, types of tablets, formulation of different types of tablets, granulation technology on large scale by various techniques. Physics of tablet making, different types of tablet compression machinery and the equipments employed, processing problems.

Granulation: definition, reasons for granulation, method of granulation. Granulation mechanisms and mechanism of granule formation, pharmaceutical granulation equipments, IPQC.

Coating of tablets reasons, film coating, sugar coating, press coating. Functional coating standards for coated tablets, coating equipments, coating process. Validation of solid dosage forms, IPQC testing of tablets

**2. Capsules:**

Advantages, disadvantages.

Hard capsules: raw materials, shell manufacturing, capsule size, properties of filled material and formulation. Capsules filling equipments, processing and in process controls, evaluation of finished capsules and official standards.

Soft gelatin capsule: capsule shell, capsule content, methods of production and evaluation as a dosage form.

Importance of base adsorption and minim/gm factors in soft capsules.

Comparison between soft and hard gelatin capsules.

Stability testing and storage of capsule dosage forms.

**3. Microencapsulation:**

Definition, applications, methods and advances in microencapsulation technology, equipment used, manufacturing processes and evaluation.

**4. Oral sustained and controlled drug delivery:**

Definitions - historical development, components of therapeutic system - classification - details of matrix and diffusion control systems.

Biopharmaceutical aspects-steady state concept and calculation of maintenance dose, loading doses.

Diffusion and dissolution-steady state diffusion, lag time, diffusion cells and study of permeability of polymer and biological membranes, dissolution - the diffusion layer model, drug release, drug in polymer matrices, effect of porosity and tortuosity, membrane control, reservoir type devices.

Design and evaluation of sustained release and controlled release preparations.

Brief introduction to polymers
5. Packaging of non-sterile pharmaceutical products:

Packaging components, types, specifications and methods of evaluation, stability aspects of packaging. Packaging equipments, factors are influencing choice of containers, legal and other official requirements for container, package testing.

6. Plant layout techniques

Location, material handling, floor plans of different sections viz. Tablet, liquids, etc.

Reference Books:

1. Pharmaceutical Dosage forms - Ansel - Popovich & Allen. (Text book) and Drug Delivery system - (Williams & Wilkins)
2. American Pharmacy - Dittert (J. B. Lipincott)
3. Remington's Pharmaceutical Sciences -Alfonso R. Gennaro (Mack Publishing Co.)
5. Frobisher - Fundamentals of microbiology (Toppan) Industrial Pharmacy (Lea & Febiger),Modern Pharmaceutics - (Dekker)
6. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
### 3.6.2 Pharmaceutical Unit Operations

<table>
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<th>(3 hrs/wk.)</th>
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<tr>
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<td>Hrs</td>
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<tr>
<td><strong>1. Stoichiometry:</strong></td>
<td>03</td>
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<tr>
<td>Unit process, material and energy balances, molecular units, mole fraction, tie substance, gas laws, mole volume, primary and secondary quantities, equilibrium state, dimensionless equations, dimensionless formulae, dimensionless groups.</td>
<td>04</td>
</tr>
<tr>
<td><strong>2. Heat Transfer:</strong></td>
<td>03</td>
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<tr>
<td>Modes of heat transfer, Heat transfer in solids and liquids, Heat transfer equipments - heaters and heat exchangers. Source of heat, steam and electricity as heating media, determination of requirement of amount of steam/electrical energy, steam pressure, boiler capacity.</td>
<td>04</td>
</tr>
<tr>
<td><strong>3. Evaporation:</strong></td>
<td>03</td>
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<tr>
<td>Basic concept of phase equilibria, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators.</td>
<td>04</td>
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<tr>
<td><strong>4. Distillation:</strong></td>
<td>03</td>
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<tr>
<td>Rault’s law, phase diagram, volatility, simple steam and flash distillation, principles of rectification, Mc-Cab Thiele method for calculations of number of theoretical plates, azeotropic and extractive distillation.</td>
<td>04</td>
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<tr>
<td><strong>5. Drying:</strong></td>
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<tr>
<td>Moisture content and mechanism of drying, rate of drying and time of drying calculations, classification and types of dryers used in pharmaceutical industries and special drying methods.</td>
<td>04</td>
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<tr>
<td><strong>6. Size Reduction and Size Separation:</strong></td>
<td>03</td>
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<tr>
<td>Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mills including ball mill, hammer mill, fluid energy mill etc.</td>
<td>04</td>
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<tr>
<td><strong>7. Mixing:</strong></td>
<td>03</td>
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<tr>
<td>Theory of mixing, solid - solid, solid - liquid and liquid - liquid mixing equipments.</td>
<td>04</td>
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<tr>
<td><strong>8. Fluidization:</strong></td>
<td>03</td>
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<tr>
<td>Theory of fluidization. Application of fluidization in pharmacy in the areas of powder handling, agglomeration, drying and coating.</td>
<td>04</td>
</tr>
<tr>
<td><strong>9. Reactors:</strong></td>
<td>03</td>
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<tr>
<td>Fundamentals of Reactors, design for chemical reactions.</td>
<td>04</td>
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<tr>
<td><strong>10. Water purification:</strong></td>
<td>03</td>
</tr>
<tr>
<td>Deionization, reverse osmosis and distillation processes and large scale for manufacturing.</td>
<td>04</td>
</tr>
</tbody>
</table>
Reference Books:

8. Industrial Instrumentation, Donald P. Eckman, Seventh Wiley Eastern, Reprint, 1983, Wiley Eastern Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002
3.6.3 **Medicinal Chemistry – II**  

The following classes of drugs should be discussed in relation to:  
Introduction to the rational development (if any)  
Detailed classification of each class  
Mechanism of action  
Synthesis of compounds with asterisk  
Structure-activity relationship  
Generic names / Trade names  
Chemical nomenclature  
Metabolism  
Uses

1. **Antiamoebics:**  
   Life cycle of parasite, Ipecac alkaloids – emetine, metronidazole* and tinidazole, dicloxanide furoate*, quinfamide

2. **Anthelmintics**  
   Trematode diseases (Schistosomiasis): Lucanthone, hycanthone, niridazole, oxamniquine, praziquantel.  
   Cestode disease (Tapeworm): Niclosamide*.  
   Nematode infections: Diethylcarbamazine, ivermectin.  
   Gastrointestinal nematode infections: Benzimidazole like mebendazole*, parbendazole, thiabendazole* and others, pyrantel pamoate, levamisole.

3. **Antifungal agents**  
   Antibiotic like amphotericin B, Nystatin, and Griseofulvin, Tolnaftate*, Imidazole derivatives like miconazole*, fluconazole, ketoconazole*, clotrimazole, flucytosine.

4. **Quinoline Antibacterials:** Nalidixic acid, norfloxacin, ciprofloxacin*, sparfloxacin, ofloxacin.

5. **Anti Tubercular and Antileprotic Agents:** PAS*, isoniazid*, pyrazinamide*, ethionamide*, ethambutol*, antitubercular Antibiotics like rifampicin, cycloserine & streptomycin, dapsone, clofazimine, general principles and significance involving drug combinations.
6. **Antimalarials**

Life cycle of parasite and drugs acting on the various stages. Cinchona alkaloids, 4-Aminoquinoline, chloroquine* & others

- 8-Aminoquinoline – Primaquine* and others
- 9-Aminoacridine – quinacrine
- Quinoline methanol derivative – Mefloquine
- Folic acid inhibitors: Pyrimethamine*
- Antimalerial antibiotics & Misc. like halofantrine

7. **Antibiotics:**


8. **Antineoplastic agents**


- Antimetabolites-methotrexate*, 5-fluorouracil*, Ara-c, 6-HP, 6-TG.

**Reference Books:**

6. Profiles in Drug Synthesis : V.N. Gogte
9. Principle of Medicinal Chemistry (Volume I & II) by Kadam, Mahadik and Bothara
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson
3.6.4 Pharmaceutical Analysis – III Theory (3 hrs/wk.)

The theoretical aspect, basic instrumentation and applications of following analytical techniques should be discussed:

1. **UV-Visible spectrophotometry:**
   - In applications point to be covered
     - Single component analysis, absorbivity value, calibration curve, Single point and double point standard.
     - Multiple component analysis, simultaneous equation method, difference spectroscopy.
     - Colorimetric estimation by Oxidation, complexation and condensation reaction.
     - Determination of $\lambda_{\text{max}}$ by Woodward-Fischer rule.

2. **Infrared spectrophotometry**, Introduction to FTIR

3. **Nephelo-turbidimetry**

4. **Fluorimetry & Phosphorimetry**

5. **Nuclear Magnetic Resonance spectroscopy including $^{13}$C NMR**

6. **Mass spectrometry**

Reference Books:
5. Instrumental methods of Analysis- Ewing.
7. Garrat- The quantitative analysis of Drug (Toppan & Co.)
13. Merck Index.
3.6.5 Pharmacology – III  

**Theory**  
(3 hrs/wk.)

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<td>08 – 12</td>
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</table>

1. **Immunopharmacology**
   Definition and scope of immunology, immunity, types, vaccination, bacterial and viral vaccines, neonatal and pediatric vaccines, Various types of immune reactions, Immune complex reactions and secondary neuro transmitters in immunological reactions. Immune modulators, Immunosuppressents and its role in graft rejections.

2. **Endocrinological disorders.**
   - Drugs used in the endocrine disorders-
     - Thyroid hormone and Thyroid Inhibitors.
     - Insulin, Oral hypoglycemic drugs and Glucagon.
     - Gonadal hormones and their antagonists

3. **Chemotherapy:**
   - General considerations: - General principles of chemotherapy of infections
   - Drug resistance: Introduction, types, mechanism and its importance in chemotherapy
   - Mechanism of action, Pharmacokinetics, Uses & Adverse effect only to be discussed
   - Sulfonamides, Cotrimoxazole, Quinolones
   - Antibiotics effective against Gram-positive organisms- Penicillins
   - Antibiotics effective against Gram negative organisms- Amino glycosides
   - Antibiotics effective against both Gram positive & Gram negative organisms- Cephalosporins, Tetracycline & chloramphenicol.
   - Macrolide and other Antibacterial antibiotics, treatment of urinary tract infections and STDs
   - Chemotherapy of - Tuberculosis & leprosy including National TB programmes (DOTS)
   - Protozoal infections (Antimalarials, antiamoebics, Trichomoniasis, leishmaniasis & Kala azar infections)
   - Helminthiasis
• Fungal infections and its treatment
• Viral & HIV infections process and Antiretroviral drugs. HAART therapy of AIDS
• Antineoplastic agents.

(Disturbances of growth of cells, Carcinogenesis and its types, molecular mechanism of carcinogenesis, General biology of tumors, Differences between benign and malignant tumors, Classification of tumors, Histological diagnosis of malignancy, Etiology and pathogenesis of cancer, Invasions, metastasis, patterns of spread of cancer.)

Reference Books:
2. Essential Pathology – Emanuel Rubin, John L., Farber J. B. Lippincott company.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
16. Pharmacotherapy: A Pathophysiological approach, Dipiro, J. L. Elsevier.3
1. **Study of biological sources**, cultivation, collection, commercial varieties

   Chemical constituents, general biosynthetic pathways, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of following groups of drugs containing glycosides:

   - **Saponins**: Liquorice, ginseng, Dioscorea, Sarsaparilla and Senega
   - **Cardioactive sterols**: Digitalis, Squill, Strophanthus and Thevetia.
   - **Anthroquinone cathartics**: Aloe, Senna, Rhubarb and Cascara
   - **Others**: Psoralea, Ammi majus, Ammi visnaga, Saffron, Chirata, Quassia. Wild cherry bark, mustard

2. **Introduction** to alternative systems of medicine, with special emphasis given on Ayurveda

3. **Studies of traditional drugs**, common vernacular names, botanical Sources, morphology, chemical nature of chief constituents, pharmacology, Categories and common uses and marketed formulations of following Indigenous drugs Amla, Kantakari, Shatavari, Tylophora, Bhilawa, Kalijiri, Buch, Rasana, Punarnava, Chitrak, Apamarg, Gokhru, Shankhpushpi, Brahmi, Adulsa, Arjuna, Ashoka, Fenugreek, Garlic, Palash, Guggul, Gymnema, Shilajit, Nagarmotha and Neem.

4. **The holistic concept of drug administration in traditional systems of medicine**.

   Introduction to Ayurvedic preparations likes Aristas, Asvas, Gutikas, Tailas, Churnas, Lehyas and Bhasmas.
Reference Books:

2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
12. Handa & kapoor, Book of pharmacognosy
3.6.7 Pharmaceutical Technology - II Practical (3 hrs/wk.)

1. Tablets:
   Preparation and evaluation of tablets (any four)
2. Capsules:
   Filling of hard gelatin capsules
   Evaluation of capsules
3. Microencapsulation:
   Preparation and evaluation of microencapsulated products.
4. Oral sustained and controlled release:
   Evaluation of polymers used therein.
   Preparation and evaluation of SR/CR tablets/capsules/granules.

Reference Books:

1. Pharmaceutical Dosage forms - Ansel - Popovich & Allen. (Text book) and Drug Delivery system - (Williams & Wilkins)
2. American Pharmacy - Dittert (J.B. Lipincott)
3. Remington's Pharmaceutical Sciences -Alfonso R. Gennaro (Mack Publishing Co.)
3.6.8 Pharmaceutical Unit Operations Practical (3 hrs/wk.)

1. Determination of rate of evaporation
2. Experiments based on steam, extractive and azeotropic distillations.
3. Determination of rate of drying, free moisture content and bound moisture content.
4. Experiments to illustrate the influence of various parameters on rate of drying.
5. Experiments illustrate principles of size reduction, laws governing energy and power requirement of size reduction.

Reference Books:

8. Industrial Instrumentation, Donald P. Eckman,Seventh Wiley Eastern, Reprint, 1983,Wiley Eastern Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002
1. Laboratory scale preparation of the following compounds
   - Picric acid.
   - Cinnamic acid (Perkin Reaction)
   - Benzhydrol from Benzophenone (MVP Reduction)
   - 8-Hydroxyquinoline (Skraup’s synthesis)
   - Benzocaine
   - PABA
   - Spectral Analysis of Drugs Synthesized.
   - Determination of Partition Coefficient, Dissociation Constant and Molar Refractivity of Compounds for QSAR analysis.

Reference Books:

7. Principle of Medicinal Chemistry (Volume I & II ) by Kadam, Mahadik and Bothara
8. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science
10. Practical Organic Chemistry - Mann and Sanders
11. Systematic identification of Organic Composition, Shriner and Fuson
3.6.10 Pharmaceutical Analysis – III Practical (3 hrs/wk.)

2. Spectrophotometric analysis of finished products.
4. Estimation of Na⁺, K⁺ by flame photometer.
5. Estimation of drugs by using turbidometer & nephelometer.

Reference Books:
5. Instrumental methods of Analysis- Ewing.
7. Garrat- The quantitative analysis of Drug (Toppan & Co.)
13. Merck Index.
3.6.11 Pharmacognosy & Phytochemistry - III

Practical (3 hrs/wk.)

1. Identification of crude drugs listed in theory.
2. Microscopic study of some important glycoside containing crude drugs with their powder characters like Liquorice, Digitalis, Senna, Quassia, Cascara
3. Identification of traditional crude drugs listed in theory.
4. Standardization of some traditional drug formulations

Reference Books:

1. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
### Semester – VII

<table>
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<td>Biopharmaceutics &amp; Pharmacokinetics</td>
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<td>4.7.2</td>
<td>Medicinal Chemistry – III</td>
<td>3</td>
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<td>4.7.3</td>
<td>Pharmaceutical Analysis – IV</td>
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<td>4.7.4</td>
<td>Pharmacology – IV</td>
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<td>4.7.5</td>
<td>Pharmacognosy &amp; Phytochemistry – IV</td>
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<td>4.7.11</td>
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* Elective subjects

1. Pharm. Marketing
2. Medicinal Plant Biotechnology
3. Quality Assurance
4. Drug Design and Lead Identification
5. Bioavailability and TDM
6. Cosmeceutics
7. Packaging Technology
8. Any other emerging area availing local expertise of Pharmaceutical relevance.
4.7.1 Biopharmaceutics and Pharmacokinetics. Theory (3 hrs/wk.)

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<td>05 - 08</td>
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</table>

1. Plasma concentration and therapeutic response.
   An introduction to pharmacodynamics.
   
2. Mechanisms of drug transport:
   Different mechanisms of drug transport, passive transport and pH-partition theory, facilitated diffusion, active transport, blood and its drug binding constituents as carriers of drugs in the body, perfusion, limitation and permeability limitation in drug transport
   
3. Absorption:
   Physiochemical and physiological factors affecting bioavailability of drugs from parenteral routes - examples of procaine penicillin g suspension and insulin - zinc suspension. Basic concepts of intranasal, oral, mucosal, rectal, transdermal, intravaginal, ophthalmic, and intrauterine delivery of drugs.
   
4. Distribution:
   Rate of distribution, perfusion limitation and permeability limitation, extent of distribution, plasma and tissue binding of drugs, drugs with small, intermediate and high volume of distributions and their relative plasma and tissue binding.
   
5. Elimination:
   Organ clearance concepts, hepatic clearance, hepatic extraction ratio, blood flow limitation in hepatic clearance, first pass effect.
   
6. Non Linear Pharmacokinetics
   Non-linearities in absorption and elimination. Examples of drug showing non-linear absorption or elimination’s, Individualization of dosage regimens and non-linear Pharmacokinetics.
   
7. Compartmental modelling of Drugs
   Pharmacokinetics of one compartment model drug, mathematical treatment to pharmacokinetic upon I.V. bolus dosing, I.V. infusion and first order extravascular input. Multicomartment model behavior (excluding
derivation or mathematical treatment), Central and Peripheral Compartments, distribution phase and pseudo distribution equilibrium phase.

Definition of pharmacokinetic parameters including volumes of distribution, clearance, biological half-life, renal clearance, non-renal clearances, additivity of clearance, absolute bioavailability, relative bioavailability, Bioequivalence and other miscellaneous parameters. Methods of estimation of pharmacokinetic parameters and parameters of bioavailability/Bioequivalence, including method of residuals, rate method and sigma-minus method of estimation of renal clearance, area under the curve, area under moment curve, mean residence time.

Reference Books:

7. Notari, R.E., Biopharmaceutics and Clinical Pharmacokinetics, Marcel Dekker.
9. Leon Shargel and Andrew B.C. Yu., Applied Biopharmaceutics and Pharmacokinetics (Appleton Century - Crofts)
10. Leon Shargel and Andrew B.C. Yu., Applied Biopharmaceutics and Pharmacokinetics (Appleton Century - Crofts)
11. Sarfaraz Niazi - Text Book of Biopharmaceutics and Clinical Pharmacokinetics (Appleton Century Crofts, New York)
12. Biopharmaceutics and Pharmacotherapeutics – Brahmankar
13. Textbook of therapeutics - Herfindal
4.7.2 Medicinal Chemistry – III Theory (3 hrs/wk.)

Hrs Marks

The following classes of drugs should be discussed in relation to:

- Introduction to the rational development (if any)
- Mechanism of action
- Synthesis of compounds with asterisk
- Structure-activity relationship
- Generic names
- Chemical nomenclature
- Detailed classification of each class
- Metabolism
- Uses

1. **Drugs Acting on Central Nervous System**
   05 05 - 07
   - **Hypnotics and Sedatives:**

2. **Drugs acting as anticonvulsants:**
   05 04 - 06
   - Phenytoin*, Mephtoin, Trimethadione, Clonazepam, Phensuximide*, Ethesuximide, Phenacimide, Phenobarbital*, Mephobarbital (Classification of barbiturates) Metharbital, Carbamazepine, Sodium Valproate

3. **Psychotherapeutic Agents:**
   05 04 - 06
   - Phenothiazines such as Chlorpromazine*, Triflupromazine, Fluphenazine, Carphenazine, Chlorprothixene, Thioridazine, Fluplenthixol, Haloperidol*, Chlordiazepoxide, Flurazepam, Oxazepam, Diazepam*, Meprobamate*, Imipramine, Desipramine, Amitriptyline, Nortriptyline, Doxepin, Phenelzine, Tranlycypromine, Pargylone, Fluoxetine, Loxapine.

4. **CNS Stimulants:**
   02 03 - 05

5. **Drugs used in Parkinsonism:**
   02 03 - 05
   - Benztropine mesylate, procyclidine, orphendine, hydrochloride, Ethopropazine, levodopa, Carbidopa*, Benserazide, Amantadine*.
5. Drugs for Alzheimer's Diseases:
Tacrine, Velnacrine, Aniracetam, Sibopiridine

6. General Anesthetics:
Ether, Nitrous Oxide, Halothane, ultra short acting Barbiturates

2. CHEMOTHERAPY

a. Anti Virals:
Viral replications and difficulties involved in designing an effective antiviral agent as opposed to an antibacterial drug.
Nucleoside derivatives like Idoxuridine*, Vidarabine, trifluridine, acyclovir, ganciclovir,
Inhibitors of reverse transcriptase like Zidovudine* & (AZT) and nevirapine
HIV-protease Inhibitors like sanquinavir, and ritonavir, Other agents like amantadine*.
Interferon and its properties


3. Vitamins and Related Compounds
Water soluble & lipid soluble vitamins

Reference Books:

5. Profiles in Drug Synthesis : V.N. Gogte
8. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam, Mahadik and Bothara
10. Practical Organic Chemistry - Mann and Sanders
11. Systematic Identification of Organic Composition, Shriner and Fuson
### 4.7.3 Pharmaceutical Analysis – IV

**Theory** (3 hrs/wk.)

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1. **Quality Assurance:**
   - Organization and responsibilities of QC, QA and TQM: Documentation, introduction to concept of ISO, ICH and GLP.
   - Validation of analytical method.

2. **Chromatography:**
   - Terminology used in different chromatographic techniques.
   - Classification of chromatographic techniques.
   - Development of chromatogram in different techniques.

   **Planer chromatography:**
   - **Paper chromatography:** Theory, method of development, detection techniques and applications.
   - **Thin-layer chromatography:** Theory, selection of adsorbent, preparation of the plate, spotting, development of chromatogram, detection of compound, recovery of components, Quantitative measurements and applications.
   - **HPTLC:** Introduction, theory and applications.

   **Column chromatography:** Introduction, theory and applications.

   **Gas chromatography:** Theory, instrumentation, detectors, applications and introduction to GC-MS.

   **HPLC:** Theory, instrumentation (pumps, detectors and columns), applications.

   **Ion-exchange chromatography:** Theory / Principle, instrumentation and applications.

   **Gel permeation chromatography:** Theory / Principle, instrumentation and applications.
Reference Books:

5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth
15. Pharmaceutical Drug analysis by Ashutosh Kar.
25. Lamprecht- Implementing ISO 9000 Series (Dekker).
4.7.4 Pharmacology – IV Theory (3 hrs/wk.)

1. **Central Nervous System:**
   - General Considerations- Neuro humoral transmission in the CNS
   - General Anesthetics- phases of anaesthesia.
   - Local Anesthetics
   - Sedative & Hypnotics, Antianxiety agents. Alcohol
   - Anti-epileptic drugs-types of epilepsy, mechanism.
   - Psychopharmacological agents- disorders of psychology-psychosis, neurosis (Anti-psychotic), Anti-depressants-theory of depression, Anti-maniacs, and hallucinogens
   - Analgesic, Antipyretic & Anti-inflammatory agents
   - Anti-gout agents.
   - Opioids analgesics and their antagonists- pain and nociception, types of pains, endogenous pain inhibiting system.
   - Central Nervous system Stimulants.
   - Pathophysiology and pharmacotherapy of neurodegenerative disorders: (Neural death, Ischemic brain death, Anoxia Huntington’s disease, Ischemic brain damage, Parkinsonism disease, Alzheimer’s disease, Rheumatoid arthritis, Osteoarthritis.)

2. **Respiratory disorders:**
   - Drugs for Cough, COPD and Bronchial asthma.
   - (Pathophysiology of cough, tonsillitis, emphysema, bronchitis, lung abscess, pneumonia, pulmonary embolism.)

3. **Gastrointestinal disorders and pharmacotherapy:**
   - Gastric acidity and Peptic ulcer
   - Irritable bowel syndroms - Ulcerative colitis, Crohn’s disease, Achalasia, Harnia, Oesophagitis, Gastritis.
   - Constipation.
   - Emesis
   - Diarrhoea
   - Flatulence
   - Liver disorders – Cirrhosis, Hepatitis.
   - (Terminological introduction to various other disorders likes Pancreatitis, Gastro-oesophageal reflux disease, Portal hypertension, Cholelithiasis, Cholecystitis, Hepatic encephalopathy, asities, Gall stone formation)
Reference Books:

2. Essential Pathology – Emanuel Rubin, John L., Farber J.B. Lippancot company.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
16. Pharmacotherapy: A Pathophysiologial approach, Dipiro, J.L. Elsevier.3
4.7.5 Pharmacognosy and Phytochemistry – IV Theory (3 hrs/wk.)

1. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, general biosynthetic pathways, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of the following alkaloid containing drugs
   a) Pyridine-piperidine: Tobacco, Areca, and Lobelia.
   b) Tropane: Belladonna, Hyoscyamus, Datura, Duboisia, Coca and Withania,
   c) Quinoline and isoquinoline: Cinchona, Ipecac and Opium.
   d) Indole: Ergot, Rauwolfia, Catharanthus, Nux vomica and Physostigma.
   e) Imidazole: Pilocarpus.
   f) Steroidal: Veratrum and Kurchi.
   g) Alkaloidal amines: Ephedra and Colchicum.
   h) Glycoalkaloid: Solanum.
   i) Purines: Coffee, Tea and Cola.

