North Maharashtra University, Jalgaon

Model for Implementation of the

Credit –Grade based Performance and Assessment (CGPA) system

For B. Pharmacy course being run in theFaculty of Pharmacy

From Academic Year 2012-2013

In the tune with the concept and suggestions of the UGC, AICTE, NAAC and NBA, technological advancement and social needs and to make the teaching effective and meaningful, Faculty of Pharmacy has been permitted to adopt Credit –Grade based Performance and Assessment(CGPA) system from the academic year 2012- 2013 for all the courses being run in the faculty**.** The modalities and operational details of the credit system shallbe as follows;

A. Features of the CGPA system:

1] Degree course **B.Pharmacy** being run in Faculty of Pharmacy would be of **214**credits during **four year of B.Pharmacy (i.e. Eight Semesters).**The total credit points for each year of Four year of B. Pharmacy would be as given in Table below.

Note: For lateral entry admitted students (Diploma and B.Sc. students),total no. of credits allotted shall be **162**.

2] Each theory course of **3/4hr** per week teaching shall be of**1** credit per hour.

3] Each practical course **3hr** per week will be of **2** credits.

4] Every student shall complete **214** credits in eight terms of four academic years.

5] Academic calendar showing dates of commencement and end ofteaching, internal examination and term end examination shall duly notified during the academic year by the **Faculty ofPharmacy**.

6] There shall be some credit courses having grade points and some audit courses having audit points. However audit points shall not be counted in calculation of final SGPA and CGPA.

Year	Semester	Total Credit Points	Total Credits Points for Year
First	I	26	52
	II	26	
Second	III	28	56
	IV	28	
Third	V	28	54
	VI	26	
Final	VII	26	52
	VIII	26	
	Total	214	214

] Evaluation of Student:

a. The evaluation of the student shall be strictly based on "Credit –Grade based Performance and AssessmentSystem(CGPAS)".

b. The Theory and Practical Teaching hours of each Subject has assigned **Credit Points** of as approvedby the Faculty of Pharmacy.

c. The Semester Theory and Practical Examination have 100 marks each for every subject of eight semesters divided as follows- 80 marks for University Exam. + 20 marks for Internal Exam.

d. The marks obtained out of 100 marks in the Final University Semester Exam will be converted in to**Grade and Grade Points** as given in the Table: 1 for Theory and Practical of each Subjects

e. Standard of Passing

i) The attendance for Practical and Theory Examination shall be compulsory.

ii) Minimum marks for passing shall be **40 i.e. at least 'C' Grade and '5' Grade Points** in each theory and practical.

iii) Below **40** marks **'F' Grade** will be given for which **'0' (Zero) Grade Points** will consider in each Theory and Practical.

f. Practical Assessment

i. Concerned teacher and college shall coordinate this activity and maintain the record of the activity conducted during the year.

ii. The Internal assessment for Practical will be of **20 marks**, based on attendance viva and practical performance.

iii. It is compulsory to complete Environment Science audit course for all admitted students. ESE for Environmental Science shall be conducted as per the prevalent rules of the university. There shall be **10** audit points for the Environment Science.

iv. Every Third year (VISEM.) Student has to undertake a project work. He/ She has to select a suitable topic for research and complete it under the guidance of the guide appointed by the principal of the college or head of the department and submit one copy of the same to college. The guide of the candidate shall be internal examiner. The internal examiner and external examiner shall jointly conduct viva voce of the candidate and evaluate the dissertation. It has **10**Audit points.

v. Every Final year (VIII SEM.) Student has to complete one month industrial Training in the Pharmaceutical Industry. External examiner shall conduct viva voce of the candidate and evaluate the industrial training report. It has **10**Audit points.

g. For theory papers :

i. Minimum marks for passing shall be **40 out of 100 (minimum '5' Grade Points with 'C' Grade)** in each Theory and Practical Examination.(**i. e. minimum 32 marks in annual theory examination and minimum 8 marks in sessional examination.**)

ii. There will be one Sessional Examination during each semester of the academic year. Performance of student sessional examinations in each Theory paper will be taken into consideration. The marks obtained by student in each theory paper will be communicated to the University for Inclusion in his/her final result of the examination.

iii. The improvement theory sessional examination shall be conducted by respective College only for the failures students at sessional examination in the respective subject heads in the immediate subsequent semester. However, the improvement sessional examination shall be held on entire syllabus of respective subjects. Further the improvement sessional examination can be conducted for the candidates if they wish to appear, who are otherwise passed in the subjects but wanted to secure the prescribed aggregate of 50% marks,. The marks should be submitted to the University by respective college. The failure students in university examination can appear for the examination in the subsequent university semester examination conducted by university.

h. Grades and Grade Points

Marks for each course would be converted to Grades and Grade Points as shown in Table below:

Table : Conversion of Marks to Grades and Grade Points.

Marks obtained	Grade	Grade points
90 -100	A+	10
80- 89	A	9
70 -79	B+	8
60-69	B	7
50-59	C+	6
40- 49	C	5*
less than 40 marks	F	0

* Passing grade for the course grade point will be 5.

ii) The Grade point will be given on the total marks (Sum of mark obtained in Internal Theory/ Practical and university Theory/ Practical Examination) obtained in the same subject.

iii) A student who fails in Theory course and Practical course (i.e. score less than 40 out of 100 marks in each paper) shall be given F Grade have to clear concerned course and concerned paper in subsequent semesters.

iv) The **Total Grade Points Earned (GPE)** in each Subject shall be calculated as

GPE = CP×GP

Where, GPE = Grade Point Earned for each subject

CP = Credit Point obtained for each subject

GP = Grade point obtained for each subject

v) SemesterGrade Point Average (SGPA)

The performance of the student ina Semester is indicated by a number called**SGPA.** It can be calculated by taking ratio of Total Grade Point Earned of the Semester to the Total Credit Points obtained of the Semester. It shall be calculated as follows,

$$\mathbf{SGPA} = \frac{\sum \mathbf{GPE}}{\sum \mathbf{CP}} \qquad \textbf{OR}$$

$$SGPA = \frac{\sum_{i=1}^{n} C_i \; p_i}{\sum_{i=1}^{n} C_i}$$

The SGPA is rounded up to the 2nd decimal.

vi) AnnualGrade Point Average (AGPA)

The performance of the student in ayear is indicated by a number called **AGPA.** It can be calculated by taking ratio of Total Grade Point Earned of the Academic year to the Total Credit Points obtained of the Academic year. It shall be calculated as follows,

$$AGPA = \frac{\sum GPE}{\sum CP}$$

The AGPA is rounded up to the 2nd decimal.

vii) Final result : Up to date assessment of the overall performance of a student from thetime of his/her first registration is obtained by calculating a number called **Cumulative Grade Point Average(CGPA)**which is weighed average of the grade points obtained (AGPA) in all courses registered by the student since he/she entered the department.

$$CGPA = \frac{\sum_{j=1}^{m} C_j \, p_j}{\sum_{j=1}^{m} C_j}$$

The CGPA is rounded upto 2nddecimal point

The final grade earned shall be as per given table below:

Table - Final Grades obtained for the 4 year Course as per CGPA.

Grade	CGPA
A+	9.00 – 10.00
A	8.00 – 8.99
B+	7.00 -7.99
B	6.00 -6.99
C+	5.50- 5.99
C	5.00 -5.49
F	0.0 – 4.99

The minimum CGPA for passing will be ‘5’with grade ‘C’, CGPA below ‘5’ will get ‘F’ Grade consider as fail grade.

viii) Conversion of CGPA to Percentage Marks and Vice-versa

Percentage Marks = (CGPA - 0.5) * 10 %

CGPA = (% Marks + 5.0) / 10

ix) Audit Courses

In addition to academic credits, student has to complete audit courses for obtaining audit points. The following audit courses shall be completed.

- Environment Science
- Project Report
- Industrial training report
- Co-curricular activities
- Extra Curricular activities

A minimum **05** Audit points for each Environment Science, Project Report, Industrial Training Report shall be obtained by the student during his course of study.A minimum **05**Audit points for co-curricular activities and minimum**05**Audit points for Extra-curricular activities shall be obtained by thestudent during his course of study distributed over at least **4** semesters.As per the audit points obtained in the Environment Science, Project Report and Industrial Training Report the Grade earned shall be given as shown in Table below:

Audit Points	Grade
10	A+
9	A
8	B+
7	B
6	C+
5*	C
0	F

Environment Science-

It is compulsory to complete Environment Science audit course for all admitted students. ESE for Environmental Science shall be conducted as per the prevalent rules of the university. There shall be **10** audit points for the Environment Science.

Project Work-

Every Third year (VI SEM.) Student has to undertake a project work. He/ She has to select a suitable topic for research and complete it under the guidance of the guide appointed by the principal of the college or head of the department and submit one copy of the same to college. The guide of the candidate shall be internal examiner. The internal examiner and external examiner shall jointly conduct viva voce of the candidate and evaluate the dissertation. It has **10** Audit points.

Industrial Training Report-

Every Final year (VIII SEM.) Student has to complete one month industrial Training in the Pharmaceutical Industry. External examiner shall conduct viva voce of the candidate and evaluate the industrial training report. It has **10** Audit points.

Co-curricular Activity-

Audit points for co-curricular activities shall be obtained by the student during his course of study distributed over at least **4** semesters. There is no limit on maximum audit points obtained by the student. The final grade sheet will include the actual number of audit points obtained by the student during his entire course of study.

Sr. No.	Name of Activity	Audit Points
01	Technical Conference Attendance (Minimum State Level)	01
02	Technical Paper Presentation (Minimum State Level) **Presenting Author will get 02 Audit Points and Co-Author will earn 01 Audit Point**	02
03	Award Winning Technical Paper Presentation at State Level **Presenting Author will earn 02 Audit Points and Co-Author will earn 01 Audit Point**	02
04	Award Winning Technical Paper Presentation at National/International Level **Presenting Author will earn 04 Audit Points and Co-Author will earn 01 Audit Point**	04
04	Technical Workshop for Minimum 2 Days	02
05	Professional Society Membership **(1 point for each membership)**	01

Extra-curricular Activity-

Audit points for Extra - curricular activities shall be obtained by the student during his course of study distributed over at least **4**semesters. There is no limit on maximum audit points obtained by the student.The final grade sheet will include the actual number of audit points obtained by the student during his entire course of study.

Sr. No.	Name of Activity	Audit Points
	SPORTS	
01	Member of Inter College Team	01
02	Member of Inter University/ State Team	02
	Cultural Events	
01	Inter College Level	01
02	Inter University/State Level	02
03	Social Service Activities (Blood Donation, Tree Plantation, Adult Education etc.) and Membership of NSS, NCC	04

The grade card in **each even semester** shall contain the information about audit points obtained by the student as shown in the following table:

Sr.No.	Description	Maximum Audit Points	Audit Points Obtained	Grade
01	Environment Science	10		
01	Project Report	10		
02	Industrial training report	10		
03	Co-curricular activities	--		--
04	Extra Curricular activities	--		--

Audit Point Report of Environment Science,Co-curricular Activity and Extracurricular Activity:

The college shall send the audit point report of all admitted students in following format in **VI semester of Third year and VIII semester of Final year:**

Sr. No.	Name of Student	PRN	Exam.Seat No.	No. of audit points Obtained	
				Co-curricular Activity	Extracurricular Activity
01					

The college shall keep the detailed record of audit points obtained by eachstudent with documentary proof for verification till he / she shall complete the requirement of the degree.

Audit Points Report of Project Report and Industrial Training:

The College shall send the audit point report of all admitted students of Project Report at the end of VI Semester and Industrial Training Report at the end of VIII Semester.

Format for the Audit Points Report of Project Report and Industrial Training:

Sr. No.	Name of Student	PRN	Exam.Seat No.	No. of Audit points Obtained
01				

Semester-I

Teaching Scheme				Examination Scheme								
Sub Code	Subject	No. of Papers	Teaching Scheme	Semester Examination			Periodic tests			Total Maximum Marks for subject	Minimum marks for passing subject	Total Credit Point
				Duration (Hours)	Maximum marks	Min for passing	Duration Hours	Maximum marks	Min for passing			
T1.1.1.	Pharmaceutics-I(Dispensing Pharmacy)	**1**	**4**	**3**	**80**	**32**	**1**	**20**	**08**	**100**	**40**	**4**
P1.1.1	Pharmaceutics-I(Dispensing Pharmacy)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**08**	**100**	**40**	**2**
T1.1.2.	Pharmacognosy-I	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**08**	**100**	**40**	**3**
P1.1.2	Pharmacognosy-I	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**08**	**100**	**40**	**2**
T1.1.3	Pharmaceutical Chemistry-I (Inorganic Pharmaceutical Chemistry)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**08**	**100**	**40**	**3**
P1.1.3.	Pharmaceutical Chemistry-I (Inorganic Pharmaceutical Chemistry)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**08**	**100**	**40**	**2**
T1.1.4	Applied Biostatistics & Computer Applications in Pharmacy	**1**	**4**	**3**	**80**	**32**	**1**	**20**	**08**	**100**	**40**	**4**
P1.1.4	Applied Biostatistics &Computer Applications in Pharmacy	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**08**	**100**	**40**	**2**
T1.1.5	Communicating skills & soft Skills development	**1**	**4**	**3**	**80**	**32**	**1**	**20**	**08**	**100**	**40**	**4**
Total		**TH-18 / PR-12**								**900**		**26**

Semester-II

Teaching Scheme				Examination Scheme								
Sub Code	Subject	No. of Papers	Teaching Scheme	Semester Examination			Periodic tests			Total Maximum Marks for subject	Minimum for passing subject	Total Credit Point
				Duration (Hours)	Maximum marks	Min for passing	Duration Hours	Maximum marks	Min for passing			
T 1.2.1.	Pharmaceutics -II(Unit Operations)	1	4	3	80	32	1	20	08	100	40	4
P 1.2.1.	Pharmaceutics -II(Unit Operations)	1	3	4	80	32	---	20	08	100	40	2
T 1.2.2	Pharmaceutical Chemistry –II (Inorganic &Physical Chemistry)	1	3	3	80	32	1	20	08	100	40	3
P 1.2.2.	Pharmaceutical Chemistry –II (Inorganic &Physical Chemistry)	1	3	4	80	32	---	20	08	100	40	2
T 1.2.3	Pharmaceutical Chemistry-III (Organic Chemistry-I)	1	4	3	80	32	1	20	08	100	40	4
P 1.2.3.	Pharmaceutical Chemistry-III (Organic Chemistry-I)	1	3	4	80	32	---	20	08	100	40	2
T 1.2.4	Anatomy, Physiology & Health Education (APHE) – I	1	4	3	80	32	1	20	08	100	40	4
P 1.2.4.	Anatomy, Physiology & Health Education(APHE) – I	1	3	4	80	32	---	20	08	100	40	2
T 1.2.5	Industrial Psychology	1	3	3	80	32	1	20	08	100	40	3
5555	Environmental Science	1	3	3	80	32	--	20	08	100	40	Max. Audit Points = 10
TOTAL		TH-18 / PR-12								900		26

Semester-III

Teaching Scheme				Examination Scheme								
Sub Code	Subject	No. of Papers	Teaching Scheme	Semester Examination			Periodic tests			Total Maximum Marks for subject	Minimum for passing subject	Total Credit Point
				Duration (Hours)	Maximum marks	Min for passing	Duration Hours	Maximum marks	Min for passing			
T 2.3.1	Pharmaceutics-III (Physical Pharmacy-I)	1	3	3	80	32	1	20	08	100	40	3
P 2.3.1	Pharmaceutics-III(Physical Pharmacy-I)	1	3	4	80	32	---	20	08	100	40	2
T 2.3.2.	Pharmaceutical Chemistry-IV (Organic Chemistry - II)	1	3	3	80	32	1	20	08	100	40	3
P 2.3.2.	Pharmaceutical Chemistry-IV (Organic Chemistry - II)	1	3	4	80	32	---	20	08	100	40	2
T 2.3.3.	Pharmacognosy –II	1	3	3	80	32	1	20	08	100	40	3
P 2.3.3.	Pharmacognosy –II	1	3	4	80	32	---	20	08	100	40	2
T 2.3.4.	Pharmaceutical Analysis – I	1	3	3	80	32	1	20	08	100	40	3
P 2.3.4.	Pharmaceutical Analysis – I	1	3	4	80	32	---	20	08	100	40	2
T 2.3.5	A P HE-II	1	3	3	80	32	1	20	08	100	40	3
P 2.3.5	A P HE-II	1	3	4	80	32	---	20	08	100	40	2
T 2.3.6	Pathophysiology of Common Diseases-I	1	3	3	80	32	1	20	08	100	40	3
TOTAL		Th 18 / Pr 15								1100		28

Semester-IV

Teaching Scheme				Examination Scheme								
Sub Code	Subject	No. of Papers	Teaching Scheme	Semester Examination			Periodic tests			Total Maximum Marks for subject	Minimum for passing subject	Total Credit Point
				Duration (Hours)	Maximum Marks	Min for passing	Duration Hours	Maximum marks	Min for passing			
T.2.4.1.	Pharmaceutics–IV (Physical Pharmacy-II)	1	3	3	80	32	1	20	08	100	40	3
P.2.4.1.	Pharmaceutics–IV (Physical Pharmacy-II)	1	3	4	80	32	---	20	08	100	40	2
T.2.4.2.	Pharmaceutical Microbiology	1	3	3	80	32	1	20	08	100	40	3
P.2.4.2.	Pharmaceutical Microbiology	1	3	4	80	32	---	20	08	100	40	2
T.2.4.3.	Pharmacognosy – III	1	3	3	80	32	1	20	08	100	40	3
P.2.4.3.	Pharmacognosy – III	1	4	4	80	32	---	20	08	100	40	2
T.2.4.4.	Pharmaceutics –V (Hospital Pharmacy)	1	3	3	80	32	1	20	08	100	40	3
P.2.4.4.	Pharmaceutics –V (Hospital Pharmacy)	1	3	4	80	32	---	20	08	100	40	2
T.2.4.5.	Pharmaceutical Chemistry – V (Biochemistry)	1	3	3	80	32	1	20	08	100	40	3
P.2.4.5.	Pharmaceutical Chemistry – V (Biochemistry)	1	3	4	80	32	---	20	08	100	40	2
T.2.4.6.	Pathophysiology of Common Diseases-II	1	3	3	80	32	1	20	08	100	40	3
TOTAL		Th 18 / Pr 15								1100		28

Semester V

Teaching Scheme				Examination Scheme								
Sub Code	Subject	No. of Papers	Teaching Scheme	Semester Examination			Periodic tests			Total Maximum Marks for Subject	Minimum for passing subject	Total Credit Point
				Duration (Hours)	Maximum marks	Min for passing	Duration Hours	Maximum marks	Min for passing			
T 3.5.1.	Pharmaceutical Chemistry – VI (Medicinal Chemistry - I)	1	4	3	80	32	1	20	08	100	40	4
P 3.5.1.	Pharmaceutical Chemistry – VI (Medicinal Chemistry - I)	1	3	4	80	32	---	20	08	100	40	2
T 3.5.2.	Pharmaceutics – VI (Pharmaceutical Technology I)	1	4	3	80	32	1	20	08	100	40	4
P 3.5.2.	Pharmaceutics – VI (Pharmaceutical Technology I)	1	3	4	80	32	---	20	08	100	40	2
T 3.5.3.	Pharmacology – I	1	4	3	80	32	1	20	08	100	40	4
P 3.5.3.	Pharmacology – I	1	3	4	80	32	---	20	08	100	40	2
T 3.5.4.	Pharmacognosy –IV	1	3	3	80	32	1	20	08	100	40	3
P 3.5.4.	Pharmacognosy –IV	1	3	4	80	32	---	20	08	100	40	2
T 3.5.5.	Pharmaceutical Analysis-II	1	3	3	80	32	1	20	08	100	40	3
P 3.5.5.	Pharmaceutical Analysis-II	1	3	4	80	32	---	20	08	100	40	2
TOTAL		Th 18 / Pr 15								1000		28

Semester-VI

Teaching Scheme				Examination Scheme								
Sub Code	Subject	No. of Papers	Teaching Scheme	Semester Examination			Periodic tests			Total Maximum Marks for subject	Minimum for passing subject	Total Credit Point
				Duration (Hours)	Maximum marks	Min for passing	Duration Hours	Maximum marks	Min for passing			
T 3.6.1.	Pharmaceutical Chemistry - VII (Medicinal Chemistry -II)	1	4	3	80	32	1	20	08	100	40	4
P 3.6.1.	Pharmaceutical Chemistry – VII (Medicinal Chemistry - II)	1	3	4	80	32	---	20	08	100	40	2
T 3.6.2.	Pharmaceutics –VII (Bio-pharmaceutics & Pharmacokinetics)	1	3	3	80	32	1	20	08	100	40	3
P. 3.6.2.	Pharmaceutics –VII (Bio-pharmaceutics & Pharmacokinetics)	1	3	3	80	32	----	20	08	100	40	2
T. 3.6.3.	Pharmacology –II	1	4	4	80	32	1	20	08	100	40	4
P 3.6.3.	Pharmacology –II	1	3	3	80	32	---	20	08	100	40	2
T 3.6.4.	Pharmacognosy - V (Chemistry of Natural Products)	1	3	3	80	32	1	20	08	100	40	3
P 3.6.4.	Pharmacognosy - V (Chemistry of Natural Products)	1	3	4	80	32	---	20	08	100	40	2
T 3.6.5.	PharmaceuticalJurisprudence& Ethics	1	4	3	80	32	1	20	08	100	40	4
P.3.6.6	Project Report			Grade A/B/C				Max. Audit Points= 10				
Total		Th 18 / Pr 12								900		26

Semester-VII

Teaching Scheme				Examination Scheme								
Sub Code	Subject	No. of Papers	Teaching Scheme	Semester Examination			Periodic tests			Total Maximum Marks for subject	Minimum for passing subject	Credit Point
				Duration (Hours)	Maximum Marks	Min for passing	Duration Hours	Maximum marks	Min for passing			
T 4.7.1.	Pharmaceutics – VIII (Pharmaceutical Technology - II)	1	3	4	80	32	1	20	08	100	40	3
P. 4.7.1.	Pharmaceutics – VIII (Pharmaceutical Technology - II)	1	3	3	80	32	----	20	08	100	40	2
T 4.7.2.	Pharmaceutical Chemistry- VIII (Medicinal Chemistry – III)	1	3	3	80	32	1	20	08	100	40	3
P 4.7.2	Pharmaceutical Chemistry-VIII (Medicinal Chemistry – III)	1	3	4	80	32	---	20	08	100	40	2
T 4.7.3.	Pharmacology –III	1	3	3	80	32	1	20	08	100	40	3
P 4.7.3.	Pharmacology –III	1	3	4	80	32	---	20	08	100	40	2
T.4.7.4.	Pharmaceutical Analysis-III	1	3	3	80	32	1	20	08	100	40	3
P.4.7.4.	Pharmaceutical Analysis-III	1	3	4	80	32	---	20	08	100	40	2
T 4.7.5.	Pharmaceutical Biotechnology	1	3	3	80	32	1	20	08	100	40	3
T 4.7.6.	Pharmaceutical Industrial Management	1	3	3	80	32	1	20	08	100	40	3
TOTAL		Th 18/ Pr 12								1000		26

Semester-VIII

Teaching Scheme				Examination Scheme								
Sub Code	Subject	No. of Papers	Teaching Scheme	Semester Examination			Periodic tests			Total Maximum Marks for subject	Minimum for passing subject	Total Credit Point
				Duration (Hours)	Maximum marks	Min for passing	Duration Hours	Maximum marks	Min for passing			
T 4.8. 1.	Pharmaceutics – IX	1	3	3	80	32	1	20	08	100	40	3
P 4.8. 1.	Pharmaceutics – IX	1	3	4	80	32	---	20	08	100	40	2
T 4.8.2.	Pharmaceutical Analysis – IV	1	3	3	80	32	1	20	08	100	40	3
P 4.8.2.	Pharmaceutical Analysis – IV	1	3	4	80	32	---	20	08	100	40	2
T 4.8.3.	Pharmaceutical Chemistry-IX (Medicinal Chemistry- IV)	1	3	3	80	32	1	20	08	100	40	3
P 4.8.3.	Pharmaceutical Chemistry–IX (Medicinal Chemistry- IV)	1	3	4	80	32	---	20	08	100	40	2
T 4.8.4.	Pharmacognosy – VI	1	3	3	80	32	1	20	08	100	40	3
P. 4.8.4.	Pharmacognosy – VI	1	3	4	80	32	---	20	08	100	40	2
T.4.8.5.	Pharmacology - IV (Clinical Pharmacy & Drug Interactions)	1	3	3	80	32	1	20	08	100	40	3
T.4.8.6.	Elective(Theory)	1	3	3	80	32	1	20	08	100	40	3
P.4.8.7.	Industrial training report	**Grade A/B/C**						**Max. Audit Points= 10**				
TOTAL		Th 18 Pr 12								**1000**		**26**

NORTH MAHARASHTRA UNIVERSITY
(Introduced from June, 2012)

Ordinances Regulating Including Scheme and Syllabi relating to the Degree of Bachelor of Pharmacy (B. Pharm.) Degree Course (NEW) with effect from Academic Year (2012-13)

Course Title : Bachelor of Pharmacy

Abbreviation : B. Pharm.

Type of Course : A four year degree course divided into eight Semesters.

Pattern : Semester.

Number of Years and Semester : Four Years divided into eight semesters with two semesters per year.

Nomenclature of Semesters :

Semester-I & Semester-II	First Year B. Pharm.
Semester-III & Semester-IV	Second Year B. Pharm.
Semester-V & Semester-VI	Third Year B. Pharm.
Semester-VII & Semester-VIII	Final Year B. Pharm.

Award of the Degree : Degree will be awarded for those passing in all the eight semesters as per the rules and regulations given subsequently.

Duration of Semester : Each Semester will be normally of 15 weeks duration for class room teaching/ lecture and internal evaluation.

Definitions :

1. University means North Maharashtra University until and otherwise specified.
2. The college/Institute- Any college conducting B. Pharmacy course and affiliated to North Maharashtra University, Jalgaon.
3. State Govt.: Govt. of Maharashtra
4. Admission Authority: Any authority to conduct admission process as prescribed by Govt. of Maharashtra
5. Director / DTE – Directorate of Technical Education, Maharashtra State.
6. AICTE – All India Council of Technical Education, New Delhi

B. Pharm. 1 Entry levels into the course, eligibility criteria, admission authority and procedures.

Admission authority and procedure at the entry levels into the course will be as per the directions of Government of Maharashtra / Director of Technical Education/ All India Council of Technical Education, New Delhi prevailing at the time of admissions.
Entry levels into the course will be at the beginning of the Semester- I or at the beginning of the Semester -III.

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 fulfill 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 45% marks (40% for backward class candidates from Maharashtra) in Physics, Chemistry, and the subject of maximum marks amongst the four subjects of

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

OR

Must have passed Diploma in Pharmacy or its equivalent examination by Board of Technical education or equivalent examination. with not less than 45% of marks in the aggregate of all subjects taken together at the Final Year Examination.

O 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 50% at part-II examination for the Diploma in Pharmacy Course (45% for backward class candidates from Maharashtra) as per ER-91 (i.e. Post H.S.C. two year Diploma Course) be held eligible for admission to semester-III.

O B. Pharm. 2 Examinations:

O B. Pharm. 2.1 Examination conducting authority: North Maharashtra University, Jalgaon

O B. Pharm. 2.2 Regular and Supplementary Examinations and time: (Tentative schedule) The University will decide exact schedule on the basis of prevailing situation.

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

Duration of Examinations, Marks, etc. See examination scheme at Annexure

O B. Pharm. 2.3 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 O. B. Pharm. 3 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.

Clarifications:

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

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

For all the remaining cases, the candidate has to appear for examination in all those subject heads in which the candidate has failed.
E_suvidha : For E_suvidha scheme, student should check the website for enrollment and examination timely.

O B. Pharm. 2.4 Periodic Tests (Sessional Examintion):

Each Semester will consist of a minimum of 15 weeks instructions.

*i.e. 15x6 = 90 instructional days (Actual teaching).

75% attendance is compulsory.

To ensure uniform attention of the students of their work throughout each semester of their study, Periodic tests will be conducted for each semester. Conducting authority shall be Institutes where candidate is admitted.

Number of Periodic tests (Sessional Examintion):

There will be a minimum of one sessional examination of 20 marks in each of the theory subjects during each semester.

One periodic test (Sessional Examination) will be conducted as per the examination scheme (See Annexure) for each semester. The students who will either secure less than 40% mark in the test or 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 as prescribed by the institution.

Practical sessional examination of 20 marks will be based on internal assessment of practical, day to day attendance, viva, laboratory record. The distribution of marks for practical examination will be as given below –

Attendance - 40%

Viva Voce - 20%

Laboratory Record/Performance - 40%

Internal assessment of practicals (20%) will be based on day to day attendance, viva, laboratory record, etc.

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

Time Schedule:

After completion of at least two thirds syllabus of the semester.

The Retest/ Improvement test/ or supplementary test for the periodic tests will be allowed for the failed candidates in the University examination, if he/she is appearing for the University exam of that subject head.

The Retest/ Improvement test/ or supplementary test shall be carried 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 in soft copy and print before the commencement of theory or practical examination whichever is later.

Scaling down technique will be implemented for the periodic test.

O B. Pharm. 3 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.

O B. Pharm. 3.1 A candidate, to be eligible for the Degree will be required to pass examinations, as under:-

First year B. Pharm.	Semester-I & Semester-II
Second year B. Pharm.	Semester-III & Semester-IV
Third year B. Pharm.	Semester-V & Semester-VI
Fourth year B. Pharm.	Semester-VII & Semester-VIII

O B. Pharm. 3.2

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

O B. Pharm. 3.3 – Promotion from odd semester to even semester in the same academic year-

a)A Candidate who fails in 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 in 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 in 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 in Semester – VII examination of Fourth Year B. Pharm. will be allowed to keep term for his Semester – VIII Examination of Fourth Year B. Pharm.

O B. Pharm. 3.4- Promotion to subsequent academic year-

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

O B. Pharm. 3.5-Clarification of 3.3 and 3.4-

a) No candidate will be admitted to the Semester III course unless he/she passes his/her Semester I and Semester II examination of B. Pharm.

OR

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 O B. Pharm. 3.4

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

i) passes his/her Semester I & Semester II., Semester III & 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 & Semester IV Examinations of B. Pharm. in accordance with O B. Pharm.3.4:

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

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

OR

ii) passes his/her Semester I & Semester II., Semester III & Semester IV Examinations of B. Pharm. and
fails in not more than One third of total number of subjects at the Semester V & Semester VI Examinations of B. Pharm. in accordance with O B. Pharm.3.4:

Allowed to Keep Terms (ATKT) rules.

Number of subjects: ATKT will be awarded to those who have failed in 1/3 subject head (33%) as described in table **given** below

At the end of academic year		Total subject heads at the end of academic year.	33 % of total subjects (To nearest full digit) for ATKT
First	Theory	05+06=11	4
	Practical	04+04=08	3
Second	Theory	06+06=12	4
	Practical	05+05=10	3
Third	Theory	05+05=10	3
	Practical	05+04=09	3

O B. Pharm. 4 Marks, Criteria for passing and other conditions.

O B. Pharm. 4.1 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 given in Annexure.
No separate passing is required for periodic test and if the candidate remains absent for the test, the candidate will be just treated as not appeared for the test securing zero marks. What so ever mark obtained by the candidate will be added to the marks obtained by the candidate in University examination as shown in scheme of examination given in Annexure.

In no circumstance previous marks will be considered. If a candidate's application form for reappearing in the examination in a subject head is accepted, and the candidate appear in the examination (Periodic test & Semester examination) fresh marks will be considered.

O B. Pharm.4.2 Passing of the semester.

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

O B .Pharm. 4.3 Award of the degree and Class.

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

Class will be awarded on the basis of combined marks at the Semester-V to Semester VIII.

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

A student will be allowed to improve his/her class at B. Pharm. by reappearing for the subjects (maximum 3 theory subjects of that examination) from V or/and VIII Semesters of B. Pharm. Course as per prevalent policy of University.

O B. Pharm. 4.4 With holding of results.

A candidate's result will be with held under the following situations and of the respective Semester.

1. Withholding of result for not fulfilling passing criteria for advancement to subsequent classes-

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

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

Result of Semester VIII will be with held if the candidate has not passed Semester- V& Semester-VI.

2. Withholding of result for failure to comply University rules-

The result of candidate shall be withhold if the candidate found guilty in malpractices during examinations and any other failure to comply University rules and regulation as confirmed by appropriate body of University.

O B. Pharm. 4.6 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.

Notwithstanding above if a candidate has passed in all the subjects but failed due to not getting 50% of the aggregate marks may appear for the examination in any three theory subject heads the candidate desires so as to get over all 50% marks. In such cases, Higher marks obtained in the subject heads, the candidate has appeared for the fresh examination and the marks obtained in the previous examination of the same subject will only be considered irrespective of the examination and fresh result will be declared. For example if the candidate gets over all 50% marks but fails in one of the subject heads in which the candidate had passed earlier, the candidate will be treated as passed in that subject head as per previous examination and result will be declared as per the rules applicable to the passed candidates. The marks in which the candidate has not appeared for the examination will be carried forward.

O B. Pharm. 4.7 Every candidate shall be required to work for at least four weeks in a Pharmaceutical Industry after the Semester- IV of the course of study, and shall submit satisfactory report of such work to the head of the institute. The candidate should also submit one copy to the University for the Award of Degree along with convocation form. The candidate may undergo practical training in parts, each constituting not less than two weeks.

O B. Pharm. 4.8 The Detailed Scheme of Examination & Syllabus for each semester-See Annexure.

The pattern for University theory examination question paper shall be as given below:

Scheme for theory Examination: - Each Theory paper should be divided in 2 sections which should be attempted in separate answer sheet.

Sr. No.	Head	Marks distribution
Section – I		
Q.1.	Small Questions-Reasoning, Definition, Structures, Justifications, Diagram etc. (Note: True false, match the pairs, fill in the blanks, MCQ should not be asked)	10 (2 mark x 5 Qs, out of 7 Qs.)
Q.2	Short answers type questions – 5 marks	20 (5 mark x 4 Qs, out of 6 Qs.)
Q.3	Long answers questions	10 (10 mark x 1 Qs, out of 2 Qs.
Section – II		
Q.4	Small Questions-Reasoning, Definition structures, Justifications, diagram etc. (Note: true false, match the pairs, fill in the blanks, MCQ should not be asked)	10 (2 mark x 5 Qs, out of 7 Qs.)
Q.5	Short answers type questions – 5 marks	20 (5 mark x 4 Qs, out of 6 Qs.)
Q.6	Long answers questions	10 (10 mark x 1 Qs, out of 2 Qs.)
	Total maximum marks of section I and II	80
	Duration of examination	3 Hrs.

