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SHIVAJI UNIVERSITY, KOLHAPUR-416 004. MAHARASHTRA

PHONE : EPABX-2609000 GRAM : UNISHIVAJI

FAX 0091-0231-2691533 & 0091-0231-2692333 – BOS - 2609094

शिवाजी विद्यापीठ, कोल्हापूर - ४१६ ००४.

दुरध्वनी : (ईपीएबीएक्स) २६०९००० (अभ्यास मंडळे विभाग- २६०९०९४) तार : युनिशिवाजी

फॅक्स : ००९१-०२३१-२६९१५३३ व २६९२३३३. e-mail bos@unishivaii.ac.in

SU/BOS/Engg./Pharm/833

Date:27/04/2009

To,  
The Principal ,  
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 :-

Sr.No.	Examinations	Two Chances for the examinations to be held in
1	First year B. Pharmacy Sem.I & II	Oct.-2009 & April -2010
2	Second year B. Pharmacy Sem.III& IV	Oct.-2010 & April -2011
3	Third Year B. Pharmacy Sem.IV & V	Oct.-2011 & April -2012
4	Final Year B. Pharmacy Sem.V& VI	Oct.-2012 & April -2013

Sr.No.	Examinations	Two Chances for the examinations to be held in
1	First year M. Pharmacy Sem.I & II	Oct.-2009 & April -2010
2	Second year M. Pharmacy Sem.III& IV	Oct.-2010 & April -2011

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

Thanking you,

Yours faithfully,

Sd/-

Dy. Registrar

Enclosed:- As above

Copy f.w.c.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	:	<ul style="list-style-type: none"><li>• Semester-I and Semester-II First B. Pharm.</li><li>• Semester-III and Semester-IV Second B. Pharm.</li><li>• Semester-V and Semester-VI Third B. Pharm.</li><li>• Semester-VII and Semester-VIII Final B. Pharm.</li></ul>
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 16 <sup>th</sup> week from the commencement of the semester.

**R. B. Pharm. - 1** 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.

**R. B. Pharm. - 1.1** 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
4. Computer Sciences.

**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.

**R. B. Pharm. - 1.2** 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.

**R. B. Pharm. - 2** 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 fulfils 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<sup>st</sup> & II<sup>nd</sup> (First B. Pharm.), III<sup>rd</sup> & IV<sup>th</sup> (Second B. Pharm.), V<sup>th</sup> & VI<sup>th</sup> (Third B. Pharm.) and VII<sup>th</sup> & VIII<sup>th</sup> (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

**R. B. Pharm. – 4.2** 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.

**R. B. Pharm. – 4.3** 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.

**R. B. Pharm. – 5** 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.

**R. B. Pharm. – 6 Examinations:**

**R. B. Pharm. – 6.1** Examination conducting authority: Shivaji University, Kolhapur.

**R. B. Pharm. – 6.2** Regular and Supplementary Examinations and time:

<b>Semester</b>	<b>Regular Examination</b>	<b>Supplementary Examination</b>
I, III, V and VII	(November/December)	(April/May)
II, IV, VI and VIII	(April/May)	(November/December)

**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.

**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,

**Semester I**

THEORY PAPERS									
Sub Code	Subject	No. of Papers	Semester Examination			Periodic tests	Total Maximum for Subject		
			Duration (Hours)	Maximum marks	Minimum for passing		Duration (Hours)	Maximum marks	Minimum for passing
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
PRACTICALS									
1.1.6	Pharmaceutics (Practical)	1	4	40	16	3	10	4	50
1.1.7	Dispensing of Medication and Hospital Pharmacy (Practical)	1	4	40	16	3	10	4	50
1.1.8	Pharmaceutical Inorganic Chemistry (Practical)	1	4	40	16	3	10	4	50
1.1.9	Pharmaceutical Analysis - I (Practical)	1	4	40	16	3	10	4	50
1.1.10	Anatomy Physiology & Health Education - I (Practical)	1	4	40	16	3	10	4	50
Total Marks for the Semester									: 500
Minimum Marks for passing the Semester I									: 200

**Semester II**

THEORY PAPERS					
Sub Code	Subject	No. of Papers	Semester Examination	Periodic tests	Total Maximum

			Duration (Hours)	Maximum marks	Minimum for passing	Duration (Hours)	Maximum marks	Minimum for passing	
1.2.1	Pharmaceutical Technology - I	1	2	40	16	1	10	4	50
1.2.2	Pharmaceutical Organic Chemistry	1	2	40	16	1	10	4	50
1.2.3	Pharmaceutical Analysis - II	1	2	40	16	1	10	4	50
1.2.4	Anatomy Physiology & Health Education - II	1	2	40	16	1	10	4	50
1.2.5	Pharmacognosy & Phytochemistry - I	1	2	40	16	1	10	4	50
<b>PRACTICALS</b>									
1.2.6	Pharmaceutical Technology - I (Practical)	1	4	40	16	3	10	4	50
1.2.7	Pharmaceutical Organic Chemistry (practical)	1	6	40	16	3	10	4	50
1.2.8	Pharmaceutical Analysis - II (Practical)	1	4	40	16	3	10	4	50
1.2.9	Anatomy Physiology & Health Education - II (Practical)	1	4	40	16	3	10	4	50
1.2.10	Pharmacognosy & Phytochemistry - I (Practical)	1	4	40	16	3	10	4	50
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

<b>THEORY PAPERS</b>									
Sub Code	Subject	No. of Papers	Semester Examination			Periodic tests			Total Maximum for Subject
			Duration (Hours)	Maximum marks	Minimum for passing	Duration (Hours)	Maximum marks	Minimum for passing	
2.3.1	Physical Pharmacy - I	1	2	40	16	1	10	4	50
2.3.2	Pharmaceutical Microbiology & Immunology	1	2	40	16	1	10	4	50
2.3.3	Pharmaceutical Biochemistry	1	2	40	16	1	10	4	50
2.3.4	Pharmacognosy &	1	2	40	16	1	10	4	50

	Phytochemistry - II								
2.3.5	Biostatistics and Computer applications	1	2	40	16	1	10	4	50
<b>PRACTICALS</b>									
2.3.6	Physical Pharmacy - I (Practical)	1	4	40	16	3	10	4	50
2.3.7	Pharmaceutical Microbiology & Immunology (Practical)	1	4	40	16	3	10	4	50
2.3.8	Pharmaceutical Biochemistry (Practical)	1	4	40	16	3	10	4	50
2.3.9	Pharmacognosy & Phytochemistry - II (Practical)	1	4	40	16	3	10	4	50
2.3.10	Biostatistics and Computer applications (Practical)	1	4	40	16	3	10	4	50
Total Marks for the Semester									: 500
Minimum Marks for passing the Semester III									: 200

#### Semester IV

<b>THEORY PAPERS</b>									
Sub Code	Subject	No. of Papers	Semester Examination			Periodic tests			Total Maximum for Subject
			Duration (Hours)	Maximum marks	Minimum for passing	Duration (Hours)	Maximum marks	Minimum for passing	
2.4.1	Physical Pharmacy - II	1	2	40	16	1	10	4	50
2.4.2	Pharmaceutical Biotechnology	1	2	40	16	1	10	4	50
2.4.3	Pharmaceutical Heterocyclic & Polycyclic Chemistry	1	2	40	16	1	10	4	50
2.4.4	Pharmaceutical Chemistry	1	2	40	16	1	10	4	50
2.4.5	Pharmacology - I	1	2	40	16	1	10	4	50
<b>PRACTICALS</b>									
2.4.6	Physical Pharmacy - II (practical)	1	4	40	16	3	10	4	50
2.4.7	Pharmaceutical Biotechnology (practical)	1	4	40	16	3	10	4	50

2.4.8	Pharmaceutical Heterocyclic & Polycyclic Chemistry (practical)	1	6	40	16	3	10	4	50
2.4.9	Pharmaceutical Chemistry (practical)	1	4	40	16	3	10	4	50
2.4.10	Pharmacology - I (practical)	1	4	40	16	3	10	4	50
Total Marks for the Semester									: 500
Minimum Marks for passing the Semester IV									: 200
Minimum Marks for passing Second B. Pharm. (Sem. III & Sem. IV)									: 500

### Semester V

THEORY PAPERS									
Sub Code	Subject	No. of Papers	Semester Examination			Periodic tests			Total Maximum for Subject
			Duration (Hours)	Maximum marks	Minimum for passing	Duration (Hours)	Maximum marks	Minimum for passing	
3.5.1	Cosmeticology	1	2	40	16	1	10	4	50
3.5.2	Pharmaceutical Engineering	1	2	40	16	1	10	4	50
3.5.3	Medicinal Chemistry - I	1	2	40	16	1	10	4	50
3.5.4	Pharmaceutical Polymer Chemistry	1	2	40	16	1	10	4	50
3.5.5	Pharmacology - II	1	2	40	16	1	10	4	50
PRACTICALS									
3.5.6	Cosmeticology (Practical)	1	4	40	16	3	10	4	50
3.5.7	Pharmaceutical Medicinal Chemistry - I (Practical)	1	6	40	16	3	10	4	50
3.5.8	Pharmaceutical Polymer Chemistry (Practical)	1	4	40	16	3	10	4	50
3.5.9	Pharmacology - II (Practical)	1	4	40	16	3	10	4	50
Total Marks for the Semester									: 450
Minimum Marks for passing the Semester V									: 180

### Semester VI

THEORY PAPERS					
Sub Code	Subject	No. of Papers	Semester Examination	Periodic tests	Total Maxi

			Duration (Hours)	Maximum marks	Minimum for passing	Duration (Hours)	Maximum marks	Minimum for passing	
3.6.1	Pharmaceutical Technology - II	1	2	40	16	1	10	4	50
3.6.2	Pharmaceutical Unit Operations	1	2	40	16	1	10	4	50
3.6.3	Medicinal Chemistry - II	1	2	40	16	1	10	4	50
3.6.4	Pharmaceutical Analysis - III	1	2	40	16	1	10	4	50
3.6.5	Pharmacology - III	1	2	40	16	1	10	4	50
3.6.6	Pharmacognosy & Phytochemistry - III	1	2	40	16	1	10	4	50
<b>PRACTICALS</b>									
3.6.7	Pharmaceutical Technology - II (Practical)	1	4	40	16	3	10	4	50
3.6.8	Pharmaceutical Unit Operations (Practical)	1	4	40	16	3	10	4	50
3.6.9	Medicinal Chemistry - II (Practical)	1	6	40	16	3	10	4	50
3.6.10	Pharmaceutical Analysis - III (Practical)	1	4	40	16	3	10	4	50
3.6.11	Pharmacognosy & Phytochemistry - III (Practical)	1	4	40	16	3	10	4	50
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

<b>THEORY PAPERS</b>									
Sub Code	Subject	No. of Papers	Semester Examination			Periodic tests			Total Maximum for Subject
			Duration (Hours)	Maximum marks	Minimum for passing	Duration (Hours)	Maximum marks	Minimum for passing	
4.7.1	Biopharmaceutics & Pharmacokinetics	1	2	40	16	1	10	4	50
4.7.2	Medicinal Chemistry - III	1	2	40	16	1	10	4	50
4.7.3	Pharmaceutical Analysis - IV	1	2	40	16	1	10	4	50

4.7.4	Pharmacology - IV	1	2	40	16	1	10	4	50
4.7.5	Pharmacognosy & Phytochemistry - IV	1	2	40	16	1	10	4	50
4.7.6	<b>Elective *</b>	1	2	40	16	1	10	4	50
<b>PRACTICALS</b>									
4.7.7	Biopharmaceutics & Pharmacokinetics. (Practical)	1	4	40	16	3	10	4	50
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
<b>*Elective</b>	1. Pharmaceutical Marketing		2. Medicinal Plant			4. Quality			
			3. Biotechnology			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

<b>THEORY PAPERS</b>									
Sub Code	Subject	No. of Papers	Semester Examination	Periodic tests					Total Maximum for Subject
				Duration (Hours)	Maximum marks	Minimum for passing	Duration (Hours)	Maximum marks	
4.8.1	Pharmaceutical Technology - III	1	2	40	16	1	10	4	50
4.8.2	Pharmaceutical Jurisprudence	1	2	40	16	1	10	4	50
4.8.3	Pharmaceutical Industrial Management	1	2	40	16	1	10	4	50
4.8.4	Medicinal Chemistry - IV	1	2	40	16	1	10	4	50
4.8.5	Pharmacology - V	1	2	40	16	1	10	4	50

<b>PRACTICALS</b>									
4.8.6	Pharmaceutical Technology - III (Practical)	1	4	40	16	3	10	4	50
4.8.7	Medicinal Chemistry - IV (Practical)	1	6	40	16	3	10	4	50
4.8.8	Pharmacology - V (Practical)	1	4	40	16	3	10	4	50
4.8.9	Project work* (Under Pharmaceutics)	1	4	40	16	3	10	4	50
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**



## Annexure - II

## Semester - I

Sub Code	Subject	Hours / Week	Maximum marks
		Th	
1.1.1	Pharmaceutics	3	50
1.1.2	Dispensing of Medication and Hospital Pharmacy	3	50
1.1.3	Pharmaceutical Inorganic Chemistry	4	50
1.1.4	Pharmaceutical Analysis - I	3	50
1.1.5	Anatomy Physiology & Health Education - I	3	50
	<b>Total</b>	<b>16</b>	<b>250</b>
<b>Practical</b>			
1.1.6	Pharmaceutics (Practical)	3	50
1.1.7	Dispensing of Medication and Hospital Pharmacy (Practical)	3	50
1.1.8	Pharmaceutical Inorganic Chemistry (Practical)	3	50
1.1.9	Pharmaceutical Analysis - I (Practical)	3	50
1.1.10	Anatomy Physiology & Health Education - I (Practical)	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

## Semester - II

Sub Code	Subject	Hours / Week	Maximum marks
		Week	
1.2.1	Pharmaceutical Technology - I	3	50
1.2.2	Pharmaceutical Organic Chemistry	4	50
1.2.3	Pharmaceutical Analysis - II	4	50
1.2.4	Anatomy Physiology & Health Education - II	3	50
1.2.5	Pharmacognosy & Phytochemistry - I	3	50
	<b>Total</b>	<b>17</b>	<b>250</b>
<b>Practical</b>			
1.2.6	Pharmaceutical Technology - I (Practical)	3	50
1.2.7	Pharmaceutical Organic Chemistry (practical)	3	50
1.2.8	Pharmaceutical Analysis - II (Practical)	3	50
1.2.9	Anatomy Physiology & Health Education - II (Practical)	3	50
1.2.10	Pharmacognosy & Phytochemistry - I (Practical)	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

**Semester - III**

Sub Code	Subject	Hours / Week	Maximum marks
2.3.1	Physical Pharmacy - I	3	50
2.3.2	Pharmaceutical Microbiology & Immunology	4	50
2.3.3	Pharmaceutical Biochemistry	3	50
2.3.4	Pharmacognosy & Phytochemistry - II	3	50
2.3.5	Biostatistics and Computer applications	2	50
	<b>Total</b>	<b>15</b>	<b>250</b>
<b>Practical</b>			
2.3.6	Physical Pharmacy - I (Practical)	3	50
2.3.7	Pharmaceutical Microbiology & Immunology (Practical)	3+1	50
2.3.8	Pharmaceutical Biochemistry (Practical)	3	50
2.3.9	Pharmacognosy & Phytochemistry - II (Practical)	3	50
2.3.10	Biostatistics and Computer applications (Practical)	3	50
	<b>Total</b>	<b>16</b>	<b>250</b>

**Semester - IV**

Sub Code	Subject	Hours / Week	Maximum marks
2.4.1	Physical Pharmacy - II	3	50
2.4.2	Pharmaceutical Biotechnology	3	50
2.4.3	Pharmaceutical Heterocyclic & Polycyclic Chemistry	4	50
2.4.4	Pharmaceutical Chemistry	3	50
2.4.5	Pharmacology - I	4	50
	<b>Total</b>	<b>17</b>	<b>250</b>
<b>Practical</b>			
2.4.6	Physical Pharmacy - II (practical)	3	50
2.4.7	Pharmaceutical Biotechnology (practical)	3	50
2.4.8	Pharmaceutical Heterocyclic & Polycyclic Chemistry (practical)	3	50
2.4.9	Pharmaceutical Chemistry (practical)	3	50
2.4.10	Pharmacology - I (practical)	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

**Semester - V**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
3.5.1	Cosmeticology	3	50
3.5.2	Pharmaceutical Engineering	3	50
3.5.3	Medicinal Chemistry - I	3	50
3.5.4	Pharmaceutical Polymer Chemistry	3	50
3.5.5	Pharmacology - II	4	50
	<b>Total</b>	<b>16</b>	<b>250</b>
<b>Practical</b>			
3.5.6	Cosmeticology (Practical)	3	50
3.5.7	Pharmaceutical Medicinal Chemistry - I (Practical)	3+3	50
3.5.8	Pharmaceutical Polymer Chemistry (Practical)	3	50
3.5.9	Pharmacology - II (Practical)	3	50
	<b>Total</b>	<b>15</b>	<b>200</b>

**Semester - VI**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
3.6.1	Pharmaceutical Technology - II	3	50
3.6.2	Pharmaceutical Unit Operations	3	50
3.6.3	Medicinal Chemistry - II	3	50
3.6.4	Pharmaceutical Analysis - III	3	50
3.6.5	Pharmacology - III	3	50
3.6.6	Pharmacognosy & Phytochemistry - III	3	50
	<b>Total</b>	<b>18</b>	<b>300</b>
<b>Practical</b>			
3.6.7	Pharmaceutical Technology - II (Practical)	3	50
3.6.8	Pharmaceutical Unit Operations (Practical)	3	50
3.6.9	Medicinal Chemistry - II (Practical)	3	50
3.6.10	Pharmaceutical Analysis - III (Practical)	3	50
3.6.11	Pharmacognosy & Phytochemistry - III (Practical)	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

**Semester - VII**

Sub Code	Subject	Hours / Week	Maximum marks
4.7.1	Biopharmaceutics & Pharmacokinetics	3	50
4.7.2	Medicinal Chemistry - III	3	50
4.7.3	Pharmaceutical Analysis - IV	3	50
4.7.4	Pharmacology - IV	3	50
4.7.5	Pharmacognosy & Phytochemistry - IV	3	50
4.7.6	Elective *	2	50
	<b>Total</b>	<b>17</b>	<b>300</b>
<b>Practical</b>			
4.7.7	Biopharmaceutics & Pharmacokinetics. (Practical)	3	50
4.7.8	Medicinal Chemistry - III (Practical)	3+3	50
4.7.9	Pharmaceutical Analysis - IV (Practical)	3	50
4.7.10	Pharmacology - IV (Practical)	3	50
4.7.11	Pharmacognosy & Phytochemistry - IV (Practical)	3	50
	<b>Total</b>	<b>18</b>	<b>250</b>

**Semester - VIII**

Sub Code	Subject	Hours / Week	Maximum marks
4.8.1	Pharmaceutical Technology - III	3	50
4.8.2	Pharmaceutical Jurisprudence	3	50
4.8.3	Pharmaceutical Industrial Management	3	50
4.8.4	Medicinal Chemistry - IV	3	50
4.8.5	Pharmacology - V	4	50
	<b>Total</b>	<b>16</b>	<b>250</b>
<b>Practical</b>			
4.8.6	Pharmaceutical Technology - III (Practical)	3	50
4.8.7	Medicinal Chemistry - IV (Practical)	3+3	50
4.8.8	Pharmacology - V (Practical)	3	50
4.8.9	Project work.	3	50
	<b>Total</b>	<b>15</b>	<b>200</b>

**\* 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.

Semester - I

Sub Code	Subject	Hours / Week	Maximum marks
		Th	
1.1.1	<a href="#">Pharmaceutics</a>	3	50
1.1.2	<a href="#">Dispensing of Medication and Hospital Pharmacy</a>	3	50
1.1.3	<a href="#">Pharmaceutical Inorganic Chemistry</a>	4	50
1.1.4	<a href="#">Pharmaceutical Analysis - I</a>	3	50
1.1.5	<a href="#">Anatomy Physiology &amp; Health Education - I</a>	3	50
	<b>Total</b>	<b>16</b>	<b>250</b>
<b>Practical</b>			
1.1.6	<a href="#">Pharmaceutics (Practical)</a>	3	50
1.1.7	<a href="#">Dispensing of Medication and Hospital Pharmacy (Practical)</a>	3	50
1.1.8	<a href="#">Pharmaceutical Inorganic Chemistry (Practical)</a>	3	50
1.1.9	<a href="#">Pharmaceutical Analysis - I (Practical)</a>	3	50
1.1.10	<a href="#">Anatomy Physiology &amp; Health Education - I (Practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

<b>1.1.1 Pharmaceutics</b>	<b>Theory</b>	<b>(3 Hrs/Wk)</b>	
		<b>Hrs</b>	<b>Marks</b>
1. Introduction to pharmaceutics and its scope.		02	03 – 06
2. Pharmaceutical industry in India. Historical background and development of various dosage forms. Introduction to pharmacopoeia and other compendia (I.P., B.P., U.S.P., International Pharmacopoeia, European Pharmacopoeia). History, General Notices, Monographs		06	03 – 06
3. History of pharmaceutical education in India.		02	03 – 06
4. Introduction to dosage forms. Historical background and development of profession of pharmacy. Classification of dosage forms, advantages and disadvantages.		08	09 – 12
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		18	22 – 30

**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. Bentleys Text Book of Pharmaceutics -Rawlins (ELBS)
5. Banker and Rhodes -Modern Pharmaceutics -(Dekker)
6. Swarbrick and Boytan -Encyclopedia of Pharmaceutical technology (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****Theory (3 Hrs/Wk)**

	<b>Hrs</b>	<b>Marks</b>
1. Definition and scope of dispensing and compounding of drug.	2	02 – 03
2. General dispensing procedures (to be covered in practical)	--	02 – 03
3. Imperial system of weights and measures (to be covered in practical)	--	02 – 05
4. Latin terms used in pharmacy (to be covered in practical)	3	03 – 05
5. Prescription and its parts: 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.	6	05 – 08
6. Pharmaceutical calculations: Percentage calculations, alligation methods, calculations involving isotonic solutions, proof spirit, posology, calculations of doses for infants and children, weights and measures.	5	03 – 06
7. Incompatibilities in prescriptions: Types of incompatibilities -physical, chemical and therapeutic. Study of various prescription examples involving the same.	8	06 – 09
8. Organization and structure of hospital pharmacy.	2	03 – 05
9. Hospitals -classification, functions, organization administration.	2	03 – 05
10. Hospital formulary.	1	02 – 03
11. Duties and responsibilities of hospital pharmacist.	1	02 – 03
12. Drug distribution system.	3	03 – 06
13. Drug information services.	2	02 – 03
14. Records and reports.	1	02 – 03



## 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
9. Dispensing Pharmaceutical Student by Cooper and Gunn, 12<sup>th</sup> Edi.
10. Hospital Pharmacy, Merchant and Quadry
11. Drug dosage calculations, A guide for clinical practice, by Geraldine Ann Medici, 2<sup>nd</sup> Edi.
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
14. Hospital Pharmacy, by William Hassan jr. 5<sup>th</sup> Edi. Lea and Febiger.

1.1.3 Pharmaceutical Inorganic Chemistry		Theory	(4 Hrs/Wk)	
			Hrs	Marks
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.		06	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.		05	05 - 07
3	Major Intra & Extra cellular Electrolytes Physiological ions, Electrolytes used for replacement therapy, acid base balance, Combination therapy		08	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.		05	05 - 08
5	Topical Agents Protective, astringents, Anti-infective like talk, zinc oxide, calamine, hydrogen peroxide, potassium permanganate, iodine with their mechanism of action.		04	03 - 05
6	Gases & Vapors Oxygen, anesthetics, respiratory stimulants such as nitrogen oxide, carbon dioxide and helium.		04	04 - 06
7	Dental Products Dentifrices & Anti-carries agent like sodium fluoride, SnF <sub>2</sub> , concentrated fluorides and polishing agents, zinc chloride.		03	03 - 05
8	Complexing & Chelating agents , other antidotes Complexing agent - EDTA, penicillamine. Antidotes - cynide poisoning, sodium thiosulphate. Precipitation - copper sulphate, sodium phosphate and magnesium sulphate.		03	03 - 05

9	Sclerosing agents, Expectorants, Emetics such as ammonium chloride and Antioxidants sodium bisulphide, metabisulphide and sulphur dioxide.	03	03 - 05
10	Radiopharmaceuticals - Introduction, radioactivity, $\alpha$ $\beta$ $\gamma$ radio decay, radioisotopes and medicinal applications (examples carbon monoxide and iodine). Radio-opaque contrast media - Barium sulphate.	05	04 - 06

**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.
4. Text book of Pharmaceutical Chemistry, By Chatten L.G.(Dekker series)
5. Textbook of Pharmaceutical analysis By Connors K.A.
6. Text book of Pharmaceutical Analysis By Dr. H. N. More
7. Indian Pharmacopoeia
8. Remington's Pharmaceutical Sciences.

**1.1.4 Pharmaceutical Analysis - I****Theory (3 hr./wk)**

	<b>Hrs</b>	<b>Marks</b>
<b>1. Introduction:</b> 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.	03	03 - 06
<b>2. Aqueous Acid-Base titrations:</b> 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.	05	06 - 08
<b>3. Non-Aqueous titrations:</b> Types of solvents, end point detection, application in assay of Sodium acetate, Sodium benzoate, Norfloxacin tablet.	03	04 - 06
<b>4. Oxidation-Reduction titrations:</b> 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.	07	06 - 08
<b>5. Complexometric titrations:</b> 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.	05	05 - 08
<b>6. Argentometric titrations:</b> 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.	04	06 - 08

7.	Miscellaneous methods of analysis: Diazotisation titrations, Kjeldahl's method of nitrogen determination and Oxygen flask combustion method.	03	04 - 06
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.	06	06 - 10

### Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A. H. and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II, The Anthlone Press of University of London.
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. I & II, A.V.Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More – Nirali Publication.
11. Analytical Chemistry an introduction, Skoog/ West/ Holler, 6<sup>th</sup> Edition.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle-Wadsworth Pub. Co.).
15. Merck Index.
16. Pharmaceutical Drug analysis by Ashutosh Kar.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.

1.1.5 Anatomy Physiology & Health Education – I		Theory	(3 Hrs/Wk)
		Hrs	Marks
1.	Scope of Anatomy and Physiology, basic terminology used in this subject.	01	01 – 03
2.	Structure of cell – Its components and their functions	01	01 – 03
3.	<b>Elementary tissues of the human body:</b> <ul style="list-style-type: none"> <li>• Epithelial, connective, muscular and Nervous tissues – their subtypes and characteristics.</li> <li>• Contraction of skeletal muscle</li> <li>• Neuro muscular transmission</li> <li>• Contraction of smooth muscle</li> </ul>	02	03 – 05
4.	<b>Haemopoietic system</b> Composition and functions of blood. <ul style="list-style-type: none"> <li>• Haemopoiesis and disorders of blood &amp; its components, Disorders of Haemopoietic system).</li> <li>• RBC metabolism</li> <li>• Blood groups.</li> <li>• Clotting factors and mechanism. Platelets and disorders of coagulation.</li> </ul>	07	06 – 10
5.	<b>Lymph and Lymphatic system –</b> <ul style="list-style-type: none"> <li>• Composition, formation and circulation of lymph</li> <li>• Disorders of Lymph and lymphatic system (Definitions only)</li> <li>• Spleen: Physiology and function.</li> </ul>	02	01 – 03
6.	<b>Cardiovascular system –</b> <ul style="list-style-type: none"> <li>• Anatomy of heart</li> <li>• Physiology of cardiac muscle and heart</li> <li>• Conduction system of heart</li> <li>• Blood vessels and its disorders</li> <li>• Cardiac cycle and Heart Sounds,</li> <li>• ECG, Blood pressure and its regulation (short term and long term).</li> <li>• Definitions, types, etiology, and pathophysiology of the following disorders- Hypertension, Hypotension, Arteriosclerosis, Angina, Myocardial infarction, Congestive Heart failure and Cardiac arrhythmias.</li> </ul>	09	08 – 10

7. <b>Respiratory System</b>	04	04 – 05
<ul style="list-style-type: none"> <li>• Anatomy of respiratory organs and functions</li> <li>• Mechanism and regulation of Respiration</li> <li>• Physiology of respiration: transport of respiratory gases</li> <li>• Respiratory volumes and vital capacity</li> <li>• Disorders of respiratory tract like TB, COPD, asthma</li> </ul>		
8. <b>Digestive System</b>	04	05 – 06
<ul style="list-style-type: none"> <li>• Anatomy of Gastro Intestinal Tract (GIT)</li> <li>• Secretions functions and anatomy of Salivary glands, Pancreas, Stomach, Intestine, Liver</li> <li>• Physiological and biochemical aspects of digestion and absorption of food</li> <li>• Disorders of GIT</li> </ul>		
9. <b>Health Education-</b>	01	01 – 03
Definition of Health (Physical & Mental) and Health Education, objectives of Health Education.		
<b>Family Planning</b>	02	03 – 05
Principles underlying various family planning methods.		
<b>Nutrition:</b>	03	05 – 06
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 <b>Skeletal muscles</b>	02	02 – 03
<ol style="list-style-type: none"> <li>1. Histology</li> <li>2. Physiology of muscle contraction</li> <li>3. Physiological properties of skeletal muscle performance (definition of the disorders)</li> </ol>		

### Reference Books:

1. AB Mc Naught and Callander R., "Illustrated Physiology", B.I. Churchill Living Stone, New Delhi, 1<sup>st</sup> edition, 1987.
2. Anne Waugh and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", Churchill Living Stone, Edinburgh, 9<sup>th</sup> edition, 2002.
3. Arthur C. Guyton and John E. Hall, "Text book of Medical Physiology" W.B. Saunders company, 10<sup>th</sup> edition, 2000.
4. Bhise S.B. and Yadav "Human Anatomy and Physiology", Nirali Prakashan, Pune (India), 8<sup>th</sup> edition, 2000.
5. C.C. Chatterjee, "Human Physiology" (Vol. I & Vol. II), Medical Allied Agency, Calcutta, 11<sup>th</sup> edition, 1985.
6. Chaudhry Sujit K., "Consise Medical Physiology", New Central Book Agency, Calcutta, 2<sup>nd</sup> Edition, 1993.
7. De Gruchy`s Clinical Haematology, "Clinical Haematology in Medical Practice, Blackwell Science publishers, 5<sup>th</sup> Edition, 1989.
8. Douglas E., Kelly, Richard Wood and Allen C. Enders, "Bailey`s TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London, 18<sup>th</sup> Edition, 1984.
9. Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 4<sup>th</sup> edition, 1997.
10. Elaine N. Marieb, "Human Anatomy and Physiology", Benjamin / Cumings publishing company, 2<sup>nd</sup> edition, 1992.
11. Gerard J. Toratora, "Principles of Anatomy and Physiology", John-Wiley & sons New York, 10<sup>th</sup> edition, 2003.
12. Inderbir Singh, " Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, 4<sup>th</sup> edition, 2002.
13. Park J.E. and Park K., "Preventive and Social Medicine", Banarasidas Bhanot, India, 13<sup>th</sup> edition, 1991.
14. Thakaore Bhai, P. Gandhi and Harit R., Derasari, " Elements of Human Anatomy Physiology and Health Education" B.S. Shah Publishers, Ahmedabad, 4<sup>th</sup> Edition, 1991.
15. Anatomy and Physiology by Kimber - Grey - Stacktole`s
16. Practical Physiology and Biochemistry by Goel, Shah and Patel



### 1.1.6 Pharmaceutics - I

Practical (3 Hrs/Wk)

1. Preparation and evaluation of- (at least two preparation from each category)
  - Solutions A. Syrups
  - Mixtures B. Elixirs
  - Aromatic waters and concentrated aromatic waters C. Linctuses
  - Infusions and Decoction D. Paints
  - Glycerites 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)
3. Remington : The Science and practice of Pharmacy -A. R. Gennaro (Mack Publishing Co)
4. Bentleys 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

Practical (3 Hrs/Wk)

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.
  - 1) Incompatibilities in prescription:
    - Incompatibility of Alkaloids
    - Incompatibility of soluble Iodides
    - Incompatibility of soluble salicylates and benzoates
    - Incompatibility causing evolution of CO<sub>2</sub>
    - Incompatibility of soluble barbiturates
    - Incompatibility of emulsifying agent
  - 2) Compounding of proprietaries 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 a 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
7. Pharmaceutical calculations - Joel L. Zatz.
8. Remington's Pharmaceutical sciences.

**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.
4. Text book of Pharmaceutical Chemistry, By Chatten L.G.(Dekker series)
5. Textbook of Pharmaceutical analysis By Connors K.A.
6. Text book of Pharmaceutical Analysis By Dr. H. N. More
7. Indian Pharmacopoeia
8. Remington's Pharmaceutical Sciences.

### 1.1.9 Pharmaceutical Analysis – I

Practical (3 hr./wk)

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.
  - Oxidation-Reduction titrations: Ferrous sulfate, Ascorbic acid, Isoniazide, Hydrogen Peroxide.
  - 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:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A. H. and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II, The Anthlone Press of University of London.
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. I & II, A.V.Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More – Nirali Publication.
11. Analytical Chemistry an introduction, Skoog/ West/ Holler, 6<sup>th</sup> Edition.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle-Wadsworth Pub. Co.).
15. Merck Index.
16. Pharmaceutical Drug analysis by Ashutosh Kar.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.

**1.1.10 Anatomy Physiology & Health Education - I**

**Practical (3 Hrs/Wk)**

**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:

1. AB Mc Naught and Callander R., "Illustrated Physiology", B.I. Churchill Living Stone, New Delhi, 1<sup>st</sup> edition, 1987.
2. Anne Waugh and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", Churchill Living Stone, Edinburgh, 9<sup>th</sup> edition, 2002.
3. Arthur C. Guyton and John E. Hall, "Text book of Medical Physiology" W.B. Saunders company, 10<sup>th</sup> edition, 2000.
4. Bhise S.B. and Yadav "Human Anatomy and Physiology", Nirali Prakashan, Pune (India), 8<sup>th</sup> edition, 2000.
5. C.C. Chatterjee, "Human Physiology" (Vol. I & Vol. II), Medical Allied Agency, Calcutta, 11<sup>th</sup> edition, 1985.
6. Chaudhry Sujit K., "Consise Medical Physiology", New Cenrtal Book Agency, Calcutta, 2<sup>nd</sup> Edition, 1993.
7. De Gruchy`s Clinical Haematology, "Clinical Haematology in Medical Practice, Blackwell Science publishers, 5<sup>th</sup> Edition, 1989.
8. Douglas E., Kelly, Richard Wood and Allen C. Enders, "Bailey`s TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London, 18<sup>th</sup> Edition, 1984.
9. Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 4<sup>th</sup> edition, 1997.
10. Elaine N. Marieb, "Human Anatomy and Physiology", Benjamin / Cumings publishing company, 2<sup>nd</sup> edition, 1992.
11. Gerard J. Toratora, "Principles of Anatomy and Physiology", John-Wiley & sons New York, 10<sup>th</sup> edition, 2003.
12. Inderbir Singh, " Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, 4<sup>th</sup> edition, 2002.
13. Park J.E. and Park K., "Preventive and Social Medicine", Banarasidas Bhanot, India, 13<sup>th</sup> edition, 1991.
14. Thakaore Bhai, P. Gandhi and Harit R., Derasari, " Elements of Human Anatomy Physiology and Health Education" B.S. Shah Publishers, Ahmedabad, 4<sup>th</sup> Edition, 1991.
15. Anatomy and Physiology by Kimber - Grey - Stacktole`s
16. Practical Physiology and Biochemistry by Goel, Shah and Patel

**Semester - II**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours/ Week</b>	<b>Maximum marks</b>
1.2.1	<a href="#">Pharmaceutical Technology - I</a>	3	50
1.2.2	<a href="#">Pharmaceutical Organic Chemistry</a>	4	50
1.2.3	<a href="#">Pharmaceutical Analysis - II</a>	4	50
1.2.4	<a href="#">Anatomy Physiology &amp; Health Education - II</a>	3	50
1.2.5	<a href="#">Pharmacognosy &amp; Phytochemistry - I</a>	3	50
	<b>Total</b>	<b>17</b>	<b>250</b>
<b>Practical</b>			
1.2.6	<a href="#">Pharmaceutical Technology - I (Practical)</a>	3	50
1.2.7	<a href="#">Pharmaceutical Organic Chemistry (practical)</a>	3	50
1.2.8	<a href="#">Pharmaceutical Analysis - II (Practical)</a>	3	50
1.2.9	<a href="#">Anatomy Physiology &amp; Health Education - II (Practical)</a>	3	50
1.2.10	<a href="#">Pharmacognosy &amp; Phytochemistry - I (Practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

**1.2.1 Pharmaceutical Technology - I****Theory (3 hr./wk)**

	Hrs	Marks
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: Types and classification. Therapeutic applications, classification of bases. Drug release and absorption considerations. Formulation, preparation and evaluation.	11	14 - 20



**Reference Books:**

1. B.M. Mittal: Textbook of Pharmaceutical Formulation, 4<sup>th</sup> Edition, Vallabh Prakashan, Delhi.
2. Banker and Rhodes. Modern Pharmaceutics, 4<sup>th</sup> ed 2002 Marcel Dekker Inc.
3. Disperse Systems, Vol. I, II, III, M. Decker.
4. E.A.Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
5. James Swarbrick and James C. Boylan: Encyclopedia of pharmaceutical Technology, Marcel Dekker Inc. New York.
6. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.
7. M. E. Aulton: Pharmaceutics, Science of Dosage Form Design.
8. Martin: Physical Pharmacy, Vargheese Publishing House, Mumbai, 1991.
9. Pharmaceutical Dosage Forms and Drug delivery systems. and 7<sup>th</sup> Ed. Ansel, Lippincott Williams and Wilkins, PA, 1999.
10. Remington's "The Science and Practice of Pharmacy", 20<sup>th</sup> Ed; 2000, Lippincott. Williams and Wilkins.
11. Pharmaceutical process validation, by Nash Wachler, Marcel Dekker

<b>1.2.2 Pharmaceutical Organic Chemistry</b>	<b>Theory</b>	<b>4 hrs/wk.</b>
	<b>Hrs</b>	<b>Marks</b>
<b>1. Factors affecting electron availability in bonds and at individual atoms:</b> Electronegativity, inductive effect, Resonance including rules of the Resonance, Concept and types of Tautomerism.	<b>7</b>	<b>08-12</b>
<b>2. Classes of reactions and reagents:</b> Including electrophiles, nucleophiles and radicals, transition reaction intermediates, Carbocations, Carbanions, Carbenes and Nitrenes, Kinetics and thermodynamic control of reactions.	<b>6</b>	<b>06-10</b>
<b>3. Theories of acidity and basicity with respect to organic compounds:</b> Factors effecting acidity and basicity – Resonance, Inductive effect, steric parameters and hydrogen bonding.	<b>6</b>	<b>06-10</b>
<b>4. Structure, Nomenclature [multifunctional groups also], preparation and reactions of:</b> 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].	<b>28</b>	<b>18-26</b>
<b>5. Benzene and Aromaticity :</b> Huckel's Rule, Resonance in benzene and derivatives, Mechanisms of electrophilic substitution reactions- halogenation, nitration, sulphonation and Friedl Crafts reaction, Orientation and reactivity in electrophilic and aromatic substitution, Mechanisms of nucleophilic aromatic substitution, Reaction involving Benzene intermediate.	<b>7</b>	<b>08-12</b>

### Reference Books:

1. Advanced Organic Chemistry, Ed. 4 -Jerry March.
2. Fundamentals of Organic Chemistry Vol. I & II Finar I.L.
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
7. Advanced Organic Chemistry: Bahl B.S. & Bahl A.
8. Organic Chemistry by Jain M.K.
9. Reaction Mechanisms and Reagents: Gurudeep Chatwal.
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.