2. Plant cell and tissue culture
   Introduction to PTC, Enzyme technology, isolation of enzymes, immobilization of enzyme, cell and plant tissue culture, immobilized plant cells, raising mutants in plant cell cultures, protoplasts and cell fusion, plant cell cultivation and production of secondary metabolites, germplasm storage

3. Utilization of aromatic plants and products derived from them
4. Natural allergens and photosensitizing agents and fungal toxins
5. Herbs as health food
6. Herbal cosmetics
7. Plant bitters and sweeteners.
Reference Books:

1. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
4.7.6  Elective *  

Theory  (2 hrs/wk.)

1. Pharmaceutical Marketing
2. Medicinal Plant Biotechnology
3. Quality assurance
4. Drug Design and lead Identification
5. Bioavailability and TDM
6. Cosmeceutics
7. Packaging Technology
8. Any Other Emerging Area availing Local Expertise of Pharmaceutical Relevance

1. Pharmaceutical Marketing

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<td>03 – 05</td>
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<tr>
<td>3</td>
<td>03 – 05</td>
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</tbody>
</table>

REFERENCE BOOKS:

1. Salesmanship, Sales management and advertisement – M. Satyanarayana
2. Business organization and management – M. C. Shukla
4. Modern marketing – Hapnar
5. Personal management
2. Medicinal Plant Biotechnology

1. Introduction & Historical Perspective: Historical Background of Biotechnology and introduction to Medicinal Plant Biotechnology
   - Hrs: 02  
   - Marks: 02 – 03

2. Enzymes:
   - Introduction, mechanism of action, factors affection action, classification, types of inhibition, isolation techniques, Immobilization of enzymes, Application of enzymes to plant biotechnology
   - Hrs: 03  
   - Marks: 05 – 07

3. Fermentation Technology:
   - Fermentation techniques, types, working of terminators, application of fermentation techniques to biotechnology, industrial production of Vitamins
   - Hrs: 03  
   - Marks: 06 – 09

4. Plant Cell & Tissue culture:
   - Introduction, cell culture techniques, cellular tot potency, Laboratory Organisation & Media, application to plant biotechnology
   - Hrs: 05  
   - Marks: 10 – 12

5. Introduction to genetics:
   - Genetics As Applied to Medicinal Herbs, Mutation, Polyploidy, Chemical races, Artificial Mutations, Hybridization, genetic engineering of plants.
   - Hrs: 03  
   - Marks: 06 – 09

6. Recombinant DNA Technology:
   - Introduction, transgenic plants, recombinant DNA techniques (Gene Splicing)
   - Hrs: 04  
   - Marks: 06 – 09

7. Drug Delivery in Gene Therapy:
   - Gene Transfer, objectives of gene therapy, diseases & gene therapy
   - Hrs: 04  
   - Marks: 05 – 09

Reference Books:


3. **Quality assurance**

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<tr>
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<th>Hrs</th>
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</thead>
</table>
| 1. | Introduction  
   Definition, objectives, brief introduction to components of quality assurance | 1 | 02 – 03 |
| 2. | GMP, cGMP, GLP & cGLP:  
   Definition of GMP and cGMP, Components, Building and facilities, 20 point programme of cGMP, History of GLP & cGLP, GLP in an automated laboratory, Process confirmation goals for automation, The Economic Behavior model, Japanese Good Laboratory Practice Standards for drugs. | 6 | 09 – 15 |
| 3. | Calibration:  
   Definition, Calibration master plan  
   Purpose, Responsibility & Frequency of Calibration  
   Tracing of measurement, Adequacy and contract services, Records of calibration, Scheduling of calibration, Labeling practice, Guidelines for preparation of Calibration SOPs, One example of Calibration of any one equipment. (pH meter, Tablet Hardness apparatus, Dissolution apparatus, analytical balance) | 3 | 06 – 08 |
| 4. | Validation.  
   Definition, Principles, Importance, Scope and limitations of validation  
   Process validation, Equipment validation – Autoclave validation with special mention of protocol for autoclave validation.  
   Environment validation:  
   Area decontamination, Sanitizing agents, Qualification and validation, Nonviable particulate monitoring, Surface sampling – RODAC & swab testing (Fallout or settling plates, RCS, Slit to agar), Aseptic filling, Factors in cleaning validation, Validation of Buildings and facilities. | 3 | 06 – 08 |
| 5. | Documentation:  
   Introduction, Steps in Total PMD Programme (Pharmaceutical Manufacturing Documentation), Guidelines for designing and implementing PMD programme, Master production and control record, Site master file.  
   Documentation formats for the following  
   Operations for handling materials and products, Rejected materials and products, Validated process, Release of batches, SOPs | 2 | 06 – 08 |
| 6. | Training:  
   Introduction, Qualification, experience and training, Responsibilities and key personnel, Personal hygiene and clothing, Legal aspects, Training manual document, Significance of Training, three steps training Programme (Classroom/Orientation, Technical and on the job training) | 3 | 05 – 08 |
| 7. | Introduction to various agencies imparting Quality standards (ISO, WHO, Etc.): Brief introduction to following regulatory agencies. | 4 | 06 – 08 |
ISO, WHO, USFDA, TGA, MCC, MHRA, ICH

References:
1. S. Weinberg, Good laboratory practice Regulations, Marcel and Dekker.
2. J. Swarbrick Boylan, encyclopedia of pharmaceutical technology, Marcel and Dekker.
5. R.F. Brewer, Design of experiments for process improvement and quality Assurance Narrosa.
7. D.H. Stamatis, Understanding ISO 9000 and implementing the basics to quality; Marcel Dekker.
9. Chronicle Pharmabiz
10. Pharmapulse
4. **Drug Design and lead Identification**

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<tr>
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<th>Hrs</th>
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<tbody>
<tr>
<td>1.</td>
<td>Receptor: Introduction to receptors, Types of receptors with example, Receptor theories, Drug receptor interactions, Design of agonist and antagonist with example.</td>
<td>06</td>
<td>08 – 12</td>
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<tr>
<td>2.</td>
<td>QSAR: QSAR parameters, QSAR models-General concept, Applications and limitations of QSAR in drug design</td>
<td>08</td>
<td>12 – 15</td>
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<tr>
<td>3.</td>
<td>Drug discovery: Historical perspective, Target selection- Target specificity and selectivity between species and within body, Targeting drugs to specific organs and tissues. Lead identification- Serendipity, Screening of natural products, Screening synthetic compound libraries, Modifying existing drugs, computer aided drug design.</td>
<td>08</td>
<td>12 – 15</td>
</tr>
<tr>
<td>4.</td>
<td>Molecular modeling &amp; drug design: General concept, Introduction to molecular mechanics and quantum mechanics, Concept of known and unknown receptor</td>
<td>06</td>
<td>08 – 12</td>
</tr>
</tbody>
</table>

**References:**

1. Ariens – drug design Vol. – II.
2. Annual Reports in medicinal chemistry (Academic press Inc.)
6. Burgers - Medicinal Chemistry & Drug Discovery
5. Bioavailability and TDM

1. Bioavailability & Bioequivalence:
   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)
   Drug dissolution rate and bioavailability
   Theories of dissolution in-vitro drug dissolution testing models invitro - invivo correlation
   Invitro and insitu absorption studies
   Various Invitro & insitu models - selection of animals
   Correlation between invitro & invivo studies.

2. INTRODUCTION TO THERAPEUTIC DRUG MONITORING
   Definition & introduction.
   Indication for TDM & clinical applications.
   Monitoring plasma drug levels.
   Role of Clinical pharmacist in TDM.

3. TECHNIQUES USED IN TDM
   Physical methods
   HPLC, HPTLC, GC: Sensitivity and selectivity of detection with respect to applications for TDM and related pharmacoeconomics.
   Immuno assays.
   RIA, ELISA, EMITH, NIIA : Sensitivity and selectivity of detection with respect to applications for TDM and related pharmacoeconomics.

4. TDM OF SPECIFIC DRUGS
   Clinical pharmacokinetics, general guidelines, sample collection, time of sample collection, clinical comments, clinical monitoring parameters, usual dosing parameters, common toxicities, adverse drug reactions & drug interactions, techniques used for estimation, importance of
   2. Gentamicin.   5. Theophylline   8. Carbamazepine
References:

2. Therapeutic drug monitoring - B. Widdop
3. TDM & Clinical biochemistry – Mike Hallworth
6. Handbook of TDM. – Simkin
7. TDM – Abbot
6. Cosmeceutics

1. **Physiological Consideration:**
Skin, hair, nail and eye- in relation to cosmetic application.

2. **Rheology of cosmetics:**
Rheological additives in cosmetics, rheology of nail products, antiperspirants, deodorants, hair products, creams and lotions.

3. **Manufacturing techniques:**
Cosmetics creams, powders, compacts, sticks, liquids, foam and aerosol cosmetics.

4. **Evaluation of cosmetics: Performance,**

5. **Clinical safety tasting :**
Irritation, sensitization, photoirritation, photoallergy, ocular irritation and protocols for the same.

6. **Packaging :**
Package development and design for cosmetics including aerosol packs.

**References:**

1. J. Knowlton and S. Rearce; Handbook of Cosmetic Sciences and Technology Elsevier Science Publisher.
3. S. N. Katju’s; Law of Drugs; Law Publishers (India) Pvt. Ltd.
4. E. G. Thomssen; Modern cosmetics; Universal Publishing Corporation.
5. M. S. Balsam and E. Sagarin; Cosmetics, Science and Technology; John Wiley and Sons.
6. R. L. Elder; Cosmetic Ingredients, their safety assessment; Pathotox.
7. H. R. Moskowitz; Cosmetic Product Testing; Marcel Dekker.
8. W.C.Waggoner; Clinical safety and efficacy testing of cosmetics; Marcel Dekker.
10. L.Appell; The formulation and preparation of cosmetics, fragrances and flavours; Micelle Press.
11. W.A.Poucher; Poucher’s Perfumes, cosmetics and soaps; vol.3 Chapman and Hall
12. Dr. Laba; ‘Rheological properties of cosmetics and toiletries; Marcel Dekker.
7. Packaging Technology

1. Introduction to Packaging Technology
   Importance/need of packaging, ideal characters of packaging materials.
   Hrs Marks 02 03 – 05

2. Packaging Materials used in Pharmacy
   Primary & secondary packages:
   Glass: Composition of glass, types, production of glass materials, defects in glass
   Metals: Tin, Aluminium, Lead, Stainless Steel & others
   Rubber: Composition & types, Applications as closure.
   Hrs Marks 05 10 – 12

3. Types of Packaging
   Categories in packaging containers like glass, plastic, polyethylene, polyethylene terphthalate and polyethylene terphthalate G, polypropylene, PVC.
   Metal containers: paper, paperboard & cardboard, multiple & single unit containers & closures, unit of use, labelling, storage conditions specified, stability testing, good packaging practices.
   Hrs Marks 02 03 – 05

4. Evaluation of Packaging materials & Packages
   Evaluation of mechanical & functional properties of elastomeric closures, evaluation of plastics: sorption, desorption, photodegradation, polymer modification tests, Glass: chemical & light resistance testing, typical tests for packaging material as per IP & USP. Evaluation tests for metal, paper & board packagings as per IP & USP.
   Hrs Marks 08 12 – 15

5. Equipments used in packaging of Pharmaceuticals
   Detailed study of machines mentioned below used in packaging of pharmaceuticals – Blister, strip, bubble packaging machine, sachets/pouche sealing machine, bottle capping machine, collapsible tube sealing machine, aerosol container sealing machine, plastic bottle sealing machine, prefilled syringe packaging machine, soft gelatin capsule packaging machine.
   Hrs Marks 04 08 – 12

6. Innovations in Packaging Technology
   Introduction to regulatory issues related to pharmaceutical packaging; poison prevention packaging act 1970 (PPPA), the fair packaging & labelling act (FPLA), innovative packaging like child-resistant, senior friendly, identifiable, functional & hermatically sealed pharmaceutical containers, introduction to ‘blow-fill-seal-technology’
   Hrs Marks 03 04 – 06
References:

1. Pharmaceutical Dosage forms - Ansel - Popovich & Allen. (Text book) and Drug Delivery system - (Williams & Wilkins)
2. Remington's Pharmaceutical Sciences -Alfonso R. Gennaro (Mack Publishing Co.)
5. Handbook of packaging of medicinal devices – Dekker
7. Indian Pharmacopoeia & United States Pharmacopoeia
4.7.7 Biopharmaceutics and Pharmacokinetics Practical (3 hrs/wk.)

1. Experiments designed for estimation of various pharmacokinetic parameters with given data.
5. Statistical treatment of pharmaceutical data.

Reference Books:

7. Notari, R.E., Biopharmaceutics and Clinical Pharmacokinetics, Marcel Dekker.
9. Leon Shargel and Andrew B.C. Yu., Applied Biopharmaceutics and Pharmacokinetics (Appleton Century - Crofts)
10. Leon Shargel and Andrew B.C. Yu., Applied Biopharmaceutics and Pharmacokinetics (Appleton Century - Crofts)
11. Sarfaraz Niazi - Text Book of Biopharmaceutics and Clinical Pharmacokinetics (Appleton Century Crofts, New York)
12. Biopharmaceutics and Pharmacotherapeutics – Brahankar
13. Textbook of therapeutics - Herfindal
1. Laboratory scale preparation of the following compounds & characterization by TLC & IR
   - Sulphanilamide
   - Esters
   - Hydrazide
   - Chloramine – T
   - Benztriazole
   - Paracetamol
   - Aspirin
   - Benzophenones
   - Phynetoin
   - Methyl orange

Reference Books:

5. Profiles in Drug Synthesis : V.N. Gogte
8. Principle of Medicinal Chemistry (Volume I & II) by Kadam, Mahadik and Bothara
10. Practical Organic Chemistry – Mann and Sanders
11. Systematic identification of Organic Composition, Shriner and Fuson
1. Determination of $R_f$ value from Thin-layer chromatography (any two).
2. Determination of $R_f$ value from Paper chromatography (any two).
3. Demonstration on HPLC, GC.

Reference Books:
5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth
15. Pharmaceutical Drug analysis by Ashutosh Kar.
25. Pharmaceutical Process Validation by Nash (Dekker).
4.7.10 Pharmacology - IV Practical (3 hrs/wk.)

1. To study the Analgesic activity of morphine in mice using analgesiometer.
2. To study the anticonvulsant activity of drugs using MES induced convulsions (by using electroconvulsometer).
3. To study the anticonvulsant activity of drugs using pentylene tetrazole induced convulsions.
4. To study the CNS stimulant activity of drugs using Actophotometer.
5. To study the CNS depressant activity of drugs using Actophotometer.
6. To estimate the aspartate aminotransferase level in serum.
7. To estimate the alanine aminotransferase level in serum.
8. To estimate the alkaline phosphates level in serum.
9. To estimate the acid phosphates level in serum.
10. To demonstrate the working and functional aspects of student physiograph

Note: Wherever possible the simulated experiments may be done
CPCSEA approval to be obtained for experiments on animals

Reference Books:

4.7.11 Pharmacognosy and Phytochemistry – IV Practical (3 hrs/wk.)

1. Identification of crude drugs listed in theory.
2. Microscopic study of some important alkaloid containing crude drugs with their powder characters (any seven)
3. Study of powder mixture mentioned in theory.
4. Formulations of some Herbal Cosmetics- Shampoo, Creams, Hair dye, lotions, Hair oils.

Reference Books:

1. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
## Semester – VIII

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<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
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<td>Pharmaceutical Technology - III</td>
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<td>4.8.2</td>
<td>Pharmaceutical Jurisprudence</td>
<td>3</td>
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<td>4.8.3</td>
<td>Pharmaceutical Industrial Management</td>
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<td>4.8.4</td>
<td>Medicinal Chemistry - IV</td>
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<td>4.8.5</td>
<td>Pharmacology – V</td>
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### Practical

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<td>Pharmaceutical Technology - III (Practical)</td>
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<tr>
<td>4.8.7</td>
<td>Medicinal Chemistry - IV (Practical)</td>
<td>3+3</td>
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<td>4.8.8</td>
<td>Pharmacology – V (Practical)</td>
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<td>Project work.</td>
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### 4.8.1 Pharmaceutical Technology - III Theory (3 hrs/wk.)

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<td>08 – 12</td>
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1. **Sterile delivery system:**
   - Introduction and concepts.

2. **Parenteral drug delivery system:**
   - **General requirements**
   - Types and their formulation with reference to powders for reconstitution solutions, suspensions, emulsions, freeze dried products and depot preparations, preparation of sterile water for injection. Pharmacopoeial evaluation of sterile water for injection.
   - Containers and closures (glass, plastics and rubber) and their evaluation, form, fill, seal technology, evaluation of containers and closures including a mention of compatibility testing (to be covered more extensively under stability).
   - Design of facilities and environmental control: basic design concepts, cleanliness classes, air handling (hvac systems), hepa filters, laminar flow and laminar flow rooms, change room design, materials of construction, sterilization, validation of environment and filters.
   - Personnel factors: selection, training, monitoring and motivation concepts to be considered for education of workers - personal hygiene, gowning and entry procedure, restrictions in work area and importance of the same.
   - Processing of parenteral products by terminal sterilization, filtration sterilization followed by aseptic filling and by aseptic compounding. Validation of sterilization and process validation.
   - Quality control and quality assurance.
   - Factory layout: different departments, services and utilities

3. **Ophthalmic products:** anatomy and physiology of eye, general requirement / safety considerations, formulation, isotonicity adjustment, isotonicity calculation, manufacture, packaging and quality control. Introduction to contact lens solutions and their formulations

4. **Biological Pharmaceuticals**
   - Glandular products: Extraction of pancreas and isolation of Insulin, Insulin Injections, transportation and storage, processing / extractions, purification, packaging, safety and efficacy evaluation and other standards.
   - Surgical Products: Definition, primary wound dressing, absorbents, surgical cotton, surgical gauzes etc. bandages, absorbable and
monoabsorbable sutures, ligatures and catguts. Medical prosthetics and organ replacement materials.

5. Novel Drug delivery Systems: Mucosal, transdermal, parenteral implants and pumps, I. U. D. osmotic pumps, bioadhesive, targeted delivery, externally modulated devices and delivery: iontophoresis, sonophoresis, etc. (No details to be taught).

5. Pilot plant scale up technique

Reference Books:

1. Industrial Pharmacy – Lachman et al. (Lea & Febiger)
2. Pharmaceutical Dosage forms - Ansel - Popovich & Allen.
3. American Pharmacy -Dittert (J. B. Lipincott)
4. Remington's Pharmaceutical Sciences - Alfonso R. Gennaro (Mack Publishing Co.)
5. Bentley's T. B. of Pharmaceutics - Rawlins (ELBS)
6. Modern Pharmaceutics - Banker and Rhodes -(Dekker)
8. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
10. Swarbrick & Boylan - Encyclopedia of Pharm. Technology. – (Dekker)
11. Remington's Pharmaceutical Sciences. (Mack)
4.8.2 Pharmaceutical Jurisprudence (3 hrs/wk.)

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<th>Hrs</th>
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<td>10 - 15</td>
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1. Pharmacy Act 1948:
   Extent, commencement - Important definitions
   Drugs Technical Advisory Board and Central Drugs laboratory - their composition and functions - Ayurvedic / Allopathic drugs, prohibitions - Ayurvedic, Homeopathic and Allopathic medicines in respect of Import and Export, Indigenous manufacture, sale or distribution - Drugs Consultative Committee, its composition and functions - Inspectors - their powers and duties - sampling procedure - Inspection enquiry, Investigation / Cosmetics / Ayurvedic drugs) - Imported drugs, Cosmetics and Indigenously manufactures drugs and cosmetics - offences and penalties, confiscation’s - Govt. Analyst, Licensing Authorities and Controlling Authority, qualifications, functions and powers - Licenses for different systems for Medicine.

2. Drugs and Cosmetics Act 1940/Rules 1945:
   Historical background of Opium Act and Dangerous Drugs Act. Prohibitions and penalties.

3. Narcotic Drugs and Psychotropic Substances Act 1985:
   Historical background of Opium Act and Dangerous Drugs Act. Prohibitions and penalties.

4. Drugs and Magic Remedies Act 1954:
   Definitions, Official's duties, Prohibitions, Penalties etc.

5. Drugs Price Control Order 1987:
   Historical background - Essential commodities Act - Relevant provisions, Drugs Prices Display Rule 1961 and other relevant orders - Applicability to Imported drugs and Indigenously manufactured drugs - definitions - prices to wholesaler and retailer - MAP - penal provisions.

6. Prevention of Food adulterations Act 1954 and Rules 1955:
   Important definitions, Central Board of Food Standard, Central Food Laboratory, Composition and Functions.
   Public Analyst: Qualifications, duties, Food Inspectors: Qualification powers, duties sampling procedures.


8. Code of Pharmaceutical Ethics
Reference Books:

1. D & C act 1940 and rules 1945
2. Pharmaceutical Jurisprudence – N. K. Jain
3. Forensic Pharmacy – Kuchekar & Khadtare
4. Textbook of Forensic Pharmacy. – B. M. Mithal
5. Textbook of Forensic Pharmacy. – B. Suresh
4.8.3 Pharmaceutical Industrial Management  

   Deciding whether to go abroad, Deciding how to enter the markets.
   Indirect Export, Direct Export, Licensing, Joint ventures, Direct investment, Internationalization process, Deciding on the Marketing Organization, Export Department, International Division, Global Organization.
   Patents and its implications:
   Indian Patents act 1970, New patent requirement as per TRIPS agreement Patent (amendment) Bill 1995
   Hrs Marks 02 03 – 05

2. Trade related intellectual property (TRIPS):
   TRIPS agreement, Intellectual Property Rights, Types of intellectual properties, Copyrights, trademarks, geographical indications. Industrial designs, layout designs, trade revert.
   Hrs Marks 02 03 – 05

3. GATT agreement and its impact on pharmaceutical industry:
   GATT, History of GATT, Its impact on pharmaceutical industry, Pharmaceutical market in India
   Hrs Marks 02 03 – 05

4. Concepts of Management:
   Business Management Thought, Functions, types of Organizations, Techniques of Communication, direction Participation, delegation, decision making, control Tools like PERT, CPM, systems.
   Hrs Marks 05 06 – 08

5. Production Planning and Control systems:
   Hrs Marks 03 03 – 05

6. Materials Management systems:
   Purchase and Inventory Control, Material Handling.
   Hrs Marks 03 03 – 05

7. Understanding marketing management:
   Role of marketing in today’s organization, identifying and classifying market, understanding market behavior/consumer behavior, Pharmaceutical market in India, Pharmaceutical Industry Scenario.
   Hrs Marks 05 06 – 08

8. Analyzing Marketing Opportunities:
   Hrs Marks 05 04 – 06

9. Interviewing techniques
   Hrs Marks 03 03 – 05

10. Community Pharmacy Practice
    Hrs Marks 02 03 – 05

11. Sales Management
    Hrs Marks 03 04 – 08
Reference Books:

1. Principles and Practice of Drug store administration - Dr.Mahesh Burande [Nirali Prakashan]
2. R. M. Mehta - Drug Store and Management [Vallabh prakashan]
3. Smith - Principles and methods of Pharmacy management
4. The practice of Management by Peter Dracket [Allied Publication, New Delhi.]
5. Principles of Pharmaceutical Marketing – Smith
6. Pharmaceutical Marketing Management – Mukhopadhya
7. Marketing Management - Philip Kotlor
4.8.4 Medicinal Chemistry – IV Theory (3 hrs/wk.)

1. **Introduction to QSAR**
   Statistical prediction & pharmacological activity – partition coefficient, QSAR models, stearic factors, molecular modeling (CADD) Hansch equation.

2. **Introduction to Prodrugs and orphan drugs**
   The following classes of drugs should be discussed in relation to:
   a. Introduction to the rational development (if any)
   b. Mechanism of action
   c. Synthesis of compounds with asterisk
   d. Structure-activity relationship
   e. Generic names
   f. Chemical nomenclature
   g. Detailed Classification of each class
   h. Uses

3. **Analgesics, Antipyretics and Anti-inflammatory agents:**

   **Narcotic Analgesic Agents:**
   Morphine, Oripavine, Codeine, ethylmorphine, dihydroxycodeine*, Metopan, Levarphanol, Dextromethorphan, Meperidine*, anilaridine, Methadone*, meperidine, dextropropoxyphene and pentazocine.

   **Non-narcotic analgesic agents:**
   Dextropropoxyphene* and Ethoheptazine, Morphine antagonists, n-allyl-nor morphine levellorphan, naloxone.
4. **Steroids:**

Classification of steroids, configuration and conformation.

Adrenocorticoids: Cortisol, Hydrocortisone acetate, Fludrocortisone acetate, Betamethasone, Flucinolone acetomide, Triamcinolone, Methyl prednisolone

Androgens and Anabolic Steroids: Testosterone, Fluoxymesterone

Estrogens: Ethinyl estradiol, Estradiol, Mestramol, chlorotrainisene, Estrone, Dienesterol, Diethylstilbesterol and other non-steroidal estrogens

Progestational agents: Progesterone, Norethindrone, Norgestrel, Dimethisterone.

