

**Syllabus Applicable**

**in**

**Gautam Buddh Technical University  
Lucknow**

**is adopted by the Executive Council of**

**Mahamaya Technical University  
Noida**

**vide resolution no.13, dated 24 Feb, 2011**

**for batches admitted in session: 2010-11**

**BACHELOR OF PHARMACY**

**1<sup>st</sup>, 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> Year**

**MAHAMAYA TECHNICAL UNIVERSITY, NOIDA**  
**STUDY AND EVALUATION SCHEME**  
**[Effective from the session : 2010-11]**

**Course: B.Pharm.**

**Year-I, Semester-I**

S.N	Course Code	Subject Name	Period (Hours)		Sessional			Exam	Subject Total
			L	P	CT	TA	Total	ESE	
1.	PHARM-111M	Remedial Mathematics	3	0	15	05	20	80	100
	PHARM-111B	Or Remedial Biology	3	0	10	10	20	80	100
2.	PHARM-112	Pharmaceutical Analysis-I	3	0	15	05	20	80	100
3.	PHARM-113	Pharmaceutical Chemistry-I (Inorganic Pharm. Chem.)	3	0	15	05	20	80	100
4.	PHARM-114	Pharmaceutics-I(General Pharmacy)	3	0	15	05	20	80	100
5.	PHARM-115	Anatomy, Psysiology and Path physiology-I	3	0	15	05	20	80	100
6.	PHARM-116	Professional Communication-I	3	0	15	05	20	80	100
<b>Practical Day to Day Evaluation</b>									
7	PHARM-111 P	Remedial Biology	0	4	--	--			
8	PHARM-112P	Pharmaceutical Analysis-I	0	4	--	--	20	80	100
9	PHARM-113 P	Pharmaceutical Chemistry-I (Inorganic Pharm. Chem.)	0	4	--	--	20	80	100
10	PHARM-114P	Pharmaceutics-I(General Pharmacy)	0	4	--	--	20	80	100
11	PHARM-115P	Anatomy, Physiology and Path physiology-I	0	4	--	--	20	80	100
			18	20	--	--	200	800	1000

**T.A-** Teacher Assessment **ESE-**End Semester Examination **CT-**Cumulative Test

**NOTE-** Duration in Theory & Practical of ESE shall be 3 (three) hours and 4 (four) hours respectively.

# MAHAMAYA TECHNICAL UNIVERSITY, NOIDA

## STUDY AND EVALUATION SCHEME

[Effective from the session : 2010-11]

Course: B.Pharm.

### Year-I, Semester-II

S.N	Course Code	Subject Name	Period (Hours)		Sessional			Exam	Subject Total
			L	P	CT	TA	Total	ESE	
1.	PHARM-121	Physical Chemistry	3	0	15	05	20	80	100
2.	PHARM-122	Pharmaceutical Chemistry-II (Organic Chemistry-I)	3	0	15	05	20	80	100
3.	PHARM-123	Anatomy, Physiology and Path physiology-II	3	0	15	05	20	80	100
4.	PHARM-124	Computer Fundamentals & Programming	3	0	15	05	20	80	100
5	PHARM-125	Pharmaceutical Biostatistics	3	0	15	05	20	80	100
<b>Practical Day to Day Evaluation</b>									
6	PHARM-121 P	Physical Chemistry	0	4	--	--	20	80	100
7	PHARM-122P	Pharmaceutical Chemistry-II (Organic Chemistry-I)	0	4	--	--	20	80	100
8	PHARM-124 P	Computer Fundamentals & Programming	0	4	--	--	20	80	100
			15	12	--	--	160	640	800

T.A- Teacher Assessment ESE-End Semester Examination CT-Cumulative Test

NOTE- Duration in Theory & Practical of ESE shall be 3 (three) hours and 4 (four) hours respectively.

**MAHAMAYA TECHNICAL UNIVERSITY, NOIDA**  
**STUDY AND EVALUATION SCHEME**  
**[Effective from the session : 2011-12]**

Course: B.Pharm.

**Year-II, Semester-III**

S. N.	Course Code	Subject Name	Period (Hours)		Sessional			Exam	Subject Total
			L	P	CT	TA	Total	ESE	
1.	PHARM-231	Pharmaceutics-II (Unit Operation-I)	3	----	15	05	20	80	100
2.	PHARM-232	Pharmaceutical Jurisprudence & Ethics	3	-----	15	05	20	80	100
3.	PHARM-233	Pharmacognosy-I	3	-----	15	05	20	80	100
4.	PHARM-234	Pharmaceutical Chemistry-III (Organic Chemistry-II)	3	----	15	05	20	80	100
5	PHARM-235	Pharmaceutics-III (Community Pharmacy)	3	----	15	05	20	80	100
6	PHARM-236	Anatomy, Physiology and Path physiology-III	3	----	15	05	20	80	100
<b>Practical Day to Day Evaluation</b>									
7	PHARM-231 P	Pharmaceutics-II (Unit Operations-I)	----	4	--	--	20	80	100
8	PHARM-233P	Pharmacognosy-I	----	4	--	--	20	80	100
9	PHARM-234 P	Pharmaceutical Chemistry-III (Organic Chemistry-II)	----	4	--	--	20	80	100
10	PHARM-235 P	Pharmaceutics-III (Community Pharmacy)	----	4	----	----	20	80	100
			18	16	--	--	200	800	1000

**T.A-** Teacher Assessment **ESE-**End Semester Examination **CT-**Cumulative Test

**NOTE-** Duration in Theory & Practical of ESE shall be 3 (three) hours and 4 (four) hours respectively.

**MAHAMAYA TECHNICAL UNIVERSITY, NOIDA**  
**STUDY AND EVALUATION SCHEME**  
**[Effective from the session : 2011-12]**

Course: B.Pharm.

**Year-II, Semester-IV**

S. N.	Course Code	Subject Name	Period (Hours)		Sessional			Exam	Subject Total
			L	P	CT	TA	Total	ESE	
1.	PHARM-241	Pharmaceutics-IV (Unit Operation-II)	3	----	15	05	20	80	100
2.	PHARM-242	Pharmaceutical Microbiology	3	----	15	05	20	80	100
3.	PHARM-243	Pharmacognosy-II	3	----	15	05	20	80	100
4.	PHARM-244	Pharmaceutical Analysis-II	3	----	15	05	20	80	100
5.	PHARM-245	Anatomy, Physiology and Pathophysiology-IV	3	----	15	05	20	80	100
<b>Practical Day to Day Evaluation</b>									
6	PHARM-241 P	Pharmaceutics-IV (Unit Operations-II)	----	4	--	--	20	80	100
7	PHARM-242P	Pharmaceutical Microbiology	----	4	--	--	20	80	100
8	PHARM-243 P	Pharmacognosy-II	----	4	--	--	20	80	100
9	PHARM-244 P	Pharmaceutical Analysis-II	----	4	----	----	20	80	100
			15	16	--	--	180	720	900

**T.A-** Teacher Assessment **ESE-**End Semester Examination **CT-**Cumulative Test

**NOTE-** Duration in Theory & Practical of ESE shall be 3 (three) hours and 4 (four) hours respectively.

# MAHAMAYA TECHNICAL UNIVERSITY, NOIDA

## STUDY AND EVALUATION SCHEME

[Effective from the session : 2012-13]

Course: B.Pharm.

Year-III, Semester-V

S. N.	Course Code	Subject Name	Period (Hours)		Sessional			Exam	Subject Total
			L	P	CT	TA	Total	ESE	
1.	PHARM-351	Pharmaceutical Chemistry-IV (Biochemistry)	3	----	15	05	20	80	100
2.	PHARM-352	Pharmaceutics-V (Pharmaceutical Technology-I)	3	-----	15	05	20	80	100
3.	PHARM-353	Pharmacology-I	3	-----	15	05	20	80	100
4.	PHARM-354	Pharmaceutical Chemistry-V (Medicinal Chemistry-I)	3	----	15	05	20	80	100
5.	PHARM-355	Pharmaceutics-VI (Physical Pharmacy)	3	----	15	05	20	80	100
<b>Practical Day to Day Evaluation</b>									
6	PHARM-351 P	Pharmaceutical Chemistry-IV (Biochemistry)	----	4	--	--	20	80	100
7	PHARM-352P	Pharmaceutics-V (Pharmaceutical Technology-I)	----	4	--	--	20	80	100
8	PHARM-353 P	Pharmacology-I	----	4	--	--	20	80	100
9	PHARM-354 P	Pharmaceutical Chemistry-V (Medicinal Chemistry-I)	----	4	----	----	20	80	100
10	PHARM-355P	Pharmaceutics-VI (Physical Pharmacy)	-----	4	----	----	20	80	100
			15	20	--	--	200	800	1000

**T.A-** Teacher Assessment **ESE-**End Semester Examination **CT-**Cumulative Test

**NOTE-** Duration in Theory & Practical of ESE shall be 3 (three) hours and 4 (four) hours respectively.

**MAHAMAYA TECHNICAL UNIVERSITY, NOIDA**  
**STUDY AND EVALUATION SCHEME**  
**[Effective from the session : 2012-13]**

Course: B.Pharm.