<b>1.2.3</b>	<b>Pharmaceutical Analysis - II</b>	<b>Theory</b>	<b>4 hrs/wk.</b>
		<b>Hrs</b>	<b>Marks</b>
1.	<b>Polarimetry:</b> Introduction, Instrumentation and Applications.	04	03 - 05
2.	<b>Refractometry:</b> Introduction, Instrumentation (Abbey's, Dipping /Immersion, Pulfrich and Image displacement refractometer), Applications.	04	03 - 05
3.	Electrochemical Analysis: <b>Definition of all types of electrochemical analysis.</b>	01	03 - 05
	<b>a. Conductometry:</b> Principle, instrumentation, Applications including conductometric titrations. High frequency method.	04	03 - 05
	<b>b. Potentiometry:</b> Introduction, Different types of electrodes, measurement of electrode potential and pH, Applications including potentiometric titrations.	06	05 - 08
	<b>c. Polarography:</b> Introduction, Instrumentation and Applications.	07	05 - 08
	<b>d. Amperometry:</b> Introduction, Instrumentation and Applications including amperometric titrations.	04	03 - 05
6.	<b>Karl-Fischer titrations:</b> Introduction, Instrumentation, and Applications.	03	03 - 05
7.	<b>Thermal Analysis:</b> Introduction, Principle, Methods, Instrumentation, and Factors affecting results, Applications of TG, DSC and DTA.	09	06 - 08
8.	<b>X-ray diffraction:</b>	06	06 - 08
	i. Laue photographic method.		
	ii. Bragg X-ray spectrophotometry.		
	iii. Rotating crystal method.		
	iv. Powder method.		

## Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II., The Anthlone Press of University of London.
4. Connors K A, A Textbook of Pharmaceutical Analysis,Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. I & II, A.V.Kasture, S.G.Wadhodkar, K.R.Mahadik, H.N.More – Nirali Publication.
11. Analytical Chemistry an introduction, Skoog/West/Holler, 6<sup>th</sup> Edition.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
16. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
18. Meites-Handbook of Analytical Chemistry (McGraw Hill).
19. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).

<b>1.2.4</b>	<b>Anatomy Physiology &amp; Health Education – II</b>	<b>Theory</b>	<b>(3 hr./wk)</b>
		<b>Hrs</b>	<b>Marks</b>
<b>1</b>	<b>Nervous systems:</b> Definitions and classification of nervous system <ul style="list-style-type: none"> <li>• anatomy and physiology of neurons, initiation and conduction of nerve impulses, CNS synapses</li> <li>• definition, types and functions of central and peripheral neurotransmitters and its receptors</li> <li>• Functional areas and functions of cerebrum</li> <li>• Cerebellum, basal ganglia and motor control</li> <li>• Pons and medulla</li> <li>• Thalamus and hypothalamus</li> <li>• Spinal cord: structure and functions</li> <li>• Cranial nerves-names and functions</li> <li>• ANS-anatomy and functions of sympathetic and parasympathetic nervous system.</li> </ul>	10	10 – 12
<b>2</b>	<b>Urinary system</b> <ul style="list-style-type: none"> <li>• Parts of urinary system and gross structure of the kidney.</li> <li>• Structure of nephron.</li> <li>• Formation of urine.</li> <li>• Renin angiotensin system, juxta -glomerular apparatus. Acid base balance,</li> <li>• Disorders of renal function</li> <li>• Renal function test.</li> </ul>	05	05 – 08
<b>3</b>	<b>Endocrine system</b> Endocrine glands <ul style="list-style-type: none"> <li>• Pituitary gland and its hormones</li> <li>• Adrenal gland and adrenocortical hormones</li> <li>• Thyroid and parathyroid gland and metabolic hormones</li> <li>• Pancreas and gonads and their secretions.</li> <li>• Endocrine disorders</li> </ul>	06	09 – 15
<b>4</b>	<b>Reproductive system</b>	05	05 – 08

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.** 04 05 – 09
6. **Communicable and non communicable diseases:-** 08 06 – 09
- 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, gonorrhoea, AIDS.

#### Reference Books:

1. AB Mc Naught and Callander R., "Illustrated Physiology", B.I. Churchill Living Stone, New Delhi, 1<sup>st</sup> edition, 1987.
2. Anne Waugh and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", Churchill Living Stone, Edinburgh, 9<sup>th</sup> edition, 2002.
3. Arthur C. Guyton and John E. Hall, "Text book of Medical Physiology" W.B. Saunders company, 10<sup>th</sup> edition, 2000.
4. Bhise S.B. and Yadav "Human Anatomy and Physiology", Nirali Prakashan, Pune (India), 8<sup>th</sup> edition, 2000.
5. C.C. Chatterjee, "Human Physiology" (Vol. I & Vol. II), Medical Allied Agency, Calcutta, 11<sup>th</sup> edition, 1985.
6. Chaudhry Sujit K., "Concise Medical Physiology", New Central Book Agency, Calcutta, 2<sup>nd</sup> Edition, 1993.
7. De Gruy's Clinical Haematology, "Clinical Haematology in Medical Practice, Blackwell Science publishers, 5<sup>th</sup> Edition, 1989.
8. Douglas E., Kelly, Richard Wood and Allen C. Enders, "Bailey's TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London, 18<sup>th</sup> Edition, 1984.
9. Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 4<sup>th</sup> edition, 1997.
10. Elaine N. Marieb, "Human Anatomy and Physiology", Benjamin / Cummings publishing company, 2<sup>nd</sup> edition, 1992.
11. Gerard J. Tortora, "Principles of Anatomy and Physiology", John-Wiley & sons New York, 10<sup>th</sup> edition, 2003.
12. Inderbir Singh, "Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, 4<sup>th</sup> edition, 2002.

13. Park J.E. and Park K., "Preventive and Social Medicine", Banarasidas Bhanot, India, 13<sup>th</sup> edition, 1991.



1.2.5	<b>Pharmacognosy &amp; Phytochemistry - I</b>	<b>Theory</b>	<b>(3 Hrs/Wk)</b>
		<b>Hrs</b>	<b>Marks</b>
1.	Definition, history, scope and development of pharmacognosy	02	02 - 03
2.	<b>Sources of crude drugs:</b> biological, marine, microbes, mineral, animal and plant tissue culture as sources of drugs.	01	01 - 03
3.	<b>Classification of crude drugs (organized &amp; unorganized):</b> alphabetical, morphological, taxonomical, chemical, pharmacological and chemotaxonomical classification of crude drugs	03	03 - 05
4.	<b>Plant taxonomy :</b> study of following families with special reference to medicinal important plants of apocynaceae, solanaceae, rutaceae, umbelliferae, leguminosae and liliaceae	04	05 - 08
5.	<b>Cultivation, collection, processing and storage of crude drugs:</b> 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.	05	05 - 08
6.	<b>Quality control of crude drugs :</b> adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation	04	05 - 08
7.	An introduction to active constituents of crude drugs, their general isolation and classification	03	03 - 05
8.	<b>Systematic pharmacognostic study of following:</b> Carbohydrates and derived products : agar, guar gum, acacia, honey, isabgol, pectin, tragacanth, starch, modified starches and inulin	07	08 - 10
9.	<b>Lipids :</b> bees wax, castor oil, coca butter, cod liver oil, linseed oil, rice bran oil, shark liver oil and wool fat	07	08 - 10

## Reference Books:

1. Gamborg O. L. Wetter L. R., Plant tissue culture methods, National Research Council of Canada, Sakatchewan.
2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
3. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
4. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
5. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
6. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
8. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
9. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
10. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
12. Atal C. K. and Kapur B. M. Cultivation and utilization of Medicinal plants, RRL, Jammu.
13. Barz W, Rinhard E and Zenk M. H. Plant tissue culture and its biotechnological application, Springier, Berlin.
14. Brain K. R. and Turner T. D. , The practical Evaluation of phytopharmaceuticals, Wright-Scientehnica, Bristil.
15. Chandha K.L. and Gupta R. Advances in Horticulture Vol II- medicinal and aromatic plants, Malhotra publishing House, New Delhi.
16. Chopra R. N., Nayar S. L. and Chopra I. C., Glossary of Indian Medicinal plants CS I R, New Delhi.
17. Clarke ECG, Isolation and Identification of Drugs, The Pharmaceutical Press, London.
18. De Mayo, The chemistry of Natural Products, 2-3, Interscience New York.
19. Export potential of selected medicinal plants, prepared by basic chemicals, pharmaceuticals and cosmeticexport promotion council, Bombay, and other reports.
20. Fabn A, Plant anatomy, 3<sup>rd</sup> Ed. Pergamon press, Oxford.
21. Faulkner D. J. and Fenical W. H. , Marine Natural Product Chemistry (NATO conference series 4) plenum press, New York.
22. Kokate C. K., Cultivation of Medicinal Plants.
23. Pulok Mukharji, Quality control of Herbal drugs.

### 1.2.6 Pharmaceutical Technology - I

Practical (3 hr./wk)

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. B. M. Mittal: Textbook of Pharmaceutical Formulation, 4<sup>th</sup> Edition, Vallabh Prakashan, Delhi.
2. Banker and Rhodes. Modern Pharmaceutics, 4<sup>th</sup> ed 2002 Marcel Dekker Inc.
3. Disperse Systems, Vol. I, II, III, M. Decker.
4. E. A. Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
5. James Swarbrick and James C. Boylan: Encyclopedia of pharmaceutical Technology, Marcel Dekker Inc. New York.
6. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.
7. M. E. Aulton: Pharmaceutics, Science of Dosage Form Design.
8. Pharmaceutical Dosage Forms and Drug delivery systems. and 7<sup>th</sup> Ed. Ansel, Lippincott Williams and Wilkins, PA, 1999.
9. Remington's "The Science and Practice of Pharmacy", 20<sup>th</sup> Ed; 2000, Lippincott. Williams and Wilkins.

### 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-Phenylhydroxylamine 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
2. Fundamentals of Organic Chemistry vol. I & II : Finar I.L.
3. Organic Chemistry: Pine
4. Advanced Organic Chemistry: Solomans
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry : Peter Sykes
7. Advanced Organic Chemistry : Bahl B.S. & Bahl A.
8. Organic Chemistry : Jain M.K.
9. Reaction Mechanisms and Reagents: Gurudeep Chatwal.
10. Vogel's Textbook of practical organic chemistry
11. Practical Organic Chemistry : Mann and Saunders
12. Stereochemistry of Organic Compounds : Nasipuri D.
13. Stereochemistry of Organic Compounds : Kalsi P.S.

### 1.2.8 Pharmaceutical Analysis - II

Practical 3 hrs/wk.

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.
6. Calibration of pH meter.
7. Potentiometric analysis: - pKa determination of phosphoric acid / boric acid.
8. Potentiometric titration of Acid Vs Base.
9. Water determination by Karl-fischer method.

#### Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II., The Anthlone Press of University of London.
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry - 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. I & II, A.V.Kasture, S.G.Wadhodkar, K.R.Mahadik, H.N.More - Nirali Publication.
11. Analytical Chemistry an introduction, Skoog/West/Holler, 6<sup>th</sup> Edition.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
16. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
18. Meites-Handbook of Analytical Chemistry (McGraw Hill).
19. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).

**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. AB Mc Naught and Callander R., "Illustrated Physiology", B.I. Churchill Living Stone, New Delhi, 1<sup>st</sup> edition, 1987.
2. Anne Waugh and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", Churchill Living Stone, Edinburgh, 9<sup>th</sup> edition, 2002.
3. Arthur C. Guyton and John E. Hall, "Text book of Medical Physiology" W.B. Saunders company, 10<sup>th</sup> edition, 2000.
4. Bhise S.B. and Yadav "Human Anatomy and Physiology", Nirali Prakashan, Pune (India), 8<sup>th</sup> edition, 2000.
5. C.C. Chatterjee, "Human Physiology"(Vol. I & Vol. II), Medical Allied Agency, Calcutta, 11<sup>th</sup> edition, 1985.
6. Chaudhry Sujit K., "Consise Medical Physiology", New Cenrtal Book Agency, Calcutta, 2<sup>nd</sup> Edition, 1993.
7. De Gruchy`s Clinical Haematology, "Clinical Haematology in Medical Practice, Blackwell Science publishers, 5<sup>th</sup> Edition, 1989.
8. Douglas E., Kelly, Richard Wood and Allen C. Enders, "Bailey`s TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London, 18<sup>th</sup> Edition, 1984.
9. Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 4<sup>th</sup> edition, 1997.
10. Elaine N. Marieb, "Human Anatomy and Physiology", Benjamin / Cumings publishing company, 2<sup>nd</sup> edition, 1992.

11. Gerard J. Toratora, "Principles of Anatomy and Physiology", John-Wiley & sons New York, 10<sup>th</sup> edition, 2003.
12. Inderbir Singh, "Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, 4<sup>th</sup> edition, 2002.
13. Park J.E. and Park K., "Preventive and Social Medicine", Banarasidas Bhanot, India, 13<sup>th</sup> edition, 1991.

#### **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:**

1. Gamborg O. L. Wetter L. R., Plant tissue culture methods, National Research Council of Cannada, Sakatchewan.
2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
3. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
4. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
5. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
6. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
8. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
9. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
10. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
12. Atal C. K. and Kapur B. M. Cultivation and utilization of Medicinal plants, RRL, Jammu.
13. Barz W, Rrinhard E and Zenk M. H. Plant tissue culture and its biotechnological application, Springier, Berlin.
14. Brain K. R. and Turner T. D. , The practical Evaluation of phytopharmaceuticals, Wright-Scientehnica, Bristil.

15. Chandha K.L. and Gupta R. Advances in Horticulture Vol II- medicinal and aromatic plants, Malhotra publishing House, New Delhi.
16. Chopra R. N., Nayar S. L. and Chopra I. C., Glossary of Indian Medicinal plants CS I R, New Delhi.
17. Clarke ECG, Isolation and Identification of Drugs, The Pharmaceutical Press, London.
18. De Mayo, The chemistry of Natural Products, 2-3, Interscience New York.
19. Export potential of selected medicinal plants, prepared by basic chemicals, pharmaceuticals and cosmetic export promotion council, Bombay, and other reports.
20. Fabn A, Plant anatomy, 3<sup>rd</sup> Ed. Pergamon press, Oxford.
21. Faulkner D. J. and Fenical W. H. , Marine Natural Product Chemistry (NATO conference series 4) plenum press, New York.
22. Kokate C. K., Cultivation of Medicinal Plants.
23. Pulok Mukharji, Quality control of Herbal drugs.



**Semester - III**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
2.3.1	<a href="#">Physical Pharmacy – I</a>	3	50
2.3.2	<a href="#">Pharmaceutical Microbiology &amp; Immunology</a>	4	50
2.3.3	<a href="#">Pharmaceutical Biochemistry</a>	3	50
2.3.4	<a href="#">Pharmacognosy &amp; Phytochemistry – II</a>	3	50
2.3.5	<a href="#">Biostatistics and Computer applications</a>	2	50
	<b>Total</b>	<b>15</b>	<b>250</b>
<b>Practical</b>			
2.3.6	<a href="#">Physical Pharmacy – I (Practical)</a>	3	50
2.3.7	<a href="#">Pharmaceutical Microbiology &amp; Immunology (Practical)</a>	3+1	50
2.3.8	<a href="#">Pharmaceutical Biochemistry (Practical)</a>	3	50
2.3.9	<a href="#">Pharmacognosy &amp; Phytochemistry – II (Practical)</a>	3	50
2.3.10	<a href="#">Biostatistics and Computer applications (Practical)</a>	3	50
	<b>Total</b>	<b>16</b>	<b>250</b>

**2.3.1 Physical Pharmacy - I****Theory****3 hrs/wk.**

	<b>Hrs</b>	<b>Marks</b>
1. Behaviour of gases: Kinetic theory of gases, derivation from behaviours and explanation.	03	05 - 08
2. The liquid state: Physical properties such as surface tension, parachor, viscosity, refractive index, optical rotation and dipole moment	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	06	06 - 10
4. Thermodynamics: First law, second law, third law of thermodynamics, zeroth law, absolute temperature scale.	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.	05	05 - 08
6. Adsorption: Types, factors affecting, Freudlich and Gibbs adsorption isotherm, Langmuir theory of adsorption, adsorption on solid interface, solid-gas and solid-liquid interfaces, applications in pharmacy	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.	06	06 - 10
8. Numerical problems: Problems based on all above chapters	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 - Engene Parrot

2.3.2 Pharmaceutical Microbiology & Immunology		Theory	4 hrs/wk.
		Hrs	Marks
1.	Scope of Microbiology: Historical development (Antony Van Leuenhook, Koch's postulates, Pastuers contribution) applications of microbiology to pharmaceuticals.	02	02 - 04
2.	Classification of microorganisms and their taxonomy: Whittkers 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.)	03	03 - 05
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).	08	07 - 12
4.	Study of Yeasts, Fungi & Rickettsia: Introduction, characteristics, clinical significance & applications in Pharmacy	05	03 - 05
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.	04	03 - 05
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).	13	12 - 17

7. Fundamentals of Immunology -

13 10 - 12

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:

1. Pharmaceutical Microbiology - Hugo and Russell, sixth ed., Blackwell Science.
2. Tutorial Pharmacy - Cooper and Gunn
3. Basic & Clinical Immunology - H. H. Fundenberg, Large Medical Publication, Maruzen Company Limited.
4. General Microbiology by Pelczar & Rid
5. General Microbiology by Powar & Dagainawala
6. Text book of microbiology by Ananthnarayanan, Jarayam Panikar

2.3.3 Pharmaceutical Biochemistry		Theory	(3 hr./wk)	
			Hrs	Marks
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
- 4 Harper's Biochemistry, By R. K. Murry.
- 5 Practical Biochemistry By David T. Plummer
- 6 Jayaraman J, Laboratory manual in Biochemistry, Wiley Eastern Ltd. New Delhi.

### 2.3.4 Pharmacognosy & Phytochemistry - II

Theory (3 hr./wk)

	Hrs	Marks
<b>1. Volatile oils:</b> 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	10	12 - 15
<b>2. Resins:</b> 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.	09	08 - 12
<b>3. Tannins:</b> Study of tannins and tannin containing drugs like gambir, black catechu, myrobalan, behera.	04	04 - 06
<b>4. Phytochemical screening:</b> a. Preparation of extracts. b. Screening of alkaloids, glycosides (Cardiac, saponins, anthraquinones, flavonoids, coumarins and cynogenetic glycosides), Tannins, steroids, carbohydrates, proteins and amino acids.	08	08 - 10
<b>5. Fibres:</b> Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass wool, polyester and asbestos	04	04 - 06
<b>6. Pharmaceutical aids &amp; technical products:</b> Study of pharmaceutical aids like talc, Diatomite, kaolin, bentonite, gelatin	04	04 - 06

## Reference Books:

1. Gamborg O. L. Wetter L. R. , Plant tissue culture methods, National Research Council of Canada, Sakatchewan.
2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
3. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
4. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
5. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
6. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
8. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
9. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
10. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.



**2.3.5 Biostatistics and Computer applications****Theory****2 hrs/wk.**

	<b>Hrs</b>	<b>Marks</b>
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	02	03 - 05
2. Probability and Probability distribution Terminology, theoretical, binomial, normal probability distribution	01	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.	02	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	03	04 - 06
5. Analysis of Variance and Experimental Design Meaning and the Technique of ANOVA	01	03 - 05
6. History and Generation of Computers Fundamentals, evolution and generation, types of computers	01	03 - 05
7. Anatomy and Computer Peripherals CPU, Input and Output devices, Ancillary machines, characteristics of computers, memories and storage devices	02	03 - 05
8. Operating systems Terminology MS-DOS, MS Windows, Introduction to other operating systems.	04	06 - 10
9. Microsoft office MS Word, MS Excel, MS PowerPoint	05	08 - 10
10. Introduction to internet basics and networking Internet browsing, search engines, e-mail networking concepts, LAN, WAN.	02	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	01	03 - 05

## Reference Books:

1. Introduction to Biostatistics and Computer science by Y. I. Shah, Dr. A. R. Paradkar, and M. G. Dhaygude, Nirali Prakashan, Pune - 02
2. Methods of Biostatistics for Medical and Research students by B. K. Mahajan, Jaypee brothers medical publishers (P) Ltd., New Delhi - 02
3. Fundamentals of Applied statistics by S. C. Gupta, V. K. Kapoor, Sultan Chand and Sons Publishers New Delhi - 02
4. Statistical methods for cost accountants by S. P. Gupta, Sultan Chand and Sons Publishers, New Delhi - 02
5. Donald Sanders - Computer Today (3 rd Edition) Publisher - McGraw - Hill Book Company
6. William and Fassett - Computer Applications in Pharmacy.
7. Computer-Aided Drug Design (Methods & Applications) Edited by - Thomas Perun, Propst Publisher- Marcel Dekker Inc.
8. Computer Medicine by J. Rose, Publisher: J. & A. Churchill Ltd.
9. Computer Programming - I by Sneha Phadke, Publisher: Technova Publication
10. Microsoft office 97 by Ginicourter & Annette Marquis, BPB Publications, N. Delhi - 01
11. The ABC's of the Internet by Cristain Crumlish, BPB Publications, N. Delhi - 01

### 2.3.6 Physical Pharmacy - I

Practical 3 hrs/wk.

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, (cocci 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.                      medium.
6. Study of yeast Aspergillus and Penicillium with respect to morphology. (wet mount preparation).
7. Sterility testing.
8. Study of air and water microbiology.
9. Phenol coefficient.
10. Serological diagnosis of Typhoid.

**Reference Books:**

1. Pharmaceutical Microbiology - Hugo and Russell, sixth ed., Blackwell Science.
2. Tutorial Pharmacy - Cooper and Gunn
3. Basic & Clinical Immunology - H. H. Fundenberg, Large Medical Publication, Maruzen Company Limited.
4. General Microbiology by Pelczar & Rid
5. General Microbiology by Powar & Dagainawala
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
4. Harper's Biochemistry, By R. K. Murry.
5. Practical Biochemistry By David T. Plummer
6. Jayaraman J, Laboratory manual in Biochemistry, Wiley Eastern Ltd. New Delhi.

### 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:

1. Gamborg O. L. Wetter L. R. , Plant tissue culture methods, National Research Council of Canada, Sakatchewan.
2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
3. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
4. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
5. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
6. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
8. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
9. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
10. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
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
3. Fundamentals of Applied statistics by S. C. Gupta, V. K. Kapoor, Sultan Chand and Sons Publishers New Delhi - 02
4. Statistical methods for cost accountants by S. P. Gupta, Sultan Chand and Sons Publishers, New Delhi - 02
5. Donald Sanders - Computer Today (3 rd Edition) Publisher - McGraw - Hill Book Company
6. William and Fassett - Computer Applications in Pharmacy.
7. Computer-Aided Drug Design (Methods & Applications) Edited by - Thomas Perun, Propst Publisher- Marcel Dekker Inc.
8. Computer Medicine by J. Rose, Publisher: J. & A. Churchill Ltd.
9. Computer Programming - I by Sneha Phadke, Publisher: Technova Publication
10. Microsoft office 97 by Ginicourter & Annette Marquis, BPB Publications, N. Delhi- 01
11. The ABC's of the Internet by Cristain Crumlish, BPB Publications, N. Delhi - 01



**Semester - IV**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
2.4.1	<a href="#">Physical Pharmacy - II</a>	3	50
2.4.2	<a href="#">Pharmaceutical Biotechnology</a>	3	50
2.4.3	<a href="#">Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry</a>	4	50
2.4.4	<a href="#">Pharmaceutical Chemistry</a>	3	50
2.4.5	<a href="#">Pharmacology - I</a>	4	50
	<b>Total</b>	<b>17</b>	<b>250</b>
<b>Practical</b>			
2.4.6	<a href="#">Physical Pharmacy - II (practical)</a>	3	50
2.4.7	<a href="#">Pharmaceutical Biotechnology (practical)</a>	3	50
2.4.8	<a href="#">Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry (practical)</a>	3	50
2.4.9	<a href="#">Pharmaceutical Chemistry (practical)</a>	3	50
2.4.10	<a href="#">Pharmacology - I (practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

**2.4.1 Physical Pharmacy - II****Theory 3 hrs/wk.**

	Hrs	Marks
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.	03	04 - 08
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.	06	05 - 08
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.	08	08 - 12
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.	06	06 - 10
5. Dispersed systems: A) Colloidal dispersion: definition, types, properties of colloids: protective colloids, applications of colloids in pharmacy. B) Coarse Dispersions: interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of brownian moment, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations, emulsion types, theories, physical stability.	08	10 - 15
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, $Q_{10}$ value, accelerated stability study, expiration dating.	06	07 - 09

**Reference Books:-**

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone and Lewis
3. Physical Chemistry – Maron S. and Pruton
4. Remington's Pharmaceutical Sciences.
5. Theory & Practice of Industrial Pharmacy – Lachman Liebermann and Kanig
6. Physical Chemistry – Bahl and Tuli
7. Pharmaceutical Technology – Eugene Parrott
8. Essentials of Physical Chemistry and Pharmacy – S. S. Kadam, H. J. Arnikar and K. N. Gujar

## 2.4.2 Pharmaceutical Biotechnology

Theory

(3 hrs/wk.)

	Hrs	Marks
1. Definition and scope - potential and achievements	02	03 - 05
2. Fermentation technology and industrial microbiology 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.	13	15 - 18
3. Animal cell culture and genetic engineering 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.	07	06 - 10
4. Preparation and characterization of immunologicals 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.	06	05 - 08
5. Biotechnology derived products (therapeutic proteins) Examples of biotechnology derived therapeutics products, production of human Insulin, interferon, somatostatin, somatotropin.	04	03 - 05
6. Characterization and quality control of biotech derived products: 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.	10	08 - 12

## Reference Books:

1. Bainse William, *Biotechnology from A to Z*, 2<sup>nd</sup> Edition, 2002, Oxford University Press.
2. Berger S. L., et. al., *Methods in Enzymology*, Academic Press Inc., CA 1992.
3. *British Pharmacopoeia*, 1993, London, HMSO.
4. Carter S. J., Cooper and Gunn's *Tutorial Pharmacy*, 6<sup>th</sup> Edition, 1996, CBS Publishers and Distributors, Delhi.
5. Casida L. E., *Industrial Microbiology*, 2000, New Age International, Delhi.
6. De Kalyan Kumar, *Plant Tissue Culture*, 1<sup>st</sup> Edition, 1997, New Central Book Agency (P) Ltd.
7. Freifelder David, *Molecular Biology*, 2<sup>nd</sup> Edition, 1998, Narosa Publishing House.
8. J. I. Disouza, Killedar S. G., *Biotechnology and Fermentation Process*, Nirali Prakashan
9. Gennaro A. R., *Remington-the Science and Practice of Pharmacy*, 20<sup>th</sup> Edition, 2002, Lippincott Williams and Wilkins, New York.
10. Gupta P. K., *Elements of Biotechnology*, 1<sup>st</sup> Edition, 2001, Rastogi Pub., Meerut.
11. Higgins, Best D.J. and Jones J., *Biotechnology: Principles and Applications*, Blackwell Scientific Publications, Boston, MA 1985.
12. Hugo W. B., Russell A. D., *Pharmaceutical Microbiology*, 6<sup>th</sup> Edition, 1998,
13. Jay James M., *Modern Food Microbiology*, 4<sup>th</sup> Edition, 1996, CBS Publishers and Distributors, Delhi.
14. Kumar H. D., *Textbook of Biotechnology*, 2<sup>nd</sup> Edition, 1991, Affiliated East West Press Pvt. Ltd., New Delhi.
15. Patel A. H., *Industrial Microbiology*, 1984, Macmillan Ltd., Delhi.
16. *Pharmacopoeia of India*, 1985, Govt. of India, Ministry of Health and Family Welfare.
17. Prasad B., *Veterinary Pharmaceuticals*, 4<sup>th</sup> Edition, 2001, CBS Publishers and Distributors, Delhi.
18. Razdan M. K., *An Introduction to Plant Tissue Culture*, 1993, Oxford IBH Pub., New Delhi.
19. Reed Gerald, Prescott Dunn's *Industrial Microbiology*, 4<sup>th</sup> Edition, 1987, CBS Publishers and Distributors, Delhi.
20. Singh B. D., *Biotechnology*, 2001, Kalyani Publisher.
21. Stanbury P. F., Whitekar A. and Hall S. J., *Principles of Fermentation Technology*, 2<sup>nd</sup> Edition, 1997, Aditya Books (P) Ltd., New Delhi.
22. Trevan Keshav, *Biotechnology*, 4<sup>th</sup> Edition, 1990, New Age International Ltd. Pub., New Delhi.
23. Vyas, S. P., Dixit V. K., *Pharmaceutical Biotechnology*, 1<sup>st</sup> Edition, 1999, CBS Publishers and Distributors, Delhi.

2.4.3 Pharmaceutical Heterocyclic & Polycyclic Chemistry	Theory	4 hrs/wk.
<b>1. Stereochemistry:</b>	Hrs 08	Marks 05 – 08
<ul style="list-style-type: none"> <li>• Isomerism and its types - Optical isomerism-nomenclatures [including D/L &amp; R/S] and projection formulas, enantiomers, distereoisomers, chirality, racemic mixtures, resolution of racemic mixtures.</li> <li>• Geometrical isomerism-Z &amp; E, cis-trans isomerisms.</li> <li>• Methods of determination of configurations.</li> <li>• iv. Conformational isomerism: Conformations of n-butane &amp; cyclohexane and disubstituted cyclohexanes, locking of conformation with respect to t-butyl cyclohexane, Conformational analysis.</li> </ul>		
<b>2. Heterocyclic Compounds:</b>	13	12 – 16
<p>Introduction &amp; Nomenclature of all heterocyclic compounds, Preparation, reactivity and Chemical reactions of Aziridines, Furan, Pyrrole, Pyridine, other fused pyridines, purines, diazines, triazines &amp; tetrazines, oxazines, thiazines, pyrazoles, tetrazoles, oxadiazoles, thiadiazoles, isooxazoles, isothiazoles &amp; there benzo dervs, Pyrimidine, Thiophene, Indole, Quinoline, Imidazole, Thiazole, Oxazole, Triazole, azipines , diazepines &amp; benzodiazepines.</p>		
<b>3. Molecular Rearrangements:</b>	18	12 – 18
<p>General considerations, types of rearrangement Nucleophilic, electrophilic, free radical), Principle, reaction mechanism and stereochemistry of...</p> <ul style="list-style-type: none"> <li>• Electron deficient Rearrangements- Whitmore 1,2 shift. Wagner Meerwein rearrangement, Pinacol rearrangement, Wolf rearrangement, Beckmann rearrangement, Hoffman rearrangement, Lossen rearrangement, Schmidt rearrangement, Benzillic acid rearrangement.</li> <li>• Electron rich Rearrangements: Stevens rearrangement, Wittig rearrangement, Neber rearrangement, Sommelet rearrangements, Favourskii rearrangement.</li> <li>• Rearrangements involving migration of Aromatic ring-Fries rearrangement, Claisen rearrangement.</li> </ul>		
<b>4. Fused polynuclear Compound:</b> Preparation, reactivity and chemical properties of Naphthalene, Anthracene and Phenanthrene.	5	05 – 08
<b>5. Oxidation &amp; reduction reactions:</b> 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.	10	06 – 10

### Reference Books:

1. Advanced Organic Chemistry, Ed. 4 -Jerry March.
2. Fundamentals of Organic Chemistry Vol. I & II Finar I.L.
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
7. Advanced Organic Chemistry: Bahl B.S. & Bahl A.
8. Organic Chemistry by Jain M.K.
9. Reaction Mechanisms and Reagents: Gurudeep Chatwal.
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
<b>1. Amino-acids, Peptides, and Proteins:</b> 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.	8	8-11
<b>2. Vitamins:</b> Chronological development of vitamins, General structure of vitamins- Structural elucidation of Vitamin A (Retinol), Vitamin B <sub>1</sub> (Thiamine), Vitamin D <sub>2</sub> and $\alpha$ -Tocopherol.	5	5-7
<b>3. Glycosides:</b> General Chemistry of Glycosides, Determination of structure, Methods in determination of constitution of Arbutin, Amygdalin and Salicin.	6	7-10
<b>4. Alkaloids:</b> General Chemistry of Alkaloids, General methods of determination of molecular structure, Methods in determination of constitution of Ephedrine, Nicotine, Atropine and Quinine.	7	6-9
<b>5. Chiral Technology:</b> Introduction, chirality, Resolution, asymmetric synthesis, chiral pool, chiral reagents, chiral auxillary & chiral catalyst.	4	5-8
<b>6. Medicinal dyes and pigments:</b> 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.	7	8-10



### 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.
3. The Chemistry of Natural Products by De Mayo P, Interscience, New York.
4. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
5. Biochemistry of Phenolic Compounds by Harborne J. B., Academic Press, New York.
6. Isolation and Identification of Drugs by Clarke ECG, The Pharmaceutical Press, London.
7. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
8. Martindale, The Extra Pharmacopoeia, Pharmaceutical Society of Great Britain, London.
9. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
10. Pharmacopoeia Of India, 1985, 1996, Govt. Of India, Ministry Of Health and Family Welfare.
11. Terpenoids in Plants by Pridham J. B., Academic Press, New York.
12. The Biochemistry of Alkaloids by Robinson T., Springer- Verlag.

**2.4.5 Pharmacology - I**

Theory

4 hrs/wk.