Oral contraceptives

5. **Antihistaminics, Antiemetics and antiulcer drugs:** Metoclopramide, Diphenhydramine*, Doxylamine, Triprolidine, chlorpheniramine, Antazoline, Cyproheptadine, Terfenadine, Cimetidine, Omeprazole*, Lansoprazole, Ranitidine*, Famotidine, Ondansetron, Tripeledniamine*.

6. **Thyroid Function and Thyroid Drugs:**

Thyroid Hormone, Methimazole, Propyl Thiouracil, Thyroid Analogs.

7. **Oral Hypoglycemics:**

Sulfonylureas-Tolbutamide*, Glimepiride*, Biguanides- Metformin, Thiazolidinediones- Ciglitazone, Rosiglitazone, Acarbose, Repaglinide.

**Reference Books:**

6. Profiles in Drug Synthesis : V.N. Gogte
9. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson
1. Drugs used in the disorders of eye, skin & ENT
   a) Ocular pharmacology – Glaucoma, keratitis, conjunctivitis, loss of vision, cataract, Squint. (Pharmacotherapy of Glaucoma)
   b) ENT – Acute epiglotitis, allergic rhinitis, otitis externa, otitis media, wax (cerumen), vertigo, meniere’s disease.
   c) Dermatology - Acne, candidiasis, alopecia, erythema nodusum, eczema, contact dermatitis, Herpes simplex, pediculosis, psoriasis, pyoderma scabies, urticaria, pruritis.

2. Drugs used in emergency - coma, shock, burns, snakebite.

3. Pathophysiology of blood disorders and drugs acting on hemopoietic system -
   Coagulants and anti-coagulants.
   Haemopoietics.
   Thrombolytics and antiplatelet agents.

4. Miscellaneous:-
   1. Drugs used in pediatrics and Geriatrics, pregnancy and lactation.
   2. Drug abuse and misuse, Drug induced diseases.
   3. Concept of Essential drugs and rational drug use.
   4. Interpretation of clinical laboratory tests.

5. Adverse drug reactions – types, reporting and monitoring.


7. General principles of Toxicology - Acute, Sub acute & Chronic toxicity.
   General principles of treatment of acute toxicity and acute poisoning.
   Signs, Symptoms and treatment of acute and chronic poisoning due to

8. Introduction to TDM.

9. **Bioassays:**

10. **Clinical trials**
Reference Books:

11. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
Formulation and evaluation of the following sterile dosage forms

1. Small Volume Parenterals:
   - Ascorbic acid Injection, I. P.
   - Calcium gluconate Injection, I. P.
   - Atropine Sulphate Injection
   - An injection demonstrating co-solvent phenomenon.
   - An injection containing Colloidal Calcium with Vitamin D.

2. Large Volume Parenterals:
   - Normal Saline Injection I. P.
   - % Dextrose Injection I. P.
   - Sodium Chloride and Dextrose Infusion I. P.
   - Ringer Lactate Injection I. P.
   - An injection containing fat emulsion

3. Ophthalmic Preparation:
   - Sulphacetamide eye drops, B.P.C.
   - Chloramphenicol eye drops, I. P.
   - Gentamicin eye drops, I. P.
   - Tetracycline eye ointment, I. P.
   - Chloramphenicol eye ointment, I. P.

4. Quality Control of Blood Products

Reference Books:

1. Industrial Pharmacy – Lachman et al. (Lea & Febiger)
2. Pharmaceutical Dosage forms - Ansel - Popovich & Allen.
3. American Pharmacy - Dittert (J. B. Lipincott)
4. Remington's Pharmaceutical Sciences - Alfonso R. Gennaro (Mack Publishing Co.)
5. Bentley's T. B. of Pharmaceutics - Rawlins (ELBS)
6. Modern Pharmaceutics - Banker and Rhodes -(Dekker)
8. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
10. Swarbrick & Boylan - Encyclopedia of Pharm. Technology. – (Dekker)
1. **Synthesis and Characterization:**
   1. Hydantoin
   2. Reaction involving the following operation – Oxidation, Reduction
   3. Preparation of Iso-Nicotinic acid, Cyclization.
   4. Benzophenone
   5. Acetoacetanilide
   6. 1, 2, 4-triazole
   7. Anthraquinone
   8. Determination of partition coefficient, dissociation constant, molar refractivity, of compounds for QSAR analysis.

**Reference Books:**

6. Profiles in Drug Synthesis: V. N. Gogte
10. Practical Organic Chemistry - Mann and Saunders
11. The systematic identification of Organic Compounds -Shriner and Fuson
12. Systematic Qualitative organic Analysis by H. Middleton
13. Principle of Medicinal Chemistry (Volume I & II) by Kadam, Mahadik and Bothara
1. To record the dose response curve of histamine using isolated guinea pig ileum preparation.
2. To carry out bioassay of Histamine using isolated guinea pig ileum preparation by interpolation method.
3. To carry out bioassay of Histamine using isolated guinea pig ileum preparation by three point method.
4. To record the dose response curve of Acetylcholine using isolated ileum/rectus abdominis muscle preparation.
5. To carry out bioassay of Acetylcholine using isolated ileum/rectus abdominis muscle preparation by interpolation method.
6. To carry out bioassay of Acetylcholine using isolated ileum/rectus abdominis muscle preparation by three-point method.
7. To carry out bioassay of d-Tc/Gallamine using isolated rectus abdominis muscle preparation by interpolation method.
8. To record the dose response curve of oxytocin using isolated rat uterus preparation.

Note: Wherever possible the simulated experiments may be done
CPCSEA approval to be obtained for experiments on animals

Reference Books:

4.8.1 Project work. Practical (3 hrs/wk.)

1. Pharmaceutical Marketing
2. Medicinal Plant Biotechnology
3. Quality assurance
4. Drug Design and lead Identification
5. Bioavailability and TDM
6. Cosmeticology
7. Packaging Technology
8. Any Other Emerging Area availing Local Expertise of Pharmaceutical Relevance
9. Clinical Pharmacology
## Semester syllabus
### Department wise work load

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## Annual Workload Department wise

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1.1.1 Pharmaceutics Theory (3 Hrs/Wk)

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6. Introduction to pharmaceutics and its scope.
7. Pharmaceutical industry in India.
   - Historical background and development of various dosage forms.
8. History of pharmaceutical education in India.
9. Introduction to dosage forms.
   - Historical background and development of profession of pharmacy.
   - Classification of dosage forms, advantages and disadvantages.
10. Drug delivery systems:
    - Detail study of non sterile monophasic liquid - solutions, mixtures, aromatic waters and conc. Aromatic waters, infusions and decoction, glycerites, syrups, elixirs, linctuses, paints, mouth-washes

Reference Books:

12. Pharmaceutical Dosage and Drug Delivery System - Ansel Popovich and Allen (Williams and Wilkins)
13. American Pharmacy - Dittert (J.B. Lipincott)
14. Remington- The Science and practice of Pharmacy (Mack Publishing Co)
15. Bentley's Text Book of Pharmaceutics - Rawlins (ELBS)
16. Banker and Rhodes - Modern Pharmaceutics - (Dekker)
17. Swarbrick and Boytan - Encyclopedia of Pharmaceutical technology (Dekker).
18. Register Pharmacy
19. Indian Pharmacopoeia
20. Tutorial Pharmacy - Cooper and Gunn
22. Textbook of Professional Pharmacy - Jain and Sharma
### 1.1.2 Dispensing of Medication and Hospital Pharmacy

<table>
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<td>Incompatibilities in prescriptions:</td>
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<td>Types of incompatibilities - physical, chemical and therapeutic.</td>
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<td>Study of various prescription examples involving the same.</td>
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<td>Organization and structure of hospital pharmacy.</td>
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<td>Hospitals - classification, functions, organization administration.</td>
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</tr>
<tr>
<td>26</td>
<td>Drug distribution system.</td>
<td>3</td>
<td>03 – 06</td>
</tr>
<tr>
<td>27</td>
<td>Drug information services.</td>
<td>2</td>
<td>02 – 03</td>
</tr>
<tr>
<td>28</td>
<td>Records and reports.</td>
<td>1</td>
<td>02 – 03</td>
</tr>
</tbody>
</table>
Reference Books:

15. Remington's Pharmaceutical Sciences AH. Gennaro (Mack Publishing)
16. Pharmaceutical Practice Collett and Aulton (ELBS)
17. Dispensing of Medications Hoover (Mack Publishing)
18. Prescription Pharmacy Sprowls (Lippincott)
19. Pharmaceutical Calculations Stocklosa
20. USP Vol. I and II
21. IP, BP, USP-NF, NF1 and the Official Pharmacopoeia
22. Martindale Extra Pharmacopoeia Official
23. Dispensing Pharmaceutical Student by Cooper and Gunn, 12th Edi.
24. Hospital Pharmacy, Merchant and Quadry
27. Hospital and Clinical Pharmacy, by P.C. Dandiya and Mukul Mathur
1.1.3 Pharmaceutical Inorganic Chemistry Theory (4 Hrs/Wk)

<table>
<thead>
<tr>
<th>No.</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Acid, Bases, Buffers</td>
</tr>
<tr>
<td></td>
<td>Types &amp; Mechanism, Pharmaceutical buffers, Buffer equation and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurement of tonicity and calculation and methods of adjusting isotonicity.</td>
</tr>
<tr>
<td></td>
<td>06 05 – 08</td>
</tr>
<tr>
<td>2</td>
<td>Gastrointestinal Agents</td>
</tr>
<tr>
<td></td>
<td>Acidifying agents, antacids specifically aluminium hydroxide, magnesium hydroxide, sodium bicarbonate, calcium carbonate, magnesium carbonate and polymethyl siloxime, protectives &amp; adsorbents specially activated charcoal, milk of bismuth, bismuth subcarbonate, bismuth subnitrate and kaolin, Cathartics such as sodium phosphate, magnesium sulphate, sulphur containing compounds and calomel.</td>
</tr>
<tr>
<td></td>
<td>05 05 – 07</td>
</tr>
<tr>
<td>3</td>
<td>Major Intra &amp; Extra cellular Electrolytes</td>
</tr>
<tr>
<td></td>
<td>Physiological ions, Electrolytes used for replacement therapy, acid base balance, Combination therapy</td>
</tr>
<tr>
<td></td>
<td>08 05 – 08</td>
</tr>
<tr>
<td>4</td>
<td>Essential &amp; Trace elements</td>
</tr>
<tr>
<td></td>
<td>Transition elements &amp; their compounds of Pharmaceutical importance such as iron, copper, iodine and zinc with their official preparations, Haematinics like ferrous sulphate, ferrous gluconate, ferrous fumarate and iron dextran injection.</td>
</tr>
<tr>
<td></td>
<td>05 05 – 08</td>
</tr>
<tr>
<td>5</td>
<td>Topical Agents</td>
</tr>
<tr>
<td></td>
<td>Protective, astringents, Anti-infective like talk, zinc oxide, calamine, hydrogen peroxide, potassium permanganate, iodine with their mechanism of action.</td>
</tr>
<tr>
<td></td>
<td>04 03 – 05</td>
</tr>
<tr>
<td>6</td>
<td>Gases &amp; Vapors</td>
</tr>
<tr>
<td></td>
<td>Oxygen, anesthetics, respiratory stimulants such as nitrogen oxide, carbon dioxide and helium.</td>
</tr>
<tr>
<td></td>
<td>04 04 – 06</td>
</tr>
<tr>
<td>7</td>
<td>Dental Products</td>
</tr>
<tr>
<td></td>
<td>Dentifrices &amp; Anti-carries agent like sodium fluoride, SnF₂, concentrated fluorides and polishing agents, zinc chloride.</td>
</tr>
<tr>
<td></td>
<td>03 03 – 05</td>
</tr>
<tr>
<td>8</td>
<td>Complexing &amp; Chelating agents, other antidotes</td>
</tr>
<tr>
<td></td>
<td>Complexing agent – EDTA, penicillamine.</td>
</tr>
<tr>
<td></td>
<td>Antidotes – cyanide poisoning, sodium thiosulphate.</td>
</tr>
<tr>
<td></td>
<td>Precipitation – copper sulphate, sodium phosphate and magnesium sulphate.</td>
</tr>
</tbody>
</table>
9  Sclerosing agents, Expectorants, Emetics such as ammonium chloride and Antioxidants sodium bisulphide, metabisulphide and sulphur dioxide.


Reference Books:

1. Vogel’s Textbooks of qualitative Inorganic Analysis By Denny, Jeffery.
2. Practical Pharmaceutical inorganic chemistry, By Beckett & Stenlake.
3. Inorganic Medicinal & Pharmaceutical Chemistry By Block & Roche.
5. Textbook of Pharmaceutical analysis By Connors K.A.
6. Text book of Pharmaceutical Analysis By Dr. H. N. More
7. Indian Pharmacopoeia
1.1.4 Pharmaceutical Analysis – I Theory (3 hr./wk)

1. Introduction:
   Significance of quantitative analysis in quality control, different techniques of analysis, preliminaries and definitions, types of errors, selection of sample, precision and accuracy. Fundamentals of volumetric analysis, methods of expressing concentrations, primary and secondary standards. Calculation of equivalent weight and stiochiometry.

2. Aqueous Acid-Base titrations:
   Law of mass action, hydrolysis of salts, neutralization curves, and theory of indicators, choice of indicators, mixed indicator. Application in assay of Benzoic acid, Boric acid, Aspirin.

3. Non-Aqueous titrations:
   Types of solvents, end point detection, application in assay of Sodium acetate, Sodium benzoate, Norfloxacin tablet.

4. Oxidation-Reduction titrations:
   Theory of redox titration, measurement of electrode potential, oxidation-reduction curves, redox Indicators. Titrations involving potassium permanganate, potassium dichromate, potassium bromate, potassium iodate, cerium (IV) sulfate, Iodine (Iodimetry and Iodometry), titanous chloride. Applications in assay of Ferrous sulfate, Ascorbic acid, Isoniazide, Hydrogen peroxide.

5. Complexometric titrations:
   Theory, formation of complex and its stability, titration curves, metallochrome indicators (no structures), types of EDTA titrations, application in assay of Magnesium sulfate, Lead nitrate and calcium gluconate.

6. Argentometric titrations:
   Theory, factors affecting solubility of a precipitate, titration methods-Mohr’s, Volhard’s, Gay lussac, and Fajan’s method, indicators. Applications in assay of Potassium chloride, Sodium chloride and Ammonium chloride.
7. Miscellaneous methods of analysis:
   Diazotisation titrations, Kjeldahl’s method of nitrogen determination and Oxygen flask combustion method.
8. Gravimetric analysis:
   Precipitation techniques, solubility products, colloidal state, supersaturation, co-precipitation, post precipitation, digestion, filtration, ignition, weighing and calculation. Application in assay of Alum by oxime reagent, Calcium as calcium oxalate and magnesium as magnesium pyrophosphate.

Reference Books:

5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
1. Scope of Anatomy and Physiology, basic terminology used in this subject.  

2. Structure of cell – Its components and their functions

3. **Elementary tissues of the human body:**
   - Epithelial, connective, muscular and Nervous tissues – their subtypes and characteristics.
   - Contraction of skeletal muscle
   - Neuro muscular transmission
   - Contraction of smooth muscle

4. **Haemopoietic system** Composition and functions of blood.
   - Haemopoiesis and disorders of blood & its components, Disorders of Haemopoietic system).
   - RBC metabolism
   - Blood groups.
   - Clotting factors and mechanism. Platelets and disorders of coagulation.

5. **Lymph and Lymphatic system** –
   - Composition, formation and circulation of lymph
   - Disorders of Lymph and lymphatic system (Definitions only)
   - Spleen: Physiology and function.

6. **Cardiovascular system** –
   - Anatomy of heart
   - Physiology of cardiac muscle and heart
   - Conduction system of heart
   - Blood vessels and its disorders
   - Cardiac cycle and Heart Sounds,
   - ECG, Blood pressure and its regulation (short term and long term).
   - Definitions, types, etiology, and pathophysiology of the following disorders- Hypertension, Hypotension, Arteriosclerosis, Angina, Myocardial infarction, Congestive Heart failure and Cardiac arrhythmias.
7. **Respiratory System**  
   - Anatomy of respiratory organs and functions  
   - Mechanism and regulation of Respiration  
   - Physiology of respiration: transport of respiratory gases  
   - Respiratory volumes and vital capacity  
   - Disorders of respiratory tract like TB, COPD, asthma

8. **Digestive System**  
   - Anatomy of Gastro Intestinal Tract (GIT)  
   - Secretions functions and anatomy of Salivary glands, Pancreas, Stomach, Intestine, Liver  
   - Physiological and biochemical aspects of digestion and absorption of food  
   - Disorders of GIT

9. **Health Education-**  
   - Definition of Health (Physical & Mental) and Health Education, objectives of Health Education.  
   - **Family Planning**  
     Principles underlying various family planning methods.
   - **Nutrition:**  
     - Definition of nutrition, nutrient, Food – classification – origin, chemical composition, function and nutritive value, Balanced Diet.  
     - Nutritional Disorders: of protein, fat, carbohydrates, vitamins and minerals.

10. **Skeletal muscles**  
    - 4. Histology  
    - 5. Physiology of muscle contraction  
    - 6. Physiological properties of skeletal muscle performance  
    (definition of the disorders)
Reference Books:

15. Anatomy and Physiology by Kimber - Grey - Stacktole’s
16. Practical Physiology and Biochemistry by Goel, Shah and Patel
1. Preparation and evaluation of- (at least two preparation from each category)
   - Solutions
   - Mixtures
   - Aromatic waters and concentrated aromatic waters
   - Infusions and Decoction
   - Glycerites
   - F. Syrups
   - G. Elixirs
   - H. Linctuses
   - I. Paints
   - J. Mouth washes

Reference Books:

7. Pharmaceutical Dosage and Drug Delivery System - Ansel - Popovich and Allen -(Williams and Wilkins)
8. American Pharmacy - Dittert (J. B. Lipincott)
10. Bentley's Text Book of Pharmaceutics - Rawlins (ELBS)
11. Banker and Rhodes - Modern Pharmaceutics - (Dekker)
12. Register Pharmacy
1.1.7 Dispensing of Medication and Hospital Pharmacy Practical (3 Hrs/Wk)

1. General instructions to be explained and practiced:
   k) Dispensing vs compounding.
   l) Weighing technique for the dispensing balance sensitivity, weight box calibration and accuracy, precision of weighing and error evaluation, devices for accurate dosage measurement
   m) Handling of prescription- reading, checking, labeling and dispensing, with detailing.
   n) General dispensing procedure - different containers for dispensing labeling of dispensed medicines - documentation.
   o) Posology and calculations
   p) Weights and measures
   q) Reducing and enlarging recipes
   r) Percentage calculations
   s) Dilutions and concentration (stock solutions)
   t) Isotonic solutions

2. 3) Incompatibilities in prescription:
   • Incompatibility of Alkaloids
   • Incompatibility of soluble Iodides
   • Incompatibility of soluble salicylates and benzoates
   • Incompatibility causing evolution of CO₂
   • Incompatibility of soluble barbiturates
   • Incompatibility of emulsifying agent

4) Compounding of proprieties for the following preparations:
   • Topicals containing ointment/cream with powders, liquids of antimycotic, antibacterial and anti-inflammatory
   • Anti diarrhoeal powder for paediatric use containing anti bacterial, antispasmodic, antiamoebic with kaolin and pectin.
   • Mouth washes containing thymol, menthol, peppermint oil and an suitable antiseptic.
   • Scalp lotion containing mercuric chloride, panthenol and a hair conditioning agent etc.
   • Prepackaging and bulk compounding of paracetamol/trimethoprim/sulpha tablets.
   • Drug information - source - an exercise on drug information.
Reference Books:

1. Prescription pharmacy – sprowls
2. Dispensing for pharmacy students - cooper & gunn - 12th edition
3. Pharmaceutical practice - Collet & Aulton
4. Dispensing of medication – Hoover
5. The extra pharmacopoeia - Martindale
6. Pharmaceutical calculations - stoklosa

1.1.8 Pharmaceutical Inorganic Chemistry Practical (3 Hrs/Wk)

1. Systematic qualitative analysis of inorganic mixtures containing two anions and two cations. (06)
2. Practicals based on Limit test (04)
3. Preparation of inorganic compounds. (05)

Reference Books:

1. Vogel’s Textbooks of qualitative Inorganic Analysis By Denny, Jeffery.
2. Practical Pharmaceutical inorganic chemistry, By Beckett & Stenlake.
3. Inorganic Medicinal & Pharmaceutical Chemistry By Block & Roche.
5. Textbook of Pharmaceutical analysis By Connors K.A.
6. Text book of Pharmaceutical Analysis By Dr. H. N. More
7. Indian Pharmacopoeia
1. The students should be introduced to the main Analytical tools through demonstration. They should have a clear understanding of a typical analytical balance, weights, care and use of balance, methods of weighing and errors of weighing. The students should also be acquainted with the general apparatus required in various analytical procedures.

2. Standardization of analytical weights and calibration of balances and volumetric apparatus.

3. Perform following assays as per IP including preparation and standardization of titrants.
   - Acid-base titrations: Benzoic acid, Boric acid, Aspirin
   - Non-Aqueous titrations: Sodium acetate, Sodium benzoate, Norfloxacin tablet.
   - Complexometric titrations: Magnesium sulfate, Lead nitrate, calcium gluconate
   - Argentometric titrations: Potassium chloride, Sodium chloride and Ammonium chloride.
   - Gravimetric analysis: Alum by oxime reagent, Calcium as calcium oxalate and magnesium as magnesium pyrophosphate (Demonstration of any one).

Reference Books:

5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
14. Merck Index.
15. Merck Index.
1. **Haematology**
   - Determination of Total Leukocyte Count
   - Determination of RBC Count
   - Estimation of hemoglobin content
   - Determination of bleeding time
   - Determination of Clotting time
   - Determination of Blood Group

2. **Study of Models**
   Different models covering, Heart, Respiratory system, Digestive system

3. **Study of Histological Slides**
   Different histological slides based on chapters covered in theory to be studied

4. **Study of family planning devices**
   Like condoms, copper ‘T’, foam tablets, contraceptive pills, etc.
Reference Books:


15. Anatomy and Physiology by Kimber - Grey - Stacktoles

16. Practical Physiology and Biochemistry by Goel, Shah and Patel
<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.2.1</td>
<td>Pharmaceutical Technology – I</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>1.2.2</td>
<td>Pharmaceutical Organic Chemistry</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>1.2.3</td>
<td>Pharmaceutical Analysis – II</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>1.2.4</td>
<td>Anatomy Physiology &amp; Health Education – II</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>1.2.5</td>
<td>Pharmacognosy &amp; Phytochemistry – I</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>17</strong></td>
<td><strong>250</strong></td>
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<tr>
<td></td>
<td><strong>Practical</strong></td>
<td></td>
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<tr>
<td>1.2.6</td>
<td>Pharmaceutical Technology – I (Practical)</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>1.2.7</td>
<td>Pharmaceutical Organic Chemistry (practical)</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>1.2.8</td>
<td>Pharmaceutical Analysis – II (Practical)</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>1.2.9</td>
<td>Anatomy Physiology &amp; Health Education – II (Practical)</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>1.2.10</td>
<td>Pharmacognosy &amp; Phytochemistry – I (Practical)</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>250</strong></td>
</tr>
</tbody>
</table>
1.2.1 Pharmaceutical Technology - I Theory (3 hr./wk)

1. Design and development of pharmaceuticals, general considerations:
   Preformulation and formulation of dosage forms, general principles
   05 04 – 06

2. Evaluation of active ingredients [Brief introduction]:
   Content, uniformity, physical and chemical stability, safety and efficacy considerations, quality control, manufacturer's reliability, manufacturer's drug information profile.
   04 04 – 06

3. Excipients used in pharmacy
   Thickening agents, surfactants, sweetening agents, antioxidants, preservatives.
   04 04 – 06

4. Suspensions:
   Flocculated and deflocculated systems, structured vehicle, particle, size and charge, caking in suspension, suspending agents, wetting agents, deflocculating and flocculating agents, formulation development, manufacturing and packaging equipments, stability of suspension, evaluation, preservation and storage, pharmaceutical applications.
   05 06 – 10

5. Emulsions:
   Physical properties, creaming, coalescence, cracking, destabilization kinetics, multiple emulsion emulsifier and choice of emulgent, HLB, phase inversion temperature Formulation, manufacturing equipments stability and evaluation, packaging and storage.
   07 08 – 12

6. Semisolid dosage forms:
   Classification, Structure of skin, penetration, absorption and bioavailability of drugs.
   a. Ointments:
      Ointment bases and their selection, properties of the drug and the base governing drug release from ointments, manufacturing processes and equipments, packaging and evaluation.
   b. Creams:
      Definition, advantages and disadvantages, types, ingredients, processing environmental controls, in-process and finished product controls, stability of creams and evaluation.
   c. Gels and jellies:
      Definition, natural and synthetic gelling materials, types of gels, formulation and components, packaging, stability and evaluation.
   d. Suppositories:
Reference Books:

22. Pharmaceutical process validation, by Nash Wachler, Marcel Dekker
1.2.2 Pharmaceutical Organic Chemistry

1. Factors affecting electron availability in bonds and at individual atoms:
   Electronegativity, inductive effect, Resonance including rules of the Resonance, Concept and types of Tautomerism.

