Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

Syllabus and Scheme of

Degree of Pharmacy

(Semester, Credit & Grade system)

2013-14

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Appendix-I

Scheme of Teaching for B. Pharm. (Semester wise)
First to Eight Semesters
(Hours per week)

Sub. Code	Subject	Scheme of Teaching Hrs/week	
		Theory	Practical
Semester – I			
1.1	Pharmaceutics-I (General and Dispensing)	03	03
1.2	Pharmaceutical Chemistry-I (Inorganic)	03	03
1.3	Human Anatomy and Physiology-I	03	03
1.4	Pharmaceutical Biochemistry	03	03
1.5	Pharmacognosy and Phytochemistry-I	03	03
1.6	Hospital Pharmacy	03	-
Semester – II			
2.1	Pharmaceutics-II (General and Dispensing)	03	03
2.2	Pharmaceutical Chemistry-II (Organic)	03	03
2.3	Human Anatomy and Physiology-II	03	03
2.4	Pharmaceutical Analysis-I	03	03
2.5	Pharmacognosy and Phytochemistry-II	03	03
2.6	Statistics and Computer Application in Pharmacy	03	-
Semester – III			
3.1	Pharmaceutics-III (Unit operations)	03	03
3.2	Pharmaceutical Chemistry-III (Organic)	03	03
3.3	Pathophysiology and Clinical Biochemistry (Pathophysiology of common diseases)	03	03
3.4	Pharmacology-I	03	03
3.5	Pharmaceutical Microbiology and Immunology-I	03	03
3.6	Pharmaceutical Jurisprudence and ethics	03	-
Semester – IV			
4.1	Pharmaceutics-IV(Unit operations)	03	03
4.2	Pharmaceutical chemistry-IV(Heterocyclic and Macromolecules)	03	03
4.3	Pharmaceutical Analysis-II (Electroanalytical and Physical methods)	03	03
4.4	Pharmacology-II	03	03
4.5	Pharmaceutical Microbiology and Immunology-II	03	03
4.6	Pharmaceutical Management	03	-
Semester – V			
5.1	Pharmaceutics-V (Physical Pharmacy)	03	03
5.2	Pharmaceutical Medicinal chemistry-I	03	03
5.3	Pharmacology-III	03	03
5.4	Pharmacognosy and Phytochemistry-III (Chemistry of Natural Products)	03	03
5.5	Clinical Pharmacy	03	03
5.6	Regulatory Affairs and Intellectual Property Right	03	-
Semester – VI			
6.1	Pharmaceutics-VI (Physical Pharmacy)	03	03
6.2	Pharmaceutical Medicinal Chemistry-II	03	03
6.3	Pharmacology-IV	03	03
6.4	Pharmacognosy and Phytochemistry-IV(Recent Advances in Phytochemistry)	03	03

6.5	Clinical Pharmacotherapeutics-I	03	03
6.6	Pharmaceutical Validation	03	-
Semester – VII			
7.1	Pharmaceutics (DFT-I) (Conventional)	03	03
7.2	Pharmaceutical Medicinal chemistry-III	03	03
7.3	Pharmaceutical Analysis-III (Separation Techniques)	03	03
7.4	Clinical Pharmacotherapeutics-II	03	03
7.5	Pharmacognosy and Phytochemistry-V (Phytopharmaceutical /Herbal Technology)	03	03
7.6	Biopharmaceutics and Pharmacokinetics	03	-
Semester – VIII			
8.1	Pharmaceutics (DFT-II) (NDDS)	03	03
8.2	Pharmaceutical Biotechnology and Molecular Biology	03	03
8.3	Pharmaceutical Analysis-IV (Spectroscopy)	03	03
8.4	Pharmacognosy and Phytochemistry-VI(Industrial Pharmacognosy)	03	03
8.5	Pharmacovigilence (Drug safety)	03	-
8.6	Industrial Pharmacy	03	-
8.7	Project	-	03

Appendix-II

Scheme of Examination for B. Pharm. (Semester wise)
First to Eight Semesters

Sub. Code	Subject	Scheme of Examination						Minimum Marks for passing		Total Marks in Theory / practical (Credits)
		Theory		Practical		Theory Int. Marks	Pract. Int. Marks	Theory	Practical	
		Hrs	Marks	Hrs	Marks					
Semester – I										
1.1	Pharmaceutics-I (General and Dispensing)	3	80	4	80	20	20	45	45	3 + 2 = 5
1.2	Pharmaceutical Chemistry-I (Inorganic)	3	80	4	80	20	20	45	45	3 + 2 = 5
1.3	Human Anatomy and Physiology-I	3	80	4	80	20	20	45	45	3 + 2 = 5
1.4	Pharmaceutical Biochemistry	3	80	4	80	20	20	45	45	3 + 2 = 5
1.5	Pharmacognosy and Phytochemistry-I	3	80	4	80	20	20	45	45	3 + 2 = 5
1.6	Hospital Pharmacy	3	80	-	-	20	-	45	-	3
		Total Marks (credits) for the Semester								**28**
Semester – II										
2.1	Pharmaceutics-II (General and Dispensing)	3	80	4	80	20	20	45	45	3 + 2 = 5
2.2	Pharmaceutical Chemistry-II (Organic)	3	80	4	80	20	20	45	45	3 + 2 = 5
2.3	Human Anatomy and Physiology-II	3	80	4	80	20	20	45	45	3 + 2 = 5
2.4	Pharmaceutical Analysis-I	3	80	4	80	20	20	45	45	3 + 2 = 5
2.5	Pharmacognosy and Phytochemistry-II	3	80	4	80	20	20	45	45	3 + 2 = 5
2.6	Statistics and Computer Application in Pharmacy	3	80	-	-	20	-	45	-	3
		Total Marks (credits) for the Semester								**28**
Semester – III										
3.1	Pharmaceutics-III (Unit operations)	3	80	4	80	20	20	45	45	3 + 2 = 5
3.2	Pharmaceutical Chemistry-III (Organic)	3	80	4	80	20	20	45	45	3 + 2 = 5
3.3	Pathophysiology and Clinical Biochemistry (Pathophysiology of common diseases)	3	80	4	80	20	20	45	45	3 + 2 = 5
3.4	Pharmacology-I	3	80	4	80	20	20	45	45	3 + 2 = 5
3.5	Pharmaceutical Microbiology and Immunology-I	3	80	8*	80	20	20	45	45	3 + 2 = 5
3.6	Pharmaceutical Jurisprudence and ethics	3	80	-	-	20	-	45	-	3
		Total Marks (credits) for the Semester								**28**

Sub. Code	Subject	Scheme of Examination						Minimum Marks for passing		Total Marks in Theory / practical (Credits)
		Theory		Practical		Theory Int. Marks	Pract. Int. Marks	Theory	Practical	
		Hrs	Marks	Hrs	Marks					
Semester – IV										
4.1	Pharmaceutics-IV (Unit operations)	3	80	4	80	20	20	45	45	3 + 2 = 5
4.2	Pharmaceutical chemistry-IV (Heterocyclic and Macromolecules)	3	80	6	80	20	20	45	45	3 + 2 = 5
4.3	Pharmaceutical Analysis-II (Electroanalytical and Physical methods)	3	80	6	80	20	20	45	45	3 + 2 = 5
4.4	Pharmacology-II	3	80	4	80	20	20	45	45	3 + 2 = 5
4.5	Pharmaceutical Microbiology and Immunology-II	3	80	8*	80	20	20	45	45	3 + 2 = 5
4.6	Pharmaceutical Management	3	80	-	-	20	-	45	-	3
		Total Marks (credits) for the Semester								**28**
Semester – V										
5.1	Pharmaceutics-V (Physical Pharmacy)	3	80	6	80	20	20	45	45	3 + 2 = 5
5.2	Pharmaceutical Medicinal chemistry-I	3	80	6	80	20	20	45	45	3 + 2 = 5
5.3	Pharmacology-III	3	80	6	80	20	20	45	45	3 + 2 = 5
5.4	Pharmacognosy and Phytochemistry-III (Chemistry of Natural Products)	3	80	6	80	20	20	45	45	3 + 2 = 5
5.5	Clinical Pharmacy	3	80	6	80	20	20	45	45	3 + 2 = 5
5.6	Regulatory Affairs and Intellectual Property Right	3	80	-	-	20	-	45	-	3
		Total Marks (credits) for the Semester								**28**
Semester – VI										
6.1	Pharmaceutics-VI (Physical Pharmacy)	3	80	6	80	20	20	45	45	3 + 2 = 5
6.2	Pharmaceutical Medicinal Chemistry-II	3	80	6	80	20	20	45	45	3 + 2 = 5
6.3	Pharmacology-IV	3	80	6	80	20	20	45	45	3 + 2 = 5
6.4	Pharmacognosy and Phytochemistry-IV (Recent Advances in Phytochemistry)	3	80	6	80	20	20	45	45	3 + 2 = 5
6.5	Clinical Pharmacotherapeutics-I	3	80	6	80	20	20	45	45	3 + 2 = 5
6.6	Pharmaceutical Validation	3	80	-	-	20	-	45	-	3

Total Marks (credits) for the Semester **28**

Sub. Code	Subject	Scheme of Examination						Minimum Marks for passing		Total Marks in Theory / practical (Credits)
		Theory		Practical		Theory Int. Marks	Pract. Int. Marks	Theory	Practical	
		Hrs	Marks	Hrs	Marks					
Semester – VII										
7.1	Pharmaceutics (DFT-I) (Conventional)	3	80	6	80	20	20	45	45	3 + 2 = 5
7.2	Pharmaceutical Medicinal chemistry-III	3	80	6	80	20	20	45	45	3 + 2 = 5
7.3	Pharmaceutical Analysis-III (Separation Techniques)	3	80	6	80	20	20	45	45	3 + 2 = 5
7.4	Clinical Pharmacotherapeutics-II	3	80	6	80	20	20	45	45	3 + 2 = 5
7.5	Pharmacognosy and Phytochemistry-V (Phytopharmaceutical /Herbal Technology)	3	80	6	80	20	20	45	45	3 + 2 = 5
7.6	Biopharmaceutics and Pharmacokinetics	3	80	-	-	20	-	45	-	3
		Total Marks (credits) for the Semester								**28**
Semester – VIII										
8.1	Pharmaceutics (DFT-II) (NDDS)	3	80	12*	80	20	20	45	45	3 + 2 = 5
8.2	Pharmaceutical Biotechnology and Molecular Biology	3	80	8*	80	20	20	45	45	3 + 2 = 5
8.3	Pharmaceutical Analysis-IV (Spectroscopy)	3	80	6	80	20	20	45	45	3 + 2 = 5
8.4	Pharmacognosy and Phytochemistry-VI (Industrial Pharmacognosy)	3	80	6	80	20	20	45	45	3 + 2 = 5
8.5	Pharmacovigilence (Drug safety)	3	80	-	-	20	-	45	-	3
8.6	Industrial Pharmacy	3	80	-	-	20	-	45	-	3
8.7	Project[#]	-	-	-	100	-	-	-	45	2
	* hrs in two days	Total Marks (credits) for the Semester								**28**

Credits : 28 x 8 = 224

Marks : Theory : 600 x 8 = 4800

Practical : 500 x 8 = 4000

8800

[#]Project Report:-

The topic for the project shall be based on the practical work/theoretical/review oriented/any topic from current Pharmaceutical development and shall be assigned to him/her by the respective guide from faculty member (Maximum eight students per teacher) immediate from the date of the commencement of the eighth semester

Report to be submitted in the institute and examination (seminars on the project report) shall be conducted on the college level.

Examination/Evaluation of the project shall be based on introduction and information retrieval systems, organization of material and references in the project report, representation, skill in oral presentation, questioning and defending and finally on the report.

The project report shall be compulsory for each and every student of Semester VIII.

Appendix-III

Distribution of Marks & Credits

Subject Code	Subject	Maximum Marks (Credits)		Total Marks (Credits)
		Theory	**Practical**	
Semester – I				
1.1	Pharmaceutics-I (General and Dispensing)	100 (3)	100 (2)	200 (5)
1.2	Pharmaceutical Chemistry-I (Inorganic)	100 (3)	100 (2)	200 (5)
1.3	Human Anatomy and Physiology-I	100 (3)	100 (2)	200 (5)
1.4	Pharmaceutical Biochemistry	100 (3)	100 (2)	200 (5)
1.5	Pharmacognosy and Phytochemistry-I	100 (3)	100 (2)	200 (5)
1.6	Hospital Pharmacy	100 (3)	-	100 (3)
	Total			**1100 (28)**
Note - Students having Diploma in Pharmacy and admitted to First year have to appear one theory paper of Semester II viz. 2T-6 Statistics and Computer applications in pharmacy				
Semester – II				
2.1	Pharmaceutics-II (General and Dispensing)	100 (3)	100 (2)	200 (5)
2.2	Pharmaceutical Chemistry-II (Organic)	100 (3)	100 (2)	200 (5)
2.3	Human Anatomy and Physiology-II	100 (3)	100 (2)	200 (5)
2.4	Pharmaceutical Analysis-I	100 (3)	100 (2)	200 (5)
2.5	Pharmacognosy and Phytochemistry-II	100 (3)	100 (2)	200 (5)
2.6	Statistics and Computer Application in Pharmacy	100 (3)	-	100 (3)
	Total			**1100 (28)**
Semester – III				
3.1	Pharmaceutics-III (Unit operations)	100 (3)	100 (2)	200 (5)
3.2	Pharmaceutical Chemistry-III (Organic)	100 (3)	100 (2)	200 (5)
3.3	Pathophysiology and Clinical Biochemistry (Pathophysiology of common diseases)	100 (3)	100 (2)	200 (5)
3.4	Pharmacology-I	100 (3)	100 (2)	200 (5)
3.5	Pharmaceutical Microbiology and Immunology-I	100 (3)	100 (2)	200 (5)
3.6	Pharmaceutical Jurisprudence and ethics	100 (3)	-	100 (3)
	Total			**1100 (28)**
Note-Students admitted on the basis of Diploma in Pharmacy directly to to Second year (Third semester) have to appear one theory paper of Semester II viz. 2T-6 Statistics and Computer applications in pharmacy				
Semester – IV				
4.1	Pharmaceutics-IV (Unit operations)	100 (3)	100 (2)	200 (5)
4.2	Pharmaceutical chemistry-IV (Heterocyclic and Macromolecules)	100 (3)	100 (2)	200 (5)

4.3	Pharmaceutical Analysis-II (Electroanalytical and Physical methods)	100 (3)	100 (2)	200 (5)
4.4	Pharmacology-II	100 (3)	100 (2)	200 (5)
4.5	Pharmaceutical Microbiology and Immunology-II	100 (3)	100 (2)	200 (5)
4.6	Pharmaceutical Management	100 (3)	-	100 (3)
	Total			**1100 (28)**
Semester – V				
5.1	Pharmaceutics-V (Physical Pharmacy)	100 (3)	100 (2)	200 (5)
5.2	Pharmaceutical Medicinal chemistry-I	100 (3)	100 (2)	200 (5)
5.3	Pharmacology-III	100 (3)	100 (2)	200 (5)
5.4	Pharmacognosy and Phytochemistry-III (Chemistry of Natural Products)	100 (3)	100 (2)	200 (5)
5.5	Clinical Pharmacy	100 (3)	100 (2)	200 (5)
5.6	Regulatory Affairs and Intellectual Property Right	100 (3)	-	100 (3)
	Total			**1100 (28)**
Semester – VI				
6.1	Pharmaceutics-VI (Physical Pharmacy)	100 (3)	100 (2)	200 (5)
6.2	Pharmaceutical Medicinal Chemistry-II	100 (3)	100 (2)	200 (5)
6.3	Pharmacology-IV	100 (3)	100 (2)	200 (5)
6.4	Pharmacognosy and Phytochemistry-IV (Recent Advances in Phytochemistry)	100 (3)	100 (2)	200 (5)
6.5	Clinical Pharmacotherapeutics-I	100 (3)	100 (2)	200 (5)
6.6	Pharmaceutical Validation	100 (3)	-	100 (3)
	Total			**1100 (28)**
Semester – VII				
7.1	Pharmaceutics (DFT-I) (Conventional)	100 (3)	100 (2)	200 (5)
7.2	Pharmaceutical Medicinal chemistry-III	100 (3)	100 (2)	200 (5)
7.3	Pharmaceutical Analysis-III (Separation Techniques)	100 (3)	100 (2)	200 (5)
7.4	Clinical Pharmacotherapeutics-II	100 (3)	100 (2)	200 (5)
7.5	Pharmacognosy and Phytochemistry-V (Phytopharmaceutical /Herbal Technology)	100 (3)	100 (2)	200 (5)
7.6	Biopharmaceutics and Pharmacokinetics	100 (3)	-	100 (3)
	Total			**1100 (28)**
Semester – VIII				
8.1	Pharmaceutics (DFT-II) (NDDS)	100 (3)	100 (2)	200 (5)
8.2	Pharmaceutical Biotechnology and Molecular Biology	100 (3)	100 (2)	200 (5)
8.3	Pharmaceutical Analysis-IV (Spectroscopy)	100 (3)	100 (2)	200 (5)
8.4	Pharmacognosy and Phytochemistry-VI (Industrial Pharmacognosy)	100 (3)	100 (2)	200 (5)
8.5	Pharmacovigilence (Drug safety)	100 (3)	-	100 (3)
8.6	Industrial Pharmacy	100 (3)	-	100 (3)
8.7	Project	-	100 (2)	100 (2)

	Total	**1100 (28)**

Year	**Semester**	**Total Marks (Credits)**
First year	Semester-I	1100 (28)
	Semester-II	1100 (28)
Second year	Semester-III	1100 (28)
	Semester-IV	1100 (28)
Third year	Semester-V	1100 (28)
	Semester-VI	1100 (28)
Fourth year	Semester-VII	1100 (28)
	Semester-VIII	1100 (28)
	Total Marks (Credits)	**8800 (224)**

APPENDIX IV

Scheme of Practical Examination

Duration of each practical examination : As presented in the syllabus.

Maximum marks allotted to each practical : 80

Suggested distribution of marks -

Question Number 1 : Synopsis	10
Question Number 2 : Major Experiments	30
Question Number 3: Minor Experiments	20
Question Number 4 : Viva voce	20

Note: The major and minor experiments are set by the examiners considering the scope of subject as described in the syllabus.

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur
B. Pharm. Syllabus
Credit-grade based performance and assessment system (CGPA)
Features of the Credit System
With effect from Academic Session 2013- 2014

1. Features of the Credit System:-

- Graduate Programme in Pharmaceutical Sciences would be of credits prescribed by the Board of Studies in Pharmaceutical Sciences.
- One credit course of theory will be of one clock hour per week running for 15 weeks.
- One credit course of practical will consist of 1.5 hours of laboratory exercise for 15 weeks.
- Credit system offer more options to students and has more flexibility.
- Students can get requisite credits from the concerned colleges where she/he is mutually permitted on terms mutually agreed to complete the same and be eligible to appear for term end examination.
- The term end examination, however, shall be conducted by the RTM Nagpur University, Nagpur in the allotted centres.

2. FIRST YEAR MAY DIVIDE INTO TOTAL TWO SEMESTERS (SEMESTER-I AND SEMESTER-II) AND SHALL HAVE TOTAL 12 THEORY COURSES, 10 PRACTICAL COURSES.

- 12 Theory courses x 3 credits = 36 credits
- 10 Laboratory courses x 2 credits = 20 credits

Total = 56 credits

3. SECOND YEAR MAY DIVIDE INTO TOTAL TWO SEMESTERS (SEMESTER-III AND SEMESTER-IV) AND SHALL HAVE TOTAL 12 THEORY COURSES, 10 PRACTICAL COURSES.

- 12 Theory courses x 3 credits = 36 credits
- 10 Laboratory courses x 2 credits = 20 credits

Total = 56 credits

4. THIRD YEAR MAY DIVIDE INTO TOTAL TWO SEMESTERS (SEMESTER-V AND SEMESTER-VI) AND SHALL HAVE TOTAL 12 THEORY COURSES, 10 PRACTICAL COURSES.