	Hrs	Marks
<b>1. General Pharmacology</b>		22 - 32
• 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, placental 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	
<b>2. Drugs acting on Autonomic Nervous System</b>		18 - 28
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	

**Reference Books:**

1. General Pathology – Y.M. Bhende, S, G. Deodhare, S. S. Kelkar (Popular Prakashan).
2. Essential Pathology – Emanuel Rubin, John L., Farber J.B. Lippincott company.
3. Text book of Robbins Pathology Basis of Disease – Robbins, Cotran, Kumar, Prism Indian Edition
4. Pocket comparison to Robbins Pathologic Basis of Disease, 5<sup>th</sup> Edition - Robbins, Cotran, Kumar, Prism Indian Edition.
5. Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T. W. Rall, AIS, Nies, P. Taylor, Pergamon Press, 2000.
6. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
7. M. P. Rang, M. M. Dale, J. M. Ritter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
8. Modern Pharmacology, C. R. Craig and R. E. Stitzel, Little Brown and Company, 1994.
9. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
10. Mycek MJ, Harvey RA and Champe PC, Lippincott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lippincott Williams & Wilkins, 1997.
11. Barar F.S.K., Test book of Pharmacology, Interprint, New Delhi.
12. Lawrence, D.R. and Bennet P.N. Clinical Pharmacology, Scientific Book agency, Calcutta.
13. P.S.R.K. Haranath, Synopsis of Pharmacology, 1995, Bombay.
14. Clinical Pharmacy and Therapeutics, Herfindal E.T., and Hirschman J.L. Williams and Wilkins.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
16. Pharmacotherapy: A Pathophysiological approach, Dipiro, J.L. Elsevier.3
17. Tripathi KD: Essentials of Medical Pharmacology. 2001, 4<sup>th</sup> Edition, Jaypee Brothers, New Delhi.
18. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
20. Hand book of Experimental Pharmacology, 2nd Ed., S. K. Kulkarni., Vallabh Prakashan, Delhi.

#### 2.4.6 Physical Pharmacy – II

Practical 3 hrs/wk.

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
7. Pharmaceutical Technology – Eugene Parrott
8. Physical Pharmacy – Martin, Swarbrick and Commarata
9. Practical Pharmaceutics (Physical Pharmacy) - H. N. More, Ashok Hajare
10. Practical Physical Pharmacy - U. B. Hadkar, T.N. Vasudevan, K. S. Laddha

#### **2.4.7 Pharmaceutical Biotechnology**

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

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 B<sub>12</sub>)

### Reference Books:

1. Bainse William, *Biotechnology from A to Z*, 2<sup>nd</sup> Edition, 2002, Oxford University Press.
2. Berger S. L., et. al., *Methods in Enzymology*, Academic Press Inc., CA 1992.
3. *British Pharmacopoeia*, 1993, London, HMSO.
4. Carter S. J., Cooper and Gunn's *Tutorial Pharmacy*, 6<sup>th</sup> Edition, 1996, CBS Publishers and Distributors, Delhi.
5. Casida L. E., *Industrial Microbiology*, 2000, New Age International, Delhi.
6. De Kalyan Kumar, *Plant Tissue Culture*, 1<sup>st</sup> Edition, 1997, New Central Book Agency (P) Ltd.
7. Freifelder David, *Molecular Biology*, 2<sup>nd</sup> Edition, 1998, Narosa Publishing House.
8. Gennaro A. R., *Remington-the Science and Practice of Pharmacy*, 20<sup>th</sup> Edition, 2002, Lippincott Williams and Wilkins, New York.
9. Gupta P. K., *Elements of Biotechnology*, 1<sup>st</sup> Edition, 2001, Rastogi Pub., Meerut.
10. Higgins, Best D.J. and Jones J., *Biotechnology: Principles and Applications*, Blackwell Scientific Publications, Boston, MA 1985.
11. Hugo W. B., Russell A. D., *Pharmaceutical Microbiology*, 6<sup>th</sup> Edition, 1998, Backwell Science.
12. Jay James M., *Modern Food Microbiology*, 4<sup>th</sup> Edition, 1996, CBS Publishers and Distributors, Delhi.
13. Kumar H. D., *Textbook of Biotechnology*, 2<sup>nd</sup> Edition, 1991, Affiliated East West Press Pvt. Ltd., New Delhi.
14. Patel A. H., *Industrial Microbiology*, 1984, Macmillan Ltd., Delhi.
15. *Pharmacopoeia of India*, 1985, Govt. of India, Ministry of Health and Family Welfare.
16. Prasad B., *Veterinary Pharmaceuticals*, 4<sup>th</sup> Edition, 2001, CBS Publishers and Distributors, Delhi.
17. Razdan M. K., *An Introduction to Plant Tissue Culture*, 1993, Oxford IBH Pub., New Delhi.
18. Reed Gerald, Prescott Dunn's *Industrial Microbiology*, 4<sup>th</sup> Edition, 1987, CBS Publishers and Distributors, Delhi.
19. Singh B. D., *Biotechnology*, 2001, Kalyani Publisher.
20. Stanbury P. F., Whitekar A. and Hall S. J., *Principles of Fermentation Technology*, 2<sup>nd</sup> Edition, 1997, Aditya Books (P) Ltd., New Delhi.
21. Trevan Keshav, *Biotechnology*, 4<sup>th</sup> Edition, 1990, New Age International Ltd. Pub., New Delhi.
22. Vyas, S. P., Dixit V. K., *Pharmaceutical Biotechnology*, 1<sup>st</sup> Edition, 1999, CBS Publishers and Distributors, Delhi.

## 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
2. Fundamentals of Organic Chemistry vol. I & II : Finar I.L.
3. Organic Chemistry : Pine
4. Advanced Organic Chemistry : Solomans
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry: Peter Sykes
7. Advanced Organic Chemistry-----Bahl B.S. & Bahl A.
8. Organic Chemistry-----Jain M.K.
9. Reaction Mechanisms and Reagents -----Gurudeep Chatwal.
10. Vogel's Textbook of practical organic chemistry
11. Stereochemistry of Organic Compounds – Nasipuri D.
12. Stereochemistry of Organic Compounds – Kalsi P.S.

#### 2.4.9 Pharmaceutical Chemistry

Practical 3 hrs/wk.

1. Extraction of strychnine and brucine from nuxvomica, ammonium glycyrrhizinate 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.
2. The Chemistry of Natural Products by De Mayo P, Interscience, New York.
3. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
4. Biochemistry of Phenolic Compounds by Harborne J. B., Academic Press, New York.
5. Isolation and Identification of Drugs by Clarke ECG, The Pharmaceutical Press, London.
6. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
7. Martindale, The Extra Pharmacopoeia, Pharmaceutical Society of Great Britain, London.
8. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
9. Practical Pharmacognosy by Dr. C.K. Kokate, Vallabh Prakashan, Delhi.



#### 2.4.10 Pharmacology - I

Practical 3 hrs/wk.

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 ( $Mg SO_4$ )
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:

1. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
2. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi.
3. Sheth, U. K. Dadkar, N. k. and Kamat, U. G. Selected Topics in Experimental pharmacology.
4. Perry, W. L. M. Pharmacological Experiments on Isolated preparations.

**Semester - V**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
3.5.1	<a href="#">Cosmeticology</a>	3	50
3.5.2	<a href="#">Pharmaceutical Engineering</a>	3	50
3.5.3	<a href="#">Medicinal Chemistry - I</a>	3	50
3.5.4	<a href="#">Pharmaceutical Polymer Chemistry</a>	3	50
3.5.5	<a href="#">Pharmacology - II</a>	4	50
	<b>Total</b>	<b>16</b>	<b>250</b>
<b>Practical</b>			
3.5.6	<a href="#">Cosmeticology (Practical)</a>	3	50
3.5.7	<a href="#">Medicinal Chemistry - I (Practical)</a>	3+3	50
3.5.8	<a href="#">Pharmaceutical Polymer Chemistry (Practical)</a>	3	50
3.5.9	<a href="#">Pharmacology - II (Practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>200</b>

<b>3.5.1</b>	<b>Cosmeticology</b>	<b>Theory</b>	<b>3 hrs/wk.</b>
		Hrs	Marks
1.	<b>Physiological Consideration:</b> Skin, hair, nail and eye- in relation to cosmetic application.	03	03 - 06
2.	<b>Properties, significance &amp; applications of</b> a. Excipients used in various cosmetic formulations b. sensitivity & irritation tests for colours	03	03 - 06
3.	<b>Formulation, Manufacturing &amp; evaluation of cosmetics for</b> <b>a. Skin:</b> Powders, creams, lotions, deodorants, antiperspirants, suntan preparations, bathing preparations Make up preparations - Rouge, Lipsticks	14	15 - 20
	<b>b. Hair:</b> Shampoos, hair grooming preparations, preshave & after shave preparations, shaving preparations, depilatories & dyes.	06	08 - 12
	<b>c. Nail:</b> Nail lacquers, removers, nail bleach.	02	02 - 05
	<b>d. Eye:</b> Eye shadow, mascara, eyebrow pencil, eye make-up remover, eyeliners, eye cover-up makeup.	02	03 - 06
4.	<b>Aerosols:</b> Definition, advantages, disadvantages. Components, propellants, General formulation, Manufacturing, Evaluation & Pharmaceutical applications,	06	06 - 12

## References:

1. J. Knowlton and S. Rearce; Handbook of cosmetic sciences and technology Elsevier science publisher.
2. J. B. Wilkinson and R. J. Moore; Harry's cosmetology; Longman science and Technical.
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.)

	Hrs	Marks
1. Fluid flow: Fluid statics, mechanism of fluid flow, Bernoulli's theorem, fluid heads, fluid handling (liquid and air)	06	08 - 12
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.	06	05 - 08
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.	05	05 - 08
4. Boilers: Main parts, mountings and accessories-industrial boilers including cochran, babcock wilcox and lancashire.	03	03 - 05
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.	06	08 - 12
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	05	05 - 08

- construction in the design of pharma packaging.
- |    |  |    |         |
|----|--|----|---------|
| 7. | Maintenance:   | 03 | 03 – 05 |
|    | 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 :   | 02 | 03 – 05 |
|    | 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:

1. Pharmaceutical Engineering by K. Sambamurthy ,New Age International Pvt. Ltd., New Delhi 1998
2. Introduction to Chemical Engineering (International Student Edition),By Walter L. Badger & Jullus T. Banthero, McGraw Hill Publications (29<sup>th</sup> Printing 1987)
3. Unit Process in Pharmacy by David Ganderton, William Helnemann Medical Borks Ltd, London, 1968
4. Perry's Chemical Engg. Handbook, 7<sup>th</sup> Edition/1997/International Edition McGraw Hill, Author Robert H. Perry, Don W. Green.
5. Elements of Mechanical and Electrical Technology, B.H. Deshmukh P.V. Mondke, Seventh Edition - Aug'92, Nirali Prakashan
6. Machine Drawing,By N.D. Bhat, 10<sup>th</sup> Edition,Published by Character Bork Stall, Tulsi Sadan, Anand; 1974
7. Elements of Heat Engines ,By N.G. Pandya, C.S. Shah,Fifth Revised and Enlarged Edition - 1966,Charotar book stall, Tulsi Sadan, Station Road, Anand (W.Rly), India
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.)
		Hrs	Marks
<b>1. Introduction :</b>		01	02 - 03
	Sources of Drugs- Serendipity, Random Screening, Extraction from Natural Sources, Molecular Modification.		
<b>2. Theoretical Aspects of Drug Action</b>		04	04 - 06
	The Ferguson's Principle		
	Physicochemical Parameters and Pharmacological Activity- Solubility, Partition Coefficient, Surface Activity, pKa, Ionisation, Stereochemical Factors, Bio-isosterism.		
<b>3. Metabolism</b>		04	04 - 06
	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.)		
<b>4. Introduction to Receptor Concept</b>		04	03 - 05
	History, affinity, receptor & biological response, drug-receptor interaction, forces involved in drug-receptor interaction, receptor theories, conformational flexibility and multiple modes of action.		
<b>5. The following classes of drugs should be discussed in relation to:</b>			
	<ul style="list-style-type: none"> <li>• Introduction to the rational development (if any)</li> <li>• Detailed Classification of each class</li> <li>• Mechanism of action</li> <li>• Synthesis of compounds with asterisk</li> </ul>	<ul style="list-style-type: none"> <li>• Structure-activity relationship</li> <li>• Generic names / Trade names</li> <li>• Chemical nomenclature</li> <li>• Metabolism</li> <li>• Uses</li> </ul>	
<b>6. Drugs Acting on ANS</b>		05	04 - 06
	<b>a. Drugs Acting on Cholinergic Nervous System:</b>		
	Bethanechol, Methacholin, Neostigmine, Physostigmine, Parathion, Atropine, Scopolamine, Hyocyamine, Dicyclomine*, Cyclopentolate*, Papaverine, Mecamylamine, d-Tubocurarine, Succinyl Choline.		
	<b>b. Drugs Acting on Adrenergic Nervous System:</b>	04	04 - 06
	Methyldopa, Reserpine, Ephedrine, Amphetamine, Pargyline, Norepinephrine, Epinephrine, Phenylephrine, Metarminol, Salbutamol*, Phenoxybenzamine, Tolazoline, Propranolol*, Atenolol, Metoprolol.		

<b>c. Local Anaesthetics:</b>	02	03 - 05
Lignocaine, Benzocaine, Lidocaine, Procaine, Bupivacaine.		
<b>7. Drugs Acting on Cardio Vascular System:</b>	05	05 - 07
<b>Anti Hypertensives &amp; Anti Arrhythmic Agents:</b>		
Calcium channel blockers lanotosides 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.		
<b>8. Antilipedemic Agents (Lipid lowering agents):</b>	Lipoproteins: 03	03 - 05
Classes & Metabolism, Hyperlipoproteineamias, Types and therapy, Clofibrate*, HMG-COA reductase inhibitors. (Provastatin*, Lovastatin, Simvastatin, Atorvastatin).		
<b>9. Diuretics:</b>	03	05 - 07
Acetazolamide*, Chlorothiazide*, Hydrochlorothiazide, Bendroflumethiazide, Furosemide, Torsemide, Ethacrynic Acid, Spironolactone, Triamterene, Amiloride*, Mannitol, Theophylline.		
<b>10 Hypotensive agents acting on vascular smooth muscle:</b>	Nitrites, amyl nitrite, glyceryl trinitrate, sodium nitrite, tetranitrate, mannitol, penterithritol tetranitrate, Isosorbide mononitrate, Isosorbide dinitrite.	02 03 - 05

#### Reference Books:

- Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
- Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
- Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
- Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
- The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols 1-6.
- Profiles in Drug Synthesis : V.N. Gogte
- Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
- Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
- Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
- Text Book of Practical Organic Chemistry - A.I. Vogel
- Practical Organic Chemistry - Mann and Sanders
- Systematic Identification of Organic Composition, Shriner and Fuson



3.5.4 Pharmaceutical Polymer Chemistry

Theory (3 hrs/wk.)

	Hrs	Marks
<p><b>1. Introduction to Polymer Chemistry and its pharmaceutical applications:</b> 7      <b>8-11</b></p> <p>Introduction:</p> <p>Monomers, Polymers, backbone and side chains of polymers.</p> <p>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</p> <p>Classification of Polymers</p> <p>a) Addition Polymers: Addition to pi bonds- PVC, Teflon, polystyrene, polymethacrylate</p> <p>Macroscopic properties of these polymers- Crystalline (HDPE), Amorphous, Random conformation.</p> <p>b) Condensation Polymers/Co-polymers: Formation of condensation polymers- PET (polyethyleneterephthalate) and Nylon (6, 6).</p> <p>Pharmaceutical uses of polymers.</p>		
<p><b>2. Purines, Pyrimidines and nucleic acids:</b> 5      <b>6-9</b></p> <p>General knowledge of Nitrogenous 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.</p>		
<p><b>3. Introduction to chemistry of Pharmaceutical Excipients</b> 7      <b>8-10</b></p> <p>General Chemistry and Structure Property Relationship of</p> <p><b>1.1-Cellulose derivatives-</b></p> <p>Ethyl Cellulose, Hydroxy propyl methyl cellulose, Hydroxy propyl cellulose, Microcrystalline cellulose and Sodium carboxy methyl cellulose.</p> <p><b>1.2-Carbopols-</b></p> <p><b>1.3-PEG Derivatives-</b> Polyvinyl Alcohol, Polyvinyl Phthalate</p> <p><b>1.4-Plasticizers-</b> Triethyl citrate, Tri acetin, Propylene Glycol, and Glycerin.</p> <p><b>1.5- pH sensitive polymers-</b></p> <p><b>(a) Acrylic acid derivatives-</b> Solid and liquid eudragits.</p> <p><b>(b) Cellulose derivatives-</b> Cellulose acetate phthalate, hydroxyl propyl cellulose phthalate.</p> <p><b>1.6- Binders, Disintegrants and Super disintegrants -</b></p> <p><b>(a) Polysaccharides-</b> Gums and mucilages of starch, acacia and tragacanth.</p> <p><b>(b) Resins-</b> Indion-414 (Vinyl and divinyl benzene copolymers), Pyrrillidones, cross-povidone/ acdisol/ polyplasdone.</p> <p><b>1.7 Solubility enhancers/ Emulsifiers-</b> Tweens and Spans.</p>		

<b>4. Lipids:</b>	<b>6</b>	<b>6-8</b>
<p>Classification of lipids- Fats and oils, Phospholipids (Cephalins, Lecithins, Phosphatidyl serine &amp; 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.</p>		
<b>5. Carbohydrates:</b>	<b>5</b>	<b>6-8</b>
<p>General Chemistry of carbohydrates, classification, General methods of determination of molecular structure, Methods in determination of constitution of</p> <p>Monosaccharides-Glucose, Fructose and their reactions, Configuration of Aldoses, Cyclic Structure of D- Glucose, Mutarotation and Conformations, Amino sugars, D-Ribose, 2-deoxy-D-Ribose, Determination of Structure of Disaccharides-Maltose, Lactose, Sucrose, Structure of Polysaccharides-Starch, Cellulose, Dextran, Glycogen, Inulin and cyclodextrins.</p>		
<b>6. Natural Pigments:</b>	<b>7</b>	<b>6-9</b>
<p>Chemistry, classification and functions of Carotenoids, Anthocyanins and porphyrins. General Methods in elucidating their structures, determination of constitution of <math>\alpha</math> - Carotenes, <math>\beta</math> - Carotenes, Lycopene and haemoglobin. Pigments of medicinal importance.</p>		

#### Reference Books:

1. An Introduction to Physical Chemistry, Das Ishwar , Sharma Archana , New Age International (P), Limited, New Delhi
2. Biochemistry of Phenolic Compounds by Harborne J. B., Academic Press, New York.
3. Chemistry of Natural Products by O. P. Agrawal vol. I and II.
4. Hand book of Pharmaceutical excipients by R. C. Rowe, P. J. Sheskey and S. C. Owen.
5. Introduction to Polymers, By Robert J. Young, Amazon, UK.
6. Isolation and Identification of Drugs by Clarke ECG, The Pharmaceutical Press, London.
7. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
8. Martindale, The Extra Pharmacopoeia, Pharmaceutical Society of Great Britain, London.
9. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
10. Organic chemistry of natural product by Gurdeep chatwal vol. I and II.
11. Pharmacopoeia Of India, 1985, 1996, Govt. Of India, Ministry Of Health and Family Welfare.
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
14. Polymers: Chemistry and Physics of Modern Materials, Second Edition: Chemistry and Physics of Modern Materials, By John McKenzie Grant Cowie, Amazon, UK.
15. Terpenoids in Plants by Pridham J. B., Academic Press, New York.
16. The Biochemistry of Alkaloids by Robinson T., Springer- Verlag.
17. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
18. The Chemistry of Natural Products by De Mayo P, Interscience, New York.



3.5.5 Pharmacology - II		Theory	(4 hrs/wk.)
		Hrs	Marks
1	<b>Introduction to Pathophysiology</b>	02	02 - 04
2.	<b>Basic principles of cell injury and adaptations.</b>	03	05 - 08
	a. Causes, pathogenesis and morphology of cell injury.		
	b. Abnormalities in lipoproteinaemia, glycogen infiltration and glycogen storage disease.		
3.	<b>Basics mechanisms involved in the process of inflammation and repair.</b>	06	05 - 08
	a. Pathogenesis of acute inflammation.		
	b. Chemical mediators in inflammation.		
	c. Pathogenesis of chronic inflammation.		
	d. Repair of wounds in the skin. Factors influencing healing of wound.		
4	<b>Diuretics-</b>	02	02 - 04
	Role of nephron segments		
	Basic and clinical pharmacology of diuretics		
	Oedematous states and nonoedematous state		
5.	<b>Pathology, pharmacology and pharmacotherapy of</b>		13 - 21
	CCF	04	
	Arrhythmia	05	
	Ischemic heart diseases: angina pectoris and myocardial infarction.	05	
	Hypertension		
	Hyperlipidemia	05	
	Kidney and urinary tract disease	02	
	(terminological introduction to various disorders-		
	Glomerulonephritis, nephrotic syndrome, acute & chronic renal failure, pylonephritis.)	04	
4.	<b>Autocoids</b>	12	13 - 17
	Kinins, prostaglandins ,Leukotrienes and cytokines		
	Thromboxane- biosynthesis and pharmacology		
	Histamines- release, immunological and non-immunological release and its pharmacology		
	Antihistaminics - H1 and H2 antagonists		
	Platelet activating factor.		

### **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 Livingstone)
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 Livingstone)
8. McLeod LJ - Pharmacological experiments on intact preparation (E & S Livingstone)
9. Gaitonde BB & Nanivadekar - Tutorials in Pharmacology (New Literature Pub.)

### **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:**

1. Cosmetics: Formulation, Manufacturing Quality Control. P Sharma, Vandana Publications, 1998.
2. Modern Cosmetics : Thomson
3. Harry's Cosmeticology
4. Perry's Book of Cosmetics
5. Cosmetics Science & Technology : Edward Saggarin

### 3.5.7 Medicinal Chemistry – I

Practical (6 hrs/wk.)

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:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
5. The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols 1-6.
6. Profiles in Drug Synthesis : V.N. Gogte
7. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
8. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
9. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
10. Text Book of Practical Organic Chemistry - A.I. Vogel
11. Practical Organic Chemistry - Mann and Sanders
12. 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.
3. Experiments on Paper and Thin Layer Chromatographic evaluation of amino acids and proteins.
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.
2. The Chemistry of Natural Products by De Mayo P, Interscience, New York.
3. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
4. Biochemistry of Phenolic Compounds by Harborne J. B., Academic Press, New York.
5. Isolation and Identification of Drugs by Clarke ECG, The Pharmaceutical Press, London.
6. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
7. Martindale, The Extra Pharmacopoeia, Pharmaceutical Society of Great Britain, London.
8. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
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 , CaCl<sub>2</sub>)
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:

1. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
2. Hand book of Experimental Pharmacology, 2nd Ed., S. K. Kulkarni., Vallabh Prakashan, Delhi.
3. Sheth, U. K. Dadkar, N. k. and Kamat, U. G. Selected Topics in Experimental pharmacology.
4. Perry, W. L. M. Pharmacological Experiments on Isolated preparations.

**Semester - VI**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
3.6.1	<a href="#">Pharmaceutical Technology - II</a>	3	50
3.6.2	<a href="#">Pharmaceutical Unit Operations</a>	3	50
3.6.3	<a href="#">Medicinal Chemistry - II</a>	3	50
3.6.4	<a href="#">Pharmaceutical Analysis - III</a>	3	50
3.6.5	<a href="#">Pharmacology - III</a>	3	50
3.6.6	<a href="#">Pharmacognosy &amp; Phytochemistry - III</a>	3	50
	<b>Total</b>	<b>18</b>	<b>300</b>
<b>Practical</b>			
3.6.7	<a href="#">Pharmaceutical Technology - II (Practical)</a>	3	50
3.6.8	<a href="#">Pharmaceutical Unit Operations (Practical)</a>	3	50
3.6.9	<a href="#">Medicinal Chemistry - II (Practical)</a>	3	50
3.6.10	<a href="#">Pharmaceutical Analysis - III (Practical)</a>	3	50
3.6.11	<a href="#">Pharmacognosy &amp; Phytochemistry - III (Practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

### 3.6.1 Pharmaceutical Technology - II

Theory (3 hrs/wk.)

	Hrs	Marks
1. Tablets:	10	12 - 18
<p>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.</p> <p>Granulation: definition, reasons for granulation, method of granulation. Granulation mechanisms and mechanism of granule formation, pharmaceutical granulation equipments, IPQC.</p> <p>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</p>		
2. Capsules:	05	05 - 10
<p>Advantages, disadvantages.</p> <p>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.</p> <p>Soft gelatin capsule: capsule shell, capsule content, methods of production and evaluation as a dosage form.</p> <p>Importance of base adsorption and minim/gm factors in soft capsules.</p> <p>Comparison between soft and hard gelatin capsules.</p> <p>Stability testing and storage of capsule dosage forms.</p>		
3. Microencapsulation:	05	05 - 10
<p>Definition, applications, methods and advances in microencapsulation technology, equipment used, manufacturing processes and evaluation.</p>		
4. Oral sustained and controlled drug delivery:	10	12 - 20
<p>Definitions - historical development, components of therapeutic system - classification - details of matrix and diffusion control systems.</p> <p>Biopharmaceutical aspects-steady state concept and calculation of maintenance dose, loading doses.</p> <p>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.</p> <p>Design and evaluation of sustained release and controlled release preparations.</p> <p>Brief introduction to polymers</p>		

- |    |   |    |         |
|----|---|----|---------|
| 5. | Packaging of non-sterile pharmaceutical products:<br>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. | 04 | 03 – 06 |
| 6. | Plant layout techniques<br>Location, material handling, floor plans of different sections viz. Tablet, liquids, etc.  | 02 | 03 – 06 |

**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
2. American Pharmacy - Dittert (J. B. Lipincott)
3. Remington's Pharmaceutical Sciences -Alfonso R. Gennaro (Mack Publishing Co.)
4. E. A. Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
5. Frobisher - Fundamentals of microbiology (Toppan) Industrial Pharmacy (Lea & Febiger),Modern Pharmaceutics - (Dekker)
6. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
8. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.

3.6.2 Pharmaceutical Unit Operations		Theory	(3 hrs/wk.)	
			Hrs	Marks
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.		03	05 - 08
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.		04	05 - 08
3.	Evaporation: Basic concept of phase equilibria, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators.		03	03 - 10
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.		05	05 - 10
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.		04	05 - 10
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.		04	05 - 10
7.	Mixing: Theory of mixing, solid - solid, solid - liquid and liquid - liquid mixing equipments.		03	03 - 06
8.	Fluidization: Theory of fluidization. Application of fluidization in pharmacy in the areas of powder handling, agglomeration, drying and coating.		04	03 - 06
9.	Reactors: Fundamentals of Reactors, design for chemical reactions.		03	03 - 05
10.	Water purification: Deionization, reverse osmosis and distillation processes and large scale for manufacturing.		03	03 - 05

### Reference Books:

1. Pharmaceutical Engineering by K. Sambamurthy ,New Age International Pvt. Ltd., New Delhi 1998
2. Introduction to Chemical Engineering (International Student Edition),By Walter L. Badger & Julius T. Banthero, McGraw Hill Publications (29<sup>th</sup> Printing 1987)
3. Unit Process in Pharmacy by David Ganderton, William Helnemann Medical Borks Ltd, London, 1968
4. Perry's Chemical Engg. Handbook, 7<sup>th</sup> Edition/1997/International Edition McGraw Hill, Author Robert H. Perry, Don W. Green.
5. Elements of Mechanical and Electrical Technology, B.H. Deshmukh P.V. Mondke, Seventh Edition - Aug'92, Nirali Prakashan
6. Machine Drawing, By N.D. Bhat, 10<sup>th</sup> Edition, Published by Character Bork Stall, Tulsi Sadan, Anand; 1974
7. Elements of Heat Engines ,By N.G. Pandya, C.S. Shah, Fifth Revised and Enlarged Edition - 1966,Charotar book stall, Tulsi Sadan, Station Road, Anand (W.Rly), India
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

Theory (3 hrs/wk.)

	Hrs	Marks
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. <b>Antiamoebics:</b>	03	03 – 05
Life cycle of parasite, Ipecac alkaloids – emetine, metronidazole* and tinidazole, dicloxacillin furoate*, quinifamide		
2. <b>Anthelmintics</b>	04	04 – 06
Trematode diseases (Schistosomiasis): Lucanthone, hycanthone, niridazole, oxfamiquine, praziquantel.		
Cestode disease (Tapeworm): Niclosamide*.		
Nematode infections: Diethylcarbamazine, ivermectin.		
Gastrointestinal nematode infections: Benzimidazole like mebendazole*, parbendazole, thiabendazole* and others, pyrantel pamoate, levamisole.		
3. <b>Antifungal agents</b>	03	03 – 05
Antibiotic like amphotericin B, Nystatin, and Griseofulvin, Tolnaftate*, Imidazole derivatives like miconazole*, fluconazole, ketoconazole*, clotrimazole, flucytosine.		
4. <b>Quinoline Antibacterials:</b>	02	03 – 05
Nalidixic acid, norfloxacin, ciprofloxacin*, sparfloxacin, ofloxacin.		
5. <b>Anti Tubercular and Antileprotic Agents:</b>	05	05 – 07
PAS*, isoniazid*, pyrazinamide*, ethionamide*, ethambutol*, antitubercular Antibiotics like rifampicin, cycloserine & streptomycin, dapsone, clofazimine, general principles and significance involving drug combinations.		

6.	<b>Antimalarials</b> 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* Antimalarial antibiotics & Misc. like halofantrine	04	06 – 08
7.	<b>Antibiotics:</b> $\beta$ -Lactam Antibiotics- Penicillins and Cephalosporins, Tetracyclines, Macrolide Antibiotics, Aminoglycosides, Lincomycins, Polypeptides, Chloramphenicol.	07	08 – 12
8.	<b>Antineoplastic agents</b> Problems faced in cancer chemotherapy, Alkylating Agents-Nitrogen mustards, cyclophosphamide*, busulfan*, carmustine, lomustine, mitomycin C, dacarbazine, and procarbazine. Antimetabolites-methotrexate*, 5-fluorouracil*, Ara-c, 6-HP, 6-TG. Antibiotics like dactinomycin, daunorubicin, doxorubicin, bleomycin, Plant products – vincristine, vinblastine, Misc. products like cisplatin, Hormones – Tamoxifen, Immunotherapy.	06	08 – 12

#### Reference Books:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
4. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
5. The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols. 1-6.
6. Profiles in Drug Synthesis : V.N. Gogte
7. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
8. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
9. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
10. Text Book of Practical Organic Chemistry - A.I. Vogel
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson



<b>3.6.4</b>	<b>Pharmaceutical Analysis - III</b>	<b>Theory</b>	<b>(3 hrs/wk.)</b>
			<b>Hrs    Marks</b>
	The theoretical aspect, basic instrumentation and applications of following analytical techniques should be discussed:		
1.	<p><b>UV-Visible spectrophotometry:</b></p> <p>In applications point to be covered</p> <p>Single component analysis, absorbtivity value, calibration curve, Single point and double point standard.</p> <p>Multiple component analysis, simultaneous equation method, difference spectroscopy.</p> <p>Colorimetric estimation by Oxidation, complexation and condensation reaction.</p> <p>Determination of <math>\lambda_{\max}</math> by Woodward-Fischer rule.</p>	06	08 - 12
2.	<b>Infrared spectrophotometry</b> , Introduction to FTIR	06	06 - 08
3.	<b>Nephelo-turbidimetry</b>	03	03 - 05
4.	<b>Fluorimetry &amp; Phosphorimetry</b>	04	03 - 05
5.	<b>Nuclear Magnetic Resonance spectroscopy including <sup>13</sup>C NMR</b>	06	08 - 10
6.	<b>Mass spectrometry</b>	06	06 - 08
7.	<b>Atomic Spectroscopy:</b> Introduction, Principle, Instrumentation, Interference, Applications of Atomic absorption spectroscopy and Flame photometry.	06	06 - 08

**Reference Books:**

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II, The Anthlone Press of University of London.
4. Gary Christian- Analytical Chemistry (John Wiley).
5. Instrumental methods of Analysis- Ewing.
6. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
7. Garrat- The quantitative analysis of Drug (Toppan & Co.)
8. Analytical Chemistry an introduction, Skoog/West/Holler, 6<sup>th</sup> Edition.
9. Florey- Analytical profiles of drug substances (Academic press).
10. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition
11. Pharmaceutical Analysis Vol. II, A. V. Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More – Nirali Publication.
12. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.)
13. Merck Index.
14. Pharmaceutical Drug analysis by Ashutosh Kar.
15. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
16. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
17. Meites-Hand book of Analytical Chemistry (McGraw Hill).
18. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
19. Instrumental methods of Chemical Analysis by B. K. Sharma, 13<sup>th</sup> Edition.
20. Spectrometric Identification of Organic Compounds by Silverstein/Webster, 6<sup>th</sup> Edition.
21. Quantitative Analysis of Drug in Pharmaceutical Formulations by P.D. Sethi, 3<sup>rd</sup> Edition

3.6.5	<b>Pharmacology - III</b>	<b>Theory</b>	<b>(3 hrs/wk.)</b>
		<b>Hrs</b>	<b>Marks</b>
1.	<b>Immunopharmacology</b> 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, Immunosuppressants and its role in graft rejections.	3	08 - 12
2.	<b>Endocrinological disorders.</b> <ul style="list-style-type: none"> <li>• Drugs used in the endocrine disorders-</li> <li>• Thyroid hormone and Thyroid Inhibitors.</li> <li>• Insulin, Oral hypoglycemic drugs and Glucagon.</li> <li>• Gonadal hormones and their antagonists</li> </ul>	8	10 - 16
3.	<b>Chemotherapy:</b> <ul style="list-style-type: none"> <li>• General considerations: - General principles of chemotherapy of infections</li> <li>• Drug resistance: Introduction, types, mechanism and its importance in chemotherapy</li> <li>• Mechanism of action, Pharmacokinetics, Uses &amp; Adverse effect only to be discussed</li> <li>• Sulfonamides, Cotrimoxazole, Quinolones</li> <li>• Antibiotics effective against Gram-positive organisms- Penicillins</li> <li>• Antibiotics effective against Gram negative organisms- Amino glycosides</li> <li>• Antibiotics effective against both Gram positive &amp; Gram negative organisms- Cephalosporins, Tetracycline &amp; chloramphenicol.</li> <li>• Macrolide and other Antibacterial antibiotics, treatment of urinary tract infections and STDs</li> <li>• Chemotherapy of - Tuberculosis &amp; leprosy including National TB programmes (DOTS)</li> <li>• Protozoal infections (Antimalarials, antiamoebics, Trichomoniasis, leishmaniasis &amp; Kala azar infections)</li> <li>• Helminthiasis</li> </ul>	22 - 30	

- Fungal infections and its treatment
- Viral & HIV infections process and Antiretroviral drugs. HAART therapy of AIDS
- Antineoplastic agents. 4  
(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:

1. General Pathology - Y.M. Bhende, S. G. Deodhare, S. S. Kelkar (Popular Prakashan).
2. Essential Pathology - Emanuel Rubin, John L., Farber J. B. Lippincott company.
3. Text book of Robbins Pathology Basis of Disease - Robins, Cotran, Kumar, Prism Indian Edition
4. Pocket comparison to Robbins Pathologic Basis of Disease, 5<sup>th</sup> Edition - Robbins, Cotran, Kumar, Prism Indian Edition.
5. Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T. W. Rall, AIS, Nies, P. Taylor, Pergamon Press, 2000.
6. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
7. M. P. Rang, M. M. Dale, J. M. Ritter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
8. Modern Pharmacology, C. R. Craig and R. E. Stitzel, Little Brown and Company, 1994.
9. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
10. Mycek MJ, Harvey RA and Champe PC, Lippincott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lippincott Williams & Wilkins, 1997.
11. Barar F. S. K., Test book of Pharmacology, Interprint, New Delhi.
12. Lawrence, D. R. and Bennet P.N. Clinical Pharmacology, Scientific Book agency, Calcutta.
13. P.S.R.K. Haranath, Synopsis of Pharmacology, 1995, Bombay.
14. Clinical Pharmacy and Therapeutics, Herfindal E. T., and Hirschman J. L. Williams and Wilkins.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
16. Pharmacotherapy: A Pathophysiological approach, Dipiro, J. L. Elsevier.3
17. Tripathi K D: Essentials of Medical Pharmacology. 2001, 4<sup>th</sup> Edition, Jaypee Brothers, New Delhi.
18. Ghosh M. N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
19. Hand book of Experimental Pharmacology, 2<sup>nd</sup> Ed., S. K. Kulkarni., Vallabh Prakashan, Delhi

**3.6.6 Pharmacognosy & Phytochemistry - III**

Theory

(3 hrs/wk.)

	Hrs.	Marks
1. <i>Study of biological sources, cultivation, collection, commercial varieties</i> <i>Chemical constituents, general biosynthetic pathways, substitutes, adulterants,</i> <i>uses, diagnostic macroscopic and microscopic features and specific chemical tests of</i> <i>following groups of drugs containing glycosides:</i> <ul style="list-style-type: none"><li>• <b>Saponins:</b> Liquorice, ginseng , Dioscorea , Sarsaparilla and Senega</li><li>• <b>Cardioactive sterols:</b> Digitalis, Squill, Strophanthus and Thevetia.</li><li>• <b>Anthroquinone cathartics:</b> Aloe, Senna, Rhubarb and Cascara</li><li>• <b>Others:</b> Psoralea, Ammi majus, Ammi visnaga, Saffron, Chirata, Quassia. Wild cherry bark, mustard</li></ul>	18	20 - 28
2. <b>Introduction</b> to alternative systems of medicine, with special emphasis given on Ayurveda	03	04 - 06
3. <b>Studies of traditional drugs</b> , 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.	11	12 - 15
4. <b>The holistic concept of drug administration in traditional systems of medicine.</b>  Introduction to Ayurvedic preparations likes Aristas, Asvas, Gutikas, Tailas, Churnas, Lehyas and Bhasmas.	04	04 - 06

## Reference Books:

1. Gamborg O. L. Wetter L. R., Plant tissue culture methods, National Research Council of Canada, Saskatoon.
2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
3. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
4. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
5. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
6. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
8. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
9. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
10. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
12. Handa & Kapoor, Book of pharmacognosy
13. Ashutosh kar, Pharmacognosy and pharmacobiotechnology, New age International (P) Limited.