2. Classes of reactions and reagents:
   Including electrophiles, nucleophiles and radicals, transition reaction intermediates, Carbocations, Carbanions, Carbenes and Nitrenes, Kinetics and thermodynamic control of reactions.

3. Theories of acidity and basicity with respect to organic compounds:
   Factors effecting acidity and basicity – Resonance, Inductive effect, steric parameters and hydrogen bonding.

4. Structure, Nomenclature [multifunctional groups also], preparation and reactions of:
   cycloalkanes, alkenes, dienes, alkynes, alcohol, alkyl halides, amines, phenols, aldehydes & ketones, carboxylic acids and functional derivatives of carboxylic acids including beta keto esters [Mechanisms of reactions to be covered].

5. Benzene and Aromaticity:
Reference Books:

1. Advanced Organic Chemistry, Ed. 4 - Jerry March.
3. Organic Chemistry by Pine
4. Advanced Organic Chemistry by Solomans
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry: Peter Sykes
8. Organic Chemistry by Jain M.K.
10. Vogel’s Textbook of practical organic chemistry
11. Practical Organic Chemistry – Mann and Saunders
12. Qualitative Analysis in Organic Chemistry-Nadkarni V.V. and Fernades P.S.
13. A Laboratory handbook of Organic qualitative analysis and separations-Kulkarni V.S. and Pathak S.P.
1.2.3 Pharmaceutical Analysis – II Theory 4 hrs/wk.

1. **Polarimetry:**
   Introduction, Instrumentation and Applications.

2. **Refractometry:**
   Introduction, Instrumentation (Abbey’s, Dipping /Immersion, Pulfrich and Image displacement refractometer), Applications.

3. **Electrochemical Analysis:**
   **Definition of all types of electrochemical analysis.**
   - **e. Conductometry:**
     Principle, instrumentation, Applications including conductometric titrations. High frequency method.
   - **f. Potentiometry:**
     Introduction, Different types of electrodes, measurement of electrode potential and pH, Applications including potentiometric titrations.
   - **g. Polarography:**
     Introduction, Instrumentation and Applications.
   - **h. Amperometry:**
     Introduction, Instrumentation and Applications including amperometric titrations.

4. **Karl-Fischer titrations:** Introduction, Instrumentation, and Applications.

5. **Thermal Analysis:** Introduction, Principle, Methods, Instrumentation, and Factors affecting results, Applications of TG, DSC and DTA.

6. **X-ray diffraction:**
   - v. Laue photographic method.
   - vii. Rotating crystal method.
Reference Books:

5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
### 1.2.4 Anatomy Physiology & Health Education – II

**Theory** (3 hr./wk)

<table>
<thead>
<tr>
<th>Hrs</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td>10</td>
<td>10 – 12</td>
</tr>
</tbody>
</table>

#### 1 Nervous systems:
- Definitions and classification of nervous system
  - anatomy and physiology of neurons, initiation and conduction of nerve impulses, CNS synapses
  - definition, types and functions of central and peripheral neurotransmitters and its receptors
  - Functional areas and functions of cerebrum
  - Cerebellum, basal ganglia and motor control
  - Pons and medulla
  - Thalamus and hypothalamus
  - Spinal cord: structure and functions
  - Cranial nerves-names and functions
  - ANS-anatomy and functions of sympathetic and parasympathetic nervous system.

#### 2 Urinary system
- Parts of urinary system and gross structure of the kidney.
- Structure of nephron.
- Formation of urine.
- Renin angiotensin system, juxta -glomerular apparatus. Acid base balance,
- Disorders of renal function
- Renal function test.

#### 3 Endocrine system
- Endocrine glands
  - Pituitary gland and its hormones
  - Adrenal gland and adrenocortical hormones
  - Thyroid and parathyroid gland and metabolic hormones
  - Pancreas and gonads and their secretions.
  - Endocrine disorders

#### 4 Reproductive system
- 05 05 – 08
6. Male and female reproductive systems 
7. Their hormones – physiology of menstruation 
8. Spermatogenesis and oogenesis 
9. Sex determination (genetic basis) 
10. Early pregnancy tests and changes during pregnancy, its maintenance and parturition

5 Sense organ-structure and functioning of eye, ear, skin, nose, tongue.

6. Communicable and non communicable diseases:– 
Causative agents modes of transmission, symptoms, treatment and prevention of chicken pox, small pox, measles, mumps, rubella, influenza, diphtheria, whooping cough and tuberculosis, tetanus, hepatitis, cholera, typhoid, malaria, filariasis, kala azar, syphilis, gonorrhea, AIDS.

Reference Books:

### 1.2.5 Pharmacognosy & Phytochemistry - I Theory (3 Hrs/Wk)

<table>
<thead>
<tr>
<th></th>
<th>Hrs</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Definition, history, scope and development of pharmacognosy</td>
<td>02</td>
<td>02 – 03</td>
</tr>
<tr>
<td>11. <strong>Sources of crude drugs</strong>: biological, marine, microbes, mineral, animal and plant tissue culture as sources of drugs.</td>
<td>01</td>
<td>01 – 03</td>
</tr>
<tr>
<td>12. <strong>Classification of crude drugs (organized &amp; unorganized)</strong>: alphabetical, morphological, taxonomical, chemical, pharmacological and chemotaxonomical classification of crude drugs</td>
<td>03</td>
<td>03 – 05</td>
</tr>
<tr>
<td>13. <strong>Plant taxonomy</strong>: study of following families with special reference to medicinal important plants of apocynaceae, solanaceae, rutaceae, umbelliferae, leguminosae and liliaceae</td>
<td>04</td>
<td>05 – 08</td>
</tr>
<tr>
<td>14. <strong>Cultivation, collection, processing and storage of crude drugs</strong>: factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation, hybridization with reference to medicinal plants.</td>
<td>05</td>
<td>05 – 08</td>
</tr>
<tr>
<td>15. <strong>Quality control of crude drugs</strong>: adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation</td>
<td>04</td>
<td>05 – 08</td>
</tr>
<tr>
<td>16. An introduction to active constituents of crude drugs, their general isolation and classification</td>
<td>03</td>
<td>03 – 05</td>
</tr>
<tr>
<td>17. <strong>Systematic pharmacognostic study of following</strong>: Carbohydrates and derived products: agar, guar gum, acacia, honey, isabgol, pectin, tragacanth, starch, modified starches and inulin</td>
<td>07</td>
<td>08 - 10</td>
</tr>
<tr>
<td>18. <strong>Lipids</strong>: bees wax, castor oil, coca butter, cod liver oil, linseed oil, rice bran oil, shark liver oil and wool fat</td>
<td>07</td>
<td>08 - 10</td>
</tr>
</tbody>
</table>
Reference Books:

30. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
31. Kokate C. K. Purohit A. P. and Gokhale S. B., Pharmacognosy (degree) Nirali Prakashan
34. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
42. Export potential of selected medicinal plants, prepared by basic chemicals, pharmaceuticals and cosmetic export promotion council, Bombay, and other reports.
44. Faulkner D. J. and Fenical W. H., Marine Natural Product Chemistry (NATO conference series 4) plenum press, New York.
45. Kokate C. K., Cultivation of Medicinal Plants.
46. Pulok Mukharji, Quality control of Herbal drugs.
1. Evaluation of excipients used in the formulations mentioned in theory (one each)
2. Preparation and evaluation of
   - Suspensions for internal and external use – 04
   - Emulsions for internal and external use – 04
   - Ointments using different bases – 04
   - Creams using different bases – 02
   - Gels using different gelling agents – 02
   - Suppositories – 04

Reference Books:

1. Synthesis of organic compounds
   - p-Bromoacetanilide
   - m-Dinitrobenzene/p-Nitroacetanilide
   - Anthraquinone from anthracene
   - Aniline/N-Phenylhyroxylamine from Nitrobenzene by Reduction.

2. Qualitative analysis of Organic compounds [at least 3 single compounds] and Binary mixtures [at least 6 Mixtures] Only water insoluble solid mixtures.

Reference:

1. Advanced Organic Chemistry, Ed. 4 -Jerry March
3. Organic Chemistry: Pine
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry : Peter Sykes
8. Organic Chemistry : Jain M.K.
10. Vogel’s Textbook of practical organic chemistry
11. Practical Organic Chemistry : Mann and Saunders
12. Stereochemistry of Organic Compounds : Nasipuri D.
1. Exercises involving Polarimetry.
2. Calibration of Refractometer and measurement of RI of glycerine, nitrobenzene, specific and molar refraction.
3. Calibration of conductometer and conductance of distilled water.
4. Conductometric titration (SA Vs SB and WA Vs SB).
5. Determination of cell constant.
7. Potentiometric analysis: - pKa determination of phosphoric acid / boric acid.
8. Potentiometric titration of Acid Vs Base.

Reference Books:
5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
1. **Study of the Physiology**
   Normal & Abnormal Constituents of urine

2. **Study of Models**
   Different models covering, Brain, Urinary system, Reproductive system, Eye, Ear, Skin, Nose, Tongue

3. **Study of Histological Slides**
   Different histological slides based on chapters covered in theory to be studied

4. **Study of human skeleton. (Osseous system )**
   - Structure, Classification of Bones, composition of Bones
   - Functions of the skeleton. Classification of joints, types of movements of joints and Disorders of joints.

5. Recording of body temperature, pulse rate and blood pressure, recording and understanding of Electrocardiogram-PQRST waves and their significance.

6. **Differential leukocyte count**

7. **E.S.R.**

**Reference Books:**


1.2.10 Pharmacognosy & Phytochemistry – I Practical (3 Hrs/Wk)

1. Morphological characteristics of plant families mentioned in theory
2. Microscopic measurement of cell and cell contents: Starch grains, Calcium oxalate crystals and phloem fibres.
3. Determination of leaf constants such as stomatal index, stomatal number, vein-islet number, Vein-termination number, palisade ratio and lycopodium method (Any four)
4. Identification of crude drugs belonging to carbohydrates and lipids (chemical evaluation)
5. Preparation of herbarium sheets

Reference Books:

30. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
31. Kokate C. K. Purohit A. P. and Gokhale S. B., Pharmacognosy (degree) Nirali Prakashan
34. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
42. Export potential of selected medicinal plants, prepared by basic chemicals, pharmaceuticals and cosmetics export promotion council, Bombay, and other reports.
44. Faulkner D. J. and Fenical W. H., Marine Natural Product Chemistry (NATO conference series 4) plenum press, New York.
45. Kokate C. K., Cultivation of Medicinal Plants.
46. Pulok Mukharji, Quality control of Herbal drugs.
## Semester – III

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
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<tr>
<td>2.3.1</td>
<td>Physical Pharmacy – I</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>2.3.2</td>
<td>Pharmaceutical Microbiology &amp; Immunology</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>2.3.3</td>
<td>Pharmaceutical Biochemistry</td>
<td>3</td>
<td>50</td>
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<tr>
<td>2.3.4</td>
<td>Pharmacognosy &amp; Phytochemistry – II</td>
<td>3</td>
<td>50</td>
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<tr>
<td>2.3.5</td>
<td>Biostatistics and Computer applications</td>
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### Practical

<table>
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<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
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<tbody>
<tr>
<td>2.3.6</td>
<td>Physical Pharmacy – I (Practical)</td>
<td>3</td>
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<tr>
<td>2.3.7</td>
<td>Pharmaceutical Microbiology &amp; Immunology (Practical)</td>
<td>3+1</td>
<td>50</td>
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<tr>
<td>2.3.8</td>
<td>Pharmaceutical Biochemistry (Practical)</td>
<td>3</td>
<td>50</td>
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<tr>
<td>2.3.9</td>
<td>Pharmacognosy &amp; Phytochemistry – II (Practical)</td>
<td>3</td>
<td>50</td>
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<tr>
<td>2.3.10</td>
<td>Biostatistics and Computer applications (Practical)</td>
<td>3</td>
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<td><strong>Total</strong></td>
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<td><strong>16</strong></td>
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### 2.3.1 Physical Pharmacy – I

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<th>Hrs</th>
<th>Marks</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>3 hrs/wk.</td>
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</table>

#### 1. Behaviour of gases:
- Kinetic theory of gases, derivation from behaviours and explanation.

#### 2. The liquid state:
- Physical properties such as surface tension, parachor, viscosity, refractive index, optical rotation and dipole moment

#### 3. Solubility and Solutions:
- Types of solutions, solubility expressions, factors affecting solubility, methods of solubility determination, heat of solution, Ideal and real solution, colligative properties, specific and equivalent conductance, dielectric constant, partition coefficient and its determination, Phase rule; upper and lower consolute temperatures, one, two and three component systems, Debye Huckel theory; applications of solubility in pharmacy

#### 4. Thermodynamics:
- First law, second law, third law of thermodynamics, zeroth law, absolute temperature scale.

#### 5. Ionic Equilibria
- Arrhenious, Bronsted-Lowry and Lewis acid-base theory, pH Scale, Pharmaceutical Buffers, buffer capacity, buffer action, buffers in pharmaceutical preparations, isotonic solutions and buffered isotonic solutions, tonicity adjustments and measurements.

#### 6. Adsorption:
- Types, factors affecting, Freundlich and Gibbs adsorption isotherm, Langmuir theory of adsorption, adsorption on solid interface, solid-gas and solid-liquid interfaces, applications in pharmacy

#### 7. Chemical kinetics:
- Zero, first, and second order reactions, complex reactions, theories of reaction kinetics, biological half life, types and characteristics of catalysis, applications of kinetics in pharmacy.

#### 8. Numerical problems:
- Problems based on all above chapters
Reference Books:-

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone & Lewis
3. Practical Pharmaceutics (Physical Pharmacy) – H. N. More, Ashok Hajare
4. Physical Chemistry – Maron S. & Pruton
5. Remington’s Pharmaceutical Sciences
6. Theory & Practice of Industrial Pharmacy – Lachman Liebermann & Kanig
7. Physical Chemistry – Bahl and Tuli
8. Pharmaceutical Technology – Eugene Parrott
9. Physical Pharmacy – Martin, Swarbrick and Commarata
10. Practical Pharmaceutical Technology - Eugene Parrot
8. Scope of Microbiology:
   Historical development (Antony Van Leuvenhook, Koch’s postulates, Pasteur's contribution) applications of microbiology to pharmaceuticals.

9. Classification of microorganisms and their taxonomy:
   Whittaker's five kingdom concept, Classification of microorganisms into bacteria, actinomycetes, yeast and fungi, rickettsia and viruses. (General features and applications) Introduction to microscopy (optical, electron, phase contrast, etc.)

10. Study of Bacteria:
   Structure, locomotion, reproduction, genetic exchange isolation, nutritional requirements, culture media, growth curve, and mean generation time, counting methods, identification procedure & characteristics of pathogens (Staphylococcus, Clostridium, Vibrio, Mycobacterium, Corynebacterium).

11. Study of Yeasts, Fungi & Rickettsia:
   Introduction, characteristics, clinical significance & applications in Pharmacy

12. Study of Viruses:
   Introduction - General properties (size, nucleic acid content, metabolism) - structure of viruses (helical symmetry and icosahedral symmetry) - effect of chemical and physical agents on viruses - virus-host cell interactions - bacteriophage and its epidemiological uses (lytic growth cycle and lysogeny) - human viruses and their cultivation in cell culture, chick embryo and animal inoculation - multiplication of human viruses - interferon’s HIV.

13. Sterilization, Disinfection and Infection control :
   Sterilization - Definition - classification into thermal and non-thermal methods - details of hot air sterilization, autoclaving, gaseous, radiation, sterile filtration (method of packaging and equipment to be used should also be covered)
   Bioburden determination - sterilization monitors (physical, chemical and biological indicators) - sensitivity of microorganisms, survivor curves, expression of resistance (D-values and z-values), sterility assurance
   Disinfection: Definition (antiseptics, preservatives and sanitizing agents) chemical classification (acids and esters, alcohols etc.) - factors affecting choice of antimicrobial agent (properties of chemical agent and microbiological challenge, environmental factors and toxicity of agent) - factors affecting disinfection process - evaluation of disinfectant (RW coefficient, Kelsey-Sykes test).
14. Fundamentals of Immunology –

Definitions of pathogen, virulence, attenuation, exaltation, antigens, antibodies and antisera - defense mechanisms of host - non-specific (skin and mucous membranes, phagocytosis, complement system, inflammation, host damage with exotoxins and endotoxins) - specific defense mechanisms - cellular immunity - humoral immunity - Immunity - types of immunity (natural, naturally acquired, acquired (active and passive) Types and Structure of immunoglobulins.

Reference Books:

2. Tutorial Pharmacy - Cooper and Gunn
4. General Microbiology by Pelczar & Rid
5. General Microbiology by Powar & Daginawala
6. Text book of microbiology by Ananthnarayanan, Jarayam Panikar
2.3.3 Pharmaceutical Biochemistry Theory (3 hr/wk)

<table>
<thead>
<tr>
<th>Hrs</th>
<th>Marks</th>
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<tbody>
<tr>
<td>06</td>
<td>05 – 08</td>
</tr>
</tbody>
</table>

1. **Enzymes and co-enzymes:**
   Nomenclature, enzyme kinetics and its mechanism of kinetics, types of inhibition, drugs used as enzyme inhibitor, resistance related to drugs, enzymes and isoenzymes used in clinical diagnosis.

2. **Co-enzyme:**
   Biochemical role of vitamins and metals as co-enzymes.
   Significance of SGOT, SGPT, LDL, alkaline and acid phosphatases, serum amylase and serum lipase

3. **Brief introduction to carbohydrate metabolism and diseases related to carbohydrate metabolism:**
   Diabetes mellitus, methyl keto urea, galactosemia glycogen storage disease, lactose intolerance and glucose tolerance test.

4. **Lipid metabolism:**
   Oxidation of fatty acid, beta oxidation and energetics, control of metabolism, with reference to physiological and pathophysiological significance essential fatty acids and ecosinoids, (prostaglandins, thromboxanes and leukotriene) phospholipids, sphingolipids clinical orientation of lipid metabolism.
   Disease related to lipid metabolism. Hyper lipidemia, cholesterol metabolism, fatty liver and lipotropic factors, hypolipoproteinous atherosclerosis.

5. **Biological oxidation:**
   Redox potential, energy rich compounds. The respiratory chain, mechanism and energetics of oxidative phosphorylation, study of cytochromes, bioenergetics, production of atp and its biological significance.

6. **Metabolism of ammonia and nitrogen containing monomers:**
   Nitrogen balance, essential amino acid, transamination, deamination, conversion of amino acids to specialized product assimilation of ammonia urea cycle, metabolic disorders, formation of bile salts and pigment and clinical significance.

7. **Nucleic acid biosynthesis:**
   Biosynthesis of dna and its replication, mutation, physical and chemical mutagenesis/ carcinogenesis, dna repair mechanism, biosynthesis of rna and its types

8. **Genetic code and Protein Synthesis:**
   Genetic code, components of protein synthesis, Inhibition of protein synthesis, Brief account of genetic engineering.
**Reference Books:**

1. Textbook of Medical biochemistry, By Dr. Rana Shinde.
2. Outlines of Biochemistry , E. E. Cohn and P. K. Stumpf
3. Biochemistry by Albert Lehninger
5. Practical Biochemistry By David T. Plummer

### 2.3.4 Pharmacognosy & Phytochemistry - II

<table>
<thead>
<tr>
<th><strong>Hrs</strong></th>
<th><strong>Marks</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Volatile oils:</strong></td>
<td>10</td>
</tr>
<tr>
<td>General methods of obtaining volatile oils from plants, study of volatile oils of mentha, coriander, cinnamon, cassia, lemon peel, orange peel, lemon grass, citronella, dill, clove, fennel, nutmeg, eucalyptus, musk, chenopodium, cardamom, valerian, palmarosa, gaultheria, sandal wood, patchouli</td>
<td></td>
</tr>
<tr>
<td><strong>Resins:</strong></td>
<td>09</td>
</tr>
<tr>
<td>Study of drugs containing resin combination like colophony, podophyllum, jalap, cannabis, capsicum, myrrh, asafoetida, balsam of tolu, balsam of peru, benzoin, turmeric, storax and ginger.</td>
<td></td>
</tr>
<tr>
<td><strong>Tannins:</strong></td>
<td>04</td>
</tr>
<tr>
<td>Study of tannins and tannin containing drugs like gambir, black catechu, myrobalan, behera.</td>
<td></td>
</tr>
<tr>
<td><strong>Phytochemical screening:</strong></td>
<td>08</td>
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<tr>
<td>c. Preparation of extracts.</td>
<td></td>
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<tr>
<td>d. Screening of alkaloids, glycosides (Cardiac, saponins, anthraquinones, flavonoids, coumarins and cynogenetic glycosides), Tannins, steroids, carbohydrates, proteins and amino acids.</td>
<td></td>
</tr>
<tr>
<td><strong>Fibres:</strong></td>
<td>04</td>
</tr>
<tr>
<td>Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass wool, polyester and asbestos</td>
<td></td>
</tr>
<tr>
<td><strong>Pharmaceutical aids &amp; technical products:</strong></td>
<td>04</td>
</tr>
<tr>
<td>Study of pharmaceutical aids like talc, Diatomite, kaolin, bentonite, gelatin</td>
<td></td>
</tr>
</tbody>
</table>
Reference Books:

2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
2.3.5 **Biostatistics and Computer applications**  

<table>
<thead>
<tr>
<th>Course</th>
<th>Theory</th>
<th>Hrs</th>
<th>Marks</th>
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<tbody>
<tr>
<td>1. Basic Concepts of Statistics</td>
<td></td>
<td>02</td>
<td>03 - 05</td>
</tr>
<tr>
<td>Introduction and Meaning of statistics, statistical data and Data graphics, collection and Classification of data, frequency distribution, mean, mode, median, types of measures, absolute and standard deviation and Coefficient of variance</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. Probability and Probability distribution</td>
<td></td>
<td>01</td>
<td>03 - 05</td>
</tr>
<tr>
<td>Terminology, theoretical, binomial, normal probability distribution</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Sample, Sampling Methods and Statistical Inferences</td>
<td></td>
<td>02</td>
<td>04 – 06</td>
</tr>
<tr>
<td>Methods of sampling, statistical tests for rejection, testing procedures, t-test, chi square test, confidence intervals in biological assays.</td>
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<td></td>
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<tr>
<td>4. Correlation and Regression analysis</td>
<td></td>
<td>03</td>
<td>04 – 06</td>
</tr>
<tr>
<td>Methods of studying correlation, spearman’s rank correlation and Significance, methods to find regression line, properties of regression coefficient</td>
<td></td>
<td></td>
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<tr>
<td>5. Analysis of Variance and Experimental Design</td>
<td></td>
<td>01</td>
<td>03 – 05</td>
</tr>
<tr>
<td>Meaning and the Technique of ANOVA</td>
<td></td>
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</tr>
<tr>
<td>6. History and Generation of Computers</td>
<td></td>
<td>01</td>
<td>03 – 05</td>
</tr>
<tr>
<td>Fundamentals, evolution and generation, types of computers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Anatomy and Computer Peripherals</td>
<td></td>
<td>02</td>
<td>03 – 05</td>
</tr>
<tr>
<td>CPU, Input and Output devices, Ancillary machines, characteristics of computers, memories and storage devices</td>
<td></td>
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<tr>
<td>8. Operating systems</td>
<td></td>
<td>04</td>
<td>06 – 10</td>
</tr>
<tr>
<td>Terminology MS-DOS, MS Windows, Introduction to other operating systems.</td>
<td></td>
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</tr>
<tr>
<td>9. Microsoft office</td>
<td></td>
<td>05</td>
<td>08 – 10</td>
</tr>
<tr>
<td>MS Word, MS Excel, MS PowerPoint</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>10. Introduction to internet basics and networking</td>
<td></td>
<td>02</td>
<td>03 - 05</td>
</tr>
<tr>
<td>Internet browsing, search engines, e-mail networking concepts, LAN, WAN.</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>11. Computer applications in pharmacy</td>
<td></td>
<td>01</td>
<td>03 - 05</td>
</tr>
<tr>
<td>Applications to pharmacokinetics, drug design, hospital and clinical pharmacy, pharmaceutical analysis, crude drug identification, diagnosis and data analysis, bulk drug and pharmaceutical manufacturing, sales and marketing</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Reference Books:

1. Introduction to Biostatics and Computer science by Y. I. Shah, Dr. A. R. Paradkar, and M. G. Dhaygude, Nirali Prakashan, Pune - 02
2. Methods of Biostatics for Medical and Research students by B. K. Mahajan, Jaypee brothers medical publishers (P) Ltd., New Delhi - 02
4. Statistical methods for cost accountants by S. P. Gupta, Sultan Chand and Sons Publishers, New Delhi - 02
6. William and Fassett - Computer Applications in Pharmacy.
9. Computer Programming - I by Sneha Phadke, Publisher: Technova Publication
11. The ABC’s of the Internet by Cristain Crumlish, BPB Publications, N. Delhi - 01
1. Physical Properties of Drug Molecules
   - Determination of Density / Specific gravity of given liquids
   - Determination of Refractive index of given liquids
   - Determination of Molecular weight by Freezing Point Depression Method (Rast camphor method)
   - Determination of viscosity of given liquids by Ostwald, Suspended and Rotary viscometer

2. Solubility and distribution co-efficient:
   - Determination of partition coefficient of iodine between carbon tetrachloride and water.
   - Determination of partition coefficient of benzoic acid between water and benzene.
   - Determination of critical solution temperature of phenol water system.
   - Study of the effect of third component on CST
   - To study phase behaviour of 3 component system and construct ternary phase diagram.
   - Determination of heat of solution by solubility method.
   - Determination of solubility of drugs.
   - Conductivity: Verification of Ostwald's dilution law by conductometry.