**Year-III, Semester-VI**

S. N.	Course Code	Subject Name	Period (Hours)		Sessional			Exam	Subject Total
			L	P	CT	TA	Total	ESE	
1.	PHARM-361	Pharmaceutical Chemistry-VI (Medicinal Chemistry-II)	3	----	15	05	20	80	100
2.	PHARM-362	Pharmaceutics-VII (Pharmaceutical Technology-II)	3	----	15	05	20	80	100
3.	PHARM-363	Pharmacology-II	3	----	15	05	20	80	100
4.	PHARM-364	Pharmacognosy-III	3	----	15	05	20	80	100
5.	PHARM-365	Professional Communication-II	3	----	15	05	20	80	100
6.	PHARM-366	Environment & Ecology	3	----	15	05	20	80	100
<b>Practical Day to Day Evaluation</b>									
7	PHARM-361 P	Pharmaceutical Chemistry-VI (Medicinal Chemistry-II)	----	4	--	--	20	80	100
8	PHARM-362P	Pharmaceutics-VII (Pharmaceutical Technology-II)	----	4	--	--	20	80	100
9	PHARM-363 P	Pharmacology-II	----	4	--	--	20	80	100
10	PHARM-364 P	Pharmacognosy-III	----	4	----	----	20	80	100
			18	16	--	--	200	800	1000

**T.A-** Teacher Assessment **ESE-**End Semester Examination **CT-**Cumulative Test

**NOTE-** Duration in Theory & Practical of ESE shall be 3 (three) hours and 4 (four) hours respectively.

**MAHAMAYA TECHNICAL UNIVERSITY, NOIDA**  
**STUDY AND EVALUATION SCHEME**  
**[Effective from the session : 2013-14]**

**Course: B.Pharm.**

**Year-IV, Semester-VII**

S. N.	Course Code	Subject Name	Period (Hours)		Sessional			Exam	Subject Total
			L	P	CT	TA	Total	ESE	
1.	PHARM-471	Pharmaceutical Analysis-III	3	----	15	05	20	80	100
2.	PHARM-472	Pharmaceutics-VIII(Biopharmaceutics & Pharmacokinetics)	3	-----	15	05	20	80	100
3.	PHARM-473	Pharmacology-III	3	-----	15	05	20	80	100
4.	PHARM-474	Pharmaceutical Chemistry-VI (Medicinal Chemistry-III)	3	----	15	05	20	80	100
5	PHARM-475	Pharmacognosy-IV	3	----	15	05	20	80	100
<b>Practical Day to Day Evaluation</b>									
6	PHARM-471 P	Pharmaceutical Analysis-III	----	4	--	--	20	80	100
7	PHARM-472P	Pharmaceutics-VIII (Biopharmaceutics & Pharmacokinetics)	----	4	--	--	20	80	100
8	PHARM-473 P	Pharmacology-III	----	4	--	--	20	80	100
9	PHARM-475 P	Pharmacognosy-IV	----	4	----	----	20	80	100
10	PHARM-476P	Report on Industrial Visit						100	100
			15	16	--	--	180	820	1000

**T.A-** Teacher Assessment **ESE-**End Semester Examination **CT-**Cumulative Test

**NOTE-** Duration in Theory & Practical of ESE shall be 3 (three) hours and 4 (four) hours respectively.

**MAHAMAYA TECHNICAL UNIVERSITY, NOIDA**  
**STUDY AND EVALUATION SCHEME**  
**[Effective from the session : 2013-14]**

Course: B.Pharm.

**Year-IV, Semester-VIII**

S. N.	Course Code	Subject Name	Period (Hours)		Sessional			Exam	Subject Total
			L	P	CT	TA	Total	ESE	
1.	PHARM-481	Pharmaceutical Biotechnology	3	----	15	05	20	80	100
2.	PHARM-482	Natural Products	3	-----	15	05	20	80	100
3.	PHARM-483	Pharmaceutical Industrial Management	3	-----	15	05	20	80	100
4.	PHARM-484	Hospital Pharmacy	3	----	15	05	20	80	100
5	PHARM-485	Elective (A)- Standardization of Herbal Drugs Or (B)- Drug Design Or (C)- Clinical Pharmacy & Drug Interactions Or (D)- Pharmaceutical Marketing Or (E)- Pharmaceutical Packaging Or (F)- Novel Drug Delivery Systems Or (G)-GMP, Quality Assurance & Validation	3	----	15	05	20	80	100
<b>Practical Day to Day Evaluation</b>									
6	PHARM-482 P	Natural Products	----	4	--	--	20	80	100
7	PHARM-485P	Project on Elective:- A)- Standardization of Herbal Drugs Or (B)- Drug Design Or (C)- Clinical Pharmacy & Drug Interactions Or (D)- Pharmaceutical Marketing Or (E)- Pharmaceutical Packaging Or (F)- Novel Drug Delivery Systems Or (G)-GMP, Quality Assurance & Validation	----	4	--	--	20	80	100
			15	8	--	--	140	560	700

T.A- Teacher Assessment ESE-End Semester Examination CT-Cumulative Test

**NOTE-** Duration in Theory & Practical of ESE shall be 3 (three) hours and 4 (four) hours respectively.

## SEMESTER I

### *PHARM-IIIM*

#### REMEDIAL MATHEMATICS

**Unit-I: Algebra:** Equations reducible to quadratics, Cramer's Rule

Algebra of matrices-1. Addition

2. Subtraction

3. Multiplication

4. Inverse of matrices

Simultaneous equation by matrices.

**Unit-II:** Certain co-ordinates, distance between two parts, area of triangle, locus of points, straight line, intercept form in normal.

**Unit-III:** Differential Calculus-

1. Limit and function

2. Definition and formulation of differential calculus.

3. Rules of standard form of differential calculus.

4. Chain Rule, Parametric rule.

**Unit-IV:** 1. Standard form of Integral calculus

2. Partial fraction of Integral

3. Trigonometric function of Integral calculus.

**Unit-V:** Linear differential equation of order greater than one with constant coefficient complimentary function, and particular Integral ( $X^n e^{ax}$ , Trigonometric (  $\sin/ \cos^{ex}$  )

#### BOOKS RECOMENDED

1. A textbook of Mathematics for XI-XII Students, NCERT Publication Vol. I-IV.
2. Loney, S.L "Plane Trigonometry" AITBS Publishers.
3. Loney, S.L "The elements of coordinate geometry" AITBS Publishers.
4. Gupta S.P. Statistical Methods, Sultan Chand and Co., New Delhi
5. Narayan Shanti, Integral calculus , Sultan Chand & Co.

6. Prasad Gorakh Text book on differential calculus, Pothishala Pvt. Ltd., Allahabad.
7. Narayan Shanti, Differential calculus , Shyamlal Charitable Trust, New Delhi.
8. Prasad Gorakh Text book on integral calculus , Pothishala Pvt. Ltd., Allahabad.
9. Vishal Mehta, “ Remedial Mathematics for Pharmacy’.
10. Shyam, Patkar “ Comprehensive remedial mathematics”.

### ***PHARM-IIIB***

#### **REMEDIAL BIOLOGY**

##### **THEORY**

**Unit-I:**General survey of Animal Kingdom. Structure and life history of parasites as illustrated by amoeba,entamoeba, trypanosoma, plasmodium, taenia, ascaris, schistosoma, oxyuris and ancylostoma.

[08]

##### **Unit-II**

General structure and life history of insects like mosquito, house fly, mites and silk worm. [08]

##### **Unit-III**

Morphology and histology of root, stem, bark, wood, leaf, flower, fruit and seed, modification of stems and roots.

[12]

##### **Unit-IV**

Plant cell: Its structure and non living inclusions, mitosis and meiosis, different types of plant tissues and their functions. Basic concept of molecular biology (DNA,RNA) [08]

##### **Unit-V**

Methods of classification of plants. [04]

### ***PHARM-IIIP***

## REMEDIAL BIOLOGY PRACTICAL

### PRACTICAL

1. Morphology of plant parts indicated in theory.
2. Care, use and type of microscopes.
3. Gross identification of slides of structures and life cycle of lower plants/animals mentioned in theory.
4. Morphology of plant parts indicated in theory.
5. Preparation, microscopic examination of stem, root and leaf of monocot and dicot plants.
6. Structure of human parasites and insects mentioned in theory with the help of specimens.