Scheme for University Examination

Sr. No.	Head	Marks distribution
1	Spotting/ Identification(If spotting/Identification is not applicable to any subject, marks will be included in Major & Minor Experiment)	10
2	Synopsis	10
3	Major experiment	35
4	Minor experiment	15
5	Viva	10
	Total Marks	80
	Duration	04 Hrs.

Scheme for Practical Sessional Examination

Sr. No.	Head	Marks distribution
1	Attendance	08
2	Viva	04
3	Lab Record and Performance	08
	Total Marks	20
	Duration	03 Hrs.

Subject Semester 1

Subject Code	Subject	Workload
T.1.1.1.	Pharmaceutics-I(Dispensing Pharmacy)	4
P.1.1.1.	Pharmaceutics-I(Dispensing Pharmacy)	3
T.1.1.2.	Pharmacognosy-I	3
P.1.1.2.	Pharmacognosy-I	3
T.1.1.3.	Pharmaceutical Chemistry-I (Inorg. Pharm. Chemistry)	3
P.1.1.3.	Pharmaceutical Chemistry-I (Inorg. Pharm. Chemistry)	3
T.1.1.4.	Applied Biostatistics & Computer Applications in Pharmacy	4
P.1.1.4.	Applied Biostatistics & Computer Applications in Pharmacy	3
T.1.1.5.	Communicating Skills and soft skill development	4
Total		Th 18/Pr 12

Semester II

Subject Code	Subject	Workload
T 1.2.1.	Pharmaceutics -II(Unit operation)	4
P 1.2.1.	Pharmaceutics -II(Unit operation)	3
T 1.2.2.	Pharmaceutical Chemistry -II(Inorganic & Physical Chemistry)	3
P 1.2.2.	Pharmaceutical Chemistry -II(Inorganic & Physical Chemistry)	3
T 1.2.3.	Pharmaceutical Chemistry-III(Organic Chemistry-I)	4
P 1.2.3.	Pharmaceutical Chemistry-III(Organic Chemistry-I)	3
T 1.2.4.	Anatomy, Physiology & Health Education (APHE) – I	4
P 1.2.4.	Anatomy, Physiology & Health Education (APHE) – I	3
T 1.2.5.	Industrial Psychology	3
5555	Environmental Science	3
Total		Th 18/Pr 12

Semester III

Subject Code	Subject	Workload
T 2.3.1	Pharmaceutics -III (I Physical Pharmacy-I)	3
P 2.3.1	Pharmaceutics -III (I Physical Pharmacy-I)	3
T 2.32.	Pharmaceutical Chemistry-IV (Organic Chemistry - II)	3
P 2.32.	Pharmaceutical Chemistry-IV (Organic Chemistry - II)	3
T 2.3.3.	Pharmacognosy –II	3
P 2.3.3.	Pharmacognosy –II	3
T 2.3.4.	Pharmaceutical Analysis – I	3
P 2.3.4.	Pharmaceutical Analysis – I	3
T 2.3.5	A P HE-II	3
P 2.3.5	A P HE-II	3
T.2.3.6	Pathophysiology of Common Diseases-I	3
		Th 18/Pr15

Semester IV

Subject Code	Subject	Workload
T.2.4.1.	Pharmaceutics – IV (Physical Pharmacy-II)	3
P.2.4.1.	Pharmaceutics – IV (Physical Pharmacy -II)	3
T.2.42.	Pharmaceutical Microbiology	3
P.2.42.	Pharmaceutical Microbiology	3
T.2.4.3.	Pharmacognosy – III	3
P.2.4.3.	Pharmacognosy – III	3
T.2.4.4.	Pharmaceutics –V (Hospital Pharmacy)	3
P.2.4.4.	Pharmaceutics –V (Hospital Pharmacy)	3
T 2.4.5.	Pharmaceutical Chemistry - V(Biochemistry)	3
P 2.4.5.	Pharmaceutical Chemistry - V(Biochemistry)	3
T.2.4.6.	Pathophysiology of Common Diseases-II	3
		Th 18/Pr 15

Semester V

Subject Code	Subject	Workload
T 3.5.1.	Pharmaceutical Chemistry - VI (Medicinal Chemistry - I)	4
P 3.5.1.	Pharmaceutical Chemistry - VI (Medicinal Chemistry - I)	3
T 3.5.2.	Pharmaceutics - VI (Pharmaceutical Technology I)	4
P 3.5.2.	Pharmaceutics - VI (Pharmaceutical Technology I)	3
T 3.5.3.	Pharmacology – I	4
P 3.5.3.	Pharmacology – I	3
T 3.5.4.	Pharmacognosy –IV	3
P 3.5.4.	Pharmacognosy –IV	3
T 3.5.5.	Pharmaceutical Analysis-II	3
P 3.5.5.	Pharmaceutical Analysis-II	3
Total		Th 18/Pr 15

Semester VI

Subject Code	Subject	Th
T 3.6.1.	Pharmaceutical Chemistry - VII (Medicinal Chemistry -II)	4
P 3.6.1.	Pharmaceutical Chemistry - VII (Medicinal Chemistry - II)	3
T 3.6.2.	Pharmaceutics -VII(Biopharmaceutics & Pharmacokinetics)	3
P 3.6.2.	Pharmaceutics -VII(Biopharmaceutics & Pharmacokinetics)	3
T 3.6.3.	Pharmacology –II	4
P 3.6.3.	Pharmacology –II	3
T 3.6.4.	Pharmacognosy - V (Chemistry of Natural Products)	3
P 3.6.4.	Pharmacognosy - V (Chemistry of Natural Products)	3
T 3.6.5.	Pharmaceutical Jurisprudence & Ethics	4
P 3.6.6	Project report	
		Th 18/Pr 12

Compulsory Industrial Training of Four Weeks with Component of Evaluation after Completion of IV Semester

Semester VII

Subject Code	Subject	Workload
T 4.7.1.	Pharmaceutics – VIII (Pharmaceutical Technology - II)	3
P 4.7.1.	Pharmaceutics – VIII (Pharmaceutical Technology - II)	3
T 4.7.2.	Pharmaceutical Chemistry _ VIII(Medicinal Chemistry - III	3
P 4.7.2.	Pharmaceutical Chemistry _ VIII(Medicinal Chemistry - III	3
T 4.7.3.	Pharmacology –III	3
P 4.7.3.	Pharmacology –III	3
T 4.7.4.	Pharmaceutical Analysis – III	3
P 4.7.4.	Pharmaceutical Analysis – III	3
T 4.7.5.	Pharmaceutical Biotechnology	3
T 4.7.6.	Pharmaceutical Industrial Management	3
		Th 18/Pr12

Semester VIII

Subject Code	Subject	Workload
T 4.8.1.	Pharmaceutics – IX	3
P 4.8.1.	Pharmaceutics – IX	3
T 4.8.2.	Pharmaceutical Analysis – IV	3
P 4.8.2.	Pharmaceutical Analysis – IV	3
T 4.8.3.	Pharmaceutical Chemistry –IX (Medicinal Chemistry- IV)	3
P 4.8.3.	Pharmaceutical Chemistry – IX (Medicinal Chemistry- IV)	3
T 4.8.4.	Pharmacognosy – VI	3
P 4.8.4.	Pharmacognosy – VI	3
T 4.8.5.	Pharmacology - IV (Clinical Pharmacy & Drug Interactions)	3
T 4.8.6.	Elective (Theory)	3
P 4.8.7.	Industrial training report	-
		Th 18/Pr 12

* 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.

Annexure

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

Teaching Scheme				Examination Scheme						
Sub Code	Subject	No. of Papers	Teaching Scheme	Semester Examination			Periodic tests		Total Maximum Marks for subject	Minimum marks for passing subject
				Duration (Hours)	Maximum marks	Min for passing	Duration Hours	Maximum marks		
T1.1.1.	Pharmaceutics-I(Dispensing Pharmacy)	1	4	3	80	32	1	20	100	40
P1.1.1	Pharmaceutics-I(Dispensing Pharmacy)	1	3	4	80	32	---	20	100	40
T1.1.2.	Pharmacognosy-I	1	3	3	80	32	1	20	100	40
P1.1.2	Pharmacognosy-I	1	3	4	80	32	---	20	100	40
T1.1.3	Pharmaceutical Chemistry-I (Inorganic Pharmaceutical Chemistry)	1	3	3	80	32	1	20	100	40
P1.1.3.	Pharmaceutical Chemistry-I (Inorganic Pharmaceutical Chemistry)	1	3	4	80	32	---	20	100	40
T1.1.4	Applied Biostatistics & Computer Applications Pharmacy	1	4	3	80	32	1	20	100	40
P1.1.4	Applied Biostatistics & Computer Applications Pharmacy	1	3	4	80	32	---	20	100	40
T1.1.5	Communicating skills & soft Skills development	1	4	3	80	32	1	20	100	40
Total		TH-18 / PR-12								

Semester-II

Teaching Scheme				Examination Scheme						
Sub Code	**Subject**	**No. of Papers**	**Teaching Scheme**	**Semester Examination**			**Periodic tests**		**Total Maximum subject**	**Minimum for passing subject**
				Duration (Hours)	**Maximum marks**	**Min for passing**	**Duration Hours**	**Maximum marks**		
T 1.2.1.	Pharmaceutics -II(Unit Operation)	1	4	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 1.2.1.	Pharmaceutics -II(Unit Operation)	1	3	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 1.2.2	Pharmaceutical Chemistry –II (Inorganic & Physical Chemistry)	1	3	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 1.2.2.	Pharmaceutical Chemistry –II (Inorganic & Physical Chemistry)	1	3	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 1.2.3	Pharmaceutical Chemistry-III (Organic Chemistry-I)	1	4	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 1.2.3.	Pharmaceutical Chemistry-III (Organic Chemistry-I)	1	3	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 1.2.4	Anatomy, Physiology & Health Education (APHE) – I	1	4	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 1.2.4.	Anatomy, Physiology & Health Education (APHE) – I	1	3	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 1.2.5	Industrial Psychology	1	3	**3**	**80**	**32**	**1**	**20**	**100**	**40**
5555	Environmental Science	1	3	**3**	**80**	**32**	**--**	**20**	**100**	**40**
TOTAL-				**TH-18 / PR-12**						

Semester-III

Teaching Scheme				Examination Scheme						
Sub Code	**Subject**	**No. of Papers**	**Teaching Scheme**	**Semester Examination**			**Periodic tests**		**Total Maximum subject**	**Minimum for passing subject**
				Duration (Hours)	**Maximum marks**	**Min for passing**	**Duration Hours**	**Maximum marks**		
T 2.3.1	Pharmaceutics-III (Physical Pharmacy-I)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 2.3.1	Pharmaceutics-III (Physical Pharmacy-I)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 2.3.2.	Pharmaceutical Chemistry-IV (Organic Chemistry - II)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 2.3.2.	Pharmaceutical Chemistry-IV (Organic Chemistry - II)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 2.3.3.	Pharmacognosy –II	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 2.3.3.	Pharmacognosy –II	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 2.3.4.	Pharmaceutical Analysis – I	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 2.3.4.	Pharmaceutical Analysis – I	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 2.3.5	A P H E-II	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 2.3.5	A P H E-II	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 2.3.6	Pathophysiology of Common Diseases-I	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
TOTAL--							Th 18 / Pr 15			

Semester-IV

Teaching Scheme				Examination Scheme						
Sub Code	**Subject**	**No. of Papers**	**Teaching Scheme**	**Semester Examination**			**Periodic tests**		**Total Maximum subject**	**Minimum for passing subject**
				Duration (Hours)	**Maximum marks**	**Min for passing**	**Duration Hours**	**Maximum marks**		
T.2.4.1.	Pharmaceutics – IV((Physical Pharmacy-II)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P.2.4.1.	Pharmaceutics – IV((Physical Pharmacy-II)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T.2.4.2.	Pharmaceutical Microbiology	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P.2.4.2.	Pharmaceutical Microbiology	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T.2.4.3.	Pharmacognosy – III	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P.2.4.3.	Pharmacognosy – III	**1**	**4**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T.2.4.4.	Pharmaceutics –V (Hospital Pharmacy)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P.2.4.4.	Pharmaceutics –V (Hospital Pharmacy)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T.2.4.5.	Pharmaceutical Chemistry – V (Biochemistry)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P.2.4.5.	Pharmaceutical Chemistry – V (Biochemistry)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T.2.4.6.	Pathophysiology of Common Diseases-II	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
TOTAL--							Th 18 / Pr 15			

Semester V

Teaching Scheme				Examination Scheme						
Sub Code	**Subject**	**No. of Papers**	**Teaching Scheme**	**Semester Examination**			**Periodic tests**		**Total Maximum subject**	**Minimum for passing subject**
				Duration (Hours)	**Maximum marks**	**Min for passing**	**Duration Hours**	**Maximum marks**		
T 3.5.1.	Pharmaceutical Chemistry – VI (Medicinal Chemistry - I)	**1**	**4**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 3.5.1.	Pharmaceutical Chemistry – VI (Medicinal Chemistry - I)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 3.5.2.	Pharmaceutics – VI (Pharmaceutical Technology I)	**1**	**4**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 3.5.2.	Pharmaceutics – VI (Pharmaceutical Technology I)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 3.5.3.	Pharmacology – I	**1**	**4**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 3.5.3.	Pharmacology – I	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 3.5.4.	Pharmacognosy –IV	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 3.5.4.	Pharmacognosy –IV	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 3.5.5.	Pharmaceutical Analysis-II	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 3.5.5.	Pharmaceutical Analysis-II	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
TOTAL--							Th 18 / Pr 15			

Semester-VI

Teaching Scheme				Examination Scheme						
Sub Code	**Subject**	**No. of Papers**	**Teaching Scheme**	**Semester Examination**			**Periodic tests**		**Total Maximum subject**	**Minimum for passing subject**
				Duration (Hours)	**Maximum marks**	**Min for passing**	**Duration Hours**	**Maximum marks**		
T 3.6.1.	Pharmaceutical Chemistry - VII (Medicinal Chemistry -II)	**1**	**4**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 3.6.1.	Pharmaceutical Chemistry – VII (Medicinal Chemistry - II)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 3.6.2.	Pharmaceutics –VII (Bio pharmaceutics & Pharmacokinetics)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P. 3.6.2.	Pharmaceutics –VII (Bio pharmaceutics & Pharmacokinetics)	**1**	**3**	**3**	**80**	**32**	**----**	**20**	**100**	**40**
T. 3.6.3.	Pharmacology –II	**1**	**4**	**4**	**80**	**32**	**1**	**20**	**100**	**40**
P 3.6.3.	Pharmacology –II	**1**	**3**	**3**	**80**	**32**	**---**	**20**	**100**	**40**
T 3.6.4.	Pharmacognosy - V (Chemistry of Natural Products)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 3.6.4.	Pharmacognosy - V (Chemistry of Natural Products)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 3.6.5.	Pharmaceutical Jurisprudence & Ethics	**1**	**4**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P.3.6.6	Project Report	**Grade A/B/C**								
Total							Th 18 / Pr 12			

Semester-VII

Teaching Scheme				Examination Scheme						
Sub Code	**Subject**	**No. of Papers**	**Teaching Scheme**	**Semester Examination**			**Periodic tests**		**Total Maximum subject**	**Minimum for passing subject**
				Duration (Hours)	**Maximum marks**	**Min for passing**	**Duration Hours**	**Maximum marks**		
T 4.7.1.	Pharmaceutics – VIII (Pharmaceutical Technology - II)	**1**	**3**	**4**	**80**	**32**	**1**	**20**	**100**	**40**
P. 4.7.1.	Pharmaceutics – VIII (Pharmaceutical Technology - II)	**1**	**3**	**3**	**80**	**32**	**----**	**20**	**100**	**40**
T 4.7.2.	Pharmaceutical Chemistry- VIII (Medicinal Chemistry – III)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 4.7.2	Pharmaceutical Chemistry-VIII (Medicinal Chemistry – III)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 4.7.3.	Pharmacology –III	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 4.7.3.	Pharmacology –III	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T.4.7.4.	Pharmaceutical Analysis-III	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P.4.7.4.	Pharmaceutical Analysis-III	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 4.7.5.	Pharmaceutical Biotechnology	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
T 4.7.6.	Pharmaceutical Industrial Management	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
TOTAL--							Th 18/ Pr 12			

Semester-VIII

Teaching Scheme				Examination Scheme						
Sub Code	**Subject**	**No. of Papers**	**Teaching Scheme**	**Semester Examination**			**Periodic tests**		**Total Maximum subject**	**Minimum for passing subject**
				Duration (Hours)	**Maximum marks**	**Min for passing**	**Duration Hours**	**Maximum marks**		
T 4.8. 1.	Pharmaceutics – IX	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 4.8. 1.	Pharmaceutics – IX	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 4.8.2.	Pharmaceutical Analysis – IV	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 4.8.2.	Pharmaceutical Analysis – IV	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 4.8.3.	Pharmaceutical Chemistry –IX (Medicinal Chemistry- IV)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P 4.8.3.	Pharmaceutical Chemistry – IX (Medicinal Chemistry- IV)	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T 4.8.4.	Pharmacognosy – VI	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P. 4.8.4.	Pharmacognosy – VI	**1**	**3**	**4**	**80**	**32**	**---**	**20**	**100**	**40**
T.4.8.5.	Pharmacology - IV (Clinical Pharmacy & Drug Interactions)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
T.4.8.6.	Elective(Theory)	**1**	**3**	**3**	**80**	**32**	**1**	**20**	**100**	**40**
P.4.8.7.	Industrial training report	**Grade A/B/C**								
TOTAL--							Th 18 Pr 12			

Industrial Training Report & Project Report grade will be awarded as follow

Grade A : Excellent

Grade B : Good

Grade C : Poor

***Above both the report can be completed during T.Y. / Final B. Pharm.**

For project report one project should be given in group of 3 Students. Under one teacher. 5-7 group can study and complete their project. During final Year (VIII Sem.) oral examination will be conducted by appointing External Examiner from Industry or Academic for both the project and grades will be allotted individually.

* 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.

T.1.1.1 – Pharmaceutics-I (Dispensing Pharmacy)
(Theory 4hours/week)
Section I

	Topics	Hrs.
1	**Introduction to dosage form**	3
	Pharmacist: A Health Care Provider: Pharmacy education, role of pharmacist, pharmacy practice in India, pharmaceutical healthcare, role of community pharmacist.	
2	**Pharmaceutical Additives**	3
3	**Prescription:** Introduction, parts of prescription, handling of prescription, patient counseling, types of prescription, prescription pricing and documentation.	5
4	**Compounding and Dispensing of Medication:** Definition of compounding, dispensing and manufacturing. Fundamental operations in compounding, containers and closures for dispensed products, labeling and storage of compounded products. Good compounding practices, good dispensing practices, record keeping, PMR, product information leaflet, medication card, pictograms.	5
5	**Pharmaceutical Calculations:** Weights and measures, % calculations, allegation method, proof spirit, isotonicity.	4
6	**Posology:** Introduction, factors affecting dose, calculation of doses according to age, body weight and surface area.	2
7	**Pharmaceutical Incompatibility:** Definition, introduction, classification. Physical incompatibility, chemical incompatibility and therapeutic incompatibility.	4
		23

Section II

	Topics	Hrs.
1	**Suspension:** Introduction, classification, advantages, disadvantages, formulation, compounding and dispensing aspects of suspension. Oral suspensions, dry powders for suspension, inhalations and topical suspensions.	5
2	**Emulsion:** Introduction, classification, applications of emulsion. Formulation, emulsifying agents, selection of emulsifying agents, HLB values, compounding of emulsion (bottle method, wet gum and dry gum method), identification of type of emulsion, stability and causes of instability of emulsion (cracking, creaming and phase inversion). Oral and topical emulsion.	5
3	**Semisolids:** Ointments, classification, advantages, disadvantages, formulation, ointment bases, compounding of ointments (incorporation, fusion and dilution method). Creams, definition and uses, formulation, compounding and filling. Pastes, definition and uses, formulation and compounding. Gel and Jellies, definition and uses, types of gel, compounding of gels. Poultices and Plasters, definition and uses, formulation and compounding.	5
4	**Suppositories:** Introduction, classification, merits and limitations. Formulation of suppositories, oleaginous base, hydrophilic base, compounding of suppositories by moulding, hand rolling and compression. (evaluation parameters shall not be included)	3
5	**Ligatures and Sutures:** Introduction, classification, absorbable and non-absorbable sutures. Processing, manufacturing, packaging and quality control test of catgut.	2
6	**Monophasic liquid dosage forms**	7
7	**Powders and granules**	3
8	**Introduction to Pharmacopoeias and other Compendia:** IP, BP, USP, BPC, extra pharmacopoeia and European pharmacopoeia	2
		22

P.1.1.1 Dispensing Pharmacy
(Practical) (3 hrs/week)

A. Introduction to Laboratory Apparatus.

B. Introduction to Weights and Measures.

C. Introduction to Latin Terms Abbreviations.

D. Handling of Prescription.

E. Suspensions

1. Pediatric Kaolin Mixture*.
2. Magnesium Trisillicate Mixture*.
3. Pediatric Chalk Mixture**.
4. Menthol and Eucalyptus Inhalation*.
5. Calamine Lotion*.

F. Emulsions

1. Castor Oil Emulsion*.
2. Turpentine Liniment**.
3. Oily Calamine Lotion**.
4. Benzyl Benzoate Application*.

G. Ointments/Paste/Gel

1. Sulphur Ointment*.
2. Benzoic Acid Ointment (Whitfield's Ointment) **.
3. Methyl Salicylate Ointment**.
4. Zinc Oxide and Salicylic Acid Paste (Lassar's Paste) **.
5. Resorcinol and Sulphur Paste*.
6. Lubricating Gel*.

H. Suppositories

1. Use of Displacement Value*.
2. Suppository with Fatty Base**.
3. Suppository with PEG Base**.
4. Glycerin Suppositories**.

*** Indicates Minor Experiments** **** Indicates Major Experiment**

T. 1.1.2 - Pharmacognosy– I

(Theory)(3 hours/week)

Section I

Topics		Hrs.
1	Definition, history, scope and development of Pharmacognosy	03
2	Sources of drugs :Biological, marine, mineral and plant tissue cultures as sources of drugs	02
3	Classification of drugs : Alphabetical, morphological, taxonomical, chemical and pharmacological classification of drugs	03
4	Plant taxonomy : study of the following families with special reference to medicinally important plants - Apocynacae, Solanaceae, Rutacease, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae, Graminae, Labiatae, Cruciferae, Papaveraceae.	07
5	Cultivation, Collection, Processing and storage of crude drugs: Factors influencing cultivation of medicinal plants. Types of soils and fertilizers of common use. Pest management and natural pest control agents. Plant hormones and their applications. Polyploidy, mutation and hybridization with reference to medicinal plants.	08
	TOTAL	**23**

Section II

Topics		Hrs.
1	Quality control of crude drugs: Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods and properties.	06
2	An introduction to active constituents of drugs: their isolation, classification and properties.	04
3	Systematic pharmacognostic study of following a) Carbohydrates and derived products: agar, guar gum, acacia, Honey, Isabgol, pectin, Starch, sterculia and Tragacantyh. b) Lipids: Bees wax, Castor oil, Cocoa butter, Cod~liver oil, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Rice, Bran oil, Shark liver oil and Wool fat.	12
	TOTAL	**22**

P. 1.1.2 - Pharmacognosy– I

(Practical) (3 hours/week)

1. Morphological characteristics of plant families mentioned in theory.**
2. Microscopic measurements of cells and Cell contents: Starch grains, calcium oxalate crystals and phloem fibers.*
3. Determination of leaf constants such as stomatal index, stomatal number, vein-islet number, vein-termination number and palisade ratio.**
4. Identification of crude drugs belonging to carbohydrates and lipids.*
5. Preparation of herbarium sheets.*

Indicates Minor Experiments** * **Indicates Major Experiment**

Books Recommended:

1. Kokate C. K. Purohit A. P. and Gokhale S. B., Pharmacognosy (degree), Nirali Prakashan
2.Kokate C.K., Practical Pharmacognosy, Vallabh Prakashan, Delhi
3. Atal C. K. and Kapur B. M., Cultivation and utilization of Medicinal plants, RRL, Jammu.
4. Brain K. R. and Turner T. D., The practical Evaluation of phytopharmaceuticals
5. Khandelwal KR, Practical Pharmacognosy, Nirali Prakashan, Pune.
6. Chandha K.L. and Gupta R., Advances in Horticulture, Vol II, medicinal and aromatic plants
7. Chopra R. N., Nayar S. L. and Chopra I. C., Glossary of Indian Medicinal plants CSIR, New Delhi.
8. Iyengar M.A., Study of Crude Drugs, Manipal Power Press, Manipal.
9. Iyengar M.A. , Pharmacognosy Lab Manual., Manipal Power Press, Manipal.
10. Medicinal Plants of India, Zafar R., C.B.S. Publisher, New Delhi.
11. Swain T., Chemical Plant Taxonomy, Academic Press London.
12. Swain T., Comparative Phytochemistry, Academic Press London.
13. The Wealth of India, Raw Marerials (All Volumes), Council of Scientific and Industrial Research,
14. Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne.
15. Siddiqui A.A. and Siddiqui Seemi, Natural products chemistry practical manual, CBS Publishers and Distributors Pvt Ltd.
16. Whistler R.L., Industrial Gums, Polysaccharides and their derivatives, 2nd Edition, Academic Press,
17. Tyler, V.E., Brady, R., Pharmacognosy, Lea and Febiger, London.
18. Wagner, S.B., Zgainsky, Plant drug Analysis, Springer, Second edition.
19. A.C.Dutta, A Class Book of Botany, Seventeenth edition, Oxford university press
20. V.D.Rangari, Pharmacognosy and Phytochemistry, Volume I & II
21. Fahn A, Plant anatomy, 3rd Ed. Pergamon press, Oxford.
22. Mohammed Ali, Textbook of Pharmacognosy, Second edition, CBS Publishers and Distributors Pvt Ltd.
23. Wallis, T.E. Textbook of Pharmacognosy, J.A. Churchill Limited, London.

T. 1.1.3 - Pharmaceutical Chemistry - I (Inorganic Pharmaceutical Chemistry) (Theory)(3 hours/week)

Section I

Topics		Hrs.
1.	**Purity of pharmaceuticals:** sources of impurities, tests for purity and identity, including limit tests for iron, arsenic, heavy metals(lead), chloride, sulphate and special tests if any, of the following classes of inorganic pharmaceuticals included in Indian Pharmacopoeia.	07
2.	**Acids, Bases and Buffers :**Theories of acid and base, Types of pharmaceutical buffers, mechanism of action, Buffer equation, Buffer capacity, Measurement of tonicity, Calculations and methods of adjusting isotonicity.	08
3.	**Water:** Types ,physical and chemical properties of water, methods of softening of water	03
4.	**Gastrointestinal Agents:** Acidifying agents, Antacids, ProtectivesandAdsorbents, Saline Cathartics.	05
	TOTAL	**23**

Section II

Topics		Hrs.
5	**Major Intra-and Extra-cellular Electrolytes:** Physiological ions. Electrolytes usedfor replacement therapy, acid-base balance and combination therapy.	07
6	**Essential and Trace Elements:** Transition elements and their compounds ofpharmaceutical importance: Iron and haematinics, mineral supplements.	08
7	**Cationic and anionic components** of inorganic drugs useful for systemic effects.	03
8	Gases and Vapours: Oxygen, Anesthetics and Respiratory stimulants.	04
	TOTAL	**22**

P.1.1.3 - Pharmaceutical Chemistry – I (Inorganic Pharmaceutical Chemistry) (Practical)) (3 hours/week)

Sr.no.	Topic	No. of experiments
1	systematic qualitative analysis of inorganic mixtures containing two anions and two cations**	minimum five practicals
2	Limit test for the following as per the procedure given in Indian pharmacopoeia: • Chloride* • Sulphate* • Heavy metals* • Iron* • Arsenic**	At least one for each
3	Preparation of inorganic compounds:* • Copper sulphate • Magnesium oxide • Ferrous sulphate	Minimum 2

Indicates Minor Experiments** * Indicates Major Experiment**

Books Recommended:

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. British Pharmacopoeia.
9. Remington's Pharmaceutical Sciences.
10. Textbook of Inorganic pharmaceutical chemistry By Siddique.
11. Textbook of Inorganic pharmaceutical chemistry By Dr. K.G.Bothara.
12. Textbook of Inorganic pharmaceutical chemistry By Dr. Kasture and Wadodkar.
13. Textbook of Inorganic pharmaceutical chemistry By Dr. Kasture and Wadodkar.

T.1.1.4. Biostatistics And Computer Application in Pharmacy

Theory (4 hrs/ week)

Section-I

TOPICS	Hrs.
1. Introduction to Statistics :Meaning of statistics, uses and limitation of Statistics. Collection of data, Classification of raw data into ungrouped and grouped frequency distribution, Representation of data by diagram and multiple bar diagram, simple bar diagram and pie diagram. Representation of data by graph : Histogram, frequency polygram. Statistical population, meaning of sample, Introduction of sampling, simple random sampling, stratified random sampling, systematic sampling.	6
2. Measures of central tendency- A.M. G. M. and H. M., mean, mode, median, Measures of dispersion-Range, quartile range, mean deviation, variance and standard deviation, Coefficient of variance.	6
3. Bivariate data, correlation, scatter diagram, karl pearson's coefficient of correlation, spearman's rank correlation, Regression, line of regression, method of least square, non linear regression, Analysis of variance, one way and two way classification.	6
4. Probability and Probability distribution- Meaning of classical probability, Axiomatic approach to probability, probability theorem, Binomial distribution, normal probability distribution.	6
5. Testing of Hypothesis – Null hypothesis, alternative hypothesis, parameter statistics, testing of significance, standard error, critical region, acceptance region, one tailed and two tailed test. Type I and Type II error.	6

Section-II

TOPICS	Hrs.
1. History and Generation of Computers Fundamentals, evolution and generation, types of computers	4
2. Anatomy and Computer Peripherals CPU, Input and Output devices, Ancillary machines, characteristics of computers, memories and storage devices	6
3. Operating systems Terminology MS-DOS, MS Windows, Introduction to other operating systems.	4
4. Microsoft office MS Word, MS Excel, MS PowerPoint	10
5. Introduction to internet basics and networking Internet browsing, search engines, e-mail networking concepts, LAN, WAN.	3

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.	3

P.1.1.4. Biostatistics And Computer Application in Pharmacy

Practical (3 hrs/ week)

Exercises based on the following are to be dealt:

1. Computer operating systems like MS DOS, MS WINDOWS etc.
2. Study of soft-ware packages like MS Word, MS Excel, MS PowerPoint etc.
3. Browsing of Internet.

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. Applied Statistics by S. P. Gupta and Kapoor Sultan Chand and Sons Publishers, New Delhi – 02
5. Pharmaceutical Statistics by S. Boton
6. Donald Sanders - Computer Today (3 rd Edition) Publisher – McGraw - Hill Book Company
7. William and Fassett - Computer Applications in Pharmacy.
8. Computer-Aided Drug Design (Methods & Applications) Edited by - Thomas Perun, Propst Publisher- Marcel Dekker Inc.
9. Computer Medicine by J. Rose, Publisher: J. & A. Churchill Ltd.
10. Computer Programming - I by Sneha Phadke, Publisher: Technova Publication
11. Microsoft office 97 by Ginicourter & Annette Marquis, BPB Publications, N. Delhi – 01
12. The ABC's of the Internet by Cristain Crumlish, BPB Publications, N. Delhi –

T.1.1.5. Communicating Skills and soft skill development

(Theory 4 Hours/week)

Section – I

Topics	Hrs
1) **Introduction on language and communication:** Meaning and importance of communication, Objectives of Communication. Need for Communication. Types of communication. Written & Verbal communication. Formal and informal communication (The grapevine), upward and downward communication. Non-Verbal, Body Language and Graphic Language. Barriers to effective communication and how to overcome them; brevity, clarity and appropriateness in communication. 2) **Channels of communication:** language as a tool for communication. Developing effective messages: Thinking about purpose, knowing the audience, structuring the message, selecting proper channels, minimizing barriers & facilitating feedback. 3) **Writing:** Selecting material for expository, descriptive , and argumentative pieces, business letters; formal report; summarizing and abstracting ; expressing ideas within a restricted word limit; paragraph division; the introduction and the conclusion; listing reference material; use of charts, graphs and tables ; punctuation and spelling; semantics of connectives, modifiers and modals; variety in sentences and paragraphs. Preparing Agenda and writing minutes for meetings, Case writing and Documentation 4) **Technical Communication:** Nature, Origin and Development. Salient features. Scope & Significance. Forms of Technical Communication. Difference between Technical Communication & General writing. Objective Style vs. Literary Composition. 5) **Business communication**: Importance of written business correspondence. General principles and essentials of good commercial correspondence. Different types of commercial correspondence & their drafting. Types of Business letters. Official letters, electronic communication process.	

Section – II

Topic	Hrs
1) **Career Skills:** Interview skills**,** Applying for job, Cover letters, Resume and Effective Profiling, group discussion, letter writing, e-mail writing and e-mail etiquettes. 2) **Formal written skills:** Report writing – preparing rough draft, editing and preparing final report, Office Drafting: Circular, Notice, and Memo. Business correspondence: Enquiry, Order letter, Complaint letter, and Adjustment letter. Defining, Describing Objects & Giving Instructions. 3) **Introduction to Phonetics:** Introduction to Vowels and Consonants and associated Phonetic symbols. Introduction to Accent, Intonation and Rhythm.	

4) **Soft Skills:** Empathy (Understanding of someone else point's of view) Intrapersonal skills, Interpersonal skills, Problem solving, Reflective thinking, Critical thinking, Negotiation skills. 5) **Modern Technology and Communication:** Globalization of Business, Role of Information Technology. Tele-communication. Internet. Tele-conferencing and Video-conferencing.	