3. Ionic Equilibria
   Determination of buffer capacity at various stages of titration of weak acid against strong base thus determining pKa of the acid

4. Adsorption
   Determination of specific surface area by adsorption method

5. Chemical Kinetics:
   First order kinetics. (any one)
   Determination of degree of hydrolysis of given ester.
   Determination of relative strengths of 2 acids.
   Second order reaction (any two)
   To find the degree of hydrolysis of a second order reaction when a=b.
   To verify Ostwald’s dilution law for a second order reaction.
   Determination of energy of activation of acid hydrolysis of methyl acetate.
   Kinetics of Inversion of Cane Sugar
Reference Books:-

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone & Lewis
3. Practical Pharmaceutics (Physical Pharmacy) - H. N. More, Ashok Hajare
4. Physical Chemistry – Maron S. & Pruton
5. Remington’s Pharmaceutical Sciences
6. Theory & Practice of Industrial Pharmacy – Lachman Liebermann & Kanig
7. Physical Chemistry – Bahl and Tuli
8. Pharmaceutical Technology – Eugene Parrott
9. Physical Pharmacy – Martin, Swarbrick and Commarata
10. Practical Pharmaceutical Technology - Engene Parrot
2.3.7 Pharmaceutical Microbiology & Immunology (Practical) Practical 3 + 1 hrs/wk.

1. Study of microscope and other lab equipments
2. Identification of morphology of bacteria by
   - Monochrome staining
   - Negative staining
   - Gram staining
   - Cell wall staining
   - Spore staining
   - Capsule staining
   - Acid fast staining
   - Motility by Hanging drop technique
3. Preparation and standardization of nutrient broth, agar slants, stabs, plates.
4. Techniques of inoculation on different types of media, (coci and bacilli)
5. Inoculation, isolation and study of growth pattern of micro organism (Colony Characteristics) on selective media.
   - Escherichia coli - MacConkey’s agar.  
   - Pseudomonas - Cetrimide agar.  
   - Salmonella - Xylose - lysine medium or  
   - Staphylococcus aureus - Vogel Johnson’s suitable selective medium.  
   - Pseudomonas - Cetrimide agar.  
7. Sterility testing.
8. Study of air and water microbiology.
10. Serological diagnosis of Typhoid.

Reference Books:

2. Tutorial Pharmacy - Cooper and Gunn
4. General Microbiology by Pelczar & Rid
5. General Microbiology by Powar & Daginawala
6. Microbiological methods by Collins & Lyne
2.3.8 Pharmaceutical Biochemistry Practical (3 hr./wk)

1. **Titration curves for amino acids:**
   Potentiometric / conductometric titration of sample of amino acids (at least two).

2. **Quantitative estimation of**
   - Amino acids by ninhydrin, biuret assay
   - Protein by folin-lowery method
   - Carbohydrate by folin-wu method, benedict’s quantitative reagent method

3. **Electrophoresis:**
   - Separation of serum protein
   - Separation of amino acid

4. Determination of abnormal constituents of urine.
   Demonstrations...

5. Enzymatic hydrolysis of glycogen by $\alpha$ amylase

6. Effect of temperature on activity of salivary $\alpha$ amylase.

7. Enzymatic determination of Glucose.

**Reference Books:**

1. Textbook of Medical biochemistry, By Dr. Rana Shinde.
2. Outlines of Biochemistry, E.E.Cohn and P. K. Stumpf
3. Biochemistry by Albert Lehninger
5. Practical Biochemistry By David T. Plummer
2.3.9 Pharmacognosy & Phytochemistry – II Practical (3 hr./wk)

1. Identification of crude drugs mentioned in theory
2. Study of fibres and pharmaceutical aids
3. Microscopic studies of seven selected crude drugs and their powder characters mentioned under the category of vol. oils and their chemical tests (Fennel, Cassia, Clove, Cardamom, Coriander, Ginger, Eucalyptus)
4. General chemical tests for alkaloids, glycosides, steroids, flavonoids and tannins.

Reference Books:
2. Gibbs R Darnely, Chemotaxanomy of Flowering Plants 4 volumes, McGill, University Press.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
2.3.10 Biostatistics and Computer applications

Practical 3 hrs/wk.

1. Fundamentals:
The basic anatomy of Computers, Components of Computer system Viz. memory, CPU, various input-output units, Low and High level languages, units of size (Capacity), System software, Application software, Utility Software, IBM compatible personal computer and its components.

2. Anatomy and Computer Peripherals
CPU, Input and Output devices, Ancillary machines, characteristics of computers, memories and storage devices.

3. Introduction to Operating systems
Terminology MS-DOS, Introduction and need, MS-DOS operating system Internal Commands, External Commands, batch files, MS Windows, Introduction to other operating systems.

4. Microsoft office
MS Word, MS Excel, MS PowerPoint

5. Introduction to internet basics and networking
Internet browsing, search engines, e-mail networking concepts, LAN, WAN.

6. Computer applications in pharmacy
Applications to pharmacokinetics, drug design, hospital and clinical pharmacy, pharmaceutical analysis, crude drug identification, diagnosis and data analysis, bulk drug and pharmaceutical manufacturing, sales and marketing

Reference Books:

1. Introduction to Biostatics and Computer science by Y. I. Shah, Dr. A. R. Paradkar, and M. G. Dhaygude, Nirali Prakashan, Pune – 02
2. Methods of Biostatics for Medical and Research students by B. K. Mahajan, Jaypee brothers medical publishers (P) Ltd., New Delhi – 02
4. Statistical methods for cost accountants by S. P. Gupta, Sultan Chand and Sons Publishers, New Delhi - 02
6. William and Fassett - Computer Applications in Pharmacy.
9. Computer Programming - I by Sneha Phadke, Publisher: Technova Publication
11. The ABC’s of the Internet by Cristain Crumlish, BPB Publications, N. Delhi – 01
### Semester – IV

<table>
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<td>2.4.1</td>
<td>Physical Pharmacy – II</td>
<td>3</td>
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<tr>
<td>2.4.2</td>
<td>Pharmaceutical Biotechnology</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>2.4.3</td>
<td>Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry</td>
<td>4</td>
<td>50</td>
</tr>
<tr>
<td>2.4.4</td>
<td>Pharmaceutical Chemistry</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>2.4.5</td>
<td>Pharmacology – I</td>
<td>4</td>
<td>50</td>
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<tr>
<td></td>
<td><strong>Total</strong></td>
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#### Practical

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<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
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<tr>
<td>2.4.6</td>
<td>Physical Pharmacy – II (practical)</td>
<td>3</td>
<td>50</td>
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<tr>
<td>2.4.7</td>
<td>Pharmaceutical Biotechnology (practical)</td>
<td>3</td>
<td>50</td>
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<tr>
<td>2.4.8</td>
<td>Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry (practical)</td>
<td>3</td>
<td>50</td>
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<td>2.4.9</td>
<td>Pharmaceutical Chemistry (practical)</td>
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<td>50</td>
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<td>2.4.10</td>
<td>Pharmacology – I (practical)</td>
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<td></td>
<td><strong>Total</strong></td>
<td><strong>15</strong></td>
<td><strong>250</strong></td>
</tr>
</tbody>
</table>
2.4.1 Physical Pharmacy - II

1. Matter and its properties:
   Introduction to state of matter, change in the state of matter, latent heat, sublimation, critical point, eutectic mixture, relative humidity, liquid complexes, liquid crystals, glassy state, solid-crystalline, amorphous and polymorphism.

2. Surface tension and interfacial phenomenon:
   Liquid interfaces, surface tension and surface free energy, measurement of surface and interfacial tension, spreading coefficient; surfactants, their classification, HLB, complex films, zeta and Nernst potential, applications in pharmacy.

3. Micromeritics:
   Particle size and size distribution, average particle size, number and weight distribution, particle number, methods to determine particle size; optical microscopy, sieving, sedimentation measurement, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness and flow properties, compressibility index.

4. Rheology:
   Newtonian systems: Newton’s law of flow; types of viscosities, factors affecting viscosity, non newtonian system: plastic flow, pseudo plastic flow, dilatent flow; thixotropy, thixotropy in formulation, viscosity measurements, and applications in pharmacy.

5. Dispersed systems:
   A) Colloidal dispersion: definition, types, properties of colloids: protective colloids, applications of colloids in pharmacy.

6. Drug stability:
   General considerations and concepts, Mechanisms of drug instability: Interactions with containers and closures and their evaluation - compatibility testing. Half life determinations, factors affecting drug stability, Q10 value, accelerated stability study, expiration dating.
Reference Books:-

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone and Lewis
3. Physical Chemistry – Maron S. and Pruton
5. Theory & Practice of Industrial Pharmacy – Lachman Liebermann and Kanig
6. Physical Chemistry – Bahl and Tuli
7. Pharmaceutical Technology – Eugene Parrott
2.4.2 Pharmaceutical Biotechnology

<table>
<thead>
<tr>
<th>Theory</th>
<th>(3 hrs/wk.)</th>
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</thead>
<tbody>
<tr>
<td>Hrs</td>
<td>Marks</td>
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<tr>
<td>1. Definition and scope - potential and achievements</td>
<td>02</td>
</tr>
<tr>
<td>2. Fermentation technology and industrial microbiology</td>
<td>13</td>
</tr>
<tr>
<td>Fermentation as a biochemical process, bioconversion and biotransformation, fermenter construction and working, downstream processing, fermentation monitoring, in-situ recovery of fermentation products, waste discharge and effluent treatment, definition of BOD and COD, safety and proof of efficacy of biotech products, general applications of fermentation in the manufacturing of antibiotics (Penicillin, streptomycin, tetracycline) dextran, vitamins (Vit.B2 and Vit.B12), microbial enzymes, microbial limit tests and assays (antibiotics, vitamins, amino acids etc.), standards of water used in fermentation, pharmaceutical and cosmetic industry.</td>
<td></td>
</tr>
<tr>
<td>3. Animal cell culture and genetic engineering</td>
<td>07</td>
</tr>
<tr>
<td>Introduction to mammalian genome, genetic recombination of animal cells, purified DNA, vectors probing and cloning, strain and restrictional enzymes, gene machine, DNA hybridization, molecular engineering, polymerase chain reaction, genetic diseases, human gene therapy, tissue engineering.</td>
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<tr>
<td>4. Preparation and characterization of immunologicals</td>
<td>06</td>
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<tr>
<td>Preparation and standardization of vaccines, sera, allergenic extracts, diagnostics, biologicals, Introduction to veterinary vaccines, immunomodulating substances, lymphokines, preparation of monoclonal antibodies, applications of monoclonal antibodies.</td>
<td></td>
</tr>
<tr>
<td>5. Biotechnology derived products (therapeutic proteins)</td>
<td>04</td>
</tr>
<tr>
<td>Examples of biotechnology derived therapeutics products, production of human Insulin, interferon, somatostatin, somatotropin.</td>
<td></td>
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<tr>
<td>6. Characterization and quality control of biotech derived products:</td>
<td>10</td>
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<tr>
<td>Purification, characterization and analysis, establishing safety and efficacy, impurities presents in biotechnology derived products, foreign contaminants (e.g. host cells, proteins, DNA/RNA and pyrogens) and related substances (e.g. clips i.e. aggregates of desired protein derived from isolation and purification), heterogeneity of desired protein-analytic technique (gel electrophoresis, HPLC/FPLC, tryptic mapping, N-terminal sequencing, light scattering, circular dichroism and ultracentrifugation), immunoassay and ELISA, enzyme substrate assays and bioassays, degradation pathways and stability, regulatory requirements governing marketing.</td>
<td></td>
</tr>
</tbody>
</table>
Reference Books:

39. Pharmacopoeia of India, 1985, Govt. of India, Ministry of Health and Family Welfare.
43. Singh B. D., Biotechnology, 2001, Kalyani Publisher.
### 2.4.3 Pharmaceutical Heterocyclic & Polycyclic Chemistry

<table>
<thead>
<tr>
<th>Theory</th>
<th>4 hrs/wk.</th>
</tr>
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#### 1. Stereochemistry:
- Isomerism and its types - Optical isomerism-nomenclatures [including D/L & R/S] and projection formulas, enantiomers, distereoisomers, chirality, racemic mixtures, resolution of racemic mixtures.
- Geometrical isomerism-Z & E, cis-trans isomerisms.
- Methods of determination of configurations.
- iv. Conformational isomerism: Conformations of n-butane & cyclohexane and disubstituted cyclohexanes, locking of conformation with respect to t-butyl cyclohexane, Conformational analysis.

#### 2. Heterocyclic Compounds:
Introduction & Nomenclature of all heterocyclic compounds, Preparation, reactivity and Chemical reactions of Aziridines, Furan, Pyrrole, Pyridine, other fused pyridines, purines, diazines, triazines & tetrazines, oxazines, thiazines, pyrazoles, tetrozoles, oxadiazoles, thia diazoles, isooxazoles, isothiazoles & there benzo dervs, Pyrimidine, Thiophene, Indole, Quinoline, Imidazole, Thiazole, Oxazole, Triazole, azipines, diazepines & benzodiazepines.

#### 3. Molecular Rearrangements:
General considerations, types of rearrangement Nucleophilic, electrophilic, free radical), Principle, reaction mechanism and stereochemistry of...
- Electron rich Rearrangements: Stevans rearrangement, Wittig rearrangement, Neber rearrangement, Sommelet rearrangements, Favourskii rearrangement.
- Rearrangements involving migration of Aromatic ring-Fries rearrangement, Claisen rearrangement.

#### 4. Fused polynuclear Compound:
Preparation, reactivity and chemical properties of Naphthalene, Anthracene and Phenanthrene.

#### 5. Oxidation & reduction reactions:
General consideration of mechanisms, elimination of hydrogen, oxidation involving cleavage of carbon-carbon bonds, replacement of hydrogen by oxygen, oxygen is added to the substrate, oxidative coupling, reduction involving replacement of oxygen by hydrogen, oxygen is removed from the substrate.
Reference Books:

3. Organic Chemistry by Pine
4. Advanced Organic Chemistry by Solomans
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry: Peter Sykes
8. Organic Chemistry by Jain M.K.
10. Vogel’s Textbook of practical organic chemistry
11. Practical Organic Chemistry –Mann and Saunders
12. Qualitative Analysis in Organic Chemistry-Nadkarni V.V. and Fernades P.S.
13. A Laboratory handbook of Organic qualitative analysis and separations-Kulkarni V.S. and Pathak S.P.
2.4.4 Pharmaceutical Chemistry

Theory 3 hrs/wk.

Hrs. Marks

1. Amino-acids, Peptides, and Proteins:
Introduction to amino acids, proteins and peptides, Classification of amino acids, General Synthetic methods for amino acids, General principle of Polypeptide synthesis, Isolation and analysis of amino acids from proteins, Determination of C-terminal, N- terminal and the sequence of amino acids in peptides, Classification of Proteins, Protein organization and structure, Characteristics of proteins with details of peptide bond geometry, Quartenary structure of Insulin and Oxytocin. Peptides and drug action.

2. Vitamins:
Chronological development of vitamins, General structure of vitamins- Structural elucidation of Vitamin A (Retinol), Vitamin B₁ (Thiamine), Vitamin D₂ and α-Tocopherol.

3. Glycosides:
General Chemistry of Glycosides, Determination of structure, Methods in determination of constitution of Arbutin, Amygdalin and Salicin.

4. Alkaloids:
General Chemistry of Alkaloids, General methods of determination of molecular structure, Methods in determination of constitution of Ephedrine, Nicotine, Atropine and Quinine.


6. Medicinal dyes and pigments:
Introduction to synthetic and natural dyes, Chemical classification of synthetic dyes, Constitution, synthesis and properties of Indigotin and Alizarin. Structure and uses of dyes/colors/pigments official in IP. Medicinal uses of dyes.
Reference Books:

1. Chemistry of Natural Products by O. P. Agrawal vol. I and II.
2. Organic chemistry of natural product by Gurdeep chatwal vol. I and II.
7. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
2.4.5 Pharmacology – I  

Theory  4 hrs/wk.

<table>
<thead>
<tr>
<th>Hrs</th>
<th>Marks</th>
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<td>22–32</td>
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</table>

1. **General Pharmacology**
   - Introduction and definitions- Sources and active ingredients of drugs. 02
   - Various drug discovery and development stages (preclinical and clinical). 02
   - Routes of administration of drugs. 02
   - Basic pharmacokinetics: absorption, distribution, metabolism and excretion. Basic pharmacokinetic parameters, Biopharmaceutical factors influencing bioavailability 01
   - Absorption kinetics, factors influencing absorption, cell membrane, transport of drug across the biological barriers, presystemic metabolism 03
   - Drug distribution -tissue distribution, plasma protein binding, blood brain barrier, plancental barrier. 03
   - Biotransformation – phase-I, phase-II, enzyme induction, enzyme inhibition, First pass effect. 03
   - Excretion, Half life. 02
   - Pharmacodynamics -Mechanism of drug action receptor, its types, Drug-Receptor interactions and molecular & biochemical basis of drug action. Additive effect, synergism, potentiation. Factors modifying drug effects. 05
   - Dose response relationship, structure activity relationship 02
   - Adverse drug reactions. 02

2. **Drugs acting on Autonomic Nervous System**
   - Introduction to Autonomic Nervous System: Cholinergic, adrenergic transmission & other peripheral transmitters 02
     - Cholinergic & anticholinergic drugs 05
     - Sympathomimetic & Sympatholytic drugs : adrenoceptor agonist and antagonists 06
     - Skeletal muscle relaxants 02
     - Ganglion transmission, Ganglion Stimulants & Blocking drug 02
     - Drugs used in the treatment of eye disorders 01

18–28
• Management of atropine, muscarine, scorpion poisoning

Reference Books:

2. Essential Pathology – Emanuel Rubin, John L., Farber J.B. Lippincot company.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
2.4.6 Physical Pharmacy – II

Practical 3 hrs/wk.

1. Surface Tension and Interfacial Phenomena:
   - Determination of surface tension of given liquid – 02
   - Determination of Interfacial tension of given liquid – 02
   - Determination of HLB of surfactant – 02

2. Micromeritics:
   - Determination of particle size and size distribution of any material by
     - Sieve Analysis
     - Microscopy
   - Determination of derived properties of powders or granules

3. Rheology:
   - Determination of Viscosity of given liquids
   - Determination of composition of a binary mixture by viscosity method.
   - Demonstration of Brookfield viscometer

4. Dispersed systems:
   - Determination of critical micelle concentration of a surfactant with stalagmometer.
   - Determination of mol. wt. of polymer by viscosity method
   - Determination of sedimentation volume of suspension prepared by different suspending agents.
   - Identification of type of emulsion by different methods

Reference Books:-

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone & Lewis
3. Physical Chemistry – Maron S. & Pruton
4. Remington’s Pharmaceutical Sciences
5. Theory and Practice of Industrial Pharmacy – Lachman Liebermann & Kanig
6. Pharmaceutical Technology - Eugene Parrott
7. Physical Pharmacy – Martin, Swarbrick and Commarata
8. Practical Pharmaceutics (Physical Pharmacy) - H. N. More, Ashok Hajare
9. Practical Physical Pharmacy - U. B. Hadkar, T.N. Vasudevan, K. S. Laddha
1. Standardization of water used in fermentation and pharmaceutical industry by MPN and IMViC
2. Microbial limit tests
3. Microbial assays
4. Preparation of plant cell culture media
5. Measurement of plant cell growth
6. Development of callus culture
7. Development of embryo culture
8. Isolation of DNA
9. Isolation of RNA
10. SDS polyacrylamide gel electrophoresis of seed proteins
11. Production of secondary metabolites using any available plant cell
12. Isolation of enzyme by adsorption
13. Isolation of enzyme by entrapment in carrageenan / calcium alginate
14. Fermentative production of antibiotics (penicillin) / Vitamins (Vit B₁₂)
Reference Books:
37. Pharmacopoeia of India, 1985, Govt. of India, Ministry of Health and Family Welfare.
41. Singh B. D., Biotechnology, 2001, Kalyani Publisher.
2.4.8 Pharmaceutical Heterocyclic & Polycyclic Chemistry

Practical 3 hrs/wk.

1. **Synthesis of organic compounds**
   - Benzillic acid [Benzillic acid Rearrangement]
   - Antranillic acid [Hoffmann Rearrangement]
   - Benzanilide from benzophenone [Beckmann Rearrangement]
   - Benzyldiene acetophenone [Claisen Schmidt reaction]
   - Benzimidazole
   - Benzotriazole
   - 1, 2, 3, 4 Tetreahydrocarbazole

2. **Estimation of functional groups**
   - Phenols, Amines, Nitro groups

3. **Analysis of oils**
   - Acid and, Iodine Value, Sap Value

4. One practical workshop on Molecular Models with the help of ball and stick Model.

**Reference Books:**

1. Advanced Organic Chemistry, Ed. 4 – Jerry March
3. Organic Chemistry : Pine
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry: Peter Sykes
8. Organic Chemistry-------Jain M.K.
10. Vogel’s Textbook of practical organic chemistry
11. Stereochemistry of Organic Compounds — Nasipuri D.
1. Extraction of strychnine and brucine from nuxvomica, ammonium glycirrhizinate from liquorice, aloin from aloe and nicotine picrate from tobacco leaves.

2. Estimation of simple functional groups like alcoholic, methoxy and amino groups of biomolecules stated under theory.

3. Identification tests of Alkaloids, Glycosides and carbohydrates.

4. Titrimetric analysis of any two antibiotics.

Reference Books:
1. Chemistry of Natural Products by O. P. Agrawal.
6. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
9. Practical Pharmacognosy by Dr. C.K. Kokate, Vallabh Prakashan, Delhi.
2.4.10 Pharmacology – I

1. Study of laboratory animals and their handling (a. Frogs, b. Mice, c. Rats, d. Guinea pigs and Rabbits)
2. Study of laboratory appliances used in experimental pharmacology
3. Study of use of anesthetics in lab animals (open method and closed method).
4. Study of routes of administration (mice/rats/rabbits).
5. Different modes of collection blood from animal like mice, rat, rabbit and guinea pig.
6. Study of route of administration as a factor modifying drug action (Mg SO₄)
7. Study of effect of autonomic drugs on rabbit’s eye.
8. Effect of drugs on ciliary motility of frog’s esophagus
9. Study the effect of skeletal muscle relaxants using rota rod apparatus.
10. Study the effect of acetylcholine on frog rectus abdominus muscle.

Note: Wherever possible the simulated experiments may be done
   CPCSEA approval to be obtained for experiments on animals.

Reference Books:

### Semester – V

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
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<td>3.5.1</td>
<td>Cosmeticology</td>
<td>3</td>
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<td>3.5.2</td>
<td>Pharmaceutical Engineering</td>
<td>3</td>
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<td>3.5.3</td>
<td>Medicinal Chemistry – I</td>
<td>3</td>
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<td>3.5.4</td>
<td>Pharmaceutical Polymer Chemistry</td>
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<td>3.5.5</td>
<td>Pharmacology – II</td>
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### Practical

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<td>3.5.6</td>
<td>Cosmeticology (Practical)</td>
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<td>3.5.7</td>
<td>Medicinal Chemistry – I (Practical)</td>
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<td>3.5.8</td>
<td>Pharmaceutical Polymer Chemistry (Practical)</td>
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<td>3.5.9</td>
<td>Pharmacology – II (Practical)</td>
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<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>15</strong></td>
<td><strong>200</strong></td>
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</table>
3.5.1 Cosmeticology Theory 3 hrs/wk.

1. **Physiological Consideration:**
   Skin, hair, nail and eye- in relation to cosmetic application.
   
2. **Properties, significance & applications of**
   a. Excipients used in various cosmetic formulations
   b. sensitivity & irritation tests for colours

3. **Formulation, Manufacturing & evaluation of cosmetics for**
   a. **Skin:**
      Powders, creams, lotions, deodorants, antiperspirants, suntan preparations, bathing preparations
      Make up preparations - Rouge, Lipsticks
   b. **Hair:**
      Shampoos, hair grooming preparations, preshave & after shave preparations, shaving preparations, depilatories & dyes.
   c. **Nail:**
      Nail lacquers, removers, nail bleach.
   d. **Eye:**
      Eye shadow, mascara, eyebrow pencil, eye make-up remover, eyeliners, eye cover-up makeup.