- 12 Theory courses x 3 credits = 36 credits
- 10 Laboratory courses x 2 credits = 20 credits

Total = 56 credits

5. FOURTH YEAR MAY DIVIDE INTO TOTAL TWO SEMESTERS (SEMESTER-VII AND SEMESTER-VIII) AND SHALL HAVE TOTAL 12 THEORY COURSES, 10 PRACTICAL COURSES.

- 12 Theory courses x 3 credits = 36 credits
- 9 Laboratory courses x 2 credits = 18 credits
- 1 Project x 2 credits = 2 credits

Total = 56 credits

6. EVERY STUDENT SHALL COMPLETE 224 CREDITS IN EIGHT SEMESTERS

- First year (semester I and II) = 56 credits
- Second year (semester III and IV) = 56 credits
- Third year (semester V and VI) = 56 credits
- Fourth year (semester VII and VIII) = 56 credits

Eight semester total credits = 224 credits

7. SCHEME OF SYLLABUS AND CREDIT SYSTEM

• Three credits (theory) = 100 marks

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

• Two credits (Practical) = 100 marks

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

The Internal Assessment marks for theory subject should be based on average marks of two Class Tests.

c) The internal assessment marks for practical subject should be based upon actual performance in one class test (10 marks) and Day to day assessment in the practical class test (10 marks).

8. **Grades:-**Marks would be converted to grades as shown in Table 1.

Table 1: Conversion of marks to grades in credit system

Marks Obtained	Grade	Grade Points
100-85	O	10
84-75	A	9
74-65	B	8
64-55	C	7
54-50	D	6
49-45	E	5
44 and less	F	0-Failed (Clear course)

a. A student failed to score minimum 45% marks in each head of passing and in aggregate shall be given F grade.
b. A student who passes the internal tests but fails in Term End Examination of a course shall be given F grade.
c. Student with F grade in a course would be granted credit for that course but not the grade for that course.

9. The computation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA) of an examinee shall be as given below:-

i. The marks will be given in all examinations which will include college assessment marks and the total marks for each Theory /Practical shall be converted into Grades as per Table 1. SGPA shall be calculated based on Grade Points corresponding to Grade as given in Table 1 and the Credits allotted to respective Theory / Practical shown in the scheme for respective semester.

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

$$\text{SGPA} = \frac{C1 \times G1 + C2 \times G2 + \ldots\ldots + Cn\ Gn}{C1 + C2 + \ldots\ldots + Cn}$$

Where C1 = Credit of individual Theory / Practical
G1 = Corresponding Grade Point obtained in the Respective Theory / Practical

$$\text{CGPA} = \frac{(\text{SGPA})\ V \times (\text{Cr})\ V + (\text{SGPA})\ VI \times (\text{Cr})\ VI + (\text{SGPA})\ VII \times (\text{Cr})\ VII + (\text{SGPA})\ VIII \times (\text{Cr})\ VIII}{(\text{Cr})\ V + (\text{Cr})\ VI + (\text{Cr})\ VII + (\text{Cr})\ VIII}$$

Where, (SGPA) V = SGPA of V Semester
(Cr) V = Total Credits for V Semester
(SGPA) VI = SGPA of VI Semester
(Cr) VI = Total Credits for VI Semester
(SGPA) VII = SGPA of VII Semester
(Cr) VII = Total Credits for VII Semester
(SGPA) VIII = SGPA of VIII Semester

(Cr) VIII = Total Credits for VIII Semester

CGPA	**Final Grade**
9.0 – 10	O
8.0 – 8.9	A
7.0 – 7.9	B
6.0 – 6.9	C
5.5 – 5.9	D
5.0 – 5.4	E
4.9 and less	F

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

10. CGPA equal to 6.75 and above shall be considered as equivalent to First Class which shall be mentioned on Grade Card of VIII Semester as a foot note.

11. CGPA equal to 7.00 and above shall be considered as distinction in that particular subject

12. **ACADEMIC CALENDAR AND TERMS**

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

Syllabus
SEMESTER-I

Subject code: 1T1
Subject: Pharmaceutics-I (General and Dispensing)
THEORY: **45 Hours (3 Hrs. /week)**

1. **Pharmaceutical literature** **4 Hrs**
   Historical background to the profession of Pharmacy in India in brief. Brief overview of status of Pharmaceutical industry in India. Introduction to Pharmacopoeias. Development of Indian Pharmacopoeia and other Compendia including B.P.,U.S.P., N.F., Ph Eur., International pharmacopoeia and B.P.C.

2. **Introduction to pharmacological terms & Dosage forms** **6 Hrs**
   Introduction to important pharmacological terms. Definition of drug and dosage form. The desirable properties of a dosage form, the need of dosage form

3. **Routes of administration** **3 Hrs**
   Introduction and Classification on the basis of nature, routes of administration with respect to dosage form design

4. **Prescription** **3 Hrs**
   Prescription and its parts, handling of prescription, labeling and packing, prescription containers and closure, pricing the prescription

5. **Posology** **5 Hrs**
   Meaning, factors affecting dose, calculation of doses for infants and children.

6. **Liquid dosage forms for internal administration** **8 Hrs**
   Aromatic water, syrups, elixirs, spirits, tinctures

7. **Liquid dosage forms for external administration** **8 Hrs**
   Mouthwash, gargles, linctus, douches, enemas, sprays, throat paint, Inhalation, Lotion, liniment, eye drop, ear drop, nasal drop

8. **Ointment** **4 Hrs**
   Classification of ointment and ointment bases, factors governing selection of ointment base, preparation, packaging, labeling, and storage of Ointments.

9. **Pastes and jellies** **4 Hrs**
   Definition, bases of paste, preparation of paste and storage. Introduction to different types of jellies and their preparation.

Subject code: 1P1
Subject: Pharmaceutics-I (General and Dispensing)
PRACTICAL: **3 Hrs. /week**
Compounding and dispensing of prescriptions:

AROMATIC WATER

1. Prepare and submit Camphor Water I.P. 1966.
2. Prepare and submit Chloroform Water I.P. 1966.
3. Prepare and submit Conc. Cinnamon Water B.P. 1980.

SYRUP

4. Prepare and submit Simple Syrup I.P. 1966.
5. Prepare and submit Orange Syrup B.P. C. 1973
6. Prepare and submit Ferrous sulphate Syrup U.S.P. 1990.

ELIXIR

7. Prepare and submit Simple elixir I.P. 1966.
8. Prepare and submit Piperazine citrate elixir I.P. 1966.

SOLUTION

9. Prepare and submit Weak iodine solution I.P. 1966.
10. Prepare and submit Aqueous iodine solution I.P. 1966

SPIRIT

11. Prepare and submit Chloroform Spirit I.P. 1966

LOTION

12. Prepare and submit Calamine Lotion B.P. 1980
13. Prepare and submit Oily Calamine Lotion B.P. 1980

LINIMENT

15. Prepare and submit Camphor Liniment I.P. 1966
16. Prepare and submit Ammoniated Camphor Liniment I.P. 1966

17. Prepare and submit White Liniment B.P. 1980

GLYCERIDES

18. Prepare and submit Phenol Glycerides I.P. 1966
19. Prepare and submit Borax Glycerides I.P. 1966
20. Prepare and submit Tannic acid Glycerides I.P. 1966

MUCILAGE

21. Prepare and submit Starch Mucilage I.P. 1985

OINTMENT

22. Prepare and submit Simple Ointment I.P. 1966
23. Prepare and submit Sulphur Ointment I.P. 1966
24. Prepare and submit Zinc oxide Ointment I.P. 1966
25. Prepare and submit Nonstaining iodine Ointment B.P.C. 1973
26. Prepare and submit Nonstaining iodine Ointment with methyl salicylate B.P.C. 1973
27. Prepare and submit Emulsifying Ointment I.P. 1966
28. Prepare and submit Hydrous emulsifying Ointment I.P. 1966

CREAMS

29. Prepare and submit Zinc Oxide Cream B.P. 1980
30. Prepare and submit Cold Cream
31. Prepare and submit Vanishing Cream

PASTE

32. Prepare and submit Zinc oxide and gelatin Paste
33. Prepare and submit Bentonite and glycerine Paste

Subject code: 1T2
Subject: Pharmaceutical Chemistry-I (Inorganic)
THEORY: 45 Hours (3 Hrs. /week)

An outline of methods of preparation, uses, sources of impurities, tests for purity and identity, including limit tests for iron, arsenic, lead, heavy metals, chloride, sulphate and special tests if any of the following classes of inorganic pharmaceuticals included in Indian Pharmacopoeia.

1. Pharmaceutical aids and necessities **8 Hrs**

- Acids and bases
- Buffers
- Antioxidant
- Water

2. Major Intra and Extra-cellular Electrolytes **8 Hrs**

- Electrolytes used in replacement therapy
- Physiological acid base balance
- Electrolytes used in acid base therapy
- Electrolytes combination therapy

3. Gastrointestinal Agents **7 Hrs**

- Acidifying agents
- Antacids
- Protective and Adsorbents
- Saline Cathartic

4. Topical Agents **6 Hrs**

- Protective
- Antimicrobial
- Astringents

5. Dental Products **3 Hrs**

- Dentifrices
- Anti-caries agents.

6. Inorganic Radio Pharmaceuticals: **8 Hrs**

- Measurement of radioactivity
- Artificial radioactivity
- Radio-opaque contrast media
- Application of radiopharmaceuticals

7. Miscellaneous Agents **5 Hrs**

- Poisons and antidotes
- Respiratory stimulants

- Expectorants and emetics
- Tableting aids and Suspending agents

Subject code: 1P2
Subject: Pharmaceutical Chemistry-I (Inorganic)
PRACTICAL: **3 Hrs. /week**

1. Limit test (As Per I. P.)
   - Chloride
   - Sulphate
   - Iron
   - Heavy Metals
   - Lead and Arsenic
2. Preparation of following inorganic pharmaceuticals and perform Identification tests
   - Aluminium hydroxide
   - Barium Sulphate
   - Calcium carbonate
   - Ferrous Sulphate
   - Potassium citrate
   - Boric acid
3. To check swelling power of Bentonite
4. To check acid neutralising capacity of aluminium hydroxide gel
5. To determine percentage of iodine in potassium iodide
6. To determine percentage of ammonium salts in potash alum
7. To study adsorption property of heavy kaolin

Subject code: 1T3
Subject: Human Anatomy and Physiology-I
THEORY: **45 Hours (3 Hrs. /week)**

1. Basic terminologies used in anatomy and physiology, levels of structural organization, body cavities and their membrane, planes and sections. **3 Hrs**
2. Cell physiology: cell membrane (structure, functions, transport of substances and membrane potentials), cell organelles (structure and functions), and cell cycle. **8 Hrs**
3. Elementary tissues of human body: epithelial, connective, muscular and nervous tissues. Their subtypes and characteristics. **4 Hrs**
4. Haempoitic system: blood-composition and functions, plasma proteins, RBC-genesis and fate, anaemia, WBC-types and physiological role, platelets, mechanism of blood coagulation and blood groups. **9 Hrs**
5. Cardiovascular system: anatomy of heart, action potential & contraction of contractile fibres, conducting system, ECG, cardiac cycle, blood vessels and circulation (pulmonary, coronary, systemic and portal), blood pressure-maintenance and regulation. **9 Hrs**
6. Lymphatic system: lymph-(composition, functions and circulation), lymph node (structure and functions), spleen (structure and function). **4 Hrs**
7. Respiratory system: Anatomy of respiratory organs and their functions, exchange of respiratory gases, transport of respiratory gases, regulation of respiration (nervous and chemical), respiratory volumes and vital capacity. **8 Hrs**

Subject code: 1P3
Subject: Human Anatomy and Physiology-I
PRACTICAL: **3 Hrs. /week**

1. Study of microscope.
2. Determination of bleeding time of own blood.
3. Determination of clotting time of own blood.
4. Determination of haemoglobin content of own blood.

5. Determination of RBC count of own blood.
6. Determination of WBC count of own blood.
7. Determination of differential count of own blood (DLC).
8. Determination of blood group.
9. Recording of pulse rate and blood pressure.
10. Recording of ECG.
11. Recording of breathing rate.
12. Determination of vital capacity.
13. Study of gross anatomy & physiology of various organs/system by models/charts/specimens:
    i) Circulatory system
    ii) Lymphatic system
    iii) Respiratory system
14. Histology: Microscopic study of different types of primary tissues and organs from permanent slides.

Subject code: 1T4
Subject: Pharmaceutical Biochemistry
THEORY: **45 Hours (3 Hrs. /week)**

1. Carbohydrates **12 Hrs**

Introduction, biological roles, classification and reactions of carbohydrates (oxidation, reduction, hemiacetal/ hemiketal formation, acetate / ketal formation, Osazone formation), Discussion of glycolysis, Glycogenesis, Glycogenolysis, TCA cycle, Amphibolic nature of TCA cycle, HMP shunt, Gluconeogenesis, Uronic acid pathway, Galactose metabolism, Blood glucose regulation.

2. Proteins **11 Hrs**

Introduction to protein and amino acid, biological roles, classification of protein and amino acid, Reactions of amino acids(acid base behavior, isoelectric pH, optical activity, N-acylation, ninhydrin reaction, reaction with flurodinitrobenzene, Dansyl chloride reaction, Edman reaction, Schiff base formation, esterification, side chain reactions), Introduction to primary, secondary, tertiary and quaternary protein structure, General reactions of amino acids (Transamination, Deamination, Decarboxylation), Urea cycle, Porphyrins, Bile pigment, Hyperbilirubinemia.

3. Lipid **10 Hrs**

Introduction, biological roles, classification of lipids and fatty acids, reactions of lipid and fatty acids, Properties of fatty acids (physical properties, formation of esters, acid value, iodine value, ester value, rancidity, hydrolysis of fats, hydrogenation of oils), β-oxidation of fatty acid (saturated acid) formation and breakdown of ketone bodies, Biosynthesis of eicosanoids, phospholipid and sphingolipid and prostaglandin.

4. **Nucleic acids** **7 Hrs**

Definition of DNA and RNA, nitrogenous bases, nucleosides, nucleotides, structure of DNA, Types of RNA, their structure and their biological role, Translocation and Transcription.

5. **Enzyme** **5 Hrs**

Defination and Classification of enzymes, Biological role, ,Properties and chemical tests, Factors affecting enzyme activity, Michaclis – Menten equation and meanings of Km and Vmax, Mechanism of enzyme action, Enzyme inhibition.

Subject code: 1P4
Subject: Pharmaceutical Biochemistry
PRACTICAL: **3 Hrs. /week**

1. Identification of carbohydrates (Glucose, fructose, lactose, maltose,sucrose, starch)
2. Identification of proteins and amino acid (Casein, albumin, gelatin)
3. Identification of lipids (Cholesterol).
4. Estimation of protein (Biuret method).
5. Estimation of glucose in blood (Folin / Glucose-oxidase method).
6. Estimation of creatinine (Alkaline picrate method).

Subject code: 1T5
Subject: Pharmacognosy and Phytochemistry-I
THEORY: **45 Hours (3 Hrs. /week)**

1. **Introduction to Pharmacognosy**
   Origin, scope and history of Pharmacognosy. Classification of crude drugs. **3 Hrs**
2. **Various factors affecting quality and purity of crude drugs**
   (a) Exogenous factors
   (b) Endogenous factors
   (c) Preparation of crude drug for market
   (d) Adulteration and types of adulteration **4 Hrs**
3. Alternative and Complementary systems of medicine – Ayurveda, Unani, Siddha, Homeopathy, Chinese medicine and Aromatherapy **4 Hrs**
4. Introduction to different plant metabolites **14 Hrs**

   Primary metabolites
   a. Brief study of basic metabolic pathways and formation of different primary metabolites through these pathways- Photosynthesis
   b. Correlation of primary and secondary metabolites
   c. Introduction to following primary metabolites- Carbohydrates, Lipids and Proteins

   Secondary metabolites
   a. Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.
   b. Introduction to following secondary metabolites - Glycosides, Flavonoids, Saponins, Alkaloids, Tannins, Terpenoids, Steroids.

5. Study of organized crude drugs viz. - Stems, Barks, Woods, Roots, Rhizomes, Leaves, Flowers, Fruits, Seeds. **10 Hrs**
6. Cell differentiation and ergastic cell contents – Cell wall, Parenchymatous tissue, Epidermis, Epidermal trichomes, Stomata, Endodermis, Cork tissue, Collenchymas, Schlereides, Fibers, Xylem, Phloem, Secretary tissues, and Ergastic cell contents. **10 Hrs**

Subject code: 1P5
Subject: Pharmacognosy and Phytochemistry-I
PRACTICAL: **3 Hrs. /week**

1. Study on the laboratory microscope
2. Study of morphology and microscopy of crude drugs
   i. Stems- Kalmegh
   ii. Bark- Arjuna, Ashoka
   iii. Wood- Sandalwood, Quassia
   iv. Roots- Jalap, Ashwagandha
   v. Rhizomes and stolons- Turmeric, Picrrorhiza, Acorus
   vi. Leaves- Tulsi
   vii. Flowers- Saffron
   viii. Fruits- Lemon peel, Bael
   ix. Seeds- Isapghula, Nux vomica
3. To perform preliminary phytochemical screening of crude drugs for the identification of different primary and secondary metabolites i.e. carbohydrates, lipids, proteins, alkaloids, tannins, saponins, flavonoids, steroids.

Subject code: 1T6
Subject: Hospital Pharmacy
THEORY: **45 Hours (3 Hrs. /week)**

1. **Hospital pharmacy – organization and management:** Organisational structure – staff, infrastructure & work load statistics. Organization, Administration and functions. Roles & responsibilities of hospital pharmacist. **5 Hrs**
2. **Hospital drug policy:** Pharmacy and therapeutic committee (PTC), Hospital formulary, Hospital committees: Infection committee, Research and Ethical committee **4 Hrs**
3. **Hospital pharmacy services:** Procurement & warehousing of drugs and pharmaceuticals Inventory control: definition, methods of inventory control, ABC, VED, EOQ, lead time, safety stock. **7 Hrs**
4. **Drug distribution in Hospitals:** Outpatient and inpatient services, unit dose, drug distribution system, Floor wards stock system, satellite pharmacy services, bed side pharmacy, distribution of controlled drugs. **6 Hrs**
5. **Central sterile service:** Advantages, management, plan, location, Sterilization of rubber gloves, syringes, needles, catheters, surgical instruments, powders and other materials. **5 Hrs**
6. **Health accessories:** Wheel chairs, canes, crutches, bedpans, vaporizers, syringes, needles, clinical thermometers. **3 Hrs**
7. **Drug house management:** Selection of site, space layout and legal requirements. Codification, handling of drug store and other hospital supplies. **4 Hrs**
8. **Channels of distributions**: Differnet channels of distribution of drugs. Importance and objectives of purchasing, selection of suppliers. Credit information, tenders, contract and price determination and legal requirements thereto. **5 Hrs**
9. **Community pharmacy:** Concept, development of community pharmacy in India, role of community pharmacist **3 Hrs**
10. **Patient counseling:** Meaning, steps involved in patient counseling, interactions with doctors **3 Hrs**

SEMESTER-II

Subject code: 2T1
Subject: Pharmaceutics-II (General and Dispensing)

THEORY: **45 Hours (3 Hrs. /week)**

1. **Pharmacutical calculation** **9 Hrs**
   Percentage calculation, allegation method, calculation involving preparation of isotonic solutions, proof spirit, weights and measures.
2. **Dispersed system** **8 Hrs**
   Emulsion-Definition, types and identification test, merits and demerits, uses and classification of emulsifying agents, preparation and stability of emulsion
   Suspension- Definition, types, merits and demerits, uses and classification of suspending agents, flocculated and deflocculated suspension, preparation and stability of suspension.
3. **Suppositories and pessaries** **4 Hrs**
   Bases, additives, preparation, displacement value and calculations
4. **Powders** **4 Hrs**
   Definition, advantages, disadvantages, special problems, types of powders – tablet trichurates, granular effervescent powder, cachets,simple and compound powder, dusting powder, insufflations, snuffs, dentifrices, Effervecent granule
5. **Tablets** **4 Hrs**
   Definition, types, processing, excipients, defects, evaluation, tablet coating,
6. **Capsules** **4 Hrs**
   Hard and soft gelatin capsules, processing and their evaluation.
7. **Surgical aids** **3 Hrs**
   Surgical dressing, sutures, ligatures and their standards
8. **Extraction** **5 Hrs**
   Infusion, decoction, maceration and percolation process and preparation involving them
9. **Blood and plasma substitutes** **4 Hrs**

Subject code: 2P1
Subject: Pharmaceutics-II (General and Dispensing)
PRACTICAL: **3 Hrs. /week**
Compounding and dispensing of prescriptions:

EMULSIONS

1. Prepare and submit Olive oil Emulsion(Wet gum method)
2. Prepare and submit Olive oil Emulsion(Dry gum method)
3. Prepare and submit Turpentine oil Emulsion(Wet gum method)
4. Prepare and submit Castor oil Emulsion(Wet gum method)
5. Prepare and submit Olive oil Emulsion(Wet gum method)

MIXTURES

6. Prepare and submit Mixture containing Soluble medicaments.
7. Prepare and submit Mixture containing Indiffusible solids.
8. Prepare and submit Mixture containing Diffusible solids.
9. Prepare and submit Mixture containing Slightly soluble liquid
10. Prepare and submit Mixture containing Small dose of potent medicament.