### 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.)
4. E. A. Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
5. Swarbrick & Boyan - Encyclopedia of Pharm. Technol - Dekker
6. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.

### 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.
6. Experiments illustrate solid - solid mixing, determination of mixing efficiency using different types of mixers.

#### Reference Books:

1. Pharmaceutical Engineering by K. Sambamurthy ,New Age International Pvt. Ltd., New Delhi 1998
2. Introduction to Chemical Engineering (International Student Edition),By Walter L. Badger & Jullus T. Banthero, McGraw Hill Publications (29<sup>th</sup> Printing 1987)
3. Unit Process in Pharmacy by David Ganderton, William Helnemann Medical Borks Ltd, London, 1968
4. Perry's Chemical Engg. Handbook, 7th Edition/1997/International Edition McGraw Hill, Author Robert H. Perry, Don W. Green.
5. Elements of Mechanical and Electrical Technology, B.H. Deshmukh P.V. Mondke, Seventh Edition - Aug'92, Nirali Prakashan
6. Machine Drawing, By N.D. Bhat, 10<sup>th</sup> Edition,Published by Charotar book stall, Tulsi Sadan, Anand; 1974
7. Elements of Heat Engines ,By N.G. Pandya, C.S. Shah, Fifth Revised and Enlarged Edition - 1966, Charotar book stall, Tulsi Sadan, Station Road, Anand (W.Rly), India
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:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
4. The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Volume 1-6.
5. Profiles in Drug Synthesis: V.N. Gogte Publication.
6. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
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
9. Text Book of Practical Organic Chemistry – A.I. Vogel
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.)

1. Spectrophotometric analysis of raw materials.
2. Spectrophotometric analysis of finished products.
3. Spectrophotometric & photofluorometric analysis of vitamins.
4. Estimation of Na<sup>+</sup>, K<sup>+</sup> by flame photometer.
5. Estimation of drugs by using turbidometer & nephelometer.

#### Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II., The Anthlone Press of University of London.
4. Gary Christian- Analytical Chemistry (John Wiley).
5. Instrumental methods of Analysis- Ewing.
6. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
7. Garrat- The quantitative analysis of Drug (Toppan & Co.)
8. Analytical Chemistry an introduction, Skoog/West/Holler, 6<sup>th</sup> Edition.
9. Florey- Analytical profiles of drug substances (Academic press).
10. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
11. Pharmaceutical Analysis Vol. II, A. V. Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More -Nirali Publication.
12. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.).
13. Merck Index.
14. Pharmaceutical Drug analysis by Ashutosh Kar.
15. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
16. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
17. Meites-Hand book of Analytical Chemistry (McGraw Hill).
18. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
19. Instrumental methods of Chemical Analysis by B. K. Sharma, 13<sup>th</sup> Edition.
20. Spectrometric Identification of Organic Compounds by Silverstein/Webster, 6<sup>th</sup> Edition.
21. Quantitative Analysis of Drug in Pharmaceutical Formulations by P.D. Sethi, 3<sup>rd</sup> Edition

### 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.
2. Miller L. P. Phytochemistry, 1-3 Van Nostrand Reinhold Co.
3. Nadkarni A. K. Indian Materia Medica, 1-2, Popular Prakashan Pvt. Ltd. Bombay.
4. Official methods of analysis, Association of official analytical chemists publications, Washington.
5. Peach K, and Tracey M. V., Modern methods of plant analysis, 1-4, Narosa Publishing house, New Delhi.
6. Pharmacopoeia of India, 1985, 1996, Govt. of India, Ministry of Health and Family Welfare.
7. Pridham J. B. and Swain T., Biosynthetic Pathways in Higher Plants, Academic Press, New York.
8. Pridham J. B. Terpenoids in Plants, Academic Press, New York.
9. Reinert J and Bajaj P. S. Applied and Fundamental aspects of plant cell tissue and organ culture, Berlin.
10. Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York.
11. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
12. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.

## Semester - VII

Sub Code	Subject	Hours / Week	Maximum marks
4.7.1	<a href="#">Biopharmaceutics &amp; Pharmacokinetics</a>	3	50
4.7.2	<a href="#">Medicinal Chemistry - III</a>	3	50
4.7.3	<a href="#">Pharmaceutical Analysis - IV</a>	3	50
4.7.4	<a href="#">Pharmacology - IV</a>	3	50
4.7.5	<a href="#">Pharmacognosy &amp; Phytochemistry - IV</a>	3	50
4.7.6	<a href="#">Elective</a> *	2	50
	<b>Total</b>	<b>17</b>	<b>300</b>
<b>Practical</b>			
4.7.7	<a href="#">Biopharmaceutics &amp; Pharmacokinetics. (Practical)</a>	3	50
4.7.8	<a href="#">Medicinal Chemistry - III (Practical)</a>	3+3	50
4.7.9	<a href="#">Pharmaceutical Analysis - IV (Practical)</a>	3	50
4.7.10	<a href="#">Pharmacology - IV (Practical)</a>	3	50
4.7.11	<a href="#">Pharmacognosy &amp; Phytochemistry - IV (Practical)</a>	3	50
	<b>Total</b>	<b>18</b>	<b>250</b>

### \* 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.)
		Hrs	Marks
1.	Plasma concentration and therapeutic response. An introduction to pharmacodynamics.	03	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	04	05 - 09
3.	Absorption: Factors affecting bioavailability, modified ph-partition theory or effect of unstirred water layer, dissolution rate and methods of enhancing dissolution rates. Official and unofficial methods of estimation of dissolution/in-vitro release of drugs from dosage forms. In-vitro in-vivo correlation and its significance. 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.	10	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.	04	05 - 09
5.	Elimination: Organ clearance concepts, hepatic clearance, hepatic extraction ratio, blood flow limitation in hepatic clearance, first pass effect. Clinical applications: effect of enzyme induction, enzyme inhibition, blood flow and protein binding on hepatic clearance, bioavailability, steady state plasma concentration and dosage regimens renal clearance and mechanisms of renal excretion, estimation of renal clearance, factors affecting renal elimination: clinical applications. Biliary clearance, enterohepatic cycling and other miscellaneous modes of drug elimination.	04	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.	03	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	08	05 - 10

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:**

1. Wagner, J.G. Biopharmaceutics and Relevant Pharmacokinetics, Drug Intelligence Pub. Hamilton.
2. Swarbrick, J: Current Concepts in the Pharmaceutical Sciences: Biopharmaceutics. Lea and Febiger, Philadelphia.
3. Wagner, J.G., Fundamentals of Clinical Pharmacokinetics. Drug Intelligence Publications, Hamilton.
4. Swarbrick, J: Current Concepts in the Pharmaceutical Sciences: Dosage Form Design and Bioavailability. Lea & Febiger, Philadelphia.
5. Gibaldi, M: Biopharmaceutics and Clinical Pharmacokinetics. Lea & Febiger, Philadelphia.
6. Rowland, M, and Tozer, T. N. Clinical pharmacokinetic: Concepts and Applications. Lea & Febiger, Philadelphia.
7. Notari, R.E., Biopharmaceutics and Clinical Pharmacokinetics, Marcel Dekker.
8. Gibaldi, M and Perrier, D: 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 - Brahmanekar
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:		
<ul style="list-style-type: none"> <li>• Introduction to the rational development (if any)</li> <li>• Mechanism of action</li> <li>• Synthesis of compounds with asterisk</li> <li>• Structure-activity relationship</li> <li>• Generic names</li> <li>• Chemical nomenclature</li> <li>• Detailed classification of each class</li> <li>• Metabolism</li> <li>• Uses</li> </ul>		
1. <i>Drugs Acting on Central Nervous System</i>	05	05 - 07
<b>a. Hypnotics and Sedatives :</b> Chloral hydrate, Ethinamate, Glutethimide*, Phenobarbital, Talbutal, Pentobarbital*, Secobarbital, Hexobarbital, Nitrazepam, Bromazepam, Temazepam.		
<b>1. Drugs acting as anticonvulsants:</b> Phenytoin*, Mephentoin, Trimethadione, Clonazepam, Phensuximide*, Ethosuximide, Phenacimide, Phenobarbital*, Mephobarbital (Classification of barbiturates) Metharbital, Carbamazepine, Sodium Valproate	05	04 - 06
<b>2. Psychotherapeutic Agents :</b> Phenothiazines such as Chlorpromazine*, Triflupromazine, Fluphenazine, Carphenazine, Chlorprothixene, Thioridazine, Fluplenthixol, Haloperidol*, Chlordiazepoxide, Flurazepam, Oxazepam, diazepam*, Meprobamate*, Imipramine, Desipramine, Amitriptyline, Nortriptyline, Doxepin, Phenelzine, Tranlycypromine, Pargyline, Fluoxetine, Loxapine.	05	04 - 06
<b>3. CNS Stimulants :</b> Phenmetrazine, Phendimetrazide, Fenfluramine, Methyl Phenidate, Nikethamide*, Iproniazide, Picrotoximes, Tetrazole and Hydrazine derivatives Amphetamine*, Methamphetamine.	02	03 - 05
<b>4. Drugs used in Parkinsonism :</b> Benzotropine mesylate, procylidine, orphendine, hydrochloride, Ethopropazine, levodopa, Carbidopa*, Benserazide, Amantadine*.	02	03 - 05

<b>5. Drugs for Alzheimer's Diseases :</b>	01	03 - 05
Tacrine, Velnacrine, Aniracetam, Sibopiridine		
<b>6. General Anesthetics:</b>	02	03 - 05
Ether, Nitrous Oxide, Halothane, ultra short acting Barbiturates		
<b>2. CHEMOTHERAPY</b>	04	05 - 07
<b>a. Anti Virals:</b>		
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		
<b>b. Sulfonamides:</b> Importance of pKa in designing good Sulfonamides, Short, Intermediate & Long acting Sulphonamides, Sulphonamides for Ophthalmic Infections, Burn Therapy & Ulcerative colitis, Synergism with DHFR Inhibitors. Synthesis of Sulfacetamide*, Sulphapyridine*, Sulphaguanidine*, Sulphanilamide*.	04	04 - 06
<b>3. Vitamins and Related Compounds</b>	05	06 - 08
Water soluble & lipid soluble vitamins		

#### Reference Books:

- Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
- Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
- Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
- The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols 1-6.
- Profiles in Drug Synthesis : V.N. Gogte
- Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
- Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
- Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
- Text Book of Practical Organic Chemistry - A.I. Vogels
- Practical Organic Chemistry - Mann and Sanders
- Systematic Identification of Organic Composition, Shriner and Fuson





**4.7.3 Pharmaceutical Analysis - IV****Theory (3 hrs/wk.)**

	<b>Hrs</b>	<b>Marks</b>
<b>1. Quality Assurance:</b> Organization and responsibilities of QC, QA and TQM: Documentation, introduction to concept of ISO, ICH and GLP. Validation of analytical method.	04	03 - 05
<b>2. Chromatography :</b> Terminology used in different chromatographic techniques. Classification of chromatographic techniques. Development of chromatogram in different techniques.	04	03 - 05
<b>Planer chromatography:</b>	05	04 - 06
<b>Paper chromatography:</b> Theory, method of development, detection techniques and applications.		
<b>Thin-layer chromatography:</b> Theory, selection of adsorbent, preparation of the plate, spotting, development of chromatogram, detection of compound, recovery of components, Quantitative measurements and applications.	06	06 - 08
<b>HPTLC:</b> Introduction, theory and applications.	03	03 - 05
<b>Column chromatography:</b> Introduction, theory and applications.	03	03 - 05
<b>Gas chromatography:</b> Theory, instrumentation, detectors, applications and introduction to GC-MS.	06	06 - 08
<b>HPLC:</b> Theory, instrumentation (pumps, detectors and columns), applications.	07	06 - 08
<b>Ion-exchange chromatography:</b> Theory / Principle, instrumentation and applications.	03	03 - 05
<b>Gel permeation chromatography:</b> Theory /Principle, instrumentation and applications.	03	03 - 05

## Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II.,
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. II, A.V.Kasture, S.G.Wadhodkar, K.R. Mahadik, H.N. More – Nirali Publication.
11. Juran- Quality Control Handbook- McGraw Hill.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth)
14. OPPI- Quality Assurance Guide.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
16. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
18. Meites-Hand book of Analytical Chemistry (McGraw Hill).
19. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
20. Instrumental methods of Chemical Analysis by B.K.Sharma, 13<sup>th</sup> Edition.
21. Spectrometric Identification of Organic Compounds by Silverstein/Webster, 6<sup>th</sup> Edition.
22. Quantitative Analysis of Drug in Pharmaceutical Formulations by P.D. Sethi, 3<sup>rd</sup> Edition.
23. Haftmann- Chromatography (McGraw Hill).
24. Browning- Chromatography (McGraw Hill).
25. Lamprecht- Implementing ISO 9000 Series (Dekker).
26. Pharmaceutical Process Validation by Nash (Dekker).

4.7.4 Pharmacology - IV	Theory	(3 hrs/wk.)
	Hrs	Marks
<p><b>1. Central Nervous System:</b></p> <p>General Considerations- Neuro humoral transmission in the CNS</p> <p>General Anesthetics- phases of anaesthesia.</p> <p>Local Anesthetics</p> <p>Sedative &amp; Hypnotics, Antianxiety agents. Alcohol</p> <p>Anti-epileptic drugs-types of epilepsy, mechanism.</p> <p>Psychopharmacological agents- disorders of psychology-psychosis, neurosis (Anti-psychotic), Anti-depressants-theory of depression , Anti-maniacs, and hallucinogens</p> <p>Analgesic, Antipyretic &amp; Anti-inflammatory agents</p> <p>Anti-gout agents.</p> <p>Opioids analgesics and their antagonists- pain and nociception, types of pains, endogenous pain inhibiting system.</p> <p>Central Nervous system Stimulants.</p> <p>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.)</p>	18	20 - 26
<p><b>2. Respiratory disorders:</b></p> <p>Drugs for Cough, COPD and Bronchial asthma.</p> <p>(Pathophysiology of cough, tonsillitis, emphysema, bronchitis, lung abscess, pneumonia, pulmonary embolism.)</p>	5	06- 12
<p><b>3. Gastrointestinal disorders and pharmacotherapy:</b></p> <ul style="list-style-type: none"> <li>• Gastric acidity and Peptic ulcer</li> </ul> <p>Irritable bowel syndroms - Ulcerative colitis, Crohn's disease, Achalasia, Harnia, Oesophagitis, Gastritis.</p> <ul style="list-style-type: none"> <li>• Constipation.</li> <li>• Diarrhoea</li> <li>• Emesis</li> <li>• Flatulence</li> </ul> <p>Liver disorders - Cirrhosis, Hepatitis.</p> <p>(Terminological introduction to various other disorders likes Pancreatitis, Gastro-oesophageal reflux disease, Portal hypertension, Cholelithiasis, Cholecystitis, Hepatic encephalopathy, asities, Gall stone formation)</p>	13	14 - 20

## Reference Books:

1. General Pathology – Y.M. Bhende, S, G. Deodhare, S.S. Kelkar (Popular Prakashan).
2. Essential Pathology – Emanuel Rubin, John L., Farber J.B. Lippincott company.
3. Text book of Robbins Pathology Basis of Disease – Robbins, Cotran, Kumar, Prism Indian Edition
4. Pocket comparison to Robbins Pathologic Basis of Disease, 5<sup>th</sup> Edition - Robbins, Cotran, Kumar, Prism Indian Edition.
5. Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T.W.Rall, AIS, Nies, P.Taylor, Pergamon Press, 2000.
6. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
7. M.P.Rang, M.M.Dale, J.M.Riter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
8. Modern Pharmacology, C.R.Craig and R.E.Stitzel, Little Brown and Company, 1994.
9. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
10. Mycek MJ, Harvey RA and Champe PC, Lippincott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lippincott Williams & Wilkins, 1997.
11. Barar F.S.K., Test book of Pharmacology, Interprint, New Delhi.
12. Lawrence, D.R. and Bennet P.N. Clinical Pharmacology, Scientific Book agency, Calcutta.
13. P.S.R.K. Haranath, Synopsis of Pharmacology, 1995, Bombay.
14. Clinical Pharmacy and Therapeutics, Herfindal E.T., and Hirschman J.L. Williams and Wilkings.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
16. Pharmacotherapy: A Pathophysiological approach, Dipiro, J.L. Elsevier.3
17. Tripathi KD: Essentials of Medical Pharmacology. 2001, 4<sup>th</sup> Edition, Jaypee Brothers, New Delhi.
18. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
19. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi

**4.7.5 Pharmacognosy and Phytochemistry - IV****Theory (3 hrs/wk.)**

	<b>Hrs.</b>	<b>Marks</b>
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	17	16 - 22
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	05	05 - 08
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	03	04 - 06
4. Natural allergens and photosensitizing agents and fungal toxins	03	04 - 06
5. Herbs as health food	03	04 - 06
6. Herbal cosmetics	03	04 - 06
7. Plant bitters and sweeteners.	02	03 - 05

### Reference Books:

1. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
2. Miller L. P. *Phytochemistry*, 1-3 Van Nostrand Reinhold Co.
3. Nadkarni A. K. *Indian Materia Medica*, 1-2, Popular Prakashan Pvt. Ltd. Bombay.
4. *Official methods of analysis*, Association of official analytical chemist publications, Washington.
5. Peach K, and Tracey M. V., *Modern methods of plant analysis*, 1-4, Narosa Publishing house, New Delhi.
6. *Pharmacopoeia of India*, 1985, 1996, Govt. of India, Ministry of Health and Family Welfare.
7. Pridham J. B. and Swain T., *Biosynthetic Pathways in Higher Plants*, Academic Press, New York.
8. Pridham J. B. *Terpenoids in Plants*, Academic Press, New York.
9. Reinert J and Bajaj P. S. *Applied and Fundamental aspects of plant cell tissue and organ culture*, Berlin.
10. Robinson, T., *The biochemistry of alkaloids*, Springer- Verlag, New York.

#### 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

	Hrs	Marks
1. Introduction to Pharmaceutical marketing	2	02 - 03
2. Influence of Pharmaceutical Technology on marketing new drugs & Optimizing therapeutic outcomes	3	03 - 05
3. Marketing of medicines for self medication	3	04 - 06
4. Retail pharmacist as a marketing target	2	04 - 06
5. Drug distribution channels & Practices	4	08 - 10
6. Advertising & Sales Promotion	3	06 - 08
7. Market Research & Sales Forecasting	3	07 - 10
8. International marketing	2	03 - 05
9. Industrial marketing	3	03 - 05

#### REFERENCE BOOKS:

1. Salesmanship, Sales management and advertisement - M. Satyanarayana
2. Business organization and management - M. C. Shukla
3. Principles of Pharmaceutical marketing. - Smith.
4. Modern marketing - Hapnar
5. Personal management



## 2. Medicinal Plant Biotechnology

		<b>Hrs</b>	<b>Marks</b>
1.	Introduction & Historical Perspective: Historical Background of Biotechnology and introduction to Medicinal Plant Biotechnology	02	02 – 03
2.	Enzymes: Introduction, mechanism of action, factors affecting action, classification, types of inhibition, isolation techniques, Immobilization of enzymes, Application of enzymes to plant biotechnology	03	05 – 07
3.	Fermentation Technology: Fermentation techniques, types, working of terminators, application of fermentation techniques to biotechnology, industrial production of Vitamins	03	06 – 09
4.	Plant Cell & Tissue culture: Introduction, cell culture techniques, cellular totipotency, Laboratory Organisation & Media, application to plant biotechnology	05	10 – 12
5.	Introduction to genetics: Genetics As Applied to Medicinal Herbs, Mutation, Polyploidy, Chemical races, Artificial Mutations, Hybridization, genetic engineering of plants.	03	06 – 09
6.	Recombinant DNA Technology: Introduction, transgenic plants, recombinant DNA techniques (Gene Splicing)	04	06 – 09
7.	Drug Delivery in Gene Therapy: Gene Transfer, objectives of gene therapy, diseases & gene therapy	04	05 – 09

### Reference Books:

1. Casida L. E., Industrial Microbiology, 2000, New Age International, Delhi.
2. De Kalyan Kumar, Plant Tissue Culture, 1<sup>st</sup> Edition, 1997, New Central Book Agency (P) Ltd.
3. Freifelder David, Molecular Biology, 2<sup>nd</sup> Edition, 1998, Narosa Publishing House.
4. J. I. Disouza, Killedar S. G., Biotechnology and Fermentation Process, Nirali Prakashan
5. Gennaro A. R., Remington-the Science and Practice of Pharmacy, 20<sup>th</sup> Edition, 2002, Lippincott Williams and Wilkins, New York.
6. Gupta P. K., Elements of Biotechnology, 1<sup>st</sup> Edition, 2001, Rastogi Pub., Meerut.
7. Higgins, Best D.J. and Jones J., Biotechnology: Principles and Applications, Blackwell Scientific Publications, Boston, MA 1985.
8. Kumar H. D., Textbook of Biotechnology, 2<sup>nd</sup> Edition, 1991, Affiliated East West Press Pvt. Ltd., New Delhi.
9. Patel A. H., Industrial Microbiology, 1984, Macmillan Ltd., Delhi.
10. Razdan M. K., An Introduction to Plant Tissue Culture, 1993, Oxford IBH Pub., New Delhi.
11. Reed Gerald, Prescott Dunn's Industrial Microbiology, 4<sup>th</sup> Edition, 1987, CBS Publishers and

Distributors, Delhi.

12. Singh B. D., *Biotechnology*, 2001, Kalyani Publisher.
13. Stanbury P. F., Whitekar A. and Hall S. J., *Principles of Fermentation Technology*, 2<sup>nd</sup> Edition, 1997, Aditya Books (P) Ltd., New Delhi.
14. Trevan Keshav, *Biotechnology*, 4<sup>th</sup> Edition, 1990, New Age International Ltd. Pub., New Delhi.
15. Vyas, S. P., Dixit V. K., *Pharmaceutical Biotechnology*, 1<sup>st</sup> Edition, 1999, CBS Publishers and Distributors, Delhi.

### 3. Quality assurance

	<b>Hrs</b>	<b>Marks</b>
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.
3. J.R. Berry and R.A. Nash, Pharmaceutical process validation. Marcel and Dekker.
4. S.H. Will and J.R. Stoker, good manufacturing Practices for Pharmaceutics Marcel Dekker.
5. R.F. Brewer, Design of experiments for process improvement and quality Assurance Narrosa.
6. B. Othery. ISO 14000 and ISO 9000 Gower.
7. D.H. Stamatis, Understanding ISO 9000 and implementing the basics to quality; Marcel Dekker.
8. Pharmaceutical Quality Assurance – Prof. M.A. Potdar – Nirali Prakashan
9. Chronicle Pharmabiz
10. Pharmapulse
11. Pharmaceutical product development – N. K. Jain – CBS Publications.

#### 4. Drug Design and lead Identification

		<b>Hrs</b>	<b>Marks</b>
1.	Receptor: Introduction to receptors, Types of receptors with example, Receptor theories, Drug receptor interactions, Design of agonist and antagonist with example.	06	08 - 12
2.	QSAR: QSAR parameters, QSAR models-General concept, Applications and limitations of QSAR in drug design	08	12 - 15
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.	08	12 - 15
4.	Molecular modeling & drug design: General concept, Introduction to molecular mechanics and quantum mechanics, Concept of known and unknown receptor	06	08 - 12

#### References:

1. Ariens - drug design Vol. - II.
2. Annual Reports in medicinal chemistry (Academic press Inc.)
3. Smith - William - Introduction to the principles of drug design.
4. Woodridge - Progress in pharmaceutical Research.
5. Medicinal Chemistry - Monographs series (Academic Press).
6. Burgers - Medicinal Chemistry & Drug Discovery

## 5. Bioavailability and TDM

	<b>Hrs</b>	<b>Marks</b>
<b>1. Bioavailability &amp; Bioequivalence:</b>	06	10 - 15
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.		
<b>2. INTRODUCTION TO THERAPEUTIC DRUG MONITORING</b>	04	08 - 10
Definition & introduction.		
Indication for TDM & clinical applications.		
Monitoring plasma drug levels.		
Role of Clinical pharmacist in TDM.		
<b>3. TECHNIQUES USED IN TDM</b>	07	11 - 15
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.		
<b>4. TDM OF SPECIFIC DRUGS</b>	07	11 - 15
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	4. Lithium	7. Phenobarbitone
2. Gentamicin.	5. Theophylline	8. Carbamazepine
3. Lidocaine	6. Phenytoin	9. Valproic acid

**References:**

1. Clinical pharmacy practice - C. W. Blissit.
2. Therapeutic drug monitoring - B. Widdop
3. TDM & Clinical biochemistry - Mike Hallworth
4. Textbook of therapeutics, Drug & disease management - 7<sup>th</sup> edition - Eric T. Herfindel, Dick. R. Gourley.
5. Recent developments in TDM & Clinical toxicology - I. Sunshine - Marcel - Dekker - 1992.
6. Handbook of TDM. - Simkin
7. TDM - Abbot

## 6. Cosmeceutics

	<b>Hrs</b>	<b>Marks</b>
1. <b>Physiological Consideration:</b> Skin, hair, nail and eye- in relation to cosmetic application.	03	04 – 06
2. <b>Rheology of cosmetics:</b> Rheological additives in cosmetics, rheology of nail products, antiperspirants, deodorants, hair products, creams and lotions.	02	03 – 05
3. <b>Manufacturing techniques:</b> Cosmetics creams, powders, compacts, sticks, liquids, foam and aerosol cosmetics.	07	15 – 20
4. <b>Evaluation of cosmetics: Performance,</b> Physicochemical, microbiological and psychometric evaluation of cosmetics. Design and Assessment of preservative systems for cosmetics, valuation of preservatives in cosmetic products and factors affecting activity of preservatives. Testing of moisturizers, deodorants, antiperspirants, sunscreens and anti-aging products.	05	08 – 12
5. <b>Clinical safety tasting :</b> Irritation, sensitization, photoirritation, photoallergy, ocular irritation and protocols for the same.	03	05 – 07
6. <b>Packaging :</b> Package development and design for cosmetics including aerosol packs.	02	05 – 07

### References:

1. J. Knowlton and S. Rearce; Handbook of Cosmetic Sciences and Technology Elsevier Science Publisher.
2. J. B. Wilkinson and R. J. Moore; Harry's cosmetology; Longman Science and Technical.
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.
9. C. G. Gebelein, T. C. Cheng and V. C. Yang; Cosmetic and Pharmaceutical applications of polymers; Plenum Press.
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

	<b>Hrs</b>	<b>Marks</b>
1. Introduction to Packaging Technology Importance/ need of packaging, ideal characters of packaging materials.	02	03 – 05
2. Packaging Materials used in Pharmacy Primary & secondary packages: Glass: Composition of glass, types, production of glass materials, defects in glass Plastic: comparison of plastic & glass, thermosetting & thermoplastics, polyethylene, polypropylene, PVC, Polystyrene, Nylon, Polycarbonate, acrylic multipolymers, polyethylene terphthalate, drug plastic considerations. Metals: Tin, Aluminium, Lead, Stainless Steel & others Rubber: Composition & types, Applications as closure.	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.	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.	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.	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 & hermetically sealed pharmaceutical containers, introduction to 'blow-fill-seal-technology'	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.)
3. E. A. Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
4. Swarbrick & Boyan - Encyclopedia of Pharm. Technol - Dekker
5. Handbook of packaging of medicinal devices - Dekker
6. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.
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.
2. Analysis of biological specifications for drug content and estimation of the pharmacokinetic parameter.
3. In vitro evaluation of different dosage forms for drug release.
4. Absorption studies- in-vitro and in- situ.
5. Statistical treatment of pharmaceutical data.

#### Reference Books:

1. Wagner, J.G. Biopharmaceutics and Relevant Pharmacokinetics, Drug Intelligence Pub. Hamilton.
2. Swarbrick, J: Current Concepts in the Pharmaceutical Sciences: Biopharmaceutics. Lea and Febiger, Philadelphia.
3. Wagner, J.G., Fundamentals of Clinical Pharmacokinetics. Drug Intelligence Publications, Hamilton.
4. Swarbrick, J: Current Concepts in the Pharmaceutical Sciences: Dosage Form Design and Bioavailability. Lea & Febiger, Philadelphia.
5. Gibaldi, M: Biopharmaceutics and Clinical Pharmacokinetics. Lea & Febiger, Philadelphia.
6. Rowland, M, and Tozer, T. N. Clinical pharmacokinetic: Concepts and Applications. Lea & Febiger, Philadelphia.
7. Notari, R.E., Biopharmaceutics and Clinical Pharmacokinetics, Marcel Dekker.
8. Gibaldi, M and Perrier, D: 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

#### 4.7.8 Medicinal Chemistry – III

Practical (6 hrs/wk.)

1. Laboratory scale preparation of the following compounds & characterization by TLC & IR
  - Sulphanilamide
  - Esters
  - Hydrazide
  - Chloramine – T
  - Benzotriazole
  - Paracetamol
  - Aspirin
  - Benzophenones
  - Phenytoin
  - Methyl orange

#### Reference Books:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
4. The Organic Chemistry of Drug Synthesis: Daniel Ledmicer, John Wiley and Sons. Inc. Vols 1-6.
5. Profiles in Drug Synthesis : V.N. Gogte
6. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
7. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
8. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
9. Text Book of Practical Organic Chemistry – A.I. Vogel
10. Practical Organic Chemistry – Mann and Sanders
11. Systematic identification of Organic Composition, Shriner and Fuson

#### 4.7.9 Pharmaceutical Analysis – IV

Practical (3 hrs/wk.)

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.
4. Chromatographic analysis of Pharmaceutical formulations from following classes-Tablets, Capsule, Injectables, Liquid orals, Eye ointments.
5. Column chromatographic separations of two component mixtures.

#### Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II.,
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. II, A.V.Kasture, S.G.Wadhodkar, K.R. Mahadik, H.N. More – Nirali Publication.
11. Juran- Quality Control Handbook- McGraw Hill.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth)
14. OPPI- Quality Assurance Guide.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
16. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
18. Meites-Hand book of Analytical Chemistry (McGraw Hill).
19. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
20. Instrumental methods of Chemical Analysis by B.K.Sharma, 13<sup>th</sup> Edition.
21. Spectrometric Identification of Organic Compounds by Silverstein/Webster, 6<sup>th</sup> Edition.
22. Quantitative Analysis of Drug in Pharmaceutical Formulations by P.D. Sethi, 3<sup>rd</sup> Edition.
24. Browning- Chromatography (McGraw Hill).
25. Lamprecht- Implementing ISO 9000 Series (Dekker).
26. 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:

1. Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T.W.Rall, AIS, Nies, P.Taylor, Pergamon Press, 2000.
2. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
3. M.P.Rang, M.M.Dale, J.M.Riter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
4. Modern Pharmacology, C.R.Craig and R.E.Stitzel, Little Brown and Company, 1994.
5. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
6. Mycek MJ, Harvey RA and Champe PC, Lipponcott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lipponcott Williams & Wilkins, 1997.
7. Barar F.S.K., Test book of Pharmacology, Interprint, New Delhi.

#### 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.
2. Miller L. P. Phytochemistry, 1-3 Van Nostrand Reinhold Co.
3. Nadkarni A. K. Indian Materia Medica, 1-2, Popular Prakashan Pvt. Ltd. Bombay.
4. Official methods of analysis, Association of official analytical chemists publications, Washington.
5. Peach K, and Tracey M. V., Modern methods of plant analysis, 1-4, Narosa Publishing house, New Delhi.
6. Pharmacopoeia of India, 1985, 1996, Govt. of India, Ministry of Health and Family Welfare.
7. Pridham J. B. and Swain T., Biosynthetic Pathways in Higher Plants, Academic Press, New York.
8. Pridham J. B. Terpenoids in Plants, Academic Press, New York.
9. Reinert J and Bajaj P. S. Applied and Fundamental aspects of plant cell tissue and organ culture, Berlin.
10. Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York.

**Semester - VIII**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
4.8.1	<a href="#">Pharmaceutical Technology - III</a>	3	50
4.8.2	<a href="#">Pharmaceutical Jurisprudence</a>	3	50
4.8.3	<a href="#">Pharmaceutical Industrial Management</a>	3	50
4.8.4	<a href="#">Medicinal Chemistry - IV</a>	3	50
4.8.5	<a href="#">Pharmacology - V</a>	4	50
	<b>Total</b>	<b>16</b>	<b>250</b>
<b>Practical</b>			
4.8.6	<a href="#">Pharmaceutical Technology - III (Practical)</a>	3	50
4.8.7	<a href="#">Medicinal Chemistry - IV (Practical)</a>	3+3	50
4.8.8	<a href="#">Pharmacology - V (Practical)</a>	3	50
4.8.9	<a href="#">Project work.</a>	3	50
	<b>Total</b>	<b>15</b>	<b>200</b>



4.8.1 Pharmaceutical Technology - III		Theory	(3 hrs/wk.)	
		Hrs	Marks	
1.	Sterile delivery system: Introduction and concepts.	03	03 - 06	
2.	Parenteral drug delivery system: <ul style="list-style-type: none"> <li>• General requirements</li> <li>• 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.</li> <li>• 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).</li> <li>• 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.</li> <li>• 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.</li> <li>• Processing of parenteral products by terminal sterilization, filtration sterilization followed by aseptic filling and by aseptic compounding. Validation of sterilization and process validation.</li> <li>• Quality control and quality assurance.</li> <li>• Factory layout: different departments, services and utilities</li> </ul>	15	12 - 18	
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	7	09 - 12	
4.	Biological Pharmaceuticals <ul style="list-style-type: none"> <li>• Blood Products: Whole human blood, blood products and plasma substitutes and its quality control.</li> <li>• 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.</li> <li>• Surgical Products: Definition, primary wound dressing, absorbents, surgical cotton, surgical gauzes etc. bandages, absorbable and</li> </ul>	7	08 - 12	

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). | 4  | 05 - 09 |
| 5. | Pilot plant scale up technique<br>Groups responsibilities - facilities - example of scaling up  | 02 | 03 - 06 |

### 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)
7. Pharmaceutical Microbiology- Hugo and Roussel - (McGraw Hill)
8. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
9. Hanlon - H.B. of package Engg. - (McGraw Hill)
10. Swarbrick & Boylan - Encyclopedia of Pharm. Technology. - (Dekker)
11. Remington's Pharmaceutical Sciences. (Mack)

#### 4.8.2 Pharmaceutical Jurisprudence

Theory (3 hrs/wk.)