Books Recommended:

1. M.Ashraf Rizvi **Effective Technical Communication (Tata McGraw Hill Companies)**
2. Bhaskaran & Horsburgh **Strengthen Your English** (**Oxford University Press)**
3. Andrea J Rutherfoord Basic **Communication Skills for Technology (Pearson Education Asia)**
4. Orient Longman **English Skills for Technical Students**, **WBSCTE with British Council,**
5. P.Eliah **A hand book of English for professionals**. **(Pharma book syndicate)**
6. Judy Garton-Sprenger **B.B.C. English Stage 1 (B.B.C. English)**
7. **Spoken English** in 3 volumes with 6 cassettes, OUP. **(CIEFL)**
8. T.Balasubramanian **A textbook of English Phonetics for Indian Students by (Macmillan)**
9. KK Ramchandran **Business communication (Macmilan)**
10. S R Inthira & V Saraswathi " **Enrich your English – a) Communication skills b) Academic skills " (CIEFL & OUP)**
11. Mohan Krishna & Banerji Meera. **Developing communication skills (Macmillan)**

T.1.2.1Pharmaceutics – II(Unit Operation)
Theory -4 hour/week

Section I	Hrs
Note: - Numerical problems not included.	
1.Heat Transfer: - Modes of heat transfer, heat transfer in solid & liquids, heat transfer equipments, heater & heat exchanger.	04
2.Distillation :- Boiling point & equilibrium diagrams, principles of fractionation, small scale **&** large scale batch type & continuous type fractionation, fractionating columns & their accessories, reflux, vacuum, steam distillation & their molecular distillation. Application of distillation to solvent purification, mfg. of essential oils & alcohol distillation.	05
3.Drying: - Theory & mechanism of drying, equipments, classification, batch dryers, continuous dryers, atmospheric pressure & vacuum dryers, introduction to tray, cabinate, truck, tumbling, fluidized bed, spray, drum, rotary & freeze drying. Uses of dryers in pharma departments like tablets.	07
4.Filtration: Mechanism of filtration, Theories of filtration, Factors influencing filtration, filter media and filter aids. Classification of filtration equipment- Plate and frame filter press, Filter leaf, Metafilter, Cartridge filter, Drum filter.	04
5.Corrosion: Mechanism of corrosion, types of corrosion and ageing, factors influencing corrosion and method of combating corrosion.	03
6.Fluid flow: Fluid status, mechanism of fluid flow, Bernoulli's theorem, fluid heads, fluid Handling	04
7.Fluidization: Theory of Fluidization, Application of fluidization in pharmacy in the areas of powder handling, agglomeration, drying and coating.	03

Section II	
Topic	Hr.
1.Evaporation: - Introduction, Factors influencing rate of evaporation, classification of evaporates, pan kettles, horizontal tube, vertical tube & film evaporators. Evaporator accessories, multiple effect evaporators .application related to galenicals.	04
2. Extraction:- Solid -liquid and liquid-liquid extraction ,various small scale and large scale equipment , application of various extractors in the extraction of drugs.	03
3.Crystallization:- Crystal forms and habits , solubility curves , supersaturation, nucleation , growth, yield and purity -Mier's theory-crystallizers, their classification, design, operation and selection, uses of crystallizers in the mfg. of various therapeutic entities having specific crystalline nature .	04
4. Centrifugation: Theory, classification of centrifuges, principle**,** construction and working of the centrifuges Ex: Perforated basket centrifuge, Horizontal continuous centrifuge, supercentrifuge and conical disc centrifuge.	04
5. Environmental control:- air conditioning ,refrigeration , water vapour – air mixture ,humidity and particulates in air refrigeration.	04
6.Size reduction: Importance in pharmacy, factors influencing size reduction grinding mills of various types like hammer mill, multimill, conico cylindrical, ball mill, edge and end runner mill, fluid energy mill.	04
7.Size separation : Sieves, sifting, size gradation, size distribution- methods of determining size distribution	03
8. Handling and Conveying: Solids: trucks, trailers, power shovels, gantry cranes. Permanent installations for handling solids, conveyors belt, chain, screw and pneumatic conveyors. **Fluids:** pumps, pipes and fittings, valves, pipe connections. Application in pharmacy	04
Total: 60 Hrs	

P.1.2.1 Pharmaceutics – II(Unit Operation)
Practical 3 hour/week

Experiments

1) Determination of rate of evaporation*
2) Determination of rate of drying, free moisture content and bound moisture content**
3) Experiments to illustrate the influence of various parameters on the rate of drying**
4) Experiments to illustrate principles of size reduction*
5) Determination of humidity- use of Dry and Wet bulb.*
6) Evaluation of filter media, determination of rate of filtration and study of factors affecting filtration*
7) Drying of wet granules and to plot the rate of drying curves. **
8) Operation of sieve shaker and sieve analysis. **
9) Particle size measurement by stokes law. *
10) Experiment of homogenizer and to measure homogeneity of the* product
11) Experiments on methods of crystallization, study of crystal habits**
12) Demonstration of simple distillation process.
13) Experiment based on extraction process**

Major Expt**
Minor Expt*

Books Recommended

1) **K. Sambamurthy--** Pharmaceutical Engineering, New Age International Pvt. Ltd.
2) **W.L.Badger & J. T. Banthero--** Introduction to Chemical Engineering
3) **David Ganderton.** --- Unit Process in Pharmacy, Medical Books Ltd. London
4) **G.G. Brown**--- Unit Operations, CBS Publishers and Distributors, New Delhi.
5) **Robbert H. Perry, Don W, Green.---**Perry's Chemical Engineering Hand Book, 7th edition, International Edition, McGraw Hill
6) **N.G.Pandya., C.S.Shah**---- Elements of Heat Engines, Charotar Book Stall, Tulsi Sadan, Anand (W. Rly), India
7) **Donald P. Eckman** ---- Industrial Instrumentation, Seventh Wiley Eastern, Reprint, 1983, Wiley Eastern Ltd, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002
8) **C**. **V.S. Subrahmanyam----** Pharmaceutical Engineering principles and practices**,** Vallabh prakashan, New Delhi.

T. 1.2.2 - Pharmaceutical Chemistry – II (Inorganic &Physical Chemistry) (Theory)(3 hours/week)

Section I

Sr. No.	Topics	Hrs.
1	**Topical Agents:** Protectives, Astringents and Anti-infectives.	06
2	**Dental products:** Dentifrices, Anti-caries agents	03
3	**Complexing and chelating agents used in pharmacy**	02
4	**Inorganic radiopharmaceuticals and contrast media :**Radiopharmaceuticals, Radiation dosimetry, Biological effects of radiations, Applications of Radiopharmaceut Radiopaque contrast media.	06
5	**Miscellaneous agents :** Sclerosing agents, Expectorants, Emetics, Poison and Antidotes Sedatives, Antioxidants, Pharmaceutical aids used in pharmaceutical industry.	06
	TOTAL	**23**

Section II

	Topics	Hrs.
6	**Behavior of Gases** : Kinetic theory of Gases, Deviation from behavior and explanation	04
7	Chemical Kinetics: Zero, first and second order reactions, complex reactions, theories of reaction kinetics, catalysis, characteristics of homogeneous and heterogeneous catalysis, acid base and enzyme catalysis	08
8	Quantum Mechanics: Postulates of quantum mechanics, operators in quantum mechanics, the Schrodinger wave equation	06
9	**Photochemistry:** Consequences of light absorption, Jablenski diagram, Lambert-Beer'law, Quantum efficiency	04
	TOTAL	**22**

P. 1.2.2 - Pharmaceutical Chemistry – II (Inorganic &Physical Chemistry) (Practical)(3 hours/week)

Sr.No.	Topics	No. of Experiments
1	Identification tests for pharmacopoeial inorganic pharmaceu and qualitative tests for cations and anions should be covered **	At least 04
2	To determine molar mass by Rast method and cryoscopic method.*	At Least 02
3	To determine molar mass of volatile liquids by Victor-Meyer method.*	At Least 02
4	To determine the heat of solution, heat of hydration and heat of neutralization.**	At Least 02
5	To determine rate constant of simple reaction.*	At Least 02

*** Indicates Minor Experiments** **** Indicates Major Experiment**

Books Recommended:

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. British Pharmacopoeia.
9. Remington's Pharmaceutical Sciences.
10. Textbook of Inorganic pharmaceutical chemistry By Siddique.
11. Textbook of Inorganic pharmaceutical chemistry By Dr. K.G.Bothara.
12. Textbook of Inorganic pharmaceutical chemistry By Dr. Kasture and Wadodkar.
13. Textbook of Inorganic pharmaceutical chemistry By Dr. Kasture and Wadodkar.
14. Essentials of Physical chemistry By Bahl and Tuli.
15. Principles of Physical chemistry By Maron and Prutton.
16. Physical pharmacy and pharmaceutical sciences by Martin.

T.1.2.3 Pharmaceutical Chemistry – III (Organic Chemistry-I)

Theory: 4 hours / week

Section I

	Topics	Hrs.
1.	Introduction to organic chemistry :Importance and properties of carbon, Hybridization of elements, Atomic structure, Atomic orbitals, Molecular orbital theory, Types of Bonding , Bond dissociation energy, Polarity of bonds, Polarity of molecules.	10
2.	Stereochemistry: Isomerism, stereo isomerism, Geometric isomerism, optical activity, Fischer and Newmanns projections of molecules, Enantiomers, Disteriomers, Racemic modifications, Meso compounds, Elements of symmetry, chirality, chiral centers, R & S, Z & E,D& L configurations, Sequence rule.	14
3.	Reactive intermediates - carbocations, carbanions, carbenes, Reagents: Electrophiles and Nucleophiles.	06
	TOTAL	**30**

Section II

	Topics	Hrs.
4.	Structure; Nomenclature; Preparation and Reactions of: **A.** Alkanes, Alkenes, Alkynes, Cycloalkanes, Dienes, Trienes **B.** Aldehydes and ketones, Amines, Alcohols, Ethers, Benzene, Epoxides, Arenes, Carboxylic acids, Functional derivatives of Carboxylic acids **C.** Polynuclear aromatic compounds (Naphthalene, Phenanthrene, Anthracene)	10 15 05
	TOTAL	**30**

P.1.2.3. Pharmaceutical Chemistry – III (Organic Chemistry-I)

Practical :3hrs / week

Sr.no.	Topic
1	The student should be introduced to the various laboratory techniques involving synthesis of selected organic compounds ➢ P-Nitroaniline* ➢ P-Bromoacetanilide* ➢ Benzanilide* ➢ Phenyl Benzoate* ➢ Anthraquinone* ➢ 2,4,6 Tribromophenol*
2	Identification of organic compounds and their derivatisation (Atleast 05).**
3	Introduction to the use of stereomodels.

***** **Indicates Minor Experiments** ****** **Indicates Major Experiment**

Books Recommended:

1. Organic Chemistry by I.L. Finar vol. I and II ELBS / Longman, London
2. Organic synthesis by Gilman and Blatt Collective vol 3
3. Stereochemistry of carbon compounds by E.L. Eliel Mc. Graw Hill Book Co, Inc. New York.
4. Advanced organic chemistry by Bahl and Bahl
5. Organic chemistry by T.R. Morrison and R. Boyd, Prentice Hall of India Pvt. Ltd. New Delhi
6. Organic chemistry by Hendrickson, Cram and Hammond.
7. Frontier orbitals and organic chemistry by lan Flaming.
8. Principles of organics synthesis by R.O.C. Norman
9. Introduction to organic chemistry – By Streitweiser and Health Cook
10. Reaction mechanisms in organic chemistry by Mukherjee and Singh.

T.1.2.4- Anatomy, Physiology And Health Education-I (Theory) (3 Hrs/ Week)

SECTION-I

	Topics	Hrs
1	Introduction to anatomy and physiology and common anatomical terms.	02
2	Cells, Tissues and organization of the body. - Structure, components , functions, cell cycle, protein synthesis	04
3	Musculoskeletal System - Bone- Types, Structure, Composition and Functions - Skeleton- Axial and Appendicular Skeleton and cavities of the body. - Joints- Classification, Types and Functions - Muscle tissue- Smooth, Cardiac, Skeletal muscle and its contraction,structure, principle and functions	10
4	Special sense organs- Structure, and functions of organs of Taste, Smell, Vision, Touch and Hearing	05
5	Resistance and Immunity- Types and its functions	02

SECTION-II

	Topics	Hrs
1	Nervous System- - Defination, Classification, Structure and functions of various parts of CNS and PNS, transmission of impulse, reflex action	06
2	Endocrine System Location, hormones and functions of various endocrine glands and negative feedback mechanism	04
3	Haemopoeitic System Composition, functions of blood and its elements, transfusion of blood , coagulation of blood and blood group	04
4	Lymh and Lymphatic System - Functions, composition, formation and circulation of lymph, structure and functions of lymph glands and spleen	02
5	Health Education Concept of health - Defination, Types, Determinant and Indicator of Health, Role of pharmacist in community. Concept of disease -Defination, Web of causation, History of disease- agents, host and environment, concept of prevention of diseases. Demography and family planning -Demography, Demographic cycle, Family Planning, Role of WHO, Measurement of fertility, Contraceptive methods	06

Total Hrs:-45

Books Recommended:

1) Guyton & Hall. Textbook of medical physiology, Elsevier. New Delhi, 2000 10th edition.

2) Vander, Sherman, Luciano. Human Physiology. Mc-Graw Hill Publication New Delhi 1998 7th edition.
3) Tortora G.J. Principles of anatomy & physiology. Harper Collins College Publishers, New York 1996 8th
edition.
4) Chatterjee C.C. Human Physiology. Medical allied agency. Kolkata 2003
11th Edition.
5) Ross and Wilson. Anatomy and Physiology in health and illness. Churchill Livingstone 2001. 9th edition.
6) AB Mc Naught and Callander R., " Illustrated Physiology", B.I. Churchill Living Stone, New Delhi, 987. 1st edition.
7) Chaudhry Sujit K., "Consise Medical Physiology", New Cenrtal Book Agency, Calcutta, 1993. 2nd edition
8) Douglas E., Kelly, Richard Wood and Allen C. Enders, " Bailey`s TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London,
1984. 18th Edition
09) Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 1997 4th edition.
10) Inderbir Singh, " Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, 2002. 4th edition.
11) P.C.Dandiya " Health Education and Community Pharmacy", Vallabh Prakashan New Delhi, 2007, 5th edition
12) R.P.Phate " Anatomy Physiology and Health Education" Carrier Publication,Nashik,2007,3rd edition

P.1.2.4- Anatomy, Physiology And Health Education-I (Practicals) (3 Hrs/ Week)

1	Study of human skeleton – Identification of bones*
2	Study with the help of charts and models of following Systems and organs* - Nervous System - Endocrine System - Haemopoeitic System - Lymphatic System
3	Study of different family planning devices*
4	Study of Microscope*
5	Microscopic study of permanent slides* - Epithelial , Connective, Nervous and muscular tissue - Tongue , thyroid , testes, ovary, blood smear blood vessel, pancreas, spleen, stomach, intestine, spinal cord, cerebrum, cerebellum, lungs
6	Haematology - Determination of RBC count of blood** - Determination of total WBC count of blood** - Determination of differential WBC count of blood** - Determination of clotting time and bleeding time of blood* - Determination of haemoglobin content of blood* - Determination of ESR** - Determination of blood group* - Determination of blood pressure* -

* Indicate Minor Experiment ** Indicate Major Experiment

Books Recommended Books-

1. Ranade V.G., Pradhan S, Joshi P.N. Text Book of Practical Physiology. Pune Vidyapith Griha Prakashan, Pune, 1997

2. Mukherjee K.L. Medical Laboratory Technology. Tata McGraw Hill. New Delhi,1999 4th edition (Vol.I,II,III)

3. Bharihoke V. Text book of Histology .A.I.T.B.S Publication. 2005, 2nd edition

T.1.2.5. Industrial Psychology

(Theory) (3 hrs/ week)

Section-I

	TOPICS	Hrs.
1.	**Introduction to Industrial Psychology** Definition of Psychology : subfields of Psychology; Industrial Psychology; its definition, nature and scope. History of Industrial Psychology, Premises of Industrial Psychology. Modus operandi of Industrial Psychology. Development of Industrial Psychology. Hurdles in the way of Industrial Psychology.	05
2.	**Personnel Selection** Occupational information, individual differences. Personnel specification, its types and objectives. Methods of Job analysis. Uses of Job analysis. Types of personnel actions. Selection techniques : Application blanks, references, interview and Psychological Tests. Intelligence (otis, standord-Binet, Weehster adult Intelligence test, Multifactor test); Aptitude (DAT); Personality (Rorschaeh, TAT and MMPI).	08
3.	**Personnel Development** **Motivation :** Theories of Motivation (Maslow, Vroom) Motivation & Organisation. Incentives, financial and non-financial job satisfaction. Herzberg's two factor theory. Factors affecting satisfaction. Morale and Monotony. Definition and nature of leadership. Functions of leaders. Trait theory of leadership: Managerial grid. Fieldless contingency Model.	07 02
4.	**Accident Prevention and Safety measures**.	

Section - II

	TOPICS	Hrs.
5.	**Introduction to Sociology** What is Sociology ? The relevance of sociology to industry. Personality and social behaviour, Social adjustment of workers, Definition and levels of communication, Process of communication, Types of communication, Improving communication in organisation.	05
6.	**Industrial Democracy** What is Industrial Democracy ? Worker participation in Management.	05
7.	**Trade Unions** Problem of trade unions in India. Collective bargaining. Industrial disputes, its causes and methods to resolve.	06 06
8.	**Science, Technology, Industry and Society** Science & Technology, Impact of Science & Technology on industry and society. The role of industry in national development. Cottage, small and large scale industries. Problems of industrialisation with special reference to the Pharmaceutical industry.	

Total Hrs. :- 44

Books

Text book

1. Bhagwatwar P.A., Psychology of Industrial and Organisational behaviour.

Reference books

1. Ghosh, P.K. & Ghorpode, M.B. Industrial Psychology.
2. Ghosh, P.K. & Ghorpode, M.B., Industrial and Organisational Psychology.
3. Rao, P.K. & Thakurdesai, V.U. Industrial Psychology and Organisational behaviour.
4. Giri, V.V. Labour problems in Indian industries.
5. Trade Unionism by Varma and Dixit.
6. Industrial Psychology by V.Schneider.
7. A Sociology of work in Industry by A.Fox.
8. Social Psychology by Barrew and Byrne.
9. Industrial Conflicts by A.Kornhauser, R.Dubiw and A.M.Ross.

North Maharashtra University, Jalgaon.

Syllabus of

Second Year B.Pharmacy [Sem III &Sem IV]

(CGPA Pattern)

W.E.F. Academic Year 2013-14

T 2.3.1Pharmaceutics III (Physical Pharmacy-I)

(Theory) (3 Hrs/week)

Sr. No.	Topic	Hrs.
	SECTION-I	
1	**States of Matter** **A. Gases and liquid** Introduction:-Kinetic Molecular Theory. Real gases & Ideal gases, Deviation from gas theory, effects of temperature and pressure, compressibility factor; Critical phenomenon,Critical constant and their determination; van der Waal's equation and critical state, correction for pressure and volume, law of corresponding states (Equation only, no derivation), Methods for liquefaction of gases:- Faraday's method, Linde's process, and Claude's process. Aerosols:- Introduction, Definition, Advantages, Disadvantages, Applications. Application of liquefaction to aerosols i.e. principle of aerosols. Brief explanation of Propellants & their classes. (No discussion about nomenclature of Propellants). **B. Solids** Types of solids, Crystallization, Definition of Habit, Faces of crystal.X-ray crystallography: Braggs equation its derivation. Methods of crystal analysis, Bragg's method and powder method. Polymorphism: Definition, Enantiotropy and Monotropy, examples and Pharmaceutical applications of polymorphism. Detection techniques of polymorphism. **NOTE: Problems only using Bragg's equation to calculate'd' and 'n'.**	**08**
2	**Thermodynamics** Definition, Introduction, limitations. Thermodynamic terms & basic concepts: Homogeneous & Heterogeneous systems, Types of Thermodynamic systems{like Isolated, Closed & Open system}, Intensive & Extensive properties, Thermodynamic processes{like Isothermal, Adiabatic, Isobaric, Isochoric & Cyclic processes}. First law of thermodynamics: Various forms of first law & its significance, Concept of reversible & irreversible processes. Concept of Enthalpy. Introduction to exothermic & endothermic reactions. Heat of reaction, Heat of formation, Heat of combustion. Hesse's law of constant heat summation & its applications;Second law of thermodynamic and Third law of thermodynamics, Concept of Gibbs and Helmholtz free energy. Statement and introduction of Zeroth law. **NOTE: No Derivations only equations.**	**06**
3	**Diffusion and Dissolution** **A. Diffusion:** Definition, Introduction, Diffusion related phenomenon like Dialysis, Osmosis,microfiltration and ultrafiltration. Pharmaceutical applications of diffusion, terms used in diffusion {steady state, non steady state & sink condition}.Sink condition and its significance. Fick's first law of diffusion: flux, statement, mathematical equation, Applications. Fick's second law of diffusion: statement, mathematical equation.	**08**

	Diffusion cells: Various types of diffusion cells. Simple diffusion cell. Detail explanation of Horizontal & Vertical type cells. **B. Dissolution:** Definition, Introduction, Pharmaceutical applications of dissolution, Noyes and Whitney equation. Official dissolution test apparatus {Rotating basket & Paddle type only}. Powder dissolution: Hixson – Crowell cube root law and its significance.	
	Number of lectures	**22**
	SECTION II	
4	**Complexation** Definition, Introduction, Classification of complexes, Pharmaceutical and Medical applications of complexation. Methods of preparation & analysis.	**04**
5	**Solution of Non Electrolytes** Properties and types of solutions, Ideal & real solution, Escaping tendency, Raoulte's law and deviation from Roulte's law. Henry's law. Boiling point diagram, Azeotrops. Colligative properties: Lowering of vapor pressure- methods to study {like Manometric, Isopiestic, Hill and Blades apparatus, Osmometer}. Elevation of boiling point- methods to study {like Landsberger- Walker & Cottrell's method}. Depression of freezing point methods to study {like Beckman's method &Rast's camphor method}. Osmotic pressure: semipermiable membrane and osmotic pressure. Measurement of osmotic pressure {like Pfeffer's, Berkeley & Hartley's method, modern osmometer}. Brief explanation of isotonic solution, Van't Hoff & Morse equation for osmotic pressure. NOTE: Problems for determination of molecular weight based on above Colligative properties.	**08**
6	**Solution of Electrolytes** Definitions, Introduction. Electrolysis, Faraday's laws of electrolysis: First law- Statement, mathematical equation, Second law- Statement, mathematical equation, Conductance: specific and equivalent conductance, Conductometric titrations, conductance and degree of dilution, Colligative properties of solution of electrolyte, Arrhenius theory and Debye- Huckel theory.	**06**
7	**Solubility and Distribution Phenomenon** Solute, solvent and solution. General principles and types of solvent. Solubility of gases in liquids, effect of temperature, pressure, chemical reaction and salting out of gases. Solubility of liquids in liquids. Solubility of salts: solubility of slightly soluble electrolyte, solubility of weak electrolyte- influence of pH, influence of solvent, combine influence of pH and solvents, , influence of surfactants: Distribution coefficient{Nernst coefficient}. Phase rule – 1 component system.	**05**
	Number of lectures	**23**
	TOTAL NUMBER OF LECTURES	**45**

BOOKS RECOMMENDED

1. Martin, Swarbrick: Physical pharmacy
2. C.V.S. Subrahmanyam: Text Book of Physical Pharmaceutics, IInd edition, VallabhPrakashan
3. Glasstone and Lewis: Elements of physical chemistry
4. Maron and Pruton: Physical chemistry
5. Alfonso R.Gennaro, Remington:The Science and Practice of Pharmacy (Mack Publishing Co.)
6. Lachman and Liebermann: Theory and practice of Industrial Pharmacy
7. Bahl and Tuli: Physical Chemistry
8. Eugene Parrott: Pharmaceutical Technology
9. E A Rawling: Bentleys Text book of Pharmaceutics
10. Gurdeep Raj: Advanced Physical chemistry
11. P. G. Yeole: Highlights of Pharmacovigilance, Studium Press I Pvt Ltd.

P 2.3.1Pharmaceutics III (Physical Pharmacy-I)

(Practical) (3 Hrs/week)

1. Determination of density of given unknown liquid samples* (minimum two samples).
2. Determination of specific gravity of given unknown liquid samples* (minimum two samples).
3. Determination of molecular weight of given substance by Rast's camphor method* (minimum two samples).
4. **Conductometric titrations:**
   a) Determination of normality of given acid by conductometric titration*.
   b) Verification of Ostwald's dilution law*.
5. **Distribution coefficient** **
   a) Determination of partition coefficient of iodine between carbon tetrachloride and water.
   b) Determination of partition coefficient of benzoic acid between water and benzene.
6. **Diffusion** (minimum two experiments)
   a) Demonstration of diffusion cell.
   b) To perform *in vitro* diffusion study of salicylic acid using diffusion cell acrosscellophane membrane*.
   c) To perform *in vitro* diffusion study of salicylic acid using diffusion cell across dialysis membrane*.
7. **Dissolution**
   a) Demonstration of dissolution test apparatus (USP Type-I and Type-II apparatus).
8. Determination of Critical Solution Temperature (CST) of phenol-water system**.
9. Determination of solubility of given substance by gravimetric analysis**.
10. Determination of solubility of given substance by titrimetric analysis**.

*** Indicates minor experiment**
**** Indicates major experiment**

BOOKS RECOMMENDED

1. Dr. Derle D. V. - Experimental physical pharmacy
2. H. N. More and Ashok Hajare- Practical Pharmaceutics (Physical Pharmacy)
3. R. S. Gaud, G. D. Gupata- Practical Physical Pharmacy
4. Dr. U. B. Hadkar, T. N. Vasudevan, K. S. Laddha– Practical Physical pharmacy
5. Engeen Parrot– Practical Pharmaceutical Technology
6. C.V.S. Subrahmanyam, S.G. Vasantharaju –Laboratory manual of Physical Pharmacy
7. U. B. Hadkar- A Hand Book of Practical Physical Pharmacy & Physical Pharmaceutics
8. C. VijayaRaghavan- A Practical Hand Book of Physical Pharmaceutics

T2.3.2 PHARMACEUTICAL CHEMISTRY- IV (ORGANIC CHEMISTRY-II)

(Theory) (3 Hrs/ week)

Sr. no.	Topic	Hours
	SECTION-I	
1.	a) **Classes of reactions** :- Nucleophilic and Electrophilic reactions b) Concept and types of Tautomerism c) Resonance and rules for Resonance. d) Electronegativity and concept of Aromaticity. e) Theories of Acidity and Basicity.	**06**
2.	**Chemistry of Carbohydrates :-**Introduction, Classification, Mutarotation, Killiani- fischer synthesis, Ruff degradation, Epimerization, Cyclic structure of carbohydrates, Determination of Ring size of D-glucose.	**07**
3.	**Chemistry of Proteins:-**Geometry of peptide linkage, Formation of peptide bond, Determination of structure of peptides, Methods of peptide synthesis, Zwitterion ion, Isoelectric point.	**07**
4.	**Concept of Racemic mixture and methods of resolution of Racemic mixture**	**03**
	Number of lectures	**23**
	SECTION-II	
5	a) Introduction and Classification of Rearrangements. b) Molecular Rearrangement Reaction with their Mechanism and Examples given below- Benzoin condensation, Chichibabin reaction, Fries rearrangement, Benzilic acid rearrangement, Manich reaction, Reformatsky reaction, Perkins reaction, Knoevenagel reaction, Witting reaction, Lossen rearrangement, Schimidt's reaction, Hoffman's degradation reaction, Beckman rearrangement**,** Malonic ester synthesis,Cope rearrangement	**20**
6	**Chemistry of heterocyclic compounds** – Structure and numbering of the following Heterocyclic compounds – Furan, Thiophene, Pyrrole, Pyrazole, Thiazole, Imidazole, Oxazole, Iso-oxazole, Pyridine, Pyrimidine, Indole, Benzimidazole, Quinolone, Isoquinoline, Purine.	**02**
	Number of lectures	**22**
	TOTAL NUMBER OF LECTURES	**45**

P-2.3.2 PHARMACEUTICAL CHEMISTRY-IV (ORGANIC CHEMISTRY-II)

(Practical) (3Hrs/week)

1) Synthesis/preparation involving more than one step. **
a. p-Ditroaniline form acetanilide
b. Benzylic acid form Benzoin
c. Synthesis of quinoline (skraup method)

2) Separation of Binary mixtures (at least 4) **

3) Quantitative determination of organic compounds via function groups:*

- Phenolic group by bromination method
- Alcoholic group by acetylation method
- Carbonyl group by hydroxymine hydrochloric – pyridine method
- Amino group by bromination method.
- Ester group by hydrolysis method

Minimum 12 experiments should be covered
*** Indicate Minor experiments ** Indicate Major experiments**

Books Recommended:

1. Elementary practical organic chemistry – A.I Vogel Part III – quantitative organic analysis,ELBSLongmann, London
2. Practical organic chemistry by F.C. Mann and B.C. Saunders, ELBS Longmann, London
3. I.P. 1985 and 1966 Govt. of India, Ministry of Health 3rd Edition 1985, 4th Edition 1996.
4. Practical pharmaceutical chemistry vol I and II by Beckett and J.B. Stanlake, Stahlone Press ofUniversity of London.
5. Text Book of Practical organic chemistry by A.I. Vogel ELBS Longmann, London.

T2.3.3 Pharmacognosy-II

(Theory) (3 Hrs / week)

Sr. no.	Topic	Hours
	SECTION-I	
1	**Phytochemical Screening of Natural Products** a. Principles of extraction, Different methods of extraction including maceration, percolation, hot continuous extraction (Soxhlet), supercritical fluid extraction and other advanced techniques with their merits and demerits. b. Preliminary Phytochemical investigation of natural products**.**	**11**
2	**Resins** a. Introduction, Classification, Physical & Chemical properties, distribution, General extraction methodology and analysis of resins. b. Biological source, collection, preparation, chemical constituents, Identification tests, uses, adulterants and substituent of Asafoetida, Guggul, Podophyllum, capsicum, Ginger, turmeric. c. Biological source & uses of Balsam of Tolu, Balsam of Peru, Benzoin, Myrrh, Storax, Colophony, Jalap.	**7**
3	**Fibres** a. Study of Fibers Used in Pharmacy Such As Cotton, Silk, Wool, Nylon, Glass-Wool, Polyester and Asbestos.	**3**
	Number of Lecture	**21**
	SECTION II	
4	**Tannins** a. Definition, classification, chemistry, methods of extraction and analysis of tannins. b. Biological source, collection, preparation, chemical constituents, Identification tests, uses, adulterants and substituent of Pale Catechu, Black Catechu, Gall and Myrobalan, Bahera, Arjuna, Ashoka, Pterocarpus**.**	**8**
5	**Volatile Oils** a. Introduction, Classification, Physical & Chemical properties, occurrence/distribution, General extraction methodology and analysis of volatile oil. b. Pharmacognosy of Fennel, coriander, cassia, clove, Cinnamon c. Biological source, collection, chemical constituents, Identification tests, uses, adulterants and substituent of Dill, Caraway, Ajowan, Cardamom, Nutmeg, Eucalyptus oil, Lemon grass oil, Oil of Citronella, Orange peel oil, Mentha oil, Lavender, Musk, Palmrosa, Vaj, Jatamansi	**14**
6	**Pharmaceutical aids** a. Study of pharmaceutical aids like Talc, Diatomite, Kaolin,Bentonite, Gelatin	**2**
	Number of lecture	**24**
	TOTAL NUMBER OF LECTURES	**45**

P2.3.3. Pharmacognosy - II

(Practical) (3Hrs / week)

1. Demonstration of percolation and continuous extraction technology (Soxhlet apparatus).
2. Chemical test of resinous crude drugs*.
3. Study of morphology*, histology and micro chemical test** of Fennel, coriander, cinnamon, Clove, Eucalyptus, Ginger
4. Extraction of volatile oil**
5. Extraction of Capsicum oleo resin and Ginger oleo resin**
6. Identification of phytoconstituents by General chemical tests* for alkaloids, glycosides, steroids, flavonoids and tannins
7. Study of fibers by chemical test.*
8. Extraction and Estimation of total tannins. **

***Indicates Minor experiments**
**** Indicates Major experiments**

Books Recommended

1. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
2. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree) NiraliPrakashan
3. Kokate C. K. Practical Pharmacognosy, VallabhPrakashan, Delhi.
4. Brain K. R. and Turner T. D., The practical Evaluation of phytopharmaceuticals, Wright-Scientechnica, Bristil.
5. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
6. PulokMukharji, Quality control of Herbal drugs.
7. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
8. Pharmacopoeia of India, 1985, 1996, Govt. of India, Ministry of Health and Family Welfare.
9. Iyengar M.A., Study of Crude Drugs, Manipal Power Press, Manipal.
10. IyengarM.A. ,Pharmacognosy Lab Manual. Manipal Power Press, Manipal.
11. The Wealth of India, Raw Marerials (All Volumes), Council of Scientific and Industrial Research, New Delhi.
12. Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, BailliereTindall, Eastbourne, U.K.
13. Wallis, T.E. Analytical Microscopy, J.A. Churchill Limited, London.
14. Wallis, T.E. Textbook of Pharmacognosy, J.A. Churchill Limited, London.
15. Tyler, V.E., Brady, R., Pharmacognosy
16. V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II.
17. Pharmacognosy, Phytochemistry, Medicinal Plants 2nd Edn. – Jean Bruneton

18. Quality Control Methods for Medicinal Plants – WHO, AITBS Publication.
19. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain London.
20. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
21. Pharmacopoeia Of India, 1985, 1996, Govt. Of India, Ministry Of Health and Family Welfare.
22. Terpenoids in Plants by Pridham J. B., Academic Press, New York
23. Pharmacognosy by Ansari
24. Experimental Phytopharmacognosy –A Comprehensive Guide By SS Khadabdi, DeoreSl, and BA Baviskar, NiraliPrakashan, Pune.
25. Standardization Of Botanicals- Testing & Extraction Methods Of Medicinal Herbs By V. Rajpal, Eastern Publisher, New Delhi

T2.3.4 PHARMACEUTICAL ANALYSIS-I

(Theory) (3 Hrs/ week)

Sr. no.	Topic	Hours
	SECTION-I	
1	**Data handling in analytical chemistry:** Types of errors, Experimental errors, significant figures, arithmetic operations and errors, propagation of errors, statistical treatment of analytical measurements: random errors, confidence limits, precision and accuracy, tests of significance of differences, detections limits, sampling. Significance of quantitative analysis in quality control, different techniques of analysis, preliminaries and definitions, Selection of sample, Fundamentals of volumetric analysis, methods of expressing concentrations, primary and secondary standards.Stoichiometric Calculations	**04**
2	**Applications of Microsoft Excel in pharmaceutical Analysis**	**02**
3	**Aqueous Acid-Base titrations:** • Law of mass action, hydrolysis of salts, neutralization curves, • Theory of indicators, choice of indicators, mixed indicator. • Applications in assay of Benzoic acid, Boric acid, Aspirin.	**05**
4	**Non-Aqueous titrations:** • Types of solvents, end point detection, • Application in assay of Sodium acetate, Sodium benzoate, Norfloxacin tablet.	**04**
5	**Oxidation-Reduction titrations:** • Theory of redox titration, measurement of electrode potential. • Oxidation-reduction curves, redox Indicators. • Titrations involving potassium permanganate, potassium dichromate, potassium bromate, potassium iodate, cerium (IV) sulfate, Iodine (Iodimetry and Iodometry), titanous chloride. • Applications in assay of Ferrous sulfate, Ascorbic acid, Isoniazide, Hydrogen peroxide.	**08**
	Number of lectures	**23**
	SECTION-II	
6	**Argentometric titrations:** • Theory, factors affecting solubility of a precipitate, titration methods- • Mohr's, Volhard's, Gay lussac, and Fajan's method, indicators. • Applications in assay of Potassium chloride, Sodium chloride and Ammonium chloride.	**04**
7	**Complexometric Reactions and Titrations:** • Theory, formation of complex and its stability, titration curves • Concepts in equilibria and formation constants (kf) of metal ion-ligand complexes and distribution of complex ion species in solution • Metallochrome indicators (no structures), types of EDTA titrations • Application in assay of Magnesium sulfate,Lead nitrate and calcium gluconate • Use of complexation as an titrimetric analytical tool	**06**