SUPPOSITORIES

11. Prepare and submit Soap-Glycerine Suppositories.
12. Prepare and submit Glycerol Suppositories
13. Prepare and submit Bismuth subgallate Suppositories.

TINCTURE

14. Prepare and submit Orange tincture.
15. Prepare and submit Lemon tincture.
16. Prepare and submit Ginger tincture.
17. Prepare and submit Compound cardamom tincture.

EYE DROP

18. Prepare and submit Atropine sulphate eye drop.

EAR DROP

19. Prepare and submit Chloramphenicol ear drop.

NASAL DROP

20. Prepare and submit Ephedrine hydrochloride Nasal drop.

POWDERS

21. Prepare and submit Aspirin (Compound Powder)
22. Prepare and submit Phenacetin (Compound Powder)
23. Prepare and submit Sodium bicarbonate (Compound Powder)
24. Prepare and submit Codeine phosphate Powder(containing small dose of potent medicament)
25. Prepare and submit Dizepam Powder(containing small dose of potent medicament)
26. Prepare and submit Dusting Powder (Bulk Powder)

TOOTH POWDER

27. Prepare and submit Tooth Powder

GARGLES

28. Prepare and submit Gargles containing potassium chlorate

MOUTHWASH

29. Prepare and submit zinc Sulphate Mouthwash

INHALATION

30. Prepare and submit Eucalyptus oil Inhalation

THROAT PAINT

31. Prepare and submit Throat paint.

ENEMAS

32. Prepare and submit Magnesium sulphate Enema.

POULTIES

35. Prepare and submit Kaoline Poultics.

CAPSULE

36. Prepare and submit Rifampicin capsule.

DOUCHES

37. Prepare and submit Potassium permanganate Solution (douche)

GRANULES

38. Prepare and submit Citrotartaric acid effervescent granules
39. Prepare and submit Granules ready for compression.

LINCTUS

40. Prepare and submit Codeine Linctus.

Subject code: 2T2
Subject: Pharmaceutical Chemistry-II (Organic)
THEORY: **45 Hours (3 Hrs. /week)**

1.Stucture and Properties

Concept of structural theory, atomic orbitals, electronic configuration, molecular orbital theory, hybridization, intermolecular and intramolecular forces, bonds, polarity of bonds, electronegativity, hydrogen bond and its effects, physical properties of the molecules. **10 Hrs**

Organic compounds their sources and scope. Detection and estimation of elements (C, H, O, N, S, P and Halogens). Empirical and molecular formula. **5 Hrs**

Nomenclature, physical properties, uses and detection of organic compounds of following classes
Alkanes, Alkenes, Dienes, Alkynes, Alcohols, Aldehydes and Ketones, Amines, Phenols, Alkyl Halides, Carboxylic acids, Cycloalkanes. **10 Hrs**

2.Stereochemistry

Stereoisomerism, various projections of molecules, optical activity, enantiomers, diastereomers, Racemic modification and resolution, Geometrical Isomerism, Nomenclature in stereoisomerism (RS, EZ, DL configurations), sequence rule. Configuration and conformations, Bayer strain theory. **10 Hrs**

Introduction to chemical reactions

Functional Groups, Types of organic reactions, substrate, reagent, hemolytic and heterolytic reactions, factors affecting organic reactions. **10 Hrs**

Subject code: 2P2
Subject: Pharmaceutical Chemistry-II (Organic)
PRACTICAL: **3 Hrs. /week**

1 To study the apparatus used in the organic chemistry laboratory.
2 To determine the melting point of the organic compound.
3 To determine the boiling point of the organic compound.
4 To determine the solubility of the organic compound.
5 To detect the functional groups present in the organic compound.
6 To build the structure of organic compounds by using stereomodels.
7 To synthesize benzamide from ammonia and benzoyl chloride.
8 To synthesize Phenyl Benzoate from benzoyl chloride.
9 To synthesize Benzoic acid from benzamide.
10 To synthesize benzoyl glycine from benzoyl chloride and glycine.

Subject code: 2T3
Subject: Human Anatomy and Physiology-II
THEORY: **45 Hours (3 Hrs. /week)**

1. **Digestive system:** Anatomy and physiology of organs of digestive system. Secretion and functions of – salivary glands, stomach, small intestine, large intestine pancreas and liver. Digestion and absorption of Carbohydrate, Proteins and Fats. **8 Hrs**
2. **Nervous system:** Organization, Neurons – membrane potentials as signals, Cerebrum – functional areas, sensory & motor pathways, anatomy and physiology of other parts of brain (mid brain, pons, medulla oblongata, cerebellum, thalamus and hypothalamus), extra pyramidal system, limbic system, Spinal cord (Structure and reflexes), cranial nerves (Names and functions) Autonomus nervous system (Sympathetic and parasympathetic). **12 Hrs**
3. **Urinary system:** Anatomy and physiology of urinary system, structure of Nephron, formation of urine, micturition, Renin angiotensin system. **7 Hrs**
4. **Endocrine system:** Physiology of hormones of hypothalamus-pituitary gland, adrenal gland, thyroid gland, pancreas and gonads (testis and ovary). **8 Hrs**
5. **Integumentary system:** Structure and functions of skin, regulation of body temperature. **4 Hrs**
6. **Sense organs:** Anatomy and physiology of eye and ear, sense of smell and taste. **6 Hrs**

Subject code: 2P3
Subject: Human Anatomy and Physiology-II
PRACTICAL: **3 Hrs. /week**

1. Recording of body temperature.
2. Study of human skeleton.
3. Study of axial skeleton.
4. Study of appendicular skeleton.
5. Study of joints.
6. Study of gross anatomy & physiology of various organs/system by models/charts/specimens:
    a. Digestive system
    b. Central nervous system
    c. Urinary system
    d. Eye
    e. Ear
7. Histology: Microscopic study of different types of primary tissues and organs from permanent slides.
8. Study of first aid measures.
9. Urine analysis for normal and abnormal constituents.
10. Demonstration of simple muscle curve using computer software.
11. Demonstration of the effect of temperature on muscle contraction using computer software.
12. Demonstration of muscle fatigue curve using computer software.

Subject code: 2T4
Subject: Pharmaceutical Analysis-I
THEORY: **45 Hours (3 Hrs. /week)**

1. **Quantitative Analysis**: **6 Hrs**.
   - Pharmaceutical analysis- Definition and scope
   - Different techniques of analysis
   - Methods of expressing concentration
   - Primary and secondary standards
   - Precision and accuracy
   - Errors-concept, classification and minimization of errors

An outline of theoretical consideration, general methodologies, applications (in drug analysis and quality control), advantages, limitation, standardization and assay procedures of following volumetric techniques.

2. **Acid-Base Titration**: **7 Hrs**
   - Neutralization theory & Neutralization curves
   - Theory of Indicators

3**. Non-aqueous Titrations:** **7 Hrs**
   - Theory, advantages and limitation
   - Non-aqueous solvents
   - Acidimetry and Alkalimetry in non-aqueous solvents

4. **Redox Titrations** **7 Hrs**
   - Redox titration curve and detection of end point/redox indicators
   - Potassium permanganate
   - Ceric Ammonium Sulphate
   - Iodimetry and Iodometry

5. **Gravimetric Analysis** **7 Hrs**
   - Practical aspect of gravimetric analysis-precipitation, digestion, filtration, washing, drying/ignition of precipitate
   - Purity of the precipitate:co-precipitation and post precipitation
   - Thermogravimetry

6. **Precipitation Titrations**: **5 Hrs**
   - Mohr's method
   - Volhard's method
   - Adsorption indicators.

7. **Complexometric Titrations**: **6 Hrs**
   - Types of EDTA - titrations with applications in Pharmaceuticals.
   - Titration of mixtures, selectivity, masking and demasking
   - Metal ion indicators- theory of the visual use of metal ion indicator

Subject code: 2P4
Subject: Pharmaceutical Analysis-I
PRACTICAL: **3 Hrs. /week**

1. Assay of aspirin I.P.
2. Assay of boric acid I.P.
3. Assay of ammonium chloride I.P.
4. Assay of sodium bicarbonate I.P.
5. Preparation and standardization of 0.1 N potassium permangnate solution.
6. Preparation and standardization of 0.1 N iodine solution.
7. Assay of hydrogen peroxide I.P
8. Assay of phenol I.P
9. Preparation and standardization of 0.1 N silver nitrate Solution
10. Assay of sodium chloride I.P.
11. Assay of potassium chloride I.P.
12. Preparation and standardization of EDTA solution.
13. Assay of calcium gluconate I.P.

Subject code: 2T5
Subject: Pharmacognosy and Phytochemistry-II
THEORY: **45 Hours (3 Hrs. /week)**

1. **Carbohydrates and related compounds** **12 Hrs**
   Introduction, Collection, Preparation, Chemistry, Chemical tests and uses of-
   Sugars- Honey, Sorbitol, Mannitol, Carmel, Liquid glucose
   Starches and Modified starches
   Cellulose and their derivatives
   Polysaccharides from marine sources- Agar, Sodium alginate, and Carrageenan
   Other Polysaccharides- Bael, Dextrin, Dextran, Inulin, Pectin
   Gums- Acacia, Tragacanth, Gum Karaya, Guar gum
   Mucilages- Isapghula
2. **Lipids** **9 Hrs**
   Definition, method of extraction, chemistry
   Study of method of production, chemical constituents, tests, uses of the following drugs-
   Fixed Oils: Castor oil, olive oil, Linseed oil, Seasame oil, Soya oil, Cod liver oil, Shark liver oil.
   Fats: Cocoa butter, Kokum butter
   Waxes: Bees wax, Wool fat, Carnauba wax
3. **Natural fibers** **6 Hrs**
   Introduction, Classification, Chemical tests and uses of following fibers- Cotton, Jute, Silk, Wool.
4. **Drugs of mineral and Herbo-mineral origin** **8 Hrs**
   Introduction, Classification, Chemical tests and uses of following drugs- Talc, Chalk, Kaolin, Kieselghur, Bentonite, Calamine and Shilajit
5. **Drugs of animal origin** **5 Hrs**
   Musk, Civet, Cantharides, Shellac, and Gelatin.
6. **Enzymes of Pharmaceutical interest** **5 Hrs**
   Papain, Pancreatin, Pepsin, Hyaluronidase, Streptokinase.

Subject code: 2P5
Subject: Pharmacognosy and Phytochemistry-II
PRACTICAL: **3 hrs. /week**

1. Identification of following crude drugs by morphological study and chemical tests -
   Tragacanth, Acacia, Karaya gum, Guar gum, Sodium alginate, Agar, Starch, Honey and Pectin
2. Evaluate following drugs by their morphological characters and chemical tests -
   Castor oil, Wool fat, Bees wax and Sesame oil
3. Detection of adulteration of fixed oil by chemical tests
4. Identification of mineral drugs chemical tests -
   Talc, Chalk, Kaolin, Kieselguhur and Bentonite
5. Determination of swelling factor of Isapghula seeds
6. Identification of fibers by morphological characters and chemical tests - Cotton, Jute, Silk, Wool
7. Isolation of starch from potato

Subject code: 2T6
Subject: Statistics and Computer Application in Pharmacy
THEORY: **45 Hours (3 Hrs. /week)**

1. **Basic Concepts of Statistics** **7 Hrs**
   Introduction, Statistical data, data graphics, types of variables, collection and classification of data, frequency distribution, measure of central tendency, arithmetic mean, mode and median, measure of data dispersion – range, mean deviation and standard deviation
2. **Linear Regression and Correlation** **7 Hrs**

Concepts and method for studying correlation, significance of testing of correlation coefficient, lines of regression, properties of coefficient, methods to find regression lines, application of linear regression

3. **Analysis of Variance (ANOVA)** **5 Hrs**
   Meaning, techniques, one way and two way ANOVA

4. **Statistical Inferences** **7 Hrs**
   Sampling method, estimation, statistical tests for rejection of discordant data – Q test, Z test, Confidence interval estimation, Testing, testing procedure, 't' test, Chi square test, confidence interval in Bio-assays

5. **Computer Fundamentals** **7 Hrs**
   Introduction, history of computer development, hardware, general components of computer viz, memory, various input-output units, C.P.U., secondary storage units, low and high level languages, unit of capacity, classification of computers on the basis of size and capacity

6. **Internet and Networking** **4 Hrs**
   Introduction and history, connecting to internet, World Wide Web and Browser, e-mail. Need and advantages of networking – Concepts of LAN and WAN

7. **Operating system and MS-OFFICE** **4 Hrs**
   Types and functions of operating systems, overview of DOS and UNIX operating system. Introduction to word, Excel and Power-point

8. **Applications** **4 Hrs**
   Application of computer in Pharmacy viz, drug information, storage and retrieval, pharmacokinetics, drug design, crude drug identification, hospital and clinical pharmacy, pharmaceutical analysis, diagnosis and data analysis, bulk drug and pharmaceutical manufacture

SEMESTER-III

Subject code: 3T1
Subject: Pharmaceutics-III (Unit Operations)
THEORY: **45 Hours (3 Hrs. /week)**

1. **Size reduction** **5 Hrs**
   Theories and objectives of size reduction, Factors affecting size reduction, Mechanisms of size reduction with examples of equipment.
2. **Size separation** **5 Hrs**
   Screens, Air separation methods – cyclone separator, bag filter
3. **Mixing** **5 Hrs**
   Types of mixtures, Equipment's used in mixing of powders, liquids and semi-solids.
4. **Mass Transfer** **6 Hrs**
   Molecular diffusion in gases & liquids, mass transfer in turbulent & laminar flow, theories of interphase mass transfer.
5. **Flow of fluids** **7 Hrs**
   Fluid statics, dynamics, transportation of fluids-reciprocating, rotary and centrifugal pumps, fluid flow rate measuring devices-orifice meter, pitots meter, venturi meter and rotameter.
6. **Transportation of solids** **5 Hrs**
   Belt, screw, bucket and pneumatic conveyer for transportation of solids
7. **Filtration** **7 Hrs**
   Mechanisms and types of filtration, Theories of filtration, factors influencing filtration, filter aids, Study of Filter press, Meta filter, rotary drum filter and disc filter.
8. **Centrifugation** **5 Hrs**
   Principle of centrifugation, study of perforated basket centrifuge, tubular bowl centrifuge, conical disc centrifuge.

Subject code: 3P1
Subject: Pharmaceutics-III (Unit operations)
PRACTICAL: **3 Hrs. /week**

1. Sieve analysis to study particle size distribution.
2. Study of particle sedimentation using Stoke's law.
3. Study of filter aid on rate of filtration.
4. Study of effect of centrifugation speed and time on rate of sedimentation.
5. Study of thickeners area using batch settling method.
6. Study of efficiency of pump.
7. Determination of hardness of water sample.
8. Reduction of particle size using ball mill.
9. Determination of drag coefficient for particles settling method.
10. Study of sedimentation behavior using suspending agents.
11. Engineering Drawing sheets (Minimum 5 Experiments): Alphabets and numbering, and Geometric constructions (minimum 5 per sheet)

Subject code: 3T2
Subject: Pharmaceutical Chemistry-III (Organic)
THEORY: 45 Hours (3 Hrs. /week)

Preparation and reactions of the following groups of compounds. (Including mechanism of reaction wherever necessary)

1. Aliphatic and alicyclic compounds like alkanes alkenes, alkynes, cycloalkanes. **10 Hrs**
2. Alkyl Halides **5 Hrs**
3. Aldehydes and Ketones **7 Hrs**
4. Aliphatic and Aromatic Amines **5 Hrs**
5. Organometallic Compounds, Grignards reagent, organolithium compounds, their preparation and synthetic applications. **7 Hrs**
6. Aromatic Hydrocarbons, Huckel's Rule, Aromatic Character, structure of benzene, resonance, orientation of substitution, Electrophilic aromatic substitution reaction. **5 Hrs**
7. Phenols **3 Hrs**
8. Carboxylic Acids and their derivatives. **3 Hrs**

Subject code: 3P2
Subject: Pharmaceutical Chemistry-III (Organic)
PRACTICAL: 3 Hrs. /week

1 To detect the functional group present in the organic compound.
2 To identify the organic compound and prepare its derivative.
3 To synthesize 2,4,6 trinitrophenol (Picric acid) from Phenol.
4 To synthesize p-iodo nitro benzene from p-nitroaniline.
5 To synthesize 1-phenyl Azo-2- Napthol from aniline and 2- Napthol.
6 To synthesize benzanilide from aniline and benzoyl chloride.

Subject code: 3T3
Subject: Pathophysiology and Clinical Biochemistry (Pathophysiology of common diseases)
THEORY: 45 Hours (3 Hrs. /week)

1. Cell injury, death and adaptations: Causes of cell injury, mechanism of cell injury, forms and morphology of injury. Cellular adaptations of growth and differentiation, cellular ageing. **5 Hrs**
2. **Inflammation:** Basic mechanism involved in the process of inflammation and repair, alteration in vascular permeability and blood flow, migration of WBCs, acute and chronic inflammation, and mediators of inflammation and brief outline of the process of repair. **5 Hrs**
3. **Pathophysiology of common diseases:** Rheumatoid arthritis, gout, epilepsy, parkinsonism, schizophrenia, depression and mania, hypertension, angina, myocardial infraction, congestive heart failure, atherosclerosis, diabetes mellitus, peptic ulcer, hepatitis, cirrhosis, acute and chronic renal failure, asthma, chronic obstructive pulmonary disease, sexually transmitted diseases (syphilis, gonorrhea, AIDS), pneumonia, typhoid, urinary tract infection, tuberculosis, leprosy, malaria, dysentery (bacterial and amoebic), and common types of neoplasm. **20 Hrs**
4. **Clinical Biochemistry:** Analytical, therapeutic and diagnostic use of enzymes. Diseases related to carbohydrate metabolism – Galactosemia, glycogen storage diseases. Diseases related to protein metabolism – disorders associated with urea cycle, disorders associated with metabolism of various amino acids, Kwashiorkar and marasmus. Disorders associated with lipid metabolism – hyperlipidemia, fatty liver and obesity. **10 Hrs**
5. Liver function tests, Renal function tests, Gastric function tests and Pancreatic function tests. **5 Hrs**

Subject code: 3P3

Subject: Pathophysiology and Clinical Biochemistry (Pathophysiology of common diseases)
PRACTICAL: 3 Hrs. /week

1. Different methods for collection of blood.
2. Estimation of Haematocrit
3. Estimation of packed cell volume.
4. Physical examination of urine
5. Chemical examination of urine. (Protein, Albumin)
6. Chemical test of urine sugar, ketone bodies.
7. Test for bile salt and bile pigment in urine.
8. Determination of glucose in serum.
9. Estimation of serum cholesterol.
10. Estimation of serum triglycerides.
11. Estimation of serum proteins.
12. Estimation of SGOT and SGPT in serum
13. Estimation of creatinine in serum and urine
14. Estimation of urea in serum and urine.
15. Estimation of serum acid and alkaline phospatase.
16. Estimation of bilirubin content in blood

Note: Animal blood or discarded blood from pathology lab. or blood bank can be used for above mentioned experiments.