	Hrs	Marks
1. Pharmacy Act 1948:	08	08 - 12
2. Drugs and Cosmetics Act 1940/Rules 1945 : 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.	12	10 - 15
3. Narcotic Drugs and Psychotropic Substances Act 1985: Historical background of Opium Act and Dangerous Drugs Act. Prohibitions and penalties.	04	05 - 08
4. Drugs and Magic Remedies Act 1954: Definitions, Official's duties, Prohibitions, Penalties etc.	02	03 - 05
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.	04	05 - 08
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.	03	03 - 06
7. Prevention of Cruelty to Animals Act-CPSEA rules.	03	03 - 05
8. Code of Pharmaceutical Ethics	02	03 - 05

**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
6. Bare Acts.
7. Handbook of Drug Laws - M. L. Mehta

<b>4.8.3 Pharmaceutical Industrial Management</b>		<b>Theory</b>	<b>(3 hrs/wk.)</b>
		<b>Hrs</b>	<b>Marks</b>
1.	Global Market (Import – Export): 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	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.	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	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.	05	06 – 08
5.	Production Planning and Control systems:	03	03 – 05
6.	Materials Management systems: Purchase and Inventory Control, Material Handling.	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.	05	06 – 08
8.	Analyzing Marketing Opportunities: Market measurement and sales forecasting, Market segmentation, Market targeting. Planning marketing programmes, Role of product manager, New product launch and development, Product life cycle, Planning marketing tactics, National drug policy, Product, Brand and Packing. Marketing channel decisions, Wholesalers, Retailers.	05	04 – 06
9.	Interviewing techniques	03	03 – 05
10.	Community Pharmacy Practice	02	03 – 05
11.	Sales Management	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 - Mukhopadhyaya
7. Marketing Management - Philip Kotlor
8. Pharmaceutical Marketing in India - SVR Subha Rao
9. Patenting - N.R.Subbram [Pharma book syndicate]

4.8.4	<b>Medicinal Chemistry - IV</b>	<b>Theory</b>	<b>(3 hrs/wk.)</b>
		<b>Hrs</b>	<b>Marks</b>
1.	<b>Introduction to QSAR</b> Statistical prediction & pharmacological activity - partition coefficient, QSAR models, steric factors, molecular modeling (CADD) Hansch equation.	05	06 - 08
2.	<b>Introduction to Prodrugs and orphan drugs</b> The following classes of drugs should be discussed in relation to: <ol style="list-style-type: none"> <li>a. Introduction to the rational development (if any)</li> <li>b. Mechanism of action</li> <li>c. Synthesis of compounds with asterisk</li> <li>d. Structure-activity relationship</li> <li>e. Generic names</li> <li>f. Chemical nomenclature</li> <li>g. Detailed Classification of each class</li> <li>h. Uses</li> </ol>	04	05 - 07
3.	<b>Analgesics, Antipyretics and Anti-inflammatory agents:</b> Aspirin*, Acetaminophen*, Phenylbutazone*, Oxyphenbutazone, Ibuprofen, Sulindac, Naproxen*, Probenecid, Allopurinol, Ketoprofen, Diclofenac, Oxicams like piroxicam, Nimesulide, Fenamates.  <b>Narcotic Analgesic Agents :</b> Morphine, Oripavine, Codeine, ethylmorphine, dihydrocodeine*, Metopon, Levarphanol, Dextromethorphan, Meperidine*, anilaridine, Methadone*, meperidine, dextropropoxyphene and pentazocine.  <b>Non-narcotic analgesic agents :</b> Dextropropoxyphene* and Ethoheptazine, Morphine antagonists, n-allyl-nor morphine levallorphan, naloxone.	08	09 - 14

4.	<b>Steroids :</b> 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, Mestramol, chlorotrainisene, Estrone, Dienesterol, Diethylstilbesterol and other non-steroidal estrogens Progestational agents: Progesterone, Norethindrone, Norgestrel, Dimethisterone. Oral contraceptives	08	08 -11
5.	<b>Antihistaminics, Antiemetics and antiulcer drugs:</b> Metoclopramide, Diphenhydramine*, Doxylamine, Triprolidine, chlorpheniramine, Antazoline, Cyproheptadine, Terfenadine, Cimetidine, Omeprazole*, Lansoprazole, Ranitidine*, Famotidine, Ondansetron, Tripeleminast*.	04	04 - 06
6.	<b>Thyroid Function and Thyroid Drugs:</b> Thyroid Hormone, Methimazole, Propyl Thiouracil, Thyroid Analogs.	04	04 - 07
7.	<b>Oral Hypoglycemics:</b> Sulfonylureas-Tolbutamide*, Glimpiride*, Biguanides- Metformin, Thiazolidinediones- Ciglitazone, Rosiglitazone, Acarbose, Repaglinide.	03	04 - 07

#### Reference Books:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
4. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
5. The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols 1-6.
6. Profiles in Drug Synthesis : V.N. Gogte
7. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
8. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
9. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
10. Text Book of Practical Organic Chemistry - A.I. Vogel
11. Practical Organic Chemistry - Mann and Sanders



12. Systematic Identification of Organic Composition, Shriner and Fuson

4.8.5 Pharmacology - V		Theory	(4 hrs/wk.)
		Hrs	Marks
1.	Drugs used in the disorders of eye, skin & ENT	06	06 - 08
	a) Ocular pharmacology -Glaucoma, keratitis, conjunctivitis, loss of vision, cataract, Squint. (Pharmacotherapy of Glaucoma)		
	b) ENT -Acute epiglottitis, allergic rhinitis, otitis externa, otitis media, wax (cerumen), vertigo, meneiers 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.	03	02 - 03
3.	Pathophysiology of blood disorders and drugs acting on hemopoietic system - Coagulants and anti-coagulants. Haemopoietics. Thrombolytics and antiplatelet agents.	06	03 - 04
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.	10	05 - 07
5.	Adverse drug reactions - types, reporting and monitoring.	03	03 - 04
6.	Drug interactions - Definitions of Drug-Drug, Drug-food interaction classification of Drug-Drug interaction. Basic concepts of mechanisms of drug - drug interactions.	03	05 - 07
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 i) Barbiturates ii) Alcohols iii) Benzodiazepines iv) Antidepressants v) Neuroleptics vi) Insecticides vii) Snake bite viii) Heavy metals (iron, lead, mercury, arsenic). Managements of poisonous patient.	07	05 - 07
8.	Introduction to TDM.	02	02 - 03
9.	<b>Bioassays:</b> Definition, Applications, Principles & Types of bioassays. Bioassay of Acetylcholine, d-TC, Histamine, Adrenaline, Digitalis, Heparin, Insulin.	06	06 - 10
10.	<b>Clinical trials</b>	02	03 - 04

## Schedule Y, ICH -GCP guidelines

### Reference Books:

- 1 Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T.W.Rall, AIS, Nies, P.Taylor, Pergamon Press, 2000.
2. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
3. M.P.Rang, M.M.Dale, J.M.Riter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
4. Modern Pharmacology, C.R.Craig and R.E.Stitzel, Little Brown and Company, 1994.
5. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
6. Mycek MJ, Harvey RA and Champe PC, Lipponcott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lipponcott Williams & Wilkins, 1997.
7. Barar F.S.K., Test book of Pharmacology, Interprint, New Delhi.
8. Lawrence, D.R. and Bennet P.N. Clinical Pharmacology, Scientific Book agency, Calcutta.
9. P.S.R.K. Haranath, Synopsis of Pharmacology, 1995, Bombay.
10. Clinical Pharmacy and Therapeutics, Herfindal E.T., and Hirschman J.L. Williams and Wilkings.
11. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
12. Pharmacotherapy: A Pathophysiological approach, Dipiro, J.L. Elsevier.3
13. Tripathi KD: Essentials of Medical Pharmacology. 2001, 4<sup>th</sup> Edition, Jaypee Brothers, New Delhi.
14. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
15. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi

#### 4.8.6 Pharmaceutical Technology - III

Practical (3 hrs/wk.)

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.)
9. Hanlon - H.B. of package Engg. - (McGraw Hill)
10. Swarbrick & Boylan - Encyclopedia of Pharm. Technology. - (Dekker)
11. Latest IP, BP, USP, Etc.

#### 4.8.7 Medicinal Chemistry - IV

Practical (6 hrs/wk.)

##### 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:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. J. B. Stenlake Vol. I & II: Foundations of Molecular Pharmacology - The Chemical basis of drug action (Athlone Press - The University of London).
4. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
5. The Organic Chemistry of Drug Synthesis: Daniel Ledmicer, John Wiley and Sons. Inc. Vols. 1-6.
6. Profiles in Drug Synthesis: V. N. Gogte
7. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
8. Textbook of Pharmaceutical Chemistry by Harkishan singh & Kapoor.
9. Textbook of Practical Organic Chemistry - A.I. Vogel; ELBS
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.
9. To carry out bioassay of oxytocin using isolated rat uterus preparation by interpolation method.

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

#### Reference Books:

1. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
2. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi.
3. Sheth, U. K. Dadkar, N. k. and Kamat, U. G. Selected Topics in Experimental pharmacology.
4. Perry, W. L. M. Pharmacological Experiments on Isolated preparations.

**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**

Semester	Pharmaceutical Chemistry		Pharmaceutics		Pharmacology		Pharmacognosy		Other allied subjects	
	Th	Practical	Th	Practical	Th	Practical	Th	Practical	Th	Prac.
Semester – I	07	6X3=18	06	6X3=18	03	3X3=09	--	--	--	--
Semester – II	08	6X3=18	03	3X3=09	03	3X3=09	03	3X3=09	--	--
Semester – III	03	3X3=09	07	7X3=21	--	--	03	3X3=09	02	3X3=09
Semester – IV	07	6X3=18	06	6X3=18	04	3X3=09	--	--	--	--
Semester – V	06	9X3=27	06	3X3=09	04	3X3=09	--	--	--	--
Semester – VI	06	6X3=18	06	6X3=18	03	--	03	3X3=09	--	--
Semester – VII	06	9X3=27	03	3X3=09	03	3X3=09	03	3X3=09	02	--
Semester – VIII	03	6X3=18	09	3X3=09	04	3X3=09	--	--	--	3X3=09
<b>Total</b>	46	153	46	111	24	54	12	36	04	18
Total / 2	23	77	23	56	12	27	06	18	02	09
<b>Total Workload</b>	<b>100</b>		<b>79</b>		<b>39</b>		<b>24</b>		<b>11</b>	



**Annual Workload Department wise**

Year	Pharmaceutical Chemistry		Pharmaceutics		Pharmacology		Pharmacognosy		Other allied subjects	
	Th	Practic	Th	Practi.	Th	Practi	Th	Practi.	Th.	Prac.
<b>B.Pharm I</b>	04+06 = 10	09 +18 =27	06+03 =09	18+09 =27	03+03 =06	09+09 =18	03+03 =06	09+09 =18		
<b>B.Pharm II</b>	08+07 = 15	18+18 =36	07+06 =13	21+18 =39	00+04 =04	00+09 =09	--	--	02+00 = 02	09+00 = 09
<b>B.Pharm III</b>	06+06 = 12	27+18 = 45	06+06 =12	09+18 =27	04+03 =07	09+00 =09	00+03 =03	00+09 =09		
<b>B.Pharm IV</b>	06+03 = 09	27+18 =45	03+09 =12	09+09 =18	03+04 =07	09+09 =18	03+00 =03	09+00 =09	02+00 = 02	00+09 = 09
<b>Total</b>	<b>46</b>	<b>153</b>	<b>46</b>	<b>111</b>	<b>24</b>	<b>54</b>	<b>12</b>	<b>36</b>	<b>04</b>	<b>18</b>
Total / 2	23	77	23	56	12	27	6	18	02	09
<b>Total Workload</b>	<b>100</b>		<b>79</b>		<b>39</b>		<b>24</b>		<b>11</b>	

## Semester - I

Sub Code	Subject	Hours / Week	Maximum marks
		Th	
1.1.1	<a href="#">Pharmaceutics</a>	3	50
1.1.2	<a href="#">Dispensing of Medication and Hospital Pharmacy</a>	3	50
1.1.3	<a href="#">Pharmaceutical Inorganic Chemistry</a>	4	50
1.1.4	<a href="#">Pharmaceutical Analysis - I</a>	3	50
1.1.5	<a href="#">Anatomy Physiology &amp; Health Education - I</a>	3	50
	<b>Total</b>	<b>16</b>	<b>250</b>
<b>Practical</b>			
1.1.6	<a href="#">Pharmaceutics (Practical)</a>	3	50
1.1.7	<a href="#">Dispensing of Medication and Hospital Pharmacy (Practical)</a>	3	50
1.1.8	<a href="#">Pharmaceutical Inorganic Chemistry (Practical)</a>	3	50
1.1.9	<a href="#">Pharmaceutical Analysis - I (Practical)</a>	3	50
1.1.10	<a href="#">Anatomy Physiology &amp; Health Education - I (Practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

1.1.1 Pharmaceutics	Theory	(3 Hrs/Wk)	
		Hrs	Marks
6. Introduction to pharmaceutics and its scope.		02	03 – 06
7. Pharmaceutical industry in India. Historical background and development of various dosage forms. Introduction to pharmacopoeia and other compendia (I.P., B.P., U.S.P., International Pharmacopoeia, European Pharmacopoeia). History, General Notices, Monographs		06	03 – 06
8. History of pharmaceutical education in India.		02	03 – 06
9. Introduction to dosage forms. Historical background and development of profession of pharmacy. Classification of dosage forms, advantages and disadvantages.		08	09 – 12
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		18	22 – 30

**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. Bentleys 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
21. Practical notebook on Pharmaceutics – A. Gupta and V. K. Jain, CBS Publication
22. Textbook of Professional Pharmacy – Jain and Sharma

**1.1.2 Dispensing of Medication and Hospital Pharmacy****Theory (3 Hrs/Wk)**

	<b>Hrs</b>	<b>Marks</b>
15. Definition and scope of dispensing and compounding of drug.	2	02 – 03
16. General dispensing procedures (to be covered in practical)	--	02 – 03
17. Imperial system of weights and measures (to be covered in practical)	--	02 – 05
18. Latin terms used in pharmacy (to be covered in practical)	3	03 – 05
19. Prescription and its parts: 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.	6	05 – 08
20. Pharmaceutical calculations: Percentage calculations, alligation methods, calculations involving isotonic solutions, proof spirit, posology, calculations of doses for infants and children, weights and measures.	5	03 – 06
21. Incompatibilities in prescriptions: Types of incompatibilities -physical, chemical and therapeutic. Study of various prescription examples involving the same.	8	06 – 09
22. Organization and structure of hospital pharmacy.	2	03 – 05
23. Hospitals -classification, functions, organization administration.	2	03 – 05
24. Hospital formulary.	1	02 – 03
25. Duties and responsibilities of hospital pharmacist.	1	02 – 03
26. Drug distribution system.	3	03 – 06
27. Drug information services.	2	02 – 03
28. Records and reports.	1	02 – 03

### 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, 12<sup>th</sup> Edi.
24. Hospital Pharmacy, Merchant and Quadry
25. Drug dosage calculations, A guide for clinical practice, by Geraldine Ann Medici, 2<sup>nd</sup> Edi.
26. Hospital and Clinical Pharmacy, by A. R. Paradkar and S. A. Chunawala, Nirali Prakashan
27. Hospital and Clinical Pharmacy, by P.C. Dandiya and Mukul Mathur
28. Hospital Pharmacy, by William Hassan jr. 5<sup>th</sup> Edi. Lea and Febiger.

1.1.3 Pharmaceutical Inorganic Chemistry		Theory	(4 Hrs/Wk)	
			Hrs	Marks
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.		06	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.		05	05 - 07
3	Major Intra & Extra cellular Electrolytes Physiological ions, Electrolytes used for replacement therapy, acid base balance, Combination therapy		08	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.		05	05 - 08
5	Topical Agents Protective, astringents, Anti-infective like talk, zinc oxide, calamine, hydrogen peroxide, potassium permanganate, iodine with their mechanism of action.		04	03 - 05
6	Gases & Vapors Oxygen, anesthetics, respiratory stimulants such as nitrogen oxide, carbon dioxide and helium.		04	04 - 06
7	Dental Products Dentifrices & Anti-carries agent like sodium fluoride, SnF <sub>2</sub> , concentrated fluorides and polishing agents, zinc chloride.		03	03 - 05
8	Complexing & Chelating agents , other antidotes Complexing agent - EDTA, penicillamine. Antidotes - cynide poisoning, sodium thiosulphate. Precipitation - copper sulphate, sodium phosphate and magnesium sulphate.		03	03 - 05

9	Sclerosing agents, Expectorants, Emetics such as ammonium chloride and Antioxidants sodium bisulphide, metabisulphide and sulphur dioxide.	03	03 - 05
10	Radiopharmaceuticals - Introduction, radioactivity, $\alpha$ $\beta$ $\gamma$ radio decay, radioisotopes and medicinal applications (examples carbon monoxide and iodine). Radio-opaque contrast media - Barium sulphate.	05	04 - 06

**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.
4. Text book of Pharmaceutical Chemistry, By Chatten L.G.(Dekker series)
5. Textbook of Pharmaceutical analysis By Connors K.A.
6. Text book of Pharmaceutical Analysis By Dr. H. N. More
7. Indian Pharmacopoeia
8. Remington's Pharmaceutical Sciences.

**1.1.4 Pharmaceutical Analysis - I****Theory (3 hr./wk)**

	<b>Hrs</b>	<b>Marks</b>
<b>1. Introduction:</b> 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.	03	03 - 06
<b>2. Aqueous Acid-Base titrations:</b> 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.	05	06 - 08
<b>3. Non-Aqueous titrations:</b> Types of solvents, end point detection, application in assay of Sodium acetate, Sodium benzoate, Norfloxacin tablet.	03	04 - 06
<b>4. Oxidation-Reduction titrations:</b> 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.	07	06 - 08
<b>5. Complexometric titrations:</b> 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.	05	05 - 08
<b>6. Argentometric titrations:</b> 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.	04	06 - 08



7.	Miscellaneous methods of analysis: Diazotisation titrations, Kjeldahl's method of nitrogen determination and Oxygen flask combustion method.	03	04 - 06
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.	06	06 - 10

### Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A. H. and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II, The Anthlone Press of University of London.
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. I & II, A.V.Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More – Nirali Publication.
11. Analytical Chemistry an introduction, Skoog/ West/ Holler, 6<sup>th</sup> Edition.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle-Wadsworth Pub. Co.).
15. Merck Index.
16. Pharmaceutical Drug analysis by Ashutosh Kar.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.

1.1.5 Anatomy Physiology & Health Education – I		Theory	(3 Hrs/Wk)
		Hrs	Marks
1.	Scope of Anatomy and Physiology, basic terminology used in this subject.	01	01 – 03
2.	Structure of cell – Its components and their functions	01	01 – 03
3.	<b>Elementary tissues of the human body:</b> <ul style="list-style-type: none"> <li>• Epithelial, connective, muscular and Nervous tissues – their subtypes and characteristics.</li> <li>• Contraction of skeletal muscle</li> <li>• Neuro muscular transmission</li> <li>• Contraction of smooth muscle</li> </ul>	02	03 – 05
4.	<b>Haemopoietic system</b> Composition and functions of blood. <ul style="list-style-type: none"> <li>• Haemopoiesis and disorders of blood &amp; its components, Disorders of Haemopoietic system).</li> <li>• RBC metabolism</li> <li>• Blood groups.</li> <li>• Clotting factors and mechanism. Platelets and disorders of coagulation.</li> </ul>	07	06 – 10
5.	<b>Lymph and Lymphatic system –</b> <ul style="list-style-type: none"> <li>• Composition, formation and circulation of lymph</li> <li>• Disorders of Lymph and lymphatic system (Definitions only)</li> <li>• Spleen: Physiology and function.</li> </ul>	02	01 – 03
6.	<b>Cardiovascular system –</b> <ul style="list-style-type: none"> <li>• Anatomy of heart</li> <li>• Physiology of cardiac muscle and heart</li> <li>• Conduction system of heart</li> <li>• Blood vessels and its disorders</li> <li>• Cardiac cycle and Heart Sounds,</li> <li>• ECG, Blood pressure and its regulation (short term and long term).</li> <li>• Definitions, types, etiology, and pathophysiology of the following disorders- Hypertension, Hypotension, Arteriosclerosis, Angina, Myocardial infarction, Congestive Heart failure and Cardiac arrhythmias.</li> </ul>	09	08 – 10

7. <b>Respiratory System</b>	04	04 – 05
<ul style="list-style-type: none"> <li>• Anatomy of respiratory organs and functions</li> <li>• Mechanism and regulation of Respiration</li> <li>• Physiology of respiration: transport of respiratory gases</li> <li>• Respiratory volumes and vital capacity</li> <li>• Disorders of respiratory tract like TB, COPD, asthma</li> </ul>		
8. <b>Digestive System</b>	04	05 – 06
<ul style="list-style-type: none"> <li>• Anatomy of Gastro Intestinal Tract (GIT)</li> <li>• Secretions functions and anatomy of Salivary glands, Pancreas, Stomach, Intestine, Liver</li> <li>• Physiological and biochemical aspects of digestion and absorption of food</li> <li>• Disorders of GIT</li> </ul>		
9. <b>Health Education-</b>	01	01 – 03
Definition of Health (Physical & Mental) and Health Education, objectives of Health Education.		
<b>Family Planning</b>	02	03 – 05
Principles underlying various family planning methods.		
<b>Nutrition:</b>	03	05 – 06
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 <b>Skeletal muscles</b>	02	02 – 03
4. Histology		
5. Physiology of muscle contraction		
6. Physiological properties of skeletal muscle performance (definition of the disorders)		

### Reference Books:

1. AB Mc Naught and Callander R., "Illustrated Physiology", B.I. Churchill Living Stone, New Delhi, 1<sup>st</sup> edition, 1987.
2. Anne Waugh and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", Churchill Living Stone, Edinburgh, 9<sup>th</sup> edition, 2002.
3. Arthur C. Guyton and John E. Hall, "Text book of Medical Physiology" W.B. Saunders company, 10<sup>th</sup> edition, 2000.
4. Bhise S.B. and Yadav "Human Anatomy and Physiology", Nirali Prakashan, Pune (India), 8<sup>th</sup> edition, 2000.
5. C.C. Chatterjee, "Human Physiology" (Vol. I & Vol. II), Medical Allied Agency, Calcutta, 11<sup>th</sup> edition, 1985.
6. Chaudhry Sujit K., "Consise Medical Physiology", New Central Book Agency, Calcutta, 2<sup>nd</sup> Edition, 1993.
7. De Gruchy`s Clinical Haematology, "Clinical Haematology in Medical Practice, Blackwell Science publishers, 5<sup>th</sup> Edition, 1989.
8. Douglas E., Kelly, Richard Wood and Allen C. Enders, "Bailey`s TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London, 18<sup>th</sup> Edition, 1984.
9. Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 4<sup>th</sup> edition, 1997.
10. Elaine N. Marieb, "Human Anatomy and Physiology", Benjamin / Cumings publishing company, 2<sup>nd</sup> edition, 1992.
11. Gerard J. Torotora, "Principles of Anatomy and Physiology", John-Wiley & sons New York, 10<sup>th</sup> edition, 2003.
12. Inderbir Singh, " Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, 4<sup>th</sup> edition, 2002.
13. Park J.E. and Park K., "Preventive and Social Medicine", Banarasidas Bhanot, India, 13<sup>th</sup> edition, 1991.
14. Thakaore Bhai, P. Gandhi and Harit R., Derasari, " Elements of Human Anatomy Physiology and Health Education" B.S. Shah Publishers, Ahmedabad, 4<sup>th</sup> Edition, 1991.
15. Anatomy and Physiology by Kimber - Grey - Stacktole`s
16. Practical Physiology and Biochemistry by Goel, Shah and Patel

**1.1.6 Pharmaceutics - I**

**Practical (3 Hrs/Wk)**

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)
9. Remington : The Science and practice of Pharmacy -A. R. Gennaro (Mack Publishing Co)
10. Bentleys 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 CO<sub>2</sub>
    - Incompatibility of soluble barbiturates
    - Incompatibility of emulsifying agent
  - 4) Compounding of proprietaries 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 a 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
7. Pharmaceutical calculations - Joel L. Zatz.
8. Remington's Pharmaceutical sciences.

**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.
4. Text book of Pharmaceutical Chemistry, By Chatten L.G.(Dekker series)
5. Textbook of Pharmaceutical analysis By Connors K.A.
6. Text book of Pharmaceutical Analysis By Dr. H. N. More
7. Indian Pharmacopoeia
8. Remington's Pharmaceutical Sciences.

### 1.1.9 Pharmaceutical Analysis – I

Practical (3 hr./wk)

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.
  - Oxidation-Reduction titrations: Ferrous sulfate, Ascorbic acid, Isoniazide, Hydrogen Peroxide.
  - 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:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A. H. and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II, The Anthlone Press of University of London.
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. I & II, A.V.Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More – Nirali Publication.
11. Analytical Chemistry an introduction, Skoog/ West/ Holler, 6<sup>th</sup> Edition.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle-Wadsworth Pub. Co.).
15. Merck Index.
16. Pharmaceutical Drug analysis by Ashutosh Kar.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.



**1.1.10 Anatomy Physiology & Health Education - I**

**Practical (3 Hrs/Wk)**

**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:

1. AB Mc Naught and Callander R., "Illustrated Physiology", B.I. Churchill Living Stone, New Delhi, 1<sup>st</sup> edition, 1987.
2. Anne Waugh and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", Churchill Living Stone, Edinburgh, 9<sup>th</sup> edition, 2002.
3. Arthur C. Guyton and John E. Hall, "Text book of Medical Physiology" W.B. Saunders company, 10<sup>th</sup> edition, 2000.
4. Bhise S.B. and Yadav "Human Anatomy and Physiology", Nirali Prakashan, Pune (India), 8<sup>th</sup> edition, 2000.
5. C.C. Chatterjee, "Human Physiology" (Vol. I & Vol. II), Medical Allied Agency, Calcutta, 11<sup>th</sup> edition, 1985.
6. Chaudhry Sujit K., "Consise Medical Physiology", New Cenrtal Book Agency, Calcutta, 2<sup>nd</sup> Edition, 1993.
7. De Gruchy`s Clinical Haematology, "Clinical Haematology in Medical Practice, Blackwell Science publishers, 5<sup>th</sup> Edition, 1989.
8. Douglas E., Kelly, Richard Wood and Allen C. Enders, "Bailey`s TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London, 18<sup>th</sup> Edition, 1984.
9. Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 4<sup>th</sup> edition, 1997.
10. Elaine N. Marieb, "Human Anatomy and Physiology", Benjamin / Cumings publishing company, 2<sup>nd</sup> edition, 1992.
11. Gerard J. Toratora, "Principles of Anatomy and Physiology", John-Wiley & sons New York, 10<sup>th</sup> edition, 2003.
12. Inderbir Singh, " Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, 4<sup>th</sup> edition, 2002.
13. Park J.E. and Park K., "Preventive and Social Medicine", Banarasidas Bhanot, India, 13<sup>th</sup> edition, 1991.
14. Thakaore Bhai, P. Gandhi and Harit R., Derasari, " Elements of Human Anatomy Physiology and Health Education" B.S. Shah Publishers, Ahmedabad, 4<sup>th</sup> Edition, 1991.
15. Anatomy and Physiology by Kimber - Grey - Stacktole`s
16. Practical Physiology and Biochemistry by Goel, Shah and Patel

**Semester - II**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours/ Week</b>	<b>Maximum marks</b>
1.2.1	<a href="#">Pharmaceutical Technology - I</a>	3	50
1.2.2	<a href="#">Pharmaceutical Organic Chemistry</a>	4	50
1.2.3	<a href="#">Pharmaceutical Analysis - II</a>	4	50
1.2.4	<a href="#">Anatomy Physiology &amp; Health Education - II</a>	3	50
1.2.5	<a href="#">Pharmacognosy &amp; Phytochemistry - I</a>	3	50
	<b>Total</b>	<b>17</b>	<b>250</b>
<b>Practical</b>			
1.2.6	<a href="#">Pharmaceutical Technology - I (Practical)</a>	3	50
1.2.7	<a href="#">Pharmaceutical Organic Chemistry (practical)</a>	3	50
1.2.8	<a href="#">Pharmaceutical Analysis - II (Practical)</a>	3	50
1.2.9	<a href="#">Anatomy Physiology &amp; Health Education - II (Practical)</a>	3	50
1.2.10	<a href="#">Pharmacognosy &amp; Phytochemistry - I (Practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

**1.2.1 Pharmaceutical Technology - I****Theory (3 hr./wk)**

	Hrs	Marks
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: Types and classification. Therapeutic applications, classification of bases. Drug release and absorption considerations. Formulation, preparation and evaluation.	11	14 - 20

**Reference Books:**

12. B.M. Mittal: Textbook of Pharmaceutical Formulation, 4<sup>th</sup> Edition, Vallabh Prakashan, Delhi.
13. Banker and Rhodes. Modern Pharmaceutics, 4<sup>th</sup> ed 2002 Marcel Dekker Inc.
14. Disperse Systems, Vol. I, II, III, M. Decker.
15. E.A.Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
16. James Swarbrick and James C. Boylan: Encyclopedia of pharmaceutical Technology, Marcel Dekker Inc. New York.
17. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.
18. M. E. Aulton: Pharmaceutics, Science of Dosage Form Design.
19. Martin: Physical Pharmacy, Varghese Publishing House, Mumbai, 1991.
20. Pharmaceutical Dosage Forms and Drug delivery systems. and 7<sup>th</sup> Ed. Ansel, Lippincott Williams and Wilkins, PA, 1999.
21. Remington's "The Science and Practice of Pharmacy", 20<sup>th</sup> Ed; 2000, Lippincott. Williams and Wilkins.
22. Pharmaceutical process validation, by Nash Wachler, Marcel Dekker

**1.2.2 Pharmaceutical Organic Chemistry**

Theory

4 hrs/wk.

	Hrs	Marks
<b>1. Factors affecting electron availability in bonds and at individual atoms:</b> Electronegativity, inductive effect, Resonance including rules of the Resonance, Concept and types of Tautomerism.	7	08-12
<b>2. Classes of reactions and reagents:</b> Including electrophiles, nucleophiles and radicals, transition reaction intermediates, Carbocations, Carbanions, Carbenes and Nitrenes, Kinetics and thermodynamic control of reactions.	6	06-10
<b>3. Theories of acidity and basicity with respect to organic compounds:</b> Factors effecting acidity and basicity – Resonance, Inductive effect, steric parameters and hydrogen bonding.	6	06-10
<b>4. Structure, Nomenclature [multifunctional groups also], preparation and reactions of:</b> 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].	28	18-26
<b>5. Benzene and Aromaticity :</b> Huckel's Rule, Resonance in benzene and derivatives, Mechanisms of electrophilic substitution reactions- halogenation, nitration, sulphonation and Friedl Crafts reaction, Orientation and reactivity in electrophilic and aromatic substitution, Mechanisms of nucleophilic aromatic substitution, Reaction involving Benzene intermediate.	7	08-12

### Reference Books:

1. Advanced Organic Chemistry, Ed. 4 -Jerry March.
2. Fundamentals of Organic Chemistry Vol. I & II Finar I.L.
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
7. Advanced Organic Chemistry: Bahl B.S. & Bahl A.
8. Organic Chemistry by Jain M.K.
9. Reaction Mechanisms and Reagents: Gurudeep Chatwal.
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.**

	<b>Hrs</b>	<b>Marks</b>
1. <b>Polarimetry:</b> Introduction, Instrumentation and Applications.	04	03 - 05
2. <b>Refractometry:</b> Introduction, Instrumentation (Abbey's, Dipping /Immersion, Pulfrich and Image displacement refractometer), Applications.	04	03 - 05
3. <b>Electrochemical Analysis:</b> <b>Definition of all types of electrochemical analysis.</b>	01	03 - 05
<b>e. Conductometry:</b> Principle, instrumentation, Applications including conductometric titrations. High frequency method.	04	03 - 05
<b>f. Potentiometry:</b> Introduction, Different types of electrodes, measurement of electrode potential and pH, Applications including potentiometric titrations.	06	05 - 08
<b>g. Polarography:</b> Introduction, Instrumentation and Applications.	07	05 - 08
<b>h. Amperometry:</b> Introduction, Instrumentation and Applications including amperometric titrations.	04	03 - 05
6. <b>Karl-Fischer titrations:</b> Introduction, Instrumentation, and Applications.	03	03 - 05
7. <b>Thermal Analysis:</b> Introduction, Principle, Methods, Instrumentation, and Factors affecting results, Applications of TG, DSC and DTA.	09	06 - 08
8. <b>X-ray diffraction:</b> v. Laue photographic method. vi. Bragg X-ray spectrophotometry. vii. Rotating crystal method. viii. Powder method.	06	06 - 08



## Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II., The Anthlone Press of University of London.
4. Connors K A, A Textbook of Pharmaceutical Analysis,Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. I & II, A.V.Kasture, S.G.Wadhodkar, K.R.Mahadik, H.N.More – Nirali Publication.
11. Analytical Chemistry an introduction, Skoog/West/Holler, 6<sup>th</sup> Edition.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
16. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
18. Meites-Handbook of Analytical Chemistry (McGraw Hill).
19. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).

<b>1.2.4</b>	<b>Anatomy Physiology &amp; Health Education – II</b>	<b>Theory</b>	<b>(3 hr./wk)</b>
		<b>Hrs</b>	<b>Marks</b>
<b>1</b>	<b>Nervous systems:</b> Definitions and classification of nervous system <ul style="list-style-type: none"> <li>• anatomy and physiology of neurons, initiation and conduction of nerve impulses, CNS synapses</li> <li>• definition, types and functions of central and peripheral neurotransmitters and its receptors</li> <li>• Functional areas and functions of cerebrum</li> <li>• Cerebellum, basal ganglia and motor control</li> <li>• Pons and medulla</li> <li>• Thalamus and hypothalamus</li> <li>• Spinal cord: structure and functions</li> <li>• Cranial nerves-names and functions</li> <li>• ANS-anatomy and functions of sympathetic and parasympathetic nervous system.</li> </ul>	10	10 – 12
<b>2</b>	<b>Urinary system</b> <ul style="list-style-type: none"> <li>• Parts of urinary system and gross structure of the kidney.</li> <li>• Structure of nephron.</li> <li>• Formation of urine.</li> <li>• Renin angiotensin system, juxta -glomerular apparatus. Acid base balance,</li> <li>• Disorders of renal function</li> <li>• Renal function test.</li> </ul>	05	05 – 08
<b>3</b>	<b>Endocrine system</b> Endocrine glands <ul style="list-style-type: none"> <li>• Pituitary gland and its hormones</li> <li>• Adrenal gland and adrenocortical hormones</li> <li>• Thyroid and parathyroid gland and metabolic hormones</li> <li>• Pancreas and gonads and their secretions.</li> <li>• Endocrine disorders</li> </ul>	06	09 – 15
<b>4</b>	<b>Reproductive system</b>	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.** 04 05 – 09
6. **Communicable and non communicable diseases:-** 08 06 – 09
- 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, gonorrhoea, AIDS.

#### Reference Books:

1. AB Mc Naught and Callander R., " Illustrated Physiology", B.I. Churchill Living Stone, New Delhi, 1<sup>st</sup> edition, 1987.
2. Anne Waugh and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", Churchill Living Stone, Edinburgh, 9<sup>th</sup> edition, 2002.
3. Arthur C. Guyton and John E. Hall, "Text book of Medical Physiology" W.B. Saunders company, 10<sup>th</sup> edition, 2000.
4. Bhise S.B. and Yadav "Human Anatomy and Physiology", Nirali Prakashan, Pune (India), 8<sup>th</sup> edition, 2000.
5. C.C. Chatterjee, "Human Physiology" (Vol. I & Vol. II), Medical Allied Agency, Calcutta, 11<sup>th</sup> edition, 1985.
6. Chaudhry Sujit K., "Consise Medical Physiology", New Cenrtal Book Agency, Calcutta, 2<sup>nd</sup> Edition, 1993.
7. De Gruchy`s Clinical Haematology, "Clinical Haematology in Medical Practice, Blackwell Science publishers, 5<sup>th</sup> Edition, 1989.
8. Douglas E., Kelly, Richard Wood and Allen C. Enders, "Bailey`s TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London, 18<sup>th</sup> Edition, 1984.
9. Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 4<sup>th</sup> edition, 1997.
10. Elaine N. Marieb, "Human Anatomy and Physiology", Benjamin / Cumings publishing company, 2<sup>nd</sup> edition, 1992.
11. Gerard J. Toratora, "Principles of Anatomy and Physiology", John-Wiley & sons New York, 10<sup>th</sup> edition, 2003.
12. Inderbir Singh, " Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, 4<sup>th</sup> edition, 2002.

13. Park J.E. and Park K., "Preventive and Social Medicine", Banarasidas Bhanot, India, 13<sup>th</sup> edition, 1991.

1.2.5 Pharmacognosy & Phytochemistry - I		Theory	(3 Hrs/Wk)
		Hrs	Marks
10.	Definition, history, scope and development of pharmacognosy	02	02 - 03
11.	<b>Sources of crude drugs:</b> biological, marine, microbes, mineral, animal and plant tissue culture as sources of drugs.	01	01 - 03
12.	<b>Classification of crude drugs (organized &amp; unorganized):</b> alphabetical, morphological, taxonomical, chemical, pharmacological and chemotaxonomical classification of crude drugs	03	03 - 05
13.	<b>Plant taxonomy :</b> study of following families with special reference to medicinal important plants of apocynaceae, solanaceae, rutaceae, umbelliferae, leguminosae and liliaceae	04	05 - 08
14.	<b>Cultivation, collection, processing and storage of crude drugs:</b> 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.	05	05 - 08
15.	<b>Quality control of crude drugs :</b> adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation	04	05 - 08
16.	An introduction to active constituents of crude drugs, their general isolation and classification	03	03 - 05
17.	<b>Systematic pharmacognostic study of following:</b> Carbohydrates and derived products : agar, guar gum, acacia, honey, isabgol, pectin, tragacanth, starch, modified starches and inulin	07	08 - 10
18.	<b>Lipids :</b> bees wax, castor oil, coca butter, cod liver oil, linseed oil, rice bran oil, shark liver oil and wool fat	07	08 - 10

## Reference Books:

24. Gamborg O. L. Wetter L. R., Plant tissue culture methods, National Research Council of Canada, Sakatchewan.
25. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
26. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
27. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
28. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
29. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
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
32. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
33. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
34. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
35. Atal C. K. and Kapur B. M. Cultivation and utilization of Medicinal plants, RRL, Jammu.
36. Barz W, Rrinhard E and Zenk M. H. Plant tissue culture and its biotechnological application, Springier, Berlin.
37. Brain K. R. and Turner T. D. , The practical Evaluation of phytopharmaceuticals, Wright-Scientehnica, Bristil.
38. Chandha K.L. and Gupta R. Advances in Horticulture Vol II- medicinal and aromatic plants, Malhotra publishing House, New Delhi.
39. Chopra R. N., Nayar S. L. and Chopra I. C., Glossary of Indian Medicinal plants CS I R, New Delhi.
40. Clarke ECG, Isolation and Identification of Drugs, The Pharmaceutical Press, London.
41. De Mayo, The chemistry of Natural Products, 2-3, Interscience New York.
42. Export potential of selected medicinal plants, prepared by basic chemicals, pharmaceuticals and cosmeticexport promotion council, Bombay, and other reports.
43. Fabn A, Plant anatomy, 3<sup>rd</sup> Ed. Pergamon press, Oxford.
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.