**Note:** There shall be no University Examination for Remedial Biology Practical.

### BOOKS RECOMMENDED

1. Dutta A.C. "Botany for Degree students" Oxford.
2. Marshall & Williams "Text Book of Zoology" CBS Publishers & Distributors, Delhi.
3. Fahn "Plant Anatomy" Aditya Books Private Limited, New Delhi.
4. Weiz, Paul B "Laboratory Manual in Science of Biology" Mc Graw-hill book company.

## PHARM –112

### PHARMACEUTICAL ANALYSIS-1

#### THEORY

##### Unit-1 :

Significance of quantitative analysis in quality control different techniques of analysis, preliminaries and definitions, precision and accuracy. Fundamentals of volumetric analysis, methods of expressing concentration, primary and secondary standards. [06]

##### Unit-II: Acid Base Titrations:

Acid base concepts, role of solvent, relative strengths of acids and bases, ionization, law of mass action, common-ion effect, ionic product of water, pH, hydrolysis of salts, Henderson-Hasselbach equation, buffer solution, neutralization curves, acid base indicators, theory of indicators, choice of indicators, mixed indicators, polyprotic system. [10]

##### Unit-III: Oxidation reduction Titrations:

Concepts of oxidation and reduction, redox reactions, strengths and equivalent weights of oxidizing and reducing agents, theory of redox titrations, redox indicators, oxidation reduction curves, iodimetry and iodometry, titrations involving ceric sulphate, potassium iodate, potassium bromate, potassium permanganate. [10]

#### **Unit-IV: Precipitation Titrations:**

Precipitation reactions, solubility products, effect of acids, temperature and solvent upon the solubility of precipitate. Argentometric titrations and titrations involving ammonium or potassium thiocyanate, mercuric nitrate indicators, Gaylussac method, Mohr's method, Volhard's method and Fajan's method. [06]

#### **Unit-V : Gravimetric Analysis:**

Precipitation techniques, solubility products, the colloidal state, supersaturation, coprecipitation, post-precipitation, digestion, washing of the precipitate, filtration, filter papers and crucibles, Ignition, thermogravimetric curves, specific examples like barium as barium sulphate, aluminium as aluminium oxide, organic precipitants. [08]

### ***PHARM-II2P***

#### **PHARMACEUTICAL ANALYSIS - 1**

#### **PRACTICAL**

The students should be introduced to the main analytical tools through demonstration. They should have a clear understanding of a typical analytical balance, the requirements of a good balance, weights, care & use of balance, methods of weighing, and errors in weighing. The students should also be acquainted with the general apparatus requiring various analytical procedures.

1. Standardization of analytical weights and calibration of volumetric apparatus.
2. Acid Base Titrations : Preparation and Standardization of acids and bases, some exercises related with determination of acids and bases separately or in mixture form, some official assay procedures, e.g. boric acid, should also be covered.
3. Oxidation Reduction Titrations : Preparation & standardization of some redox titrants e.g. potassium permanganate, potassium dichromate, iodine, sodium thiosulphate etc. Some exercises related to determinations of oxidizing & reducing agents. Exercises involving potassium iodate, potassium bromate, iodine solution and ceric ammonium sulphate.

4. Precipitation Titrations: Preparation and standardization of titrants like silver nitrate and Ammonium thiocyanate, titrations according to Mohr's, Volhards and Fajan's methods.
5. Gravimetric Analysis : Preparation of gooch crucible for filtration and use of sintered glass crucible. Determination of water of hydration, some exercise related to gravimetric analysis should be covered.

**BOOKS RECOMMENDED :**

1. Mendham J, Denney R.C., Barnes J.D., Thomas M, Jeffery G.H., "Vogel's Textbook of Quantitative Chemical Analysis", Pearson Education Asia.
2. Connors K.A., "A Text book of Pharmaceutical Analysis", Wiley Inter-science.
3. Beckett, A.H., and Stenlake, J.B., Practical Pharmaceutical Chemistry, Vol. I&II. The Atherden Press of the University of London.
4. British Pharmacopocia, Her Majesty's Stationary Office, University Press, Cambridge.
5. Alexeyev V. "Quantitative Analysis". CBS Publishers & Distributors
6. The Pharmacopoeia of India.

**PHARM – 113**

**PHARMACEUTICAL CHEMISTRY-1  
(INORGANIC PHARMACEUTICAL CHEMISTRY)**

**Unit-I**

- A. Sources of impurities & their control, limit test for iron, arsenic, lead, heavy metals, chloride & sulphate
- B. An outline of methods of preparation, uses, sources of impurities, tests of purity and identification and special tests, if any, of the following classes of inorganic pharmaceuticals included in Indian Pharmacopoeia. (1996)

**Gases and Vapors :** Inhalants (Oxygen), Anaesthetics( Nitrous oxide).

**Pharmaceutical aids and necessities:** water (purified water, water for injection and sterile water for injection), pharmaceutical acceptable glass, acids and bases (Sodium hydroxide, phosphoric acid).

**Topical Agents :** Protectives (Calamine, titanium dioxide, talc, kaolin), astringents(Zinc oxide, Zinc Sulphate) and anti infectives (Boric Acid, Hydrogen peroxide, Iodine, Povidone Iodine, Potassium permanganate, Silver nitrate).

**Dental Products** : Dentrifices- anti-caries agents (Sodium fluoride). [08]

**Unit-II:Gastrointestinal Agents** : Acidifying agents (Dilute Hydrochloric acid), antacids(Bismuth subcarbonate, Aluminium hydroxide, Calcium carbonate, Magnesium hydroxide, Magnesium oxide { light and heavy}, Magnesium carbonate { light and heavy}, Magnesium trisilicate ), cathartics ( disodium hydrogen phosphate, Magnesium sulphate and other Magnesium

compounds), protective and adsorbents( Activated Charcoal, Light Kaolin, Aluminium sulphate

**Miscellaneous Agents:** Expectorants (Ammonium chloride, Potassium Iodide), antioxidants (Sodium metabisulphite). [08]

**Unit-III : Major intra and extra- cellular electrolytes** : Physiological ions, Electrolytes used for replacement therapy, acid-base balance & combination therapy( Calcium chloride, Calcium gluconate, Calcium lactate, Calcium levulinate, Sodium dihydrogen phosphate, sodium acetate, sodium bicarbonate, sodium chloride, potassium chloride, magnesium chloride).

Cationic and anionic components of inorganic drugs useful for systemic effects. [08]

**Unit-IV : Essential and Trace Elements** : Transition elements and their compounds of pharmaceutical importance. Iron and haematinics(Ferrous fumarate, Ferrous gluconate, Ferrous sulphate, Ferric Ammonium citrate), mineral supplements (Cu, Zn, Cr, Mn, Sb, S, I).

**Co-ordination compounds and complexation-** study of such compounds used in therapy including poison antidotes(Calcium folinate, Sodium thiosulphate). [08]

#### **Unit-V**

**Inorganic Radio-Pharmaceuticals:** Nuclear radio pharmaceuticals, nomenclature, methods of obtaining, standards and units of activity, measurement of activity, clinical application and dosage,hazards and precautions. [08]

**PHARM-113P**

### **PHARMACEUTICAL CHEMSITRY-I (INORGANIC PHARMACEUTICAL CHEMISTRY)**

#### **List of Experiments**

#### **No. of Labs**

1. To perform limit test of chloride, sulphate, Iron, Heavy metal and

5

- arsenic in the given sample.
2. Salt analysis 7
3. Preparation of following compounds:- 3
- Boric acid
- Magnesium sulphate
- Heavy magnesium carbonate
- Calcium Carbonate
- Alum
- Zinc sulphate

**BOOKS RECOMMENDED :**

1. Block, J.H. Roche, E, Soine, T and Wilson, C., “Inorganic, Medicinal & Pharmaceutical Chemistry”, Lea & Febiger.
2. Discher, C.A., et.al Modern Inorganic Pharmaceutical Chemistry, waveland press.
3. Pharmacopoeia of India, 1996 edition.
4. Atherden L.M., Bentley and Drivers’ “Text Book of Pharmaceutical Chemistry”, Oxford University Press, London.