Subject code: 3T4
Subject: Pharmacology-I
THEORY: 45 Hours (3 Hrs. /week)

1. General Pharmacology **20 Hrs**

A. Definition, introduction and scope of pharmacology **2 Hrs**
B. Different routes of drug administration in humans and laboratory animals **2 Hrs**
C. Pharmacokinetics:
   1. Principles and applications of pharmacokinetics. **2 Hrs**
   2. Transport across cell membrane **2 Hrs**
   3. Absorption of drug and factors affecting absorption **3 Hrs**
   4. Drug distribution: physiolological barriers and factors affecting **3 Hrs**
   5. Biotransformation of drugs **4 Hrs**
   6. Excretion of drugs **2 Hrs**
D. Pharmacodynamics: General, molecular & biochemical aspects of drug actions, receptors, drug receptor interactions, factors modifying drug effects. **4 Hrs**

Study of Pharmacological action of following classes of drug with respect to classification of recently available drugs, Mechanism of action, Receptors, Adverse effects, Drug interaction, Contraindication and Therapeutic uses:

2. Pharmacology of drugs acting on ANS **22 Hrs**

A. Introduction- Neurohumoral transmission **2 Hrs**
B. Adrenergic and cholinergic receptors **3 Hrs**
C. Adrenergic drugs **3 Hrs**
D. Adrenergic receptor blockers **3 Hrs**
E. Cholinomimetics, anticholinesterases **3 Hrs**
F. Anti- muscarinic agents **3 Hrs**
G. Ganglionic blockers and stimulants **3 Hrs**
H. Neuromuscular blocking agents **2 Hrs**

3. Bio-Assay **3 Hrs**

Scope, Principle and Design of official bioassays.

Subject code: 3P4
Subject: Pharmacology-I
PRACTICAL: 3 Hrs. /week

1. Introduction to experimental Pharmacology.

2. Study of laboratory animals used in experimental pharmacology.
3. Study of laboratory appliances used in experimental pharmacology.
4. Preparation of various physiological salts solution used in experimental pharmacology.
5. Demonstration of rat dissection in general.
6. To isolate ileum, fundus, trachea, uterus and anacoccygeous muscle and to record concentration response curve using these tissues of rats.
7. Demonstrate the effect of cholinergic agents on rabbit eye.
8. Demonstrate the effect of anticholinergic agents on rabbit eye.
9. Demonstrate the effect of local anesthetic on rabbit eye.

Subject code: 3T5
Subject: Pharmaceutical Microbiology and Immunology-I
THEORY: 45 Hours (3 Hrs. /week)

1. Introduction to Microbiology: 10 Hrs
Scope and applications to Pharmaceuticals, Whittaker's five kingdom concept, classification of microbes into bacteria, rickettsia, actinomycetes, fungi, protozoa, algae and viruses. Historical developments – contributions of Alexander Fleming, Antony Van Leeuwenhoek, Louis Pasteur, Robert Koch and Paul Ehrlich.

2. Microscopy: 6 Hrs
Principle and applications of compound, Dark-field, phase contrast and fluorescence microscope. Different parts of compound microscope, resolving power, magnification power, numerical aperture and working distance. Electron microscopy – SEM and TEM

3. Microbiology of Bacteria: 12 Hrs
Size, shape and arrangement, structure of bacterial cell, reproduction, growth, growth requirements, growth curve, culture media, measurements of bacterial growth, colony characteristics, methods for isolation. Identification and preservation of microbial cultures.
Genetics – DNA, RNA, Protein synthesis, transposons, plasmids. Mutation- Types of mutation, mutagenic agents.

Recombination in bacteria – conjugation, transformation and transduction, Replica plate technique.

4. Microbiology of fungi: 4 Hrs
Introduction, classification, nutrition and reproduction

5. Microbiology of Viruses: 6 Hrs
Introduction, general properties, structure, bacteriophage – lytic growth cycle and lysogeny. Human viruses – cultivation and multiplication, quantitative determination.

6. Microbial diseases (Etiology, pathophysiology, transmission, prevention and treatment) 7 Hrs
Bacterial and viral diseases i.e. Tuberculosis, AIDS, Leprosy, Syphilis, Influenza, Typhoid, Malaria. Cholera. Fungal infections.

Subject code: 3P5
Subject: Pharmaceutical Microbiology and Immunology-I
PRACTICAL: 3 Hrs. /week

1. Study of equipments and apparatus used in experimental microbiology.
2. Preparation and sterilization of culture media.
3. Aseptic transfer techniques.
4. Isolation of pure culture by streak plate method.
5. Isolation of pure culture by pour plate method.
6. Study of cultural characteristics of microorganisms.
7. Total count of micro-organisms by direct microscopy method.
8. Viable count of micro-organisms by plate count method.
9. Viable count of micro-organisms by spread plate method.
10. Smear preparation and fixation.
11. Study of bacterial morphology by simple staining.
12. Study of bacterial morphology by negative staining.
13. Study of bacterial morphology by Gram staining.
14. Motility studies.
15. Biochemical tests (Starch hydrolysis, Lipid hydrolysis, Casein hydrolysis, Oxidase test and Catalase test)

Subject code: 3T6
Subject: Pharmaceutical Jurisprudence and Ethics
THEORY: **45 Hours (3 Hrs. /week)**

1. **Historical background of Drug legislation in India.** **3 Hrs**
   Origin and nature of pharmaceutical legislation in India, Its scope and objective, new drug policy and future trends.
2. **Code of Ethics for Pharmacists.** **2 Hrs**
   Principles and significance of professional ethics, critical study of code of pharmaceutical ethics drafted by PCI regarding to pharmacist in relation to his job, to his trade, and to medical profession.
3. **Pharmacy Act 1948.** **6 Hrs**
   Definition, PCI and State Councils, Composition and Function, Preparation of Registers and qualifications for entry into registers, Educational Regulation and Approval of Courses and Institutions, Offences and Penalties
4. **Medicinal and Toilet Preparations (Excise Duties) Act 1955, Rules 1976.** **4 Hrs**
   Definitions, restricted and unrestricted preparations, Manufacturing in bond and outside bond
5. **Drug Price Control Order** **2 Hrs**
6. **Drugs and Magic Remedies (Objectionable Advertisements) Act 1954.** **2 Hrs**
   Definitions, Prohibited Advertisement, Savings
7. **Drugs and Cosmetics Act 1940, Rules 1945**. **15 Hrs**
   Definitions, Advisor bodies DTAB and DCC Composition and function, Drug Control Laboratories and Government Analysts, Drug inspectors, Licensing Authorities, Controlling Authorities and Customs Collectors Provisions Governing Import, Manufacture and Sale of Drugs. Labeling and Packaging of Drugs. Provisions applicable to manufacture and Sale of Ayurvedic Drugs, Provisions Governing Import, Various offences and corresponding Penalties, Broad content of various Schedules of the Drugs and Cosmetic Act and Rules.
8. **Narcotic Drugs and Psychotropic Substances Act, and Rules there under** **6 Hrs**
   Definition, Prohibited and controlled operation, cultivation of poppy plants, sale of opium, import and export of narcotics as amended to date, Offences and corresponding penalties.
9. **Consumer Protection Act** **3 Hrs**
10. **Medical termination of pregnancy act 1970 and rules 1975** **2 Hrs**

SEMESTER-IV

Subject code: 4T1
Subject: Pharmaceutics-IV (Unit operations)
THEORY: **45 Hours (3 Hrs. /week)**

1. **Flow of heat** **6 Hrs**
   Mechanisms of heat transfer: conduction, convection and radiation, Fourier's law, Stefan Boltzmann's constant, Kirchoff's law, heat transfer- between fluid & solid boundary, boiling liquids, condensing vapor's, heat exchangers and heat interchangers.

2. **Evaporation** **6 Hrs**
   Theory of evaporation, classification of evaporators, study of evaporating pan, short tube (single and multiple effect) and long tube evaporators (forced and natural circulation), economy, capacity and feeding methods of multiple effect evaporators.

3. **Distillation** **9 Hrs**
   Roult's law, Henry's law and Dalton's law, Volatility and relative volatility, Simple distillation, Fractional distillation and columns used in it, Azeotropic distillation, extractive distillation and molecular distillation.

4. **Drying** **7 Hrs**
   Theory of drying, Behavior of solids on drying, Classification of solids based on drying, Tray dryer, Fluidized bed dryer, spray dryer, freeze dryer, flash dryer and drum dryer.

5. **Crystallization** **7 Hrs**
   Theory of crystallization, Mier's theory and its limitations, Nucleation and crystal growth, Study of Agitated batch crystallizer, Swenson Walker crystallizer, Krystal crystallizer, Vacuum crystallizer, Vacuum crystallizer with recirculation and its operating variables, growth type crystallizer.

6. **Environmental control** **6 Hrs**
   Theory of humidification and dehumidification, Study of air conditioning, refrigerants and refrigeration cycle, cooling towers.

7. **Corrosion** **4 Hrs**
   Mechanisms, factors influencing corrosion process, method of combating it.

Subject code: 4P1
Subject: Pharmaceutics-IV (Unit operations)
PRACTICAL: **3 Hrs. /week**

1. Study of effect of pressure on the rate of evaporation.
2. Study of effect of viscosity on the rate of evaporation.
3. Plotting of boiling point curve.
4. Study of rate of drying of solid sample (amorphous and crystalline).
5. Study of drying behavior of solid sample (amorphous and crystalline).
6. Crystallization of sodium chloride.
7. Crystallization of boric acid without seeding.
8. Crystallization of boric acid with seeding.
9. Study of effect of cooling on crystal growth.
10. Engineering Drawing sheets (Minimum 5 Experiments): Orthographic projections

Subject code: 4T2
Subject: Pharmaceutical Chemistry-IV (Heterocyclic and Macromolecules)
THEORY: 45 Hours (3 Hrs. /week)

1. Heterocyclic compounds: 15 Hrs
Structure, nomenclature, synthesis and properties including reaction mechanistic, stereochemical considerations and pharmaceutical uses of the following heterocyclic compounds:
Pyrrole, Furan, Thiophene, Imidazole, Oxazole, Pyridine, Pyrimidine, Quinoline, Isoquinoline, Indole, Purine and Phenothiazine.

2. Polynuclear aromatic compounds: 6 Hrs
Structure, nomenclature, synthesis, properties and stereochemistry of Naphthalene, Anthracene and Phenanthrene.

3. Carbohydrate: 10 Hrs
Classification, structure and reactions of Glucose, configuration of aldoses, cyclic structure of D-glucose, mutarotation and conformations, structure of Maltose, Sucrose, Starch, Simple glycosides like Salicin, and Amygdalin.

4. Amino acids and Proteins: 8 Hrs
classification, isolation, and synthesis, of amino acids; isolation, purification and hydrolysis of peptides leading to amino acid sequence determination and their general synthetic methods; classification, properties and structure of proteins,

5. Lipids: 6 Hrs
Classification and general chemistry of lipids and fats, their properties and characterization, fatty acids and their reactions, waxes, phospholipids, glycolipids, lipoproteins.

Subject code: 4P2
Subject: Pharmaceutical Chemistry-IV (Heterocyclic and Macromolecules)
PRACTICAL: 3 Hrs. /week

1. Synthesis and physico-chemical characterization of following compounds
   - Benzimidazole from o-phenylenedimine and formic acid.
   - Quinoline from Aniline by Skraup method.
   - 2-phenyl indole from acetophenone and phenyl hydrazine.
   - Piperazine-2,5-dione from glycine.
   - Eosin from phthalic anhydride and resorcinol
2. Analysis of oils and fats (I.P. method)
   - Acid value
   - Saponification value
   - Iodine value
3. Quantitative determination of organic compounds via functional groups
   - Carboxyl group by alkalimetry.
   - Phenolic group by bromination method
   - Carbonyl group by hydroxyl amine hydrochloride-pyridine method.
   - Amino group by bromination method

Subject code: 4T3
Subject: Pharmaceutical Analysis-II (Electroanalytical and Physical methods)
THEORY: 45 Hours (3 Hrs. /week)

1. Refractometry 3 Hrs
Introduction, factors affecting refractive index, specific and molar refraction, Instrumentation, Application.

2. Polarimetry
Introduction, factors affecting angle of rotation, Instrumentation, Application. **3 Hrs**

3. Potentiometry 6 Hrs
Electrochemical cell, Standard electrode potential, Mechanism of electrode potentional, Types of electrode (Reference electrode-Hydrogen, calomel, silver/silver chloride electrode and Indicator electrode- Glass, redox, ion-selective electrodes), Method of detecting end point, potentiometric titration(advantages, types, applicaions).

4. Conductometry **6 Hrs**

Introduction, Advantages and disadvantages of conductometry, Some important terms (conductance, specific resistance specific conductance, equivalent and molecular conductance), Factor affecting conductance, Measurement of conductance, Instrumentation of conductivity meter, Principle and types of conductometric titrations, Applications, Introduction of High Frequency Titration (Oscilillometry).

5. Polarography **6 Hrs**

Introduction and theory of polarography, Instrumentation, Ilkovic equation, Current potential relationship, Choice of electrode (Platinum and Dropping mercury with types, advantages and disadvantages), Applications, Derivative or Differential polarography, Pulse polarography (Normal and Differential pulse polarography),Introduction of Recent advantages in polarography (Alternating current polarography, Oscillographic polarography, Chronopotentiometry).

6. Amperometry **5 Hrs**

Introduction and principle of amperometry, Instrumentation, Advantages and disadvantages, Types of electrodes, Types of amperometric titrations, Biamperometric titrations/ Dead stop end point method, Applications.

7. Electrogravimetry **4 Hrs**

Theory, electrode reaction, overpotential, completeness of deposition, instrumentation, application.

8. Coulometry **4 Hrs**

Introduction, coulometry at controlled potential, coulometry at constant current, instrumentation, application.

9. Thermal Analysis Introduction and types of thermal analytical methods **8 Hrs**

a. **Thermogravimetry (TG):-** Introduction of thermogravimetry, Information obtained from TG scurve, Factors affecting TG curve, Instrumentation, Applications.
b. **Differential Thermal Analysis (DTA):-** Introduction, Theories of DTA, Factors affecting DTA curve, Instrumentation, Applications.
c. **Differential Scanning Calorimetry (DSC):-** Introduction, Advantages over DTA, Factors affecting DSC curve, Instrumentation, Applications.

Subject code: 4P3
Subject: Pharmaceutical Analysis-II (Electroanalytical and Physical methods)
PRACTICAL: **3 Hrs. /week**

1. Conductometric titration of strong acid Vs strong base.
2. Conductometric titration of strong acid Vs weak base.
3. Conductometric titration of weak acid Vs strong base.
4. Conductometric titration of weak acid Vs weak base.
5. Conductometric titration of very weak acid Vs strong base.
6. Determination of weak and strong acid in mixture by conductometry.
7. Potentiometric titration of strong acid Vs strong base.
8. Potentiometric titration of weak acid Vs strong base.
9. Determination of concentration and pKa of weak acid using pH meter.
10. Potentiometric assay as specified in IP.(Minimum two)
11. Determination of refractive index of sample.(Minimum three)
12. Demonstration of Karl Fischer Titration.
13. Demonstration of Polarimeter.

Subject code: 4T4
Subject: Pharmacology-II
THEORY: **45 Hours (3 Hrs. /week)**

Study of Pharmacological action of following classes of drug with respect to classification of recently available drugs, Mechanism of action, Receptors, Adverse effects, Drug interaction, Contraindication and Therapeutic uses :

1. Pharmacology of drugs acting on CVS **16 Hrs**

A. Antihypertensive drugs **3 Hrs**
B. Antianginal drugs **3 Hrs**
C. Antiarrythmic drug **3 Hrs**
D. Drugs used for CHF **3 Hrs**
E. Drugs used in Hyperlipidemia **2 Hrs**
F. Drug therapy of shock **2 Hrs**

2. Pharmacology of drugs acting on Renal system **6 Hrs**

A. Diuretics
B. Anti- diuretics

3. Autocoids and their blockers **12 Hrs**

A. Histamine and antihistaminic **3 Hrs**
B. 5- Hydroxytryptamine and its antagonist **3 Hrs**
C. Prostaglandins and non steroidal anti-inflammatory drugs, antipyretic, analgesic **3 Hrs**
D. Leukotrienes and platelet activating factor. **3 Hrs**

4. Pharmacology of drugs acting on Haemopoitic system **11 Hrs**

A. Haematinic **4 Hrs**
B. Coagulants and anticoagulants **4 Hrs**
C. Fibrinolytic and antiplatelet agents. **3 Hrs**

Subject code: 4P4
Subject: Pharmacology-II
PRACTICAL: **3 Hrs. /week**

1. To demonstrate per oral (gavage) route of drug administration in rats and mice.
2. To demonstrate parenteral route of drug administration.
3. To demonstrate blood withdrawal by puncture of retro orbital plexus from rats.
4. To demonstrate blood withdrawal from tail vein of rats.
5. To record cumulative dose response curve (CDRC) using rat ileum.
6. To record CDRC using rat fundus preparation.
7. To demonstrate antihistaminic activity using histamine aerosol model.
8. To find unknown concentration of Ach by matching bioassay using rat ileum.
9. To find unknown concentration of Ach by bracketing bioassay using rat ileum.
10. To find unknown concentration of Ach by interpolation bioassay using rat ileum.

Subject code: 4T5
Subject: Pharmaceutical Microbiology and Immunology-II
THEORY: **45 Hours (3 Hrs. /week)**

1. Sterilization: **7 Hrs**
Different methods – dry heat, moist heat, gaseous, radiation and filtration. Sterilization indicators, D-value, Z-value, Sterility testing of Pharmaceutical products as per I.P.

2. Disinfections: **5 Hrs**
Chemical classification of different disinfectants, dynamics of disinfectant and factors affecting on disinfectant action, Evaluation of disinfectant, Phenol coefficient test.

3. Aseptic Techniques: **5 Hrs**
Designing of aseptic area, sources of contamination in aseptic area, and methods of prevention, laminar air flow.

4. Immunology:
a) Fundamentals of Immunology: **10 Hrs**
Microbial flora of human body, portal of entry of microorganism, microbial pathogenecity, virulence, exotoxins, endotoxins. Defense mechanisms of host – specific and nonspecific. Types of Immunity. Antigens, antibodies, Compliment proteins.
b) Antigen - Antibody reactions: **6 Hrs**
Introduction, precipitation, agglutination, compliment fixation, immunoelectrophoresis, immunofluorescence, ELISA, radioimmunoassay.
c) Hypersensitivity reactions: **4 Hrs**
Introduction, Immediate and delayed hypersensitivity, type I, II, III, IV hypersensitivity.

d) Preparation of vaccines and sera: **8 Hrs**

Introduction, manufacturing and quality control. Preparation of vaccines (BCG, TAB, DPT, Polio, MMR and Rabies), toxoids (Tetanus and Diphtheria) and sera (antibacterial, antiviral, antitoxin and antivenum). Diagnostic agents- Tuberculin, Schick tests.

Subject code: 4P5
Subject: Pharmaceutical Microbiology and Immunology-II
PRACTICAL: 3 Hrs. /week

1. Biochemical tests (IMViC tests).
2. Antimicrobial Sensitivity testing.
3. Determination of MIC.
4. Antimicrobial activity of medicinal plant extracts.
5. Microbiological assay of antibiotics by cup plate method (Minimum two antibiotics).
6. Sterility testing by direct transfer.
7. Sterility testing by membrane filtration methods.
8. Sterility testing for powdered drug sample.
9. Bacteriological examination of air.
10. Bacteriological examination of water and milk.

Subject code: 4T6
Subject: Pharmaceutical Management
THEORY: 45 Hours (3 Hrs. /week)

1. Management: 6 Hrs
Concept of management, principles of management, primary functions of management- planning, organizing, staffing, directing, controlling, motivating, entrepreneurship development, operative management- personnel, materials, production, financial, marketing etc. Secondary functions of management: decision making, leadership, innovation, delegation authority/ responsibility.

2. Materials Management: 5 Hrs
A brief exposure or basic principles of materials management-major areas, scope, purchase, stores, inventory control and evaluation of materials management.