8	**Gravimetric analysis:** • Precipitation techniques, solubility products, colloidal state, supersaturation, coprecipitation, post precipitation, digestion, filtration, ignition, weighing and calculation. • Application in assay of Alum by oximereagent, Calcium as calcium oxalate andmagnesium as magnesium pyrophosphate.	**06**
9	**Miscellaneous methods of analysis:** • Diazotization titrations, • Kjeldahl's method of nitrogen determination • Oxygen flask combustion method.	**06**
	Number of lectures	**22**
	TOTAL NUMBER OF LECTURES	**45**

Books Recommended:

1. IP, USP, BP, European Pharmacopoeia, International pharmacopoeia
2. Pharmaceutical analysis-Higuchi and brochmann
3. Practical Pharmaceutical Chemistry Part-II – Beckett &Stenlake
4. The quantitative analysis of drugs- Garrat
5. Analytical chemistry- MEITES H.B.
6. Analytical chemistry- Garry Chrisian
7. Principles of instrumental analysis- Skoog
8. Vogel textbook of quantitative chemical analysis
9. Instrumental methods of analysis- Willard, Dean
10. Instrumental methods of analysis-Ewing.
11. Textbook of Pharmaceutical analysis- K.A. Connors
12. Instrumental methods of analysis- ChatwalandAnand

P2.3.4 PHARMACEUTICAL ANALYSIS-I

(Practical) (3 Hrs/ week)

Sr. No.	Experiments
	Instructions:-The students should have a clear understanding of the principle and working ofa typical analytical balance, the precautions to be taken during handling of analyticalbalance, methods of weighing and errors of weighing. The students should also beacquainted with use of appropriate apparatus for various analytical procedures.
1.	Calibration of analytical weights and of volumetric apparatus like volumetric flask , pipetteburette etc.*
2.	**Acid Base Titrations**: Preparation and standardization of acids (HCl, H2SO4) Bases (NaOH). Assays involving Direct and Back titrations. Benzoic acid, Boric acid, Aspirin**
3.	**Non –aqueous Titrations**: Preparation and standardization of perchloric acid and sodium/ potassium/ lithium methoxide solutions* Assays of amines or amine hydrochlorides, sodium acetate, Norfloxacin tablet**
4.	**Oxidation – reduction Titrations**: Preparation and standardization of redox titrants such as potassium permanganate, Ceric ammonium sulphate , potassium dichromate , iodine , sodium thiosulfate etc.* Assays of oxalic acis/ hydrogen peroxide, Ferrous ammonium gluconate, Ascorbic acid/Analgin **
6.	**Complexometric Titrations**: Preparation and standardization of EDTA solution.* Assay of magnesium sulfate, lead nitrate, calcium gluconate, Hardness of water**
7.	**Precipitation Titration**: Preparation and standardization of titrants like Silver nitrate, Ammonium thiocyanate.* Assay of Sodium chloride, Potassium chloride, Ammonium chloride**
8.	**Gravimetric Analysis**: Determination of Alum by Oxime reagent, Sulphate as Barium sulphate/ Ni as Ni DMG complex**
9.	**Miscellaneous methods** : Nitrogen determination by Kjeldahl method** Sodium nitrite titration. (Demonstration)

***Indicate Minor experiments ** Indicate Major experiments**

Books Recommended:

1. IP, USP,BP, European Pharmacopoeia, International pharmacopoeia
2. Pharmaceutical analysis-Higuchi and brochmann
3. The quantitative analysis of drugs- Garrat
4. Analytical chemistry- MEITES H.B.
5. Analytical chemistry- Garry Chrisian
6. Principles of instrumental analysis- Skoog
7. Vogel textbook of quantitative chemical analysis
8. Textbook of Pharmaceutical analysis- K.A. Connors
9. Guide for safety in chemical laboratory- Van Nostrand Reinhold co.
10. Practical Pharmaceutical Chemistry Part-I - Beckett and Stenlake

T2.3.5 A. P. H. E. -II

(Theory) (3 Hrs/ week)

Sr. no.	Topic	Hours
	SECTION-I	
1.	**Cardio vascular system** a) Anatomy of heart a) Blood vessels and circulation b) Pulmonary, coronary & systemic circulation c) Conduction and ECG d) Cardiac cycle and Heart Sounds f) Blood Pressure, maintenance and regulation	**08**
2.	**Urinary System** a) Parts of the Urinary System and Gross structure of the kidney b) Structure of Nephron c) Physiology of Urine Formation and Micturition d) Renin Angiotensin System – Juxtra- Glomerular apparatus e) Maintenance of Acid-Base balance	**07**
3.	**Fluid & electrolyte balance**	**03**
4.	**First Aid :** Emergency treatment of shock, snake bite, burns, poisoning, fractures and resuscitation methods	**02**
5.	**Communicable diseases:** Brief outline, their causative agents, modes of transmission and prevention (Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis, poliomyelitis, helminthiasis, malaria, filariasis, rabies, trachoma, tetanus, leprosy, syphilis, gonorrhoea, and AIDS).	**03**
	Number of Lectures	**22**
	SECTION-II	
6.	**Respiratory System** **a)**Anatomy of respiratory organs and functions b) Mechanism and regulation of respiration c) Physiology of respiration: Transport of respiratory gases d) Respiratory volumes and vital capacity e) Neural and chemical regulation of respiration O_2 and CO_2 carriage and hypoxia f) Definitions of Hypoxia, Asphyxia, Dysbarism, Oxygen Therapy and resuscitation	**08**
7.	**Digestive System** a) Anatomy of Gastro intestinal Tract (GIT) b) Anatomy, Secretions and functions of-Salivary glands, Stomach, Liver, Pancreas, Intestine c) Digestion and absorption	**07**
8.	**Reproductive system** a) Male and female reproductive systems b) Their hormones- Physiological role c) Physiology of menstruation, ovarian cycle d) Spermatogenesis e) Sex determination (genetic basis) f) Pregnancy and its maintenance and parturition g) Contraception and Contraceptive devices	**07**
	Number of Lectures	**23**
	TOTAL NUMBER OF LECTURES	**45**

Books Recommended:

1. Guyton & Hall. Textbook of medical physiology, Elsevier.New Delhi, 2000 10th edition.
2. Vander, Sherman, Luciano. Human Physiology.Mc-Graw Hill Publication New Delhi 1998, 7th edition.
3. Tortora G.J. Principles of anatomy & physiology. Harper Collins College Publishers, New York 1996 8thedition.
4. Chatterjee C.C. Human Physiology.Medical allied agency.Kolkata 2003 11th Edition.
5. Ross and Wilson. Anatomy and Physiology in health and illness. Churchill Livingstone 2001.9th edition.
6. AB Mc Naught and Callander R., " Illustrated Physiology", B.I. Churchill Living Stone, NewDelhi, 987.1st edition.
7. ChaudhrySujit K., "Consise Medical Physiology", New Cenrtal Book Agency, Calcutta, 1993.2nd edition
8. Douglas E., Kelly, Richard Wood and Allen C. Enders, " Bailey`s TextBook of Microscopic Anatomy", Williams and Wilkins publishers, London, 1984. 18th Edition
9. Elaine N. Marieb, "Human Anatomy and Physiology", Addison Wesley, New York, 1997 4th edition.
10. Inderbir Singh, " Text Book of Human Histology with Colour Atlas, Jaypee Brothers, New Delhi, , 2002. 4th edition.
11. Park J.E. and Park K., "Preventive and Social Medicine", BanarasidasBhanot, India, 1991. 13th edition

P 2.3.5 A. P. H. E. -II

(Practical) (3 Hrs/week)

1) Study of various systems using Charts/ Models#

   Cardio vascular system

   Urinary System

   Respiratory System

   Digestive System

2) Simple experiments involved in the analysis of normal and abnormal urine: Collection of specimen, appearance, determination of PH, protein, urea and creatinine,bilesalts,bile pigments, ketone bodies**

3) Estimation of i) SGPT ii) SGOT from blood sample

3) Physiological experiments on nerve muscle preparation

4) Determination of vital capacity, experiments on spirometry*

#-Experiments for preliminary knowledge and may be examined in form of identification/spotting

*** Indicate Minor Experiment ** Indicate Major Experiment**

Books Recommended-

1. Ranade V.G., Pradhan S, Joshi P.N. Text Book of Practical Physiology. Pune VidyarthiGrihaPrakashan, Pune, 1997

2. Mukherjee K.L. Medical Laboratory Technology.Tata McGraw Hill. New Delhi, 1999 4th edition (Vol.I,II,III)

T2.3.6PATHOPHYSIOLOGY OF COMMON DISEASES-I

(Theory) (3 Hrs/ week)

Sr. no.	Topic	Hours
	SECTION-I	
1	Basic Principles of cell injury and adaptation, causes, pathogenesis and morphology. Mechanism of wound healing, factors influencing healing of wounds.	**03**
2	**Inflammation.** A) Acute inflammation, Chemical mediators in inflammation. B) Chronic inflammation.	**03**
3	**Immunity –** Transplantation and immunological tolerance, allograft reactions, transplantation antigens, mechanism of rejection of allograft. Autoimmunity I) Criteria for autoimmunity II) Classifications of autoimmune diseases in man, mechanism of autoimmunity.	**04**
4	**Hypersensitivity** I) Hypersensitivity type I,II,III,IV II) Biological significance of hypersensitivity. III) Allergy due to food, chemicals and Drugs.	**04**
5	**Pain** Pain syndromes- Headache; assessment, structures involved in headache and head pain. Types of headaches- migraine, cluster headache, muscle contraction, (tension headaches) , headaches affecting elderly Joint pain: - Degenerative joint diseases- osteoarthritis, - types, causes and abnormalities assessment. Rheumatoid arthritis- causes abnormalities, course and prognosis, assessment, subjective, objective management. Gout-cause abnormalities, chronic changes, tophaceous gout- asymptomatic hyperuricemia, chronic gout, maintenance.	**05**
6	**Types of Acid-Base derangements-** Deficiency of water and solute balance, Pathogenesis, causes and management, Buffers;Different buffer systems in the body, Dehydration, Hypernatremia, Hyperosmolar state, Excess fluid and electrolyte (Na), Hypervolemia, Hyperkalemia, Hypokalemia, Respiratory acidosis, Respiratory alkalosis, Metabolic acidosis, Metabolic alkalosis.	**03**
	Number of Lectures	**22**
	SECTION-II	
7	**Central Nervous System:** Seizure and epilepsy, neural basis of epilepsy, types of epilepsy, Ischemia infarction (stroke) and intracranial hemorrhage, anoxia, brain death. Alzheimer's disease, Dementias, Parkinsonism, Schizophrenia, Depression and Mania	**05**

8	IV) Nutrition- adequate diet. Malabsorption syndrome, intestinal and pancreatic malabsorption, abnormal bacterial flora, steatorrhea. Protein calorie malnutrition vitamins, obesity, pathogenesis of starvation	**06**
9	**Disorders of gastrointestinal tract(GIT):** Disorders of esophagus: - Achalasia, gastro-esophageal reflux and reflux oesophagitis, causes consequences and management. Disorder of stomach, small intestine and large intestine - Peptic ulcer disease-acute ulcer, chronic peptic ulcer, tuberculosis of intestine, Acute intestinal obstruction. Constipation, diarrhea, Hirschsprung's disease(General disorders of GIT e. g. vomiting Nausea, Flatus etc should also be covered) Ulcerative colitis, Crohn's disease	**06**
10	**Disorders of liver**- Infectious hepatitis, types of hepatitis, liver changes in viral hepatitis, assessment-course and complications. Alcoholic liver diseases – fatty liver, Alcoholic hepatitis, cirrhosis. Laennec's cirrhosis, Portal hypertension, hepatic encephalopathy. II) Disorders of the gall bladder and bile ducts- Gall stone formation-types of gall stones assessments and management. Acute cholecystitis –causes and pathological changes. III) Disorders of exocrine pancreas- pancreatitis acute and chronic– types, causes, abnormalities, assessment and management.	**05**
11	**Biological effects of radiation :**Radioactive elements used in pharmaceuticals	**01**
	Number of Lectures	**23**
	TOTAL NUMBER OF LECTURES	**45**

Books Recommended:

1) Robbins Pathologic. Basis of Disease Harcourt Asia Pte.ltd. New Delhi 2000 6th edition

2) Harsh Mohan. Textbook of Pathology Jaypee New Delhi 2002, 4th edition

3) Davidson′s Principles and Practice of Medicine. Churchill Livingstone, London1999, 18th edition

4) Harrison's. Principle of Internal Medicine.Mc–GrawHill . New Delhi, 2005.16th edition (Vol.I,II)

T 2.4.1 Pharmaceutics IV (Physical Pharmacy II)

(Theory) (3 Hrs/week)

Sr. No.	Topic	Hrs.
	SECTION I	
1	**Chemical Kinetics:** Introduction, Definition, Applications, Rate , order, and molecularly of reaction, mathematical treatment of Zero order reaction, First order , Second order reaction, Half-life& shelf life of reaction. Complex reaction {consecutive, parallel, reversible reactions}. Determination of order of reaction {graphical, substitution &half-life method} ; energy of activation: effect oftemperature, Arrhenius equation and shelf life determination, collision theory, and transition state theory. **Catalysis**:-Definition, types, characteristics, promoters, catalytic poisoning & autocatalysis. **Accelerated stability studies:-** Introduction, objective, Garrett& Carper method, Free & Blythe method, limitations. **NOTE: - Problems for determination of rate constant, half-life& shelf life on zero, first & second order reactions.**	**08**
2	**Interfacial phenomenon:** Introduction, Surface tension & surface free energy; Young Laplace equation; measurement of surface tension and interfacial tension- capillary rise method, Du Nouy ring method, drop method {like drop number & drop weight method}, spreading of liquids; adsorption at liquid interfaces: study of surfactants including like wetting and antifoaming agent; HLB determination and importance with respect to suspension & emulsion, electrical properties of interfaces: Electrical double layer, Nernst and zeta potential.	**06**
3	**Rheology:-** Introduction, Definition, Applications, concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, Non- Newtonian system- Plastic flow, Pseudoplastic flow, Dilatent flow. Thixotropy, Brief explanation of Bulges & Spurs, rheopexy, measurement of thixotropy and its applications, Negative thixotropy. Viscosity Measurements- selection of viscometer for Newtonian and non-Newtonian system {like Capillary, Falling sphere, Cup & bob, Cone & plate viscometer. Viscoelasticity.	**07**
	Number of lectures	**21**
	SECTION II	
4	**Colloids:** Introduction, Definition, shape and size of colloidal particles, pharmaceutical applications of colloids, Classification of colloids and their method of preparation in brief. **Optical properties**- Faraday Tyndall effect, light scattering and electron microscopy; turbidity. **Kinetic properties**- Brownian motion, diffusion, osmotic pressure, viscosity & sedimentation. **Electric properties-** Basic concepts {like electric double layer, Nernst & Zeta potential} Electrokinetic Phenomenon- Electrophoresis, electro osmosis, Donnan membrane equilibrium and its application. Stability of colloidal system: DLVO theory, Schulz Hardy rule, coacervation,; sensitization and protective	**03** **04**

	colloids, gold number,solubilization of colloids: include factors affecting it ; Kraft point and Cloud point. NOTE:- Problems for determination of Molecular Wt. of colloids based on diffusion, viscosity & sedimentation.	**02**
5	**Coarse Dispersions:-** **A. Suspensions:** Interfacial properties of suspended particles, theory of sedimentation, sedimentation of flocculated particles, sedimentation parameters, formulation of suspensions, structured vehicles, rheological consideration, physical stability of suspension **B. Emulsions:-**Types, applications, theories of emulsification, Physical stability of emulsions, Evaluation of stability, Preservation of emulsion, rheologic properties of emulsion, microemulsions.	**08**
6	**Micromeritics:** Definition, Applications of micromeritics in Pharmacy, Introduction to fundamental & derived properties, Fundamental properties:- Particle size and size distribution, number & weight distribution Methods to determine particle size - method, practical consideration, applications advantages & disadvantages of Optical microscopy, Sieving, Sedimentation, Coulter counter. Methods to determine Surface area {like Adsorption & air permeability method}, pore size, derived properties, porosity and packing density and bulkiness, flow properties, compaction.	**07**
	Number of lectures	**24**
	TOTAL NUMBER OF LECTURES	**45**

BOOKS RECOMMENDED

1. Martin, Swarbrick: Physical pharmacy
2. C.V.S. Subrahmanyam: Text Book of Physical Pharmaceutics, IInd edition, VallabhPrakashan
3. Glasstone and Lewis: Elements of physical chemistry
4. Maron and Pruton: Physical chemistry
5. Alfonso R. Gennaro, Remington:The Science and Practice of Pharmacy (Mack PublishingCo.)
6. Lachman and Liebermann: Theory and practice of Industrial Pharmacy
7. Bahl and Tuli: Physical Chemistry
8. Eugene Parrott: Pharmaceutical Technology
9. E A Rawling: Bentleys Text book of Pharmaceutics
10. Gurdeep Raj: Advanced Physical chemistry

P 2.4.1 Pharmaceutics- IV (Physical Pharmacy- II)

(Practical) (3 Hrs/week)

1. Determination of velocity constant of Methyl acetate **
2. Determination of surface tension of given liquid*
3. Determination of critical micelle concentration of surfactant with stalagmometer**
4. Determination of Viscosity and relative viscosity of liquids*
5. Determination of HLB of glycerylmonosterate*
6. Determination of specific surface area of charcoal by adsorption method**
7. Determination of composition of sucrose solution by viscosity method**
8. Determination of viscosity by Brookfield viscometer (One semisolid formulation) **
9. Determination of particle size distribution of any material by**
   a) Sieve analysis
   b) Microscopy
10. To prepare and evaluate suspension **
11. To determine the derived properties of powders*
12. To study the thixotropic behavior of calamine lotion I. P. by Brookfield Viscometer**

*** Indicate minor experiments ** Indicate Major experiments**

Books Recommended-

1. Dr. Derle D. V. - Experimental physical pharmacy
2. H. N. More and Ashok Hajare- Practical Pharmaceutics (Physical Pharmacy)
3. R. S. Gaud, G. D. Gupata- Practical Physical Pharmacy
4. Dr. U. B. Hadkar, T. N. Vasudevan, K. S. Laddha– Practical Physical pharmacy
5. Engeen Parrot– Practical Pharmaceutical Technology
6. C.V.S. Subrahmanyam, S.G. Vasantharaju –Laboratory manual of Physical Pharmacy
7. U. B. Hadkar- A Hand Book of Practical Physical Pharmacy & Physical Pharmaceutics
8. C. VijayaRaghavan- A Practical Hand Book of Physical Pharmaceutics

T.2.4.2 Pharmaceutical Microbiology

(Theory) (3 Hrs/week)

Sr.No.	TOPICS	Hrs.
	SECTION I	
1.	**Brief History of Microbiology:** Scope & Applications in Pharmaceutical Sciences	**02**
2.	**Microscopy:** Simple Microscope, Compound Microscope & Electron Microscope. Resolving Power, Numerical Aperture, Magnification & Oil immersion Lens.	**04**
3.	**Structure Of Bactria:** Size, Shape, Bacterial cell wall, Plasma Membrane, Capsule, Spore, Pili, Flagella, Nucleoid, Plasmid.	**05**
4.	**Viruses:** Characteristics of Viruses& Reproduction of Viruses.(Lytic & Lysogenic Cycle),Cultivation of viruses.	**05**
5.	**Control of Microbes:** Different techniques of Sterilization-Dry heat sterilization, Moist heat sterilization, Filtration, Radiation sterilization. Disinfection , properties & application of Disinfectant.	**06**
	Number of Lectures	**22**
	SECTION II	
6.	**Immunology:** Concept of immunity, Types of immunity, Antigen, Antibody (Immunoglobulin) & its Types.	**05**
7.	**Immunology &DefenseMechanism:** Monoclonal Antibody, Autoimmunity, Complement Pathway.	**05**
8.	**Microbial Pharmaceuticals:** Vaccine, Types of vaccine, Large scale production of antibiotic (Seed Lot System of vaccine & toxoid), Edible vaccine, DNA vaccine, Applications of vaccine.	**05**
9.	**Pharmaceutical Microbiology:** Sterility test, Antibiotic Assay, Microbial Limit test, Pyrogentesting, Preservative Efficacy test, Carcinogenic test.	**04**
10.	**Industrial Microbiology:** Culture, Types of Culture, Preservation techniques of culture, Uses of Culture, Lyophilization.	**04**
	Number of Lectures	**23**
	TOTAL NUMBER OF LECTURES	**45**

Books Recommended:

1. Pleazar,Chan And Krig.-Microbiology
2. Frobisher.-Fundamentals of Microbiology
3. Stephan P. Denyer,N.A.Hodges,S.P. Gormao.-Hugo and Rusells Pharmaceutical Microbiology
4. Cooper and Gun..- Tutorial Pharmacy
5. ChandrakantKokare.-Pharmaceutical Microbiology
6. J.L.Ingraham,C.A.Ingraham,.-Introduction to Microbiology
7. Torrontam.-Foundation in Microbiology
8. J.C.Black-Microbiology Principles and Examinations,John Wiley and sons
9. Pathak and Palan-Immunology
10. Casedo-Industrial Pharmacy
11. Hugo and Russel –Pharmaceutical Microbiology

P-2.4.2 Pharmaceutical Microbiology

(Practical) (3 Hrs/week)

1.	Study of Compound Microscope*
2.	**Study of Lab Apparatus**: Autoclave ,Hot air oven,Incubator, pH Meter,Antibiotic zone reader,Colony counter,Refrigerator.*
3.	**Media Preparation**-* (Nutrient Agar, Macconkeys Agar)
4.	Air Micro Flora*
5.	Sterility Test*
6.	Streak Plate Method*
7.	Pour Plate Method*
8.	Spread Plate Method*
9.	Monochrome Staining**
10.	Grams Staining**
11.	Negative Staining**
12.	Microbial Assay of Penicillin. (Diffusion Assay)**
13.	Kirby Bauer antibiotic sensitivity test**
14.	Study of Oligodynamic Action**
15.	Study of Permanent Slides of Yeast ,Aspergillus,&Penicillium protozoa*
16.	Preparation of Bacterial Culture on Nutrient Agar Slant*

*** Indicate minor experiments ** Indicate Major experiments**

Books Recommended:

1. Cappuccino and Sherman –Microbiology of Laboratory manual, Pearson Education

2. Indian Pharnacopoeia-1996

T 2.4.3 Pharmacognosy – III

(Theory) (3 Hrs / week)

Sr.No.	TOPICS	Hrs.
	SECTION I	
1	**Glycoside** • Introduction, Classification, Physical & Chemical properties, Distribution, General extraction methodology of Glycoside. • Biological source, diagnostic features, morphology, chemical constituents, chemical tests, uses, adulterants and substituent of the following: **1.** Saponins:Liquorice*, Ginseng, Dioscorea*, Sarsaparilla, Solanum and Brahmi*. **2.** Cardio active Sterols: Digitalis*, Squill, Strophanthus and Thevetia **3.** Anthraquinone cathartics: Aloe*, Senna*, Rhubarb and Cascara **4.** Others:Psoralea, Ammimajus, Ammivisnaga, bitter almond, Gentian, Andrographis*, Saffron, Chirata ,picrorrhiza and Quassia. ***Detail Pharmacognostic study**	**13**
2	**Marine Pharmacognosy: N**ovel medicinal agents from marine sources.	**3**
3	**Natural allergens and plant toxins.**	**3**
4	**Natural pesticide & insecticides** – Introduction to herbicide, fungicides, fumigants and rodenticides- Neem, Tobacco, Pyrethrum	**3**
	Number of Lectures	**22**
	SECTION II	
5	**Study of Traditional Drugs** Common & Vernacular Names, Botanical Sources, Morphology, Chemical Nature of Chief Constituents, Common Uses and Marketed Formulations of Following Indigenous Drugs: Amla, Kantkari, Shatavari, Tylophora, Bhilawa, Bach, Punamava, Chitrack, Apamarg, Gokhru, Shankhapushpi, Adulsa, Tinospora, Methi, Lahsun, Palash, Guggal, Gymnema, Shilajit, Nagarmotha and Neem.	**10**
6	**Complementary and Alternative Medicine** • Indian Traditional Systems of Medicine: Introduction, Principle, Preparations and Standardization of Ayurvedic Medicine Ex: Asavas, Arishtas, Tailas, Churna and Bhasmas. • Introduction and Principle of Unani, Siddha, Homeopathy and Aromatherapy	**10**
7	**Chemotaxonomy of Medicinal Plants** • Introduction and significance of chemotaxonomy with special reference to flavonoids and terpenoids.	**03**
	Number of Lectures	**23**
	TOTAL NUMBER OF LECTURES	**45**

P 2.4.3. Pharmacognosy – III

(Practical) (3 Hrs / week)

1. Identification of traditional crude drugs by morphology* (Minimum Eight drugs listed in theory).
2. Study of morphology*, microscopical** and powder * characteristics of some important glycoside containing crude drugs (Minimum six drugs listed in theory).
3. Standardization of Asava and arishtaayurvedic traditional formulations (Physical *& chemical parameters**)
4. Preparation and standardization of churna*
5. Preparation and standardization of Taila**
6. Estimation of total saponin from liquorice or Gokhru**

***Minor experiments**

****Major experiments**

Books Recommended

1. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
2. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree) NiraliPrakashan
3. Kokate C. K. Practical Pharmacognosy, VallabhPrakashan, Delhi.
4. Brain K. R. and Turner T. D., The practical Evaluation of phytopharmaceuticals, Wright-Scientechnica, Bristil.
5. PulokMukharji, Quality control of Herbal drugs.
6. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
7. Nadkarni A. K. Indian Materia Medica, 1-2, Popular Prakashan Pvt. Ltd.Bombay.
8. Pharmacopoeia of India, 1985,1996, Govt. of India, Ministry of Health and Family Welfare.
9. Iyengar M.A., Study of Crude Drugs, Manipal Power Press, Manipal.
10. IyengarM.A. ,Pharmacognosy Lab Manual. Manipal Power Press, Manipal.
11. The Wealth of India, Raw Marerials (All Volumes), Council of Scientific and Industrial Research, New Delhi.
12. Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, BailliereTindall, Eastbourne, U.K.
13. Wallis, T.E. Analytical Microscopy, J.A. Churchill Limited, London.
14. Wallis, T.E. Textbook of Pharmacognosy, J.A. Churchill Limited, London.
15. Tyler, V.E., Brady, R., Pharmacognosy
16. V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II.
17. Herbal Pharmacopoeia, IDMA, Mumbai
18. A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors
19. Herbal drugs industry by R.D. Chaudari.
20. Pharmacognosy, Phytochemistry, Medicinal Plants 2nd Edn. – Jean Bruneton
21. Quality Control Methods for Medicinal Plants – WHO, AITBS Publication.
22. Ayurvedic Formulary of India, Govt. of India, New Delhi
23. Ayurvedic Pharmacopoeia of India, All Volumes
24. Pharmacopoeial standard of Ayurvedic Formulation, Minister of Health welfare ,Govt. of India, New Delhi
25. Indian Herbal Pharmacopoeia

26. Chopra R. N., Nayar S. L. and Chopra I. C., Glossary of Indian Medicinal plants CS I R, New Delhi.
27. Gibbs R Darnely, Chemotaxanomy of Flowering Plants 4 volumes, McGill, University Press.
28. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain London.
29. Kokate C. K. Practical Pharmacognosy, VallabhPrakashan, Delhi.
30. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
31. Official Methods of Analysis, Association of Official Analytical Chemists publication,Washington.
32. Peach K, and Tracey M. V., Modern methods of plant analysis, 1-4, Narosa Publishing house, New Delhi
33. Experimental Phytopharmacognosy –A Comprehensive Guide By SS Khadabdi, DeoreSl, and BA Baviskar, NiraliPrakashan, Pune.
34. Standardization Of Botanicals- Testing & Extraction Methods Of Medicinal Herbs By V. Rajpal, Eastern Publisher, New Delhi

T.2.4.4. Pharmaceutics-V (Hospital Pharmacy)

(Theory) (3 Hrs/week)

Sr.No.	TOPICS	Hrs.
	SECTION I	
1.	**Hospital - its Organization and functions** Definition, Classification based on various criteria (Types of hospitals), functions, Status of health delivery systems in India. Role of hospitals in the health delivery systems.	**03**
2	**Hospital Pharmacy- Organization, administration governing body and Management** History and Development, Definition, functions and objectives of hospital pharmacy, Location, Layout & flow chart of material and men, personnel and facilities required, including equipments. Requirements and abilities required for Hospital pharmacists. Medical staff, Infrastructure & work load statistics, clinical departments, support service, dietetic service, nursing service, medical records department, pathology service, Blood bank.	**06**
3	**Drug Distribution system in Hospital (In-patient services& Out-patient services)** Types of services i) Individual prescription method ii) Floor stock method iii) Unit dose drug distribution method iv) Satellite pharmacy services, central sterile services, Bed side pharmacy, Prepackaging	**02**
4	**Hospital drug policy** a) Hospital committees - Infection committee - Research and ethical committee b) developing therapeutic guidelines c) Hospital pharmacy communication – Newsletter	**02**
5	**Pharmacy and Therapeutic Committee** Purpose of committee, committee name, membership, frequency of meeting, the committee agenda, functions of the committee, Generic vs. brand named drugs, Evaluation of drugs, Recommended reference materials, committees role in the adverse drug reaction program, Drug experience reporting, Automatic stop order for dangerous drugs, committees role in developing emergency drug list.	**05**
6	**Hospital Formulary** Format and appearance of the formulary, distribution of the formulary, keeping the formulary current, use of non-formulary drugs, (PPI),the legal basis of the formulary system, Anti substitution laws and the formulary, preparation of the formulary, formulary vs. Drug catalogue or list, selection of guiding for admission or deletion of drug , contains, prescription writing, format, size, loose –leaf vs. bound, publication, formulary drug listing service formulary drug listing service preparation, categorizing and indexing, sample pharmacologic index, text, specialty formularies.	**05**

	Number of Lectures	**23**
	SECTION II	
7	**Hospital Pharmacy Services** a) Procurement & warehousing of drugs and Pharmaceuticals b) Inventory control Definition, various methods of Inventory Control ABC, VED, EOQ, Lead time, safety stock	**03**
8	**Medical Stores** Objectives, Layout facilities; Procedures for procurement of drugs and supplies from medical stores depot, manufacturer, distributor, local market; procedure and limits of emergency purchase.	**02**
9	**Manufacturing of Pharmaceuticals in Hospitals** **Sterile manufacture-** Large and small volume parenterals, facilities, requirements, layout production planning, man-power requirements, Total parenteral nutrition. **Non-sterile manufacture**-Liquid orals, externals (Manufacture of Ointments, lotion and creams), Bulk concentrates. Procurement of stores and testing of raw materials.	**05**
10	**Record AndReports:** a. Patient Historical and Medication Profile. b.Adverse Reactions. c. Patient Treatment Records and Auxiliary Reporting.	**03**
11	**Surgical Dressing** Like cotton, gauze, bandages and adhesive tapes including their pharmacopoeial tests for quality. Other hospital supply eg. I.V.sets, B.G. sets, Ryals tubes, Catheters, Syringes etc	**03**
12	**Radio Pharmaceuticals – Handling and packaging** Introduction to particulate radiation, half life, therapeutic and diagnostic radiopharmaceuticals, facilities required, protection of operators, preparation of radiopharmaceuticals kits.	**03**
13	**Application of computers** In maintenance of records, inventory control, medication monitoring, drug information and data storage and retrieval in hospital retail pharmacy establishment.	**03**
	Number of Lectures	**22**
	TOTAL NUMBER OF LECTURES	**45**

P.2.4.4. Pharmaceutics-V (Hospital Pharmacy)

(Practical) (3 Hrs/week)

1. Study of Proforma for patient data collection
2. Study of Patient Counseling Interview Techniques**
3. Calculation of cost of prescription**
4. Role of Hospital Pharmacist in Ward Round Participation
5. Assessment of drug interactions in the given prescriptions**
6. Assessment of suspected adverse drug reactions in the given prescriptions
7. Preparation of parenteral products by the following methods
   Asceptic technique, involving sterilization by filtration Involving terminal steam sterilization
8. Answering Drug information queries.
9. Inventory control
10. Sterilization of following classes of products **
    a. All glass syringes, with metallic needles
    b. Surgical dressings
    c. Surgical Equipments
    d. Surgeon's Gloves (Rubber)
    e. Ointment bases (Petroleum based)
    f. Powders (Starch, talcum)
11. Any other experiment illustrative of theory

****Indicate Major Experiment**

List of Assignments:

1. Design and Management of Hospital pharmacy department for a 300 bedded hospital.
2. Pharmacy and Therapeutics committee – Organization, functions, and limitations.
3. Development of a hospital formulary for 300 bedded teaching hospital
4. Preparation of ABC analysis of drugs sold in one month from the pharmacy.
5. Different phases of clinical trials with elements to be evaluated.
6. Various sources of drug information and systematic approach to provide unbiased drug information.
7. Evaluation of prescriptions generated in hospital for drug interactions and find out the suitable management.
8. Demonstration of some common surgical instruments, hospital equipments and health accessories

Note: Conduct minimum ten experiments and five assignments from aforesaid list.