***PHARM – 114***

**PHARMACEUTICS- 1  
(GENERAL PHARMACY)**

**Unit-I**

**History of Pharmacy :** Origin & development of pharmacy, scope of pharmacy, introduction to pharmacopoeias with special reference to IP, BP, USP & International Pharmacopoeia. [04]

**Pharmaceutical Additives :** Colouring, flavouring & sweetening agents, Cosolvents, preservatives, surfactants antioxidants. & their applications. [03]

**Unit-II**

**Size Reduction :** Definition, Principles and laws Governing size reduction factors affecting size reduction, principles, laws & factors affecting energy requirements, for size reduction different methods of size reduction, study of hammer mill, ball mill, fluid energy mill & disintegrator, various methods & equipments employed for size separation e.g. sieving, sedimentation, cyclone separator, elutriation methods. [06]

**Unit-III : Pharmaceutical calculations :** Posology, calculation of doses for infants, adults and elderly patients; Enlarging and reducing receipts, reducing percentage solutions, alligation, alcohol dilution, proof spirit. [10]

**Unit-IV**

**Extraction & Galenicals:** Extraction processes, study of infusion, decoction, digestion, percolation, maceration & their modifications, applications in the preparation of tinctures & extracts. Factors affecting selection of extraction processes. [07]

**Unit-V**

**Mixing:** Theory of mixing, solid-solid, solid-liquid & liquid-liquid mixing equipments. [03]

**Introduction to Pharmaceutical Dosage Forms:** A brief theory of : Solutions, mixtures, spirits, aromatic waters, glycerins, paints, syrups, elixirs, mouth washes, mucilages, lotions, liniments, pastes, inhalations and powders. [07]

**PHARM-114P**

**PHARMACEUTICS-I  
(GENERAL PHARMACY)**

**I :** Preparation of following classes of Pharmaceutical dosage forms (involving the use of calculations in metrology) as official in IP, BP, USP/NF.

a) Aromatic Waters

1. Chloroform water BP
2. Camphor Water BP
3. Rose Water NF

b) Solutions

1. Lysol solution IP
2. Strong Ammonium Acetate solution BP

c) Syrups

1. Simple syrup BP/USP/IP

d) Elixirs

1. Aromatic Elixirs USP/NF

e) Spirits

1. Aromatic Ammonia spirit BP

f) Powders

1. ORS Powder IP
2. Absorbable dusting powder USP/N

g) Lotions

1. Calamine lotion IP
2. Amino benzoic acid lotion BP

h) Liniments

1. Methyl salicylate liniment BP
2. Turpentine liniment BP

i) Mucilage

1. Starch Mucilage IP

j) Glycerins

1. Kaolin Poultice BP

k) Inhalation

1. Benzoin Inhalation BP

l) Tinctures & Extracts

1. Infusion of Tea
2. Decoction of Senna
3. Compound benzoin tincture BP
4. Strong Ginger tincture BP
5. Liquorice liquid extract BP.

**II:** Experiments to illustrate principles of size reduction using Ball Mill.

Effect of size of balls, number of balls and time on the efficiency of ball mill.

**III:** Experiments to illustrate mixing efficiency.

Solid-Solid mixing.

**BOOKS RECOMMENDED:**

1. Pharmacopoeia of India, The Controller of Publications, Delhi.
2. British Pharmacopoeia, Her Majesty's Stationary Office, University Press, Cambridge.
3. Carter S.J., "Cooper and Gunn's Tutorial Pharmacy", CBS Publishers, Delhi.
4. Rawlins E.A., "Bentley's Text Book of Pharmaceutics", ELBS Bailliere Tyndall.
5. Lachman L, Liberman H.A and Kanig J.L., "Theory and Practice of Industrial Pharmacy", Lea and Febiger.
6. Cooper and Gunn's Dispensing for Pharmaceutical Students, CBS Publishers, New Delhi.

7. Aulton, M.E, Text Book of Pharmaceutics, Vol., I & II. Churchill Livingstone.
8. United States Pharmacopoeia (National Formulary).
9. Remington – “The science and practice of pharmacy” Vol. I & II. Mack Publishing Co., Pennsylvania.

**PHARM-115**

**ANATOMY PHYSIOLOGY & PATHOPHYSIOLOGY -I**

**Unit –I**

- a. Introduction to human body & organisation of human body.
- b. Functional & structural characteristics of cell.
- c. Detailed structure of cell membrane & physiology of transport process.

Structural & functional characteristics of tissues- epithelial, connective, muscle and nerve. [08]

**Unit-II Skeletal system**

Structure, composition & functions of skeleton. Classification of joints, types of movements of joints. [08]

**Unit-III**

Anatomy & physiology of skeletal & smooth muscle, neurotransmission, physiology of skeletal muscle contraction, energy metabolism, types of muscle contraction, muscle tone. [08]

**Unit-IV**

Haemopoietic system : Composition & function of blood & its elements, erythropoiesis, blood groups, blood coagulation. [08]

**Unit-V**

- a) Concepts of health & disease: Disease causing agents & prevention of disease.
- b) Classification of food requirements : Balanced diet, Nutritional deficiency disorders, their treatment & prevention, specification for drinking water. [08]

***PHARM-II5P***

**HUMAN ANATOMY, PHYSIOLOGY  
& PATHOPHYSIOLOGY -I**

**PRACTICAL**

1. Study of human skeleton.
2. Microscopic study of different tissues.
3. Estimation of haemoglobin in blood, Determination of bleeding time, clotting time, R.B.C, Count, Total leucocyte count, D.L.C. and E.S.R.
4. Recording of body temperature, pulse rate and blood pressure, basic understanding of Electrocardiogram – PQRST waves and their significance.

**BOOKS RECOMMENDED:**

1. Ranade VG, “Text Book of Practical Physiology”, Pune Vidyarthi Griha Prakashan, Pune.
2. Difore S.H. “Atlas of Normal Histology” – Lea & Febiger Philadelphia.
3. Guyton AC, Hall JE., “Text book of Medical Physiology”, WB Saunders Company.
4. Chatterjee C.C. “Human Physiology”, Medical Allied Agency, Calcutta.
5. Ross & Wilson “Anatomy & Physiology in Health & Illness”, Churchill Livingstone.
6. Tortora GJ, & Anagnostikos NP “Principles of Anatomy & Physiology”, Harper & Row Publishers, New Delhi.
7. Parmar N.S. “Health Education & Community Pharmacy” CBS Publishers, Delhi.
8. Shalya Subhash “Human Physiology” CBS Publishers & Distributors.
9. Keele, C.A., Niel, E and Joels N, Samson Wright’s Applied Physiology, Oxford University Press.

***PHARM-116***

**PROFESSIONAL COMMUNICATION-I**

**UNIT-I**

English Grammar

Parts of speech, Articles, Preposition, Tenses, Active-Passive voice, Direct- Indirect, speech.

[12]

**UNIT-II**

Letter writing, Précis and Essay writing Comprehension Speed reading, scanning & swimming. [08]

**UNIT-III**

Working on accent neutralisation, pauses, stresses, non words, voice modulation, eye contact for small & large groups. [08]

**UNIT-IV**

Presentation techniques, - Tips.

Importance of non-verbal communication, debates, Role plays. [06]

**UNIT-V**

Personality types.

Decision making

Motivation

Attitude

Thinking [06]

**BOOKS RECOMMENDED**

1. Wren P.C and Martin H., "High School Grammar and Composition", S. Chand & Co.
2. Robbins, S "Organisational Behaviour"

## SEMESTER-II

*PHARM-121*

### PHYSICAL CHEMISTRY

#### Unit-I

1. **Behaviour of gases** : Kinetic theory of gases, deviation from ideal behaviour and explanation.
2. **The liquid state** : Physical properties (surface tension, parachor, viscosity, rheochor, refractive index, optical rotation, dipole moment) and chemical constituents.
3. **Amorphous and crystalline solids** : geometry & symmetry of crystals, Millers indices, types of crystals, Physical properties of crystals, crystal diffraction. [08]

#### Unit-II

4. **Thermodynamics** : Fundamentals, first, second, third and zeroth law, Joule-Thompson's effect, absolute temperature scale.
5. **Thermo chemistry** : Definition & conventions, heat of reaction, heat of formation, heat of solution, heat of neutralisation, heat of combustion, Hess law of constant summation, Bomb calorimeter, bond energies, Kirchoffs equation. [08]

#### Unit-III

6. **Solutions** : Ideal and real solutions, solutions of gases in liquids, colligative properties.
7. **pH** : determination of PH buffers, theory of buffers.
8. **Adsorption** : Freundlich and Gibbs adsorption Isotherms, Langmuir theory of adsorption. [08]

#### Unit-IV

9. **Electro chemistry** : Faraday's laws of Electrolysis, Electric conductance & its measurement, molar & equivalent conductivity and its variation with dilution. Kohlrausch law, Arrhenius theory, degree of ionisation & Ostwald dilution law. Transport number & migration of ion, Hittorfs theoretical device, theory of strong electrolytes (Debye Huckle theory). [08]

#### Unit-V

10. **Chemical kinetics** : Zero, first and second order reaction, complex reactions, elementary idea of reaction kinetics, characteristics of homogenous and heterogeneous catalysis, acid base and enzyme catalysis.
11. **Phase equilibria** : Phase, component, degree of freedom, phase rule (excluding derivation).