### 1.2.6 Pharmaceutical Technology - I

Practical (3 hr./wk)

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:

10. B. M. Mittal: Textbook of Pharmaceutical Formulation, 4<sup>th</sup> Edition, Vallabh Prakashan, Delhi.
11. Banker and Rhodes. Modern Pharmaceutics, 4<sup>th</sup> ed 2002 Marcel Dekker Inc.
12. Disperse Systems, Vol. I, II, III, M. Decker.
13. E. A. Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
14. James Swarbrick and James C. Boylan: Encyclopedia of pharmaceutical Technology, Marcel Dekker Inc. New York.
15. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.
16. M. E. Aulton: Pharmaceutics, Science of Dosage Form Design.
17. Pharmaceutical Dosage Forms and Drug delivery systems. and 7<sup>th</sup> Ed. Ansel, Lippincott Williams and Wilkins, PA, 1999.
18. Remington's "The Science and Practice of Pharmacy", 20<sup>th</sup> Ed; 2000, Lippincott. Williams and Wilkins.

### 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-Phenylhydroxylamine 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
2. Fundamentals of Organic Chemistry vol. I & II : Finar I.L.
3. Organic Chemistry: Pine
4. Advanced Organic Chemistry: Solomans
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry : Peter Sykes
7. Advanced Organic Chemistry : Bahl B.S. & Bahl A.
8. Organic Chemistry : Jain M.K.
9. Reaction Mechanisms and Reagents: Gurudeep Chatwal.
10. Vogel's Textbook of practical organic chemistry
11. Practical Organic Chemistry : Mann and Saunders
12. Stereochemistry of Organic Compounds : Nasipuri D.
13. Stereochemistry of Organic Compounds : Kalsi P.S.



### 1.2.8 Pharmaceutical Analysis - II

Practical 3 hrs/wk.

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.
6. Calibration of pH meter.
7. Potentiometric analysis: - pKa determination of phosphoric acid / boric acid.
8. Potentiometric titration of Acid Vs Base.
9. Water determination by Karl-fischer method.

#### Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II., The Anthlone Press of University of London.
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. I & II, A.V.Kasture, S.G.Wadhodkar, K.R.Mahadik, H.N.More – Nirali Publication.
11. Analytical Chemistry an introduction, Skoog/West/Holler, 6<sup>th</sup> Edition.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.)
14. Merck Index.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
16. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
18. Meites-Handbook of Analytical Chemistry (McGraw Hill).
19. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).

**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. AB Mc Naught and Callander R., "Illustrated Physiology", B.I. Churchill Living Stone, New Delhi, 1<sup>st</sup> edition, 1987.
2. Anne Waugh and Allison Grant, "Ross and Wilson Anatomy and Physiology in Health and Illness", Churchill Living Stone, Edinburgh, 9<sup>th</sup> edition, 2002.
3. Arthur C. Guyton and John E. Hall, "Text book of Medical Physiology" W.B. Saunders company, 10<sup>th</sup> edition, 2000.
4. Bhise S.B. and Yadav "Human Anatomy and Physiology", Nirali Prakashan, Pune (India), 8<sup>th</sup> edition, 2000.
5. C.C. Chatterjee, "Human Physiology" (Vol. I & Vol. II), Medical Allied Agency, Calcutta, 11<sup>th</sup> edition, 1985.
6. Chaudhry Sujit K., "Consise Medical Physiology", New Cenrtal Book Agency, Calcutta, 2<sup>nd</sup> Edition, 1993.
7. De Gruchy`s Clinical Haematology, "Clinical Haematology in Medical Practice, Blackwell Science publishers, 5<sup>th</sup> Edition, 1989.
8. Douglas E., Kelly, Richard Wood and Allen C. Enders, "Bailey`s TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London, 18<sup>th</sup> Edition, 1984.
9. Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 4<sup>th</sup> edition, 1997.
10. Elaine N. Marieb, "Human Anatomy and Physiology", Benjamin / Cumings publishing company, 2<sup>nd</sup> edition, 1992.

11. Gerard J. Toratora, "Principles of Anatomy and Physiology", John-Wiley & sons New York, 10<sup>th</sup> edition, 2003.
12. Inderbir Singh, "Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, 4<sup>th</sup> edition, 2002.
13. Park J.E. and Park K., "Preventive and Social Medicine", Banarasidas Bhanot, India, 13<sup>th</sup> edition, 1991.

#### 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:

24. Gamborg O. L. Wetter L. R., Plant tissue culture methods, National Research Council of Cannada, Sakatchewan.
25. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
26. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
27. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
28. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
29. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
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
32. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
33. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
34. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
35. Atal C. K. and Kapur B. M. Cultivation and utilization of Medicinal plants, RRL, Jammu.
36. Barz W, Rrinhard E and Zenk M. H. Plant tissue culture and its biotechnological application, Springier, Berlin.
37. Brain K. R. and Turner T. D. , The practical Evaluation of phytopharmaceuticals, Wright-Scientehnica, Bristil.

38. Chandha K.L. and Gupta R. Advances in Horticulture Vol II- medicinal and aromatic plants, Malhotra publishing House, New Delhi.
39. Chopra R. N., Nayar S. L. and Chopra I. C., Glossary of Indian Medicinal plants CS I R, New Delhi.
40. Clarke ECG, Isolation and Identification of Drugs, The Pharmaceutical Press, London.
41. De Mayo, The chemistry of Natural Products, 2-3, Interscience New York.
42. Export potential of selected medicinal plants, prepared by basic chemicals, pharmaceuticals and cosmetic export promotion council, Bombay, and other reports.
43. Fabn A, Plant anatomy, 3<sup>rd</sup> Ed. Pergamon press, Oxford.
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**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
2.3.1	<a href="#">Physical Pharmacy – I</a>	3	50
2.3.2	<a href="#">Pharmaceutical Microbiology &amp; Immunology</a>	4	50
2.3.3	<a href="#">Pharmaceutical Biochemistry</a>	3	50
2.3.4	<a href="#">Pharmacognosy &amp; Phytochemistry – II</a>	3	50
2.3.5	<a href="#">Biostatistics and Computer applications</a>	2	50
	<b>Total</b>	<b>15</b>	<b>250</b>
<b>Practical</b>			
2.3.6	<a href="#">Physical Pharmacy – I (Practical)</a>	3	50
2.3.7	<a href="#">Pharmaceutical Microbiology &amp; Immunology (Practical)</a>	3+1	50
2.3.8	<a href="#">Pharmaceutical Biochemistry (Practical)</a>	3	50
2.3.9	<a href="#">Pharmacognosy &amp; Phytochemistry – II (Practical)</a>	3	50
2.3.10	<a href="#">Biostatistics and Computer applications (Practical)</a>	3	50
	<b>Total</b>	<b>16</b>	<b>250</b>

**2.3.1 Physical Pharmacy - I****Theory****3 hrs/wk.**

	<b>Hrs</b>	<b>Marks</b>
1. Behaviour of gases: Kinetic theory of gases, derivation from behaviours and explanation.	03	05 - 08
2. The liquid state: Physical properties such as surface tension, parachor, viscosity, refractive index, optical rotation and dipole moment	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	06	06 - 10
4. Thermodynamics: First law, second law, third law of thermodynamics, zeroth law, absolute temperature scale.	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.	05	05 - 08
6. Adsorption: Types, factors affecting, Freudlich and Gibbs adsorption isotherm, Langmuir theory of adsorption, adsorption on solid interface, solid-gas and solid-liquid interfaces, applications in pharmacy	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.	06	06 - 10
8. Numerical problems: Problems based on all above chapters	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 - Engene Parrot

2.3.2 Pharmaceutical Microbiology & Immunology		Theory	4 hrs/wk.
		Hrs	Marks
8.	Scope of Microbiology: Historical development (Antony Van Leuenhook, Koch's postulates, Pastuers contribution) applications of microbiology to pharmaceuticals.	02	02 - 04
9.	Classification of microorganisms and their taxonomy: Whittkers 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.)	03	03 - 05
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).	08	07 - 12
11.	Study of Yeasts, Fungi & Rickettsia: Introduction, characteristics, clinical significance & applications in Pharmacy	05	03 - 05
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.	04	03 - 05
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).	13	12 - 17



14. Fundamentals of Immunology -

13 10 - 12

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:

1. Pharmaceutical Microbiology - Hugo and Russell, sixth ed., Blackwell Science.
2. Tutorial Pharmacy - Cooper and Gunn
3. Basic & Clinical Immunology - H. H. Fundenberg, Large Medical Publication, Maruzen Company Limited.
4. General Microbiology by Pelczar & Rid
5. General Microbiology by Powar & Dagainawala
6. Text book of microbiology by Ananthnarayanan, Jarayam Panikar

2.3.3 Pharmaceutical Biochemistry		Theory	(3 hr./wk)	
			Hrs	Marks
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
- 4 Harper's Biochemistry, By R. K. Murry.
- 5 Practical Biochemistry By David T. Plummer
- 6 Jayaraman J, Laboratory manual in Biochemistry, Wiley Eastern Ltd. New Delhi.

### 2.3.4 Pharmacognosy & Phytochemistry - II

Theory (3 hr./wk)

	Hrs	Marks
<b>1. Volatile oils:</b> 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	10	12 - 15
<b>2. Resins:</b> 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.	09	08 - 12
<b>3. Tannins:</b> Study of tannins and tannin containing drugs like gambir, black catechu, myrobalan, behera.	04	04 - 06
<b>4. Phytochemical screening:</b> c. Preparation of extracts. d. Screening of alkaloids, glycosides (Cardiac, saponins, anthraquinones, flavonoids, coumarins and cynogenetic glycosides), Tannins, steroids, carbohydrates, proteins and amino acids.	08	08 - 10
<b>5. Fibres:</b> Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glass wool, polyester and asbestos	04	04 - 06
<b>6. Pharmaceutical aids &amp; technical products:</b> Study of pharmaceutical aids like talc, Diatomite, kaolin, bentonite, gelatin	04	04 - 06

## Reference Books:

1. Gamborg O. L. Wetter L. R. , Plant tissue culture methods, National Research Council of Canada, Sakatchewan.
2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
3. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
4. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
5. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
6. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
8. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
9. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
10. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.

**2.3.5 Biostatistics and Computer applications****Theory****2 hrs/wk.**

	<b>Hrs</b>	<b>Marks</b>
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	02	03 - 05
2. Probability and Probability distribution Terminology, theoretical, binomial, normal probability distribution	01	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.	02	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	03	04 - 06
5. Analysis of Variance and Experimental Design Meaning and the Technique of ANOVA	01	03 - 05
6. History and Generation of Computers Fundamentals, evolution and generation, types of computers	01	03 - 05
7. Anatomy and Computer Peripherals CPU, Input and Output devices, Ancillary machines, characteristics of computers, memories and storage devices	02	03 - 05
8. Operating systems Terminology MS-DOS, MS Windows, Introduction to other operating systems.	04	06 - 10
9. Microsoft office MS Word, MS Excel, MS PowerPoint	05	08 - 10
10. Introduction to internet basics and networking Internet browsing, search engines, e-mail networking concepts, LAN, WAN.	02	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	01	03 - 05

## Reference Books:

1. Introduction to Biostatistics and Computer science by Y. I. Shah, Dr. A. R. Paradkar, and M. G. Dhaygude, Nirali Prakashan, Pune - 02
2. Methods of Biostatistics for Medical and Research students by B. K. Mahajan, Jaypee brothers medical publishers (P) Ltd., New Delhi - 02
3. Fundamentals of Applied statistics by S. C. Gupta, V. K. Kapoor, Sultan Chand and Sons Publishers New Delhi - 02
4. Statistical methods for cost accountants by S. P. Gupta, Sultan Chand and Sons Publishers, New Delhi - 02
5. Donald Sanders - Computer Today (3 rd Edition) Publisher - McGraw - Hill Book Company
6. William and Fassett - Computer Applications in Pharmacy.
7. Computer-Aided Drug Design (Methods & Applications) Edited by - Thomas Perun, Propst Publisher- Marcel Dekker Inc.
8. Computer Medicine by J. Rose, Publisher: J. & A. Churchill Ltd.
9. Computer Programming - I by Sneha Phadke, Publisher: Technova Publication
10. Microsoft office 97 by Ginicourter & Annette Marquis, BPB Publications, N. Delhi - 01
11. The ABC's of the Internet by Cristain Crumlish, BPB Publications, N. Delhi - 01

### 2.3.6 Physical Pharmacy - I

Practical 3 hrs/wk.

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, (cocci 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. medium.
6. Study of yeast Aspergillus and Penicillium with respect to morphology. (wet mount preparation).
7. Sterility testing.
8. Study of air and water microbiology.
9. Phenol coefficient.
10. Serological diagnosis of Typhoid.

**Reference Books:**

1. Pharmaceutical Microbiology - Hugo and Russell, sixth ed., Blackwell Science.
2. Tutorial Pharmacy - Cooper and Gunn
3. Basic & Clinical Immunology - H. H. Fundenberg, Large Medical Publication, Maruzen Company Limited.
4. General Microbiology by Pelczar & Rid
5. General Microbiology by Powar & Dagainawala
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
4. Harper's Biochemistry, By R. K. Murry.
5. Practical Biochemistry By David T. Plummer
6. Jayaraman J, Laboratory manual in Biochemistry, Wiley Eastern Ltd. New Delhi.

### 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:

1. Gamborg O. L. Wetter L. R. , Plant tissue culture methods, National Research Council of Canada, Sakatchewan.
2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
3. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
4. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
5. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
6. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
8. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
9. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
10. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
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
3. Fundamentals of Applied statistics by S. C. Gupta, V. K. Kapoor, Sultan Chand and Sons Publishers New Delhi - 02
4. Statistical methods for cost accountants by S. P. Gupta, Sultan Chand and Sons Publishers, New Delhi - 02
5. Donald Sanders - Computer Today (3 rd Edition) Publisher - McGraw - Hill Book Company
6. William and Fassett - Computer Applications in Pharmacy.
7. Computer-Aided Drug Design (Methods & Applications) Edited by - Thomas Perun, Propst Publisher- Marcel Dekker Inc.
8. Computer Medicine by J. Rose, Publisher: J. & A. Churchill Ltd.
9. Computer Programming - I by Sneha Phadke, Publisher: Technova Publication
10. Microsoft office 97 by Ginicourter & Annette Marquis, BPB Publications, N. Delhi- 01
11. The ABC's of the Internet by Cristain Crumlish, BPB Publications, N. Delhi - 01

**Semester - IV**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
2.4.1	<a href="#">Physical Pharmacy – II</a>	3	50
2.4.2	<a href="#">Pharmaceutical Biotechnology</a>	3	50
2.4.3	<a href="#">Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry</a>	4	50
2.4.4	<a href="#">Pharmaceutical Chemistry</a>	3	50
2.4.5	<a href="#">Pharmacology – I</a>	4	50
	<b>Total</b>	<b>17</b>	<b>250</b>
<b>Practical</b>			
2.4.6	<a href="#">Physical Pharmacy – II (practical)</a>	3	50
2.4.7	<a href="#">Pharmaceutical Biotechnology (practical)</a>	3	50
2.4.8	<a href="#">Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry (practical)</a>	3	50
2.4.9	<a href="#">Pharmaceutical Chemistry (practical)</a>	3	50
2.4.10	<a href="#">Pharmacology – I (practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

**2.4.1 Physical Pharmacy - II****Theory 3 hrs/wk.**

	Hrs	Marks
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.	03	04 - 08
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.	06	05 - 08
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.	08	08 - 12
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.	06	06 - 10
5. Dispersed systems: A) Colloidal dispersion: definition, types, properties of colloids: protective colloids, applications of colloids in pharmacy. B) Coarse Dispersions: interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of brownian moment, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations, emulsion types, theories, physical stability.	08	10 - 15
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, $Q_{10}$ value, accelerated stability study, expiration dating.	06	07 - 09

**Reference Books:-**

1. Physical Pharmacy – Martin, Swarbrick and Commarata
2. Elements of Physical Chemistry – Glasstone and Lewis
3. Physical Chemistry – Maron S. and Pruton
4. Remington's Pharmaceutical Sciences.
5. Theory & Practice of Industrial Pharmacy – Lachman Liebermann and Kanig
6. Physical Chemistry – Bahl and Tuli
7. Pharmaceutical Technology – Eugene Parrott
8. Essentials of Physical Chemistry and Pharmacy – S. S. Kadam, H. J. Arnikar and K. N. Gujar

2.4.2 Pharmaceutical Biotechnology		Theory	(3 hrs/wk.)
		Hrs	Marks
1.	Definition and scope - potential and achievements	02	03 - 05
2.	Fermentation technology and industrial microbiology 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.	13	15 - 18
3.	Animal cell culture and genetic engineering 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.	07	06 - 10
4.	Preparation and characterization of immunologicals 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.	06	05 - 08
5.	Biotechnology derived products (therapeutic proteins) Examples of biotechnology derived therapeutics products, production of human Insulin, interferon, somatostatin, somatotropin.	04	03 - 05
6.	Characterization and quality control of biotech derived products: 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.	10	08 - 12



## Reference Books:

24. Bainse William, *Biotechnology from A to Z*, 2<sup>nd</sup> Edition, 2002, Oxford University Press.
25. Berger S. L., et. al., *Methods in Enzymology*, Academic Press Inc., CA 1992.
26. *British Pharmacopoeia*, 1993, London, HMSO.
27. Carter S. J., Cooper and Gunn's *Tutorial Pharmacy*, 6<sup>th</sup> Edition, 1996, CBS Publishers and Distributors, Delhi.
28. Casida L. E., *Industrial Microbiology*, 2000, New Age International, Delhi.
29. De Kalyan Kumar, *Plant Tissue Culture*, 1<sup>st</sup> Edition, 1997, New Central Book Agency (P) Ltd.
30. Freifelder David, *Molecular Biology*, 2<sup>nd</sup> Edition, 1998, Narosa Publishing House.
31. J. I. Disouza, Killedar S. G., *Biotechnology and Fermentation Process*, Nirali Prakashan
32. Gennaro A. R., *Remington-the Science and Practice of Pharmacy*, 20<sup>th</sup> Edition, 2002, Lippincott Williams and Wilkins, New York.
33. Gupta P. K., *Elements of Biotechnology*, 1<sup>st</sup> Edition, 2001, Rastogi Pub., Meerut.
34. Higgins, Best D.J. and Jones J., *Biotechnology: Principles and Applications*, Blackwell Scientific Publications, Boston, MA 1985.
35. Hugo W. B., Russell A. D., *Pharmaceutical Microbiology*, 6<sup>th</sup> Edition, 1998,
36. Jay James M., *Modern Food Microbiology*, 4<sup>th</sup> Edition, 1996, CBS Publishers and Distributors, Delhi.
37. Kumar H. D., *Textbook of Biotechnology*, 2<sup>nd</sup> Edition, 1991, Affiliated East West Press Pvt. Ltd., New Delhi.
38. Patel A. H., *Industrial Microbiology*, 1984, Macmillan Ltd., Delhi.
39. *Pharmacopoeia of India*, 1985, Govt. of India, Ministry of Health and Family Welfare.
40. Prasad B., *Veterinary Pharmaceuticals*, 4<sup>th</sup> Edition, 2001, CBS Publishers and Distributors, Delhi.
41. Razdan M. K., *An Introduction to Plant Tissue Culture*, 1993, Oxford IBH Pub., New Delhi.
42. Reed Gerald, Prescott Dunn's *Industrial Microbiology*, 4<sup>th</sup> Edition, 1987, CBS Publishers and Distributors, Delhi.
43. Singh B. D., *Biotechnology*, 2001, Kalyani Publisher.
44. Stanbury P. F., Whitekar A. and Hall S. J., *Principles of Fermentation Technology*, 2<sup>nd</sup> Edition, 1997, Aditya Books (P) Ltd., New Delhi.
45. Trevan Keshav, *Biotechnology*, 4<sup>th</sup> Edition, 1990, New Age International Ltd. Pub., New Delhi.
46. Vyas, S. P., Dixit V. K., *Pharmaceutical Biotechnology*, 1<sup>st</sup> Edition, 1999, CBS Publishers and Distributors, Delhi.

<b>2.4.3 Pharmaceutical Heterocyclic &amp; Polycyclic Chemistry</b>	<b>Theory</b>	<b>4 hrs/wk.</b>
	<b>Hrs</b>	<b>Marks</b>
<b>1. Stereochemistry:</b>	08	05 – 08
<ul style="list-style-type: none"> <li>• Isomerism and its types - Optical isomerism-nomenclatures [including D/L &amp; R/S] and projection formulas, enantiomers, distereoisomers, chirality, racemic mixtures, resolution of racemic mixtures.</li> <li>• Geometrical isomerism-Z &amp; E, cis-trans isomerisms.</li> <li>• Methods of determination of configurations.</li> <li>• iv. Conformational isomerism: Conformations of n-butane &amp; cyclohexane and disubstituted cyclohexanes, locking of conformation with respect to t-butyl cyclohexane, Conformational analysis.</li> </ul>		
<b>2. Heterocyclic Compounds:</b>	13	12 – 16
<p>Introduction &amp; Nomenclature of all heterocyclic compounds, Preparation, reactivity and Chemical reactions of Aziridines, Furan, Pyrrole, Pyridine, other fused pyridines, purines, diazines, triazines &amp; tetrazines, oxazines, thiazines, pyrazoles, tetrazoles, oxadiazoles, thiadiazoles, isooxazoles, isothiazoles &amp; there benzo dervs, Pyrimidine, Thiophene, Indole, Quinoline, Imidazole, Thiazole, Oxazole, Triazole, azipines , diazepines &amp; benzodiazepines.</p>		
<b>3. Molecular Rearrangements:</b>	18	12 – 18
<p>General considerations, types of rearrangement Nucleophilic, electrophilic, free radical), Principle, reaction mechanism and stereochemistry of...</p> <ul style="list-style-type: none"> <li>• Electron deficient Rearrangements- Whitmore 1,2 shift. Wagner Meerwein rearrangement, Pinacol rearrangement, Wolf rearrangement, Beckmann rearrangement, Hoffman rearrangement, Lossen rearrangement, Schmidt rearrangement, Benzillic acid rearrangement.</li> <li>• Electron rich Rearrangements: Stevens rearrangement, Wittig rearrangement, Neber rearrangement, Sommelet rearrangements, Favourskii rearrangement.</li> <li>• Rearrangements involving migration of Aromatic ring-Fries rearrangement, Claisen rearrangement.</li> </ul>		
<b>4. Fused polynuclear Compound:</b> Preparation, reactivity and chemical properties of Naphthalene, Anthracene and Phenanthrene.	5	05 – 08
<b>5. Oxidation &amp; reduction reactions:</b> 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.	10	06 – 10

### Reference Books:

1. Advanced Organic Chemistry, Ed. 4 -Jerry March.
2. Fundamentals of Organic Chemistry Vol. I & II Finar I.L.
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
7. Advanced Organic Chemistry: Bahl B.S. & Bahl A.
8. Organic Chemistry by Jain M.K.
9. Reaction Mechanisms and Reagents: Gurudeep Chatwal.
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
<b>1. Amino-acids, Peptides, and Proteins:</b> 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.	8	8-11
<b>2. Vitamins:</b> Chronological development of vitamins, General structure of vitamins- Structural elucidation of Vitamin A (Retinol), Vitamin B <sub>1</sub> (Thiamine), Vitamin D <sub>2</sub> and $\alpha$ -Tocopherol.	5	5-7
<b>3. Glycosides:</b> General Chemistry of Glycosides, Determination of structure, Methods in determination of constitution of Arbutin, Amygdalin and Salicin.	6	7-10
<b>4. Alkaloids:</b> General Chemistry of Alkaloids, General methods of determination of molecular structure, Methods in determination of constitution of Ephedrine, Nicotine, Atropine and Quinine.	7	6-9
<b>5. Chiral Technology:</b> Introduction, chirality, Resolution, asymmetric synthesis, chiral pool, chiral reagents, chiral auxiliary & chiral catalyst.	4	5-8
<b>6. Medicinal dyes and pigments:</b> 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.	7	8-10

### 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.
3. The Chemistry of Natural Products by De Mayo P, Interscience, New York.
4. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
5. Biochemistry of Phenolic Compounds by Harborne J. B., Academic Press, New York.
6. Isolation and Identification of Drugs by Clarke ECG, The Pharmaceutical Press, London.
7. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
8. Martindale, The Extra Pharmacopoeia, Pharmaceutical Society of Great Britain, London.
9. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
10. Pharmacopoeia Of India, 1985, 1996, Govt. Of India, Ministry Of Health and Family Welfare.
11. Terpenoids in Plants by Pridham J. B., Academic Press, New York.
12. The Biochemistry of Alkaloids by Robinson T., Springer- Verlag.

**2.4.5 Pharmacology - I**

Theory

4 hrs/wk.

	Hrs	Marks
<b>1. General Pharmacology</b>		22 - 32
• 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, placental 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	
<b>2. Drugs acting on Autonomic Nervous System</b>		18 - 28
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	

**Reference Books:**

1. General Pathology – Y.M. Bhende, S, G. Deodhare, S. S. Kelkar (Popular Prakashan).
2. Essential Pathology – Emanuel Rubin, John L., Farber J.B. Lippincott company.
3. Text book of Robbins Pathology Basis of Disease – Robbins, Cotran, Kumar, Prism Indian Edition
4. Pocket comparison to Robbins Pathologic Basis of Disease, 5<sup>th</sup> Edition - Robbins, Cotran, Kumar, Prism Indian Edition.
5. Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T. W. Rall, AIS, Nies, P. Taylor, Pergamon Press, 2000.
6. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
7. M. P. Rang, M. M. Dale, J. M. Ritter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
8. Modern Pharmacology, C. R. Craig and R. E. Stitzel, Little Brown and Company, 1994.
9. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
10. Mycek MJ, Harvey RA and Champe PC, Lippincott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lippincott Williams & Wilkins, 1997.
11. Barar F.S.K., Test book of Pharmacology, Interprint, New Delhi.
12. Lawrence, D.R. and Bennet P.N. Clinical Pharmacology, Scientific Book agency, Calcutta.
13. P.S.R.K. Haranath, Synopsis of Pharmacology, 1995, Bombay.
14. Clinical Pharmacy and Therapeutics, Herfindal E.T., and Hirschman J.L. Williams and Wilkins.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
16. Pharmacotherapy: A Pathophysiological approach, Dipiro, J.L. Elsevier.3
17. Tripathi KD: Essentials of Medical Pharmacology. 2001, 4<sup>th</sup> Edition, Jaypee Brothers, New Delhi.
18. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
20. Hand book of Experimental Pharmacology, 2nd Ed., S. K. Kulkarni., Vallabh Prakashan, Delhi.

#### 2.4.6 Physical Pharmacy – II

Practical 3 hrs/wk.

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
7. Pharmaceutical Technology – Eugene Parrott
8. Physical Pharmacy – Martin, Swarbrick and Commarata
9. Practical Pharmaceutics (Physical Pharmacy) - H. N. More, Ashok Hajare
10. Practical Physical Pharmacy - U. B. Hadkar, T.N. Vasudevan, K. S. Laddha



#### **2.4.7 Pharmaceutical Biotechnology**

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

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 B<sub>12</sub>)

### Reference Books:

23. Bainse William, *Biotechnology from A to Z*, 2<sup>nd</sup> Edition, 2002, Oxford University Press.
24. Berger S. L., et. al., *Methods in Enzymology*, Academic Press Inc., CA 1992.
25. *British Pharmacopoeia*, 1993, London, HMSO.
26. Carter S. J., Cooper and Gunn's *Tutorial Pharmacy*, 6<sup>th</sup> Edition, 1996, CBS Publishers and Distributors, Delhi.
27. Casida L. E., *Industrial Microbiology*, 2000, New Age International, Delhi.
28. De Kalyan Kumar, *Plant Tissue Culture*, 1<sup>st</sup> Edition, 1997, New Central Book Agency (P) Ltd.
29. Freifelder David, *Molecular Biology*, 2<sup>nd</sup> Edition, 1998, Narosa Publishing House.
30. Gennaro A. R., *Remington-the Science and Practice of Pharmacy*, 20<sup>th</sup> Edition, 2002, Lippincott Williams and Wilkins, New York.
31. Gupta P. K., *Elements of Biotechnology*, 1<sup>st</sup> Edition, 2001, Rastogi Pub., Meerut.
32. Higgins, Best D.J. and Jones J., *Biotechnology: Principles and Applications*, Blackwell Scientific Publications, Boston, MA 1985.
33. Hugo W. B., Russell A. D., *Pharmaceutical Microbiology*, 6<sup>th</sup> Edition, 1998, Backwell Science.
34. Jay James M., *Modern Food Microbiology*, 4<sup>th</sup> Edition, 1996, CBS Publishers and Distributors, Delhi.
35. Kumar H. D., *Textbook of Biotechnology*, 2<sup>nd</sup> Edition, 1991, Affiliated East West Press Pvt. Ltd., New Delhi.
36. Patel A. H., *Industrial Microbiology*, 1984, Macmillan Ltd., Delhi.
37. *Pharmacopoeia of India*, 1985, Govt. of India, Ministry of Health and Family Welfare.
38. Prasad B., *Veterinary Pharmaceuticals*, 4<sup>th</sup> Edition, 2001, CBS Publishers and Distributors, Delhi.
39. Razdan M. K., *An Introduction to Plant Tissue Culture*, 1993, Oxford IBH Pub., New Delhi.
40. Reed Gerald, Prescott Dunn's *Industrial Microbiology*, 4<sup>th</sup> Edition, 1987, CBS Publishers and Distributors, Delhi.
41. Singh B. D., *Biotechnology*, 2001, Kalyani Publisher.
42. Stanbury P. F., Whitekar A. and Hall S. J., *Principles of Fermentation Technology*, 2<sup>nd</sup> Edition, 1997, Aditya Books (P) Ltd., New Delhi.
43. Trevan Keshav, *Biotechnology*, 4<sup>th</sup> Edition, 1990, New Age International Ltd. Pub., New Delhi.
44. Vyas, S. P., Dixit V. K., *Pharmaceutical Biotechnology*, 1<sup>st</sup> Edition, 1999, CBS Publishers and Distributors, Delhi.

## 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
2. Fundamentals of Organic Chemistry vol. I & II : Finar I.L.
3. Organic Chemistry : Pine
4. Advanced Organic Chemistry : Solomans
5. Organic Chemistry : Morrison & Boyd
6. A Guidebook to reaction mechanism in Organic Chemistry: Peter Sykes
7. Advanced Organic Chemistry-----Bahl B.S. & Bahl A.
8. Organic Chemistry-----Jain M.K.
9. Reaction Mechanisms and Reagents -----Gurudeep Chatwal.
10. Vogel's Textbook of practical organic chemistry
11. Stereochemistry of Organic Compounds – Nasipuri D.
12. Stereochemistry of Organic Compounds – Kalsi P.S.

#### 2.4.9 Pharmaceutical Chemistry

Practical 3 hrs/wk.

1. Extraction of strychnine and brucine from nuxvomica, ammonium glycyrrhizinate 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.
2. The Chemistry of Natural Products by De Mayo P, Interscience, New York.
3. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
4. Biochemistry of Phenolic Compounds by Harborne J. B., Academic Press, New York.
5. Isolation and Identification of Drugs by Clarke ECG, The Pharmaceutical Press, London.
6. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
7. Martindale, The Extra Pharmacopoeia, Pharmaceutical Society of Great Britain, London.
8. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
9. Practical Pharmacognosy by Dr. C.K. Kokate, Vallabh Prakashan, Delhi.

#### 2.4.10 Pharmacology - I

Practical 3 hrs/wk.

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 ( $Mg SO_4$ )
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:

1. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
2. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi.
3. Sheth, U. K. Dadkar, N. k. and Kamat, U. G. Selected Topics in Experimental pharmacology.
4. Perry, W. L. M. Pharmacological Experiments on Isolated preparations.

**Semester - V**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
3.5.1	<a href="#">Cosmeticology</a>	3	50
3.5.2	<a href="#">Pharmaceutical Engineering</a>	3	50
3.5.3	<a href="#">Medicinal Chemistry - I</a>	3	50
3.5.4	<a href="#">Pharmaceutical Polymer Chemistry</a>	3	50
3.5.5	<a href="#">Pharmacology - II</a>	4	50
	<b>Total</b>	<b>16</b>	<b>250</b>
<b>Practical</b>			
3.5.6	<a href="#">Cosmeticology (Practical)</a>	3	50
3.5.7	<a href="#">Medicinal Chemistry - I (Practical)</a>	3+3	50
3.5.8	<a href="#">Pharmaceutical Polymer Chemistry (Practical)</a>	3	50
3.5.9	<a href="#">Pharmacology - II (Practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>200</b>

<b>3.5.1</b>	<b>Cosmeticology</b>	<b>Theory</b>	<b>3 hrs/wk.</b>
		Hrs	Marks
1.	<b>Physiological Consideration:</b> Skin, hair, nail and eye- in relation to cosmetic application.	03	03 - 06
2.	<b>Properties, significance &amp; applications of</b> a. Excipients used in various cosmetic formulations b. sensitivity & irritation tests for colours	03	03 - 06
3.	<b>Formulation, Manufacturing &amp; evaluation of cosmetics for</b> <b>a. Skin:</b> Powders, creams, lotions, deodorants, antiperspirants, suntan preparations, bathing preparations Make up preparations - Rouge, Lipsticks	14	15 - 20
	<b>b. Hair:</b> Shampoos, hair grooming preparations, preshave & after shave preparations, shaving preparations, depilatories & dyes.	06	08 - 12
	<b>c. Nail:</b> Nail lacquers, removers, nail bleach.	02	02 - 05
	<b>d. Eye:</b> Eye shadow, mascara, eyebrow pencil, eye make-up remover, eyeliners, eye cover-up makeup.	02	03 - 06
4.	<b>Aerosols:</b> Definition, advantages, disadvantages. Components, propellants, General formulation, Manufacturing, Evaluation & Pharmaceutical applications,	06	06 - 12

## References:

12. J. Knowlton and S. Rearce; Handbook of cosmetic sciences and technology Elsevier science publisher.
13. J. B. Wilkinson and R. J. Moore; Harry's cosmetology; Longman science and Technical.
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

Theory (3 hrs/wk.)

	Hrs	Marks
1. Fluid flow: Fluid statics, mechanism of fluid flow, Bernoulli's theorem, fluid heads, fluid handling (liquid and air)	06	08 - 12
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.	06	05 - 08
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.	05	05 - 08
4. Boilers: Main parts, mountings and accessories-industrial boilers including cochran, babcock wilcox and lancashire.	03	03 - 05
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.	06	08 - 12
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	05	05 - 08

- construction in the design of pharma packaging.
- |    |  |    |         |
|----|--|----|---------|
| 7. | Maintenance:   | 03 | 03 – 05 |
|    | 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 :   | 02 | 03 – 05 |
|    | 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:

1. Pharmaceutical Engineering by K. Sambamurthy ,New Age International Pvt. Ltd., New Delhi 1998
2. Introduction to Chemical Engineering (International Student Edition),By Walter L. Badger & Jullus T. Banthero, McGraw Hill Publications (29<sup>th</sup> Printing 1987)
3. Unit Process in Pharmacy by David Ganderton, William Helnemann Medical Borks Ltd, London, 1968
4. Perry's Chemical Engg. Handbook, 7<sup>th</sup> Edition/1997/International Edition McGraw Hill, Author Robert H. Perry, Don W. Green.
5. Elements of Mechanical and Electrical Technology, B.H. Deshmukh P.V. Mondke, Seventh Edition - Aug'92, Nirali Prakashan
6. Machine Drawing,By N.D. Bhat, 10<sup>th</sup> Edition,Published by Character Bork Stall, Tulsi Sadan, Anand; 1974
7. Elements of Heat Engines ,By N.G. Pandya, C.S. Shah,Fifth Revised and Enlarged Edition - 1966,Charotar book stall, Tulsi Sadan, Station Road, Anand (W.Rly), India
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.)
		Hrs	Marks
<b>1. Introduction :</b>		01	02 - 03
	Sources of Drugs- Serendipity, Random Screening, Extraction from Natural Sources, Molecular Modification.		
<b>2. Theoretical Aspects of Drug Action</b>		04	04 - 06
	The Ferguson's Principle		
	Physicochemical Parameters and Pharmacological Activity- Solubility, Partition Coefficient, Surface Activity, pKa, Ionisation, Stereochemical Factors, Bio-isosterism.		
<b>3. Metabolism</b>		04	04 - 06
	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.)		
<b>4. Introduction to Receptor Concept</b>		04	03 - 05
	History, affinity, receptor & biological response, drug-receptor interaction, forces involved in drug-receptor interaction, receptor theories, conformational flexibility and multiple modes of action.		
<b>5. The following classes of drugs should be discussed in relation to:</b>			
	<ul style="list-style-type: none"> <li>• Introduction to the rational development (if any)</li> <li>• Detailed Classification of each class</li> <li>• Mechanism of action</li> <li>• Synthesis of compounds with asterisk</li> </ul>	<ul style="list-style-type: none"> <li>• Structure-activity relationship</li> <li>• Generic names / Trade names</li> <li>• Chemical nomenclature</li> <li>• Metabolism</li> <li>• Uses</li> </ul>	
<b>6. Drugs Acting on ANS</b>		05	04 - 06
	<b>a. Drugs Acting on Cholinergic Nervous System:</b>		
	Bethanechol, Methacholin, Neostigmine, Physostigmine, Parathion, Atropine, Scopolamine, Hyocyanine, Dicyclomine*, Cyclopentolate*, Papaverine, Mecamylamine, d-Tubocurarine, Succinyl Choline.		
	<b>b. Drugs Acting on Adrenergic Nervous System:</b>	04	04 - 06
	Methyldopa, Reserpine, Ephedrine, Amphetamine, Pargyline, Norepinephrine, Epinephrine, Phenylephrine, Metarminol, Salbutamol*, Phenoxybenzamine, Tolazoline, Propranolol*, Atenolol, Metoprolol.		