4. **Aerosols:**
   Definition, advantages, disadvantages. Components, propellants, General formulation, Manufacturing, Evaluation & Pharmaceutical applications,
References:

12. J. Knowlton and S. Rearce; Handbook of cosmetic sciences and technology Elsevier science publisher.
14. E. G. Thomssen; Modern cosmetics; Universal Publishing Corporation.
15. M. S. Balsam and E. Sagarin; Cosmetics, science and technology; John Wiley and Sons.
16. R. L. Elder; Cosmetic Ingredients, their safety assessment; Pathotox.
17. H. R. Moskowitz; Cosmetic Product Testing; Marcel Dekker.
18. W. C. Waggoner; Clinical safety and efficacy testing of cosmetics; Marcel Dekker.
19. C. G. Gebelein, T. C. Cheng and V. C. Yang ; Cosmetic and pharmaceutical applications of polymers; Plenum.
20. L. Appell; The formulation and preparation of cosmetics, fragrances and flavours; Micelle Press.
21. W. A. Poucher; Poucher’s Perfumes, cosmetics and soaps; vol.3 Chapman and Hall
22. Dr. Laba; 'Rheological properties of cosmetics and toiletries; Marcel Dekker.
3.5.2 Pharmaceutical Engineering  

<table>
<thead>
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<th>Theory (3 hrs/wk.)</th>
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<tbody>
<tr>
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<td>03</td>
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<tr>
<td>06</td>
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<td>05</td>
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1. Fluid flow:
   Fluid statics, mechanism of fluid flow, Bernoulli’s theorem, fluid heads, fluid handling (liquid and air)

2. Handling and conveying:
   Solids: portable power driven machines, trucks, trailers, power shovels, gantry cranes. Permanent installations for handling solids, conveyors-belt, chain, screw and pneumatic conveyors.
   Fluids: pumps, pipes and fittings, valves, plug, globe, gate and check valves, pipe connections. Application in pharmacy e.g. In water management and handling of liquid dosage forms.

3. Environmental control:
   Air handling, air conditioning, refrigeration - water vapour - air mixture, humidity and particulates in air refrigeration. Application of environmental control in pharma departments like powder, tablets, capsules.

4. Boilers:
   Main parts, mountings and accessories-industrial boilers including cochrans, babcock wilcox and lancashire.

5. Measurements:
   Flow: classification and description of various fluid flow measuring devices like orifice, venturi, pilot tube, rotameter and current meters.
   Pressure: classification and description of various pressure measuring devices.
   Temperature: various direct and indirect (remote) methods using mechanical and electrical principles.

6. Material technology:
   Corrosion – Mechanism of corrosion, types of corrosion and ageing, factors influencing corrosion and methods of combating corrosion.
   Materials of construction:
   Classification into metals and non-metals. Ferrous and non-ferrous metals.
   Ferrous - cast iron, mild steel, stainless steel.
   Non ferrous - copper and alloys, nickel alloys, aluminium.
   Non metals - glass and plastics, types of plastics.
   Poly vinyl chloride, polystyrene, polyethylene, polypropylene, nylon, polyester, epoxy, polytetrafluoroethylene, polycarbonate, abs, phenolic plastics, fibre reinforced plastics and laminates, uses of materials of
construction in the design of pharma packaging.

7. Maintenance:  
Objective, preventive and corrective maintenance, maintenance record keeping, maintenance of machineries and equipments in pharmaceutical departments like - mills, micropulverizer, sifters, mixers, homogenizers, granulators, compression equipments, coating equipments, packaging equipments, balances, ph meter, polarimeter, refractometer, microscope, colorimeter and flame photometer.

8. Safety:  
Hazards and their classification - mechanical, fire, chemical and occupational, their types and prevention.

Fire and explosion - chemistry of fire, classification of fires, methods of extinguishing.

Accidents - unsafe actions, unsafe conditions, financial losses, costs prevention.

Accident safety training and education

Reference Books:

8. Industrial Instrumentation, Donald P. Eckman,Seventh Wiley Eastern, Reprint, 1983,Wiley Eastern Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002
3.5.3 Medicinal Chemistry – I Theory (3 hrs/wk.)

<table>
<thead>
<tr>
<th>Hrs</th>
<th>Marks</th>
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<tr>
<td>01</td>
<td>02 - 03</td>
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</table>

1. **Introduction**:
   Sources of Drugs- Serendipity, Random Screening, Extraction from Natural Sources, Molecular Modification.

2. **Theoretical Aspects of Drug Action**
   The Ferguson’s Principle
   Physicochemical Parameters and Pharmacological Activity- Solubility, Partition Coefficient, Surface Activity, pKa, Ionisation, Stereochemical Factors, Bio-isosterism.

3. **Metabolism**
   Routes of Elimination
   Factors Affecting Metabolism – Genetic Factors, Physiological Factors, Pharmaceutical Factors, Drug Interactions.
   Metabolic Process- Phase I (Oxidation, Reduction & Hydrolysis) and Phase II (Glucuronide Conjugation, Acetylation, Methylation, Sulphate Conjugation, Conjugation with amino acids and Mercapturic acid formation.)

4. **Introduction to Receptor Concept**
   History, affinity, receptor & biological response, drug-receptor interaction, forces involved in drug-receptor interaction, receptor theories, conformational flexibility and multiple modes of action.

5. The following classes of drugs should be discussed in relation to:
   - Introduction to the rational development (if any)
   - Detailed Classification of each class
   - Mechanism of action
   - Synthesis of compounds with asterisk
   - Structure-activity relationship
   - Generic names / Trade names
   - Chemical nomenclature
   - Metabolism
   - Uses

6. **Drugs Acting on ANS**
   **a. Drugs Acting on Cholinergic Nervous System:**

   **b. Drugs Acting on Adrenergic Nervous System:**
c. Local Anaesthetics:

Lignocaine, Benzocaine, Lidocaine, Procaine, Bupivacaine.

7. Drugs Acting on Cardio Vascular System:

Anti Hypertensives & Anti Arrhythmic Agents:
Calcium channel blockers lanatosides A,B,C, Digoxin, Quinidine, Procainamide*, Nifedipine*, Amlodipine, Verapamil, Hydralazine, ACE Inhibitors, Enalapril and related drugs, Vasodilators such as Amyl nitrite, Nitroglycerin, Isoxsuprine, Sodium Nitroprusside.

8. Antilipedemic Agents (Lipid lowering agents):

Lipoproteins:
Classes & Metabolism, Hyperlipoproteineamias, Types and therapy, Clofibrate*, HMG-COA reductase inhibitors. (Proavastatin*, Lovastatin, Simvastatin, Atorvastatin).

9. Diuretics:


10 Hypotensive agents acting on vascular smooth muscle: Nitrites, amyl nitrite, glyceryl trinitrate, sodium nitrite, tetranitrate, mannitol, penterythritol tetranitrate, Isosorbide mononitrate, Isosorbide dinitrite.

Reference Books:

6. Profiles in Drug Synthesis : V.N. Gogte
9. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam, Mahadik and Bothara
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson
3.5.4 Pharmaceutical Polymer Chemistry Theory (3 hrs/wk.)
1. **Introduction to Polymer Chemistry and its pharmaceutical applications:**

   **Introduction:**

   Monomers, Polymers, backbone and side chains of polymers.

   Tacticity of Polymers: Stereochemistry of substituents, Relative and absolute configuration, Syndiotactic (R,S alternating), Isotactic (all R or all S), Atactic (R and S random), Illustration of tacticity with polyethylene polymers (no tacticity) and polypropylene polymers

   **Classification of Polymers**

   a) Addition Polymers: Addition to pi bonds- PVC, Teflon, polystyrene, polymethacrylate

   Macroscopic properties of these polymers- Crystalline (HDPE), Amorphous, Random conformation.

   b) Condensation Polymers/Co-polymers: Formation of condensation polymers- PET (polyethyleneterephthalate) and Nylon (6, 6).

   Pharmaceutical uses of polymers.

2. **Purines, Pyrimidines and nucleic acids:**

   General knowledge of Nitrogeneous Bases in Nucleic Acids, Chemistry, structure and functions of nucleic acids, nucleosides and Nucleotides, Introduction to purines and pyrimidines, Synthesis of adenine, guanine, uracil, thiamine and cytosine. Examples of Nucleic acid analogues used as drugs.

3. **Introduction to chemistry of Pharmaceutical Excipients**

   General Chemistry and Structure Property Relationship of

   **1.1-Cellulose derivatives-**

   Ethyl Cellulose, Hydroxy propyl methyl cellulose, Hydroxy propyl cellulose, Microcrystalline cellulose and Sodium carboxy methyl cellulose.

   **1.2-Carbopols-**

   **1.3-PEG Derivatives-** Polyvinyl Alcohol, Polyvinyl Phthalate

   **1.4-Plasticizers-** Triethyl citrate, Tri acetin, Propylene Glycol, and Glycerin.

   **1.5- pH sensitive polymers-**

   (a) Acrylic acid derivatives- Solid and liquid eudragits.

   (b) Cellulose derivatives- Cellulose acetate phthalate, hydroxyl propyl cellulose phthalate.

   **1.6- Binders, Disintegrants and Super disintegrants -**

   (a) Polysaccharides- Gums and mucilages of starch, acacia and tragacanth.

   (b) Resins- Indion-414 (Vinyl and divinyl benzene copolymers), Pyrillidones, cross-povidone/ acdisol/ polyplasdone.

   **1.7 Solubility enhancers/ Emulsifiers-** Tweens and Spans.
4. **Lipids:**

Classification of lipids- Fats and oils, Phospholipids (Cephalins, Lecithins, Phosphatidyl serine & Phosphatidyl choline), Glycolipids, Steroids (cortisone, lanosterol), Terpenes (Vitamin-A) and prostaglandins (along with formation from arachidonic acid). Structure and chemistry of all classes. Nutritional facts about fatty acids, triacylglycerides and cholesterol. Chemistry of the lipoidal barriers to drug absorption and distribution.

5. **Carbohydrates:**

General Chemistry of carbohydrates, classification, General methods of determination of molecular structure, Methods in determination of constitution of


**Reference Books:**

1. An Introduction to Physical Chemistry, Das Ishwar , Sharma Archana , New Age International (P), Limited, New Delhi
3. Chemistry of Natural Products by O. P. Agrawal vol. I and II.
5. Introduction to Polymers, By Robert J. Young, Amazon, UK.
10. Organic chemistry of natural product by Gurdeep chatwal vol. I and II.
12. Polymer Chemistry: An Introduction, By Malcolm P. Stevens, Amazon, UK.
13. Polymer Composite. M. C. Gupta and A. P. Gupta. New Age International (P), Limited, New Delhi
17. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
3.5.5 Pharmacology – II

<table>
<thead>
<tr>
<th>Hrs</th>
<th>Marks</th>
<th>Theory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>02-04</td>
<td>02</td>
<td>Introduction to Pathophysiology</td>
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<td>2</td>
<td>05-08</td>
<td>03</td>
<td>Basic principles of cell injury and adaptations.</td>
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<td>c. Causes, pathogenesis and morphology of cell injury.</td>
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<td>d. Abnormalities in lipoproteinaemia, glycogen infiltration and glycogen storage disease.</td>
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<td>3</td>
<td>05-08</td>
<td>06</td>
<td>Basics mechanisms involved in the process of inflammation and repair.</td>
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<td>e. Pathogenesis of acute inflammation.</td>
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<td>f. Chemical mediators in inflammation.</td>
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<td>g. Pathogenesis of chronic inflammation.</td>
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<td>h. Repair of wounds in the skin. Factors influencing healing of wound.</td>
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<td>02-04</td>
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<td>Diuretics-</td>
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<td>Role of nephron segments</td>
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<td>Basic and clinical pharmacology of diuretics</td>
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<td>Oedematous states and nonoedematous state</td>
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<td>Pathology, pharmacology and pharmacotherapy of</td>
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<td>04</td>
<td>Arrhythmia</td>
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<td>Ischemic heart diseases: angina pectoris and myocardial infarction.</td>
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<td>05</td>
<td>Hypertension</td>
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<td>Hyperlipidemia</td>
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<td>Kidney and urinary tract disease</td>
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<td>02</td>
<td>(terminological introduction to various disorders-</td>
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<td>Glomerulonephritis, nephrotic syndrome, acute &amp; chronic renal failure, pylonphritis.)</td>
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<td>04</td>
<td>4. Autocoids</td>
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<td>Kinins, prostaglandins ,Leukotrienes and cytokines</td>
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<td>Thromboxane- biosynthesis and pharmacology</td>
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<td>Histamines- release, immunological and non-immunological release and its pharmacology</td>
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<td>Antihistaminics – H1 and H2 antagonists</td>
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<td>Platelet activating factor.</td>
</tr>
</tbody>
</table>
Reference Books:

1. Goodman & Gillman - Pharmacological basis of Therapeutics Vol 1 & 2 (Pergamon Press)
2. Satoskar RS & Bhandarkar - Pharmacology & Therapeutics pt. I & II (Popular Prakashan)
3. Lewis Pharmacology - by Crossland (Churchill Livingston)
4. Laurence DR & Bennett - Chemical Pharmacology (ELBS)
5. Rang & Dale - Pharmacology (ELBS)
6. Sheth & Others - Selected topics in experimental Pharmacology (Kothari Book Dept).
7. Perry - Pharmacological experiments on Isolated preparations (E & S Livingston)
8. McLeod LJ - Pharmacological experiments on intact preparation (E & S Livingston)

3.5.6  Cosmeticology

Practical  3 hrs/wk.

1. Preparation and evaluation of following cosmetic formulations
   - Skin cosmetics
   - Hair cosmetics
   - Eye cosmetics
   - Nail cosmetics

Reference Books:

2. Modern Cosmetics : Thomson
3. Harry’s Cosmeticology
4. Perry’s Book of Cosmetics
5. Cosmetics Science & Technology : Edward Saggarin
1. Laboratory scale preparation of the following compounds
   - p-Bromothiophenol
   - Ortho-Iodo benzoic acid and Ortho-chlorobenzoic acid (Sandmeyer reaction)
   - Benzillic acid (Benzillic acid rearrangement)
   - Phenyl Toluene-p-Sulphonate
   - Acetanilide from Acetophenone (Beckmann Rearrangement)
   - Benzanilide from Benzophenone.
   - o-Thiocresol
   - Benzoic acid
   - Dibenzylacetone

Reference Books:

5. Profiles in Drug Synthesis : V.N. Gogte
8. Principle of Medicinal Chemistry (Volume I & II) by Kadam, Mahadik and Bothara
10. Practical Organic Chemistry - Mann and Sanders
11. Systematic Identification of Organic Composition, Shriner and Fuson
3.5.8 Pharmaceutical Polymer Chemistry Practical (3 hrs/wk.)

1. Determination of Ester value and Acetyl value of Oils.
2. Simple identification tests of Proteins and Amino acids.
4. Extraction of lycopene from tomato, caseine from milk, caffeine from tea leaves and solanine from potato.
5. Demonstration of cyclodextrin biosynthesis.

Reference Books:

1. Chemistry of Natural Products by O. P. Agrawal.
6. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
9. Practical Pharmacognosy by Dr. C.K. Kokate, Vallabh Prakashan, Delhi.
3.5.9 Pharmacology - II

Practical (3 hrs/wk.)

1. To study the physiological salt solution
2. To Study the appliances
3. To study the isolated frog heart perfusion tech.
4. To study the effects of ions on isolated heart of frog (KCl, CaCl₂)
5. To study the effects of Ach & Adrenaline on isolated heart of frog.
6. To study the effects of antagonists on isolated heart of frog.
7. To identify the unknown drug acting on isolated heart of frog.
8. To study the Cardiotonic activity of drugs using isolated frog heart and mammalian heart preparations (Digitalis)
9. The study the effect of diuretics in rats/rabbits.
10. To prove the formula for ringer solution on frog heart.
11. To demonstrate the Anti-inflammatory effect of drugs using rat-paw edema method
12. To study the effect of drugs on blood vessels by using hindlimb perfusion tech.

Reference Books:

Semester – VI

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
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<tr>
<td>3.6.1</td>
<td>Pharmaceutical Technology – II</td>
<td>3</td>
<td>50</td>
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<td>3.6.2</td>
<td>Pharmaceutical Unit Operations</td>
<td>3</td>
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<td>3.6.3</td>
<td>Medicinal Chemistry – II</td>
<td>3</td>
<td>50</td>
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<td>3.6.4</td>
<td>Pharmaceutical Analysis – III</td>
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<td>50</td>
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<td>3.6.5</td>
<td>Pharmacology – III</td>
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<td>3.6.6</td>
<td>Pharmacognosy &amp; Phytochemistry - III</td>
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**Practical**

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<th>Hours / Week</th>
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<td>3.6.8</td>
<td>Pharmaceutical Unit Operations (Practical)</td>
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<td>3.6.9</td>
<td>Medicinal Chemistry – II (Practical)</td>
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<td>3.6.10</td>
<td>Pharmaceutical Analysis – III (Practical)</td>
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<td>3.6.11</td>
<td>Pharmacognosy &amp; Phytochemistry - III (Practical)</td>
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<td>50</td>
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<td><strong>Total</strong></td>
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3.6.1 Pharmaceutical Technology - II Theory (3 hrs/wk.)

1. Tablets:
   Introduction, definition, advantages, disadvantages, preformulation, tablet excipients, types of tablets, formulation of different types of tablets, granulation technology on large scale by various techniques. Physics of tablet making, different types of tablet compression machinery and the equipments employed, processing problems.
   Granulation: definition, reasons for granulation, method of granulation. Granulation mechanisms and mechanism of granule formation, pharmaceutical granulation equipments, IPQC.
   Coating of tablets reasons, film coating, sugar coating, press coating. Functional coating standards for coated tablets, coating equipments, coating process. Validation of solid dosage forms, IPQC testing of tablets

2. Capsules:
   Advantages, disadvantages.
   Hard capsules: raw materials, shell manufacturing, capsule size, properties of filled material and formulation. Capsules filling equipments, processing and in process controls, evaluation of finished capsules and official standards.
   Soft gelatin capsule: capsule shell, capsule content, methods of production and evaluation as a dosage form.
   Importance of base adsorption and minim/gm factors in soft capsules.
   Comparison between soft and hard gelatin capsules.
   Stability testing and storage of capsule dosage forms.

3. Microencapsulation:
   Definition, applications, methods and advances in microencapsulation technology, equipment used, manufacturing processes and evaluation.

4. Oral sustained and controlled drug delivery:
   Definitions - historical development, components of therapeutic system - classification - details of matrix and diffusion control systems.
   Biopharmaceutical aspects-steady state concept and calculation of maintenance dose, loading doses.
   Diffusion and dissolution-steady state diffusion, lag time, diffusion cells and study of permeability of polymer and biological membranes, dissolution - the diffusion layer model, drug release, drug in polymer matrices, effect of porosity and tortuosity, membrane control, reservoir type devices.
   Design and evaluation of sustained release and controlled release preparations.
   Brief introduction to polymers
5. Packaging of non-sterile pharmaceutical products:

Packaging components, types, specifications and methods of evaluation, stability aspects of packaging. Packaging equipments, factors are influencing choice of containers, legal and other official requirements for container, package testing.

6. Plant layout techniques

Location, material handling, floor plans of different sections viz. Tablet, liquids, etc.

Reference Books:

1. Pharmaceutical Dosage forms - Ansel - Popovich & Allen. (Text book) and Drug Delivery system - (Williams & Wilkins)
2. Encyclopedia of Pharmaceutical Technology, by Swarbrick & Boyan – Marcel Dekker
3. American Pharmacy - Dittert (J. B. Lipincott)
4. Remington's Pharmaceutical Sciences -Alfonso R. Gennaro (Mack Publishing Co.)
6. Frobisher - Fundamentals of microbiology (Toppan) Industrial Pharmacy (Lea & Febiger), Modern Pharmaceutics - (Dekker)
7. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
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<td>03 - 05</td>
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<td>03 - 05</td>
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</tbody>
</table>

### 1. Stoichiometry:
Unit process, material and energy balances, molecular units, mole fraction, tie substance, gas laws, mole volume, primary and secondary quantities, equilibrium state, dimensionless equations, dimensionless formulae, dimensionless groups.

### 2. Heat Transfer:
Modes of heat transfer, Heat transfer in solids and liquids, Heat transfer equipments - heaters and heat exchangers. Source of heat, steam and electricity as heating media, determination of requirement of amount of steam/electrical energy, steam pressure, boiler capacity.

### 3. Evaporation:
Basic concept of phase equilibria, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators.

### 4. Distillation:
Rault’s law, phase diagram, volatility, simple steam and flash distillation, principles of rectification, Mc-Cab Thiele method for calculations of number of theoretical plates, azeotropic and extractive distillation.

### 5. Drying:
Moisture content and mechanism of drying, rate of drying and time of drying calculations, classification and types of dryers used in pharmaceutical industries and special drying methods.

### 6. Size Reduction and Size Separation:
Definition, objectives of size reduction, factors affecting size reduction, laws governing energy and power requirements of a mills including ball mill, hammer mill, fluid energy mill etc.

### 7. Mixing:

### 8. Fluidization:
Theory of fluidization. Application of fluidization in pharmacy in the areas of powder handling, agglomeration, drying and coating.

### 9. Reactors:
Fundamentals of Reactors, design for chemical reactions.

### 10. Water purification:
Deionization, reverse osmosis and distillation processes and large scale for manufacturing.
Reference Books:

8. Industrial Instrumentation, Donald P. Eckman, Seventh Wiley Eastern, Reprint, 1983, Wiley Eastern Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002
The following classes of drugs should be discussed in relation to:

Introduction to the rational development (if any)

Detailed classification of each class

Mechanism of action

Synthesis of compounds with asterisk

Structure-activity relationship

Generic names / Trade names

Chemical nomenclature

Metabolism

Uses

1. **Antiamoebics:**
   - Life cycle of parasite, Ipecac alkaloids – emetine, metronidazole* and tinidazole, dicloxanide furoate*, quinfamide

2. **Anthelmintics**
   - Trematode diseases (Schistosomiasis): Lucanthone, hycanthone, niridazole, oxamniquine, praziquantel.
   - Cestode disease (Tapeworm): Niclosamide*.
   - Nematode infections: Diethylcarbamazine, ivermectin.
   - Gastrointestinal nematode infections: Benzimidazole like mebendazole*, parbendazole, thiabendazole* and others, pyrantel pamoate, levamisole.

3. **Antifungal agents**

4. **Quinoline Antibacterials:** Nalidixic acid, norfloxacin, ciprofloxacin*, sparfloxacin, ofloxacain.

5. **Anti Tubercular and Antileprotic Agents:** PAS*, isoniazid*, pyrazinamide*, ethionamide*, ethambutol*, antitubercular Antibiotics like rifampicin, cycloserine & streptomycin, dapsone, clofazimine, general principles and significance involving drug combinations.
6. **Antimalarials**

   Life cycle of parasite and drugs acting on the various stages. Cinchona alkaloids, 4-Aminoquinoline, chloroquine* & others
   8-Aminoquinoline – Primaquine* and others
   9-Aminoacridine – quinacrine
   Quinoline methanol derivative – Mefloquine
   Folic acid inhibitors: Pyrimethamine*
   Antimalerial antibiotics & Misc. like halofantrine

7. **Antibiotics:**


8. **Antineoplastic agents**


**Reference Books:**

6. Profiles in Drug Synthesis : V.N. Gogte
9. Principle of Medicinal Chemistry (Volume I & II ) by Kadam , Mahadik and Bothara
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson
### 3.6.4 Pharmaceutical Analysis – III Theory (3 hrs/wk.)

<table>
<thead>
<tr>
<th>Theoretical aspect, basic instrumentation and applications of following analytical techniques should be discussed:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. UV-Visible spectrophotometry:</strong></td>
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<td>In applications point to be covered</td>
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<tr>
<td>Single component analysis, absorbity value, calibration curve, Single point and double point standard.</td>
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<tr>
<td>Multiple component analysis, simultaneous equation method, difference spectroscopy.</td>
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<td>Colorimetric estimation by Oxidation, complexation and condensation reaction.</td>
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<td>Determination of $\lambda_{\text{max}}$ by Woodward-Fischer rule.</td>
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<td><strong>Hrs</strong></td>
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<tr>
<td><strong>2. Infrared spectrophotometry</strong>, Introduction to FTIR</td>
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<td><strong>3. Nephelo-turbidimetry</strong></td>
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<tr>
<td><strong>4. Fluorimetry &amp; Phosphorimetry</strong></td>
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<td><strong>5. Nuclear Magnetic Resonance spectroscopy including $^{13}$C NMR</strong></td>
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<tr>
<td><strong>6. Mass spectrometry</strong></td>
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<tr>
<td><strong>7. Atomic Spectroscopy:</strong> Introduction, Principle, Instrumentation, Interference, Applications of Atomic absorption spectroscopy and Flame photometry.</td>
</tr>
</tbody>
</table>
Reference Books:
5. Instrumental methods of Analysis- Ewing.
7. Garat- The quantitative analysis of Drug (Toppan & Co.)
13. Merck Index.
1. **Immunopharmacology**
   Definition and scope of immunology, immunity, types, vaccination, bacterial and viral vaccines, neonatal and pediatric vaccines, Varies types of immune reactions, Immune complex reactions and secondary neuro transmitters in immunological reactions. Immune modulators, Immunosuppressants and its role in graft rejections.