Cooling curves & Phase diagrams for one & two component system involving eutectics, congruent & incongruent melting point (examples-water, sulphur, KI-H<sub>2</sub>O, NaCl-H<sub>2</sub>O system). Distribution law & application to solvent extraction. [08]

**PHARM-121P**

**PHYSICAL CHEMISTRY**

**PRACTICAL**

1. Determination refractive index of given liquids.
2. Determination of specific rotation of sucrose at various concentrations and determine the intrinsic rotation.
3. Determination of rate constant of simple reaction.
4. Determination of cell constant, verify Ostwald dilution law and perform conductometric titrations.
5. Determination of surface tension.
6. Determination of partition co-efficient.
7. Determination of viscosity.
8. pH determination by different methods.
9. Determination of solubility.

**BOOKS RECOMMENDED:**

1. Pali S.R., and Prabartak, S.K.D.E., Practical Physical Chemistry, Haltone Limited, Calcutta.
2. Shoemaker, D.P. Garland, C.W., Experiments of Physical Chemistry, MC Graw Hill Book Co.
3. Bahl B.S., Tuli G.D. & Bahl Arun, Essential of Physical Chemistry, S. Chand & Co.
4. Negi A.S. & Anand S.C. "Textbook of Physical Chemistry" Wiley Eastern Ltd.
5. Glasstone S. & Lewis D, Elements of Physical Chemistry, Macmillan Education.
6. Atkins P & Paula, J.D. "Atkins Physical Chemistry" Oxford University Press.

**PHARM-122**

**PHARMACEUTICAL CHEMISTRY-II  
(ORGANIC CHEMISTRY- I)**

**Unit-I**

Structure and Properties : Atomic Structure, atomic orbital, molecular orbital, hybridization,

sigma & Pi bond, covalent, electrovalent and co-ordinate bond, inductive effect, resonance, Classification & Nomenclature of organic compounds. [08]

#### **Unit-II**

Isomerism, geometrical isomerism, Stereochemistry including optical activity, stereoisomerism, specification of configuration and conformational analysis. [08]

#### **Unit-III**

Important methods of preparation, reactions with special reference to mechanism of the following classes of compounds: Alkanes, alkenes, alkynes & dienes, free radical substitution reaction, alkyl halides, Alcohols. [08]

#### **Unit-IV**

Aromatic Compounds, aromatic character, structure of benzene, resonance, orientation of aromatic substitution, arenes, amines (aliphatic & aromatic), phenols, aryl halides. [08]

#### **Unit-V**

Aldehydes and ketones (aliphatic & aromatic), carboxylic acids & their derivatives, di & tricarboxylic acids, hydroxy acids. Organometallic Compounds- Grignard reagent, organolithium compounds, their preparation & synthetic application. [08]

### ***PHARM-I22P***

## **PHARMACEUTICAL CHEMISTRY –II**

### **(ORGANIC CHEMISTRY-I)**

#### **SUGGESTED LIST OF PRACTICALS**

1. Identification of elements and functional groups in given sample. 6
2. Purification of solvents like Benzene, chloroform, acetone and preparation of absolute alcohol. 4
3. Synthesis of compounds involving benzylation, acetylation, bromination, reduction & oxidation. 5

Synthesis of following compounds

Picric acid

Aniline

Acetanilide

Aspirin

Hippuric acid

P-Bromo acetanilide

Iodoform

Oxalic Acid

**BOOKS RECOMMENDED:**

1. Mann, F.G, & Saunders, B.C., Practical Organic Chemistry, ELBS/ Longman.
2. Vogel A.I., Textbook of Practical Organic Chemistry, ELBS/Longman.
3. Morrison, R.T., and Boyd R.N., Organic Chemistry, Prentice Hall of India Pvt. Ltd, New Delhi.
4. Finar, I.L., Organic Chemistry, Vol. I & II, ELBS/Longman.
5. Jain, M.K. Organic Chemistry, Sohan Lal Nagin Chand & Co. 60 B, Bunglaw Road, Delhi.
6. Hendrikson, Organic Chemistry.
7. Godly, E.W. " Naming organic compounds".
- 8.Kalsi," Organic reactions Stereochemistry & Mechanism".

**PHARM-123**

**ANATOMY, PHYSIOLOGY &  
PATHOPHYSIOLOGY-II**

**Unit-I : Central Nervous System :** Functions of different parts of brain and spinal cord.

Neurohumoral transmission in the central nervous system, reflex action, electroencephalogram, specialized functions of the brain. Cranial nerves and their functions. [06]

**Autonomic Nervous System :** Physiology and functions of the autonomic nervous system.

Mechanism of neurohumoral transmission the A.N.S. [04]

**Unit-II : Sense Organs :** Basic anatomy and physiology of the eye (vision), ear (hearing), taste buds, nose (smell), and skin (superficial receptors). [06]

**Unit-III : Lymphatic System :** Composition , formation and circulation of lymphs, lymph node and spleen. [05]

**Unit-IV : .**

**Demography and Family Planning,** Medical termination of pregnancy.

**First Aid :** Emergency treatment of shock, snake bites, burns, poisoning, fractures and resuscitation methods. [07]

**Unit-V Communicable Diseases :** Brief outline, their causative agents, modes of transmission and prevention (Chicken pox, measles, influenza, diphtheria, whooping cough, tuberculosis, poliomyelitis, helminthiasis, malaria, filariasis, rabies, trachoma, tetanus, leprosy, syphilis, gonorrhoea, and AIDS). [12]

**BOOKS RECOMMENDED:**

1. Ranade VG, Text Book of Practical Physiology, Pune Vidyarthi Griha Prakashan, Pune.
2. Difore SH, "Atlas of Normal Histology" Lea & Febiger Philadelphia.
3. Guyton AC, Hall JE., Text book of Medical Physiology, WB Saunders Company.
4. Chatterjee C.C. Human Physiology, Medical Allied Agency, Calcutta.
5. Ross & Wilson, Anatomy & Physiology in Health & Illness, Churchill Livingstone.
6. Tortora GJ, & Anagnostikos NP, Principles of Anatomy & Physiology, Harper & Row Publishers, New Delhi.
7. Parmar N.S., Health Education & Community Pharmacy CBS Publishers, Delhi.
8. Shalya Subhash, Human Physiology, CBS Publishers & Distributors.
9. Keele, C.A., Niel, E and Joels N, Samson Wright's Applied Physiology, Oxford University Press.

**PHARM-124**

**COMPUTER FUNDAMENTALS AND  
PROGRAMMING**

**Unit-1:** Definition and Overview of Computer, Computer classification, Computer Organization, Computer code, computer classification of Boolean algebra. Input Devices Output devices, Storage devices. Computer Software, Types of software. Overview of Computer Networks, LAN, MAN, WAN, Internet, Intranet, network topology. Internetworking: Bridges, Repeaters and Routers.

**Unit-2: Introduction:** Operating system and function, Evolution of operating system, Batch, Interactive, Time sharing and Real Time System. Single User Operating System and Multi-user Operating system, Compare MS-DOS vs. UNIX, Various window features. Internal and External commands in MS-DOS.

**Unit- 3:** Introduction to MS-OFFICE-2003, word 2003 Document creation, Editing, formatting table handling, mail merge, Excel-2003, Editing, working Retrieval, Important functions, short cut keys used in EXCEL.

**Unit 4:** MS-Power point 2003-Job Profile, Elements of Power point , ways of delivering Presentation, concept of Four P's (Planning , Preparation, Practice and Presentation) ways of handling presentations e.g. creating, saving slides show controls, Adding formatting, animation and multimedia effects. Database system concepts, Data models schema and instance , Database language, Introduction to MS-Access 2003, main components of Access tables, Queries, Reports, Forms table handling, working on Query and use of database.

**Unit- 5:** Computer applications in Pharmaceutical and clinical studies, uses of Internet in Pharmaceutical Industry

**BOOKS RECOMMENDED:**

1. Sinha, R.K., Computer Fundamentals, BPB Publications.
2. Raja Raman, V, Computer Programming in 'C', PHI Publication.
3. Hunt N and Shelley J. "Computers and Common Sense" Prentice Hall of India.
4. N.K.Tiwari," Computer fundamentals with Pharmacy Applications".
5. G.N.Rao, " Biostatistics & computer Applications".

**PHARM-124P**

**Computer Fundamentals and Programming**

Software Lab to be used for the following:-

1. Windows, Managing Windows, Working with Disk , Folders and files.
2. MS-Office 2003 (MS Word, MS Power point, MS Excel, MS Access).
3. Computer Operating System Like DOS and Windows.
4. Internet Features (E-mail, Browser etc.)