Book Recommended for Theory & Practical's:-

1. Merchant &Qadry , Text book of Hospital Pharmacy - (B.S. Shah Prakashan)
2. William .E. Hassan, Hospital Pharmacy (Lea and Febiger)
3. Parmar N S, Health education and Community Pharmacy
4. WHO consultative group report
5. Robin J Harman, Hand book of Pharmacy (The Pharmaceutical Press) Winfield, Richards--Pharmaceutical Practice
6. A text book of Hospital PharmacybyS.H.Merchant& Dr. J.S. Qadry. Revised by R.K.Goyal& R.K. Parikh
7. R.P.S. Vol.2. Part –B; Pharmacy Practice section.
8. Handbook of pharmacy – health care. Edt. Robin J Harman. The Pharmaceutical press.
9. Don A. Balligton, Second Edition, Pharmacy Practice for Technicians, New Age International Publishers.
10. G. Parthsarathi, Clinical Pharmacy & Therapeutics
11. H. P. Tipnis, Clinical Pharmacy
12. Roger Walker, Clinical Pharmacy & Therapeutics

T2.4.5 Pharmaceutical Chemistry-V (Biochemistry)

(Theory) (3 Hrs/ week)

Sr. no.	Topic	Hours
	SECTION I	
1.	**Animal Cell:-** Structure and Functions of different organells, like Nucleus, Plasma membrane, Endoplasmic reticulum, Lysosomes, Golgi apparatus, Mitochondria.	**02**
2.	**Biomembranes:-**Structure of composition, transport hypothesis, active and passive, facilitated transport, Na^+, K^+ pump and Diffusion.	**03**
3.	**Carbohydrates: -**Introduction, Classification and role of Carbohydrates	**02**
4.	**Proteins and amino acids:-** **Proteins:-**Introduction, Functional classification, Structures(Primary, Secondary, Tertiary and Quaternary). **Amino acids:-** Classification, physicochemical reaction with ninhydrin and formaldehyde, different methods for separation of amino acids (Paper chromatography and ion exchange chromatography)	**05**
5.	**Lipids:-** Definition, Classification, Functions, Types of fatty acids and its biological role, Acid value, Saponification value, Iodine value, Rancidity.	**04**
6.	**Vitamins and Co-enzymes:-**Definition and classification of Vitamins, Structure and biochemical function of fat soluble and water soluble vitamins, Biochemical role of coenzymes.	**06**
	Number of Lectures	**22**
	SECTION II	
7.	**Carbohydrate metabolism:-**Glycolysis (aerobic and anaerobic), TCA cycle, ETC, Gluconeogenesis, Glycogenesis, Glucogenolysis, Pentose phosphate pathway.Pharmaceutically Important Carbohydrates and their applications.	**05**
8.	**Protein metabolism:-**Digestion of proteins, Transamination, oxidative deamination, non-oxidative deamination, Urea cycle.	**03**
9.	**Lipid metabolism:-**β-oxidation, oxidation of fatty acids, biosynthesis of fatty acids and cholesterol, HDLP, LDLP, clinical significance.	**05**
10.	**Enzymes:-**Definition, Classification, properties, mechanism of enzyme action. Factors affecting rate of enzymatic reaction, enzyme inhibition with types, Isoenzymes, pharmaceutical applications of enzymes.	**05**
11.	**Nucleic acid:-** Nucleoside, nucleotide, structure of DNA, functions of DNA, Watson and crick model of DNA, DNA as a genetic material, DNA replication, Genetic code, Transcription and translation, Lac operon, Types of non-genetic RNA with their roles in protein synthesis.	**05**
	Number of Lectures	**23**
	TOTAL NUMBER OF LECTURES	**45**

P 2.4.5Pharmaceutical Chemistry-V (Biochemistry)

(Practical) (3Hrs/week)

Sr.no.	Experiments
1.	Qualitative tests for Carbohydrates**
2.	Qualitative tests for Proteins** A. Precipitation reaction B. Color reactions
3.	Quantitative estimation of carbohydrates by Folin Wu method **
4.	Quantitative estimation of glucose in urine by Benedicts method **
5.	Titration to find out acidity of gastric juice by titrating it against potassium hydroxide or sodium hydroxide*
6.	Identification of given fat sample*
7.	A study of activity of enzyme salivary amylase*
8.	Determination of ascorbic acid using dye 2,6-dichlorophenol indophenol*
9.	Determination of Acid value of given fat sample. *
10.	Electrophoresis, paper electrophoresis of serum protein. (Demonstration).*
11.	Separation of amino acids by paper chromatography. (Demonstration)*
12.	Separation of Lipids by thin layer chromatography. (Demonstration)*

Minimum 12 experiments should be covered

*** Indicate Minor experiments ** Indicate Major experiments**

Books Recommended:

1. Harpers review of Biochemistry-Martin
2. Textbook of biochemistry-D Satyanarayan
3. Textbook of Clinical chemistry- Alex Kaplan and Laverve
4. Principles of biochemistry-Lehinger
5. Textbook of biochemistry- Ramarao
6. Practical Biochemistry-David T. Plummer
7. Practical Biochemistry-Pattabhiraman

T2.4.6 PATHOPHYSIOLOGY OF COMMON DISEASES-II

(Theory) (3 Hrs/ week)

Sr. No.	Topic	Hrs.
	SECTION-I	
1	Pathophysiology and management of Cancer :Types, causes, pathogenesis and treatment	**05**
2	**Disorders caused by biological and environment agents:** Etiological agent of diseases, diagnosis of infectious diseases-test selection, specimen ,collection, preservation, transportation, testing and data interpretation infectious diseases Sexually transmitted diseases STD (HIV), pneumonias, SARS, leprosy, malaria, food poisoning, Diarrhea/Dysentery (Bacterial and amoebic), typhoid, tuberculosis.	**05**
3	**Endocrine disorders-** Pituitary gland- growth hormone- Dwarfism, Gigantism, Adrenal gland-Addison's disease,Cushing syndrome Thyroid gland-Hypo and Hyperthyroidism Sex hormones- Hirsuitism, Gynecomastia, virility, impotence etc Pancreas-Diabetes	**05**
4	**Disorder of respiration:** Chronic disorders- chronic obstructive pulmonary diseases-Atelectaxis, Emphysema, Asthma, diffuse interstitial lung disease. Acute disorder of respiratory system, Acute respiratory failure, Pneumonia, pulmonary embolism.	**04**
	Number of Lectures	**19**
	SECTION-II	
7	**Disorders of Urinary System-** Renal failure- Chronic renal failure, Acute renal failure- Obstructive renal failure, pre-renal acute failure, acute tubular necrosis, Urinary tract infections and pyelonephritis – lower urinary tract infection, acute pyelonephritis, chronic pylonephritis. Glomerular Disease:- types of glomerulonephritis and nerphrotic syndromes	**05**
8	**Disorders of CVS-** Hypertension, Ischemic Heart Diseases- Angina: types and causes diagnosis of ischemic heart disease, management of ischemia and angina pectoris. Atherosclerosis, Arrhythmia, Myocardial Infarction. CCF-Types of heart failure, causes of heart failure heart cell changes in the heart failure, consequences of decreased myocardial contractility. Clinical manifestation of congestive heart Failure and their pathophysiological basis, management of chronic heart failure. Types of shock, mechanisms and principles	**08**
9	**Diseases related to carbohydrate metabolism –** diabetes mellitus and OGTT, Carbohydrate metabolism(inborn errors), Glycogen storage disease, Galactosemia, lactose intolerance, glycosuria or mellituria	**03**

10	**Diseases of protein energy malnutrition-** Kwashiorkor and Marasmus Diseases Aromatic amino acid metabolism , Hartnup's disease, Phenylketonuria (PKU), Albinism, Alkaptonuria, Different Tyrosinemias, Sulphur containing amino acid metabolism; Cystinosis, Cystinuria, homocysteinuria, Disease of Branched chain amino acid metabolism; maple syrup urine disease Disorders related to urea cycle metaboli,smHistidinemia, Hyperprolinemia type I , Hyperprolinemia type II	**03**
11	**Disease related to lipid metabolism –** Obesity, atherosclerosis Hyperlipidemia, Hyperlipoproteinemias, Hypercholesterolemias, Hypocholesterolemias, Lipotropic Factors II) Abnormalities in Lipoproteinaemia , Glycogen Storage Diseases.	**02**
12	**Organ function tests** a. Liver function tests b. Renal function tests-blood urea nitrogen, creatinine, uric acid, creatinine clearance c. Gastric function tests- rennin, pepsin fractional test meal, stimulation of gastric secretion, hyper secretion and its treatment d. Thyroid function tests- determination of hormones- T3, T4, TSH uptake studies. e. Pancreatic function tests- Diabetes – Type – I Type- II-OGTT, glycated Hemoglobin and microalbuminurea,amylase,lipase	**05**
	Number of Lectures	**26**
	TOTAL NUMBER OF LECTURES	

Books Recommended:

1) Robbins Pathologic. Basis of Disease Harcourt Asia Pte.ltd. New Delhi 2000 6th edition

2) Harsh Mohan. Textbook of Pathology Jaypee New Delhi 2002, 4th edition

3) Davidson′s Principles and Practice of Medicine. Churchill Livingstone, London1999, 18th edition

4) Harrison's. Principle of Internal Medicine.Mc–Graw Hill. New Delhi, 2005.16th edition (Vol.I,II)

North MaharashtraUniversity, Jalgaon.

Syllabus of
Third Year B. Pharmacy [Sem V &Sem VI]
(CGPA Pattern)

W.E.F. Academic Year 2014-15

T 3.5.1. Pharmaceutical Chemistry – VI (Medicinal Chemistry - I)
(Theory) (4Hrs /week)

Section I

Sr.no.	Topic	Hours
1	I**ntroduction:** Medicinal Chemistry: Definition And Objectives— using the internet for medicinal chemistry; Sources of Drugs- Serendipity, Random Screening, Extraction from Natural Sources, Molecular Modifications. Lead compound-definition, discovery and optimization.	06
2	**Theoretical Aspects of Drug Action:** The Ferguson Principle; Drug targets: Molecular mechanisms of drug action. Physicochemical parameters affecting drug action: Solubility, **Partition Coefficient, Surface Activity, *pKa,* Ionisation.** **Stereoche**mistry and drug action: Optical isomerism, Geometrical isomerism, Bio-isosterism.	08
3	**Metabolism** Routes of Elimination: Factors Affecting Metabolism – Genetic Factors, Physiological Factors, Pharmaceutical Factors, Drug Interactions. Metabolic Process- Phase I (Oxidation, Reduction &Hydrolysis) and Phase II (Glucuronide Conjugation, Acetylation, Methylation, Sulphate Conjugation, Conjugation with amino acids and Mercapturic acid formation)	08
4	**Introduction to Receptor Concept** History, Affinity, Receptor & biological response, Drug Receptor interaction, Forces involved in drug receptor interaction. Receptor Theories, Conformational flexibility and multiple modes of Action	08

SECTION II

The following topics should be covered with the points listed below

1**.** Introduction

2. Classification

3. Mechanism of action

4. Structure-activity relationship

5. Pharmacokinetics (Metabolism) and

6. Therapeutic uses

7. *Synthesis of drugs

Sr.no.	Topic	Hours
5	**Cholinergic Drugs:** (i) cholinergic agonists (methocholine, carbochol*, bethanechol, pilocarpine) (ii) Ach esterase inhibitors (physostigmine, neostigmine*, tacrine*, ambenonium chloride, isofluorphate, pralidoxime) (iii) Cholinergic antagonists (atropine scopolamine, homatropinehydrobromide, ipratropium bromide); synthetic cholinergic antagonists (cyclopentolate*, dicyclomine*, ben/otropinemesylate, procyclidine hydrochloride, isopropamide iodide, tropicamide) (iv) Ganglion blocking agents (trimethaphan, camsylate, mecamylamine) (v) Neuromuscular blocking agents (tubocurarine, gallamine, triethiodide, succinyl choline chloride)	07
6	**Adrenergic Drugs:** (i) α-adrenergic agonists (phenylephrine, naphazoline, xylometazoline, oxymetazoline, methyldopa, clonidine*, guanabenz, guanfacine) (ii) β-adrenergic agonists (isoproternol, terbutaline*, albuterol, salmeterol, isoxsuprine, ritodrine) (iii) α-adrenergic antagonists (tolazine, phentolamine, phenoxybenzamine, prazosin, doxazosin) (iv) β-adrenergic antagonists (propranolol*, atenolol, metoprolol, acebutalol, alprenolol, timolol, labetalol*) other adrenergic agents (amphetamine, pseudophedrine, ephedrine, guanethidine*, propylhexedrine, reserpine).	05
7	**CVS Drugs:** (i) antianginal agents (amyl nitrite, isosorbide dinitrate, pentaerythritoltetra nitrate, verapamil, bepridil, diltiazem, nifendipine*, amlodipine, nimodipine, dipyridamole) (ii) antiarrhythmic agents (quinidine, procainamide*, disopyramide, lidocaine, tocainide, mexilitine, encainide, amiodarone, proafenone, verapamil, diltiazen, propranolol, sotalol*). (iii) Antihypertensive agents (a) review of adrenergic agents (b) review of Ca channel blockers (c) ACE inhibitors (captopril*, enalapril, benzepril, ramipril) (d) angiotensin II receptor antagonists (losartan, valsartan*, candersartan) (iv) Vasodilators and K-channel agonists (diazoxide, minoxidil)	18

	(v) Antihyperlipidemic agents (clofibrate*, gemfibrozil, niacin, lovastatin, atorvastatin)	

Reference Books:

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry,11 th Ed., Eds., John H Block and John M Beale, Lippincott Williams & Wilkins, 2004.

2. Foye's Principles of Medicinal Chemistry, Eds., T. L. Lemke and D. A. Williams,Williams& Wilkins, Baltimore, 2002.

3. Medicinal Chemistry, AshutoshKar, 4 th Edition, New Age International Publishers,2007.

4. The Art of Drug Synthesis, Eds., Douglas S Johnson and Jie Jack Li, WileyInterscience, 2007.

5. Pharmaceutical Chemistry, Vol. 1: Drug Synthesis, Eds., H. J. Roth, A. Kleeman, andT. Beissewenger, Ellis Horwood Ltd., 1988.

6. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Vols. 1 to 7, Wiley.

7. Profiles in Drug Synthesis : V.N. Gogte

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. Vogels

11. Practical Organic Chemistry - Mann and Sanders

12. Systematic Identification of Organic Composition, Shriner and Fuson

P 3.5.1. Pharmaceutical Chemistry – VI (Medicinal Chemistry - I) (Practical) (Duration : 3 hrs/week)

Minimum Twelve numbers of Experiments should be performed.

***Minor ****Major Experiments**

1) **Purification techniques of solvents/liquids and synthesized products by Fractional distillation and distillation under vacuum and recrystalization**
2) Demonstration of reaction monitoring by TLC.
3) *o*-Iodo benzoic acid acid (Sandmeyer Reaction)**
4) Benzoic acid*
5) Benzophenone**
6) Benzylidineacetophenone **
7) Synthesis of phenyl benzoate from phenol*

Microwave oven synthesis of the following compounds [Ref. 4, 5, 6]

1) Demonstration of Microwave oven synthesis
2) Benzil*
3) Benzpinacol*
4) Benzillic acid*
5) 3-methyl -1- phenyl -5-pyrazolone**
6) 4-nitrobenzyl benzoate*
7) Cinnamic acid (perkin/ Knoevenagel condensation)
8) 2,3 Diphenylquinoxaline**
9) 1,2,3,4-tetrahydrocarbazole (Fischer Indole Synthesis)

Book Recommended

1. Text Book of Practical Organic Chemistry - A.I. Vogel

2. Practical Organic Chemistry - Mann and Sanders

3. Systematic Identification of Organic Composition, Shriner and Fuson

4. Indian Journal of Pharmaceutical Education and Research, 39 (4) Oct-Dec. 2005, 188-190

5. Organic Synthesis Special techniques V. K. Ahluwalia, RenuAggrawal, Nerosapublishinghouse , p. no. 90 - 114

T 3.5.2. Pharmaceutics – VI(Pharmaceutical Technology I)

(Theory) **(Duration : 4 Hrs/Week)**

Section I

Sr. No.	TOPICS	Hrs.
1.	**Preformulation:** Objective, study of physico chemical properties of drug like physical form, particle size, shape, density, wetting, dielectric constant, solubility, PKa, partition coefficient, dissolution on an organoleptic property and their effect on formulation , stability and bioavailability.	**04**
2.	**Tablets:** Formulation development: Types of tablets, properties of drugs such as compressibility, flow ability, dose, stability, site of drug release & absorption, additives & factors affecting their selection. Formulation and manufacturing, IPQC and QC of tablets. Introduction to advance granulation techniques: Extrusion-spheronization & pelletization & spherical crystallization, fluid bed granulation. Problems in tabletting & remedies there of.	**09**
3.	**Coating of Tablets: -** Types (sugar, film & press coating). Material used & processed employed for each, coating equipments including different types of coating pans and advanced coating pans. fluid bed and enteric coating. Evaluation of coated tablets & packaging of coated tablets	**03**
4.	**Hard Gelatin & Soft Gelatin Capsules :-** Introduction, shell excipients, Mfg. of shells, properties of raw materials, environmental controls, evaluation, filling principles and equipments for hard Soft gelatin capsules. Processing, I.P.Q.C., evaluation of finished capsules & official standards.	**04**
5.	**Semisolid Dosage Forms: -** Classification, dermatological & transdermal preparations- Gels & Ointment Preparations. Transdermal permeation enhancer (physical, chemical and biological)-Probable Mechanism & Examples of drug penetration. Ointments: bases, formulation factors. Mfg. processes & equipments, IPQC, QC and packaging.	**06**
6.	**Suppositories**: Ideal requirements of suppository base, manufacturing equipment and procedure, IPQC and QC tests and packaging.	**04**

Section II

Sr. No.	TOPICS	Hrs.
7.	**Disperse Systems: -** Introduction, theories of emulsifications and suspensions-DLVO Theory, types of additives used in formulations, vehicles, stabilizers, preservatives wetting agents, emulsifying agents, colors and flavors. HLB values and its determination. Manufacturing, packaging and evaluation of emulsions and suspensions. Introduction to micro emulsions, multiple emulsions, nanoemulsion and nanosuspensions.	**08**
8.	**Pharmaceutical Aerosols:** Definition, propellants**,** general formulation, manufacturing and packaging methods, pharmaceutical application and Evaluation, Mathematical problems on pharmaceutical aerosol systems.	**06**
9.	**Pilot Plant Scale Up:** Groups responsibilities-Facilities, Significance of pilot plant scale up studies, Pilot scale manufacturing techniques (formula, equipment, process, stability and quality control) for tablets, capsules, liquid orals includes suspension and emulsions and semisolid includes ointments and gels**.** Technology transfer.	**11**
10.	**(Good Manufacturing Practices-** GMP and CGMP and its requirements for tablets, capsules, ointments, gels, emulsions and suspensions	**05**

Books Recommended:

1. **Leon Lachman et al**. Theory & practice of Industrial pharmacy, Lea &Febiger Varghese Publishing house, Mumbai.
2. **H.A. Lieberman & Leon Lachman**. Pharmaceutical Dosage Forms: Tablet Vol. 1, 2, 3. Marcel Dekker Series.
3. **G.S. Banker & C.T. Rhodes**. Modern Pharmaceutics. Marcel Dekker Series.
4. **H. C. Ansel**-- P'ceutical dosage forms & drug delivery systems. B.I. Waverly Pvt.ltd, New Delhi.
5. **Alfanso R. Gennaro**-- Remington's Pharmaceutical Sciences. Mack Publishing Company, Easton Pennsylvania.
6. **E.A.Rawling**-- Bentleys T.B. of pharmaceutics. BaillereTindall {London} & All India Traveller Book Seller Delhi.
7. **H. Lockhart**-- Packaging of Pharmaceuticals and healthcare products. Blackie academic & professional. London.

8. **D A Dean, E R Evans & I.H. Hall**--Pharmaceutical packaging Technology. Taylor & Francis Newyork.
9. **Swarbrick&Boyan**-- Encyclopedia of Pharm. Tech. Vol. 1, 2, 3. Marcel Dekker Series.
10. **Nielloud**-- Pharmaceutical emulsion and suspensions- Vol. 105-Marcel Dekker.
11. **Niazi-** -Handbook of Pharmaceutical manufacturing formulations- (Vol. 1-6).
12. **J.R. Robinson & Lee** – Controlled drug delivery systems: Fundamentals & Applications. Marcel Dekker Series.
13. **Dilip M**. **Parikh-** Handbook of Pharmaceutical Granulation Technology: Marcel Dekker, Vol. 81,New York.
14. **Podezeck& Jones**-- Pharmaceutical Capsules.
15. **IssacGhebre-Sellassie**.-Pharmaceutical pelletization technology. New York Marcel Dekker

P 3.5.2. Pharmaceutics – VI(Pharmaceutical Technology I) (Practical) (Duration :3 hours/ week)

1. Physico-chemical evaluation of any four excipients*.

2. Preparation and evaluation of compressed tablet (wet, dry granulation & direct compression) **

3. Evaluation of marketed tablet formulations*

4. Formulation of film coated tablets and evaluation**.

5. Filling of hard gelatin capsule & its evaluation**

6. Formulation and evaluation of ointments*

7. Formulation and evaluation of Emulsions (liq. paraffin emulsion)*

8. Formulation and evaluation of Suspensions (calamine lotion & antacid suspension) **

9. Formulation and evaluation of dry syrup*

10. Formulation and evaluation of Suppository (Two)**

11. Formulation and evaluation of gels**.

12. Formulation and evaluation of aerosol systems*.

Major Expt.: * *

Minor Expt.: * {All preparations may act as minor expt}

Books Recommended:

1. **Leon Lachman et al**. Theory & practice of Industrial pharmacy, Lea &Febiger Varghese Publishing house, Mumbai.

2. **H.A. Lieberman & Leon Lachman**. Pharmaceutical Dosage Forms: Tablet Vol. 1, 2, 3 Marcel Dekker Series.

3. **G.S. Banker & C.T. Rhodes**.ModernPharmaceutics.Marcel Dekker Series.

4. **H. C. Ansel**-- P'ceutical dosage forms & drug delivery systems. B.I. Waverly Pvt.ltd, New Delhi.

5. **Alfanso R. Gennaro**-- Remington's Pharmaceutical Sciences. Mack Publishing Company, Easton Pennsylvania.

6. **E.A.Rawling**-- Bentleys T.B. of pharmaceutics. BailliereTindall {London} & All India Traveller Book Seller Delhi.

7. **H. Lockhart**-- Packaging of Pharmaceuticals and healthcare products. Blackie academic & professional.Londan.

8. **D A Dean, E R Evans & I.H. Hall**--Pharmaceutical packaging Technology. Taylor & Francis Newyork.

9. **Swarbrick&Boyan**-- Encyclopedia of Pharm. Tech. Vol. 1, 2, 3. Marcel Dekker Series

10. **Nielloud**-- Pharmaceutical emulsion and suspensions- Vol. 105-Marcel Dekker.

11. **Niazi-** -Handbook of Pharmaceutical manufacturing formulations- (Vol. 1-6)

12.**Dilip M**. **Parikh-** Handbook of Pharmaceutical Granulation Technology: Marcel Dekker, Vol. 81,Newyark

13. **Podezeck& Jones**-- Pharmaceutical Capsules

14. **Official Compenelias I**.P. B.P. U.S.P.

T 3.5.3. Pharmacology – I

(Theory) **(Duration :4 Hrs/Week)**

Objectives

1. To introduce students to basic concepts in general pharmacology
2. Role of Pharmacologists in drug development and drug use.
3. To impart knowledge regarding mechanisms of drug action, ADR, drug interactions
4. To inform them regarding the steps involved in drug discovery. Along with stages of preclinical testing (efficacy testing, safety testing, toxicity testing) and clinical drug development (four phases of Clinical trials).
5. To highlight the importance of knowledge of Pharmacotherapeutics to preclinical, clinical and hospital pharmacologist
6. To introduce them to Pharmacotherapy of drugs acting on ANS and GIT

Sr. No.	TOPICS Section I	Hrs.
1.	**General Pharmacology: -** a) Introduction, definition, history of pharmacology in India b) Routes of administration of drug including novel drug delivery systems (inunction, iontophoresis, antibody assisted drug delivery, administration of biologicals) c) Absorption of drugs and-factors affecting them d) Drug distribution, biotransformation and excretion e) Mechanism of drug action – Types of Receptors, signal transduction mechanisms, theories of drug receptor interactions, Dose response relationship, Concept of Bioavailability f) Factors modify drug action – synergism, antagonism, drug tolerance, and tachyphylaxis.	**02** **03** **02** **06** **05** **03**
2.	**Toxicology : -** a) Defination, sub-branches and Concept of toxicology and toxicity b) Toxicity studies in animals (Acute toxicity study (LD50) by OECD guideline number 420 c) Acute, sub acute, chronic toxicity testing as per OECD guidelines d) Poisons, types and classification and general treatment of poisoning. Treatment of heavy metals (lead, arsenic, mercury) poisoning.	**09**

	Section-II	
3.	New Drug Development Process: outline of steps involved in the process of drug discovery	**02**
4.	1. Process of Neurohumoral transmission 2.Autonomic nervous system and its branches – sympathetic and parasympathetic nervous system 3.Classification, mechanism of action, pharmacokinetics, pharmacodynamics, adverse effects, contraindications, Therapeutic uses, interactions and dose and route of administration of drugs acting for following classes of drugs A. Parasympathomimetics and parasympatholytics B. Sympathomimetics (including bronchodilator and nasal decongestants) and sympatholytics C. Ganglion blockers and stimulants D. Neuromuscular junction blockers	**04** **03** **04** **04** **01** **01**
5.	**Autacoids: –** Introduction, classification of drugs and classification of receptors, respective agonists and antagonists, and therapeutic drugs related to autacoids like 1. Histamine 2. 5-HT 3. Prostaglandins 4. Leukotrienes 5. Platelet activating factor	**02** **02** **02** **01** **01**
6.	Non-steroidal anti-inflammatory drugs (NSAID): Classification, mechanism of action, pharmacokinetics, pharmacodynamics, adverse effects, contraindications, Therapeutic uses, interactions and dose and route of administration of	**03**

Book Reading:

1. Satoskar R. S. , Bhandarkar S. D., Rege N. N., Pharmacology and Pharmacotherapeutics, Popular Prakashan Mumbai,

2. Tripathi K. D., Essentials of Medical Pharmacology, Jaypee Prakashan , New Delhi

3. Barar F.S. K. Essentials of Pharmacotherapeutics, S. Chand & Company, New Delhi

4. Patil P. N and Gulati O. D. Topic in the History of Pharmacology, B.S.Shah Prakashan Ahmedabad.

5. Rang and Dale, Pharmacology, Elsevier

Extra Reading:

1. Goodman Gillmans The Pharmacological Basis of Therapeutics, McGrwe Hill, New Delhi

2. Diprio J. L. Pharamcotherapy Handbook McGrew Hill, New Delhi

3. Official Book, Indian Pharmacopoeia, British Pharmacopoeia, U.S. Pharmacopoeia

P 3.5.3. Pharmacology – I

(Practical) (Duration :3hrs/Week)

Objectives

1. Introduction to experimental animals and ethical issues related to their use (CPCSEA guidelines)
2. Collection of biological samples from experimental animals (blood, urine, CSF, bile, feces, different tissues (only through charts and video demonstrations) and protocols to handle them – separation of serum/plasma, different types of blood cells, preservation and processing of tissues for microscopy, electron microscopy, biological estimation etc)
3. Introduction to experimental design- concept of positive/negative control, biological variations, blinding techniques, concept of placebo
4. Simulated practicals: isolated frog heart, Dose response curves (shapes, dose Vs response, Log Dose Vs Response, DRCs by agonists, partial agonist, effects of antagonist of DRC of agonist etc.)
5. Concepts of bioassays. Simulated bioassays using suitable software for interpolation assay
6. Behavioral testing using video demonstrations- along with animations related to drug actions- related therapeutics (related to treatment/ poisoning etc)
7. Wet lab experiments:
    a. DRC of acetylcholine of chicken ileum, goat trachea sourced from slaughter houses (If the institute has acquired due permission from IAEC then –tissues from rat may be used)
    b. Effect of Atropine on DRC of Acetylcholine using above mentioned tissues
    c. Effect of Physostigmine on DRC of Acetylcholine using above mentioned tissues
    d. Determination of PD2 value of acetylcholine on above mentioned tissues
    e. Determination of estrous cycle in rats
    f. Isolation of white blood cells from blood samples and determination of their viability using trypan blue method
    g. Electrophoresis of DNA samples and visualization in UV chamber
    h. Non-invasive behavioral experiments where drug administration and related effects on whole animals can be demonstrated. e.g. Elevated plus maze, actophotometer, immersion method,

1. Study of laboratory animals and their specific characteristics, use of experimental animals and tissues derived from them in pharmacological screening and evaluations of drugs, Care and Handling of Experimental animals, Ethical Issue related thereof (concept of CPCSEA and IAEC covered)
2. Demonstration of routes of administration (oral, intraperitoneal, intravenous, subcutaneous, sub-plantar, intramuscular) {students are expected to perform administration of sterile water/ saline by oral, intraperitoneal and intravenous route)*
3. Equipments used in isolated tissue experiments (including information on digital data acquisition system)
4. Study of various physiological salt solutions used in experimental pharmacology.
5. Simulated experiment of recording of dose response curve of acetyl choline/ histamine on rat/ guinea pig ileum using suitable software (www.animalsimulator.com or any such Soft-ware)
6. To record the Dose Response Curve for acetylcholine on rat ileum OR goat trachea OR chicken ileum (any one tissue as per availability)**
7. Determination of PD2 of Acetylcholine on rat ileum OR goat trachea OR chicken ileum (any one tissue as per availability)**
8. Simulated experiment of study of effect of Physostigmine on DRC of Ach using suitable software (www.animalsimulator.com or any such Soft-ware)*
9. Demonstration of collection of blood sample from rat tail vein and determination of blood glucose level in it by suitable method.
10. Simulated experiment of study of various effects of drugs on isolated frog heart using suitable software (www.animalsimulator.com or X-cology, Ex-pharm)*
11. To study Myosis and Mydriasis activities using simulation software (www.animalsimulator.com or X-cology, Ex-pharm)*
12. Demonstration of Anti-inflammatory activity (using any one phlogistic agent like λ-carrageen, Histamine, or any suitable agent) {Only demonstration, Not to be performed by students}
13. Determination of effects of NSAIDs on membrane stability of red blood corpuscles from human volunteers / experimental animals**
14. Isolation of white blood cells from human / experimental animal blood (using density gradient/ dextran sedimentation and determination of their viability microscopically using trypan blue method)**

15. Demonstration of effect of Carbachol on the autonomic nervous system of experimental animals (rat) either wet lab OR video demonstration {not expected to be performed by students}

Minor * **Major****

Minimum 12 experiments from above list must be conducted

Books Recommended

1) Ghosh M.N. Fundamentals of Experimental pharmacology. Hilton & Company Kolkata 2005 3rd edition.

2) Vogel G.H. Drug discovery and evaluation. Springer Germany 2002 2nd edition.

3) Goyal R.K. Practicals in pharmacology. B.S. Shah Prakashan Ahmedabad 2005 5th edition.

4) Kulkarni S.K. Handbook of Experimental Pharmacology. Vallabh Prakashan. New Delhi, 5th edition.

5) Perry W. L. M. Pharmacological Experiments on Isolated preparations. E.&S. Livingstone, London1970, 2nd edition.

6) Kasture S.B.Text book of Experimental Pharmacology, Career Publication Nashik.1 st edition, 2006.

7) Official books - Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia.

8) www.animalsimulator.com

T 3.5.4. Pharmacognosy –IV

(Theory) (Duration :3 Hours/Week)

Section-I

Sr. No.	TOPICS	Hrs.
1.	**Alkaloids** • Introduction, Classification, Physical & Chemical properties, distribution, General extraction methodology of alkaloids. • Biological source, diagnostic features, chemical constituents, chemical tests, uses, adulterants and substituent's of following a. **Pyridine- Piperidine**: Tobacco, Areca and Lobelia b. **Tropane:** Belladonna, Hyoscyamus, Datura, Coca c. **Quinoline and Isoquinoline**: Cinchona, Ipecac, Opium*. d. **Indole**: Ergot*, Rauwolfia*, Catharanthus, Nux-vomica and Physostigma e. **Imidazole:**Pilocarpus **f. Steroidal**: Kurchi, Ashwagandha* g. **Alkaloidal amine**: Ephedra and Colchicum. h. **Glycoalkaloid**: Solanum. i. **Purines**: Coffee, Tea* and Cola. j. **Quinazoline:** Vasaka *** Detail Pharmacognostic study of plants**	**17**
2.	1. **Enzyme** Biological Sources, Preparation, Identification Tests and Uses of Diastase, Papain, Pepsin, Trypsin, Pancreatin, streptokinase, serratiopeptidase.	**03**

Section-II

Sr. No.	TOPICS	Hrs.
3.	**Introduction to biosynthesis** • General Techniques of Biosynthetic Studies and Basic Metabolic Pathways. • A Brief Account of Primary and Secondary Metabolite's Production from Carbon Metabolism In plants. • Study of shikimicacid andMevalonic acid Pathway**.**	**07**

4.	**Plant tissue culture** • Introduction, to plant tissue culture, Laboratory requirements for plant tissue culture, Preparation of culture media, callus culture, cell suspension culture, and protoplast culture with reference to medicinal plants. • Production of secondary plant metabolites by tissue culture technique. Industrial Applications of plant tissue culture In Pharmacognosy.	**09**
5	**Plant bitters and sweeteners.**	**03**
6	**Study of Neutraceuticals as health foods.**	**03**
7	**A brief introduction to natural colors & dyes-Saffron, annatto**	**03**

P 3.5.4. Pharmacognosy –

(Practical) (Duration :3Hours/Week)

1. Morphology*,Microscopic** and powder characteristics* study of eight - selected drugs given in theory.
2. Isolation of total alkaloid (any two) **
3. Estimation of total alkaloids**
4. TLC study of alkaloids*.
5. Isolation and identification of papain or any one enzymes*
6. Some experiments on plant tissue culture for production of secondary metabolites (Demonstration)
    a. Preparation of media
    b. Formation of callus

* Minor experiments

** Major experiments

Books Recommended

1. Chemistry of Alkaloids by S. W. Pelletier
2. Alkaloids by Manske.
3. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
4. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree) NiraliPrakashan
5. Kokate C. K. Practical Pharmacognosy, VallabhPrakashan, Delhi.
6. Brain K. R. and Turner T. D., The practical Evaluation of phytopharmaceuticals, Wright-Scientechnica, Bristil.
7. PulokMukharji, Quality control of Herbal drugs.
8. Medicinal Plants of India, Indian Council of Medical Research, New Delhi.
9. Nadkarni A. K. Indian Materia Medica, 1-2, Popular Prakashan Pvt. Ltd.Bombay.
10. Pharmacopoeia of India, 1985,1996, Govt. of India, Ministry of Health and Family Welfare.
11. Iyengar M.A., Study of Crude Drugs, Manipal Power Press, Manipal.
12. Iyengar M.A. , Pharmacognosy Lab Manual. Manipal Power Press, Manipal.