3. Pharmacoeconomics: 5 Hrs
Principles of economics with special reference to the laws of demand and supply, demand schedule, demand curves, labor welfare, general principle of insurance and inland and foreign trade, procedure of importing and exporting of goods.

4. Pharmaceutical Marketing 6 Hrs
Functions, buying, selling, transportation, storage, finance, feedback, information, channels of distribution, wholesale, retail, departmental store, multiple shop and mail order business.

5. Salesmanship: 5 Hrs
Principles of sales promotion, advertising, ethics of sales, merchandising, literature, detailing. Recruitment, training, evaluation, compensation to the pharmacist.

6. Accountancy: 7 Hrs
Principle of accountancy, ledger posting and book entries, preparation of trial balance, columns of cash book, profit and loss account, balance sheet, purchase, keeping and pricing of the stock, treatment of cheques, bills of exchange, promissory note and hundies, documentary bills.

7. Production Management: 6 Hrs
Human resource planning, recruitment, and interviewing, human skills evaluation through various instruments, job description, job evaluation, role clarity, career planning.

8. Human Resource Management: 5 Hrs
Human resource planning, recruitment, and interviewing, human skills evaluation through various instruments, job description, job evaluation, role clarity, career planning.

SEMESTER-V

Subject code: 5T1
Subject: Pharmaceutics-V (Physical Pharmacy)
THEORY: **45 Hours (3 Hrs. /week)**

1. **Micromeritics:** **8 Hrs**
   Particle size, size distribution, shape and surface area and their determination in heterogeneous systems. Porosity, density and packaging arrangements in flow properties and their influence on processing of solid dosage forms, Mechanism of particle bonding and granule formation.

2. **Interfacial Phenomena:** **8 Hrs**
   Cohesion, adhesion and spreading. Adsorption at solid and liquid interfaces, adsorption isotherms, adsorption in Medicine and Pharmacy, Electrical properties of interfaces, origin of charge, electrical double layer, Nernst and Zeta potential, Effect of electrolyte.

3. **Surface active agents:** **6 Hrs**
   Classification based on chemical nature and HLB scale, Factors affecting micelle formation, structure of micelle and liquid crystal, Miceller solubelization and its pharmaceutical significance.

4. **Suspension:** **8 Hrs**
   Theoretic considerations, particle interaction and behavior, flocculation and deflocculation, sedimentation parameters, role of wetting, controlled flocculation and structured vehicle in formulation and manufacture of suspension, evaluation of suspension.

5. **Emulsion:** **7 Hrs**
   Types, detection, Thermodynamic consideration, Mechanism of droplet stabilization, Theories of emulsification. Formulation and manufacturing of emulsions, stability of emulsions, assessment of emulsion shelf life.

6. **Colloidal Dispersions:** **8 Hrs**
   Properties of colloids – Optical, Kinetic and Electrical and their application in determining molecular weight of polymer. Stability of colloidal systems, Mechanism of peptization, coacervation and protective action.

Subject code: 5P1
Subject: Pharmaceutics-V (Physical Pharmacy)
PRACTICAL: **3 Hrs. /week**

1. Determination of interfacial tension between two immiscible liquids and to calculate spreading coefficient.
2. Determination of CMC of a surfactant through interfacial tension measurement method.
3. To study the effect of electrolyte on CMC of surfactant
4. Determination of HLB of surfactant.
5. To plot adsorption isotherm.
6. Formulation and evaluation of emulsion
7. Formulation and evaluation of suspension
8. Measurement of the mean globule diameter of the emulsion.
9. Measurement of the particle size of a suspension by Andreasen pipette method.
10. Study of effect of particle size on angle of repose and flow properties.
11. Study of effect of fines and lubricant on angle of repose and flow properties.
12. Determination of bulk density, True density and Granular density of few pharmaceuticals and to calculate porosity of material

Subject code: 5T2
Subject: Pharmaceutical Medicinal Chemistry-I
THEORY: **45 Hours (3 Hrs. /week)**

1. Basic principles of medicinal chemistry: **5 Hrs**
Structure of biological membrane, physicochemical parameters affecting drug action, drug absorption, distribution and elimination. Stereochemical aspects of drug action, drug receptor interaction including transduction mechanism, blood brain barrier.

2.Drug metabolism: **4 Hrs**
Phase I and phase II reaction, biological factor affecting drug metabolism, inducers and inhibitors of drug metabolism, significance of drug metabolism studies in drug development.

3. Prodrug concept: Principles of prodrug design and applications. **2 Hrs**

Following topics shall be treated covering nomenclature, synthetic procedure of official drugs, uses SAR including physicochemical and steric aspects and mode of action.

Antiasthamatics, bronchodilators, phosphodiestrase inhibitors, expectorants, decongestant and antitussives. **4 Hrs**

General and local anaesthetics, sedative and hypnotics, skeletal muscle relaxants, anticonvulsant, CNS stimulant agents, antipsychotics and antidepressants, hypoglycemic agents and oxytocics **15 Hrs**

Antihistaminics, drugs used in Parkinsonism, Alzheimer's diseases and urinary tract infection. **6 Hrs**

Thyroid hormones and antithyroid drugs, Narcotic analgesics and NSAIDs, prostaglandins and eicosanoids. **9 Hrs**

Subject code: 5P2
Subject: Pharmaceutical Medicinal Chemistry-I
PRACTICAL: **3 Hrs. /week**

1. Pharmacopoeial assay of following solid dosage form
   - Aspirin
   - Thibendazole
   - Tolbutamide
   - Ibuprofen
   - Atenolol
2. Synthesis and physico-chemical characterization of following compounds
   - Sulfanilic acid from aniline
   - Prontosil from m-phenylenediamine and sulfanilamide
   - Benzylideneacetophenone (chalcone) from benzaldehyde and acetophenone
   - Methyl orange from sulfanilic acid and dimethyl aniline
   - Anthranilic acid from phthalic anhydride and urea

Subject code: 5T3
Subject: Pharmacology-III
THEORY: **45 Hours (3 Hrs. /week)**

Study of Pharmacology of following classes of drug with respect to classification of recently available drugs, mechanism of action, receptors, adverse effects, Drug interaction, contraindication and therapeutics uses.

1 Pharmacology of drug acting on CNS **24 Hrs**
- A. Introduction : cell signaling, neurotransmission, central neurotransmitters **2 Hrs**
- B. Alcohol and alcoholism **2 Hrs**
- C. General anesthetics **2 Hrs**
- D. Sedatives and hypnotics **2 Hrs**
- E. Anticonvulsants **2 Hrs**
- F. Antipsychotics, antidepressants and anxiolytics **6 Hrs**
- G. Drug dependence and drug abuse **2 Hrs**
- H. CNS stimulants **2 Hrs**
- I. Drugs for Neurodegenerative disorders **2 Hrs**
- J. Opoid Analgesic. **2 Hrs**

2. Pharmacology of local anaesthetics **2 Hrs**

3. Pharmacology of drugs acting on Respiratory System **6 Hrs**
- A. Drug therapy of asthma
- B. Anti tussives, expectorant and mucolytic agent.

4. Pharmacology of drugs acting on GIT **6 Hrs**
- A. Drugs used in ulcers
- B. Drugs for treatment of diarrheoa and constipation.
- C. Emetic and anti-emetics.

5. Clinical Research: **7 Hrs**

A. Clinical Trials: History, Terminologies, Various phases of clinical research, Role of clinical trial in new drug development. **2 Hrs**

B. Documents in clinical study: Investigator Brochure (IB), Protocol and its amendment, case report form (CRF), Informed consent form (ICF). **2 Hrs**

C. Ethical issues in clinical trial **3 Hrs**

Subject code: 5P3
Subject: Pharmacology-III
PRACTICAL: **3 Hrs. /week**

1. General introduction to CNS experimental pharmacology.
2. To study the analgesic activity of by using tail flick method in rats or mice.
3. To study the analgesic activity of by using hot plate analgesiometer in rats or mice.
4. To study the anti-inflammatory activity by using plethysmometer in rats or mice.
5. To study the anticonvulsant activity by using electroconvulsiometer in mice
6. To study hypnotic activity by using pentobarbital induced loss of righting reflex in mice.
7. To study the antipyretic activity by using telethermometer in rats.
8. To study the antidepressant activity by using forced swim test in rats or mice.
9. To study the anxiolytic activity by using in rats or mice.
10. To study the CNS Stimulant activity by using actophotometer in rats or mice.
11. To study the CNS Depressant activity by using actophotometer in rats or mice.

Subject code: 5T4
Subject: Pharmacognosy and Phytochemistry-III (Chemistry of Natural Products)
THEORY: **45 Hours (3 Hrs. /week)**

1. Extraction, isolation and purification methods for phytopharmaceuticals **10 Hrs**

a. Extraction: Theory of mass transfer, maceration, percolation, Soxhlet extraction and super critical fluid extraction
b. Chromatography isolation and purification: General principles and applications of adsorption, ion-exchange, size-exclusion, affinity. Detailed study of thin layer chromatography, paper chromatography, column chromatography, high performance thin layer chromatography, high pressure liquid chromatography and gas liquid chromatography.

2. Terpenoids and volatile Oils **10 Hrs**

a. Introduction, occurrence, general properties, classification, chemistry, uses, methods of extraction and evaluation, general biogenetic pathway.
b. Pharmacognostic study of following drugs

Hydrocarbon:	Pepper
Alcohol:	Peppermint, Cardamom, Coriander, sandalwood
Aldehyde:	Cinnamon, Lemon Grass, Citronella
Ketone:	Caraway, Camphor, Dill
Phenol:	Clove, Tulsi
Phenolic ether:	Fennel, Nutmeg
Oxide:	Eucalyptus

3. Resins and resin combinations **10 Hrs**

a. Introduction, Biosynthetic pathways, classification, physical and chemical properties, methods of extraction, and uses.
b. Pharmacognostic study of following drugs

Resins:	Colophony, Podophyllum, Benzoin, Tolu Balsam, Peru Balsam, Storax
Gum Resins:	Gamboage
Oleo-Gum Resins:	Asafoetida, Guggul, Boswellia, Myrrh
Oleo-Resins:	Capsicum, Ginger, Turmeric

4. Isolation, purification and chromatographic profiles of following phytoconstituents - Eugenol, cineole, camphor, menthol, citral. **6 Hrs**

5. A study of structural elucidation of following phytoconstituents - Camphor, eugenol, taxol and artemisinin. **9 Hr**

Subject code: 5P4
Subject: Pharmacognosy and Phytochemistry-III (Chemistry of Natural Products)
PRACTICAL: **3 Hrs. /week**

1. Isolation of volatile oil by hydro-distillation method using Clavenger's apparatus
2. Paper chromatography and TLC of natural products.
3. Thin layer chromatography of volatile oils.
4. Demonstration of column chromatography of crude extract
5. Determination of balsamic acids in Tolu or Peru balsam
6. Estimation of citral content from lemon grass oil
7. Estimation of carvone content from Dill oil
8. Estimation of cineole content of Eucalyptus oil
9. Isolation of eugenol from Cinnamon leaf oil
10. Study of morphological and microscopical characters of-
    Coriander, Cardamom, Cinnamon, Caraway, Dill, Clove, Fennel, Eucalyptus, Ginger
11. Identification of following crude drugs by their morphological characters and chemical tests
    Colophony, Benzoin, Balsams, Storax, Asafoetida, Guggul, Boswellia, Myrrh

Subject code: 5T5
Subject: Clinical Pharmacy
THEORY: **45 Hours (3 Hrs. /week)**

1. Introduction to Clinical Pharmacy Practice **2 Hrs**

2. Toxicology
   a) Acute, Sub acute and Chronic toxicity. **2 Hrs**
   b) Poison (Types and Classification) and General treatment of Poisoning. **2 Hrs**
   c) Signs, Symptoms and treatment of acute and chronic poisoning due to
      i) Barbiturates ii) Alcohol iii) Morphine iv) Insecticides v) Snake bites vi) Heavy metals (Lead, Arsenic, Mercury). **4 Hrs**
   d) Drug and Poison information center. **1 Hrs**

3. Drug interactions: Introduction, Reason for increasing number of drug interactions, Factors affecting drug interactions, Types of drug interactions, Pharmacokinetic and Pharmacodynamic mechanism for the drug interactions. Role of Pharmacist in minimizing drug interactions. **7 Hrs**

4. Drug induced diseases: Drug induced cardiovascular diseases, Drug induced liver toxicity, Nephrotoxicity, Diarrhoea, Sexual Dysfunction, Drug induced depression and psychosis. **6 Hrs**

5. Therapeutic Drug Monitoring: Objectives, Applications, Methodology for the monitoring patient during illness. **3 Hrs**

6. Adverse Drug Reaction Monitoring: Introduction, Predisposing factors causing ADRs, Detection and reporting of adverse drug reaction. **3 Hrs**

7. Ambulatory Patient Care, Institutional Patient Care, Role of pharmacist in long term care **2 Hrs**

8. Clinical Laboratory Tests: Significance and Interferences of some diagnostics tests for Cancer, Diabetes mellitus, Liver function test, Kidney/Renal function test and Seizures. **4 Hrs**

9. Pharmacoeconomics **6 Hrs**
   a. History, introduction and importance
   b. Significance of Pharmacoeconomics
   c. Pharmacoeconomic evaluations: introduction, classification and types
   d. Methodologies of Pharmacoeconomic
   e. Drug development and Pharmacoeconomics

10. Computer application in Clinical Pharmacy Services **3 Hrs**

Subject code: 5P5
Subject: Clinical Pharmacy
PRACTICAL: **3 Hrs. /week**

1) Paracetamol/ Carbon tetra Chloride induced hepatotoxicity in rats-Changes in markers like SGOT, SGPT, and Bilirubin, LDH etc.
2) Determination and interpretation of biochemical Data by Urine analysis.
a) Urine Microscopy.
b) Determination of Normal Constituent.
c) Determination of Abnormal Constituent Like Albumin, Blood, Ketone Bodies, Uric Acid, Casts, Microorganisms.
3) Comment on the given prescriptions with reference to case report mentioning possible therapeutic uses, and contraindications, with dose, route of administration, justification of inclusion of each ingredient, and possible Drug interactions.(At least one case of important diseases should be discussed on basis of available evidences from literature and if possible from Hospitals.)
4) Patient Counseling-Interview techniques and advice on some theoretical conditions.
5) ADR Reporting According to the Blue Letter of Asthma and Allergic Diseases Research Centers (AADRC), Australia, Yellow Form of CSM, UK. ADR Reporting Form Developed By KEM, Mumbai.
6) Calculating Cost of Prescription.
7) Histological Studies in Biopsies. (Human permanent slide).
8) Preparation of information material for educating patients about drug usage.
9) Study of Prescription and Case Report on the Some Commonly Occurred Drug Induced Diseases.

Subject code: 5T6
Subject: Regulatory Affairs and Intellectual Property Right
THEORY: 45 Hours (3 Hrs. /week)

1. **Regulatory Affairs** **3 Hrs**
Introduction, Importance of regulatory affairs, Funtions of regulatory affairs, Regulation marketing and Violation and Enforcement.

2. **Drug regulatory strategy** **4 Hrs**
Regulatory strategies for different phases of product development:- Regulatory strategy during the preclinical development phase, Regulatory strategy during the clinical development Phase (Phase I, Phase II, Phase III) and Regulatory strategy for the post approval phase.

3. **Drug regulatory authorities and agencies**: - **4 Hrs**
United states food and drug administration (USFDA), Therpeutic goods administration (TGA), Medicines and healthcare regulatory agency (MHRA), International conference on harmonisation (ICH), World health organization (WHO), Ministry of health, labor and welfare (MHWL) in Japan, Central drugs standard control organization (CDSCO), Indian pharmacopoeia commission (IPC)

4. **Investigational new drug application (INDA)** **3 Hrs**
Introduction, The content and format of an IND application, Maintaining an IND

5. **New drug application (NDA)** **3 Hrs**
Introduction, FDA Guidelines, Assembling applications for submission, NDA contents.

6. **Abbreviated new drug application (ANDA)** **2 Hrs**
Introduction, Requirements for filing ANDA,

7. **Drug master file (DMF)** **2 Hrs**
Introduction, Types of DMF, DMF submission.

INTELLECTUAL PROPERTY RIGHTS

8. **Introduction** **4 Hrs**
Understanding Intellectual property rights (IPR) and review of IPR regime: - Copyrights, Trademarks, Geographical indications, Appellations of origin, Industrial designs, and Intellectual property laws in India.

9. **Patent legislation** **6 Hrs**
Patent Act 1970, Patentability criteria, Patentable subject matter, Patent amendment (1999, 2002, 2005).

10. **Patent procedure, filing, search and licensing**. **3 Hrs**

11. **Patent infringement issues and freedom to operate**. **2 Hrs**
International treaties and conventions on IPR; Trade related Intelletual property rights (TRIPS), Paris convention, World trade organization (WTO), General agreement on trade and tariff (GATT), Patent cooperation treaty (PCT). **3 Hrs**

12. **Other Features**: Hatch-Waxman Act, Compulsory licensing, Laws related to Biosimilars. **6 Hrs**

SEMESTER-VI

Subject code: 6T1
Subject: Pharmaceutics-VI (Physical Pharmacy)
THEORY: 45 Hours (3 Hrs. /week)

1. **Solubility and Distribution Phenomena: 10 Hrs**
   Mechanism of solute solvent interactions. Ideal solubility and Scatchard – Hildebrand equation, solvation and association, Quantitative approach to the factors influencing solubility of drugs. Distribution of solutes between immiscible liquids, ionic dissociation and molecular association influencing partitioning. Application of distribution phenomena in pharmacy, Phase rule and phase equilibria, phase diagram, one and two component, the solid state amorphous, crystalline and polymorphism.

2. **Diffusion and Dissolution 4Hrs**
   Diffusion, Steady state diffusion, diffusion coefficient, determination of diffusion coefficient. Importance of diffusion coefficient. Historical perspective and importance of dissolution, zero-order kinetics, first order kinetics, Hixon crowell and Higuchi equations. USP dissolution apparatus

3. **Rheology: 8 Hrs**
   Types of flow behavior, thixotropy and thixotropic coefficient. Measurement of various rheological properties, factors influencing rheology of dispersed systems.

4. Complexation and Methods of detection of complexes. **7 Hrs**

5. **Kinetics and Drug Stability: 8 Hrs**
   Influence of temperature, light, solvent, catalysts and other factors, Accelerated stability studies.

6. **Polymer Science: 8 Hrs**
   Historical background, Pharmaceutical applications of polymers, definition, Molecular weight, Average molecular weight, Determination from solution viscosity, Conformation of dissolved linear macromolecules, Polymer as thickening agent, Polymer solution overview, Solvent selection, Preparing polymer solution, Mechanical properties, Interchain cohesive forces, Crystallinity, Tacticity, Morphology, Orientation glass – rubber transition, plasticization.

Subject code: 6P1
Subject: Pharmaceutics-VI (Physical Pharmacy)
PRACTICAL: 3 Hrs. /week

1. Determination of heat of solution of Benzoic acid.
2. Determination of heat of solution of boric acid.
3. Determination of relation between dielectric constant of solvent and solubility of drugs.
4. To plot ternary phase diagram.
5. Determination of partition coefficient and distribution of drug between two phases.
6. Study of rheograms of some mucilages.
7. Determination of molecular weight of polymer by viscosity measurement method
8. To determine the distribution coefficient of benzoic acid between water – benzene system.
9. To study the effect of temperature and pH on aspirin hydrolysis.
10. To determine upper consolute temperature of phenol water system

Subject code: 6T2
Subject: Pharmaceutical Medicinal Chemistry-II
THEORY: 45 Hours (3 Hrs. /week)

Following topics shall be treated covering nomenclature, synthetic procedure of official drugs, uses SAR including physicochemical and steric aspects and mode of action.