**PHARM-125**

**Pharmaceutical Biostatistics**

**Unit-I**

1. Method of collective data
2. Diagrammatic representation of data (Pie,Histogram, Bar, Circular diagramm)
3. Classification and Tabulation of data.
4. Sampling-Types of sampling

Merits and limitations of sampling  
Sampling errors and non sampling errors.

**Unit-II- Measure of central tendency for discrete and continuous data.**

- a. Mean, Types of means.
- b. Median
- c. Mode-  
Measure of dispersion
- a. Quartile deviation
- b. Mean deviation
- c. Standard error of Mean (SEM)

**Unit-III-**

- a. Skewness and Kurtosis
- b. Correlation and regression analysis
- c. Method of least square in straight line

**Unit-IV-Statistical Inferences- Confidence (fiducial) limit.**

Tests- Hypothesis- t-test  
z-test  
 $\chi^2$ -test  
F- test ( variance ratio)

Analysis of variances- one way and two way classification, Nonlinear  
(ANOVA)

**Unit-V- 1. Theory of Probability- Simple Probability**

Addition Probability  
Multiplication Probability

- 2. Binomial distribution- Fit of Binomial
- 3. Poisson distribution- Fit of Poisson
- 4. Normal distribution –Fit of Normal

**BOOKS RECOMMENDED**

1. A textbook of Mathematics for XI-XII Students, NCERT Publication Vol. I-IV.
2. Gupta S.P. Statistical Methods, Sultan Chand and Co., New Delhi.
3. Greval B.S., Higher Engineering Mathematics, Khanna Publication, New Delhi.
4. Boltan's Pharmaceutical Statistics, Practical and Clinical Application, Marcel Dekker, N.Y.
5. Khan, Khanum, " Biostatistics for Pharmacy".

## SEMESTER-III

*PHARM-231*

### PHARMACEUTICS-II (UNIT OPERATIONS-I)

#### Unit-I

- 1. Unit Operations :** Introduction, basic laws.
- 2. Fluid Flow :** Types of flow, Reynold's number, Viscosity, Concept of boundary layer, basic situations of fluid flow, valves, flow meters, manometers and measurement of flow and pressure.

#### Unit-II

- 3. Water systems** – Raw water, soft water, purified water, water for injection , quality requirement and treatment of water. washing, cleaning and standardisation of cleaning.
- 4. Filtration and Centrifugation :** Theory of filtration, filter aids, filter media, industrial filters including filter press, rotary filter, edge filter. Factors affecting filtration, Principles of centrifugation, industrial centrifugal filters, and centrifugal sedimenters. [10]

#### Unit-III

- 5. Crystallization :** Characteristics of crystals like-purity, size, shape, geometry, habit, forms size and factors affecting them, Solubility curves and calculation of yields. Material and heat balances around Swenson Walker Crystallizer. Supersaturation theory and its limitations, Nucleation mechanisms, crystal growth, Study of various types of Crystallizer, Tanks, agitated batch, Swenson Walker, Single vacuum, circulating magma and Krystal crystallizer, Caking of crystals and its prevention. [08]

#### UNIT – IV

- 6. Heating, Ventilation & AC Systems:** Basic concepts and definition, wet bulb and adiabatic saturation temperatures, Psychrometric chart and measurement of humidity, application of humidity measurement in pharmacy, equipment for dehumidification operations. Principles and applications of refrigeration and air conditioning. [08]

#### Unit-V

- 7. Material of Construction :** General study of composition, corrosion, resistance, Properties and applications of the materials of construction with special reference to stainless steel and glass.
- 8. Industrial Hazards and Safety Precautions :** Mechanical, Chemical, Electrical, fire and dust hazards. Industrial dermititis, Accident record. [06]

**PHARMACEUTICS-II  
(UNIT OPERATIONS-I)**

**PRACTICAL**

1. Measurement of rate of flow of fluids and pressure by:

- a) Simple and differential manometers
- b) Venturimeter
- c) Orifice meter

2. Determination of Reynold Number.

3. Study of factors affecting rate of filtration

- a) Effect of different filter media
- b) Effect of viscosity of filtrate
- c) Effect of pressure
- d) Effect of thickness of cake
- e) Effect of filter aids.

4. Study principle of centrifugation for

- a) Liquid –Liquid separation and stability of emulsions.
- b) Solid – liquid separation and stability of suspension.

5. Determination of dry bulb and wet bulb temperatures and use of Psychrometric charts.

6. Study of characteristics of crystals

7. Study of solubility curve of crystals.

**BOOKS RECOMMENDED**

- 1. Badger W.L. and Banchero J.T. Introduction to Chemical Engineering Mc Graw Hill International Book Co., London.
- 2. Perry R.H. & Chilton C.H. Chemical Engineers Handbook, Mc Graw Kogakusha Ltd.
- 3. McCabe W.L. and Smith J.C. Unit Operation of Chemical Engineering Mc Graw Hill International Book Co., London.
- 4. Sambhamurthy, Pharmaceutical Engineering, New Age Publishers.
- 5. Gavhane, K.A. “Unit Opeation-I”, Nirali Prakashan.

**PHARM-232**

**PHARMACEUTICAL JURISPRUDENCE & ETHICS**

**Unit-1 : Introduction**

**1. Pharmaceutical Legislations** – A brief review.

**2. Drugs & Pharmaceutical Industry** – A brief review.

**3. Pharmaceutical Education** – A brief review.

**4. Pharmaceutical Ethics:** [06]

**Unit-II : An elaborate study of the following:**

(A) Pharmacy Act 1948

(B) Drugs and Cosmetics Act 1940 and Rules 1945 [14]

**Unit-III : (C) Medicinal & Toilet preparations (Excise duties Act 1955)**

(D) Narcotic Drugs & Psychotropic Substances Act 1985 & Rules.

(E) Drugs Price Control Order 1995. [08]

**Unit-IV : A brief study of the following with special reference to the main provisions.**

(A) Poisons Act 1919

(B) Drugs and Magic remedies (Objectionable Advertisements) Act 1954.

(C) Medical termination of Pregnancy Act 1970 & Rules 1975.

(D) Prevention of Cruelty to Animals Act 1961.

(E) States Shops & Establishments Act & Rules. [05]

**Unit-V : (F) A.I.C.T.E. Act 1987**

(G) Patents Act 1970

(H) Weight and Measures Act

(I) Package and Commodity Act

(J) U.S Food and Federal D&C Act [07]

**Note :** The teaching of all the above Acts should cover the latest amendments.

**BOOKS RECOMMENDED :**

1. B.M., Mittal, Textbook of Forensic Pharmacy, National Book Centre, Dr. Sundari Mohan Avenue, Calcutta.

2. Relevant Acts & Rules Published by the Govt. of India.

3. N.K. Jain, A Textbook of Forensic Pharmacy, Vallabh Prakashan, N. Delhi.

4. Singh, Harkishan “History of Pharmacy in India- Vol.-I, II & III” Vallabh Prakashan.

PHARMACOGNOSY – I

**Unit-I :** Definition history, scope & development of Pharmacognosy. [02]

**1. Source of Drug :** Biological, marine, mineral and plant tissue cultures as source of drugs.

Marine pharmacognosy, Novel medicinal agents from marine sources. [04]

**2. Classification of Drugs :** Alphabetical, Morphological, taxonomical, chemical & pharmacological. [02]

**Unit-II : 3. Plant taxonomy :** Study of following families with special reference to medicinally important plants – Apocynaceae, Solanaceae, Rutaceae, Umbelliferae, Leguminosae, Rubiaceae, Liliaceae, Labitae, Acanthaceae, Compositae, Papaveraceae. [04]

**Unit-III : 4. Cultivation, Collection, Processing & Storage of crude drugs :**

A. Factors influencing cultivation of medicinal plants, Type of Soils & fertilizers of common use. [02]

B. Pest & Pest Management ,natural pest control agents. [02]

C. Plant hormones and their applications. [01]

D. Polyploidy, Mutation & hybridization with reference to medicinal plants. [02]

E. Poly Houses/ Green Houses for cultivation.

**Unit-IV : 5. Quality Control of crude drugs :** Adulteration of crude drugs and their detection by organoleptic, microscopic, physical, chemical and biological methods of evaluation including Quantitative microscopy. WHO guidelines for standardisation of medicinal plants. [08]

**Unit-V : 6. Systematic pharmacognostic study of following :**

a) Carbohydrates & derived products : Agar, Guar gum, acacia, Honey, Isabgol, pectin, starch, sterculia & tragacanth. [07]

b) Lipids – Beeswax, castor oil, Cocabutter, Kokum butter, hydnocarpus oil, Codliver oil, shark liver oil, Linseed oil, wool fat, Rice-bran oil, Lard & Suet. [08]

**PHARMACOGNOSY - I**

**PRACTICAL**

1. Morphological characteristics of plant families mentioned in theory.
2. Microscopical Measurements of cell & cell contents Starch grains, Calcium oxalate Crystals & Phloem Fibres.
3. Determination of leaf Constants such as Stomatal index, Stomatal number, Vein islet number, Vein determination number and palisade ratio.
4. Identification of crude drugs belonging to carbohydrates & lipids.
5. Preparation of herbarium sheets.