13. The Wealth of India, Raw Marerials (All Volumes), Council of Scientific and Industrial Research, New Delhi.
14. Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, BailliereTindall, Eastbourne, U.K.
15. Wallis, T.E. Analytical Microscopy, J.A. Churchill Limited, London.
16. Wallis, T.E. Textbook of Pharmacognosy, J.A. Churchill Limited, London.
17. Tyler, V.E., Brady, R., Pharmacognosy
18. Wagner, S.B., Zgainsky, Plant drug Analysis.
19. V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II.
20. British Herbal Pharmacopoeia
21. Herbal Pharmacopoeia, IDMA, Mumbai
22. A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors
23. Natural Products, A Laboratory Guide – Raphael Ikan – Academic Press
24. Pharmacognosy, Phytochemistry, Medicinal Plants 2nd Edn. – Jean Bruneton
25. Manitto P. The biosynthesis of natural products, Ellis Harwood, Chichester

    Manske RHF, The alkaloids Academic press, New York
26. Clarke ECG, Isolation and Identification of Drugs, The Pharmaceutical Press, London
27. De Mayo, The chemistry of Natural Products, 2-3, Interscience New York
28. Gamborg O. L. Wetter L. R. , Plant tissue culture methods, National Research Council of Cannada, Sakatchewan.
29. Henry T. A. , The plant alkaloids, McGraw Hill, New York.
30. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
31. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain, London.
32. The Chemistry of Natural Products by De Mayo P, Interscience, New York.
33. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
34. The Biochemistry of Alkaloids by Robinson T., Springer- Verlag.
35. Peach K, and Tracey M. V., Modern methods of plant analysis, 1-4, Narosa Publishing house, New Delhi

T 3.5.5. Pharmaceutical Analysis-II

(Theory) **(Duration :3 Hours/Week)**

Sr. no.	Topic	Hrs
	SECTION-I	
1.	**Analytical separations:** Concepts in distributions of solutes in immiscible solvents, distribution coefficients (ratios), solvent-solvent extractions, solid-phase extractions	**03**
2.	**Refractometry:** Principle, Theory, Instrumentation and Applications.	**04**
3.	**Nephelo-turbidimetry**: Principles, Theory, Instrumentation and Applications	**04**
4.	**Polarimetry:** Principle, theory, instrumentation and applications including ORD and CD	**03**
5.	**Thermal Analysis**: Introduction, principle, methods, instrumentation and factors affecting results, Applications of TG, DSC, and DTA.	**07**
6.	**Introduction to Gasometric analysis**	**02**
	SECTION-II	
6.	**Basic introduction to Electrochemistry and Electrochemical Methods of Analysis.**	**01**
7.	**Electrochemical Analysis:** a. **Conductometry:** Principle, Theory, Effect of dilution, Instrumentations, Types of conduct metric titrations and Applications. b**. Potentiometry:** Nernst equation, Types of electrodes, Indicator and reference electrodes, examples, measurement of potential. Measurement of pH Types of potentiometric metric titrations . c. **Polarography:** Principle, Theory, Instrumentation Dropping Mercury electrode, Half wave potential, ILKOVIC equation and Applications. d**. Amperometry:** Principles, Theory, Instrumentation and Applications. e. **Coulometry:** Principles, Theory, Instrumentation and Applications.	**18**
8.	**Karl Fisher titration**: Introduction , instrumentation and applications	**03**

P 3.5.5. Pharmaceutical Analysis-II

(Practical) **(Duration: 3hrs/week)**

Sr.no.	Experiments
1.	Calibration of Refractometer and measurement of RI .* (At least 03 samples)
2.	Calibration of Conductometer and to measure conductance of distilled water. Determination of cellconstant.*
3.	Conductometric titration of strong acid- strong base**
4.	Conductometric titration of weak acid- strong base**
5.	Estimation of boric acid by Conductometric titration.**
6.	Calibration of pH meter and measurement of pH*
7.	Potentiometric titration of strong Acid Vs strong base **
8.	pKa determination of phosphoric acid / boric acid**
9.	Determination of specific rotation using Polarimeter. *
10.	Assay of Dextrose injection by Polarimeter as per I.P 1996.*
11.	Calibration of Nephaloturbidimeter*
12.	Determination of Sulfate using Nephaloturbidimeter**
13.	Water determination by Karl-fischer method*

* Minimum 12 experiments should be covered

* Indicate Minor experiments ** Indicate Major experiments

Books Recommended:

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 – 5th editions.

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, 6th 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, 5th 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).

20. Analytical chemistry- garryChrisian

21. Instrumental methods of analysis- Chatwal andAnand

T 3.6.1. Pharmaceutical Chemistry – VII (Medicinal Chemistry -II)
(Theory) (Duration : 4 hrs/week)

The following topics should be covered with the points listed below

1. Introduction
2. Classification
3. Mechanism of action
4. Structure-activity relationship
5. Pharmacokinetics (Metabolism) and
6. Therapeutic uses
7. *Synthesis of drugs

Sr.no.	Topic	Hours
	Section I	
1	**Antiseptic & Disinfectants –**Chlorocresol, Phenol	2
2	**Quinoline Antibacterials -** Fluroquinolones like norfloxacin*, ciprofloxacin*, sparfloxacin*, Gatifloxacin*	4
3	**Anthelmintics -** Piperazine citrate, Albendazole, Mebendazole, Levamisole, Niclosamide	7
4	**Antifungal agents -** Clotrimazole, Griseofulvin, Ketoconazole, Miconazole nitrate	7
5	**Sulfonamides –** Short, intermediate and long acting sulfonamides, sulfonamides for ophthalmic infections, for burn therapy and for intestinal infections, ulcerative colitis and for reduction of bowel flora, DHFR inhibitors	7
6	**Antiamoebic Drugss** –Metronidazole*, diloxanidefuroate, Tinidazole*, Ornidazole*, flurazolidone	03
	Section II	
7	**Antineoplastics agents:** a. alkylating agents like mechlorethamine, chlorambucil*, cyclophosphamide*, mitomycin C, busulfan, carmustine, lomustine, dacarbazine and procarbazine. b. Antimetabolites like azaserine, methotrexate*, 5fluorouracil, araC, 6MP and 6TG	10

	c. Antibiotics like dactinomycin, doxorubicin, bleomycin, and other natural products like vincristine, vinblastine, paclitaxel (only highlights of structure to be discussed) d. Miscellaneous compounds like cisplatin and some newer derivatives e. Combination therapy	
8	**Antitubercular agents** – PAS*, ethonamide, isonamide, pyrazinamide, ethambutol*, antitubercular antibiotics (streptomycin, rifampin, viomycin and cycloserine – the first three only highlights of structure to be discussed). Combination therapy. Antileprotic drugs – dapsone* and clofazimine	04
9	**Antimalarials** – Natural products like cinchona alkaloids (with stereochemistry and drug action) and artemisinin and its derivatives like artether and artemether and artesunate. Synthetic antimalarials such as 8aminoquiacridines eg. Primaquine, Quinoline methanolsegmefloquine: misc, like halofantrine and lumefantrine: DHFR inhibitors like pyrimethamine* and cycloguanil and sulfonamides like sulfodoxine, sulfadiazine*, and sulfalene. Combination therapy.	06
9	**Antibiotics** - penicillins (natural and semisynthetic penicillinslike Penicillin G, PenicillinV, ampicillin*, amoxicilline*, oxacillin ,nafcillin, methacillin and ampicillin prodrugs like bacampicillin and pivampicillin), cephalosporins (cephalexin, cephalothin, cefaxitin, cefuroxime, cefotaxime, cefepine and cefpirome) tetracycline, chlortetracycline, oxytetracycline, doxycycline and miocycline and its prodrug – rolitetracycline); macrolides (erythromycin, rocithromycin, azithromycin – only highlights of structure to be discussed); aminopglycosides (gentamicins and neomycins – only highlights of structure to be discussed) Chloramphenicol.	10

Reference Books:

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 11 th Ed., Eds., John H Block and John M Beale, Lippincott Williams & Wilkins, 2004.
2. Foye's Principles of Medicinal Chemistry, Eds., T. L. Lemke and D. A. Williams, Williams & Wilkins, Baltimore, 2002.
3. Medicinal Chemistry, AshutoshKar, 4 th Edition, New Age International Publishers, 2007.
4. The Art of Drug Synthesis, Eds., Douglas S Johnson and Jie Jack Li, Wiley Interscience, 2007.
5. Pharmaceutical Chemistry, Vol. 1: Drug Synthesis, Eds., H. J. Roth, A. Kleeman, and T. Beissewenger, Ellis Horwood Ltd., 1988.
6. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Vols. 1 to 7, Wiley.
7. Profiles in Drug Synthesis : V.N. Gogte
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. Vogels
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson

P 3.6.1. Pharmaceutical Chemistry – VII (Medicinal Chemistry - II) (Practical) (Duration : 3 hrs/week)

Minimum Twelve numbers of Experiments should be performed.

***Minor ****Major Experiments**

1) **Purification techniques of solvents/liquids and synthesized products by Fractional distillation and distillation under vacuum and recrystalization**

1. Benzylideneacetophenone(Claissen Schmitt Reaction)**
2. Benzhydrol from Benzophenone (MVP Reduction)*
3. Benzocaine*
4. Synthesis of 3,5-dinitrobenzoic acid from benzoic acid**
5. Synthesis of benzyl alcohol from benzoic acid (Cannizzarao reaction)*
6. 9-acetylanthracine from anthracine*
7. p-acetamidobenzenesulphonyl chloride from acetanilide**
8. p-acetamidobenzenesulphonamide from p-acetamidobenzenesulphonyl chloride*
9. Methyl red**
10. *o*-chlorobenzoic acid (Sandmeyer Reaction)**
11. Resacetophenone from resorcinol*
12. iodobenzene from aniline*
13. p-acetaniside from p-anisidine*
14. Benzalactoacetophenone from acetophenone and benzaldehyde*
15. Pentaerythritol from acetaldehyde. **

Book Recommended

1. Text Book of Practical Organic Chemistry - A.I. Vogel

2. Practical Organic Chemistry - Mann and Sanders

3. Systematic Identification of Organic Composition, Shriner and Fuson

4. Indian Journal of Pharmaceutical Education and Research, 39 (4) Oct-Dec. 2005, 188-190

5. Organic Synthesis Special techniques V. K. Ahluwalia, RenuAggrawal, Nerosapublishinghouse , p. no. 90 - 114

T 3.6.2. Pharmaceutics –VII (Biopharmaceutics& Pharmacokinetics)
(Theory) (Duration : 3 hrs/week)

Section- I

Sr. No.	TOPICS	Hrs.
1.	**Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting.**	**02**
2.	**Absorption of drugs: -**Introduction, Definition, Gastrointestinal absorption of drugs, Structure and Physiology of cell membrane, Mechanism of drug absorption, Factors affecting drug absorption (Pharmaceutical and Patient related), Theories of drug dissolution, Factors affecting drug dissolution and dissolution rate, pH-Partition hypothesis, Absorption of drug from extravascular routes.	**08**
3.	**Distributionof drugs: -** Introduction, Definition, Physicochemical properties of drug, organ/tissue size, blood flow to the organ, physiological barriers to the diffusion of drugs {Factors affecting distribution}, Apparent volume of distribution.	**04**
4.	**Protein binding of drugs: -** Introduction, Definition, Binding of drugs to blood components & extravascular tissue proteins. Factors affecting protein drug binding. Significance of protein/tissue drug binding.	**03**
5.	**Biotransformation of drugs:-**Introduction, Definition, Drug metabolizing organs, Drug metabolizing enzymes, Phase I and Phase II reactions. actors affecting biotransformation of drugs {Physicochemical properties of drugs, Chemical & Biological factors}.	**04**
6.	**Non- linear pharmacokinetic: -**Introduction, tests to detect nonlinearity in pharmacokinetics. Causes of nonlinearity{examples of drug showing nonlinearity in absorption, distribution, metabolism, & excretion}.Michaelis Menten equation and specific derivation for three situations by considering values of K_m and C. Estimation of K_m and V_{max}.	**02**

Section- II

Sr. No.	TOPICS	Hrs
7.	**Excretion of drugs:-**Introduction, Definition. Renal excretion of drugs {Glomerular filtration, active tubular secretion and active or passive tubular reabsorption}, Urine pH, drug pK_a and urine flow rate. Concept of clearance, Renal clearance, excretion ratio. Factors affecting renal excretion. Renal function and dose adjustment in renal failure. Non renal routes of drug excretion - Biliary excretion- factors affecting biliary excretion and enterohepatic cycling of drugs. Minor pathways of drug	**04**

	excretion{Pulmonary, Mammary, Skin, GI, and Genital excretion}.	
8.	**Pharmacokinetics: Basic considerations: -** Pharmacokinetic basic consideration, Rate, Rate constants and Orders of reactions. Concept of mixed order kinetics {Non linear kinetics}. Pharmacokinetic models – Importance, types {Compartment, non compartmental analysis, and Physiologic models}	**02**
9.	**Compartment modeling: -** Pharmacokinetic of one compartment model drug, mathematical treatment to pharmacokinetic upon I.V. bolus dosing, constant rate I.V. infusion, and extravascular administration. Urinary excretion data studies (Rate excretion and sigma minus methods), Multicompartment model behavior (excluding derivation or mathematical treatment), Central, & peripheral compartments, distribution phase & pseudo distribution equilibrium phase. Plasma concentration & therapeutic response. An introduction to pharmacodynamics.	**08**
10.	**Bioavailability and Bioequivalence:** Introduction, Definition, Objectives of bioavailability studies. Considerations in bioavailability study design – absolute versus relative bioavailability, single versus multiple dose study and healthy subjects versus patients. Measurement of bioavailability {Pharmacokinetic and Pharmacodynamic methods}.Drug dissolution rate and bioavailability - In vitro drug dissolution testing models – factors related to dissolution apparatus, dissolution fluids, and process parameters. Closed, Open compartment apparatus. Type I and II apparatus. In vitro- In vivo correlation. Bioequivalence studies. Methods of enhancement of bioavailability.	**04**
11.	**Design of Dosage Regimens: -** Introduction, Definition and applications of dosage regimen. Factors affecting dosage regimens – dose size, dosing frequency, drug accumulation during multiple dosing {accumulation index}, utility curves, & therapeutic window, multiple dose pharmacokinetics. Fluctuation, steady state concept, time to reach steady state, loading and, maintenance doses. Individualization {Pharmacokinetic and pharmacodynamic variability}, dosing of drugs in individuals. Monitoring drug therapy {Therapeutic, Pharmacodynamic, and Pharmacokinetic}.	**04**

P. 3.6.2. Pharmaceutics –VII (Biopharmaceutics& Pharmacokinetics) (Practical) (Duration : 3 hrs/week)

1) Determination of disintegration time of Tablet*
2) Dissolution Studies: Ointment* Marketed enteric coated Tablet*
3) To study the effect of enzymes / surfactant on dissolution of Tablet**
4) To study the effect of pH on dissolution of Tablet. **
5) In vitro diffusion study of drugs through one biological and two synthetic Membrane**.
6) To study the absorption of drugs using everted sac technique**
7) Equilibrium dialysis method- demonstration of protein binding
8) Equilibrium dialysis method- demonstration of drug-drug interaction at protein bind sites**.**
9**)** To study the urinary excretion of Riboflavin in healthy volunteers**
10) To determine pharmacokinetic parameters from plasma concentration time profile***.**
11) To determine Area under Curve (AUC) by trapezoidal rule from plasma concentration time profile***.**

Major Expt. **

Minor Expt. *

Books Recommended for Theory and Practical:

1. Leon Shargel, Applied Biopharmaceutics and Pharmacokinetics - McGraw Hill
2. V.Venkateshwarlu, Biopharmaceutics and pharmacokinetics- Pharma Book Syndicate
3. GibaldiM,Biopharmaceutics and clinical pharmacokinetics-. Pharma Book Syndicate
4. Rowland M. &Tozer, Clinical pharmacokinetics: Concept and application- B.I. Waverly Pvt. Ltd.
5. Notari R.E., Biopharmaceutics, and clinical pharmacokinetics- Marcel Dekker, Inc.
6. S.B. Jaiswal and D.M.Brahmankar, Biopharmaceutics and Pharmacokinetics A Treatise – VallabhPublicationDelhi.
7. Hitendra S. Mahajan. Theoretical and Experimental aspects of Biopharmaceutics and Pharmacokinetics- Career Publications.

T. 3.6.3. Pharmacology –II

(Theory) **(Duration : 4 Hours/Week)**

Section I

Sr. No.	TOPICS	Hrs.
1.	**Central Nervous System: -** a) Neurotransmitters involved in central nervous system (CNS) with their role in physiology and pathology of CNS disorders b) Pharmacology of alcohol and treatment of alcohol abuse c) General anesthetics – emphasize on the general anesthetics in actual clinical use at present d) Pharmacology of following classes of drugs acting on CNS: • Local Anesthetics • Antiparkinsonian drug • Sedatives, hypnotics and anxiolytics • CNS stimulants and respiratory stimulants • Anticonvulsants • Antipsychotics • Antidepressants. • Opiates and opoid analgesics	03 03 03 02 02 02 03 03 03 03 03 03

SectionII

Sr. No.	TOPICS	Hrs.
1.	**Concept of bioassays : -** a) Types of Bioassay – Matching, bracketing, interpolation and multiple point assays b) Alternatives to conventional bioassays including Radio-immuno assays, Enzyme linked immunosorbent assays, ligand-binding assays, receptor binding assays, functional assays (using fluorescene techniques, chemiluminiscence techniques)	**10**

2.	**1)** Pharmacology of drugs acting on r**espiratory system: -** a) Mucolytics b) Antitussives c) Expectorants d) Anti-Asthmatic drugs	**10**
3.	2) Pharmacology of drugs acting on **Endocrine system: -** a) Thyroid and antithyroid drugs. b) Insulin and insulin analogues, oral hypoglycaemic drugs. c) Male and female sex hormones and oral contraceptives. d) Oxytocin and other uterine stimulants and relaxants.	**10**

Book Reading:

1. Satoskar R. S. , Bhandarkar S. D., Rege N. N., Pharmacology and Pharmacotherapeutics, Popular Prakashan Mumbai,

2. Tripathi K. D., Essentials of Medical Pharmacology, Jaypee Prakashan , New Delhi

3. Barar F.S. K. Essentials of Pharmacotherapeutics, S. Chand & Company, New Delhi

4. Patil P. N and Gulati O. D. Topic in the History of Pharmacology, B.S.Shah Prakashan Ahmedabad.

5. Rang and Dell, Pharmacology, Elsevier

Extra Reading:

1. Goodman Gillmans The Pharmacological Basis of Therapeutics, McGrwe Hill, New Delhi

2. Diprio J. L. Pharamcotherapy Handbook McGrew Hill, New Delhi

3. Official Book, Indian Pharmacopoeia, British Pharmacopoeia, U.S. Pharmacopoeia

P 3.6.3. Pharmacology –II
(Practical) (Duration : 3 Hours/Week)

1) Determination of effect of Physostigmine on DRC of acetylcholine using pig ileum OR rat ileum OR goat trachea OR chicken ileum (any one tissue as per availability)**

2) Determination of effect of Atropine on the DRC of acetylcholine using pig ileum OR rat ileum OR goat trachea OR chicken ileum (any one tissue as per availability)**

3) Bio-assay of acetylcholine/histamine on guinea pig ileum OR rat ileum OR goat trachea OR chicken ileum by interpolation method (any one tissue as per availability)**

4) Bio-assay of acetylcholine/histamine on guinea pig ileum OR rat ileum OR goat trachea OR chicken ileum by three point assay method (any one tissue as per availability)**

5) Bioassay of Atropine on guinea pig ileum OR rat ileum OR goat trachea OR chicken ileum by interpolation method (any one tissue as per availability) – by determining % inhibition of effect of acetylcholine**

6) Bio-assay of acetylcholine/histamine on guinea pig ileum OR rat ileum OR goat trachea OR chicken ileum by three point assay method (any one tissue as per availability)**

7) Phases of estrous cycle in rats by microscopic examination of vaginal smears {Phases of Proestrus , Oestrous, Diestrus and Metaestrus shoud be identified)**

8) Determination of antidepressant effect of drugs using forced swim test / tail suspension test in mice (Oral and IP administration of drug)*

9) To study the effects of drugs on locomotor activity using Actophotometer (Oral and IP administration of drug)*

10) Demonstration of study of Anticonvulsant activity using MES/ PTZ using simulated software (www.animalsimulator.com or any other suitable software)

11) To study the analgesic activity of drug using Hot Plate/ OR Tail Flick/ Or Caudal Immersion, method in rats/ OR mouse **(**Oral and IP administration of drug)*

12) Demonstration of Haloperidol induced catalepsy in rats

13) Demonstration of difference in Pharmacokinetics of any one drug administered by oral route and intravenous route {The analytical method should be UV-visible spectroscopy based, and the drug should has short half life so that student can finish this experiment within 3 hours}

14) Marble burying paradigm in mice to determine obsessive compulsive behavior**

15) Simulated experiment of determination of PA2 value using suitable software **.

NOTES: - **1. Minor** * **Major****

Minimum 12 experiments from above list must be conducted

Books Recommended

1) Ghosh M.N. Fundamentals of Experimental pharmacology. Hilton & Company Kolkata 2005 3rd edition.

2) Vogel G.H. Drug discovery and evaluation.Springer Germany 2002 2nd edition.

3) Goyal R.K. Practicals in pharmacology. B.S. Shah Prakashan Ahmedabad 2005 5th edition.

4) Kulkarni S.K. Handbook of Experimental Pharmacology. Vallabh Prakashan. New Delhi, 5th edition.

5) Perry W. L. M. Pharmacological Experiments on Isolated preparations.E.&S. LivingstoneLondon 1970 , 2nd
edition.

6) Kasture S.B.Text book of Experimental Pharmacology, Career Publication Nashik.1 st edition, 2006

7) Official books - Indian Pharmacopoeia, British Pharmacopoeia, United States Pharmacopoeia

8) www.animalsimulator.com

T 3.6.4. Pharmacognosy – V (Chemistry of Natural Products)

(Theory) (Duration : 3 hrs / week)

Section-I

Sr. No.	TOPICS	Hrs.
1.	Chemistry and Spectral Characterization of Simple Natural Origin Molecules Using modern analytical tools (UV, IR, NMR, and Mass).	**04**
2.	Concept of Stereoisomerism of Natural Products	**03**
3.	Introduction**,** Chemistry, biogenesis and pharmacological activity of medicinally Important Monoterpenes, Sesquiterpenes, Diterpenes, Triterpenoid	**12**
4.	**Glycosides**: Introduction, Chemistry and Biosynthesis of Cardio Active Glycoside (Digitoxin, Digoxin), Sennoside, Diosgenin, Hecogeninand Sarasapogenin.	**05**

Section-II

Sr. No.	TOPICS	Hrs.
1.	**Alkaloids:** Introduction, Chemistry, Biogenesis and Pharmacological Activity of Atropine Quinine, Reserpine, Morphine, Papaverine, Ephedrine, Ergot and Vinca alkaloids.	**08**
2.	**Carotenoids:** Introduction, α-carotenoids, β-carotenes, vitamin A	**05**
3.	Introduction, Chemistry and Biogenesis of Medicinally Important Lignans and Flavonoids.	**04**
4.	Chemistry and Therapeutic Activity of Penicillin, Streptomycin and Tetracycline.	**04**

P 3.6.4. Pharmacognosy – V(Chemistry of Natural Products) (Practical) (Duration : 3hrs / week)

1. Laboratory experiments on isolation**, separation, purification** and Spectroscopic analysis* of various groups of chemical constituents of pharmaceutical significance.
2. Estimation of Total flavonoids *

* Minor experiments

** Major experiments

Book recommended

1. Chemistry of Alkaloids by S. W. PelletierAlkaloids by Manske.
2. Steroids by Fieser and Fieser.
3. Medicnal Natural Products –A biosynthetic Approach- Paul M Dewick
4. Organic Chemistry by I. L. Finar Vol. II.
5. Chemistry of Natural Products by K. W. Bentley.
6. Chemistry of Natural Products by O. P. Agrawal.
7. Biosynthesis of Aromatic Compounds by Ulrich Weiss & J. Michael Edwards.
8. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
9. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree) NiraliPrakashan
10. Kokate C. K. Practical Pharmacognosy, VallabhPrakashan, Delhi.
11. Brain K. R. and Turner T. D., The practical Evaluation of phytopharmaceuticals, Wright-Scientechnica, Bristil.
12. PulokMukharji, Quality control of Herbal drugs.
13. Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, BailliereTindall, Eastbourne, U.K.
14. Wallis, T.E. Analytical Microscopy, J.A. Churchill Limited, London.
15. Tyler, V.E., Brady, R., Pharmacognosy
16. V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II.
17. Herbal Pharmacopoeia, IDMA, Mumbai
18. Natural Products, A Laboratory Guide – Raphael Ikan – Academic Press
19. Pharmacognosy, Phytochemistry, Medicinal Plants 2nd Edn. – Jean Bruneton
20. Raphael Ikon, Natural products a laboratory Guide, Academic Press
21. Manitto P. The biosynthesis of natural products, EllisHarwood, Chichester
22. Manske RHF, The alkaloids Academic press, New York

23. Clarke ECG, Isolation and Identification of Drugs, The Pharmaceutical Press,London
24. De Mayo, The chemistry of Natural Products, 2-3, Interscience New York
25. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain,London.
26. The Chemistry of Natural Products by De Mayo P, Interscience, New York.
27. Marine Natural Products Chemistry by Faulkner D. J. and Fenical W. H., Plenum Press, New York.
28. Biochemistry of Phenolic Compounds by Harborne J. B., Academic Press, New York.
29. Official Methods of Analysis, Association of Official Analytical Chemists publication,Washington.
30. Pharmacopoeia Of India, 1985, 1996, Govt. Of India, Ministry Of Health and Family Welfare.
31. Terpenoids in Plants by Pridham J. B., Academic Press, New York
32. The Biochemistry of Alkaloids by Robinson T., Springer- Verlag.
33. Experimental Phytopharmacognosy –A Comprehensive Guide By SS Khadabdi, DeoreSl, and BA Baviskar, NiraliPrakashan, Pune.
34. Standardization Of Botanicals- Testing & Extraction Methods Of Medicinal Herbs By V. Rajpal, Eastern Publisher, New Delhi

T 3.6.5. Pharmaceutical Jurisprudence & Ethics

(THEORY) (Duration : 4 Hrs/Week)

Scope:

The subject deals with several important legislations related to the profession of pharmacy in India. The Drugs and Cosmetics Act, along with its amendments is the core of this course. Other acts, which are covered, include the Pharmacy Act, dangerous drugs, medicinal and toilet preparation Act etc. Besides this the new drug policy, professional ethics, DPCO, will be discussed.

Objectives:

At the end of the course, the student shall able to

- Know and understand the Pharmaceutical legislations and their implications in the development and marketing.
- Understand and follow the code of ethics during the pharmaceutical practice
- Know and understand various Indian pharmaceutical acts and laws
- Know about the process of drug discovery and developments
- Know the regulatory authorities and agencies governing the manufacture and sale of Pharmaceuticals
- Know the regulatory approval process and their registration in Indian and international markets

Sr No	Topic	Hrs
	Section I	
1	**Definition and scope of Forensic Pharmacy**	**1**
2	**Pharmaceutical Legislation-A brief review** Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee	**2**
3	**Code of Pharmaceutical ethics** Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath.	**2**
4	**Pharmacy act-1948 & new Amendments** Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils, Registration of Pharmacists, Offences and Penalties	**2**
5	**Drugs and cosmetics act 1940 and rules 1945 & New**	**09**

	Amendments Objectives, Definitions, Legal definitions of schedules to the act and rules Import of drugs - Classes of drugs and cosmetics prohibited from import, Import under license or permit. Manufacture of drugs - Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license. Detailed study of schedule M, N and Y. Sale of Drugs - Wholesale, Retail sale and Restricted license. Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Administration of the act and rules - Drugs Technical Advisory Board, Central Drug Committee, Government analysts, licensing authorities, controlling authorities, Drug Inspectors	
6	**Medicinal and Toilet preparations (Excise Duties) Act 1955** Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Offences and Penalties.	**2**
7	**Narcotic drugs and psychotropic substance act 1985 and rules** Objectives, Definitions, Authorities and Officers, Prohibition, Control and Regulation, opium poppy cultivation and Production of poppy straw manufacture, sale and export of opium, Offences and Penalties.	**2**
8	**Drugs and Magic remedies (Objectionable Advertisement) act 1955** Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties.	**2**
9	**Pharmaceutical Policy 2002 and its amendments** Objectives, Approaches in the review, Salient features	**2**
10	**Sales promotion employees (Conditions of service) Act** **Regulatory affairs**	**2**
11.	**Consumer Protection Act**	**4**
	Section II	
12	**Prevention of cruelty to Animals act-1960** Objectives, Definitions, Institutional Animal Ethics Committee, Breeding and Stocking of Animals, Performance of Experiments, Transfer and Acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties.	**2**
13	**Drugs (price control) order-1995 & New Amendments** Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, Implementation of prices Fixed/ revised.	**2**
14	**New Drug Discovery and development**	**8**

	Stages of drug discovery, Drug development process, pre-clinical studies, nonclinical activities, clinical studies, Concept of generics, Generic drug product development	
15	**Regulatory authorities and agencies** Overview of regulatory authorities of United States, Australia, United Kingdom. International Conference on Harmonization, World Health Organization.	**04**
16	**Regulatory Approval Process** Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.	**06**
17	**Registration of drug product in overseas market** Procedure for export of pharmaceutical products, Technical documentation, Common Technical Document (CTD), electronic Common Technical Document (eCTD)	**06**
18	**Right to information act, 2005 –** Introduction & applications	**02**

Recommended books

1. Forensic Pharmacy by B. Suresh

2. Pharmaceutical Jurispudance by B.S.Kuchekar

3.Text book of Forensic Pharmacy by B.M. Mithal

4. Hand book of drug law-by M.L. Mehra

5. A text book of Forensic Pharmacy by N.K. Jain

6. Drugs and Cosmetics Act/Rules by Govt. of India publications.

7. Medicinal and Toilet preparations act 1955 by Govt. of India publications.

8. Narcotic drugs and psychotropic substances act by Govt. of India publications

9. Drugs and Magic Remedies act by Govt. of India publications.

10. Drug Regulatory Affairs by SachinItkar, Dr. N.S. Vyawahare, NiraliPrakashan.

11. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P. Martin, Drugs and the Pharmaceutical Sciences,Vol.185. Informa Health care Publishers.

12. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD, 5thedition, Drugs and the Pharmaceutical Sciences,Vol.190.

13. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons.Inc.

14. FDA Regulatory Affairs: a guide for prescription drugs, medical devices, and

biologics/edited by Douglas J. Pisano, David Mantus.

P.3.6.6 Project Report

Project report during T.Y. B. Pharm. For Project report one project should be given in group of 3 Students. Under one teacher, 5-7 group can study and complete their project. Oral examination will be conducted by appointing External Examiner from Industry or Academic for the project and grades will be allotted individually.

North Maharashtra University, Jalgaon

Syllabus of

Final Year B. Pharmacy (Sem VII & Sem VIII)

W.E.F. Academic Year 2015-2016

T- 4.7.1 Pharmaceutical Technology II (Pharmaceutics –VIII)

(Theory)(3Hrs/week)

Sr. No.	Topics	Hrs.
	Section- I	
1.	**Parenteral Preparations:** **A} General requirements: -** Concept of sterile products**.** Definition and Introduction of Parenteral Preparation. Historical background, Ideal Requirements, Advantages, Disadvantages, Classification, Precautions, Brief discussion on preformulation factors for parenterals. Routes of Administration {Primary and Secondary}, Water for Injection (WFI) and its preparation methods, Sterile Water for Injection (SWFI), and Bacteriostatic Water for Injection (BWFI), Pharmacopoeial evaluation of SWFI and WFI. Non aqueous solvents used in parenteral formulations. Pyroginicity, sources & removal of pyrogens. Isotonicity. Formulation additives for Parenterals. Preparation of sterile powders {Liophilization}. Long acting parenteral formulations such as suspensions, emulsions, and depot preparations. Effect of route of administration. **B} Packing of Parenterals: -** Containers- Glass- Introduction, advantages and disadvantages, composition of glass. Types of glass. Problems encountered with glass containers such as leaching and flaking. Evaluation of glass containers {Powdered glass test, Water attack test and light transmission test for colored glass}. Containers- Plastic- Introduction, advantages and disadvantages, classification of plastics {thermoplastic and thermosetting type- brief explanation} evaluation of plastic containers for parenteral preparations. Closures- Rubber- Introduction, excipients or additives used in rubber closures, Ideal characteristics of rubber, types of rubbers. Evaluation of rubber closures. Aseptic packaging via Form Fill Seal Technology. Sealing of Ampoules. **C} Design of facilities and environmental control: -** Basic design, environmental control, class 100 and other areas. HEPA filters, HVAC system. Laminar Flow Rooms {Horizontal & Vertical}. Validation of Environment. Validation of HEPA filters {Hot & Cold DOP test}. Concept of CIP {Clean in Place} & SIP {Steam in Place}. **D} Personnel factors: -** Contamination in pharmaceutical parenteral plant, selection of clean room personnel, training programs for clean room employees, motivation of employees. **E} Processing of Parenteral Products: -** Processing of parenteral products by terminal sterilization, filtration sterilization. Validation of sterilization equipments, Biological & Chemical Indicators. **F} Quality control and Quality Assurance of Parenterals: -** Evaluation of Parenteral Products by Pyrogen test, Clarity test, Leaker test and sterility test.	**12**
2.	**Ophthalmic Products:** Definition, Introduction, Types of Ophthalmic Products. Anatomy and Physiology of the eye. General requirement / safety consideration. Formulation, isotonicity	**05**

	adjustment. Sodium chloride equivalent method {Calculation of dissociation factor and sodium chloride equivalent}. Problems on Isotonicity calculation. Sterilization of ophthalmic products {Steam sterilization, filtration, gaseous and radiation}. Composition of Tears, Artificial Tears. Mechanism of ocular drug absorption {Corneal & Non corneal}. Glaucoma and its management. Packing of eye drops. Evaluation of ophthalmic products.	
3.	**Drug Stability: -** Introduction, Definition of stability, Concept of expiry date or shelf life, Reasons for stability, Advantages. Kinetic studies versus stability studies. Physical degradation of Pharmaceutical Products with their preventive measures. Chemical decomposition of drugs with their preventive measures such as – Hydrolysis {Ester and amide hydrolysis with examples}, Oxidation {Auto oxidation kinetics of ascorbic acid}. Miscellaneous reactions with their preventive measures such as optical isomerisation, epimerization, geometrical isomerisation, polymerization, and decarboxylation. Effect of light {Photochemical decomposition}, pH, and temperature on drug decomposition. Brief introduction to ICH guidelines for stability testing.	**06**
	Section- II	
4.	**Oral sustained and controlled drug delivery system:** Definition, Introduction, rationale, advantages, and disadvantages. Comparison of sustained and controlled drug delivery system. Model drug selection criteria for sustained and controlled drug delivery system. Classification – details of matrix and diffusion control systems. Biopharmaceutical aspects –concept of maintenance dose & loading dose. Evaluation of SR & CR Tablets only.	**07**
5.	**Polymers used sustained and controlled drug delivery system:** Brief introduction to polymers, linear polymers, branched polymers, cross linked polymers, classification of polymers based on method of polymerization, properties of polymers, characterization of polymers. Examples of polymers such as celluloses, chitosan, Polylactide – coglycolide {PLGA}.	**04**
6.	**Microencapsulation:** Definition, Introduction, Typical shapes of Microcapsules, Types of microcapsules, importance of microcapsulation in pharmacy, Core and Coating materials, Formulation of microcapsules by coacervation phase separation, air suspension technique, multiorifice centrifugal process, solvent evaporation, spray drying and spray congealing, pan coating. Introduction of a relatively new technique "Polymerization,". Brief discussion on magnetic microspheres, evaluation of microcapsules.	**07**
7.	**Optimization:** Definition, Introduction, Optimization parameters – Problem type {Constrained & Unconstrained} and Variable type {Independent and Dependent Variables}, surface response, Classical optimization. Statistical design and optimization methods. Applications of optimization in Pharmacy.	**04**

Total Hours: 45

P - 4.7.1 Pharmaceutical Technology II (Pharmaceutics –VIII)

(Practical) (3Hrs/week)

Note: Conduct any 15 experiments from following list. A) Products may be assayed to evaluate accuracy in regular practical. Assays are not to be given to students in University examinations.