2. **Endocrinological disorders.**
   - Drugs used in the endocrine disorders-
   - Thyroid hormone and Thyroid Inhibitors.
   - Insulin, Oral hypoglycemic drugs and Glucagon.
   - Gonadal hormones and their antagonists

3. **Chemotherapy:**
   - General considerations: - General principles of chemotherapy of infections
   - Drug resistance: Introduction, types, mechanism and its importance in chemotherapy
   - Mechanism of action, Pharmacokinetics, Uses & Adverse effect only to be discussed
   - Sulfonamides, Cotrimoxazole, Quinolones
   - Antibiotics effective against Gram-positive organisms- Penicillins
   - Antibiotics effective against Gram negative organisms- Amino glycosides
   - Antibiotics effective against both Gram positive & Gram negative organisms- Cephalosporins, Tetracycline & chloramphenicol.
   - Macrolide and other Antibacterial antibiotics, treatment of urinary tract infections and STDs
   - Chemotherapy of - Tuberculosis & leprosy including National TB programmes (DOTS)
   - Protozoal infections (Antimalarials, antiamoebics, Trichomoniasis, leishmaniasis & Kala azar infections)
   - Helminthiasis
• Fungal infections and its treatment
• Viral & HIV infections process and Antiretroviral drugs.  
  HAART therapy of AIDS
• Antineoplastic agents.  
  (Disturbances of growth of cells, Carcinogenesis and its types, molecular mechanism of carcinogenesis, General biology of tumors, Differences between benign and malignant tumors, Classification of tumors, Histological diagnosis of malignancy, Etiology and pathogenesis of cancer, Invasions, metastasis, patterns of spread of cancer.)

Reference Books:
2. Essential Pathology – Emanuel Rubin, John L., Farber J. B. Lippincott company.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
16. Pharmacotherapy: A Pathophysiological approach, Dipiro, J. L. Elsevier.3
3.6.6 Pharmacognosy & Phytochemistry - III Theory (3 hrs/wk.)

1. **Study of biological sources**, cultivation, collection, commercial varieties
   Chemical constituents, general biosynthetic pathways, substitutes, adulterants,
   uses, diagnostic macroscopic and microscopic features and specific chemical tests of
   following groups of drugs containing glycosides:
   - **Saponins**: Liquorice, ginseng, Dioscorea, Sarsaparilla and Senega
   - **Cardioactive sterols**: Digitalis, Squill, Strophanthus and Thevetia.
   - **Anthroquinone cathartics**: Aloe, Senna, Rhubarb and Cascara
   - **Others**: Psoralea, Ammi majus, Ammi visnaga, Saffron, Chirata, Quassia. Wild cherry bark, mustard

2. **Introduction** to alternative systems of medicine, with special emphasis
   given on Ayurveda

3. **Studies of traditional drugs**, common vernacular names, botanical
   Sources, morphology, chemical nature of chief constituents, pharmacology,
   Categories and common uses and marketed formulations of following
   Indigenous drugs Amla, Kantakari, Shatavari, Tylophora, Bhilawa, Kalijiri,
   Buch, Rasana, Punarnava, Chitrak, Apamarg, Gokhru, Shankhpushpi,
   Brahmi, Adulsa, Arjuna, Ashoka, Fenugreek, Garlic, Palash, Guggul,
   Gymnema, Shilajit, Nagarmotha and Neem.

4. **The holistic concept of drug administration in traditional systems of
   medicine.**

   Introduction to Ayurvedic preparations likes Aristas, Asvas, Gutikas,
   Tailas, Churnas, Lehyas and Bhasmas.
Reference Books:

2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
12. Handa & Kapoor, Book of pharmacognosy
3.6.7 Pharmaceutical Technology - II  

1. Tablets:  
   Preparation and evaluation of tablets (any four)
2. Capsules:  
   Filling of hard gelatin capsules  
   Evaluation of capsules  
3. Microencapsulation:  
   Preparation and evaluation of microencapsulated products.  
4. Oral sustained and controlled release:  
   Evaluation of polymers used therein.  
   Preparation and evaluation of SR/CR tablets/capsules/granules.

Reference Books:

1. Pharmaceutical Dosage forms - Ansel - Popovich & Allen. (Text book) and Drug Delivery system - (Williams & Wilkins)
2. American Pharmacy - Dittert (J.B. Lipincott)
3. Remington's Pharmaceutical Sciences -Alfonso R. Gennaro (Mack Publishing Co.)
3.6.8 Pharmaceutical Unit Operations Practical (3 hrs/wk.)

1. Determination of rate of evaporation
2. Experiments based on steam, extractive and azeotropic distillations.
3. Determination of rate of drying, free moisture content and bound moisture content.
4. Experiments to illustrate the influence of various parameters on rate of drying.
5. Experiments illustrate principles of size reduction, laws governing energy and power requirement of size reduction.

Reference Books:

8. Industrial Instrumentation, Donald P. Eckman,Seventh Wiley Eastern, Reprint, 1983,Wiley Eastern Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002
3.6.9 Medicinal Chemistry – II Practical (3 hrs/wk.)

1. Laboratory scale preparation of the following compounds
   - Picric acid.
   - Cinnamic acid (Perkin Reaction)
   - Benzhydrol from Benzophenone (MVP Reduction)
   - 8-Hydroxyquinoline (Skraup’s synthesis)
   - Benzocaine
   - PABA
   - Spectral Analysis of Drugs Synthesized.
   - Determination of Partition Coefficient, Dissociation Constant and Molar Refractivity of Compounds for QSAR analysis.

Reference Books:

7. Principle of Medicinal Chemistry (Volume I & II ) by Kadam, Mahadik and Bothara
8. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science
10. Practical Organic Chemistry - Mann and Sanders
11. Systematic identification of Organic Composition, Shriner and Fuson
3.6.10 Pharmaceutical Analysis – III Practical (3 hrs/wk.)

2. Spectrophotometric analysis of finished products.
4. Estimation of Na⁺, K⁺ by flame photometer.
5. Estimation of drugs by using turbidometer & nephelometer.

Reference Books:
5. Instrumental methods of Analysis- Ewing.
7. Garrat- The quantitative analysis of Drug (Toppan & Co.)
13. Merck Index.
3.6.11 Pharmacognosy & Phytochemistry - III  

1. Identification of crude drugs listed in theory.
2. Microscopic study of some important glycoside containing crude drugs with their powder characters like Liquorice, Digitalis, Senna, Quassia, Cascara
3. Identification of traditional crude drugs listed in theory.
4. Standardization of some traditional drug formulations

Reference Books:

1. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
### Semester – VII

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
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<tr>
<td>4.7.1</td>
<td>Biopharmaceutics &amp; Pharmacokinetics</td>
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<td>4.7.2</td>
<td>Medicinal Chemistry – III</td>
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<td>4.7.3</td>
<td>Pharmaceutical Analysis – IV</td>
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<td>4.7.4</td>
<td>Pharmacology – IV</td>
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<tr>
<td>4.7.5</td>
<td>Pharmacognosy &amp; Phytochemistry – IV</td>
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<td>4.7.6</td>
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### Practical

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<td>4.7.8</td>
<td>Medicinal Chemistry – III (Practical)</td>
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<td>4.7.9</td>
<td>Pharmaceutical Analysis – IV (Practical)</td>
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<td>4.7.10</td>
<td>Pharmacology – IV (Practical)</td>
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<td>4.7.11</td>
<td>Pharmacognosy &amp; Phytochemistry – IV (Practical)</td>
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* Elective subjects

1. Pharm. Marketing
2. Medicinal Plant Biotechnology
3. Quality Assurance
4. Drug Design and Lead Identification
5. Bioavailability and TDM
6. Cosmeceutics
7. Packaging Technology
8. Any other emerging area availing local expertise of Pharmaceutical relevance.
4.7.1 Biopharmaceutics and Pharmacokinetics. 

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<tr>
<th>Theory</th>
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</table>

1. Plasma concentration and therapeutic response.
   An introduction to pharmacodynamics.
   
   Hrs: 03  Marks: 05 - 08

2. Mechanisms of drug transport:
   Different mechanisms of drug transport, passive transport and pH-partition theory, facilitated diffusion, active transport, blood and its drug binding constituents as carriers of drugs in the body, perfusion, limitation and permeability limitation in drug transport
   
   Hrs: 04  Marks: 05 - 09

3. Absorption:

   Physiochemical and physiological factors affecting bioavailability of drugs from parenteral routes - examples of procaine penicillin g suspension and insulin - zinc suspension. Basic concepts of intranasal, oral, mucosal, rectal, transdermal, intravaginal, ophthalmic, and intrauterine delivery of drugs.
   
   Hrs: 10  Marks: 10 - 15

4. Distribution:
   Rate of distribution, perfusion limitation and permeability limitation, extent of distribution, plasma and tissue binding of drugs, drugs with small, intermediate and high volume of distributions and their relative plasma and tissue binding.
   
   Hrs: 04  Marks: 05 - 09

5. Elimination:
   Organ clearance concepts, hepatic clearance, hepatic extraction ratio, blood flow limitation in hepatic clearance, first pass effect.

   
   Hrs: 04  Marks: 05 - 10

6. Non Linear Pharmacokinetics
   Non-linearities in absorption and elimination. Examples of drug showing non-linear absorption or elimination’s, Individualization of dosage regimens and non-linear Pharmacokinetics.
   
   Hrs: 03  Marks: 05 - 08

7. Compartmental modelling of Drugs
   Pharmacokinetics of one compartment model drug, mathematical treatment to pharmacokinetic upon I.V. bolus dosing, I.V. infusion and first order extravascular input. Multicompartment model behavior (excluding
derivation or mathematical treatment), Central and Peripheral Compartments, distribution phase and pseudo distribution equilibrium phase.

Definition of pharmacokinetic parameters including volumes of distribution, clearance, biological half-life, renal clearance, non-renal clearances, additivity of clearance, absolute bioavailability, relative bioavailability, Bioequivalence and other miscellaneous parameters. Methods of estimation of pharmacokinetic parameters and parameters of bioavailability/Bioequivalence, including method of residuals, rate method and sigma-minus method of estimation of renal clearance, area under the curve, area under moment curve, mean residence time.

Reference Books:

7. Notari, R.E., Biopharmaceutics and Clinical Pharmacokinetics, Marcel Dekker.
9. Leon Shargel and Andrew B.C. Yu., Applied Biopharmaceutics and Pharmacokinetics (Appleton Century - Crofts)
10. Leon Shargel and Andrew B.C. Yu., Applied Biopharmaceutics and Pharmacokinetics (Appleton Century - Crofts)
11. Sarfaraz Niazi - Text Book of Biopharmaceutics and Clinical Pharmacokinetics (Appleton Century Crofts, New York)
12. Biopharmaceutics and Pharmacotherapeutics – Brahmankar
13. Textbook of therapeutics - Herfindal
The following classes of drugs should be discussed in relation to:

- Introduction to the rational development (if any)
- Mechanism of action
- Synthesis of compounds with asterisk
- Structure-activity relationship
- Generic names
- Chemical nomenclature
- Detailed classification of each class
- Metabolism
- Uses

1. **Drugs Acting on Central Nervous System**
   
   b. **Hypnotics and Sedatives**:

2. **Drugs acting as anticonvulsants**:
   Phenytoin*, Mephentoin, Trimethadione, Clonazepam, Phensuximide*, Ethosuximide, Phencalimide, Phenobarbital*, Mephobarbital (Classification of barbiturates) Metharbital, Carbamazepine, Sodium Valproate

3. **Psychotherapeutic Agents**:
   Phenothiazines such as Chlorpromazine*, Triflupromazine, Fluphenazine, Carphenazine, Chlorprothixene, Thoridazine, Fluplenthixol, Haloperidol*, Chlorodiazepoxide, Flurazepam, Oxazepam, Diazepam*, Meprobamate*, Imipramine, Desipramine, Amitriptyline, Nortriptyline, Doxepin, Phencelzine, Tranyclpromine, Pargyline, Fluoxetine, Loxapine.

4. **CNS Stimulants**:

5. **Drugs used in Parkinsonism**:
   Benzotropine mesylate, procyldine, orphendine, hydrochloride, Ethopropazine, levodopa, Carbidopa*, Benserazide, Amantadine*.
11. Drugs for Alzheimer's Diseases:
Tacrine, Velnacrine, Aniracetam, Sibopiridine

12. General Anesthetics:
Ether, Nitrous Oxide, Halothane, ultra short acting Barbiturates

2. CHEMOTHERAPY

c. Anti Virals:
Viral replications and difficulties involved in designing an effective antiviral agent as opposed to an antibacterial drug.
Nucleoside derivatives like Idoxuridine*, Vidarabine, trifluridine, acyclovir, ganciclovir,
Inhibitors of reverse transcriptase like Zidovudine* & (AZT) and nevirapine
HIV-protease Inhibitors like sanquinavir, and ritonavir, Other agents like amantadine*.
Interferon and its properties


3. Vitamins and Related Compounds
Water soluble & lipid soluble vitamins

Reference Books:

5. Profiles in Drug Synthesis : V.N. Gogte
8. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam, Mahadik and Bothara
10. Practical Organic Chemistry - Mann and Sanders
11. Systematic Identification of Organic Composition, Shriner and Fuson
4.7.3 Pharmaceutical Analysis – IV

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<td>03 - 05</td>
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</table>

1. **Quality Assurance:**
   Organization and responsibilities of QC, QA and TQM: Documentation, introduction to concept of ISO, ICH and GLP.
   Validation of analytical method.

2. **Chromatography:**
   Terminology used in different chromatographic techniques.
   Classification of chromatographic techniques.
   Development of chromatogram in different techniques.

   **Planer chromatography:**
   **Paper chromatography:** Theory, method of development, detection techniques and applications.
   **Thin-layer chromatography:** Theory, selection of adsorbent, preparation of the plate, spotting, development of chromatogram, detection of compound, recovery of components, Quantitative measurements and applications.
   **HPTLC:** Introduction, theory and applications.

   **Column chromatography:** Introduction, theory and applications.
   **Gas chromatography:** Theory, instrumentation, detectors, applications and introduction to GC-MS.
   **HPLC:** Theory, instrumentation (pumps, detectors and columns), applications.
   **Ion-exchange chromatography:** Theory / Principle, instrumentation and applications.
   **Gel permeation chromatography:** Theory / Principle, instrumentation and applications.
Reference Books:

5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth
15. Pharmaceutical Drug analysis by Ashutosh Kar.
25. Lamprecht- Implementing ISO 9000 Series (Dekker).
1. **Central Nervous System:**
   - General Considerations- Neuro humoral transmission in the CNS
   - General Anesthetics- phases of anaesthesia.
   - Local Anesthetics
   - Sedative & Hypnotics, Antianxiety agents. Alcohol
   - Anti-epileptic drugs-types of epilepsy, mechanism.
   - Psychopharmacological agents- disorders of psychology-psychosis, neurosis (Anti-psychotic),Anti-depressants-theory of depression , Anti-maniacs, and hallucinogens
   - Analgesic,Antipyretic & Anti-inflammatory agents
   - Anti-gout agents.
   - Opioids analgesics and their antagonists- pain and nociception, types of pains, endogenous pain inhibiting system.
   - Central Nervous system Stimulants.
   - Pathophysiology and pharmacotherapy of neurodegenerative disorders: (Neural death, Ischemic brain death, Anoxia Huntington’s disease, Ischemic brain damage, Parkinsonism disease, Alzheimer’s disease, Rheumatoid arthritis, Osteoarthritis.)

2. **Respiratory disorders:**
   - Drugs for Cough, COPD and Bronchial asthma.
   - (Pathophysiology of cough, tonsillitis, emphysema, bronchitis, lung abscess, pneumonia, pulmonary embolism.)

3. **Gastrointestinal disorders and pharmacotherapy:**
   - Gastric acidity and Peptic ulcer
   - Irritable bowel syndroms - Ulcerative colitis, Crohn’s disease, Achalasia, Harnia, Oesophagitis, Gastritis.
   - Constipation. Emesis
   - Diarrhoea Flatulence
   - Liver disorders – Cirrhosis, Hepatitis.
   - (Terminological introduction to various other disorders likes Pancreatitis, Gastro-oesophageal reflux disease, Portal hypertension, Cholelithiasis, Cholecystitis, Hepatic encephalopathy, asities, Gall stone formation)
Reference Books:

2. Essential Pathology – Emanuel Rubin, John L., Farber J.B. Lip pancot company.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
### 4.7.5 Pharmacognosy and Phytochemistry - IV

**Theory** (3 hrs/wk.)

<table>
<thead>
<tr>
<th>Hrs.</th>
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<td>16 - 22</td>
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</table>

1. Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, general biosynthetic pathways, substitutes, adulterants, uses, diagnostic macroscopic and microscopic features and specific chemical tests of the following alkaloid containing drugs

   j) **Pyridine-piperidine**: Tobacco, Areca, and Lobelia.

   k) **Tropane**: Belladonna, Hyoscyamus, Datura, Duboisia, Coca and Withania.

   l) **Quinoline and isoquinoline**: Cinchona, Ipecac and Opium.

   m) **Indole**: Ergot, Rauwolfia, Catharanthus, Nux vomica and Physostigma.

   n) **Imidazole**: Pilocarpus.

   o) **Steroidal**: Veratrum and Kurchi.

   p) **Alkaloidal amines**: Ephedra and Colchicum.

   q) **Glycoalkaloid**: Solanum.

   r) **Purines**: Coffee, Tea and Cola.

2. **Plant cell and tissue culture**

   Introduction to PTC, Enzyme technology, isolation of enzymes, immobilization of enzyme, cell and plant tissue culture, immobilized plant cells, raising mutants in plant cell cultures, protoplasts and cell fusion, plant cell cultivation and production of secondary metabolites, germplasm storage

3. **Utilization of aromatic plants and products derived from them**

4. **Natural allergens and photosensitizing agents and fungal toxins**

5. **Herbs as health food**

6. **Herbal cosmetics**

7. **Plant bitters and sweeteners.**
Reference Books:

1. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
4.7.6 Elective * Theory (2 hrs/wk.)

9. Pharmaceutical Marketing
10. Medicinal Plant Biotechnology
11. Quality assurance
12. Drug Design and lead Identification
13. Bioavailability and TDM
14. Cosmeceutics
15. Packaging Technology
16. Any Other Emerging Area availing Local Expertise of Pharmaceutical Relevance

1. Pharmaceutical Marketing

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<tr>
<th>Topic</th>
<th>Hrs</th>
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<tbody>
<tr>
<td>Introduction to Pharmaceutical marketing</td>
<td>2</td>
<td>02 – 03</td>
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<tr>
<td>Influence of Pharmaceutical Technology on marketing new drugs &amp;</td>
<td>3</td>
<td>03 – 05</td>
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<tr>
<td>Optimizing therapeutic outcomes</td>
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<tr>
<td>Marketing of medicines for self medication</td>
<td>3</td>
<td>04 – 06</td>
</tr>
<tr>
<td>Retail pharmacist as a marketing target</td>
<td>2</td>
<td>04 – 06</td>
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<tr>
<td>Drug distribution channels &amp; Practices</td>
<td>4</td>
<td>08 – 10</td>
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<tr>
<td>Advertising &amp; Sales Promotion</td>
<td>3</td>
<td>06 – 08</td>
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<tr>
<td>Market Research &amp; Sales Forecasting</td>
<td>3</td>
<td>07 – 10</td>
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<tr>
<td>International marketing</td>
<td>2</td>
<td>03 – 05</td>
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<tr>
<td>Industrial marketing</td>
<td>3</td>
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</table>

REFERENCE BOOKS:

6. Salesmanship, Sales management and advertisement – M. Satyanarayana
7. Business organization and management – M. C. Shukla
9. Modern marketing – Hapnar
10. Personal management
2. **Medicinal Plant Biotechnology**

<table>
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<th>Section</th>
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<td>1. Introduction &amp; Historical Perspective: Historical Background of Biotechnology and introduction to Medicinal Plant Biotechnology</td>
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<td>02 – 03</td>
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<tr>
<td>2. Enzymes: Introduction, mechanism of action, factors affection action, classification, types of inhibition, isolation techniques, Immobilization of enzymes, Application of enzymes to plant biotechnology</td>
<td>03</td>
<td>05 – 07</td>
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<td>3. Fermentation Technology: Fermentation techniques, types, working of terminators, application of fermentation techniques to biotechnology, industrial production of Vitamins</td>
<td>03</td>
<td>06 – 09</td>
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<tr>
<td>4. Plant Cell &amp; Tissue culture: Introduction, cell culture techniques, cellular tot potency, Laboratory Organisation &amp; Media, application to plant biotechnology</td>
<td>05</td>
<td>10 – 12</td>
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<td>5. Introduction to genetics: Genetics As Applied to Medicinal Herbs, Mutation, Polyplody, Chemical races, Artificial Mutations, Hybridization, genetic engineering of plants.</td>
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<tr>
<td>6. Recombinant DNA Technology: Introduction, transgenic plants, recombinant DNA techniques (Gene Splicing)</td>
<td>04</td>
<td>06 – 09</td>
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</tbody>
</table>

**Reference Books:**

27. Singh B. D., Biotechnology, 2001, Kalyani Publisher.


3. Quality assurance

1. Introduction
   Definition, objectives, brief introduction to components of quality assurance
   
   Hrs: 1  
   Marks: 02 – 03

2. GMP, cGMP, GLP & cGLP:
   Definition of GMP and cGMP, Components, Building and facilities, 20 point programme of cGMP, History of GLP & cGLP, GLP in an automated laboratory, Process confirmation goals for automation, The Economic Behavior model, Japanese Good Laboratory Practice Standards for drugs.
   
   Hrs: 6  
   Marks: 09 – 15

3. Calibration:
   Definition, Calibration master plan
   Purpose, Responsibility & Frequency of Calibration
   Tracing of measurement, Adequacy and contract services, Records of calibration, Scheduling of calibration, Labeling practice, Guidelines for preparation of Calibration SOPs, One example of Calibration of any one equipment. (pH meter, Tablet Hardness apparatus, Dissolution apparatus, analytical balance)
   
   Hrs: 3  
   Marks: 06 – 08

4. Validation.
   Definition, Principles, Importance, Scope and limitations of validation
   Process validation, Equipment validation – Autoclave validation with special mention of protocol for autoclave validation.
   Environment validation:
   Area decontamination, Sanitizing agents, Qualification and validation, Nonviable particulate monitoring, Surface sampling – RODAC & swab testing (Fallout or settling plates, RCS, Slit to agar), Aseptic filling, Factors in cleaning validation, Validation of Buildings and facilities
   
   Hrs: 3  
   Marks: 06 – 08

5. Documentation:
   Introduction, Steps in Total PMD Programme (Pharmaceutical Manufacturing Documentation), Guidelines for designing and implementing PMD programme, Master production and control record, Site master file.
   Documentation formats for the following Operations for handling materials and products, Rejected materials and products, Validated process, Release of batches, SOPs
   
   Hrs: 2  
   Marks: 06 – 08

6. Training:
   Introduction, Qualification, experience and training, Responsibilities and key personnel, Personal hygiene and clothing, Legal aspects, Training manual document, Significance of Training, three steps training Programme (Classroom/Orientation, Technical and on the job training)
   
   Hrs: 3  
   Marks: 05 – 08

7. Introduction to various agencies imparting Quality standards (ISO, WHO, Etc.): Brief introduction to following regulatory agencies.
   
   Hrs: 4  
   Marks: 06 – 08
ISO, WHO, USFDA, TGA, MCC, MHRA, ICH

References:
12. S. Weinberg, Good laboratory practice Regulations, Marcel and Dekker.
13. J. Swarbrick Boylan, encyclopedia of pharmaceutical technology, Marcel and Dekker.
18. D.H. Stamatis, Understanding ISO 9000 and implementing the basics to quality; Marcel Dekker.
20. Chronicle Pharmabiz
21. Pharmapulse
4. **Drug Design and lead Identification**

<table>
<thead>
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<td>08 – 12</td>
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</table>

1. Receptor: Introduction to receptors, Types of receptors with example, Receptor theories, Drug receptor interactions, Design of agonist and antagonist with example.

2. QSAR: QSAR parameters, QSAR models-General concept, Applications and limitations of QSAR in drug design

3. Drug discovery: Historical perspective, Target selection- Target specificity and selectivity between species and within body, Targeting drugs to specific organs and tissues. Lead identification- Serendipity, Screening of natural products, Screening synthetic compound libraries, Modifying existing drugs, computer aided drug design.

4. Molecular modeling & drug design: General concept, Introduction to molecular mechanics and quantum mechanics, Concept of known and unknown receptor

**References:**

7. Ariens – drug design Vol. – II.

8. Annual Reports in medicinal chemistry (Academic press Inc.)


10. Woodridge – Progress in pharmaceutical Research.


12. Burgers - Medicinal Chemistry & Drug Discovery
5. **Bioavailability and TDM**

1. **Bioavailability & Bioequivalence:**
   - 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)
   - Drug dissolution rate and bioavailability
   - Theories of dissolution in-vitro drug dissolution testing models in vitro - in vivo correlation
   - In vitro and in situ absorption studies
   - Various In vitro & in situ models – selection of animals
   - Correlation between in vitro & in vivo studies.

2. **INTRODUCTION TO THERAPEUTIC DRUG MONITORING**
   - Definition & introduction.
   - Indication for TDM & clinical applications.
   - Monitoring plasma drug levels.
   - Role of Clinical pharmacist in TDM.

3. **TECHNIQUES USED IN TDM**
   - Physical methods
     - HPLC, HPTLC, GC: Sensitivity and selectivity of detection with respect to applications for TDM and related pharmacoeconomics.
   - Immuno assays.
     - RIA, ELISA, EMITH, NIIA : Sensitivity and selectivity of detection with respect to applications for TDM and related pharmacoeconomics.