**SUGGESTED PRACTICALS**

1. Study of Plants belonging to family Solanaceae.
2. Study of Plants belonging to family Rutaceae.
3. Study of Plants belonging to family Liliaceae
4. Study of Plants belonging to family Umbelliferae.
5. Microscopical measurements of starch grains (Wheat, Maize).
6. Microscopical measurements of starch grains (Rice, Potato).
7. Various types of calcium-oxalate crystals, their study and microscopical measurements (Rhubarb, Senna, Liquorice etc.)
8. Study of various types of phloem fibres.
9. Determination of stomatal number with the help of camera lucida along with the working of instrument.
10. Determination of stomatal index.
11. Determination of vein-islet and vein termination number.
12. Determination of palisade ratio.
13. Chemical Tests of Agar, Acacia, Sterulia and Tragacanth.
14. a) Chemical tests of Pectin, Starch and Honey.  
b) Swelling factor of Isapaghula husk.  
c) Average weight of Ispaghula husk.
15. Physical characteristics of Caster oil, Cod-liver oil, Shark-liver oil and Linseed oil.

**BOOKS RECOMMENDED**

1. Trease, G.E. & Evans, W.C., "Pharmacognosy" Bailleire Tindall East bourne, U.K.

2. Wallis, T.E., Text book of Pharmacognosy, J.A. Churchill, Ltd
4. Wallis T.E., Analytical Microscopy, J&A Churchill Limited, London.
5. Brain K.R. and Turner T D. "The Practical Evaluation of Phyto Pharmaceutical", Wright, Scientecnica- Bristol.
7. Schewer PJ, "Marine Natural products", Academic press, London.
8. Mohammed Ali, " Pharmacognosy & Phytochemistry".

**PHARM-234**

**PHARMACEUTICAL CHEMISTRY - III  
(ORGANIC CHEMISTRY -II)**

**Unit-I :**  $\alpha$ ,  $\beta$ - Unsaturated carbonyl compounds, cycloaddition.

Compounds containing active methylene group and their synthetic importance- Acetoacetic ester and malonic ester. [08]

Polynuclear hydrocarbons-Napthalene, anthracene and phenantherene.

**Unit - II :** Heterocyclic Compound – Nomenclature, Chemistry, preparation, properties and pharmaceutical importance of pyrrole, furan, thiophene, pyridine, pyrimidine, imidazole, pyrazole, thiazole, benzimidazole, indole, phenothiazines. [08]

**Unit-III :** Name reactions – Definition, reaction mechanism and synthetic application of Merwin –Pondorff, Verley reduction, Oppeneaur oxidation, Bechmann rearrangement, Mannich reaction, Diel’s alder reaction, Michel, Reformatsky, Knoevanegal reaction, Benzoin condensation. [08]

**Unit-IV:** Classification, structure, reactions, structure elucidation, identification of :

**a) Carbohydrates**

i) Monosaccharides – Glucose and fructose.

ii) Disaccharides – Sucrose, lactose and maltose.

iii) Polysaccharides – Starch. [08]

**Unit-V :** Classification, identification, general methods of preparation and reactions of amino acids and proteins.

Structure of Nucleic Acids.

Chemistry & identification of oils, fats and waxes. [08]

Polymers and polymerisation.

**PHARM-234P**

**PHARMACEUTICAL CHEMISTRY-III  
(ORGANIC CHEMISTRY-II)**

**PRACTICAL**

1. Identification of organic compounds and their mixture with derivatization.
2. Synthesis of Organic Compounds involving two steps.
3. Determination of Iodine value, saponification value, Acid value, Ester value of oils, fats and waxes.

**BOOKS RECOMMENDED**

1. Mann P G & Saunders B C, Practical Organic Chemistry, ELBS/ Longman, London.
2. Furniss B S, Hannaford A J, Smith P W G and Tatehell A R, Vogel's Textbook of Practical Organic Chemistry, The ELBS/ Longman, London.
3. Morrison, T.R. and Boyd, R.N., Organic Chemistry, Prentice Hall of India, Private Limited, New Delhi.
4. Finar, I.L., Organic Chemistry Vol. I & II, ELBS/Longman.
5. Jain, M.K. and Sharma S.C, Organic Chemistry, Shoban Lal Nagin Chand & Co., Delhi.
6. Kalsi, "Organic Reactions Stereochemistry & Mechanism".

**PHARM-235**

**PHARMACEUTICS – III  
(COMMUNITY PHARMACY)**

**Unit-I**

[06]

1. Definition, scope of community pharmacy  
Roles and responsibilities of Community pharmacist, code of Ethics.
2. Community Pharmacy Management
  - i) Selection of site, Space layout, and design
  - ii) Staff, Materials- coding, stocking
  - iii) Legal requirements
  - iv) Maintenance of various registers
  - v) Use of Computers

**Unit-II**

3. Prescriptions- parts of prescription, legality & identification of medication related problems like

drug interactions incompatibility.

4. Inventory control in community pharmacy.

Definition, various methods of Inventory Control.

ABC, VED, EOQ, Lead time, safety stock

[08]

### **Unit-III**

5. Pharmaceutical care

Definition and Principles of Pharmaceutical care.

6. Communication skills and Patient counselling

Need for good communication, Key communication skills.

Strategies to overcome barriers

Patient information leaflets- content, design, & layouts, advisory labels

7. Patient compliance

Definition, Factors affecting compliance, role of pharmacist

in improving the compliance.

[10]

### **Unit-IV**

8. Health screening services

Definition, importance, methods for screening

Blood pressure/ blood sugar/ lung function

And Cholesterol testing.

[06]

9. OTC Medication- Definition, OTC medication list & Counseling

### **Unit-V**

10. Health Education

WHO Definition of health, and health promotion, care for children, pregnant & breast feeding women, and geriatric patients.

Role of Pharmacist in family planning, prevention of communicable diseases, nutrition.

11. Pharmacoepidemiology & Pharmacoeconomics – Brief introduction

12. Rational drug therapy – Brief introduction

[10]

**PHARMACEUTICS – III  
(COMMUNITY PHARMACY)**

**PRACTICAL**

1. Categorization and storage of Pharmaceutical products bases on legal requirements of labeling and storage.
2. Project report on visit to the nearby Community for Counseling on the rational use of drugs and aspects of health care.
3. Prescription handling and identification of drug interactions, incompatibilities.
4. Health screening services and study of equipments for:-
  - Blood glucose determination (Glucometer)
  - Blood pressure (BP apparatus)
  - Lung function test (Peak flow meter)
5. Design of community pharmacy to incorporate all pharmaceutical care services (as per schedule N).
6. Study of OTC medications
  - List & Available brands
7. Interpretation of various pathological report of blood and urine.

**BOOKS RECOMMENDED :**

1. Carter S.J. Cooper and Gunn's Dispensing for Pharmaceutical Students, CBS Publishers, Delhi.
2. Ansel H.C., Introduction to Pharmaceutical Dosage Forms, K.M. Varghese & Co., Bombay.
3. Aulton M.E. Pharmaceutics – The Science of Dosage Form Design, ELBS/ Churchill Livingstone.
4. Remington Pharmaceutical Sciences, Mack Publishing Co., Pennsylvania.
5. I.P., Govt of India Publication.
6. B.P., Her Majesty's Stationary Office, Cambridge.
7. Carter S.J., Cooper and Gunn's Tutorial Pharmacy, CBS Publishers, Delhi.
8. Drugs & Cosmetics Act & Rules.
9. Parmar N.S. Community Pharmacy & Health Education, CBS Publishers.

**ANATOMY, PHYSIOLOGY AND  
PATHOPHYSIOLOGY – III**

**Unit I – Digestive system** –Parts of digestive system, their structure and functions. Various gastrointestinal secretions & their role. [08]

**Unit II** –Pathology of disorders related to digestive system Peptic Ulcer, Ulcerative colitis, Crohns disease, Zollinger- Ellison syndrome, Amoebiasis, typhoid, Hepatitis, Cirrhosis of liver, pancreatitis. [06]

**Unit-III – Urinary System** – Anatomy & physiology of urinary system, physiology of urine formation, acid- base balance, pathophysiology of renal feature, glomerulonephritis, Urinary tract infection. [08]

**Unit-IV**-Cell injury & Adaption-Courses of cell injury, pathogenesis & morphology of cell injury. Cellular AS daptation- Atropy, hypertrophy, aplasia, metaplasia, & dysplasia, intracellular accumulation & pathophysiology of Neoplasm.