<b>c. Local Anaesthetics:</b>	02	03 - 05
Lignocaine, Benzocaine, Lidocaine, Procaine, Bupivacaine.		
<b>7. Drugs Acting on Cardio Vascular System:</b>	05	05 - 07
<b>Anti Hypertensives &amp; Anti Arrhythmic Agents:</b>		
Calcium channel blockers lanotosides 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.		
<b>8. Antilipedemic Agents (Lipid lowering agents):</b>	Lipoproteins: 03	03 - 05
Classes & Metabolism, Hyperlipoproteineamias, Types and therapy, Clofibrate*, HMG-COA reductase inhibitors. (Provastatin*, Lovastatin, Simvastatin, Atorvastatin).		
<b>9. Diuretics:</b>	03	05 - 07
Acetazolamide*, Chlorothiazide*, Hydrochlorothiazide, Bendroflumethiazide, Furosemide, Torsemide, Ethacrynic Acid, Spironolactone, Triamterene, Amiloride*, Mannitol, Theophylline.		
<b>10 Hypotensive agents acting on vascular smooth muscle:</b>	Nitrites, amyl nitrite, glyceryl trinitrate, sodium nitrite, tetranitrate, mannitol, penterythritol tetranitrate, Isosorbide mononitrate, Isosorbide dinitrite.	02 03 - 05

#### Reference Books:

- Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
- Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
- Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
- Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
- The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols 1-6.
- Profiles in Drug Synthesis : V.N. Gogte
- Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
- Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
- Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
- Text Book of Practical Organic Chemistry - A.I. Vogel
- Practical Organic Chemistry - Mann and Sanders
- Systematic Identification of Organic Composition, Shriner and Fuson

**3.5.4 Pharmaceutical Polymer Chemistry**

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

	Hrs	Marks
<p><b>1. Introduction to Polymer Chemistry and its pharmaceutical applications:</b> 7      <b>8-11</b></p> <p>Introduction:</p> <p>Monomers, Polymers, backbone and side chains of polymers.</p> <p>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</p> <p>Classification of Polymers</p> <p>a) Addition Polymers: Addition to pi bonds- PVC, Teflon, polystyrene, polymethacrylate</p> <p>Macroscopic properties of these polymers- Crystalline (HDPE), Amorphous, Random conformation.</p> <p>b) Condensation Polymers/Co-polymers: Formation of condensation polymers- PET (polyethyleneterephthalate) and Nylon (6, 6).</p> <p>Pharmaceutical uses of polymers.</p>		
<p><b>2. Purines, Pyrimidines and nucleic acids:</b> 5      <b>6-9</b></p> <p>General knowledge of Nitrogenous 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.</p>		
<p><b>3. Introduction to chemistry of Pharmaceutical Excipients</b> 7      <b>8-10</b></p> <p>General Chemistry and Structure Property Relationship of</p> <p><b>1.1-Cellulose derivatives-</b></p> <p>Ethyl Cellulose, Hydroxy propyl methyl cellulose, Hydroxy propyl cellulose, Microcrystalline cellulose and Sodium carboxy methyl cellulose.</p> <p><b>1.2-Carbopols-</b></p> <p><b>1.3-PEG Derivatives-</b> Polyvinyl Alcohol, Polyvinyl Phthalate</p> <p><b>1.4-Plasticizers-</b> Triethyl citrate, Tri acetin, Propylene Glycol, and Glycerin.</p> <p><b>1.5- pH sensitive polymers-</b></p> <p><b>(a) Acrylic acid derivatives-</b> Solid and liquid eudragits.</p> <p><b>(b) Cellulose derivatives-</b> Cellulose acetate phthalate, hydroxyl propyl cellulose phthalate.</p> <p><b>1.6- Binders, Disintegrants and Super disintegrants -</b></p> <p><b>(a) Polysaccharides-</b> Gums and mucilages of starch, acacia and tragacanth.</p> <p><b>(b) Resins-</b> Indion-414 (Vinyl and divinyl benzene copolymers), Pyrrillidones, cross-povidone/ acdisol/ polyplasdane.</p> <p><b>1.7 Solubility enhancers/ Emulsifiers-</b> Tweens and Spans.</p>		

<b>4. Lipids:</b>	<b>6</b>	<b>6-8</b>
<p>Classification of lipids- Fats and oils, Phospholipids (Cephalins, Lecithins, Phosphatidyl serine &amp; 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.</p>		
<b>5. Carbohydrates:</b>	<b>5</b>	<b>6-8</b>
<p>General Chemistry of carbohydrates, classification, General methods of determination of molecular structure, Methods in determination of constitution of</p> <p>Monosaccharides-Glucose, Fructose and their reactions, Configuration of Aldoses, Cyclic Structure of D- Glucose, Mutarotation and Conformations, Amino sugars, D-Ribose, 2-deoxy-D-Ribose, Determination of Structure of Disaccharides-Maltose, Lactose, Sucrose, Structure of Polysaccharides-Starch, Cellulose, Dextran, Glycogen, Inulin and cyclodextrins.</p>		
<b>6. Natural Pigments:</b>	<b>7</b>	<b>6-9</b>
<p>Chemistry, classification and functions of Carotenoids, Anthocyanins and porphyrins. General Methods in elucidating their structures, determination of constitution of <math>\alpha</math> - Carotenes, <math>\beta</math> - Carotenes, Lycopene and haemoglobin. Pigments of medicinal importance.</p>		

#### Reference Books:

1. An Introduction to Physical Chemistry, Das Ishwar , Sharma Archana , New Age International (P), Limited, New Delhi
2. Biochemistry of Phenolic Compounds by Harborne J. B., Academic Press, New York.
3. Chemistry of Natural Products by O. P. Agrawal vol. I and II.
4. Hand book of Pharmaceutical excipients by R. C. Rowe, P. J. Sheskey and S. C. Owen.
5. Introduction to Polymers, By Robert J. Young, Amazon, UK.
6. Isolation and Identification of Drugs by Clarke ECG, The Pharmaceutical Press, London.
7. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
8. Martindale, The Extra Pharmacopoeia, Pharmaceutical Society of Great Britain, London.
9. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
10. Organic chemistry of natural product by Gurdeep chatwal vol. I and II.
11. Pharmacopoeia Of India, 1985, 1996, Govt. Of India, Ministry Of Health and Family Welfare.
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
14. Polymers: Chemistry and Physics of Modern Materials, Second Edition: Chemistry and Physics of Modern Materials, By John McKenzie Grant Cowie, Amazon, UK.
15. Terpenoids in Plants by Pridham J. B., Academic Press, New York.
16. The Biochemistry of Alkaloids by Robinson T., Springer- Verlag.
17. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
18. The Chemistry of Natural Products by De Mayo P, Interscience, New York.





3.5.5 Pharmacology – II		Theory	(4 hrs/wk.)
		Hrs	Marks
1	<b>Introduction to Pathophysiology</b>	02	02 - 04
2.	<b>Basic principles of cell injury and adaptations.</b>	03	05 – 08
	c. Causes, pathogenesis and morphology of cell injury.		
	d. Abnormalities in lipoproteinaemia, glycogen infiltration and glycogen storage disease.		
3.	<b>Basics mechanisms involved in the process of inflammation and repair.</b>	06	05 – 08
	e. Pathogenesis of acute inflammation.		
	f. Chemical mediators in inflammation.		
	g. Pathogenesis of chronic inflammation.		
	h. Repair of wounds in the skin. Factors influencing healing of wound.		
4	<b>Diuretics-</b>	02	02 – 04
	Role of nephron segments		
	Basic and clinical pharmacology of diuretics		
	Oedematous states and nonoedematous state		
5.	<b>Pathology, pharmacology and pharmacotherapy of</b>		13 – 21
	CCF	04	
	Arrhythmia	05	
	Ischemic heart diseases: angina pectoris and myocardial infarction.	05	
	Hypertension		
	Hyperlipidemia	05	
	Kidney and urinary tract disease	02	
	(terminological introduction to various disorders-		
	Glomerulonephritis, nephrotic syndrome, acute & chronic renal failure, pyelonephritis.)	04	
4.	<b>Autocoids</b>	12	13 – 17
	Kinins, prostaglandins ,Leukotrienes and cytokines		
	Thromboxane- biosynthesis and pharmacology		
	Histamines- release, immunological and non-immunological release and its pharmacology		
	Antihistaminics – H1 and H2 antagonists		
	Platelet activating factor.		

### **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)
9. Gaitonde BB & Nanivadekar - Tutorials in Pharmacology (New Literature Pub.)

### **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:**

1. Cosmetics: Formulation, Manufacturing Quality Control. P Sharma, Vandana Publications, 1998.
2. Modern Cosmetics : Thomson
3. Harry's Cosmeticology
4. Perry's Book of Cosmetics
5. Cosmetics Science & Technology : Edward Saggarin

### 3.5.7 Medicinal Chemistry – I

Practical (6 hrs/wk.)

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:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
5. The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols 1-6.
6. Profiles in Drug Synthesis : V.N. Gogte
7. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
8. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
9. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
10. Text Book of Practical Organic Chemistry - A.I. Vogel
11. Practical Organic Chemistry - Mann and Sanders
12. 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.
3. Experiments on Paper and Thin Layer Chromatographic evaluation of amino acids and proteins.
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.
2. The Chemistry of Natural Products by De Mayo P, Interscience, New York.
3. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
4. Biochemistry of Phenolic Compounds by Harborne J. B., Academic Press, New York.
5. Isolation and Identification of Drugs by Clarke ECG, The Pharmaceutical Press, London.
6. The Biosynthesis of Natural Products by Manitto P., Ellis Horwood, Chichester.
7. Martindale, The Extra Pharmacopoeia, Pharmaceutical Society of Great Britain, London.
8. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
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 , CaCl<sub>2</sub>)
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:

1. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
2. Hand book of Experimental Pharmacology, 2nd Ed., S. K. Kulkarni., Vallabh Prakashan, Delhi.
3. Sheth, U. K. Dadkar, N. k. and Kamat, U. G. Selected Topics in Experimental pharmacology.
4. Perry, W. L. M. Pharmacological Experiments on Isolated preparations.

**Semester - VI**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
3.6.1	<a href="#">Pharmaceutical Technology - II</a>	3	50
3.6.2	<a href="#">Pharmaceutical Unit Operations</a>	3	50
3.6.3	<a href="#">Medicinal Chemistry - II</a>	3	50
3.6.4	<a href="#">Pharmaceutical Analysis - III</a>	3	50
3.6.5	<a href="#">Pharmacology - III</a>	3	50
3.6.6	<a href="#">Pharmacognosy &amp; Phytochemistry - III</a>	3	50
	<b>Total</b>	<b>18</b>	<b>300</b>
<b>Practical</b>			
3.6.7	<a href="#">Pharmaceutical Technology - II (Practical)</a>	3	50
3.6.8	<a href="#">Pharmaceutical Unit Operations (Practical)</a>	3	50
3.6.9	<a href="#">Medicinal Chemistry - II (Practical)</a>	3	50
3.6.10	<a href="#">Pharmaceutical Analysis - III (Practical)</a>	3	50
3.6.11	<a href="#">Pharmacognosy &amp; Phytochemistry - III (Practical)</a>	3	50
	<b>Total</b>	<b>15</b>	<b>250</b>

### 3.6.1 Pharmaceutical Technology - II

Theory (3 hrs/wk.)

	Hrs	Marks
1. Tablets:	10	12 - 18
<p>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.</p> <p>Granulation: definition, reasons for granulation, method of granulation. Granulation mechanisms and mechanism of granule formation, pharmaceutical granulation equipments, IPQC.</p> <p>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</p>		
2. Capsules:	05	05 - 10
<p>Advantages, disadvantages.</p> <p>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.</p> <p>Soft gelatin capsule: capsule shell, capsule content, methods of production and evaluation as a dosage form.</p> <p>Importance of base adsorption and minim/gm factors in soft capsules.</p> <p>Comparison between soft and hard gelatin capsules.</p> <p>Stability testing and storage of capsule dosage forms.</p>		
3. Microencapsulation:	05	05 - 10
<p>Definition, applications, methods and advances in microencapsulation technology, equipment used, manufacturing processes and evaluation.</p>		
4. Oral sustained and controlled drug delivery:	10	12 - 20
<p>Definitions - historical development, components of therapeutic system - classification - details of matrix and diffusion control systems.</p> <p>Biopharmaceutical aspects-steady state concept and calculation of maintenance dose, loading doses.</p> <p>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.</p> <p>Design and evaluation of sustained release and controlled release preparations.</p> <p>Brief introduction to polymers</p>		

- |    |   |    |         |
|----|---|----|---------|
| 5. | Packaging of non-sterile pharmaceutical products:<br>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. | 04 | 03 – 06 |
| 6. | Plant layout techniques<br>Location, material handling, floor plans of different sections viz. Tablet, liquids, etc.  | 02 | 03 – 06 |

**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
2. American Pharmacy - Dittert (J. B. Lipincott)
3. Remington's Pharmaceutical Sciences -Alfonso R. Gennaro (Mack Publishing Co.)
4. E. A. Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
5. Frobisher - Fundamentals of microbiology (Toppan) Industrial Pharmacy (Lea & Febiger),Modern Pharmaceutics - (Dekker)
6. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
8. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.



3.6.2 Pharmaceutical Unit Operations		Theory	(3 hrs/wk.)	
			Hrs	Marks
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.		03	05 - 08
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.		04	05 - 08
3.	Evaporation: Basic concept of phase equilibria, factors affecting evaporation, evaporators, film evaporators, single effect and multiple effect evaporators.		03	03 - 10
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.		05	05 - 10
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.		04	05 - 10
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.		04	05 - 10
7.	Mixing: Theory of mixing, solid - solid, solid - liquid and liquid - liquid mixing equipments.		03	03 - 06
8.	Fluidization: Theory of fluidization. Application of fluidization in pharmacy in the areas of powder handling, agglomeration, drying and coating.		04	03 - 06
9.	Reactors: Fundamentals of Reactors, design for chemical reactions.		03	03 - 05
10.	Water purification: Deionization, reverse osmosis and distillation processes and large scale for manufacturing.		03	03 - 05

### Reference Books:

1. Pharmaceutical Engineering by K. Sambamurthy ,New Age International Pvt. Ltd., New Delhi 1998
2. Introduction to Chemical Engineering (International Student Edition),By Walter L. Badger & Julius T. Banthero, McGraw Hill Publications (29<sup>th</sup> Printing 1987)
3. Unit Process in Pharmacy by David Ganderton, William Helnemann Medical Borks Ltd, London, 1968
4. Perry's Chemical Engg. Handbook, 7<sup>th</sup> Edition/1997/International Edition McGraw Hill, Author Robert H. Perry, Don W. Green.
5. Elements of Mechanical and Electrical Technology, B.H. Deshmukh P.V. Mondke, Seventh Edition - Aug'92, Nirali Prakashan
6. Machine Drawing, By N.D. Bhat, 10<sup>th</sup> Edition, Published by Character Bork Stall, Tulsi Sadan, Anand; 1974
7. Elements of Heat Engines ,By N.G. Pandya, C.S. Shah, Fifth Revised and Enlarged Edition - 1966,Charotar book stall, Tulsi Sadan, Station Road, Anand (W.Rly), India
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

Theory (3 hrs/wk.)

	Hrs	Marks
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. <b>Antiamoebics:</b>	03	03 – 05
Life cycle of parasite, Ipecac alkaloids – emetine, metronidazole* and tinidazole, dicloxacillin furoate*, quinifamide		
2. <b>Anthelmintics</b>	04	04 – 06
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. <b>Antifungal agents</b>	03	03 – 05
Antibiotic like amphotericin B, Nystatin, and Griseofulvin, Tolnaftate*, Imidazole derivatives like miconazole*, fluconazole, ketoconazole*, clotrimazole, flucytosine.		
4. <b>Quinoline Antibacterials:</b>	02	03 – 05
Nalidixic acid, norfloxacin, ciprofloxacin*, sparfloxacin, ofloxacin.		
5. <b>Anti Tubercular and Antileprotic Agents:</b>	05	05 – 07
PAS*, isoniazid*, pyrazinamide*, ethionamide*, ethambutol*, antitubercular Antibiotics like rifampicin, cycloserine & streptomycin, dapsone, clofazimine, general principles and significance involving drug combinations.		

6.	<b>Antimalarials</b> 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* Antimalarial antibiotics & Misc. like halofantrine	04	06 – 08
7.	<b>Antibiotics:</b> $\beta$ -Lactam Antibiotics- Penicillins and Cephalosporins, Tetracyclines, Macrolide Antibiotics, Aminoglycosides, Lincomycins, Polypeptides, Chloramphenicol.	07	08 – 12
8.	<b>Antineoplastic agents</b> Problems faced in cancer chemotherapy, Alkylating Agents-Nitrogen mustards, cyclophosphamide*, busulfan*, carmustine, lomustine, mitomycin C, dacarbazine, and procarbazine. Antimetabolites-methotrexate*, 5-fluorouracil*, Ara-c, 6-HP, 6-TG. Antibiotics like dactinomycin, daunorubicin, doxorubicin, bleomycin, Plant products – vincristine, vinblastine, Misc. products like cisplatin, Hormones – Tamoxifen, Immunotherapy.	06	08 – 12

#### Reference Books:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
4. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
5. The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols. 1-6.
6. Profiles in Drug Synthesis : V.N. Gogte
7. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
8. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
9. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
10. Text Book of Practical Organic Chemistry - A.I. Vogel
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson

<b>3.6.4</b>	<b>Pharmaceutical Analysis - III</b>	<b>Theory</b>	<b>(3 hrs/wk.)</b>
			<b>Hrs    Marks</b>
	The theoretical aspect, basic instrumentation and applications of following analytical techniques should be discussed:		
1.	<p><b>UV-Visible spectrophotometry:</b></p> <p>In applications point to be covered</p> <p>Single component analysis, absorbtivity value, calibration curve, Single point and double point standard.</p> <p>Multiple component analysis, simultaneous equation method, difference spectroscopy.</p> <p>Colorimetric estimation by Oxidation, complexation and condensation reaction.</p> <p>Determination of <math>\lambda_{\max}</math> by Woodward-Fischer rule.</p>	06	08 - 12
2.	<b>Infrared spectrophotometry</b> , Introduction to FTIR	06	06 - 08
3.	<b>Nephelo-turbidimetry</b>	03	03 - 05
4.	<b>Fluorimetry &amp; Phosphorimetry</b>	04	03 - 05
5.	<b>Nuclear Magnetic Resonance spectroscopy including <sup>13</sup>C NMR</b>	06	08 - 10
6.	<b>Mass spectrometry</b>	06	06 - 08
7.	<b>Atomic Spectroscopy:</b> Introduction, Principle, Instrumentation, Interference, Applications of Atomic absorption spectroscopy and Flame photometry.	06	06 - 08

### Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II, The Anthlone Press of University of London.
4. Gary Christian- Analytical Chemistry (John Wiley).
5. Instrumental methods of Analysis- Ewing.
6. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
7. Garrat- The quantitative analysis of Drug (Toppan & Co.)
8. Analytical Chemistry an introduction, Skoog/West/Holler, 6<sup>th</sup> Edition.
9. Florey- Analytical profiles of drug substances (Academic press).
10. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition
11. Pharmaceutical Analysis Vol. II, A. V. Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More – Nirali Publication.
12. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.)
13. Merck Index.
14. Pharmaceutical Drug analysis by Ashutosh Kar.
15. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
16. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
17. Meites-Hand book of Analytical Chemistry (McGraw Hill).
18. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
19. Instrumental methods of Chemical Analysis by B. K. Sharma, 13<sup>th</sup> Edition.
20. Spectrometric Identification of Organic Compounds by Silverstein/Webster, 6<sup>th</sup> Edition.
21. Quantitative Analysis of Drug in Pharmaceutical Formulations by P.D. Sethi, 3<sup>rd</sup> Edition

3.6.5	<b>Pharmacology - III</b>	<b>Theory</b>	<b>(3 hrs/wk.)</b>
		<b>Hrs</b>	<b>Marks</b>
1.	<b>Immunopharmacology</b> 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, Immunosuppressants and its role in graft rejections.	3	08 - 12
2.	<b>Endocrinological disorders.</b> <ul style="list-style-type: none"> <li>• Drugs used in the endocrine disorders-</li> <li>• Thyroid hormone and Thyroid Inhibitors.</li> <li>• Insulin, Oral hypoglycemic drugs and Glucagon.</li> <li>• Gonadal hormones and their antagonists</li> </ul>	8	10 - 16
3.	<b>Chemotherapy:</b> <ul style="list-style-type: none"> <li>• General considerations: - General principles of chemotherapy of infections</li> <li>• Drug resistance: Introduction, types, mechanism and its importance in chemotherapy</li> <li>• Mechanism of action, Pharmacokinetics, Uses &amp; Adverse effect only to be discussed</li> <li>• Sulfonamides, Cotrimoxazole, Quinolones</li> <li>• Antibiotics effective against Gram-positive organisms- Penicillins</li> <li>• Antibiotics effective against Gram negative organisms- Amino glycosides</li> <li>• Antibiotics effective against both Gram positive &amp; Gram negative organisms- Cephalosporins, Tetracycline &amp; chloramphenicol.</li> <li>• Macrolide and other Antibacterial antibiotics, treatment of urinary tract infections and STDs</li> <li>• Chemotherapy of - Tuberculosis &amp; leprosy including National TB programmes (DOTS)</li> <li>• Protozoal infections (Antimalarials, antiamoebics, Trichomoniasis, leishmaniasis &amp; Kala azar infections)</li> <li>• Helminthiasis</li> </ul>	22 - 30	

- Fungal infections and its treatment
- Viral & HIV infections process and Antiretroviral drugs. HAART therapy of AIDS
- Antineoplastic agents. 4  
(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:**

1. General Pathology - Y.M. Bhende, S. G. Deodhare, S. S. Kelkar (Popular Prakashan).
2. Essential Pathology - Emanuel Rubin, John L., Farber J. B. Lippincott company.
3. Text book of Robbins Pathology Basis of Disease - Robins, Cotran, Kumar, Prism Indian Edition
4. Pocket comparison to Robbins Pathologic Basis of Disease, 5<sup>th</sup> Edition - Robbins, Cotran, Kumar, Prism Indian Edition.
5. Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T. W. Rall, AIS, Nies, P. Taylor, Pergamon Press, 2000.
6. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
7. M. P. Rang, M. M. Dale, J. M. Ritter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
8. Modern Pharmacology, C. R. Craig and R. E. Stitzel, Little Brown and Company, 1994.
9. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
10. Mycek MJ, Harvey RA and Champe PC, Lippincott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lippincott Williams & Wilkins, 1997.
11. Barar F. S. K., Test book of Pharmacology, Interprint, New Delhi.
12. Lawrence, D. R. and Bennet P.N. Clinical Pharmacology, Scientific Book agency, Calcutta.
13. P.S.R.K. Haranath, Synopsis of Pharmacology, 1995, Bombay.
14. Clinical Pharmacy and Therapeutics, Herfindal E. T., and Hirschman J. L. Williams and Wilkins.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
16. Pharmacotherapy: A Pathophysiological approach, Dipiro, J. L. Elsevier.3
17. Tripathi K D: Essentials of Medical Pharmacology. 2001, 4<sup>th</sup> Edition, Jaypee Brothers, New Delhi.
18. Ghosh M. N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
19. Hand book of Experimental Pharmacology, 2<sup>nd</sup> Ed., S. K. Kulkarni., Vallabh Prakashan, Delhi



3.6.6	<b>Pharmacognosy &amp; Phytochemistry - III</b>	<b>Theory</b>	<b>(3 hrs/wk.)</b>
		<b>Hrs.</b>	<b>Marks</b>
1.	<p><i>Study of biological sources, cultivation, collection, commercial varieties</i>  <i>Chemical constituents, general biosynthetic pathways, substitutes, adulterants,</i>  <i>uses, diagnostic macroscopic and microscopic features and specific chemical tests of</i>  <i>following groups of drugs containing glycosides:</i></p> <ul style="list-style-type: none"> <li>• <b>Saponins:</b> Liquorice, ginseng , Dioscorea , Sarsaparilla and Senega</li> <li>• <b>Cardioactive sterols:</b> Digitalis, Squill, Strophanthus and Thevetia.</li> <li>• <b>Anthroquinone cathartics:</b> Aloe, Senna, Rhubarb and Cascara</li> <li>• <b>Others:</b> Psoralea, Ammi majus, Ammi visnaga, Saffron, Chirata, Quassia. Wild cherry bark, mustard</li> </ul>	18	20 - 28
2.	<b>Introduction</b> to alternative systems of medicine, with special emphasis given on Ayurveda	03	04 - 06
3.	<b>Studies of traditional drugs</b> , 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.	11	12 - 15
4.	<p><b>The holistic concept of drug administration in traditional systems of medicine.</b></p> <p>Introduction to Ayurvedic preparations likes Aristas, Asvas, Gutikas, Tailas, Churnas, Lehyas and Bhasmas.</p>	04	04 - 06

## Reference Books:

1. Gamborg O. L. Wetter L. R., Plant tissue culture methods, National Research Council of Canada, Saskatoon.
2. Gibbs R Darnely, Chemotaxonomy of Flowering Plants 4 volumes, McGill, University Press.
3. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
4. Horborne J. B. Biochemistry of Phenolic Compounds, Academic Press, New York.
5. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
6. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
7. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
8. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
9. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
10. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester Manske RHF, The alkaloids Academic press, New York
11. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
12. Handa & Kapoor, Book of pharmacognosy
13. Ashutosh kar, Pharmacognosy and pharmacobiotechnology, New age International (P) Limited.

### 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.)
4. E. A. Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
5. Swarbrick & Boyan - Encyclopedia of Pharm. Technol - Dekker
6. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.

### 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.
6. Experiments illustrate solid - solid mixing, determination of mixing efficiency using different types of mixers.

#### Reference Books:

1. Pharmaceutical Engineering by K. Sambamurthy ,New Age International Pvt. Ltd., New Delhi 1998
2. Introduction to Chemical Engineering (International Student Edition),By Walter L. Badger & Jullus T. Banthero, McGraw Hill Publications (29<sup>th</sup> Printing 1987)
3. Unit Process in Pharmacy by David Ganderton, William Helnemann Medical Borks Ltd, London, 1968
4. Perry's Chemical Engg. Handbook, 7th Edition/1997/International Edition McGraw Hill, Author Robert H. Perry, Don W. Green.
5. Elements of Mechanical and Electrical Technology, B.H. Deshmukh P.V. Mondke, Seventh Edition - Aug'92, Nirali Prakashan
6. Machine Drawing, By N.D. Bhat, 10<sup>th</sup> Edition,Published by Charotar book stall, Tulsi Sadan, Anand; 1974
7. Elements of Heat Engines ,By N.G. Pandya, C.S. Shah, Fifth Revised and Enlarged Edition - 1966, Charotar book stall, Tulsi Sadan, Station Road, Anand (W.Rly), India
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:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
4. The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Volume 1-6.
5. Profiles in Drug Synthesis: V.N. Gogte Publication.
6. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
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
9. Text Book of Practical Organic Chemistry – A.I. Vogel
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.)

1. Spectrophotometric analysis of raw materials.
2. Spectrophotometric analysis of finished products.
3. Spectrophotometric & photofluorometric analysis of vitamins.
4. Estimation of Na<sup>+</sup>, K<sup>+</sup> by flame photometer.
5. Estimation of drugs by using turbidometer & nephelometer.

#### Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II., The Anthlone Press of University of London.
4. Gary Christian- Analytical Chemistry (John Wiley).
5. Instrumental methods of Analysis- Ewing.
6. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
7. Garrat- The quantitative analysis of Drug (Toppan & Co.)
8. Analytical Chemistry an introduction, Skoog/West/Holler, 6<sup>th</sup> Edition.
9. Florey- Analytical profiles of drug substances (Academic press).
10. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
11. Pharmaceutical Analysis Vol. II, A. V. Kasture, S. G. Wadhodkar, K. R. Mahadik, H. N. More -Nirali Publication.
12. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth Pub. Co.).
13. Merck Index.
14. Pharmaceutical Drug analysis by Ashutosh Kar.
15. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
16. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
17. Meites-Hand book of Analytical Chemistry (McGraw Hill).
18. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
19. Instrumental methods of Chemical Analysis by B. K. Sharma, 13<sup>th</sup> Edition.
20. Spectrometric Identification of Organic Compounds by Silverstein/Webster, 6<sup>th</sup> Edition.
21. Quantitative Analysis of Drug in Pharmaceutical Formulations by P.D. Sethi, 3<sup>rd</sup> Edition

### 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.
2. Miller L. P. Phytochemistry, 1-3 Van Nostrand Reinhold Co.
3. Nadkarni A. K. Indian Materia Medica, 1-2, Popular Prakashan Pvt. Ltd. Bombay.
4. Official methods of analysis, Association of official analytical chemists publications, Washington.
5. Peach K, and Tracey M. V., Modern methods of plant analysis, 1-4, Narosa Publishing house, New Delhi.
6. Pharmacopoeia of India, 1985, 1996, Govt. of India, Ministry of Health and Family Welfare.
7. Pridham J. B. and Swain T., Biosynthetic Pathways in Higher Plants, Academic Press, New York.
8. Pridham J. B. Terpenoids in Plants, Academic Press, New York.
9. Reinert J and Bajaj P. S. Applied and Fundamental aspects of plant cell tissue and organ culture, Berlin.
10. Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York.
11. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree ) Nirali Prakashan
12. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.

## Semester - VII

Sub Code	Subject	Hours / Week	Maximum marks
4.7.1	<a href="#">Biopharmaceutics &amp; Pharmacokinetics</a>	3	50
4.7.2	<a href="#">Medicinal Chemistry - III</a>	3	50
4.7.3	<a href="#">Pharmaceutical Analysis - IV</a>	3	50
4.7.4	<a href="#">Pharmacology - IV</a>	3	50
4.7.5	<a href="#">Pharmacognosy &amp; Phytochemistry - IV</a>	3	50
4.7.6	<a href="#">Elective</a> *	2	50
	<b>Total</b>	<b>17</b>	<b>300</b>
<b>Practical</b>			
4.7.7	<a href="#">Biopharmaceutics &amp; Pharmacokinetics. (Practical)</a>	3	50
4.7.8	<a href="#">Medicinal Chemistry - III (Practical)</a>	3+3	50
4.7.9	<a href="#">Pharmaceutical Analysis - IV (Practical)</a>	3	50
4.7.10	<a href="#">Pharmacology - IV (Practical)</a>	3	50
4.7.11	<a href="#">Pharmacognosy &amp; Phytochemistry - IV (Practical)</a>	3	50
	<b>Total</b>	<b>18</b>	<b>250</b>

### \* 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.



<b>4.7.1 Biopharmaceutics and Pharmacokinetics.</b>		<b>Theory</b>	<b>(3 hrs/wk.)</b>
		Hrs	Marks
1.	Plasma concentration and therapeutic response. An introduction to pharmacodynamics.	03	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	04	05 - 09
3.	Absorption: Factors affecting bioavailability, modified ph-partition theory or effect of unstirred water layer, dissolution rate and methods of enhancing dissolution rates. Official and unofficial methods of estimation of dissolution/in-vitro release of drugs from dosage forms. In-vitro in-vivo correlation and its significance. 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.	10	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.	04	05 - 09
5.	Elimination: Organ clearance concepts, hepatic clearance, hepatic extraction ratio, blood flow limitation in hepatic clearance, first pass effect. Clinical applications: effect of enzyme induction, enzyme inhibition, blood flow and protein binding on hepatic clearance, bioavailability, steady state plasma concentration and dosage regimens renal clearance and mechanisms of renal excretion, estimation of renal clearance, factors affecting renal elimination: clinical applications. Biliary clearance, enterohepatic cycling and other miscellaneous modes of drug elimination.	04	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.	03	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	08	05 - 10

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:**

1. Wagner, J.G. Biopharmaceutics and Relevant Pharmacokinetics, Drug Intelligence Pub. Hamilton.
2. Swarbrick, J: Current Concepts in the Pharmaceutical Sciences: Biopharmaceutics. Lea and Febiger, Philadelphia.
3. Wagner, J.G., Fundamentals of Clinical Pharmacokinetics. Drug Intelligence Publications, Hamilton.
4. Swarbrick, J: Current Concepts in the Pharmaceutical Sciences: Dosage Form Design and Bioavailability. Lea & Febiger, Philadelphia.
5. Gibaldi, M: Biopharmaceutics and Clinical Pharmacokinetics. Lea & Febiger, Philadelphia.
6. Rowland, M, and Tozer, T. N. Clinical pharmacokinetic: Concepts and Applications. Lea & Febiger, Philadelphia.
7. Notari, R.E., Biopharmaceutics and Clinical Pharmacokinetics, Marcel Dekker.
8. Gibaldi, M and Perrier, D: 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

<p><b>1. Drugs Acting on Central Nervous System</b></p> <p><b>b. Hypnotics and Sedatives :</b></p> <p>Chloral hydrate, Ethinamate, Glutethimide*, Phenobarbital, Talbutal, Pentobarbital*, Secobarbital, Hexobarbital, Nitrazepam, Bromazepam, Temazepam.</p>	05	05 - 07
<p><b>7. Drugs acting as anticonvulsants:</b></p> <p>Phenytoin*, Mephentoin, Trimethadione, Clonazepam, Phensuximide*, Ethosuximide, Phenacimide, Phenobarbital*, Mephobarbital (Classification of barbiturates) Metharbital, Carbamazepine, Sodium Valproate</p>	05	04 - 06
<p><b>8. Psychotherapeutic Agents :</b></p> <p>Phenothiazines such as Chlorpromazine*, Triflupromazine, Fluphenazine, Carphenazine, Chlorprothixene, Thioridazine, Fluplenthixol, Haloperidol*, Chlordiazepoxide, Flurazepam, Oxazepam, diazepam*, Meprobamate*, Imipramine, Desipramine, Amitriptyline, Nortriptyline, Doxepin, Phenelzine, Tranylcypramine, Pargyline, Fluoxetine, Loxapine.</p>	05	04 - 06
<p><b>9. CNS Stimulants :</b></p> <p>Phenmetrazine, Phendimetrazide, Fenfluramine, Methyl Phenidate, Nikethamide*, Iproniazide, Picrotoximes, Tetrazole and Hydrazine derivatives Amphetamine*, Methamphetamine.</p>	02	03 - 05
<p><b>10. Drugs used in Parkinsonism :</b></p> <p>Benzotropine mesylate, procyclidine, orphenidine, hydrochloride, Ethopropazine, levodopa, Carbidopa*, Benserazide, Amantadine*.</p>	02	03 - 05

<b>11. Drugs for Alzheimer's Diseases :</b>	01	03 - 05
Tacrine, Velnacrine, Aniracetam, Sibopiridine		
<b>12. General Anesthetics:</b>	02	03 - 05
Ether, Nitrous Oxide, Halothane, ultra short acting Barbiturates		
<b>2. CHEMOTHERAPY</b>	04	05 - 07
<b>c. Anti Virals:</b>		
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		
<b>d. Sulfonamides:</b> Importance of pKa in designing good Sulfonamides, Short, Intermediate & Long acting Sulphonamides, Sulphonamides for Ophthalmic Infections, Burn Therapy & Ulcerative colitis, Synergism with DHFR Inhibitors. Synthesis of Sulfacetamide*, Sulphapyridine*, Sulphaguanidine*, Sulphanilamide*.	04	04 - 06
<b>3. Vitamins and Related Compounds</b>	05	06 - 08
Water soluble & lipid soluble vitamins		

#### Reference Books:

- Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
- Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
- Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
- The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols 1-6.
- Profiles in Drug Synthesis : V.N. Gogte
- Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
- Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
- Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
- Text Book of Practical Organic Chemistry - A.I. Vogels
- Practical Organic Chemistry - Mann and Sanders
- Systematic Identification of Organic Composition, Shriner and Fuson



**4.7.3 Pharmaceutical Analysis - IV****Theory (3 hrs/wk.)**

	<b>Hrs</b>	<b>Marks</b>
1. <b>Quality Assurance:</b> Organization and responsibilities of QC, QA and TQM: Documentation, introduction to concept of ISO, ICH and GLP. Validation of analytical method.	04	03 - 05
2. <b>Chromatography :</b> Terminology used in different chromatographic techniques. Classification of chromatographic techniques. Development of chromatogram in different techniques.	04	03 - 05
<b>Planer chromatography:</b>	05	04 - 06
<b>Paper chromatography:</b> Theory, method of development, detection techniques and applications.		
<b>Thin-layer chromatography:</b> Theory, selection of adsorbent, preparation of the plate, spotting, development of chromatogram, detection of compound, recovery of components, Quantitative measurements and applications.	06	06 - 08
<b>HPTLC:</b> Introduction, theory and applications.	03	03 - 05
<b>Column chromatography:</b> Introduction, theory and applications.	03	03 - 05
<b>Gas chromatography:</b> Theory, instrumentation, detectors, applications and introduction to GC-MS.	06	06 - 08
<b>HPLC:</b> Theory, instrumentation (pumps, detectors and columns), applications.	07	06 - 08
<b>Ion-exchange chromatography:</b> Theory / Principle, instrumentation and applications.	03	03 - 05
<b>Gel permeation chromatography:</b> Theory /Principle, instrumentation and applications.	03	03 - 05

## Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II.,
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. II, A.V.Kasture, S.G.Wadhodkar, K.R. Mahadik, H.N. More – Nirali Publication.
11. Juran- Quality Control Handbook- McGraw Hill.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth)
14. OPPI- Quality Assurance Guide.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
16. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
18. Meites-Hand book of Analytical Chemistry (McGraw Hill).
19. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
20. Instrumental methods of Chemical Analysis by B.K.Sharma, 13<sup>th</sup> Edition.
21. Spectrometric Identification of Organic Compounds by Silverstein/Webster, 6<sup>th</sup> Edition.
22. Quantitative Analysis of Drug in Pharmaceutical Formulations by P.D. Sethi, 3<sup>rd</sup> Edition.
23. Haftmann- Chromatography (McGraw Hill).
24. Browning- Chromatography (McGraw Hill).
25. Lamprecht- Implementing ISO 9000 Series (Dekker).
26. Pharmaceutical Process Validation by Nash (Dekker).