4. **TDM OF SPECIFIC DRUGS**
   - Clinical pharmacokinetics, general guidelines, sample collection, time of sample collection, clinical comments, clinical monitoring parameters, usual dosing parameters, common toxicities, adverse drug reactions & drug interactions, techniques used for estimation, importance of
   - 1. Digoxin  
   - 2. Gentamicin.   
   - 3. Lidocaine   
   - 4. Lithium  
   - 5. Theophylline  
   - 6. Phenytoin  
   - 7. Phenobarbitone  
   - 8. Carbamazepine  
   - 9. Valproic acid
References:

9. Therapeutic drug monitoring - B. Widdop
10. TDM & Clinical biochemistry – Mike Hallworth
13. Handbook of TDM. – Simkin
14. TDM – Abbot
6. **Cosmeceutics**

1. **Physiological Consideration:**
   Skin, hair, nail and eye- in relation to cosmetic application.

2. **Rheology of cosmetics:**
   Rheological additives in cosmetics, rheology of nail products, antiperspirants, deodorants, hair products, creams and lotions.

3. **Manufacturing techniques:**
   Cosmetics creams, powders, compacts, sticks, liquids, foam and aerosol cosmetics.

4. **Evaluation of cosmetics: Performance,**

5. **Clinical safety tasting :**
   Irritation, sensitization, photoirritation, photoallergy, ocular irritation and protocols for the same.

6. **Packaging :**
   Package development and design for cosmetics including aerosol packs.

**References:**

13. J. Knowlton and S. Rearce; Handbook of Cosmetic Sciences and Technology Elsevier Science Publisher.
15. S. N. Katju’s; Law of Drugs; Law Publishers (India) Pvt. Ltd.
16. E. G. Thomssen; Modern cosmetics; Universal Publishing Corporation.
17. M. S. Balsam and E. Sagarin; Cosmetics, Science and Technology; John Wiley and Sons.
18. R. L. Elder; Cosmetic Ingredients, their safety assessment; Pathotox.
19. H. R. Moskowitz; Cosmetic Product Testing; Marcel Dekker.
20. W.C.Waggoner; Clinical safety and efficacy testing of cosmetics; Marcel Dekker.
22. L.Appell; The formulation and preparation of cosmetics, fragrances and flavours; Micelle Press.
23. W.A.Poucher; Poucher’s Perfumes, cosmetics and soaps; vol.3 Chapman and Hall
24. Dr. Laba; ‘Rheological properties of cosmetics and toiletries; Marcel Dekker.
7. Packaging Technology

<table>
<thead>
<tr>
<th></th>
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<th>Hrs</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Introduction to Packaging Technology&lt;br&gt;Importance/need of packaging, ideal characters of packaging materials.</td>
<td>02</td>
<td>03 – 05</td>
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<tr>
<td>2</td>
<td>Packaging Materials used in Pharmacy&lt;br&gt;Primary &amp; secondary packages:&lt;br&gt;Glass: Composition of glass, types, production of glass materials, defects in glass&lt;br&gt;Plastic: comparison of plastic &amp; glass, thermosetting &amp; thermoplastics, polyethylene, polypropylene, PVC, Polystyrene, Nylon, Polycarbonate, acrylic multipolymers, polyethylene terphthalate, drug plastic considerations.&lt;br&gt;Metals: Tin, Aluminium, Lead, Stainless Steel &amp; others&lt;br&gt;Rubber: Composition &amp; types, Applications as closure.</td>
<td>05</td>
<td>10 – 12</td>
</tr>
<tr>
<td>3</td>
<td>Types of Packaging&lt;br&gt;Categories in packaging containers like glass, plastic, polyethylene, polyethylene terphthalate and polyethylene terphthalate G, polypropylene, PVC.&lt;br&gt;Metal containers: paper, paperboard &amp; cardboard, multiple &amp; single unit containers &amp; closures, unit of use, labelling, storage conditions specified, stability testing, good packaging practices.</td>
<td>02</td>
<td>03 – 05</td>
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<tr>
<td>4</td>
<td>Evaluation of Packaging materials &amp; Packages&lt;br&gt;Evaluation of mechanical &amp; functional properties of elastomeric closures, evaluation of plastics: sorption, desorption, photodegradation, polymer modification tests, Glass: chemical &amp; light resistance testing, typical tests for packaging material as per IP &amp; USP. Evaluation tests for metal, paper &amp; board packagings as per IP &amp; USP.</td>
<td>08</td>
<td>12 – 15</td>
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<tr>
<td>5</td>
<td>Equipments used in packaging of Pharmaceuticals&lt;br&gt;Detailed study of machines mentioned below used in packaging of pharmaceuticals – Blister, strip, bubble packaging machine, sachets/ pouche sealing machine, bottle capping machine, collapsible tube sealing machine, aerosol container sealing machine, plastic bottle sealing machine, prefilled syringe packaging machine, soft gelatin capsule packaging machine.</td>
<td>04</td>
<td>08 – 12</td>
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<tr>
<td>6</td>
<td>Innovations in Packaging Technology&lt;br&gt;Introduction to regulatory issues related to pharmaceutical packaging; poison prevention packaging act 1970 (PPPA), the fair packaging &amp; labelling act (FPLA), innovative packaging like child-resistant, senior friendly, identifiable, functional &amp; hermatically sealed pharmaceutical containers, introduction to ‘blow-fill-seal-technology’</td>
<td>03</td>
<td>04 – 06</td>
</tr>
</tbody>
</table>
References:

8. Pharmaceutical Dosage forms - Ansel - Popovich & Allen. (Text book) and Drug Delivery system - (Williams & Wilkins)
14. Indian Pharmacopoeia & United States Pharmacopoeia
4.7.7 Biopharmaceutics and Pharmacokinetics  

Practical (3 hrs/wk.)

1. Experiments designed for estimation of various pharmacokinetic parameters with given data.
5. Statistical treatment of pharmaceutical data.

Reference Books:

7. Notari, R.E., Biopharmaceutics and Clinical Pharmacokinetics, Marcel Dekker.
9. Leon Shargel and Andrew B.C. Yu., Applied Biopharmaceutics and Pharmacokinetics (Appleton Century - Crofts)
10. Leon Shargel and Andrew B.C. Yu., Applied Biopharmaceutics and Pharmacokinetics (Appleton Century - Crofts)
11. Sarfaraz Niazi - Text Book of Biopharmaceutics and Clinical Pharmacokinetics (Appleton Century Crofts, New York)
12. Biopharmaceutics and Pharmacotherapeutics – Brahmankar
13. Textbook of therapeutics - Herfindal
1. Laboratory scale preparation of the following compounds & characterization by TLC & IR
   - Sulphanilamide
   - Esters
   - Hydrazide
   - Chloramine-T
   - Benztriazole
   - Paracetamol
   - Aspirin
   - Benzophenones
   - Phynetoin
   - Methyl orange

Reference Books:

5. Profiles in Drug Synthesis : V.N. Gogte
8. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
10. Practical Organic Chemistry – Mann and Sanders
11. Systematic identification of Organic Composition, Shriner and Fuson
6. Determination of $R_f$ value from Thin-layer chromatography (any two).
7. Determination of $R_f$ value from Paper chromatography (any two).
8. Demonstration on HPLC, GC.

**Reference Books:**

5. Gary Christian- Analytical Chemistry (John Wiley).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth
15. Pharmaceutical Drug analysis by Ashutosh Kar.
25. Pharmaceutical Process Validation by Nash (Dekker).
4.7.10 Pharmacology – IV

Practical (3 hrs/wk.)

1. To study the Analgesic activity of morphine in mice using analgesiometer.
2. To study the anticonvulsant activity of drugs using MES induced convulsions (by using electroconvulsometer).
3. To study the anticonvulsant activity of drugs using pentylene tetrazole induced convulsions.
4. To study the CNS stimulant activity of drugs using Actophotometer.
5. To study the CNS depressant activity of drugs using Actophotometer.
6. To estimate the aspartate aminotransferase level in serum.
7. To estimate the alanine aminotransferase level in serum.
8. To estimate the alkaline phosphates level in serum.
9. To estimate the acid phosphates level in serum.
10. To demonstrate the working and functional aspects of student physiograph

Note: Wherever possible the simulated experiments may be done

CPCSEA approval to be obtained for experiments on animals

Reference Books:

4.7.11 Pharmacognosy and Phytochemistry – IV Practical (3 hrs/wk.)

1. Identification of crude drugs listed in theory.
2. Microscopic study of some important alkaloid containing crude drugs with their powder characters (any seven)
3. Study of powder mixture mentioned in theory.
4. Formulations of some Herbal Cosmetics- Shampoo, Creams, Hair dye, lotions, Hair oils.

Reference Books:

1. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
### Semester – VIII

<table>
<thead>
<tr>
<th>Sub Code</th>
<th>Subject</th>
<th>Hours / Week</th>
<th>Maximum marks</th>
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<td>4.8.1</td>
<td>Pharmaceutical Technology - III</td>
<td>3</td>
<td>50</td>
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<td>4.8.2</td>
<td>Pharmaceutical Jurisprudence</td>
<td>3</td>
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<td>4.8.3</td>
<td>Pharmaceutical Industrial Management</td>
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<td>4.8.4</td>
<td>Medicinal Chemistry - IV</td>
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<td>4.8.5</td>
<td>Pharmacology – V</td>
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<td><strong>Total</strong></td>
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#### Practical

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<td>4.8.6</td>
<td>Pharmaceutical Technology - III (Practical)</td>
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<td>4.8.7</td>
<td>Medicinal Chemistry - IV (Practical)</td>
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<td>4.8.8</td>
<td>Pharmacology – V (Practical)</td>
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<td>4.8.9</td>
<td>Project work</td>
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<td>Hrs</td>
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<td>4.8.1 Pharmaceutical Technology - III Theory (3 hrs/wk.)</td>
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<td>1. Sterile delivery system: Introduction and concepts.</td>
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<td>15</td>
<td>12</td>
<td>2. Parenteral drug delivery system:</td>
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<td></td>
<td>12 – 18</td>
<td>• General requirements</td>
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<td>• Types and their formulation with reference to powders</td>
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<td>for reconstitution solutions, suspensions, emulsions,</td>
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<td>freeze dried products and depot preparations,</td>
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<td>preparation of sterile water for injection.</td>
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<td>Pharmacopoeial evaluation of sterile water for</td>
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<td>injection.</td>
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<td>• Containers and closures (glass, plastics and rubber)</td>
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<td>and their evaluation, form, fill, seal technology,</td>
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<td>evaluation of containers and closures including a</td>
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<td>mention of compatibility testing (to be covered</td>
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<td>more extensively under stability).</td>
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<td>• Design of facilities and environmental control:</td>
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<td>basic design concepts, cleanliness classes, air</td>
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<td>handling (hvac systems), hepa filters, laminar</td>
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<td>flow and laminar flow rooms, change room design,</td>
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<td>materials of construction, sterilization,</td>
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<td>validation of environment and filters.</td>
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<td>• Personnel factors: selection, training, monitoring</td>
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<td>and motivation concepts to be considered for</td>
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<td>education of workers - personal hygiene, gownsing</td>
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<td>and entry procedure, restrictions in work area and</td>
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<td>importance of the same.</td>
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<td>• Processing of parenteral products by terminal</td>
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<td>sterilization, filtration sterilization followed by</td>
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<td>aseptic filling and by aseptic compounding.</td>
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<td>Validation of sterilization and process validation.</td>
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<td>• Quality control and quality assurance.</td>
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<td>• Factory layout: different departments, services and</td>
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<td>utilities</td>
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<td>3. Ophthalmic products: anatomy and physiology of</td>
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<td>12</td>
<td>eye, general requirement / safety considerations,</td>
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<td>formulation, isotonicity adjustment, isotonicity</td>
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<td>calculation, manufacture, packaging and quality</td>
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<td>control. Introduction to contact lens solutions and</td>
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<td>their formulations</td>
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<td>4. Biological Pharmaceuticals</td>
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<td>• Blood Products: Whole human blood, blood products</td>
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<td>and plasma substitutes and its quality control.</td>
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<td>• Glandular products: Extraction of pancreas and</td>
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<td>isolation of Insulin, Insulin Injections, transportation and storage, processing / extractions, purification, packaging, safety and efficacy evaluation and other standards.</td>
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<td>• Surgical Products: Definition, primary wound</td>
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<td>dressing, absorbents, surgical cotton, surgical</td>
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<td>gauzes etc. bandages, absorbable and</td>
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monoabsorbable sutures, ligatures and catguts. Medical prosthetics and organ replacement materials.

5. Novel Drug delivery Systems: Mucosal, transdermal, parenteral implants and pumps, I. U. D. osmotic pumps, bioadhesive, targeted delivery, externally modulated devices and delivery: iontophoresis, sonophoresis, etc. (No details to be taught).

5. Pilot plant scale up technique
   Groups responsibilities - facilities - example of scaling up

Reference Books:

1. Industrial Pharmacy – Lachman et al. (Lea & Febiger)
2. Pharmaceutical Dosage forms - Ansel - Popovich & Allen.
3. American Pharmacy -Dittert (J. B. Lipincott)
4. Remington's Pharmaceutical Sciences - Alfonso R. Gennaro (Mack Publishing Co.)
5. Bentley's T. B. of Pharmaceutics - Rawlins (ELBS)
6. Modern Pharmaceutics - Banker and Rhodes -(Dekker)
8. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
10. Swarbrick & Boylan - Encyclopedia of Pharm. Technology. – (Dekker)
11. Remington's Pharmaceutical Sciences. (Mack)
<table>
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<tr>
<th>Hrs</th>
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1. **Pharmacy Act 1948:**
   Extent, commencement - Important definitions

2. **Drugs and Cosmetics Act 1940/Rules 1945:**
   Drugs Technical Advisory Board and Central Drugs laboratory - their composition and functions - Ayurvedic / Allopathic drugs, prohibitions - Ayurvedic, Homeopathic and Allopathic medicines in respect of Import and Export, Indigenous manufacture, sale or distribution - Drugs Consultative Committee, its composition and functions - Inspectors - their powers and duties - sampling procedure - Inspection enquiry, Investigation / Cosmetics / Ayurvedic drugs) - Imported drugs, Cosmetics and Indigenously manufactures drugs and cosmetics - offences and penalties, confiscation’s - Govt. Analyst, Licensing Authorities and Controlling Authority, qualifications, functions and powers - Licenses for different systems for Medicine.

3. **Narcotic Drugs and Psychotropic Substances Act 1985:**
   Historical background of Opium Act and Dangerous Drugs Act. Prohibitions and penalties.

4. **Drugs and Magic Remedies Act 1954:**
   Definitions, Official's duties, Prohibitions, Penalties etc.

5. **Drugs Price Control Order 1987:**
   Historical background - Essential commodities Act - Relevant provisions, Drugs Prices Display Rule 1961 and other relevant orders - Applicability to Imported drugs and Indigenously manufactured drugs - definitions - prices to wholesaler and retailer - MAP - penal provisions.

6. **Prevention of Food adulterations Act 1954 and Rules 1955:**
   Important definitions, Central Board of Food Standard, Central Food Laboratory, Composition and Functions.
   Public Analyst: Qualifications, duties, Food Inspectors: Qualification powers, duties sampling procedures.

7. **Prevention of Cruelty to Animals Act-CPSEA rules.**

8. **Code of Pharmaceutical Ethics**


Reference Books:

1. D & C act 1940 and rules 1945
2. Pharmaceutical Jurisprudence – N. K. Jain
3. Forensic Pharmacy – Kuchekar & Khadtare
4. Textbook of Forensic Pharmacy. – B. M. Mithal
5. Textbook of Forensic Pharmacy. – B. Suresh
4.8.3 Pharmaceutical Industrial Management Theory (3 hrs/wk.)

   Deciding whether to go abroad, Deciding how to enter the markets.
   Indirect Export, Direct Export, Licensing, Joint ventures, Direct investment, Internationalization process, Deciding on the Marketing Organization, Export Department, International Division, Global Organization.
   Patents and its implications:
   Indian Patents act 1970, New patent requirement as per TRIPS agreement Patent (amendment) Bill 1995
   Hrs Marks 02 03 – 05

2. Trade related intellectual property (TRIPS):
   TRIPS agreement, Intellectual Property Rights, Types of intellectual properties, Copyrights, trademarks, geographical indications. Industrial designs, layout designs, trade revert.
   Hrs Marks 02 03 – 05

3. GATT agreement and its impact on pharmaceutical industry:
   GATT, History of GATT, Its impact on pharmaceutical industry, Pharmaceutical market in India
   Hrs Marks 02 03 – 05

4. Concepts of Management:
   Business Management Thought, Functions, types of Organizations, Techniques of Communication, direction Participation, delegation, decision making, control Tools like PERT, CPM, systems.
   Hrs Marks 05 06 – 08

5. Production Planning and Control systems:
   Hrs Marks 03 03 – 05

6. Materials Management systems:
   Purchase and Inventory Control, Material Handling.
   Hrs Marks 03 03 – 05

7. Understanding marketing management:
   Role of marketing in today’s organization, identifying and classifying market, understanding market behavior/consumer behavior, Pharmaceutical market in India, Pharmaceutical Industry Scenario.
   Hrs Marks 05 06 – 08

8. Analyzing Marketing Opportunities:
   Hrs Marks 05 04 – 06

9. Interviewing techniques
   Hrs Marks 03 03 – 05

10. Community Pharmacy Practice
    Hrs Marks 02 03 – 05

11. Sales Management
    Hrs Marks 03 04 – 08
Reference Books:

1. Principles and Practice of Drug store administration - Dr. Mahesh Burande [Nirali Prakashan]
2. R. M. Mehta - Drug Store and Management [Vallabh prakashan]
3. Smith - Principles and methods of Pharmacy management
5. Principles of Pharmaceutical Marketing - Smith
6. Pharmaceutical Marketing Management - Mukhopadhyya
7. Marketing Management - Philip Kotlor
4.8.4 Medicinal Chemistry – IV Theory (3 hrs/wk.)

1. **Introduction to QSAR**
   Statistical prediction & pharmacological activity – partition coefficient, QSAR models, stearic factors, molecular modeling (CADD) Hansch equation.

2. **Introduction to Prodrugs and orphan drugs**
   The following classes of drugs should be discussed in relation to:
   i. Introduction to the rational development (if any)
   j. Mechanism of action
   k. Synthesis of compounds with asterisk
   l. Structure-activity relationship
   m. Generic names
   n. Chemical nomenclature
   o. Detailed Classification of each class
   p. Uses

3. **Analgesics, Antipyretics and Anti-inflammatory agents:**

**Narcotic Analgesic Agents:**
Morphine, Oripavine, Codeine, ethylmorphine, dihydroxycodeine*, Metopan, Levarphanol, Dextromethorphan, Meperidine*, anilaridine, Methadone*, meperidine, dextropropoxyphene and pentazocine.

**Non-narcotic analgesic agents:**
Dextropropoxyphene* and Ethoheptazine, Morphine antagonists, n-allyl-nor morphine levellorphan, nalorex.
4. **Steroids:**

Classification of steroids, configuration and conformation.
Adrenocorticoids: Cortisol, Hydrocortisone acetate, Fludrocortisone acetate, Betamethasone, Flucinolone acetamide, Triamcinolone, Methyl prednisolone
Androgens and Anabolic Steroids: Testosterone, Fluoxymesterone
Estrogens: Ethinyl estradiol, Estradiol, Mestrormol, chlorotrainisene, Estrone, Dienesterol, Diethylstilbester and other non-steroidal estrogens
Progestational agents: Progesterone, Norethindrone, Norgestrel, Dimethisterone.

Oral contraceptives

5. **Antihistaminics, Antiemetics and antiulcer drugs:** Metoclopramide, Diphenhydramine*, Doxylamine, Triprolidine, chlorpheniramine, Antazoline, Cyproheptadine, Terfenadine, Cimetidine, Omeprazole*, Lansoprazole, Ranitidine*, Famotidine, Ondansetron, Tripelennamine*.

6. **Thyroid Function and Thyroid Drugs:**

Thyroid Hormone, Methimazole, Propyl Thiouracil, Thyroid Analogs.

7. **Oral Hypoglycemics:**

Sulfonylureas-Tolbutamide*, Glimepiride*, Biguanides- Metformin, Thiazolidinediones- Ciglitazone, Rosiglitazone, Acarbose, Repaglinide.

**Reference Books:**

6. Profiles in Drug Synthesis: V.N. Gogte
9. Principle of Medicinal Chemistry (Volume I & II ) by Kadam , Mahadik and Bothara
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson
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1. **Drugs used in the disorders of eye, skin & ENT**
   a) Ocular pharmacology – Glaucoma, keratitis, conjunctivitis, loss of vision, cataract, Squint. (Pharmacotherapy of Glaucoma)
   b) ENT – Acute epiglotitis, allergic rhinitis, otitis externa, otitis media, wax (cerumen), vertigo, meneiers disease.
   c) Dermatology- Acne, candidiasis, alopecia, erythema nodusum, eczema, contact dermatitis, Herpes simplex, pediculosis, psorasis, pyoderma scabies, urticaria, pruritis.

2. **Drugs used in emergency- coma, shock, burns, snakebite.**

3. **Pathophysiology of blood disorders and drugs acting on hemopoietic system**
   - Coagulants and anti-coagulants.
   - Haemopoietics.
   - Thrombolytics and antiplatelet agents.

4. **Miscellaneous:**
   - 1. Drugs used in pediatrics and Geriatrics, pregnancy and lactation.
   - 2. Drug abuse and misuse, Drug induced diseases.
   - 3. Concept of Essential drugs and rational drug use.
   - 4. Interpretation of clinical laboratory tests.

5. **Adverse drug reactions – types, reporting and monitoring.**


7. **General principles of Toxicology – Acute, Sub acute & Chronic toxicity.**
   - General principles of treatment of acute toxicity and acute poisoning.
   - Signs, Symptoms and treatment of acute and chronic poisoning due to

8. **Introduction to TDM.**

9. **Bioassays:**

10. **Clinical trials**
Schedule Y, ICH –GCP guidelines

Reference Books:

11. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
Formulation and evaluation of the following sterile dosage forms

1. Small Volume Parenterals:
   - Ascorbic acid Injection, I. P.
   - Calcium gluconate Injection, I. P.
   - Atropine Sulphate Injection
   - An injection demonstrating co-solvent phenomenon.
   - An injection containing Colloidal Calcium with Vitamin D.

2. Large Volume Parenterals:
   - Normal Saline Injection I. P.
   - % Dextrose Injection I. P.
   - Sodium Chloride and Dextrose Infusion I. P.
   - Ringer Lactate Injection I. P.
   - An injection containing fat emulsion

3. Ophthalmic Preparation:
   - Sulphacetamide eye drops, B.P.C.
   - Chloramphenicol eye drops, I. P.
   - Gentamicin eye drops, I. P.
   - Tetracycline eye ointment, I. P.
   - Chloramphenicol eye ointment, I. P.

4. Quality Control of Blood Products

Reference Books:

1. Industrial Pharmacy – Lachman et al. (Lea & Febiger)
2. Pharmaceutical Dosage forms - Ansel - Popovich & Allen.
3. American Pharmacy -Dittert (J. B. Lipincott)
4. Remington's Pharmaceutical Sciences - Alfonso R. Gennaro (Mack Publishing Co.)
5. Bentley's T. B. of Pharmaceutics - Rawlins (ELBS)
6. Modern Pharmaceutics - Banker and Rhodes -(Dekker)
8. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
10. Swarbrick & Boylan - Encyclopedia of Pharm. Technology. – (Dekker)
4.8.7  Medicinal Chemistry – IV  Practical  (6 hrs/wk.)

1. Synthesis and Characterization:
   9. Hydantoin
   10. Reaction involving the following operation – Oxidation, Reduction
   11. Preparation of Iso-Nicotinic acid, Cyclization.
   12. Benzophenone
   13. Acetoacetanilide
   14. 1, 2, 4-triazole
   15. Anthraquinone
   16. Determination of partition coefficient, dissociation constant, molar refractivity, of compounds for QSAR analysis.

Reference Books:

6. Profiles in Drug Synthesis: V. N. Gogte
10. Practical Organic Chemistry - Mann and Saunders
11. The systematic identification of Organic Compounds -Shriner and Fuson
12. Systematic Qualitative organic Analysis by  H. Middleton
13. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam, Mahadik and Bothara
4.8.8 Pharmacology – V Practical (3 hrs/wk.)

1. To record the dose response curve of histamine using isolated guinea pig ileum preparation.
2. To carry out bioassay of Histamine using isolated guinea pig ileum preparation by interpolation method.
3. To carry out bioassay of Histamine using isolated guinea pig ileum preparation by three point method.
4. To record the dose response curve of Acetylcholine using isolated ileum/rectus abdominis muscle preparation.
5. To carry out bioassay of Acetylcholine using isolated ileum/rectus abdominis muscle preparation by interpolation method.
6. To carry out bioassay of Acetylcholine using isolated ileum/rectus abdominis muscle preparation by three-point method.
7. To carry out bioassay of d-Tc/Gallamine using isolated rectus abdominis muscle preparation by interpolation method.
8. To record the dose response curve of oxytocin using isolated rat uterus preparation.

Note: Wherever possible the simulated experiments may be done
CPCSEA approval to be obtained for experiments on animals

Reference Books:

4.8.2  Project work.  Practical  (3 hrs/wk.)

1. Pharmaceutical Marketing
2. Medicinal Plant Biotechnology
3. Quality assurance
4. Drug Design and lead Identification
5. Bioavailability and TDM
6. Cosmeticology
7. Packaging Technology
8. Any Other Emerging Area availing Local Expertise of Pharmaceutical Relevance
9. Clinical Pharmacology