1.Chemotherapeutic agents: 18 Hrs
Antimalerial, antiamoebic, anthelmentic and sulfonamides, antimycobacterial agents (antitubercular and antileprotic agents), antifungal agents, antiviral (including drugs used in AIDs), antineoplastic agents,

2/Antibiotics and prominent analogues: 15 Hrs
Penicillin, cephalosporin, aminoglycosides, tetracyclines, polypeptides, chloramphenicol, macrolide, lincomycins, lactamase inhibitors

3.Drug design: **7 Hrs**

Objectives, general principles, physicochemical properties and common approaches. Computer aided drug design (CADD), Theoretical consideration of quantitative structure activity relationship (QSAR) and its methods, molecular modeling, simple correlation equation.

Brief introduction to combinatorial chemistry **3 Hrs**

Concept and brief introduction of genetic engineering in medicinal chemistry. **2 Hrs**

Subject code: 6P2
Subject: Pharmaceutical Medicinal Chemistry-II
PRACTICAL: **3 Hrs. /week**

1. Pharmacopoeial assay of following solid dosage form
   - Mebendazole
   - Glipizide
   - Nifedipine
   - Cimetidine
   - Diclofenac
2. Synthesis and physico-chemical characterization of following compounds
   - Orange II from sulfanilic acid and β-naphthol
   - Phenothiazine from diphenyl amine
   - Isoniazid from isonicotinic acid
   - Thiobarbituric acid from diethyl malonate and thiourea
   - Chloramine-T from toluene p-sulphonamide
   - 1-phenylazo 2-naphthol from aniline and 2-naphthol

Subject code: 6T3
Subject: Pharmacology-IV
THEORY: **45 Hours (3 Hrs. /week)**

Study of Pharmacological action of following classes of drug with respect to classification of recently available drugs, mechanism of action, receptors, adverse effects, Drug interaction, contraindication and therapeutics uses:

1. Pharmacology of drug acting on endocrine systems **10 Hrs**

A. Pitutory hormone and regulation of secretion
B. Thyroid hormone, antithyroid agents
C. Parathyroid harmone, calcitonin, vitamin D.
D. Insulin, oral hypoglycemic agents.
E. Adrenocorticoids, anabolic steroids and fertility agents

2. Chemotherapy of microbial infection **24 Hrs**

A. Introduction **2 Hrs**
B. Penicillin and cephalosporin's **2 Hrs**
C. Macrolides and amino glycosides and polypeptides **2 Hrs**
D. Quinolones and fluoroquinolines **2 Hrs**
E. Chemotherapy of fungal infections **2 Hrs**
F. Chemotherapy of viral infections **3 Hrs**
G. Chemotherapy of malaria **2 Hrs**
H. Chemotherapy of tuberculosis and leprosy **3 Hrs**
I. Pharmacology of anthelmintics **2 Hrs**
J. Anti-neoplastic agents **4 Hrs**

3. Drugs acting on Immune system **3 Hrs**

A. Immunostimulants
B. Immunosupressant

4. Clinical trial: **8 Hrs**

A. Designs used in clinical trials with their advantages and disadvantages, hypothesis, risks and benefits, subject selection, inclusion and exclusion criteria, randomization, blinding and controls. **3 Hrs**
B. Management of Clinical trials: Role and responsibilities of Stakeholders of clinical trials such as FDA, CRO, Sponsor, Physicians, Nurses, Health professionals, Hospitals, Patient. **2 Hrs**
C. Guidelines for clinical research: ICH-GCP. **3 Hrs**

Subject code: 6P3
Subject: Pharmacology-IV
PRACTICAL: 3 Hrs. /week

1. To determine pA_2 value of antagonist using different tissues isolated from rats.
2. To study antipsychotic activity by using conditioned avoidance response.
3. To study antiparkinson activity using catalepsy test.
4. Demonstration of LD_{50} determination of some drugs or chemicals in rats or mice.
5. To study learning memory enhancing activity using radial arm maze.
6. To study learning memory enhancing activity using water maze.
7. To study learning memory enhancing activity using elevated plus maze.
8. To study addiction and abuse liability of some drugs.
9. To study analgesic activity using acetic acid induced writhing.
10. To record BP of rats by non invasive method
11. To record ECG and EEG of rats by non invasive method.

Subject code: 6T4
Subject: Pharmacognosy and Phytochemistry-IV (Recent Advances in Phytochemistry)
THEORY: 45 Hours (3 Hrs. /week)

1. Glycosides **13 Hrs**

a. Introduction, definition, occurrence, properties, classification, uses, general biogenetic pathways. General extraction and isolation methods.
b. Pharmacognostic study of following drugs

Anthraquinones:	Senna, Aloe, Rhubarb
Cardioactive:	Digitalis, Squill
Saponins:	Liquorice, dioscorea, shatavari
Bitter:	Quassia, Kalmegh
Cynogenetic:	Bitter almond
Isothiocyanate:	Black mustard
Flavonoid:	Orange peels
Coumarin:	Psoralea
Others:	Artemesia, Brahmi

2. Tannins **8 Hrs**

a. Introduction, definition, classification, properties, uses, chemical tests and general method of extraction.
b. Pharmacognostic study of following drugs
Pale catechu, Black catechu, Ashoka, Arjuna, Bahera, Amala, Myrobalon

3. Isolation, purification and therapeutic uses of following phytocompounds: Gingkolides, Diosgenin, Ginsenosides, Andrographolide **7 Hrs**

4. Extraction, isolation, purification and estimation of following phytocompounds: Alloin, Bacoside, Hesperidin, Picrosides, Digoxin **8 Hrs**

5. Spectral studies of following phytocompounds: Digoxin, Glycyrrhizin, Andrographolide, Gallic acid **9 Hrs**

Subject code: 6P4
Subject: Pharmacognosy and Phytochemistry-IV (Recent Advances in Phytochemistry)
PRACTICAL: 3 Hrs. /week

1. Isolation and identification of Andrographolide from *Andrographis paniculata* by TLC method.
2. Isolation and identification of Aloin from leaves of *Aloe* species by TLC method.
3. Determination of total content of tannins from Black catechu by UV spectroscopic method using Folin-Ciocalteu method (Demonstration).
4. Extraction of total sennosides from Senna leaves.
5. Perform UV and FTIR spectroscopic studies on Andrographolide.
6. Study of morphological and microscopical characters of -
a) Senna b) Digitalis c) Liquorice d) Shatavari e) Quassia f) Kalmegh

7. Identification of following crude drugs by their morphological characters and chemical tests
   a. Pale catechu, b. Black catechu, c. Bahera, d. Myrobalon

Subject code: 6T5
Subject: Clinical Pharmacotherapeutics-I

THEORY: **45 Hours (3 Hrs. /week)**

Introduction to rational drug use: Definition, role of pharmacist. Essential drug concept, rational drug formulations. **4 Hrs**

Etiopathogenesis and pharmacotherapy of diseases/disorders associated with following systems.

1. **Cardiovascular and Hemopoietic system:** Hypertension, Angina Pectoris, Atherosclerosis, Congestive Heart Failure, Arrhythmias, Myocardial infarction, Hyperlipidaemias, Thromboembolic disorders and Anaemia. **12 Hrs**
2. **Respiratory system:** Bronchial asthma, Chronic Obstructive Pulmonary Disease, Allergic rhinitis, Common cold & Cough, Cystic fibrosis. **6 Hrs**
3. **Gastro-intestinal system:** Peptic ulcer, Inflammatory Bowel Disease, Liver diseases. **6 Hrs**
4. **Central Nervous system:** Parkinsons disease, Alzheimer's disease, Behavioral disorders. **6 Hrs**
5. **Urogenital system:** Renal failure, Benign Prostatic Hypertrophy, Infertility, Dysmenorrhea, Menopause. **6 Hrs**
6. **Musculoskeletal system:** Rheumatoid arthritis, Osteoarthritis, Gout, Spondylitis, Systemic lupus erythematosis. **5 Hrs**

Subject code: 6P5
Subject: Clinical Pharmacotherapeutics-I

PRACTICAL: **3 Hrs. /week**

1. Pharmacology of neuromuscular junction.
2. Demonstration of Anesthesia (general and local).
3. Study of drugs on some models related to central nervous system.(sedative & hypnotics, locomotor, stereotypy, muscle relaxant, analgesic & anti-inflammatory).
4. Prescription related patient oriented problems on
   - Some common problems of gastro-intestinal tract (Dyspepsia, nausea, vomiting, colic, dehydration and constipation).
   - Some common problems of respiratory system (Cough, bronchial asthma).
   - Anaemia
   - Management of some painful conditions.
   - Use of some drugs in emergency (Myocardial infarction, hypertensive emergency, acute cardiac failure, anaphylaxis, cardiovascular collapse, pulmonary embolism).
   - Some common drug poisoning (Organophosphate insecticide, atropine, sedative-hypnotic drug, morphine etc.).
5. Medication errors in prescribing, drawing up and administration of medication for diseases prescribed in theory
6. Dose calculation of commonly used drugs including drugs for I.V. infusions.
7. Presentations of analysis related to Pharmacoeconomics. Data related to prescriptions from patients with similar disease to be collected & analyse in terms of cost & effectiveness.

Subject code: 6T6
Subject: Pharmaceutical Validation
THEORY: **45 Hours (3 Hrs. /week)**

1. **Validation of Pharmaceutical Processes:** **8 Hrs**
   Process validation options, the validation committee, validation master plan, validation protocol & report. Preapproval inspection, pilot plant scales up & technical transfer, stages of validation, change control, out-of-specifications, pharmaceutical chemicals.

2. **Prospective Process Validation:** **8 Hrs**
   Introduction, Organization, Master documentation, Product development, development of manufacturing capability, full-scale product/process development, defining experimental programs, experimental design & analysis.

3. **Validation of Analytical Methods:** **5 Hrs**
   Introduction, Validation of standard methods, revalidation, parameters for method validation, selectivity & specificity, precision & reproducibility, accuracy & recovery, linearity & calibration curve, range, limit of detection & quantitation, robustness.

4. **Retrospective Validation:** **12 Hrs**
   Introduction, process validation strategies, product selection criteria for retrospective validation, organizing for retrospective validation, written operating procedures, other considerations, selection & evaluation of processing data, compressed tablet (Drug A), Coated tablet (Drug B), Soft gels (Soft gelatin capsules, Drug C), Solution dosage form (Drug D), Semi solid dosage form (Drug E), computer aided analysis of data, Validation experiments to set product alert limits, reliability of the validated process, selection & evaluation of packaging data.

5. **Validation of Solid dosage form:** **12 Hrs**
   Introduction, validation of raw materials, analytical methods validation, Equipment/ facility validation, definition and control of process variables, In-process tests, finished product tests, guidelines for process validation of solid dosage form, Tablets, tablet composition, process evaluation & selection, equipment evaluation, Hard gelatin capsules, capsule composition, process evaluation and selection, encapsulation, equipment evaluation, outsourcing implications on validation.

SEMESTER-VII

Subject code: 7T1
Subject: Pharmaceutics (DFT-I) (Conventional)
THEORY: **45 Hours (3 Hrs. /week)**

1. Preformulation Considerations **5 Hrs**
Concept, study of physical properties: description, microscopic examination, particle size, partition coefficient, dissolution, solubility, membrane permeability, drug stability, crystal structure and polymorphism.
Study of chemical properties of drug like hydrolysis, oxidation, reduction, racemization, polymerization etc. and their influence on stability.

2. Tablets: **12 Hrs**
Rationale, market perspectives, types of tablets, tablet excipients, methods of tablet manufacture (wet, dry & direct compression), granulation, tablet compression: physics, mechanism, compression cycle, tablet processing problems and defects, tablet evaluation.
Types of coating (sugar, press & film coating), coating formulation, film forming materials, coating process & equipments, coating defects , evaluation of coated tablet.

3. Capsule: Hard gelatin capsule **4 Hrs**
Advantages & disadvantages, material for production and manufacturing of capsule shell, Capsule size, method of capsule filling, evaluation of capsule.
Softgels: Shell and content, manufacturing process and quality control.

4. Ointment: **4 Hrs**
Ointment bases, preparation & preservation of ointment bases, drug absorption from various ointment bases, evaluation of ointments.

5. Suppositories: **3 Hrs**
Displacement value, drug absorption from various suppositories, suppository bases, storage and evaluation of suppositories.

6. Cosmetics: **5 Hrs**
Fundamentals, structure and function of skin and hair, classification, formulation and preparation and packaging of various skin products, cold cream, vanishing cream, moisturizing cream, face powders & dentifrices, toothpastes & tooth powders.

7. Sterile Dosage Form: **12 Hrs**
Type of injections, parenteral routes of administrations, water for injection, pyrogenicity, non aqueous vehicle, isotonicity and method of its adjustment. large & small volume parenteral, ophthalmic, ear and nasal solutions and suspensions. Formulation and development of sterile dosage forms, active ingredients, solvent and vehicles, surfactant and solubilizers, antimicrobials, antioxidants, buffers, chelating agents, tonicity adjusters. Containers and closures for sterile dosage forms. Compounding, processing, filtration, sealing, sterilization, packaging and labeling of sterile dosage forms. Quality control tests like sterility, pyrogen, clarity, safety and leakage testing. Ophthalmic solutions.

Subject code: 7P1
Subject: Pharmaceutics (DFT-I) (Conventional)
PRACTICAL: **3 Hrs. /week**

1. Preparation and evaluation of following dosage forms.
   i. Tablets
   ii. Capsules
   iii. Ointments
   iv. Cold cream, vanishing cream, toothpaste, face powder, toothpaste
   v. Small volume parenterals: solution, emulsion, suspension, powder ready to use
   vi. Large volume parenterals
   vii. Ophthalmic solutions
2. Evaluation of coated tablet (Marketed formulations)

Subject code: 7T2
Subject: Pharmaceutical Medicinal Chemistry-III
THEORY: **45 Hours (3 Hrs. /week)**

Following topics shall be treated covering nomenclature, synthetic procedure of official drugs, uses SAR including physicochemical and steric aspects and mode of action.

1. Sympathetic and parasympathetic agents **10 Hrs**
including biosynthesis and metabolism of adrenergic neurotransmitters, adrenoreceptor blockers.

Cholinergic agents, cholinergic inhibitors, anticholinergic agents including antispasmodics, ganglionic stimulants and blockers, neuromuscular blockers. **10 Hrs**

2.Cardiovascular drugs **15 Hrs**
antihypertensive, cardiotonics, antiarrythmic, anticoagulant, Antithrombotics, thrombolytics, antianginal, coronary vasodilators, hypolipidemic drugs, diuretics.

3.Steroids **10 Hrs**
Androgens and anabolic agents, estrogens, progestational agents, adrenocorticoids and oral contraceptives

Subject code: 7P2
Subject: Pharmaceutical Medicinal Chemistry-III
PRACTICAL: **3 Hrs. /week**

1. Evaluation of Pharmacopoeial standards of following drugs

Ibuprofen
Sulfanilamide
Isoniazid
Aspirin
Ascorbic acid
Sulfamethoxazole

2. Synthesis and physico-chemical characterization of following compounds
Benzotriazole from o-phenylene diamine
Phenytoin from benzoin
Barbituric acid from diethyl malonate and urea
Chlorobutanol from chloroform
Benzocain from p-amino benzoic acid and ethanol
2-methylbenzimidazole from o-nitroaniline

Subject code: 7T3
Subject: Pharmaceutical Analysis-III (Separation Techniques)
THEORY: 45 Hours (3 Hrs. /week)

1. Solvent extraction **5 Hrs**
Basic Principle, Extraction process, liquid-liquid extraction, Methods of extraction, factors affecting extraction , Selection of solvent as an extraction solvent, extraction techniques, Applications.

2. Chromatography
Introduction, Important terms, Classification, Advantages and disadvantages, Application, Difference between following methods .

i) Electrophoresis **5 Hrs**
Types of electrophoresis, requirements of electrophoretic chambers, problems in electrophoresis.

ii) Column Chromatography **5 Hrs**
Adsorption column chromatography, Development Techniques (Frontal, displacement and elution analysis), Preparation of column, Factors affecting column efficiency, Partition chromatography.

iii) Ion exchange Chromatography **5 Hrs**
Principle, Ion exchange resins/material, Properties of ion exchangers, Mechanism of ion exchange process, Factors affecting ion exchange.

iv) Paper chromatography **5 Hrs**
Principle, Choice of filter papers, Solvents, Chromatographic chambers, Development techniques (Descending, Ascending, Radial multiple chromatography, two dimensional chromatography), post development derivative techniques, Factors affecting retention factor.

v) Thin layer chromatography (TLC) **5 Hrs**
Principle, Different methods / techniques, Development of chromatogragph, Rf value (Retention factor) and factors affecting Rf value.

vi) Gas chromatography **7 Hrs**
Theory, Instrumentation (Carrier gas, Columns, stationary phases for gas-liquid and gas-solid chromatography, Detectors- flame ionization, electron capture and thermal conductivity detector), Quantitative analysis/ Derivatisation technique.

vi) High Performance Thin layer chromatography (HPTLC) **4 Hrs**
Principle, Instrumentation, Preparation of plate, Development techniques.

viii) High Performance Liquid chromatography (HPLC) **4 Hrs**
Principle, Instrumentation, Solvent treatment systems, Pumps, column packing material, Detectors.

Subject code: 7P3
Subject: Pharmaceutical analysis-III (Separation Techniques)
PRACTICAL: 3 Hrs. /week

1. Separation of mixture of amino acids / sugars / dicarboxylic acids by paper chromatography. (Minimum four)
2. Experiment based on column chromatography.(Minimum two)
3. Experiment based on TLC.(Minimum three)
4. Experiment based on ion-exchange chromatography.

5. Demonstration HPLC
6. Demonstration HPTLC
7. Demonstration GC

Subject code: 7T4
Subject: Clinical Pharmacotherapeutics-II
THEORY: **45 Hours (3 Hrs. /week)**

General prescribing guidelines for – Pediatric patients, Geriatric patients, Pregnant and breast feeding. **5 Hrs**

Etiopathogenesis and pharmacotherapy of diseases/disorders associated with following systems.

1. **Endocrine system:** Diabetes mellitus, Disorders of Thyroid gland, Adrenocortical dysfunction, Oral Contraceptives. **5 Hrs**
2. **Ophthalmology:** Glaucoma, Cataract, Retinopathy, Conjunctivitis. **4 Hrs**
3. **Infectious diseases:** Tuberculosis, Leprosy, Meningitis, Respiratory tract infections, gastroenteritis, Endocarditis, Septicemia, Urinary tract infections, Malaria, AIDS and opportunistic infections, Fungal infections, Viral infections, Gonorrhea and Syphilis. **18 Hrs**
4. **Oncology:** Basic principles of cancer therapy, Chemotherapy of Breast cancer, Leukemia, Cancer of G.I. Tract, Lungs, Prostate, Skin, Gynecological. Management of adverse effects of anticancer drugs. **9 Hrs**
5. **Dermatology:** Psoriasis, Scabies, Eczema. **4 Hrs**

Subject code: 7P4
Subject: Clinical Pharmacotherapeutics-II
PRACTICAL: **3 Hrs. /week**

1. Bioassays (3 point & 4 points) on isolated tissues of rat.
2. Relevance of chemical and physical properties of drugs in therapeutics and some demonstrations about principles of detection and estimations of drugs in biological fluids.
3. Understanding of the principles of clinical trials.
4. Study of drugs on some models related to central nervous system (anticonvulsant, anxiolytic, antianxiety, catatonia & amnesia).
5. Prescription related patient oriented problems on
    a. Diabetes mellitus
    b. Some bacterial infections (Respiratory infections, urinary tract infections, infective diarrhea etc.)
    c. Malaria and amoebiasis
    d. Some common skin problems (Fungal infections, scabies, acne etc.)
    e. Some common ophthalmic problems (Acute congestive glaucoma, iridocyclitis, trachoma, catarrhal conjunctivitis).
6. Medication errors in prescribing, drawing up and administration of medication for diseases prescribed in theory
7. Comment on common pharmaceutical preparations and formulations.
8. Exercise on adverse drug reactions.