B) Formulation of different dosage forms should give stress on raw material specifications, preformulation, process controls, and documentation.

1) Introduction to Parenterals.
2) To prepare & evaluate ampoule containing SWFI.
3) To prepare & evaluate ampoule containing ascorbic acid injection.
4) To prepare & evaluate ampoule containing calcium gluconate injection.
5) To prepare & evaluate sodium chloride and dextrose injection.
6) To prepare & evaluate ampoule containing atropine sulphate injection.
7) To prepare & evaluate ampoule containing sodium thiosulphate injection.
8) Introduction to Ophthalmic Products.
9) To prepare & evaluate zinc sulphate eye drop.
10) To prepare & evaluate sulphacetamide sodium eye drop.
11) To prepare & evaluate chloramphenicol eye ointment.
12) To prepare & evaluate sulphacetamide sodium eye ointment.
13) To perform powdered glass test.
14) To perform water attack test.
15) To evaluate plastic containers used for parenteral products.
16) To evaluate rubber closures used for glass containers containing parenteral products.
17) Accelerated stability testing of an injection.
18) Preparation and evaluation of microspheres.
19) Formulation and evaluation of one controlled release/sustained release formulation.

Book Recommended for Theory & Practical's:-

1. Leon Lachman. The Theory and Practice of Industrial Pharmacy. Third edition. Varghese publication.
2. Ansel-- P'ceutical dosage forms and drug delivery system. Eight edition.Indian edition by B. I. publications.
3. Alfanso R. Gennaro-- Remington's Pharmaceutical Sciences. 21st Edition, Vol. I & II.
4. Rawling-- Bentleys T.B. of Pharmaceutics.
5. Lockhart-- Packaging of Pharmaceuticals and healthcare products
6. D A Dean, E R Evans --Pharmaceutical Packaging Technology
7. Swarbrick & Boyan -- Encyclopedia of Pharm. Tech.
8. Banker & Rhodes-- Modern pharmaceutics.
9. S J Turco-- Sterile dosage forms
10. Liberman H. A. and Leon Lachman. Pharmaceutical dosage forms: - Parenteral Medications. Vol. 1, 2 and 3. Second edition, Marcel Dekker.
11. C. V. S. Subrahmanyam. Text Book of Physical Pharmaceutics. Second edition, Vallabh prakashan.
12. B. M. Mithal. A text book of Pharmaceutical Formulation. Sixth edition, Vallabh prakashan.
13. Official Books such as I.P., B.P., B.P.C., U.S.P.
14. Niazi. Handbook of Pharmaceutical manufacturing formulations. (Vol. 1-6)
15. Deasy. Microencapsulation and related drug processes.
16. E.A. Rawlin. Bentley's textbooks of Pharmaceutics. Eighth edition. Elsevier publication.
17. Michael E. Aulton. Aulton's Pharmaceutics. The design and manufacture of medicines. Third edition. Elsevier publication.

T - 4.7.2 Pharmaceutical Chemistry – VIII (Medicinal Chemistry – III)

(Theory) (3Hrs/week)

Discussion of the following classes of drugs including, classification, chemical nomenclature, structure including stereochemistry, generic names, chemistry, physicochemical properties, SAR. Metabolism, molecular mechanism of action, and synthesis, introduction to rational development if any of the class of drugs:

Sr. No.	Topic	Hour
	Section- I	
1	**Sedatives and hypnothics** (mephobarbital, Phenobarbital, pentobarbital, secobarbital, diazepam, nitrazepam*. Oxazepam. Alprazolam. Midazolam, cholorodiazepoxide, choral hydrate, gluthethimde*, zolpidem, zopiclone)	**4**
2	**Anticonsulvants** (Phenobarbital, chlordizepoxide, diazepam, clonazepam*, phenytoin, trimethadione, paramethadione, ethosuximide*, phenosuximide, primidone, sodium valproate, carbamazepine*, progabide, lamotrigine, vigbatrin)	**5**
3	**Antipyschotics** (chlorpromazine*, triflupromazine, thioridazine, fluphenazine, chlorprothixene, loxapine, clozapine, haloperidol*,droperiodol, risperidone*, pimozide, molindone)	**5**
4	**Antidepressants** (imipramine, chlorimipramine, amitryptyline, nortriptyline, doxepine*, fluoxetine*, paroxetine, trazodone, iproniazid, pargline, isocarboxazide, tranylcypromine)	**4**
5	**Antiparkinsons** (carbidopa*, levodopa, selegiline, amantadine, bromocriptine, benzotropine*, procyclidine, trihexyphenidyl, orphenadrine)	**4**
	Section- II	
6	**General Anesthetics** Ketamine hydrochloride, Diazepam	**2**
7	**Local Anesthetics** a. Amino esters – procaine, tetracaine, benzocaine b. Amino amides – lidocaine*, mepivacaine, bupivacaine c. Amino ethers – pramoxine d. Alcohols – Benzyl alcohol, eugenol	**3**
8	**Drugs for Alzheimer's Diseases:** Pharmacological,Psychological, Care giving treatment including Aricept, Exelon, Namenda, Donepezil ,Galantamine ,Rivastagmine , Tacrine ,Memantine and other drugs	**4**
9	**Antiviral agents including HIV** Indoxuridine*, amantadine*,acyclovir, ganciclovir and ribavirin, HIV agents –both nonnucleosides like nevirapine & delaviridine and nucleosides	**6**

	like AZT and protease inhibitors like indinavir, saqvunavir, ritonavir (only highlights of structure). Combination therapy	
10	**Vitamins and Related Compounds** Water soluble & lipid soluble vitamins	**6**
11	**CNS Stimulant** Caffeine, theophylline, Pentoxifyllin, amphetamine*, Dextroamphetamine, methamphetamine, methyphenidate, doxapram, alitrine, phenteramine*	**2**

Total Hours: 45

Reference Books:

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry, 11 th Ed., Eds., John H Block and John M Beale, Lippincott Williams & Wilkins, 2004.
2. Foye's Principles of Medicinal Chemistry, Eds., T. L. Lemke and D. A. Williams, Williams & Wilkins, Baltimore, 2002.
3. Medicinal Chemistry, AshutoshKar, 4 th Edition, New Age International Publishers, 2007.
4. The Art of Drug Synthesis, Eds., Douglas S Johnson and Jie Jack Li, Wiley Interscience, 2007.
5. Pharmaceutical Chemistry, Vol. 1: Drug Synthesis, Eds., H. J. Roth, A. Kleeman, and T. Beissewenger, Ellis Horwood Ltd., 1988.
6. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Vols. 1 to 7, Wiley.
7. Profiles in Drug Synthesis : V.N. Gogte
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. Vogels
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson

P - 4.7.2 Pharmaceutical Chemistry – VIII (Medicinal Chemistry – III)

(Practical) (3Hrs/week)

Minimum Twelve numbers of Experiments should be performed.

***Minor **Major Experiments**

1. Purification techniques of solvents/liquids by Fractional distillation and distillation under vacuum
2. Synthesis of benzil from benzoin*
3. Synthesis of hydantoin from benzil*
4. Toluene –p-sulphonate from toluene –p-sulphonil chloride
5. Dichloramine –T From Toluene –p-sulphonate
6. Chloramine – T from Dichloramine –T **
7. Preparation of Iso-Nicotinic acid (oxidation of picoline with potassium permanganate)*
8. Cyclization reactions: 2-Phenylindole*
9. Benzophenone**(Friedal craft acylation)
10. Acetoacetanilide*
11. 1, 2, 4-triazole**
12. Benzimedazole from o-phenylenediamine*
13. 3H-quinazolin-4-one
14. Esterification (synthesis of nbutylacetatefrom n-butanoland acetic acid)
15. 4-methylcarbostyril from Acetoacetanilide.
16. Reduction reaction: PABA from p nitrobenzoic acid.

Microwave oven synthesis of the following compounds [Ref. 4, 5, 6]

Fluorescein*

Ethyl benzoate*

Phenytoin**

Book Recommended

1. Text Book of Practical Organic Chemistry - A.I. Vogel
2. Practical Organic Chemistry - Mann and Sanders
3. Systematic Identification of Organic Composition, Shriner and Fuson
4. Indian Journal of Pharmaceutical Education and Research, 39 (4) Oct-Dec. 2005, 188-190
5. Organic Synthesis Special techniques V. K. Ahluwalia, Renu Aggrawal, Nerosa publishing house , p. no. 90 - 114
6. Sharma S. V., Badamis S. et al. Indian Drug 40(8) August 2003, 450 – 454

T - 4.7.3 PHARMACOLOGY – III

(Theory) (3Hrs/week)

Sr. No.	Topic	Hour
	Section- I	
01	**CVS: -** a) Diuretics. Types and pharmacology of diuretics and antidiuretics b) Antihypertensives. c) Antianginal. d) Cardiotonics. e) Antiarrhythmics f) Antihyperlipidemics. Drugs acting on blood and blood forming agents g) Coagulants and anticoagulants. h) Hemopoietics. i) Thrombolytics and antiplatelets	**15**
02	**Bioassays: -** a) Concept, merits and demerits, methods, types, bioassay of insulin, digitalis as per official books. b) Biostatics with reference to bioassay.	**05**
03	**Immunopharmacology: -** a) Pharmacology of immunosuppressants. b) Pharmacology of immunostimulants.	**02**
	Section II	
04	**Chemotherapy: -** a) Introduction and molecular basis of chemotherapy. b) Sulphonamides and cotrimoxazole. c) Penicillins and cephalosporins. d) Tetracyclines and chloramphenicol. e) Macrolides, aminoglycosides, polyenes and polypeptids. f) Quinolones and fluoroquinolones. g) Chemotherapy of T. B and leprosy. h) Antifungal antibiotics. i) Antiviral agents and anti HIV agents. j) Chemotherapy of protozoal infections (malaria). k) Chemotherapy of amoebiasis and giardiasis. l) Pharmacology of anthelmintics drug. m) Chemotherapy of cancer.	**23**

Total Hours: 45

P - 4.7.3 Pharmacology - III

(Practical) (3Hrs/week)

MINOR EXPERIMENTS

1. T-test for comparing difference in means between groups by student's t test.
2. To study effects of drugs on dog-blood pressure using EP-DOG software / www.animalsimulator.com
3. Case presentations for any one non-communicable and one communicable disease
4. Cost analysis of prescriptions and concept of Pharmacoeconomics
5. Semi-quantitative determination of C-reactive protein or Rheumatoid factor or any other protein by serial dilution and agglutination method
6. Calculation of sample size using any free online software package and concept of randomization (types with advantages and disadvantages)
7. Detection of sickle cell anemia using solubility test

MAJOR EXPERIMENTS

1. Determination of Na^+ and K^+ concentrations in urine samples using flame photometry or any other suitable technique
2. Determination of effect of anti-cholineasterases on DRC of acetylcholine using any suitable isolated tissue preparation like rat ileum, goat ileum, chick ileum
3. Determination effect of atropine on DRC of Acetylcholine using suitable isolated preparation like rat ileum, goat ileum, chick ileum
4. DNA electrophoresis / protein electrophoresis using pre-extracted / ready samples
5. Micronucleus assay using blood smear microscopy (in cyclophsophamide/ acrolein treated mice)
6. Irwin's Functional observational battery testing for neurobehavioural characterization of test drugs (caffeine/ diazepam/ pentylene tetrazole/ haloperidol)

Demonstration:

1. Determination of glucose absorption through inverted rat/ chick/ goat ileum segment and effect of acarbose on it.

Books Recommended

1. Ghosh M.N. Fundamentals of Experimental pharmacology. Hilton & Company Kolkata 2005 3rd edition
2. Vogel G.H. Drug discovery and evaluation. Springer Germany 2002 2nd edition
3. Goyal R.K. Practicals in pharmacology. B.S. Shah Prakashan Ahmedabad 2005 5th edition
4. Kulkarni S.K. Handbook of Experimental Pharmacology. Vallabh Prakashan. New Delhi, 5th edition
5. Perry W. L. M. Pharmacological Experiments on Isolated preparations.E.&S. LivingstoneLondon 1970,2nd edition
6. Kasture S.B.Text book of Experimental Pharmacology, Career Publication Nashik.1 st edition, 2006

T - 4.7.4 Pharmaceutical Analysis –III

(Theory) (3hrs/week)

Sr. No.	Topic	Hours
	Section-I	
1.	**Basic concepts related to Chromatography :** Introduction, history, Chromatographic selection of methods, classification.	**02**
2.	**Planer chromatography:** **i. Paper chromatography**: Theory, development techniques and applications. **ii. Thin-layer chromatography**: Theory, selection of adsorbent, preparation of plates, spotting, development of chromatogram, detection of compounds, recovery of Components, and applications. **iii. HPTLC:** Introduction, theory and applications	**04** **06** **04**
3.	**Electrophoresis**– Principle, Instrumentation, Various types of Developments	**03**
4.	**Radioimmunoassay and related immunoassay techniques**: ELISA techniques, theory, Instrumentation and applications.	**04**
	Section-II	
5.	**Basic Concepts in Spectroscopy :** Introduction – Electromagnetic radiation, Wavelength, wave number, frequency, absorbance, transmittance, photometers, Spectrophotometers, classification of Spectroscopy, atomic Spectra, molecular spectra.	**03**
6.	**UV – Visible absorption spectroscopy:** Introduction, origin and theory of UV spectra, bathochromic & hypsochromic shift, choice of solvents, Beers Lambert's law, Deviations of Beers law, Single component analysis, use of absorptive value , multiple Component analysis, simultaneous equation method. Difference spectroscopy, derivative spectroscopy, Chemical Derivatization (Colorimetric) Reactions – diazotization, Condensation, acid dye, oxidation. Determination of lambda Max. by Woodward-Fischer rule.	**10**
7.	**Fluorescence spectroscopy :** Introduction, fluorescence spectra, excitation & emission spectra, Instrumentation, Factors affecting fluorescence intensity, quantitative aspects, application of spectroflurimetry and photofluorimetry.	**03**
8.	**Atomic emission and atomic absorption spectrophotometry:** Principle, difference between atomic absorption spectroscopy and flame emission spectroscopy, advantages of AAS over flame emission spectroscopy, limitation, instrumentation of atomic emission and atomic absorption spectroscopy, single and double beam spectrophotometer , pharmaceutical applications of atomic emission and atomic absorption spectroscopy	**06**

Total Hours: 45

Books Recommended:

1. IP, USP, BP, European Pharmacopoeia, International pharmacopoeia
2. Pharmaceutical analysis-Higuchi and brochmann
3. The quantitative analysis of drugs- Garrat
4. Analytical chemistry- Meites H.B.
5. Analytical chemistry- Garry Chrisian
6. Principles of instrumental analysis- Skoog
7. Vogel textbook of quantitative chemical analysis
8. Instrumental methods of analysis- Willard, Dean
9. Instrumental methods of analysis-Ewing.
10. Instrumental methods of analysis- Chatwal and Aanand
11. Practical Pharmaceutical chemistry Vol. II Beckett &Stenlake

P - 4.7.4 Pharmaceutical Analysis –III

(Practical) (3hrs/week)

Sr. No.	Experiments
1.	Identification of Sample by Ascending Paper Chromatography (Minimum Exp. 02)*
2.	Identification of Sample by Radial Paper Chromatography(Minimum Exp. 02)*
3.	Identification of Sample by Thin layer Chromatography (Minimum Exp. 02)*
4.	Calibration of Visible spectrophotometer / Colorimeter and determination of lambda max of drug **
5.	Colorimetric analysis of Excipient/Finished products (At least Three expt.for each)**
6.	Determination of Quinine Sulfate / Riboflavin using Fluorimeter. **
7.	Determination of Na+ and K+ by flame photometry after preparation of calibration curve**
8.	H.P.T.L.C (DEMONSTRATION ONLY)

Minimum 12 experiments should be covered

*** Indicate Minor experiments ** Indicate Major experiments**

Books Recommended:

1. IP, USP, BP, European Pharmacopoeia, International pharmacopoeia
2. Vogel textbook of quantitative chemical analysis
3. Practical pharmaceutical chemistry, Vol II by Beckett and Stenlake
4. Practical Hand Book of Pharmaceutical Analysis- Dr. S.B. Bari, Dr. L. V. Sonawane Nirali Prakashan

T - 4.7.5 Pharmaceutical Biotechnology

(Theory) (3Hrs/week)

Sr. No.	Topic	Hrs.
	Section- I	
1	Biotechnology-Definition, scope and potential (01)	**01**
2	Fermentation technology and industrial microbiology	**02**
	Fermentation as a biochemical process	**03**
	Construction, working and types of fermenter, fermentation monitoring, Downstream processing.	**02**
	Industrial production of Penicillin, Dextran and Vit B12. Waste discharge & effluent treatment	**02**
3	Plant cell and tissue culture Cellular Totipotency, Laboratory and media requirements for establishing in vitro culture.	**02**
	Cell culture techniques –organ, callus, single cell, cell suspension and Protoplast Culture	**03**
	Somatic hybridization and Cybridisation-isolation and fusion of protoplast, selection of hybrids and cybrids and their applications	**03**
	Production of secondary metabolites using hairy root culture, immobilized cell culture and elicitor-induced accumulation. Introduction to germplasm conservation	**03** **02**
	Number of lectures	**23**
	Section- II	
4	Animal cell culture Introduction to animal cell culture, media, Culture techniques and Types of animal cell culture, Application of animal cell culture.	**05**
5	Genetic recombination of animal cells Steps in genetic recombination, Endonucleases, Vectors, Strain construction and Gene transfer methods.	**04**
6	Biotechnological production of-(1) human Insulin,(2) Human growth hormone and (3)Interferons. Impurities in bioproducts.	**05**
7	Principle and applications of polymerase chain reaction (PCR), gel electrophoresis, peptide mapping, protein sequencing, HPLC and Immunoassays(RIA and ELIZA)	**05**
8	Principle and application of Blotting techniques Northern blotting, Southern blotting, Dot blotting, Colony and plaque hybridization.	**03**
	Number of lectures	**22**

Total Hours - 45

Books:

Books Recommended

1. U.Satyanarayana,Biotechnology, Books and Allied (P) Ltd Ist Edition, 2006,Kolkatta.
2. Bainse William, Biotechnology from A to Z, 2nd Edition, 2002, Oxford University Press.
3. Casida L. E., Industrial Microbiology, 2000, New Age International, Delhi.
4. P.H.Agarkar et al ,Biochemistry, Basic and Applied, Nirali Prakashan, IVth Edition,Pragati B**ooks** Pune.
5. De Kalyan Kumar, Plant Tissues Culture, 1st Edition, 1997, New Central Book Agency (P) Ltd.
6. Disouza J. I., Killedar S. G., Biotechnology and Fermentation Process, Nirali Prakashan
7. Freifelder David, Molecular Biology, 2nd Edition, 1998, Narosa Publishing House.
8. Gupta P. K., Elements of Biotechnology, 1st Edition, 2001, Rastogi Pub., Meerut.
9. Higgins, Best D.J. and Jones J., Biotechnology: Principles and Applications, Blackwell Scientific Publications, Boston, MA 1985.
10. Hugo W. B., Russell A. D., Pharmaceutical Microbiology, 6th Edition, 1998
11. Razdan M.K., An introduction to plant tissue culture, Oxford & IBH Pub., Co. Pvt. Ltd, New Delhi
12. Badlsametal: cosmetics science & technology Vol. I, II, III, ED: Willey Intervcine.
13. W. A. Poucher: Perfumes, cosmetics, & soaps Vol. I. II. III. Ed: Champman & Hall.
14. Indian standard Institution booklets.
15. Booklet: Pharmaceutical analysis.
16. A. H. Backett & J. B. Stanlake: Practical pharmaceutics Chemistry
17. www.chemist corner.com
18. www.specialchem.com

T - 4.7.6. Pharmaceutical Industrial Management

(Theory) (3 hrs/week)

Sr. No.	Topics	Hrs.
	Section- I	
1.	**Introduction to Management** Types of management, Basic concepts of management, Management process , function and principles, Levels of management, Pharmaceutical Management –Art , science or profession Social responsibilities of management, Functions of management	**05**
2.	**Planning , and Forecasting** Planning - Nature, process and types of planning, Steps in planning process, Planning premises, Advantages and limitations of planning. Management by Objective Meaning ,objective ,features , advantages and limitations Forecasting - Meaning , nature importance limitations Techniques of forecasting	**06**
3.	**Organization** Definition , nature , Theories , functions, Line and staff organization concepts	**04**
4.	**Communication** Nature, Types of communication Process, channels and barriers of communication, Importance in pharmaceutical industries, Limitations of communications.	**03**
5.	**Leadership and Motivation** Leadership: Meaning, nature , leadership styles , theories of leadership, Motivation Meaning, nature , importance , theories of motivation	**04**
	Section- II	
6.	**GATT** (General Agreement on Tariff and Trade) and its impact on pharmaceutical industry: History of GATT, Its impact on pharmaceutical industry, Pharmaceutical market in India.	**03**
7.	**World Trade Organization (WTO) and Trade Related Intellectual Property Rights (TRIPS)** Introduction to WTO, Types of intellectual property rights: Industrial property and copy rights. Indian Patent Acts, 1970 with amendment -2002 Definition, types of patents, Patentable invention, Patent Application process., Complete and provisional specifications,	**07**
8.	**Quality Assurance-** GMP, CGMP, GLP, TQM, Quality review and quality documentation Validation: Validation of process, equipments and validation of analytical procedure.	**05**
9.	**Statistics & statistical quality control:-** Statistics in Q.C., definition of terms, normal. Statistics in Q.C., definition of terms, normal distribution, *t*-test, *f*-test, linear regression, correlation coefficient. Methods of statistical analysis as applied to sampling & interpretation of results, regression lines, sampling procedures .	**03**

10.	**Standard Institutions and Regulatory Authorities** Bureau of Indian standards (BIS) International Organization for Standardization (ISO). United States of Food and Drug Administration (USFDA) Central Drug Standard Control Organization (CDSCO) International Conference on Harmonization (ICH); World Health Organization (WHO) Ministry of Health, Labour and Welfare(MHLW)	**05**

Total Hrs: - 45

Books:-

1. Management a Global Perspective by Heinz Weihrich and Harold Koontz; 10th edition; Mc Graw Hills, New Jersey 1994.
2. Management Theory and Practice by C.B. Gupta ; 9th edition ; Sultan Chand and Sons Educational publishers , New Delhi 2006.
3. What everyone should know about patents? by N. Subbaram ; 2nd edition Pharma Book syndicate , Hyderabad 2003
4. Human Resource management A contemporary Perspective by Ian Beardwell , lenHolden ,1st edition Mac Millan Indian Ltd New Delhi 2001.
5. Forensic Pharmacy by B.S. Kuchekar et.al; Nirali Prakashan, Pune 4th edition 2004.
6. Pharmaceutical Quality Assurance by M.A.Potdar; Nirali Prakashan, Pune 2nd edition 2007.

Semester VIII

T - 4.8.1 Pharmaceutics –IX

(Theory) (3Hrs/week)

Sr. No.	Topics	Hrs.
	Section- I	
1.	**Introduction to Targeted drug delivery systems:** Introduction, Advantages, disadvantages, classification, pharmaceutical applications, Stability, and storage of following systems such as - **Nanoparticles**: concept of polymeric nanoparticles, solid lipid nanoparticles {SLNs}, Nanostructured lipid carriers {NLCs}, and Lipid drug conjugate nanoparticles {LDC}. **Liposomes, Niosomes, Resealed erythrocytes. Dendrimers, Parenteral implants, and osmotic pumps.** (No details to be taught)	**12**
2.	**Ocular drug delivery system:** Definition, Introduction. Anatomy and Physiology of the eye. Conventional ocular drug delivery. Composition of tears. Mechanism of ocular drug absorption {Corneal & Non corneal}.Role of polymers in ocular drug delivery system. Mucoadhesives, Ocular Inserts – objective, non erodible {ocuserts and contact lens} and erodible inserts {lacriserts, SODI, minidisc}. Evaluation of inserts.	**05**
3.	**Transdermal drug delivery system:** Definition, Introduction, advantages and disadvantages, anatomy and physiology of skin, Percutaneous absorption, basic components, drug selection criteria for transdermal drug delivery system, approaches, evaluation of adhesives and *in vitro, ex vivo* and *in vivo* evaluation of transdermal patches.	**06**
	Section- II	
4.	**Gastroretentive drug delivery system:** Anatomy and Physiology of GIT, Advantages and disadvantages Model drug selection criteria. Formulation approaches for GRDDS {effervescent and non effervescent systems}, *in vitro* and *in vivo* evaluation techniques.	**04**
5.	**Colon-specific drug delivery system:** Introduction. Anatomy and Physiology of colon. Model drug selection criteria for colonic drug delivery system. Formulation approaches of colon specific drug delivery. Evaluation of colonic drug delivery system.	**04**
6.	**Mucosal drug delivery system:** Anatomy and Physiology of oral human mucosa, Trans and Para cellular permeation, Permeability enhancers. Brief discussion on buccal and sublingual drug delivery systems, *in vitro* and *in vivo* evaluation techniques.	**04**
7.	**Pulmonary drug delivery system: -** Structure and function of pulmonary system, Dosage forms: Nebulizers, pressurized inhalation aerosols, aerosol powder.	**03**
8.	**Nasal:** Anatomy and physiology of nasal mucosa, penetration Enhancers, formulation development, *in vitro, ex vivo* and *in vivo* methods of evaluation.	**04**
9.	**Intrauterine and Intravaginal drug delivery system**: Physiology, Development of intrauterine devices (IUDs), copper IUDs. Vaginal rings.	**03**

Total Hours: 45

P - 4.8.1 Pharmaceutics –IX

(Practical) (3Hrs/week)

Note: Conduct any 15 experiments from following list. A) Products may be assayed to evaluate accuracy in regular practical. Formulation and evaluation should consider as separate experiment. Many times evaluation is not completed in 3 hrs, conduct evaluation in slots of 3 hrs and designate each experiment as separate experiment. All evaluation aspects are not to be given to the students in University examinations by considering time.

B) Formulation of different dosage forms should give stress on raw material specifications, preformulation, process controls, and documentation.

C}Concerned faculty members are requested to take the help of various recently published research papers from national & international well reputed journals in designing and evaluating following listed experiments.

1. Introduction to Novel drug delivery system.
2. Formulation of nanoparticles by suitable technique.
3. Evaluation of prepared nanoparticles.
4. Formulation of ocular inserts.
5. Evaluation of prepared ocular inserts.
6. Formulation of transdermal patch.
7. Evaluation of prepared transdermal patch.
8. Formulation of floating tablets.
9. Evaluation of prepared floating tablets.
10. Dissolution study of marketed sustained release tablets.
11. Dissolution study of marketed enteric coated tablets.
12. Formulation of gels.
13. Diffusion study of gels.
14. Rheological study of gels. {Viscosity determination}
15. Effect of concentration of effervescent agents on floating lag time.
16. Effect of polymer concentration on drug release in floating tablets.
17. Effect of polymer concentration on swelling in floating tablets.
18. Formulation of gel by ion induced gelation technique.
19. Evaluation of gel prepared by ion induced gelation technique.
20. Formulation of gel by temperature induced gelation technique.
21. Evaluation of gel prepared by temperature induced gelation technique.
22. Formulation of gel by pH induced gelation technique.
23. Evaluation of gel prepared by pH induced gelation technique.

Book Recommended for Theory & Practical's:-

1. Dr. D. T. Baviskar. Novel drug delivery system. First edition. Nirali Prakashan.
2. Alfanso R. Gennaro-- Remington's Pharmaceutical Sciences. 21st Edition, Vol. I & II.
3. Yie W. Chien. Novel drug delivery systems. Second edition. Marcel Dekker Vol. 50.
4. Vicent H.L. Controlled drug delivery system. Second edition. Marcel Dekker. Revised and Expanded by J. R. Robinson and Vincent H. L. Lee. Vol- 29.
5. E.A. Rawlin. Bentley's textbooks of Pharmaceutics. Eighth edition. Elsevier publication.
6. Michael E. Aulton. Aulton's Pharmaceutics. The design and manufacture of medicines. Third edition. Elsevier publication.
7. N.K. Jain. Controlled and novel drug delivery. First edition. CBS publishers.
8. N.K. Jain. Advances in Controlled and novel drug delivery. First edition. CBS publishers.
9. Vyas S P & Khar R K: Targeted & controlled drug delivery. Novel carrier systems. First edition. CBS publishers.
10. Robinson, J.R. & Lee, V.H.I.: Controlled and Novel Drug Delivery Marcel Dekker, New York.
11. Morton Rosoff; Controlled release of drugs; VCH Publishers.
12. Osborne, and Amann; Topical drug delivery formulations; Marcel Dekker.
13. Barry: Dermatological formulation; Marcel Dekker
14. Robinson; Novel Drug Delivery systems; Marcel Dekker
15. P. Johnson and J. G. Lloyd – Jones; Drug delivery systems; VCH Publisher
16. P. Tyle and B. P. Ram; Targeted therapeutics systems; Marcel Dekker.
17. C.G. Wilson & N. Washington; Physiological Pharmaceutics; Ellis Horwood Limited.
18. H.S. Bean, A.H. Beckett, and J.E. Carless; Advances in Pharmaceutical Sciences; Vol. 5, Academic Press.
19. R. O. Potts, and R.H. Guy; Mechanisms of transdermal drug delivry; Marcel Dekker
20. T.J. Roseman and S.Z. Mansdorf; Contolled release delivery systems; Marcel Dekker
21. A.J. Hickey; Pharmaceutical Inhalation Aerosol Technology; Marcel Dekker.
22. J. Kreuter; Controlled drug delivery system; Marcel Dekker
23. Pharmaceutical Dissolution Testing, U.V.Bankar, Mercel Decker Inc.
24. Kydonieus Agis. Treatise on Controlled drug delivery. Fundamentals. Optimization. Applications. Marcel Dekker.