4.7.4 Pharmacology - IV	Theory	(3 hrs/wk.)
	Hrs	Marks
<p><b>1. Central Nervous System:</b></p> <p>General Considerations- Neuro humoral transmission in the CNS            General Anesthetics- phases of anaesthesia.            Local Anesthetics            Sedative &amp; 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 &amp; 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.)</p>	18	20 - 26
<p><b>2. Respiratory disorders:</b></p> <p>Drugs for Cough, COPD and Bronchial asthma.            (Pathophysiology of cough, tonsillitis, emphysema, bronchitis, lung abscess, pneumonia, pulmonary embolism.)</p>	5	06- 12
<p><b>3. Gastrointestinal disorders and pharmacotherapy:</b></p> <ul style="list-style-type: none"> <li>• Gastric acidity and Peptic ulcer</li> </ul> <p>Irritable bowel syndroms - Ulcerative colitis, Crohn's disease, Achalasia, Harnia, Oesophagitis, Gastritis.</p> <ul style="list-style-type: none"> <li>• Constipation.</li> <li>• Diarrhoea</li> <li>• Emesis</li> <li>• Flatulence</li> </ul> <p>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)</p>	13	14 - 20



## Reference Books:

1. General Pathology – Y.M. Bhende, S. G. Deodhare, S.S. Kelkar (Popular Prakashan).
2. Essential Pathology – Emanuel Rubin, John L., Farber J.B. Lippincott company.
3. Text book of Robbins Pathology Basis of Disease – Robbins, Cotran, Kumar, Prism Indian Edition
4. Pocket comparison to Robbins Pathologic Basis of Disease, 5<sup>th</sup> Edition - Robbins, Cotran, Kumar, Prism Indian Edition.
5. Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T.W.Rall, AIS, Nies, P.Taylor, Pergamon Press, 2000.
6. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
7. M.P.Rang, M.M.Dale, J.M.Riter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
8. Modern Pharmacology, C.R.Craig and R.E.Stitzel, Little Brown and Company, 1994.
9. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
10. Mycek MJ, Harvey RA and Champe PC, Lipponcott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lipponcott Williams & Wilkins, 1997.
11. Barar F.S.K., Test book of Pharmacology, Interprint, New Delhi.
12. Lawrence, D.R. and Bennet P.N. Clinical Pharmacology, Scientific Book agency, Calcutta.
13. P.S.R.K. Haranath, Synopsis of Pharmacology, 1995, Bombay.
14. Clinical Pharmacy and Therapeutics, Herfindal E.T., and Hirschman J.L. Williams and Wilkings.
15. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
16. Pharmacotherapy: A Pathophysiological approach, Dipiro, J.L. Elsevier.3
17. Tripathi KD: Essentials of Medical Pharmacology. 2001, 4<sup>th</sup> Edition, Jaypee Brothers, New Delhi.
18. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
19. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi

**4.7.5 Pharmacognosy and Phytochemistry - IV****Theory****(3 hrs/wk.)**

	<b>Hrs.</b>	<b>Marks</b>
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	17	16 - 22
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	05	05 - 08
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	03	04 - 06
4. Natural allergens and photosensitizing agents and fungal toxins	03	04 - 06
5. Herbs as health food	03	04 - 06
6. Herbal cosmetics	03	04 - 06
7. Plant bitters and sweeteners.	02	03 - 05

### Reference Books:

1. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
2. Miller L. P. *Phytochemistry*, 1-3 Van Nostrand Reinhold Co.
3. Nadkarni A. K. *Indian Materia Medica*, 1-2, Popular Prakashan Pvt. Ltd. Bombay.
4. Official methods of analysis, Association of official analytical chemist publications, Washington.
5. Peach K, and Tracey M. V., *Modern methods of plant analysis*, 1-4, Narosa Publishing house, New Delhi.
6. *Pharmacopoeia of India*, 1985, 1996, Govt. of India, Ministry of Health and Family Welfare.
7. Pridham J. B. and Swain T., *Biosynthetic Pathways in Higher Plants*, Academic Press, New York.
8. Pridham J. B. *Terpenoids in Plants*, Academic Press, New York.
9. Reinert J and Bajaj P. S. *Applied and Fundamental aspects of plant cell tissue and organ culture*, Berlin.
10. Robinson, T., *The biochemistry of alkaloids*, Springer- Verlag, New York.

#### 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

	<b>Hrs</b>	<b>Marks</b>
1. Introduction to Pharmaceutical marketing	2	02 - 03
2. Influence of Pharmaceutical Technology on marketing new drugs & Optimizing therapeutic outcomes	3	03 - 05
3. Marketing of medicines for self medication	3	04 - 06
4. Retail pharmacist as a marketing target	2	04 - 06
5. Drug distribution channels & Practices	4	08 - 10
6. Advertising & Sales Promotion	3	06 - 08
7. Market Research & Sales Forecasting	3	07 - 10
8. International marketing	2	03 - 05
9. Industrial marketing	3	03 - 05

#### REFERENCE BOOKS:

6. Salesmanship, Sales management and advertisement - M. Satyanarayana
7. Business organization and management - M. C. Shukla
8. Principles of Pharmaceutical marketing. - Smith.
9. Modern marketing - Hapnar
10. Personal management

## 2. Medicinal Plant Biotechnology

		<b>Hrs</b>	<b>Marks</b>
1.	Introduction & Historical Perspective: Historical Background of Biotechnology and introduction to Medicinal Plant Biotechnology	02	02 – 03
2.	Enzymes: Introduction, mechanism of action, factors affecting action, classification, types of inhibition, isolation techniques, Immobilization of enzymes, Application of enzymes to plant biotechnology	03	05 – 07
3.	Fermentation Technology: Fermentation techniques, types, working of terminators, application of fermentation techniques to biotechnology, industrial production of Vitamins	03	06 – 09
4.	Plant Cell & Tissue culture: Introduction, cell culture techniques, cellular totipotency, Laboratory Organisation & Media, application to plant biotechnology	05	10 – 12
5.	Introduction to genetics: Genetics As Applied to Medicinal Herbs, Mutation, Polyploidy, Chemical races, Artificial Mutations, Hybridization, genetic engineering of plants.	03	06 – 09
6.	Recombinant DNA Technology: Introduction, transgenic plants, recombinant DNA techniques (Gene Splicing)	04	06 – 09
7.	Drug Delivery in Gene Therapy: Gene Transfer, objectives of gene therapy, diseases & gene therapy	04	05 – 09

### Reference Books:

16. Casida L. E., *Industrial Microbiology*, 2000, New Age International, Delhi.
17. De Kalyan Kumar, *Plant Tissue Culture*, 1<sup>st</sup> Edition, 1997, New Central Book Agency (P) Ltd.
18. Freifelder David, *Molecular Biology*, 2<sup>nd</sup> Edition, 1998, Narosa Publishing House.
19. J. I. Disouza, Killedar S. G., *Biotechnology and Fermentation Process*, Nirali Prakashan
20. Gennaro A. R., *Remington-the Science and Practice of Pharmacy*, 20<sup>th</sup> Edition, 2002, Lippincott Williams and Wilkins, New York.
21. Gupta P. K., *Elements of Biotechnology*, 1<sup>st</sup> Edition, 2001, Rastogi Pub., Meerut.
22. Higgins, Best D.J. and Jones J., *Biotechnology: Principles and Applications*, Blackwell Scientific Publications, Boston, MA 1985.
23. Kumar H. D., *Textbook of Biotechnology*, 2<sup>nd</sup> Edition, 1991, Affiliated East West Press Pvt. Ltd., New Delhi.
24. Patel A. H., *Industrial Microbiology*, 1984, Macmillan Ltd., Delhi.
25. Razdan M. K., *An Introduction to Plant Tissue Culture*, 1993, Oxford IBH Pub., New Delhi.
26. Reed Gerald, Prescott Dunn's *Industrial Microbiology*, 4<sup>th</sup> Edition, 1987, CBS Publishers and

Distributors, Delhi.

27. Singh B. D., *Biotechnology*, 2001, Kalyani Publisher.
28. Stanbury P. F., Whitekar A. and Hall S. J., *Principles of Fermentation Technology*, 2<sup>nd</sup> Edition, 1997, Aditya Books (P) Ltd., New Delhi.
29. Trevan Keshav, *Biotechnology*, 4<sup>th</sup> Edition, 1990, New Age International Ltd. Pub., New Delhi.
30. Vyas, S. P., Dixit V. K., *Pharmaceutical Biotechnology*, 1<sup>st</sup> Edition, 1999, CBS Publishers and Distributors, Delhi.

### 3. Quality assurance

	<b>Hrs</b>	<b>Marks</b>
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:**

12. S. Weinberg, Good laboratory practice Regulations, Marcel and Dekker.
13. J. Swarbrick Boylan, encyclopedia of pharmaceutical technology, Marcel and Dekker.
14. J.R. Berry and R.A. Nash, Pharmaceutical process validation. Marcel and Dekker.
15. S.H. Will and J.R. Stoker, good manufacturing Practices for Pharmaceutics Marcel Dekker.
16. R.F. Brewer, Design of experiments for process improvement and quality Assurance Narrosa.
17. B. Othery. ISO 14000 and ISO 9000 Gower.
18. D.H. Stamatis, Understanding ISO 9000 and implementing the basics to quality; Marcel Dekker.
19. Pharmaceutical Quality Assurance – Prof. M.A. Potdar – Nirali Prakashan
20. Chronicle Pharmabiz
21. Pharmapulse
22. Pharmaceutical product development – N. K. Jain – CBS Publications.



#### 4. Drug Design and lead Identification

		<b>Hrs</b>	<b>Marks</b>
1.	Receptor: Introduction to receptors, Types of receptors with example, Receptor theories, Drug receptor interactions, Design of agonist and antagonist with example.	06	08 - 12
2.	QSAR: QSAR parameters, QSAR models-General concept, Applications and limitations of QSAR in drug design	08	12 - 15
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.	08	12 - 15
4.	Molecular modeling & drug design: General concept, Introduction to molecular mechanics and quantum mechanics, Concept of known and unknown receptor	06	08 - 12

#### References:

7. Ariens - drug design Vol. - II.
8. Annual Reports in medicinal chemistry (Academic press Inc.)
9. Smith - William - Introduction to the principles of drug design.
10. Woodridge - Progress in pharmaceutical Research.
11. Medicinal Chemistry - Monographs series (Academic Press).
12. Burgers - Medicinal Chemistry & Drug Discovery

## 5. Bioavailability and TDM

	<b>Hrs</b>	<b>Marks</b>
<b>1. Bioavailability &amp; Bioequivalence:</b>	06	10 - 15
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.		
<b>2. INTRODUCTION TO THERAPEUTIC DRUG MONITORING</b>	04	08 - 10
Definition & introduction.		
Indication for TDM & clinical applications.		
Monitoring plasma drug levels.		
Role of Clinical pharmacist in TDM.		
<b>3. TECHNIQUES USED IN TDM</b>	07	11 - 15
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.		
<b>4. TDM OF SPECIFIC DRUGS</b>	07	11 - 15
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	4. Lithium	7. Phenobarbitone
2. Gentamicin.	5. Theophylline	8. Carbamazepine
3. Lidocaine	6. Phenytoin	9. Valproic acid

**References:**

8. Clinical pharmacy practice - C. W. Blissit.
9. Therapeutic drug monitoring - B. Widdop
10. TDM & Clinical biochemistry - Mike Hallworth
11. Textbook of therapeutics, Drug & disease management - 7<sup>th</sup> edition - Eric T. Herfindel, Dick. R. Gourley.
12. Recent developments in TDM & Clinical toxicology - I. Sunshine - Marcel - Dekker - 1992.
13. Handbook of TDM. - Simkin
14. TDM - Abbot

## 6. Cosmeceutics

	<b>Hrs</b>	<b>Marks</b>
1. <b>Physiological Consideration:</b> Skin, hair, nail and eye- in relation to cosmetic application.	03	04 – 06
2. <b>Rheology of cosmetics:</b> Rheological additives in cosmetics, rheology of nail products, antiperspirants, deodorants, hair products, creams and lotions.	02	03 – 05
3. <b>Manufacturing techniques:</b> Cosmetics creams, powders, compacts, sticks, liquids, foam and aerosol cosmetics.	07	15 – 20
4. <b>Evaluation of cosmetics: Performance,</b> Physicochemical, microbiological and psychometric evaluation of cosmetics. Design and Assessment of preservative systems for cosmetics, valuation of preservatives in cosmetic products and factors affecting activity of preservatives. Testing of moisturizers, deodorants, antiperspirants, sunscreens and anti-aging products.	05	08 – 12
5. <b>Clinical safety tasting :</b> Irritation, sensitization, photoirritation, photoallergy, ocular irritation and protocols for the same.	03	05 – 07
6. <b>Packaging :</b> Package development and design for cosmetics including aerosol packs.	02	05 – 07

### References:

13. J. Knowlton and S. Rearce; Handbook of Cosmetic Sciences and Technology Elsevier Science Publisher.
14. J. B. Wilkinson and R. J. Moore; Harry's cosmetology; Longman Science and Technical.
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.
21. C. G. Gebelein, T. C. Cheng and V. C. Yang; Cosmetic and Pharmaceutical applications of polymers; Plenum Press.
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

	<b>Hrs</b>	<b>Marks</b>
1. Introduction to Packaging Technology Importance/ need of packaging, ideal characters of packaging materials.	02	03 – 05
2. Packaging Materials used in Pharmacy Primary & secondary packages: Glass: Composition of glass, types, production of glass materials, defects in glass Plastic: comparison of plastic & glass, thermosetting & thermoplastics, polyethylene, polypropylene, PVC, Polystyrene, Nylon, Polycarbonate, acrylic multipolymers, polyethylene terphthalate, drug plastic considerations. Metals: Tin, Aluminium, Lead, Stainless Steel & others Rubber: Composition & types, Applications as closure.	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.	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.	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.	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 & hermetically sealed pharmaceutical containers, introduction to 'blow-fill-seal-technology'	03	04 – 06

## References:

8. Pharmaceutical Dosage forms - Ansel - Popovich & Allen. (Text book) and Drug Delivery system - (Williams & Wilkins)
9. Remington's Pharmaceutical Sciences -Alfonso R. Gennaro (Mack Publishing Co.)
10. E. A. Rawlins: Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1988.
11. Swarbrick & Boyan - Encyclopedia of Pharm. Technol - Dekker
12. Handbook of packaging of medicinal devices - Dekker
13. L. Lachman, H. A. Lieberman and J. L. Kaing: The Theory and practice of Industrial Pharmacy, Vargheese Publishing House, Mumbai, 1987.
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.
2. Analysis of biological specifications for drug content and estimation of the pharmacokinetic parameter.
3. In vitro evaluation of different dosage forms for drug release.
4. Absorption studies- in-vitro and in- situ.
5. Statistical treatment of pharmaceutical data.

#### Reference Books:

1. Wagner, J.G. Biopharmaceutics and Relevant Pharmacokinetics, Drug Intelligence Pub. Hamilton.
2. Swarbrick, J: Current Concepts in the Pharmaceutical Sciences: Biopharmaceutics. Lea and Febiger, Philadelphia.
3. Wagner, J.G., Fundamentals of Clinical Pharmacokinetics. Drug Intelligence Publications, Hamilton.
4. Swarbrick, J: Current Concepts in the Pharmaceutical Sciences: Dosage Form Design and Bioavailability. Lea & Febiger, Philadelphia.
5. Gibaldi, M: Biopharmaceutics and Clinical Pharmacokinetics. Lea & Febiger, Philadelphia.
6. Rowland, M, and Tozer, T. N. Clinical pharmacokinetic: Concepts and Applications. Lea & Febiger, Philadelphia.
7. Notari, R.E., Biopharmaceutics and Clinical Pharmacokinetics, Marcel Dekker.
8. Gibaldi, M and Perrier, D: 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

#### 4.7.8 Medicinal Chemistry – III

Practical (6 hrs/wk.)

1. Laboratory scale preparation of the following compounds & characterization by TLC & IR
  - Sulphanilamide
  - Esters
  - Hydrazide
  - Chloramine – T
  - Benzotriazole
  - Paracetamol
  - Aspirin
  - Benzophenones
  - Phenytoin
  - Methyl orange

#### Reference Books:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
4. The Organic Chemistry of Drug Synthesis: Daniel Ledmicer, John Wiley and Sons. Inc. Vols 1-6.
5. Profiles in Drug Synthesis : V.N. Gogte
6. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
7. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
8. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
9. Text Book of Practical Organic Chemistry – A.I. Vogel
10. Practical Organic Chemistry – Mann and Sanders
11. Systematic identification of Organic Composition, Shriner and Fuson



#### 4.7.9 Pharmaceutical Analysis – IV

Practical (3 hrs/wk.)

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.
9. Chromatographic analysis of Pharmaceutical formulations from following classes-Tablets, Capsule, Injectables, Liquid orals, Eye ointments.
10. Column chromatographic separations of two component mixtures.

#### Reference Books:

1. Bassett J, Denny R C, Jeffery G H, Mendharn J, Vogel's Textbook of Quantitative Inorganic Analysis, ELBS/Longman, London.
2. Grant- Statistical Quality control (McGraw Hill).
3. Beckett A H and Stenlake J B, Practical Pharmaceutical Chemistry Vol. I and II.,
4. Connors K A, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
5. Gary Christian- Analytical Chemistry (John Wiley).
6. Instrumental methods of Analysis- Ewing.
7. Higuchi & Brochmann- Hanssen- Pharmaceutical Analysis- (Interscience).
8. Garrat- The quantitative analysis of Drug (Toppan & Co.)
9. Vogel Text Book of Practical Organic Chemistry – 5<sup>th</sup> edition.
10. Pharmaceutical Analysis Vol. II, A.V.Kasture, S.G.Wadhodkar, K.R. Mahadik, H.N. More – Nirali Publication.
11. Juran- Quality Control Handbook- McGraw Hill.
12. Florey- Analytical profiles of drug substances (Academic press).
13. Instrumental methods of Analysis- Willard, Dean, Merrit and settle- (Wadsworth)
14. OPPI- Quality Assurance Guide.
15. Pharmaceutical Drug analysis by Ashutosh Kar.
16. Principles of Instrumental analysis, Skoog/Holler/Nieman, 5<sup>th</sup> Edition.
17. Latest editions of IP, BP, USP, EP and International Pharmacopoeia.
18. Meites-Hand book of Analytical Chemistry (McGraw Hill).
19. Hamilton, Simpson and Ellis- Calculation of Analytical Chemistry (McGraw Hill).
20. Instrumental methods of Chemical Analysis by B.K.Sharma, 13<sup>th</sup> Edition.
21. Spectrometric Identification of Organic Compounds by Silverstein/Webster, 6<sup>th</sup> Edition.
22. Quantitative Analysis of Drug in Pharmaceutical Formulations by P.D. Sethi, 3<sup>rd</sup> Edition.
24. Browning- Chromatography (McGraw Hill).
25. Lamprecht- Implementing ISO 9000 Series (Dekker).
26. 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:

1. Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T.W.Rall, AIS, Nies, P.Taylor, Pergamon Press, 2000.
2. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
3. M.P.Rang, M.M.Dale, J.M.Riter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
4. Modern Pharmacology, C.R.Craig and R.E.Stitzel, Little Brown and Company, 1994.
5. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
6. Mycek MJ, Harvey RA and Champe PC, Lipponcott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lipponcott Williams & Wilkins, 1997.
7. Barar F.S.K., Test book of Pharmacology, Interprint, New Delhi.

#### 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.
2. Miller L. P. Phytochemistry, 1-3 Van Nostrand Reinhold Co.
3. Nadkarni A. K. Indian Materia Medica, 1-2, Popular Prakashan Pvt. Ltd. Bombay.
4. Official methods of analysis, Association of official analytical chemists publications, Washington.
5. Peach K, and Tracey M. V., Modern methods of plant analysis, 1-4, Narosa Publishing house, New Delhi.
6. Pharmacopoeia of India, 1985, 1996, Govt. of India, Ministry of Health and Family Welfare.
7. Pridham J. B. and Swain T., Biosynthetic Pathways in Higher Plants, Academic Press, New York.
8. Pridham J. B. Terpenoids in Plants, Academic Press, New York.
9. Reinert J and Bajaj P. S. Applied and Fundamental aspects of plant cell tissue and organ culture, Berlin.
10. Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York.

**Semester - VIII**

<b>Sub Code</b>	<b>Subject</b>	<b>Hours / Week</b>	<b>Maximum marks</b>
4.8.1	<a href="#">Pharmaceutical Technology - III</a>	3	50
4.8.2	<a href="#">Pharmaceutical Jurisprudence</a>	3	50
4.8.3	<a href="#">Pharmaceutical Industrial Management</a>	3	50
4.8.4	<a href="#">Medicinal Chemistry - IV</a>	3	50
4.8.5	<a href="#">Pharmacology - V</a>	4	50
	<b>Total</b>	<b>16</b>	<b>250</b>
<b>Practical</b>			
4.8.6	<a href="#">Pharmaceutical Technology - III (Practical)</a>	3	50
4.8.7	<a href="#">Medicinal Chemistry - IV (Practical)</a>	3+3	50
4.8.8	<a href="#">Pharmacology - V (Practical)</a>	3	50
4.8.9	<a href="#">Project work.</a>	3	50
	<b>Total</b>	<b>15</b>	<b>200</b>

4.8.1 Pharmaceutical Technology - III		Theory	(3 hrs/wk.)	
		Hrs	Marks	
1.	Sterile delivery system: Introduction and concepts.	03	03 - 06	
2.	Parenteral drug delivery system: <ul style="list-style-type: none"> <li>• General requirements</li> <li>• 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.</li> <li>• 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).</li> <li>• 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.</li> <li>• 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.</li> <li>• Processing of parenteral products by terminal sterilization, filtration sterilization followed by aseptic filling and by aseptic compounding. Validation of sterilization and process validation.</li> <li>• Quality control and quality assurance.</li> <li>• Factory layout: different departments, services and utilities</li> </ul>	15	12 - 18	
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	7	09 - 12	
4.	Biological Pharmaceuticals <ul style="list-style-type: none"> <li>• Blood Products: Whole human blood, blood products and plasma substitutes and its quality control.</li> <li>• 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.</li> <li>• Surgical Products: Definition, primary wound dressing, absorbents, surgical cotton, surgical gauzes etc. bandages, absorbable and</li> </ul>	7	08 - 12	

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). | 4  | 05 - 09 |
| 5. | Pilot plant scale up technique<br>Groups responsibilities - facilities - example of scaling up  | 02 | 03 - 06 |

### 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)
7. Pharmaceutical Microbiology- Hugo and Roussel - (McGraw Hill)
8. Groves - Parenteral Products - (William Heinemann Medical Books Ltd.)
9. Hanlon - H.B. of package Engg. - (McGraw Hill)
10. Swarbrick & Boylan - Encyclopedia of Pharm. Technology. - (Dekker)
11. Remington's Pharmaceutical Sciences. (Mack)

#### 4.8.2 Pharmaceutical Jurisprudence

Theory (3 hrs/wk.)

	Hrs	Marks
1. Pharmacy Act 1948:	08	08 - 12
2. Drugs and Cosmetics Act 1940/Rules 1945 : 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.	12	10 - 15
3. Narcotic Drugs and Psychotropic Substances Act 1985: Historical background of Opium Act and Dangerous Drugs Act. Prohibitions and penalties.	04	05 - 08
4. Drugs and Magic Remedies Act 1954: Definitions, Official's duties, Prohibitions, Penalties etc.	02	03 - 05
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.	04	05 - 08
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.	03	03 - 06
7. Prevention of Cruelty to Animals Act-CPSEA rules.	03	03 - 05
8. Code of Pharmaceutical Ethics	02	03 - 05

**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
6. Bare Acts.
7. Handbook of Drug Laws - M. L. Mehta



<b>4.8.3 Pharmaceutical Industrial Management</b>		<b>Theory</b>	<b>(3 hrs/wk.)</b>
		<b>Hrs</b>	<b>Marks</b>
1.	<p>Global Market (Import – Export):</p> <p>Deciding whether to go abroad, Deciding how to enter the markets.</p> <p>Indirect Export, Direct Export, Licensing, Joint ventures, Direct investment, Internationalization process, Deciding on the Marketing Organization, Export Department, International Division, Global Organization.</p> <p>Patents and its implications:</p> <p>Indian Patents act 1970, New patent requirement as per TRIPS agreement Patent (amendment) Bill 1995</p>	02	03 – 05
2.	<p>Trade related intellectual property (TRIPS):</p> <p>TRIPS agreement, Intellectual Property Rights, Types of intellectual properties, Copyrights, trademarks, geographical indications. Industrial designs, layout designs, trade revert.</p>	02	03 – 05
3.	<p>GATT agreement and its impact on pharmaceutical industry:</p> <p>GATT, History of GATT, Its impact on pharmaceutical industry, Pharmaceutical market in India</p>	02	03 – 05
4.	<p>Concepts of Management:</p> <p>Business Management Thought, Functions, types of Organizations, Techniques of Communication, direction Participation, delegation, decision making, control Tools like PERT, CPM, systems.</p>	05	06 – 08
5.	<p>Production Planning and Control systems:</p>	03	03 – 05
6.	<p>Materials Management systems:</p> <p>Purchase and Inventory Control, Material Handling.</p>	03	03 – 05
7.	<p>Understanding marketing management:</p> <p>Role of marketing in today’s organization, identifying and classifying market, understanding market behavior/consumer behavior, Pharmaceutical market in India, Pharmaceutical Industry Scenario.</p>	05	06 – 08
8.	<p>Analyzing Marketing Opportunities:</p> <p>Market measurement and sales forecasting, Market segmentation, Market targeting. Planning marketing programmes, Role of product manager, New product launch and development, Product life cycle, Planning marketing tactics, National drug policy, Product, Brand and Packing. Marketing channel decisions, Wholesalers, Retailers.</p>	05	04 – 06
9.	<p>Interviewing techniques</p>	03	03 – 05
10.	<p>Community Pharmacy Practice</p>	02	03 – 05
11.	<p>Sales Management</p>	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
8. Pharmaceutical Marketing in India - SVR Subha Rao
9. Patenting - N.R.Subbram [Pharma book syndicate]

4.8.4	<b>Medicinal Chemistry - IV</b>	<b>Theory</b>	<b>(3 hrs/wk.)</b>
		<b>Hrs</b>	<b>Marks</b>
1.	<b>Introduction to QSAR</b> Statistical prediction & pharmacological activity - partition coefficient, QSAR models, stearic factors, molecular modeling (CADD) Hansch equation.	05	06 - 08
2.	<b>Introduction to Prodrugs and orphan drugs</b> The following classes of drugs should be discussed in relation to: <ol style="list-style-type: none"> <li>i. Introduction to the rational development (if any)</li> <li>j. Mechanism of action</li> <li>k. Synthesis of compounds with asterisk</li> <li>l. Structure-activity relationship</li> <li>m. Generic names</li> <li>n. Chemical nomenclature</li> <li>o. Detailed Classification of each class</li> <li>p. Uses</li> </ol>	04	05 - 07
3.	<b>Analgesics, Antipyretics and Anti-inflammatory agents:</b> Aspirin*, Acetaminophen*, Phenylbutazone*, Oxyphenbutazone, Ibuprofen, Sulindac, Naproxen*, Probenecid, Allopurinol, Ketoprofen, Diclofenac, Oxicams like piroxicam, Nimesulide, Fenamates.  <b>Narcotic Analgesic Agents :</b> Morphine, Oripavine, Codeine, ethylmorphine, dihydrocodeine*, Metopan, Levarphanol, Dextromethorphan, Meperidine*, anilaridine, Methadone*, meperidine, dextropropoxyphene and pentazocine.  <b>Non-narcotic analgesic agents :</b> Dextropropoxyphene* and Ethoheptazine, Morphine antagonists, n-allyl-nor morphine levellorphan, naloxone.	08	09 - 14

4.	<b>Steroids :</b> 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, Mestramol, chlorotrainisene, Estrone, Dienesterol, Diethylstilbesterol and other non-steroidal estrogens Progestational agents: Progesterone, Norethindrone, Norgestrel, Dimethisterone. Oral contraceptives	08	08 -11
5.	<b>Antihistaminics, Antiemetics and antiulcer drugs:</b> Metoclopramide, Diphenhydramine*, Doxylamine, Triprolidine, chlorpheniramine, Antazoline, Cyproheptadine, Terfenadine, Cimetidine, Omeprazole*, Lansoprazole, Ranitidine*, Famotidine, Ondansetron, Tripeleminast*.	04	04 - 06
6.	<b>Thyroid Function and Thyroid Drugs:</b> Thyroid Hormone, Methimazole, Propyl Thiouracil, Thyroid Analogs.	04	04 - 07
7.	<b>Oral Hypoglycemics:</b> Sulfonylureas-Tolbutamide*, Glimpiride*, Biguanides- Metformin, Thiazolidinediones- Ciglitazone, Rosiglitazone, Acarbose, Repaglinide.	03	04 - 07

#### Reference Books:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
4. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
5. The Organic Chemistry of Drug Synthesis: Daniel Lednicer, John Wiley and Sons. Inc. Vols 1-6.
6. Profiles in Drug Synthesis : V.N. Gogte
7. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
8. Textbook of Pharmaceutical Chemistry by Harkishansing & Kapoor.
9. Principle of Medicinal Chemistry ( Volume I & II ) by Kadam , Mahadik and Bothara
10. Text Book of Practical Organic Chemistry - A.I. Vogel
11. Practical Organic Chemistry - Mann and Sanders

12. Systematic Identification of Organic Composition, Shriner and Fuson

4.8.5 Pharmacology - V		Theory	(4 hrs/wk.)
		Hrs	Marks
1.	Drugs used in the disorders of eye, skin & ENT	06	06 - 08
	a) Ocular pharmacology -Glaucoma, keratitis, conjunctivitis, loss of vision, cataract, Squint. (Pharmacotherapy of Glaucoma)		
	b) ENT -Acute epiglottitis, allergic rhinitis, otitis externa, otitis media, wax (cerumen), vertigo, meneiers 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.	03	02 - 03
3.	Pathophysiology of blood disorders and drugs acting on hemopoietic system - Coagulants and anti-coagulants. Haemopoietics. Thrombolytics and antiplatelet agents.	06	03 - 04
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.	10	05 - 07
5.	Adverse drug reactions - types, reporting and monitoring.	03	03 - 04
6.	Drug interactions - Definitions of Drug-Drug, Drug-food interaction classification of Drug-Drug interaction. Basic concepts of mechanisms of drug - drug interactions.	03	05 - 07
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 i) Barbiturates ii) Alcohols iii) Benzodiazepines iv) Antidepressants v) Neuroleptics vi) Insecticides vii) Snake bite viii) Heavy metals (iron, lead, mercury, arsenic). Managements of poisonous patient.	07	05 - 07
8.	Introduction to TDM.	02	02 - 03
9.	<b>Bioassays:</b> Definition, Applications, Principles & Types of bioassays. Bioassay of Acetylcholine, d-TC, Histamine, Adrenaline, Digitalis, Heparin, Insulin.	06	06 - 10
10.	<b>Clinical trials</b>	02	03 - 04

## Schedule Y, ICH -GCP guidelines

### Reference Books:

- 1 Goodman and Gilman's the Pharmacological basis of Therapeutics. Editors: A Goodman Gilman, T.W.Rall, AIS, Nies, P.Taylor, Pergamon Press, 2000.
2. Katzung, B.G.: Basic and Clinical Pharmacology, Prentice Hall, International.
3. M.P.Rang, M.M.Dale, J.M.Riter., Pharmacology, 4<sup>th</sup> Edition, Churchill, Livingstone, 1995
4. Modern Pharmacology, C.R.Craig and R.E.Stitzel, Little Brown and Company, 1994.
5. Paul, L. Principles of Pharmacology, Chapman and Hall, 1995.
6. Mycek MJ, Harvey RA and Champe PC, Lipponcott's Illustrated Reviews: Pharmacology. 2<sup>nd</sup> Edition. Lipponcott Williams & Wilkins, 1997.
7. Barar F.S.K., Test book of Pharmacology, Interprint, New Delhi.
8. Lawrence, D.R. and Bennet P.N. Clinical Pharmacology, Scientific Book agency, Calcutta.
9. P.S.R.K. Haranath, Synopsis of Pharmacology, 1995, Bombay.
10. Clinical Pharmacy and Therapeutics, Herfindal E.T., and Hirschman J.L. Williams and Wilkings.
11. Applied therapeutics: The clinical use of drugs, applied therapeutics, Inc.
12. Pharmacotherapy: A Pathophysiological approach, Dipiro, J.L. Elsevier.3
13. Tripathi KD: Essentials of Medical Pharmacology. 2001, 4<sup>th</sup> Edition, Jaypee Brothers, New Delhi.
14. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
15. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi

#### 4.8.6 Pharmaceutical Technology - III

Practical (3 hrs/wk.)

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.)
9. Hanlon - H.B. of package Engg. - (McGraw Hill)
10. Swarbrick & Boylan - Encyclopedia of Pharm. Technology. - (Dekker)
11. Latest IP, BP, USP, Etc.



#### 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:

1. Principles of Medicinal Chemistry, Foye, Lemke and Williams, Indian Ed. B. I. Waverly, Pvt. Ltd. New Delhi 1995.
2. Wilson and Gisvold, Textbook of Organic Medicinal and Pharmaceutical Chemistry, J. N. Delgado, W.A. Remers, Lipincott-Raven 10<sup>th</sup> Ed., 1998.
3. J. B. Stenlake Vol. I & II: Foundations of Molecular Pharmacology - The Chemical basis of drug action (Athlone Press - The University of London).
4. Essentials of Medicinal Chemistry by Koralkovas, 2<sup>nd</sup> edition, Wiley- Inter science Pub. 1988.
5. The Organic Chemistry of Drug Synthesis: Daniel Ledmicer, John Wiley and Sons. Inc. Vols. 1-6.
6. Profiles in Drug Synthesis: V. N. Gogte
7. Burger's Medicinal Chemistry and Drug Discovery (Vol. 1-5) Wiley Inter science Publication.
8. Textbook of Pharmaceutical Chemistry by Harkishan singh & Kapoor.
9. Textbook of Practical Organic Chemistry - A.I. Vogel; ELBS
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.
9. To carry out bioassay of oxytocin using isolated rat uterus preparation by interpolation method.

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

#### Reference Books:

1. Ghosh M.N., Fundamentals of Experimental Pharmacology, Scientific Book agency, Calcutta.
2. Hand book of Experimental Pharmacology, 2nd Ed., S.K.Kulkarni., Vallabh Prakashan, Delhi.
3. Sheth, U. K. Dadkar, N. k. and Kamat, U. G. Selected Topics in Experimental pharmacology.
4. Perry, W. L. M. Pharmacological Experiments on Isolated preparations.

**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