Subject code: 7T5
Subject: Pharmacognosy and Phytochemistry-V (Phytopharmaceutical /Herbal Technology)
THEORY: **45 Hours (3 Hrs. /week)**

Role of medicinal and aromatic plants in national economy. Importance of Natural product in new drug development and problems in Discovering New Drug from higher plants. Phytopharmaceuticals: Retrospects and prospects. Global market for Herbal Products and Opportunities in India. **5 Hrs**

1. Alkaloids **10 Hrs**

Introduction,definition, occurrence, properties, classification, chemistry. General Biosynthetic pathways for Indole, Tropane Quinoline and Isoquinoline alkaloids Systematic pharmcognostic study of following crude drugs containing Alkaloids.

a. Indole-Ergot, Rauwolfia, Nux-vomica, Vinca.
b. Tropane - Datura, Coca, Belladona.
c. Purines -Tea, Theobroma.

d. Quinoline - Cinchona.
e. Isoquinoline - Opium, Ipecac.
f. Pyridine/ Ppiperidine - Lobelia.
g. Imidazole - Pilocarpus.
h. Quinazoline – Vasaka
i. Amino alkaloids - Colchicum, Ephedra.
j. Steroidal - Ahwagandha, kurchi, solanum khasian

2.Extraction, Isolation and Estimation of following Phytoconstituents 3 Hrs
Quinine, Ephedrin and Atropine

3.Flavonoids 9 Hrs
Introduction, properties, classification, chemistry, extraction and general biosynthetic Pathway.

1. Flavones: Roman chamomile, *Passiflora incarnate,* Grape fruit.
2. Isoflavones: Derris Roots, Soyabean,
3. Flavonol: Buch Wheat, Green Tea
4. Flavonones: Liquorice, Citrus Peels
5. Chalcones: Safflower
6. Bioflavones- Gingko
7. Anthocynidine- Blueberry, Blackcurrent,Vine

4.Standardization of Herbal Drugs 6 Hrs
Importance of standardization and problems involved in the stanardisation. Standardization of single Drug and compound Formulations, W.H.O. guidelines for quality standardised Herbal formulations, Validation of Herbal products. Estimation of parameters limit Used for standardization and herbal extracts

5.Screening methods for herbal drugs & formulations 4 Hrs
Antioxidants, antidiabetic, hepatoprotective & antimicrobial drugs.

6.Patenting of Herbal Drugs 3 Hrs
Definition, Benefits of patent protection, patent application, Intellectual Property Rights with Special reference to phytoconstituents.

7.Herbal Drug Interactions 5 Hrs
General introduction to interaction and classification. Study of fallowing drugs and their possible side effects and interactions.
Hypercium, kava-kava, Ginkobiloba, Ginseng, garlic, Ginger & Ephedra.

Subject code: 7P5
Subject: Pharmacognosy and Phytochemistry-V (Phytopharmaceutical /Herbal Technology)
PRACTICAL: 3 Hrs. /week

1. Extraction, Isolation and Identification of Cinchona alkaloids by TLC.
2. Extraction, Isolation and Identification of curcumin by TLC.
3. Extraction, Isolation and Identification of caffeine by TLC.
4. Study of morphological, microscopical characters & chemical / microchemical tests for following crude drugs:
   a. Leaf: Datura, Vinca, Vasaka
   b. Roots: Rauwolfia
   c. Barks: Cinchona, Kurchi,
   d. Stem: Ephedra
   e. Seed: Nux-Vomica
   f. Wood: Quassia
5. Determination of Ash value & Extractive values of crude drugs
6. Determination of the alcohol content of Asava and aristha by suitable method (only Demonstration)
7. Estimation of the crude fibre contents in given sample
8. Estimation of the total tannins by Folin-Dennis reagent method
9. Evaluation of antimicrobial activity of herbal drugs
10. Evaluation of antioxidant activity of herbal drugs

Subject code: 7T6
Subject: Biopharmaceutics and Pharmacokinetics
THEORY: **45 Hours (3 Hrs. /week)**

1. **Absorption of Drug:** Physiology of Cell membrane, Mechanisms of drug absorption, Factors affecting drug absorption- i) Physicochemical ii) Physiological iii) Pharmaceutical. Non-oral routes of drug absorption (buccal, sublingual, transdermal, nasal and parenteral). **7 Hrs**
2. **Drug distribution:** Introduction, factors affecting drug distribution. Concept of apparent volume of distribution. Protein-drug binding. Significance of drug-protein binding and drug displacement interactions. Kinetics of protein binding. **5 Hrs**
3. **Drug metabolism and elimination:** Study of factors affecting metabolism. Pathways of metabolism. Types of drug excretion, Renal excretion, concept of clearance, factors affecting renal clearance, Non renal routes of elimination. Extraction ratio and first-pass effect, hepatic clearance, biliary excretion. **6 Hrs**
4. **Dissolution studies:** Introduction to Biopharmaceutical classification system, Theories of dissolution, In-vitro studies dissolution testing, and all latest models: Zero order, Matrix, First order, Higuchi. Hixon Crowel model.In-vitro in-vivo correlation. **6 Hrs**
5. **Bioavailability and Bioequivalence:** Definition and concept of absolute & relative bioavailability. Purpose of bioavailability testing. Methods of assessing bioavailability. Bioequivalence study and introduction to various study designs. Biowaivers. **7 Hrs**
6. Introduction to pharmacokinetics, Introduction to compartmental and physiological models. **1 Hr**
7. **Compartment models:** Assumptions of one and two compartment open model. Assessment of pharmacokinetic parameters after i. v. bolus and oral administration of drug following one and two compartment model. **8 Hrs**
8. **Non-Linear Pharmacokinetics:** Reasons for non-linearity (saturation mechanism). Michaeles Menten equation. Definition of Vmax and Km. Determination of Vmax and Km. **5 Hrs**

SEMESTER-VIII

Subject code: 8T1
Subject: Pharmaceutics (DFT-II) (NDDS)
THEORY: **45 Hours (3 Hrs. /week)**

1. Fundamental Concepts in Controlled Release **8 Hrs**
Introduction. Rationale of sustained/controlled drug delivery. Routes of drug delivery. Polymer properties influencing drug permeation. Factors influencing the design and performance of sustained/controlled drug delivery system. Physicochemical properties of a drug influencing drug product design and performance. Biological factors influencing design and performance of sustained/controlled release system.

2. Oral Controlled Drug Delivery Systems **9 Hrs**
Introduction, Design and fabrication of novel drug delivery system for oral controlled release:- osmotic pressure-controlled gastrointestinal delivery systems, hydrodynamic pressure-controlled gastrointestinal delivery systems, membrane permeation-controlled gastrointestinal delivery systems, gel diffusion-controlled gastrointestinal delivery systems, pH-controlled gastrointestinal delivery systems, ion-exchange-controlled gastrointestinal delivery systems. Modulation of gastrointestinal transit time:- gastrointestinal anatomy and dynamics, prolongation of GI retention (hydrodynamically balanced intragastric delivery system, intragastric floating gastrointestinal drug delivery system, inflatable gastrointestinal drug delivery system, intragastric osmotically controlled drug delivery system, intrarumen controlled-release drug delivery device, bio/mucoadhesive gastrointestinal drug delivery systems, co administration with GI motility-reducing drugs).

3. Ocular Controlled Drug Delivery Systems **7 Hrs**
Eye anatomical and physiological overview. Absorption of drug in eye. Controlled ocular delivery systems: - requisites of controlled ocular delivery systems, polymeric solutions, phase transition systems, mucoadhesive/bioadhesive dosage forms, collagen shields, pseudolatices, ocular penetration enhancers, ocular iontophoresis. Ocular drug delivery devices:- Matrix-type drug delivery systems, capsular-type drug delivery systems, implantable drug delivery pumps. Particulate systems for ocular drug delivery, Vesicular system for ocular drug delivery.

4. Parenteral Controlled Drug Delivery Systems **13 Hrs**

Introduction, Major routes of parenteral administration, Biopharmaceutics of sustained/controlled release parenteral drug products. Biocompatibility of polymeric materials, Sustained/controlled release dosage forms: - aqueous solution (high viscosity products, complex formation), aqueous suspension (use of viscosity builder, microspheres, microcapsules, magnetic microspheres), oil solution, oil suspensions, emulsions, biocompatible carriers (erythrocytes, biological and synthetic macromolecules), liposomes, implants, infusion devices, prodrugs. Drug targeting :- Active and passive drug targeting, carriers for targeted drug delivery system (Monoclonal antibodies, immunoliposomes, lipoproteins, polymeric micelles and nanoparticles).

5. Transdermal Drug Delivery Systems **8 Hrs**

Introduction. Fundamentals of skin permeation. Rationale for transdermal drug delivery. Approaches to development of transdermal therapeutic systems: - membrane-moderated systems, adhesive diffusion-controlled systems, matrix dispersion-type systems, microreservior system. Kinetic evaluation of transdermal therapeutic systems:- *in vitro* release kinetics, *in vitro* skin permeation kinetics, *in vitro in vivo* correlation. Skin irritation and sensitization testing of transdermal drug products.

Subject code: 8P1
Subject: Pharmaceutics (DFT-II) (NDDS)
PRACTICAL: **3 Hrs. /week**

1. To prepare floating dosage form and characterize it (Minimum two experiments).
2. To prepare microspheres by desolvation technique and characterize them.
3. To study the effect of temperature on rheological properties of thermosensitive polymers.
4. To study the effect of pH on rheological properties of Carbopol gels.
5. To prepare granules by melt granulation technique and evaluate them.
6. To prepare transdermal film and characterize it.
7. To prepare matrix tablet containing swellable polymer and perform water uptake study.
8. To prepare beads by ionotropic gelation method and characterize them.
9. To study the effect of pH on swelling properties of polymer.

Subject code: 8T2
Subject: Pharmaceutical Biotechnology and Molecular Biology
THEORY: **45 Hours (3 Hrs. /week)**

1. Basic Principles of Molecular Biology and Recombinant DNA Technology **12 Hrs**

General structure of cell, recombination in cell.

Tools and Techniques of rDNA technology - Enzymes, cloning vectors, gene cloning, gene library, Southern blotting, Western blotting, Colony hybridization, Polymerase chain reaction, Preparation of Recombinant DNA.

Pharmaceutical Application of rDNA technology- Production of recombinant proteins, insulin, growth hormones, interferon, monoclonal antibodies.

2. Plant Tissue Culture **10 Hrs**

Development of plant tissue cultures, Cellular totipotency, Organ cultures, callus and suspension cultures, Organogenesis, somatic embryo genesis, Protoplast fusion. Germplasm storage including cryopreservation.

3. Animal Tissue Culture **10 Hrs**

Animal cell & tissue culture, advantages and disadvantages, laboratory technique, primary culture, cell-lines and cloning. Disaggregation of tissue and primary culture, cultured cells and evolution of cell lines, cloning of cell lines, Large Scale Cell cultures in Biotechnology, Somatic cell fusion. Genetic recombination in animal cells, Mammalian cell cultures.

4. Introduction to fermentation process **8 Hrs**

Fermenter- Construction, type and working. Fermentation monitoring. Fermentation medium and its sterilization.

Downstream processing – *In situ* recovery of fermentation products. Isolation of fermentation products with special reference to penicillins, streptomycin, tetracyclines and vitamin B12.

5. Immobilization technology **5 Hrs**

Need, Principle, Methods- Adsorption, Entrapment, Covalent bonding, Cross-linking. Application of immobilized cell and enzymes.

Subject code: 8P2
Subject: Pharmaceutical Biotechnology and Molecular Biology
PRACTICAL: **3 Hrs. /week**

1. Protein separation by gel electrophoresis
    a. Preparation of Electrophoresis apparatus.
    b. Stacking of Gel & Well Preparation.
    c. Estimation of total Protein content from sample & preparation of standard curve.
    d. Sample preparation & loading of sample into sample wells & running of Gel.
    e. Staining.
2. Estimation of Protein with standard curve by Ninhydrine method.
3. Estimation of Protein with standard curve by Biuret method.
4. Isolation of DNA from bacteria (Demonstration).
5. Isolation of DNA from plants.
6. Immobilization of enzyme/ microbial cells by entrapment in sodium alginate.
7. Immobilization of enzyme/ microbial cells by entrapment in agarose gel.
8. Fermentative production of penicillin/Neomycin (Demonstration)
9. Fermentative production of citric acid.
10. Biological assays of various fermented products.
11. Development of secondary metabolites by plant tissue culture.

Subject code: 8T3
Subject: Pharmaceutical Analysis-IV (Spectroscopy)
THEORY: **45 Hours (3 Hrs. /week)**

1. Molecular Absorption Spectroscopy

a) UV-Visible Spectroscopy: **12 Hrs**

- Brief review of Electromagnetic Spectrum & its properties.
- Absorption Law & Limitations.
- Theory of Electronic Spectroscopy.
- The Chromophore concept, Choice of Solvent and Solvent Effects.
- Modern Instrumentation (Single Beam, Double Beam) Design & Working Principle, with significant emphasis on Source, Filters, Monochromators including Gratings, Sample Holder (Cuvette) and Detectors.
- Application of UV-Visible Spectroscopy (Qualitative & Quantitative analysis) including Difference & Derivative Spectroscopy.

b) IR Spectroscopy: **8 Hrs**

- IR regions, Requirements for IR absorption.
- Basic Principle.
- Vibrational Frequency & Factors influencing vibrational frequency.
- Fundamental Modes of Vibrations in diatomic molecule
- Instrumentaion with significant emphasis on Sampling Techniques and Heat Detectors.
- Applications in identification of functional groups.

c). Atomic Absorption & Emission Spectroscopy: **5 Hrs**

- Basic Principle.
- Difference between AAS & FES.
- Instumentation, Advantages & disadvantages and Pharmaceutical applications.

2. Mass Spectroscopy: **8 Hrs**

- Introduction.
- Basic Principle.
- Instrumentation emphasis should be on Single Focusing, Double Focusing (Quadrupole MS), Hyphenated Techniques like GCMS, HPLCMS, EIMS, CIMS, FIMS, FABMS.
- Various ions in MS- Molecular Ion, Metastable Ion, Base Peak.
- General Modes of Fragmentation.

3. Nuclear Magnetic Resonance Spectroscopy: **12 Hrs**

- Introduction.

- Theory (Spinning nucleus, effect of external magnetic field, precessional motion, precessional frequency, energy transitions)
- Chemical Shift and its measurement (delta & tau), Factors influencing Chemical Shift.
- Solvents used in NMR.
- Signal splitting, Spin-Spin coupling and Decoupling.
- Instrumentation.

Subject code: 8P3
Subject: Pharmaceutical Analysis-IV (Spectroscopy)
PRACTICAL: 3 Hrs. /week

1. Calibration of UV-Visible Spectrophotometer,
2. Determination of Wavelength of maximum absorbance using UV spectrophotometer & validity of Lambert Beer's law.
3. To study the effect of solvent & pH on UV spectrophotometer of a given compound.
4. Assay of Paracetamol Tablets using UV Spectrophotometer.
5. Assay of Metformin Tablets using UV Spectrophotometer.
6. Assay of Metaprolol Tablets using UV Spectrophotometer.
7. Assay of Propanolol Tablets using UV Spectrophotometer.
8. Assay of Furesemide Tablets using UV Spectrophotometer.
9. Assay of Bromhexine Tablets using UV Spectrophotometer.
10. Assay of Hydrochlorothiazide Tablets using UV Spectrophotometer.
11. Demonstration of IR, AAS etc
12. To study IR spectra of given compound(s) (Minimum three compounds)

Subject code: 8T4
Subject: Pharmacognosy and Phytochemistry-VI (Industrial Pharmacognosy)
THEORY: 45 Hours (3 Hrs. /week)

1.Introduction
Herbal Drug regulations in India, Intellectual Property Rights with special reference to phytoconstituents. Regulation pertaining to trade drugs. Status of India in herbal export market, Trade market in medicinal plant. **5 Hrs**

2.Herbal Formulations 10 Hrs
A comparative study of Ayurvedic and modern dosage forms, Different stages of Herbal formulations , study of methods of preprations of various ayurvedic dosages forms. like Aristas, Asava, Ghutika, Tailia, Churna, Avaleha, Ghritaand Bhasms, Unani formulations like Majooms, Safoofs and their evaluation. Determination of heavy metals in herbal preparation and alcohol contents in Aristas and Asvas.

3.Herbal cosmetics 5 Hrs
Source, Historical background and present status Raw material – Oils, Waxes, Gums, Hydrophillic colloids, colours, perfumes, protective agents, Bleaching agents,Preservatives, Antioxidants and other Auxillary agents.Formulatoin aspects of incorporating Herbal extracts in various preparations like Talcum powders,Face pack,cold cream, cleansing creams, shampoo & lipstick.

4.Quality control in the production chain of herbal product 4 Hrs
Introduction, product chain, Benefits of integral quality control and basic requirements of quality control of herbal production.

5.Neutraceutials 5 Hrs
Introduction, classification, Neutraceuticals and diseases cardiovascular, obesity, Diabetes, cancer and inflammatory diseases

6.Traditional plant drugs used in herbal formulations 7 Hrs
Common names, sources, active constituents and uses of:
Punarnava (*Boerhavia diffusa*), Shankhpushpi (*Convolvulus microphylla*), Lehsun (*Allium sativum*), Guggul (*Commiphora mukul*), Kalmegh (*Andrographis peniculata*), Tulsi (*Ocimum sanctum*), Valerian (*Valerian officinalis*), Artemisia (*Artemisia annua*), Chirata (*Swertia chirata*), Asoka (*Saraca indica*), Saffron (*Crocus sativa*), Shilajit, Brahmi *(Bacopa monnieri* and *Centella asiatica*), Salai (*Boswellia serrata*), Giloe (*Tinospora cordifolia*).

7.GMP for production of phytomedicine 4 Hrs

Introduction,personnel,Building and facilities, sanitation, Equipments, maintenance, computer system validation,calibration,warehousing , quality manual and site master file.

8.Marine Drugs **5 Hrs**

Sources and Pharmacological activities of newer medicinal agents of Marine source with special reference to Anti-inflammatory, cardiovasucular, anticancer agents and marine toxins.