T - 4.8.2 Pharmaceutical Analysis –IV

(Theory) (3hrs/week)

Sr. No.	Topic	Hours
	Section-I	
1.	**Column Chromatography:** Principle, Column packing, techniques, application, theory, Efficiency of column, Capacity factor and other Performance parameters	**02**
2.	**Gas chromatography :** Introduction, carrier gases , columns, injection system, detectors, thermal conductivity detectors (TCD), electron capture detector(ECD),thermo-ionic detector(TID), flame ionization detector(FID), nitrogen phosphorus Detector (NPD), photo-ionization detector(PID), head space analysis, applications, programmed temperature gas chromatography(PTGC)	**06**
3.	**HPLC:** Instrumentation, pumps (reciprocating pumps, displacement & pneumatic pumps), mobile phase reservoirs, solvent treatment systems, isocratic elution, gradient elution, injection system. Detectors, photometric detectors (single wavelength, multi wavelength, variable wavelength, diode array, fluorescence detectors), refractive index detectors, electrochemical detectors. Columns: analytical columns, guard columns, column thermostats, types of column packaging, Introduction of UPLC (Ultra Pressure Liquid Chromatography)	**06**
4.	**Ion exchange and Ion Pair chromatography:** Principle, Ion exchange resins, applications.	**03**
5.	**Gel permeation chromatography: -** Introduction, apparatus & techniques.	**03**
6.	**Flash Chromatography**	**01**
7.	**Hyphenated Techniques GCMS, LCMS (Interfaces and Applications only).**	**02**
	Section-II	
8.	**Infrared spectroscopy:** Introduction, range of IR radiation, Requirements of IR radiation, correct wavelength of radiation, electric dipole, theory of IR absorption spectroscopy, modes of vibration of atoms in polyatomic molecules-stretching vibration, bending vibration, types of stretching and bending vibration, interpretation of IR spectra, quantitative analysis, routine maintenance – dispersive and FT-IR instruments, instrumentations-single beam, double beam spectrophotometer, applications to pharmaceuticals, limitations of IR spectrophotometry.	**06**
9.	**NMR spectroscopy: -** Introduction to NMR, basic principles involved, instrumentation, chemical shift, Factors affecting Chemical shift spin-spin coupling, applications, quantitative analysis.	**06**
10.	**Mass spectroscopy: -** Principles & theory, instrumentation, application of mass spectroscopy, Mass spectroscopy-mass spectroscopy (MS-MS).	**05**

11.	**X- ray diffraction** Laue photographic method, Bragg's X-ray spectrophotometry, Rotating crystal methods, Powder method.	**02**
12.	**Structural elucidation problems based on IR, NMR, Mass spectroscopy (simple problems with molecular formula given)**	**03**

Total Hours: 45

Books Recommended:

1. IP, USP, BP, European Pharmacopoeia, International pharmacopoeia

2. Pharmaceutical analysis-Higuchi and brochmann

3. The quantitative analysis of drugs- Garrat

4. Analytical chemistry- Meites H.B.

5. Analytical chemistry- Garry Chrisian

6. Principles of instrumental analysis- Skoog

7. Vogel textbook of quantitative chemical analysis

8. Instrumental methods of analysis- Willard, Dean

9. Instrumental methods of analysis-Ewing.

10. Instrumental methods of analysis- Chatwal and Aanand

11. Practical Pharmaceutical chemistry Vol. II Beckett &Stenlake

P - 4.8.2 Pharmaceutical Analysis –IV

(Practical) 3hrs/week

Sr. No.	Experiments
1.	Calibration of UV- spectrophotometer and determination of lambda max of drug *
2.	UV-Spectrophotometric analysis of Raw materials / Finished products (At least Three expt. each)**
3.	To determine the effect of pH upon the Absorption Spectrum of Sulphanilamide.*
4.	To determine the effect of Solvent upon the Absorption Spectrum of Phenol.*
5.	To show the typical Pyridine absorption in Nicotinamide comparing with benzoic acid*
6.	Separation and identification of sample by Column Chromatography **(At least Two expt.)
7.	Assay of caffeine and sodium benzoate injection by simultaneous equation method And absorbance ratios method.
8.	To determine the structure of compounds by F.T.I.R (At least Two compounds)
9.	H.P.L.C (DEMONSTRATION ONLY)
10.	G.C. (DEMONSTRATION ONLY)

Minimum 12 experiments should be covered

*** Indicate Minor experiments ** Indicate Major experiments**

Books Recommended:

1. IP, USP, BP, European Pharmacopoeia, International pharmacopoeia
2. Vogel textbook of quantitative chemical analysis
3. Instrumental methods of analysis-Ewing
4. Instrumental methods of analysis- Chatwal and Aanand
5. Practical pharmaceutical chemistry, Vol II by Beckett and Stenlake

T - 4.8.3 Pharmaceutical Chemistry –IX (Medicinal Chemistry- IV)

(Theory) (3Hrs/week)

Sr. No.	Topic	Hour
	Section- I	
1	**Quantitative approaches to structure–activity Relationships** Introduction, Descriptors: Biological and physicochemical descriptors; Topliss tree and Craig plot, Determining relationships between chemical and biological data (QSAR methods): The Hansch approach, Free-Wilson analysis and related methods, Partial least squares (PLS),Linear discriminant analysis (LDA) Principal component analysis (PCA), Cluster analysis. Introduction to 3D-QSAR, Introduction to CADD: energy minimization, Quantum Mechanics, Molecular Mechanics.	**7**
2	**Designing Prodrugs And Bioprecursors** General Introduction, The Carrier-Prodrug Principle, The Bioprecursor-Prodrug Principle, Practical Applications of Prodrug Design, Carrier Prodrugs: Improvement of the bioavailability and the biomembrane passage, Site-specific delivery, Prolonged duration ofaction, Use of Cascade Prodrugs and Soft Drugs Bioprecursor Prodrugs: Oxidative Bioactivations, Reductive Bioactivations, Mixed Bioactivation Mechanisms.	**4**
3	**Diureties** a) Site 1 Carbonic: anhydrate inhibitors acetazolamide*,methazolamide. b) Site 2 High ceiling or loop diuretics is sulfamoylanthranilicacids like furosemide*, azosemide and bumetanideinphenoxyacetic acids ethacrynic acid* c) Site 3 Thiazideand Thiazide like diuretics d) Site 4 Potassium sparing diuretics such as spironoloactone triamterene and amiloride	**4**
4	Steroids – Configuration 5 α and 5 β cholestane, conventional formula and conformational representation. Reactions in ring A & B of steroids – conformation and chemical reactivity, addition, elimination, epoxide opening, relative rates of esterification and oxidation of epimeric alcohols and reduction of ketones, rearrangement reactions, Medicinal chemistry of steroids: Sex hormones (androgens like testosterone and its esters: estrogens like estradiol, ethinyl estradiol and mestranol: progestines like medroxy progesterone acetate, megesterolacetate, norethindrone and norgestrel), anabolic steroids like danazol, stanozolol and androizoxazole: non steroidal estrogens like diethylstilbestrol and cholotrianisene, antiestrogens like tamoxifen and clomiphene, corticoids and steroidal anti iflammatory like cortisone, hydrocortisone, prednisolone, dexamethasone, betamethasone and triameinolone.	**08**

	Section- II	
5	**Antihistaminics, Antiemetics and antiulcer drugs** Antihistamines H1, H2 receptors. Emphasis to be on the secondgeneration H1 antagonists such as fexofenidine, astemazole, loratidinecetrizine and acrivastine, H2 receptor antagonist like cimetidine*, ranitidine, famotidine, nizatidine, proton pump inhibitors like omeprazole and lansoprazole.	**5**
6	Analgesics (opioids) (morphine, codeine, levophanol, dextromethorphan, phenazocine, pentazocine, meperidine*, α and β prodine, pheniridine, anileridine, fentanyl, methadone*, phenadoxone, racemoramide, dextropropoxyphene*, nalorphine, naloxone, naltrexone)	**6**
7	NSAID's (aspirin, paracetamol, phenylbutazone*, oxyphenbutazone, indomethacine, sulindac, mefenamic acid, ibuprofen, naproxen*, ketoprofen, nabumetone, diclofenac*, nimesulide, celecoxib, rofecoxib, piroxicam*, colchicines, sulfinpyrazone, allopurinol).	**6**
8	Hypoglycemics (Insulin not to be discussed) 1. Biguanides e.g. metformin b. Sulfonylurea's 1st Generation like tolbutamide *, cholorpropamide, tolazamide and acetohexamide: 2nd Generation like glyburide, glypizide, 3 rd Generation like glimepride and repaglimide. 2. Thiazolidinediones such as troglitazone, ciglitazone, rosiglitazone and pioglitazone 3. β – Glycosidase inhibitors like acarbose, voglibose and miglitol.	**5**

Total Hours: 45

Reference Books:

1. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical Chemistry,11 th Ed., Eds., John H Block and John M Beale, Lippincott Williams & Wilkins, 2004.
2. Foye's Principles of Medicinal Chemistry, Eds., T. L. Lemke and D. A. Williams,Williams& Wilkins, Baltimore, 2002.
3. Medicinal Chemistry, AshutoshKar, 4 th Edition, New Age International Publishers,2007.
4. The Art of Drug Synthesis, Eds., Douglas S Johnson and Jie Jack Li, WileyInterscience, 2007.
5. Pharmaceutical Chemistry, Vol. 1: Drug Synthesis, Eds., H. J. Roth, A. Kleeman, andT. Beissewenger, Ellis Horwood Ltd., 1988.
6. The Organic Chemistry of Drug Synthesis, Daniel Lednicer, Vols. 1 to 7, Wiley.
7. Profiles in Drug Synthesis : V.N. Gogte
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. Vogels
11. Practical Organic Chemistry - Mann and Sanders
12. Systematic Identification of Organic Composition, Shriner and Fuson

P - 4.8.3 Pharmaceutical Chemistry –IX (Medicinal Chemistry- IV)

(Practical) (3Hrs/Week)

Minimum Twelve numbers of Experiments should be performed.

***Minor **Major Experiments**

1. Determination of partition coefficient, dissociation constant, molar refractivity of compound from QSAR analysis (DEMONSTRATION)
2. Methyl Salicylate**
3. Paracetamol*
4. Phenacetin*
5. Aspirin*
6. Acetylglycine*
7. 4-benzylidene-2-methyloxazole-5-one**
8. Benzoglycine form Benzoyl chloride*
9. 4-benzlidene -2-phenyloxazole- 5-one**
10. Phthalaldehydic acid from Naphthalene**
11. *p*-Methylacetophenone*
12. 3,5-dinitrobenzoic acid from benzoic acid**
13. Benzanilide from Benzophenone**
14. m-nitrophenol from m-nitro aniline

Book Recommended

1. Text Book of Practical Organic Chemistry - A.I. Vogel
2. Practical Organic Chemistry - Mann and Sanders
3. Systematic Identification of Organic Composition, Shriner and Fuson
4. Indian Journal of Pharmaceutical Education and Research, 39 (4) Oct-Dec. 2005, 188-190
5. Organic Synthesis Special techniques V. K. Ahluwalia, Renu Aggrawal, Nerosa publishing house , p. no. 90 - 114
6. Sharma S. V., Badamis S. et al. Indian Drug 40(8) August 2003, 450 – 454

T- 4.8.4 Pharmacognosy – VI

(Theory) (3Hrs/Week)

Sr. No.	Topic	Hour
	Section- I	
01	World-wide trade in medicinal plants and their derived products with special reference to diosgenin (dioscorea), Taxol (Taxus sps) ,digitalis, tropane alkaloid containing plants, Papain, cinchona, Ipecac, Liquorice, Ginseng, Aloe, Valerian, Rauwolfia and plants containing laxatives. Role of medicinal and aromatic plants in national economy.	**08**
02	A brief account of plant based industries and institutions involved in work on Medicinal and aromatic plants in India. Utilization and production of phytoconstituents such as caffeine, quinine, calcium sennoside, podophyllotoxin, diosgenin, solasodine, and tropane alkaloids.	**10**
03	**Indian trade in aromatic plants-** Utilization of aromatic plants and derived products with special reference to Sandalwood oil, mentha oil, lemon grass oil, vetiver oil, geranium oil and Eucalyptus oil.	**05**
	Section-II	
04	**Herbal cosmetics-** Brief study of Phytocosmetics of industrial significance. Herbs used for different cosmetic preparations	**04**
05	**Quality control & standardization of herbal drugs** a. Quality control of herbal drugs as per AYUSH and Pharmacopoeial standards. b. WHO Guidelines for the assessment of Crude Drugs and extract including Pharmacognostical, Physical and chemical analysis. c. WHO Guidelines for the assessment of herbal formulation by chemical and spectral analysis. d. Study of different chromatographic methods and their applications in evaluation of Herbal drugs and formulation. e. Qualitative and Quantitative estimation of active principles from herbal Extracts by HPTLC and HPLC). f. Analysis of heavy metals & microbial contamination.	**15**
06	**Global Regulatory Status and Patenting of herbal Medicines.**	**03**

Total Hours: 45

Book recommended

1. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
2. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree) Nirali Prakashan
3. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
4. Brain K. R. and Turner T. D., The practical Evaluation of phytopharmaceuticals, Wright-Scientechnica, Bristil.
5. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
6. Pulok Mukharji, Quality control of Herbal drugs.
7. Pharmacopoeia of India, 1985,1996, Govt. of India, Ministry of Health and Family Welfare.
8. Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne, U.K.
9. Tyler, V.E., Brady, R., Pharmacognosy
10. Wagner, S.B., Zgainsky, Plant drug Analysis.
11. V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II.

P - 4.8.4 Pharmacognosy – VI

(Practical) (3Hrs/Week)

*** Minor experiments**

**** Major experiments**

1. Isolation of some selected phytoconstituents studied in theory**.
2. Analysis of volatile oils *(estimation of Phenols OR and aldehyde, OR and ketone etc.) and their chromatographic profiles**.
3. Preparation of herbal skin and hair care cosmetics**
4. Standardization of herbal crude drugs & extract by physical *& chemical parameters** (Estimation of total tannins, OR and total phenolics, OR and flavonoid, OR and carbohydrates OR and alkaloids OR and sterols OR and triterpenoid, content etc.)
5. Preparation & Standardization of different Herbal formulation** (Ex. Tablet or syrup).

Book recommended

1. Horborn J. B. Phytochemical methods, Chapman and Hall, International Edition, London.
2. Kokate C. K. Purohit A. P. and Gokhale S. B. , Pharmacognosy (degree) Nirali Prakashan
3. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
4. Brain K. R. and Turner T. D., The practical Evaluation of phytopharmaceuticals, Wright-Scientechnica, Bristil.
5. Guenther, E, Me, Essential oils-4 D Van Nostrand CO Inc, New York.
6. Pulok Mukharji, Quality control of Herbal drugs.
7. Pharmacopoeia of India, 1985,1996, Govt. of India, Ministry of Health and Family Welfare.
8. Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne, U.K.
9. Tyler, V.E., Brady, R., Pharmacognosy
10. Wagner, S.B., Zgainsky, Plant drug Analysis.
11. V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II.
12. British Herbal Pharmacopoeia
13. Herbal Pharmacopoeia, IDMA, Mumbai
14. A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors
15. Herbal drugs industry by R.D. Chaudari.
16. Natural Products, A Laboratory Guide – Raphael Ikan – Academic Press
17. Quality Control Methods for Medicinal Plants – WHO, AITBS Publication.
18. Raphael Ikon, Natural products a laboratory Guide, Academic Press
19. Clarke ECG, Isolation and Identification of Drugs, The Pharmaceutical Press, London
20. Export potential of selected medicinal plants, prepared by basic chemicals pharmaceuticals and cosmetic export promotion council, Bombay, and other reports.
21. Martindale, the extra pharmacopoeia, pharmaceutical society of great Britain London.
22. Kokate C. K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
23. Official Methods of Analysis, Association of Official Analytical Chemists publication, Washington.
24. Pharmacopoeia of India, 1985, 1996, Govt. Of India, Ministry Of Health and Family Welfare.
25. Peach K, and Tracey M. V., Modern methods of plant analysis, 1-4, Narosa Publishing house, New Delhi

T - 4.8.5 Pharmacology – IV (Clinical Pharmacy and Drug Interactions)

(Theory) (3Hrs/Week)

Sr. No.	Topic	Hour
	Section- I	
01	**Drug development process: -** a) Introduction b) Various approaches to drug discovery. c) Preclinical evaluation (acute, sub acute, chronic toxicity, ADME, Therapeutic index). d) Clinical evaluation. **e)** IND application	**05**
02	**Drug interactions: -** a) Introduction, types, classification, basic concept of mechanism. b) Drug interactions and role of pharmacist in minimizing drug interactions.	**04**
03	**Drug induced diseases: -** a) Introduction b) Drug induced diseases by systems and various categories of drug lead to diseases and disorder- dermatological, hepatic, gastrointestinal, haematological, ototoxicity, ocular, pulmonary, renal, and teratogenecity effect.	**04**
04	**Therapeutic drug monitoring:** a) Introduction, definition, indications, protocol, pharmacokinetic/ pharmacodynamic correlation in drug therapy. b) TDM of drugs used in following disorders- CVS, seizure, psychiatric, organ transplantation. c) Role of clinical pharmacist in TDM	**04**
05	**Adverse drug reaction monitoring: -** a) Introduction, definition, types of ADR, predisposing factors lead to ADR, detection, management, reporting and role of clinical pharmacist in preventing ADR. b) Pharmacovigilance: Introduction, definition, reporting of ADR to pharmacovigilance centres.	**05**
	Section II	
06	**Medication errors: -** a) Introduction, definition, types, documentation and publication, causes, identification, reduction/prevention, role of clinical pharmacist in reducing medication errors.	**05**
07	**Drug utilisation evaluation:** a) Introduction, definition, types, objectives, establishment, phases and steps involved in conducting DUE study, Importance, example of any one category of drug for improvement in its safer use, role of clinical pharmacist in DUE.	**05**

08	**Essential and rational drug used:** a. Introduction, definition, Essential drug concept. b. irrational use of drug, reasons and hazards, rational drug use and prescribing, obstacles and steps for improvement, guidelines for rational prescribing for antibiotics, injections and OTC drugs, the pharmacist role in rational drug use.	**05**
09	**Pharmacoeconomics:** Introduction, definition, history, misconceptions, scope and need, types, advantages and disadvantages, guidelines for conduction or evaluation.	**04**
10	**Pharmacoepidemiology:** Introduction, definition, history, different models, scope and need, types, advantages and disadvantages, guidelines for conduction or evaluation.	**04**

Total Hrs: - 45

Books Recommended:

1. Bennett P.N, Brown M.J. Clinical Pharmacology Churchill living stone New Delhi 2003 9th edition
2. Melmon & Morrelli's Clinical Pharmacology. Mc-Graw Hill. New Delhi 2000 4th edition
3. Craig C.R, Stitzel R.E. Modern Pharmacology with Clinical application, Lippincott Williams & Wilkins, New York 2004 6th edition
4. Raymond J.M. Niesink, John de vries. Hollinger M.A. Toxicology- Principle and applications, CRC, Florida
5. Klaassen C.D, Casarett & Doull's. Toxicology. The basic science of poison Mc-Graw Hill, New Delhi 6th ed
6. Remington's Pharmaceutical Science and practice pharmacy .Lippincott Williams and Wilkins, New Delhi
7. 2004, 20th edition
8. Katzung B.G. Basic & Clinical Pharmacology. Mc-Graw Hill, New Delhi 2001 8th edition
9. Clinical pharmacy practice - C. W. Blissit
10. Therapeutic drug monitoring - B. Widdop
11. TDM & Clinical biochemistry – Mike Hallworth
12. Textbook of therapeutics, Drug & disease management - 7th edition - Eric T. Herfindel, Dick. R. Gourley
13. Recent developments in TDM & Clinical toxicology – I. Sunshine - Marcel – Dekker 1992
14. Handbook of TDM. – Simkin
15. Parrthsarthi G, Hansen Kavin Nytort & Nahata Milap C. A Textbook of Clinical Practice: Essential Concepts & skills, Orient Longman.
16. Roger walker, Clive Edwards, Clinical Pharmacy & therapeutics, 3rd International Edition, Churchill Livingstone.
17. Dr. Tipnis H. P, Dr. Bajaj Amrita, Clinical Pharmacy, Career Publication

T - 4.8.6.1 Pharma Marketing (Elective)

(Theory) (3 hrs/week)

Sr. No.	Topics	Hrs.
	Section- I	
1.	**Marketing:** Meaning, concepts, importance and emerging trends; Marketing environment; Industry and competitive analysis, Indian Pharmaceutical Industry; Analysing consumer buying behaviour; industrial buying behaviour, Pharmaceutical market segmentation & targeting.	**09**
2.	**Product Decision-** Meaning, Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and labeling decisions, Product management in pharmaceutical industry.	**09**
3.	**Pricing-** Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).	**09**
4.	**Pharmaceutical marketing channels:** Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.	**07**
5.	**Promotion-** meaning and methods, determinants of promotional mix, promotional budget; an overview - personal selling, advertising, sales promotion and public relations.	**06**
6.	**Strategic marketing planning; Marketing implementation and evaluation.**	**05**

Total Hrs: - 45

Books :

1) Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi

2) Walker, Boyd and Larreche : Marketing Strategy- Planning and Implementation, Tata MC Graw Hill, New Delhi.

3) Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill

4) Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India

5) Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)

6) Ramaswamy, U.S & Nanakamari, S: Marketing Managemnt:Global Perspective, Indian Context,Macmilan India, New Delhi.

7) Shanker, Ravi: Service Marketing, Excell Books, New Delhi

8) Subba Rao Changanti, Pharmaceutical Marketing in India (GIFT – Excel series) Excel Publications.

T - 4.8.6.2 Medicinal Plant Biotechnology (Elective)

(Theory) (3hrs/week)

Sr. No.	Topics	Hours
	Section - I	
1.	Emerging Trends in Medicinal Plant Biotechnology	**02**
2.	Plant Biotechnology- Introduction and Applications	**04**
3.	Plant Tissue culture-Principle and methodology, Culture techniques, Concept of Totipotency, Protoplast culture, protoplast fusion, somatic cell hybridisation, organogenesis, embryogenesis, somoclonal variation	**08**
4.	Plant cell immobilisation and Micropropagation in plants- Principle, methodology and applications.	**05**
5.	Biomedicines from plant tissue culture	**03**
Section-II		
6	Genetic engineering of plants-Gene transfer in Plants, Introduction, transgenic plants, methods used in gene identification. Gene transfer using DNA mediated gene transfer electroporation, micro projectile, macro & micro injection, liposomes, Ultra-sonication & chemical mediated gene transfer, Localization of transfer gene in genetically modified plants, Use of radio isotopes & molecular markers etc Applications of transgenic plants. Germ plasm storage, Gene storage bank.	**08**
7.	Methods of improving quality of plants and their applications- plant breeding, chemodemes, hybridisation, mutation, polyploidy.	**06**
8.	Germ Plasm conservation- **a**. In-situ conservation **b**. Invitro methods of conservation. Cytopreservation and cryopreservation in plant bitechnology-preparation and materials.	**05**
9.	Biotransformation in Medicinal plants-Prospects and challenges.	**04**

Total Hours 45

Books recommended:

1. Vyas S. P. and Dixit V. K., Pharmaceutical Biotechnology, CBS publishers and distributors, New Delhi, First edition (Reprint), 2008.
2. Kumar H. D. A textbook on Biotechnology, Rajkamal electric press, 2nd edition Reprint, 2003.
3. Purihit S.S., Biotechnology fundamentals and applications, Student edition, Jodhour, 2007.
4. Giriraj Kulkarni J, Biotechnology and its application in pharmacy, Jaypee Brothers, New Delhi, first edition, 2007.
5. Ashutosh Kar, Pharmacognosy and pharmacobiotechnology, New age international publishers, 2nd edition, New Delhi.
6. Disouza J. I., Killedar S. G., Biotechnology and Fermentation Process, Nirali Prakashan
7. Gupta P. K., Elements of Biotechnology, 1st Edition, 2001, Rastogi Pub., Meerut.
8. Higgins, Best D.J. and Jones J., Biotechnology: Principles and Applications, Blackwell Scientific Publications, Boston, MA 1985.
9. Kori S. S., Halkai M. A. Pharmaceutical Biotechnology-Fundamentals and applications, First edition Reprint, Vallabh Prakashan, 2003.

T - 4.8.6.3 Quality Assurance (Elective)

(Theory) (3 hrs/week)

Sr. No.	TOPICS	Hrs.
	Section- I	
1.	Introduction to Concepts of quality, quality assurance, GMP & cGMP, QC, IPQC and QA as applied to the pharmaceutical industry.	**04**
2.	**Documentation-** Pharmaceutical Manufacturing documentation (MFR, BMR, Quality control documentation) Quality assurance documentation (SOP, Protocols, reports etc). Storage, retention and retrieval of documents.	**05**
3.	**Good Laboratory Practices (GLP)** :- Regulations, biological evaluation of microbiological limit tests, sterility tests for effectiveness of antimicrobial preservatives, LD50, ED50, teratogenicity, mutagenecity, clinical trials, bioassays, pyrogens and pyrogen testing.	**05**
4.	**Process Validation-** Introduction, Concept of validation, objectives and functions of validation. **Process Validation and its types.** Prospective, concurrent, Retrospective and revalidation. **Sterilization process validation**	**04**
5.	**Equipment Validation**: - Installation qualifications and operational qualification, performance qualification of different equipments like autoclave, oven, and dissolution test apparatus.	**05**
	Section- II	
6.	**Analytical method validation-** Accuracy, precision, linearity, range, LOD, LOQ, Ruggedness, Robustness, Specificity determination for analytical techniques for assay, impurity detection and bioanalysis.	**05**
7	**Cleaning validation-** Introduction, cleansing agents, methods of cleaning, CFR requirements for cleaning validation, factors in cleaning validation, sampling techniques.	**03**
8.	Pilot plant scale up techniques and Technology transfer	**03**
9.	**Regulatory authorities**: TGA, MHRA, USFDA, WHO, ICH	**05**
10.	**Quality by Design -** Design of Experiments, Design space, factorial design, response surface methodology	**06**

Total Hours:-45

Books :

1. Pharmaceutical Quality Assurance, M.A. Potdar, Nirali Prakashan, Pune.
2. Current Good Manufacturing Practices, M.A. Potdar, Pharma-Med Press, Hyderabad.
3. GMP for Pharmaceuticals, 5th Edition, Sidney H. Willing, Marcel Decker Series
4. Regulatory guidelines related to GMP by
    a. Australian code of GMP for medicinal products,16th Aug. 2002.
    b. 21 Code of Federal Regulation, parts 210, 211 & 58. (USFDA guidelines)
    c. MHRA, UK Guidelines on GMP
    d. GMP Guidelines by Medicines Control Council of South Africa Schedule M of D & C Act
5. Assurance of Quality, Pharmaceutical Total Quality Approach, M. S. P. Khan, Chitgaon, Bangladesh, Signet Press-1990
6. Packaging of Pharmaceuticals & Healthcare Products, Lockhard,
7. Pharmaceutical Packaging, F.A.Paine,
8. Quality Control of Packaging Materials in the Pharmaceutical Industry, Kenneth & Harburn, Mercel Decker Inc.
9. Validation of active Pharmaceutical Ingredients by, I.R. Berry and Danie Harpar.
10. Analytical Method validation and Instrument Performance Verification by Churg Chan, Heiman Lam, Y.C. Lee, Yue. Zhang, Wiley Interscience.
11. Guidelines on cGMP and Quality of Pharmaceuticals product by S. Iyer
12. Quality Control of Packaging materials in the Pharmaceutical Industry by Kenneth and Hanbinn, M. Dekker. Inc.

T - 4.8.6.4 Drug Design and Lead Identification (Elective)

(Theory) (3Hrs/Week)

Sr. No.	Topic	Hrs.
1	**Introduction to The Drug Discovery/Development** A. Drug Discovery B. Drug Development C. Source of Drugs D. Structural effects on drug action	06
2	**Approaches to New Drug Discovery** A. Drugs Derived from Natural Products B. Existing Drugs as a Source for New Drug Discovery C. Using Disease Models as Screens for New Drug Leads D. Physiological Mechanisms: the Modern "Rational Approach" to Drug Design E: Approaches to Lead Optimization 1. Bioisosteric replacement 2. Conformation restriction : a) Increase selectivity b) Increase affinity 3. Pharmacophore 4. Molecular dissection 5. Metabolic stabilization	06
3	**Enzymes as Targets of Drug Design** A. Enzyme kinetics (Kimball) B. Enzyme inhibition and activation (Kimball) C. Approaches to the Rational Design of Enzyme Inhibitors	04
4	**Receptors as Targets of Drug Design** A. Receptor Theory B. Receptor Complexes and Allosteric Modulators C. Second and Third Messenger Systems D. Molecular Biology of Receptors F. Receptor Models and Nomenclature G. Receptor Binding Assays H. Lead Compound Discovery of Receptor agonists and antagonists	06
	Section II	
5	**Prodrug Design and Applications (Hu)** A. Definition B. Applications C. Prodrug Design Considerations D. Prodrug Forms of Various Functional Groups 1. Ester prodrugs of compounds containing –COOH or –OH 2. Prodrugs of compounds containing amides, imides, and other acidic NH	07

	3. Prodrugs of Amines 4. Prodrugs for compounds containing carbonyl groups E. Drug release and activation mechanisms 1. Simple one-step activation 2. Cascade release/activation systems F. Prodrugs and intellectual property rights – two court cases	
6	**Computer-Aided Drug Design** A. Docking and virtual screening B. Molecular Dynamics and binding free energy methods	**06**
7	**Combinatorial Chemistry and Microwave Chemistry** A. Introduction: Concepts and Terms B. Solid-phase Strategies C. Solution Phase Strategies D. Microwave Chemistry	**06**
8	**Introduction of Peptides in Drug discovery.** Reactivity of proteins and peptides	**04**

Total 45 Hrs

Reference Textbooks:

1) Kerns, E.H.; Di, L. Drug-Like Properties: Concepts, Structure Design and Methods: from ADME toToxicity Optimization, Academic Press, Oxford, **2008**

2) Burger's Medicinal Chemistry and Drug Discovery, 5th Edition, Vol. 1. Principles and Practice, edited by M. E. Wolff, John Wiley & Sons: New York, **1995.**

3) Principles of Medicinal Chemistry, 4th Edition, edited by W.O. Foye, T.L. Lemke, and D. A.

4) Williams, Williams and Wilkins: Philadelphia, **1995**.

5) Medicinal Chemistry: Principles and Practice, edited by F.D. King, Royal Society of Chemistry: Cambridge, **1994**.

6) A Practical Guide to Combinatorial Chemistry, edited by A. W. Czarnik and S. H. DeWitt, American Chemical Society: Washington DC, **1997**.

T - 4.8.6.5 Bioavailability and TDM (Elective)

(Theory) (3hrs/week)

Sr. No.	Topic	Hrs.
1	**Introduction:** Definition of Bioavailability, bioequivalence, generic drugs, types of BA, methods to determine BA, Hatch max-man act 1971.	04
2	**Application of Biopharmaceutics in BA/BE:** Biopharmaceutical aspects of absorption, distribution, metabolism and elimination, factors influencing bioavailability of dosage forms, methods to determine BA/BE. Bioavailability of highly variable drugs, narrow therapeutic index drugs and poorly soluble drugs. Methods for enhancement of BA.	10
3	**Protocol in BA/BE studies**: Designing of protocol, rationale of the research, selection of subjects. Construction, role and responsibilities of IRB/IEC	03
4	**Conduct of Study:** Design of the study, inclusion and exclusion criteria, sampling point, sampling volume, treatment groups. Documentation in BA/BE -Formation of investigator's information brochure, Case Record Form (CRF), presentation of Results and conclusion.	06
5	**Introduction To Therapeutic Drug Monitoring:** Definition & introduction. Indication for TDM & clinical applications. Monitoring plasma drug levels. Role of Clinical pharmacist in TDM.	05
6	**Techniques Used In TDM** a) Physical methods HPLC, HPTLC, GC b) Immuno assays. RIA, ELISA, EMITH, NIIA	04
7	**Variation of clinical laboratory tests due to drugs : -** Serum Creatinine, blood urea, nitrogen, plasma, glucose, creatine kinase, phosphatase, amylase, bilirubin, serum proteins, globulines, complete blood count & differential blood count	05
8	**Importance of TDM with reference to Adverse Drug Reaction (ADR)**	02
9	**TDM of specific drugs** Clinical pharmacokinetics, general guidelines, sample collection, time of sample collection, clinical comments, clinical monitoring parameters, usual dosing parameters, common toxicities, adverse drug reactions & drug interactions, techniques used for estimation, importance of 1. Digoxin 2. Lithium 3. Phenobarbitone 4. Gentamicin. 5. Theophylline 6. Carbamazepine 7. Lidocaine 8. Phenytoin 9. Valproic acid	06

Total Hours - 45

Reference Books:

1. Dr. Tapan Kumar Pal, M. Ganeshan. Bioavailability and Bioequivalence in Pharmaceutical Technology. CBS Publishers and Distributors
2. Llyod r. Snyder, J. J. Kirkland, J. L. Glajch. Practical HPLC method development. JohnWiley & Sons
3. Peter G. Welling, Francis L. S. Tse, Shrikant V. Dighe. Pharmaceutical Bioequivalence.Marcel Dekker Inc.
4. Jerry L. Hamelink, Peter F. Landrum, Harold L. Bergman, William H. Benson. Bioavailability. Physical, chemical, and biological interactions. Lewis publishers
5. Clinical pharmacy practice - C. W. Blissit.
6. Therapeutic drug monitoring - B. Widdop
7. TDM & Clinical biochemistry – Mike Hallworth
8. Textbook of therapeutics, Drug & disease management - 7th edition - Eric T. Herfindel,Dick. R. Gourley.
9. Recent developments in TDM & Clinical toxicology – I. Sunshine - Marcel – Dekker –1992.
10. Handbook of TDM. – Simkin
11. Therapeutic drug monitoring
12. Clinical pharmacology

T - 4.6.4.6 Cosmoceutics (Elective)

(Theory) (3hrs/week)

Sr. No.	Topics	Hrs.
	Section- I	
1.	Introduction To Cosmaceutics: Introduction, Advantages, Disadvantages, Cosmaceuticals And Pharmaceutical Applications, Stability, Evaluation Testing And Storage Of Following Systems Such As – Emulsion, Suspension, Creams, Lotion, Shampoo ,Face Mask And Packs ,Gels, Bath Product ,Sunscreen,	**08**
2.	Cosmetic Serum-Introduction, Definition Of Serum, Serums Effects , Use Of Serum, Cosmetic Serum Application, Recommendation, Advantages, Disadvantages, Various Cosmetic Formulation And Stability Testing Of Serum For Eye, Skin Care And Hair Care Products.	**05**
3	Latest Technology Advances In Cosmaceuticals- Introduction, Cosmaceuticals And Pharmaceutical Applications Of Vesicular Delivery System, Emulsion Delivery System	**04**
4	Effervescent Bath Tablet Formulation Technology. (Bath & Spa Beauty Products)- The Chemistry Of Effervescence, No Reactive Components, Processing Considerations, Quality Control	**06**
	Section- II	
5	Use of botanicals in cosmoceutics: Botanicals as natural products, available sources, extracts, plant additives that are reputed to benefit skin, formulation aspects, standardisation	**04**
6	Most commonly used cosmetics raw material: water, preservatives, humectants, surfactants, oils, fats, perfumes, colors, silicones, functional raw material, development of new raw material.	**08**
7	Processes used in manufacture of cosmetics: emulsification, mixing, compaction, moulding, packaging, product packaging material compatability, cosmetic labeling.	**07**
8	Cosmaceutics in new drug delivery systems: Phytosomes: New Cosmetic Delivery System- Benefits Of Phytosomes, Physical And Chemical Properties Of Phytosomes, Method Of Preparation, Evaluation Of Phytosomes, Difference Between Phytosomes And Liposome's, Herbal Drugs And Their Phytosomes	**03**

Total Hours: 45

References-

1- Cosmetics Formulation Manufacturing & Quality Control 4/Ed
By P P Sharma

2- The Complete Beauty Bible: The Ultimate Guide to Smart Beauty -
By Paula Begoun

3- Dermatologic, Cosmoceutics, and Cosmetic Development: Therapeutic and Novel.
Edited By Kenneth A. Walters, Michael S. Roberts

4- Vesicular & Particulate Drug Delivery Systems
By Prof.R.S.R.Murthy.

5- Healthy Healing: A Guide to Self-Healing For Everyone
By Linda R. Page

6- Cosmetic and Clinical Applications of Botox and Dermal Fillers, Second Edition
By William J. Lipham

7- Handbook of Cosmetic Science and Technology By A. O. Barel, Marc Paye, Howard I. Maibach

T - 4.8.6.7 Packaging Technology (Elective)

(Theory) (3Hrs/week)

Sr. No.	Topics	Hrs.
	Section- I	
1.	**An introduction to pharmaceutical packaging:** Characteristics of packaging, Properties of pack, Types of packaging – primary, secondary and repackaging.	**05**
2.	**Regulatory aspect of pharmaceutical packaging:** Introduction, cost of development, FDA packaging guideline, the package as a contaminator of the environment.	**05**
3.	**Glass containers:** Comparison and types of glass, properties, manufacturing processes, design and decoration, production line handling, quality control and quality assurance, filling, closuring, labeling etc., special pharmaceutical containers – ampoules, vials etc., closures, caps, seals and stoppers.	**05**
4.	**Plastic containers:** Types of plastics – thermosets, thermoplastics, properties of plastic containers, constitutes in plastics, moulding processes, sterilization of plastic containers.	**04**
5.	**Film, foils and laminates:** single ply material, shrink wrapping, stretch wrapping, regenerated cellulose films, special individual film and their uses, collapsible tubes, coatings, Foils- aluminium, Lamination and lamination processes.	**04**
	Section- II	
6.	**Metal containers:** metal containers, tinplate and associated materials, aluminium, types of metal containers, built up containers.	**04**
7.	**Paper and board based materials:** sources of cellulose fibers, manufacturing processes, machine conversion into paper and board, leaflets, folding or collapsible cartons, carton erection and filling, rigid boxes, solid and corrugated boards for casing, paper and board based containers.	**05**
8.	**Closures and closure systems:** basis of closure system, closure assessment and control, prethreaded screw caps, specific closures for containers, non-reclosables, membrane seal, adhesive sealing, specials aspect of closures and their assessment.	**05**
9.	**Blister, strip and sachet packaging:** blister packs, strip packs, sachets, recent development in blister and strip packaging.	**04**
10.	**Printing and decoration:** decoration- features and terms, print terminology, graphic reproduction, mechanical contact printing, printing machines and processes, other printing processes, printing inks, recent trends in printing.	**04**

Total Hours: 45

References:

1. DA Dean, ER Evans, IH Hall. Pharmaceutical Packaging Technology. Taylor and Francis.
2. AJ Winfield, RME Richards. Pharmaceutical practice. Churchill livingstone.
3. Lachman, Lieberman. The Theory and Practice of Industrial Pharmacy.
4. Bentley's Textbook of Pharmaceutics. Elsevier.
5. H Lockhart, FA Paine. Packaging of pharmaceuticals and health care products. Blackie academic and professionals.