Subject code: 8P4
Subject: Pharmacognosy and Phytochemistry-VI (Industrial Pharmacognosy)
PRACTICAL: **3 Hrs. /week**

1. Perform and develop qualitative "fingerprint profile" of following herbal drugs by official thin layer chromatographic methods-
    a. *Andrographis paniculata*
    b. *Bacopa monnieri*
    c. *Boswellia serrata*
2. Isolation of caffeine from Tea powder
3. Isolation of tannic acid from Myrobalan
4. Determination of heavy metals in herbal drugs by Atomic Absorption Spectroscopy (Demonstration)
5. Formulation and evaluation of following category of Aurvedic preparations (Minimum one of each category)
    i. Asava and Arista
    ii. Churna
    iii. Lepas
    iv. Ghrita and Taila
    v. Natural sunccreen oil
    vi. Natural blooming bath oil

Subject code: 8T5
Subject: Pharmacovigilence (Drug safety)
THEORY: **45 Hours (3 Hrs. /week)**

1. Introduction to Pharmacovigilance, Development of Pharmacovigilance system in India, Various legislations enacted, Safety regulations, WHO, CIOMS and Pharmacovigilance, ICH guidelines **6 Hrs**
2. **Methods of Pharmacovigilance:** Passive surveillance, Stimulated surveillance, Active surveillance, Comparative observational studies, Targeted surveillance. Case report and its contents and various data bases **4 Hrs**
3. **Adverse Drug Reactions (ADR):** Definition, Classification of ADRs, Type A and B reactions **6 Hrs**
4. **Causality Assessment:** Various types of causality assessment. Criteria of causality evaluation. Do's and Dont's of causality evaluation **4 Hrs**
5. **MedDRA:** Advantages, Structure of MedDRA, System Organ Class **4 Hrs**
6. **Single detection:** Definition, benefit and risk evaluation, data mining and case studies **7 Hrs**
7. **Special cases:** Study of special cases fall under Pharmacovigilance purview **4 Hrs**
8. **Special population:** Paediatric, Geriatric, and Pregnant population **6 Hrs**
9. **Drug safety of Biopharmaceuticals and Biosimilars:** Safety concerns of Biopharmaceuticals and Biosimilars, Immunogenicity, Limitations pertaining to drug safety, Risk management plan **4 Hrs**

Subject code: 8T6
Subject: Industrial Pharmacy
THEORY: **45 Hours (3 Hrs. /week)**

1. **Pilot Plant Scale up Techniques:** Significance of pilot plant study, requirements, raw materials, preparation of master procedures, Product considerations: solid dosage forms, injections, semisolids and ophthalmic products **6 Hrs**
2. **Pelletization Techniques:** A general overview of pellets, preparation of pellets by extrusion/spheronization, centrifugal method, fluid bed processes. Properties of pellets: size and size distribution, shape, density/porosity, mechanical properties. Formulation aspect of pellets. **6 Hrs**
3. **Microencapsulation:** Core and coat properties, Techniques of microencapsulation: phase separation, coacervation, multi orifice, spray congealing, polymerization, air suspension and coating pan, evaluation of microcapsules. **6 Hrs**
4. **Aerosols:** Principle, components of aerosol package-propellents (types), container, valves and actuators, aerosol formulations and different types of systems, manufacture, stability testing and quality of aerosols. **6 Hrs**
5. **Optimization Techniques in Pharmaceutical Formulation and processing:** Concept of optimization, optimization parameters, optimization methods. **5 Hrs**
6. **Packaging of Pharmaceuticals;** Desirable characteristics, Detail study of different types of container and closure (glass, plastic and rubbers) including their merits and demerits. Temper-resistant packaging, control of packaging materials. Selection and evaluation of pharmaceutical packaging materials. **7 Hrs**
7. **cGMP:** Introduction, Regulatory objectives of cGMP, Organization and Personnel, Buildings and Facilities, Production and Process control, packaging and Labeling control, Record and Reports. **6 Hrs**
8. **Safety management:** Industrial hazards due to fire, accident, mechanical and electrical equipment, chemicals and pharmaceutical safety measures. **3 Hrs**

RECOMMENDED BOOKS

Pharmaceutics

(Subject code : 1.1,1.6,2.1,3.1,3.6,4.1,4.6,5.1,5.6,6.1,7.1,7.6,8.1,8.6)

1. A Kydoneius. Treatis on controlled drug delivery: Fundamentals, Optimization, Applications. Marcel dekker, New York.
2. A. J. Winfield, RME Richardson. Pharmaceutical Practice. Churchill Livingstone. USA.
3. A. R., Gennero, Remington The Science and Practice of Pharmacy. Vol. I-II, Lippincott William and Wilkins
4. Alexander T. Florence, David Attwood, Physicochemical principals of pharmacy, Pharmaceutical press
5. Alfred Martin, Physical Pharmacy and Pharmaceutical Sciences, Lippincott Williams and Wilkins
6. Alfred Martin, Pilar Bustomonte. Problem solving : Physical Pharmacy, Lea and Febiger Publication
7. AM Hillary, AW Lloyd, J Swarbrick. Drug delivery and targeting for pharmacists and pharmaceutical scientists. Taylor and Francis, New York.
8. B. M., Mittal, - A Textbook of Forensic Pharmacy, Vallabh Prakashan
9. British Pharmaceutical Codex
10. British Pharmacopoeia, MHRA, London
11. CM Correa, AA Yusuf. Intellectual property and international trade: The TRIPS agreements. Kluwer Law International, London.
12. D Mathews. Globalizing intellectual property rights: The TRIPS Agreement. Taylor and Franchis Group. London.
13. D. R. Gupta, R. K. Rajput. Purchasing and Store keeping. McGraw Hill.
14. David Attwood, Alexander T. Florence, Physical Pharmacy, Pharmaceutical Press

15. DJ Pisano, D Mantus. FDA Regulatory affairs: a guide for prescription drugs,medical devices, and biologics. CRC Press, Washington DC.
16. E. A., Rawlins, Ed., Bentley's Textbook of Pharmaceutics, Ballierwe Tindall, (ELBS publication)
17. E. S. Shotton, Physical Pharmaceutics, Oxford University Press
18. G.S. Banker and C.T. Rhode, Modern Pharmaceutics, Marcel Dekker Inc., NY.
19. Graham Cole (Ed). Pharmaceutical Production Facilities: Design and Applications. Taylor and Francis.
20. H. C. Ansel, L. V. Allen & N. G. Popovich, Pharmaceutical Dosage Form and Drug Delivery Systems, Lippincott, Willaims & Wilkins, Philadelphia.
21. H. M. Burlage and C. O. Lee. Physical and Technical Pharmacy. McGraw Hill Book Co. New York.
22. H. S. Bean, A. H. Beckett. J. E. Carless, Advances in Pharmaceutical sciences, Academic Press
23. H. Weihrich & H. Koontz, Management: A global perspectives, Tata McGraw Hill Publishing Co. Ltd. Delhi.(International Edition)
24. H.A. Lieberman, L. Lachman & J.B. Schwartz, Pharmaceutical Dosage Forms: Tablets, Marcel Dekker Inc., NY.
25. H.A. Lieberman, L. Lachman & J.B. Schwartz, Pharmaceutical Dosage Forms: Disperse system, Marcel Dekker Inc., NY.
26. H.A. Lieberman, L. Lachman, Pharmaceutical Dosage Forms: Parenteral Medication, Edited By: K. E. Avis, Marcel Dekker Inc., NY.
27. Indian Pharmacopoeia, Published by The Indian Pahrmacopoeia Commission, Gaziabad.
28. J. E. Hoover. Dispensing of Medication. Mack Publishing Co. USA.
29. J. Kuanpoth. Patents Rights in Pharmaceuticals in Developing Countries: Major Challenges for the Future. Edward Elgar Publishing Inc. Massachusetts.
30. J. Swarbrick. Encyclopedia of Pharmaceutical Technology. Vol 1-6. Informahealthcare. USA
31. JD Nally. Good manufacturing Practices for Pharmaceuticals. Informa healthcare, New York.
32. JR Robinson, VHL Lee. Controlled drug delivery: Fundamentals and application, Marcel Dekker, New York.
33. L. Lachman; H.A. Liberman; J.L.Kanig.The Theory and Practice of Industrial Pharmacy,Verghese Publishing House, Mumbai.
34. L. V. Allen Jr., N. G. Popovich and H. C. Ansel "Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems ", Lippincotts Williams and Wilkin.
35. Leon Shargel, Susanna Wu-pong Andrew Yu. Applied Biopharmaceutics and Pharmacokinetics. McGraw Hill.
36. LL Augsburger and SW Hoag. (Eds). Pharmaceutical Dosage Forms: Tablets. Vol. 1: Unit Operations and Mechanical Properties. Informa healthcare, New York.
37. M C Allwood and Blackwell.Textbook of Hospital Pharmacy.
38. M. C. Smith, Principles of Pharmaceutical Marketing, CBS publisher, New Delhi.
39. M. E. Aulton, D.M. Collett(Eds). Pharmaceutical Practice. Churchill Livingstone. USA.
40. M. E., Aulton "Pharmaceutics The Science of Dosage Form Design" Churchill Livingstone, London
41. M. J., Stocklosa, H. C. Ansel, Pharmaceutical Calculations, by K.M. Varghese Company
42. M. M. Rieger, Harry's Cosmetology, Chemical Publishing Co. Inc. New York.
43. M.A. Voet. The Generic Challenge: Understanding Patents, FDA and Pharmaceuticals Life-Cycle Management. Brown Wolker Press. Florida.
44. Milo Gibaldi. Biopharmaceutics Clinical Pharmacokinetics. Lea & Febiger book publication USA.
45. MP Mathieu. New drug development: a regulatory overview. Parexel International Corporation, Waltham, MA.
46. NK Jain. Controlled and novel drug delivery, CBS publishers and distributors, New Delhi.
47. NS Gopalakrishnan. Intellectual property and criminal law. National law school of India University. Banglore.
48. O. Kayser, H. Warzecha. Pharmaceutical Biotechnology: Drug Discovery and Clinical Applications. Wiley Blackwell. Weinheim.
49. PJ Groves. Intellectual property rights and their valuation. Gresham Books, an imprint of woodhead publishing limited. England.
50. R A Guarino. New Drug Approval Process. Marcel Dekker. New York.
51. R.A. Nash and I. R. Berry. Pharmaceutical Process Validation. Marcel Dekker, Inc.
52. Remington's: The Science and Practice of Pharmacy, Lippincott, Willaims & Wilkins, Philadelphia.

53. Robert E. Notari. Biopharmaceutics and Clinical Pharmacokinetics: An Introduction. Marcel Dekker, New York.
54. Robert Perry, Don Green, James Maloney, Perry's Chemical Engineers' Handbook, McGraw Hill Inc., Singapore.
55. Roger Walker and Clive Edwards. Clinical Pharmacy and Therapeutics. Churchill Livingstone.
56. S. Chaudhari. The WTO and India's Pharmaceutical Industry: Patent Protection, TRIPs and Developing Countries. Oxford University Press.
57. S. J. Carter, Cooper and Gunn's Tutorial pharmacy, CBS Publishers & distribution, Dehli
58. S. J. Turco, R. E. King, Sterile Dosage Forms: Their preparation and clinical application, Lippincott, Willaims & Wilkins, Philadelphia.
59. S.J. Carter (Ed). Cooper and Gunn's Dispensing Pharmacy. CBS Publications.
60. SP Vyas, RK Khar. Controlled drug delivery: concepts and advances. Vallabh Prakashan, Delhi.
61. Thomas Jacobson and Albert Wertheimer. Modern Pharmaceutical Industry. Jones and Barlett publishers. LONDON, UK.
62. United States Pharmacopoeia & National Formulary, The United States Pharmacopoeial Convention, Washington DC.
63. W.E. Hassen. Hospital pharmacy, Lec & Febiger Publications.
64. Walter Badger and Julius Banchero, Introduction to Chemical Engineering, Tata-McGraw Hill Publishing Company Ltd, New Delhi.
65. Warren McCabe, Julian Smith and Peter Harriott, Unit operations of chemical engineering, McGraw Hill Inc., Singapore.
66. WR Cornish. Intellectual property. Sweet and Maxwell, London.
67. X Li, BR Jasti. Design of Controlled Release Drug Delivery Systems. McGraw-Hill, New York
68. YW Chein. Novel Drug Delivery Systems. Marcel Dekker New York.

Pharmaceutical Chemistry
(Subject code : 1.2,1.4,2.2,2.4,3.2,4.2,4.3,5.2,6.2,6.6,7.2,7.3,8.3)

1. A. Bahal and B.S. Bahl, A Text Book of Organic Chemistry, S. Chand & Company Ltd., New Delhi
2. A.H. Beckett, J.B. Stenlake, Practical Pharmaceutical Chemistry, Part I and Part II, CBS Publishers and Distributors, New Delhi.
3. A.I. Vogel, Elementary Practical Organic Chemistry, Part III, Quantitative Organic Analysis, Second Edition, CBS Publishers and Distributors, Delhi.
4. A.L. Lehninger, Principles of Biochemistry, CBS Publishers & Distributors Pvt. Ltd., India.
5. Alfonso R. Gennaro, Lippincott Williams and Wilkins, Remington, The Science and Practice of Pharmacy, A Wolters Kluwer Company, Philadelphia.
6. Ashutosh Kar, Advanced Practical Medicinal Chemistry, New Age International Publication.
7. Ayers: "Quantitative Chemical Analysis," (Harper International Ed.), Harper & Row.
8. B.K. Sharma. Instrumental Methods of Chemical Analysis, Goel Publishing House, Meerut.
9. Bentley and Driver, Textbook of Pharmaceutical Chemistry, Oxford University Press, Walton Street, Oxford
10. British Pharmacopoeia, MHRA, London
11. C.K. Mathews, K.F. Van Holde, K.G. Ahern, Biochemistry, Pearson Education.
12. Clarence A. Discher, Modern Inorganic Pharmaceutical Chemistry, Wiley, New York.
13. D. Voet, J.G. Voet, C.W. Pratt, Fundamentals of Biochemistry, John Wiley & Sons, Inc.
14. D.A., Skoog, F.J. Holler, S.R. Crouch, Principles of Instrumental Analysis. Baba Barkha Nath Printers, Haryana.
15. Daniel Lednicer and Laster A. Mitscher, The Organic Chemistry of Drug Synthesis (3 volumes), John Wiley & Sons.
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Note: Latest edition of the book is recommended.

Annexure-I

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

B. Pharm. Syllabus

Credit-grade based performance and assessment system (CGPA)

Absorption Scheme for B. Pharm. (Old Course) To B. Pharm. (New Course) semester pattern

1. The first year B. Pharm. (old course) students either ATKT or failure at his/her will can be absorbed in B. Pharm. Semester-I (new course) as fresh student.

   However, the passed or ATKT students of first year B. Pharm. (old course) can be absorbed in B. Pharm. semester-III (new course). He/she has to pass the subjects 1T6-Hospital Pharmacy, 2T4-Pharmaceutical Analysis-I (Titrations) and 2P4- Pharmaceutical Analysis-I (Titrations) of semester I and II of B. Pharm. (new course) and the subjects in which he/she has failed.

2. (i)The passed / ATKT students of second B. Pharm. (old course) have to appear and pass the following 6 theory and 4 practical subjects in addition to the subjects in which he/she has failed (for ATKT students), his / her result of semester V and VI of B. Pharm. (new course) shall not be declared unless he / she clears the subjects of semester I, II, III and IV.

   (ii) In case of failure, students of second B. Pharm. (old course) have to be absorbed in semester III of B. Pharm. (new course), they have to pass the following 6 theory papers and 4 practical subjects, in addition to the subjects in which he/she has failed.

Sr. No.	Subject code	Theory Subjects	Sr. No.	Subject code	Practical subjects
		Semester I B. Pharm (new course)			
1.	1T6	Hospital Pharmacy			
		Semester III B. Pharm (new course)			
2.	3T3	Pathophysiology and Clinical Biochemistry (Pathophysiology of common diseases)	1.	3P3	Pathophysiology and Clinical Biochemistry (Pathophysiology of common diseases)
3.	3T5	Pharmaceutical Microbiology and Immunology-I	2.	3P5	Pharmaceutical Microbiology and Immunology-I
		Semester IV B. Pharm. (new course)			
4.	4T3	Pharmaceutical Analysis-II (Electroanalytical and Physical methods)	3.	4T3	Pharmaceutical Analysis-II (Electroanalytical and Physical methods)
5.	4T5	Pharmaceutical Microbiology and Immunology-II	4.	4T5	Pharmaceutical Microbiology and Immunology-II
6.	4T6	Pharmaceutical Management			

3 (i). The passed / ATKT students of third B. Pharm. (old course) have to appear and pass the following 6 theory and 3 practical subjects in addition to the subjects in which he/she has failed (for ATKT students), unless he/she clears these subjects of semester III, IV, V and VI of B. Pharm. (new course), his / her result of semester VII and VIII shall not be declared.

(ii) Similarly, the failure students of third year B. Pharm. (old course) have to appear and pass the following 6 theory and 3 practical subjects in addition to the subjects in which he/she has failed.

Sr. No.	Subject code	Theory Subjects	Sr. No.	Subject code	Practical subjects
		Semester III B. Pharm (new course)			
1.	3T3	Pathophysiology and Clinical Biochemistry (Pathophysiology of common diseases)	1.	3P3	Pathophysiology and Clinical Biochemistry (Pathophysiology of common diseases)
		Semester IV B. Pharm. (new course)			
2.	4T6	Pharmaceutical Management			
		Semester V B. Pharm. (new course)			
3.	5T5	Clinical Pharmacy	2.	5P5	Clinical Pharmacy
4.	5T6	Regulatory Affairs and Intellectual Property Right			
		Semester VI B. Pharm. (new course)			
5.	6T5	Clinical Pharmacotherapeutics-I	3.	6P5	Clinical Pharmacotherapeutics-I
6.	6T6	Pharmaceutical Validation			

4. The failure students of final B. Pharm. (old course) have to clear their all backlog subjects of old course in 1+3 attempts. After these attempts they have to appear and clear the matchable subject(s) to these subject(s) in which they have failed as per "Scheme of Matchable subjects" given in Annexure II.

   The new B. Pharm. course is semester based with Credit and Grade system. The above absorbtion scheme is unfeasible considering the number of theory papers and especially, the practical subjects they have to pass and practically difficult for grant of Credits and Grade. Hence, it is recommended as follows:

   "Students of second year B. Pharm. (old course) and onwards shall be given 100 percent carry over for the purpose of keeping terms in the higher classes and shall be granted 1+3 attempts to pass their each examinations. Upon completion of these attempts, the failures shall be absorbed as per matchable subjects (Annexure-I) of the B. Pharm. (new course)"

   Note: The above recommendation is based on the similar earlier notification issued by N.U. notification no. Acad/60, dated 6th September 2004 (letter no. Acad/s/382/1274, dated 6th September 2004) and notification no. Acad/N/20 dated 31st January 2011.

Annexure-II

Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur

B. Pharm. Syllabus

Credit-grade based performance and assessment system (CGPA)

Scheme of Absorption & Matchable Subjects

OLD SYLLABUS		NEW SYLLABUS	
Subject Code	**Name of Subject**	**Subject Code**	**Name of Subject**
B. Pharm-I			
1T1	Pharmaceutics-I (General & Dispensing)	2.1	Pharmaceutics-II (General & Dispensing)
1T2	Pharmaceutical Chemistry-I (Organic)	2.2	Pharmaceutical Chemistry-II (Organic)
1T3	Pharmaceutical Chemistry-II (In-organic)	1.2	Pharmaceutical Chemistry-I (Inorganic)
1T4	Pharmaceutical Biochemistry	1.4	Pharmaceutical Biochemistry
1T5	Pharmacology-I (Physiology, Anatomy & Health Education)	2.3	Human Anatomy & Physiology
1T6	Pharmacognosy & Phytochemistry-I	1.5	Pharmacognosy & Phytochemistry I
1T7	Statistics & Computer Application in Pharmacy	2.6	Statistics & Computer Application in Pharmacy
B. Pharm-II			
2T1	Pharmaceutics-II (Physical)	5.1	Pharmaceutics-V (Physical Pharmacy)
2T2	Pharmaceutics-III (Engineering)	4.1	Pharmaceutics-IV (Unit Operations)
2T3	Pharmaceutical Chemistry-III (Organic)	4.2	Pharmaceutical chemistry-IV (Heterocyclic and Macromolecules)
2T4	Pharmaceutical Analysis-I	2.4	Pharmaceutical Analysis-I
2T5	Pharmacology-II	3.4	Pharmacology-I
2T6	Pharmaceutical Jurisprudence and Regulatory Affairs	3.6	Pharmaceutical Jurisprudence and Ethics
2T7	Biophysics & Molecular Biology	-	-
B. Pharm-III			
3T1	Dosage Form Technology-I	7.1	Pharmaceutics (DFT-I) (Conventional)
3T2	Pharmaceutical Microbiology and Immunology	3.5	Pharmaceutical Microbiology & Immunology
3T3	Pharmaceutical Medicinal Chemistry-I	5.2	Pharmaceutical Medicinal Chemistry-I
3T4	Pharmaceutical Analysis-II	4.3	Pharmaceutical Analysis-II (Electroanalytical and Physical Methods)
3T5	Pharmacology-III	5.3	Pharmacology-III
3T6	Pharmacognosy & Phytochemistry-II	5.4	Pharmacognosy & Phytochemistry-III (Chemistry of Natural Products)
3T7	Pharmacy Practices and Management	1.6	Hospital Pharmacy
B. Pharm-IV			
4T1	Dosage Form Technology-II	8.1	Pharmaceutics (DFT-II) (NDDS)
4T2	Biopharmaceutics and Pharmacokinetics	7.6	Biopharmaceutics and Pharmacokinetics
4T3	Biotechnology & Fermentation Processes	8.2	Pharmaceutical Biotechnology & Molecular Biology
4T4	Pharmaceutical Medicinal Chemistry-II	7.2	Pharmaceutical Medicinal Chemistry-III
4T5	Pharmaceutical Analysis-III	7.3	Pharmaceutical Analysis-III (Separation Technique)
4T6	Pharmacology-IV	6.3	Pharmacology-IV
4T7	Pharmacognosy & Phytochemistry-III	8.5	Pharmacognosy & Phytochemistry-V (Phytopharmaceutical / Herbal technology)
4T8	Quality Assurance	6.6	Pharmaceutical Validation