**Unit-V**- Basic mechanisms involved in the process of inflammation and repair Alterations in vascular permeability and blood flow, migration of WBC's mediators of inflammation. Brief outline of the process of repair.

**BOOKS RECOMMENDED**

1. Difore SH, "Atlas of Normal Histology" Lea & Febiger Philadelphia.
2. Chaurasia B.D, Human Anatomy, Regional & Applied Part I, II & III, CBS Publishers & Distributors, New Delhi.
3. Guyton AC, Hall JE., Text book of Medical Physiology, WB Saunders Company.
4. Chatterjee C.C. Human Physiology, Medical Allied Agency, Calcutta.
5. Ross & Wilson, Anatomy & Physiology in Health & Illness, Churchill Livingstone.
6. Tortora GJ, & Anagnodokos NP, Principles of Anatomy & Physiology, Harper & Rave Publishers, New Delhi.
7. Parmar N.S., Health Education & Community Pharmacy CBS Publishers, Delhi.
8. Shalya Subhash, Human Physiology, CBS Publishers & Distributors.
9. Keele, C.A., Niel, E and Joels N, Samson Wright's Applied Physiology, Oxford University Press.
10. Dipiro JL, Pharmacotherapy – A Pathophysiological Approach, Elsevier.
11. Robbins SL, Kumar V, Basic Pathology, WB Saunders.

## SEMESTER IV

**PHARM-241**

### **PHARMACEUTICS – IV (UNIT OPERATIONS – II)**

**Unit-I : Stoichiometry :** Unit processes material and energy balances, molecular units, mole fraction, tie substance, gas laws, mole volume, primary and secondary quantities, equilibrium state, rate process, steady and unsteady states, dimensionless equations, , dimensionless formulae, dimensionless groups, different types of graphic representation. [08]

**Unit-II : Evaporation :** Basic concepts of phase equilibria, factor affecting evaporation, evaporator, film evaporators, single effect and multiple evaporator. [08]

**Unit -III : Distillation :** Raoult' s law , Phase Diagrams , volatility, simple steam and flash distillations , principles of rectification, McCabe thiele method for the calculations of number of theoretical plates, Azeotropic and extractive distillation . [08]

**Unit –IV : Drying :** Moisture content and mechanism of drying , rate of drying and time of drying calculations, classification and type of dryers , dryers used in pharmaceutical industries – Tray dryer, Fluidized bed dryer, spray dryer and special drying methods. [08]

**Unit-V : Automated Process Control Systems :** Process variables, temperature, pressure, flow level and vacuum and their measurements. Elements of automatic process control and introduction to automatic process control systems. Elements of computer aided manufacturing (CAM) . Reactors and fundamentals of reactor design for chemical reactions. [08]

**PHARM-241P**

### **PHARMACEUTICS-IV (UNIT OPERATIONS-II)**

#### **PRACTICAL**

1. Determination of overall heat transfer coefficient.
2. Study of factors affecting rate of evaporation :-
  - a) Effect of surface area
  - b) Effect of temperature

3. Study of factors affecting rate of drying
  - a) Surface area
  - b) Temperature
4. Determination of rate of drying, free moisture content and bound moisture content.
5. Experiments based on
  - a) Steam distillation
  - b) Extractive distillation
  - c) Azeotropic distillation
6. Elementary knowledge of engineering drawing
  - Alphabets/ letter writing
  - Scales
  - Orthographic projections – First and third angle projection methods
  - Simple Isometric views

**BOOKS RECOMMENDED :**

1. Badger W.L. and Banchero J.T. Introduction to Chemical Engineering Mc Graw Hill International Book Co., London.
2. Perry R.H. & Chilton C.H. Chemical Engineers Handbook, Mc Graw Kogakusha Ltd.
3. McCabe W.L. and Smith J.C. Unit Operation of Chemical Engineering Mc Graw Hill International Book Co., London.
4. Gavhane, K.A. “Unit Operation-II”, Nirali Prakashan.
5. Sambhamurthi Pharmaceutical Engineering, New Age Publishers.

**PHARM-242**

**PHARMACEUTICAL MICROBIOLOGY**

**Unit-I :**

1. Introduction to the scope of microbiology.
2. Structure of bacterial cell.
3. Classification of microbes and their taxonomy: Bacteria and viruses. [08]

**Unit-II :**

4. Identification of Microbes : Stains and types of staining techniques, electron microscopy.
5. Nutrition, cultivation & isolation of bacteria & viruses. [08]

**Unit-III :**

6. Control of microbes by physical and chemical methods.

A. Disinfection, factors influencing disinfectants, dynamics of disinfection, disinfectants

And antiseptics and their evaluation.

B. Sterilization, different methods, validation of sterilization methods & equipments.

[08]

**Unit-IV :**

7. Sterility testing as per I.P.

8. Preservative efficacy

**Unit-V :**

9. Microbial assays of antibiotics, vitamin B12.

10. Factory and hospital hygiene- control of microbial contamination during manufacture, manufacture of sterile products- clean and aseptic area, nosocomial infection, control of hospital infections.

**PHARM-242P****PHARMACEUTICAL MICROBIOLOGY****PRACTICAL**

Experiments devised to prepare various types of culture media, sub-culturing of common aerobic and anaerobic bacteria, fungus and yeast, various staining methods, various methods of isolation and identification of microbes, sterilization techniques and their validation, validation of sterilization techniques, evaluation of antiseptics and disinfectants, testing the sterility of pharmaceutical products as per I.P. requirements, microbial assay of antibiotics and vitamins.

**SUGGESTED PRACTICALS**

1. Study of sterilization methods & equipments
  - Dry heat
  - Moist heat
2. Preparation of various types of culture media.
3. Isolation of bacteria.
4. Sub-culturing of common bacteria, fungi, yeast.
5. Identification and staining of bacteria.

- Simple staining
  - Gram staining
  - Acid fast staining
  - Hanging drop preparation
6. Evaluation of disinfectants and antiseptics
    - Phenol coefficient test, minimum inhibitory concentration.
  7. Test for sterility of pharmaceutical products as per IP.
  8. Microbial assay of antibiotics as per IP.

#### **BOOKS RECOMMENDED :**

1. Aneja K.R. Experiments in Microbiology, Plant Pathology, Tissue Culture & Mushroom Cultivation, Vishwa Prakashan.
2. Gunasekaran P, Lab Manual of Microbiology, New Age Publishers.
3. Davis, Dulbetco, Eisen Microbiology.
4. Stanier R.Y., Ingraham, J.L., Wheelis M.L. & Painter P.R. General Microbiology, Macmillan Press Limited.
5. Hugo and Russell, Pharmaceutical Microbiology, Black Well Scientific Publication, Oxford.
6. Prescott L.M., Harley J.P. & Klien D.A. Microbiology, McGraw Hill.
7. Sykes, Disinfection and Sterilization.
8. Pelczar & Reid, Microbiology, Tata Mc Graw Hill, Delhi.
9. Virella G. Microbiology and Infectious Diseases, William & Wilkins.
10. Ananthanarayan R & Paniker CKJ, Textbook of Microbiology, Orient Longman.

#### **PHARM-243**

#### **PHAMACOGNOSY – II**

**Unit-I : Resins :** Study of drugs containing Resins and Resin Combination like

Podophyllum, Cannabis, Capsicum, Shellac, Asafoetida, Balsam of tolu, Balsam of peru, Benzoin, Turmeric, Ginger. [05]

**Unit-II : Volatile oils :** General methods of obtaining volatile oils from plants, Study of volatile oils from Mentha, Coriander, Cinnamon, Jatamansi, Cumin, Black pepper, Cassia, Lemon peel, Orange peel, Lemon grass, Citronella, Caraway, Dill, Spearmint, Clove, Fennel, Nutmeg, Eucalyptus, Chenopodium, Cardamom, Valerian, Musk, Palmarosa, Gaultheria,

Sandalwood. [10]

**Unit-III : Phytochemical Screening :** An introduction to active constituents of drugs : Their isolation, classification and properties with Qualitative chemical tests of the followings – Alkaloids, Saponins, Cardenolides and bufadienolides, flavonoids and Leucoanthocyanidine, cyanogenetic glycosides. [14]

**Unit-IV : Fibres :** Study of fibres used in pharmacy such as cotton, silk, wool, nylon, glasswool, polyester and asbestos. [03]

**Pharmaceutical aids :-** Study of Pharmaceutical aids like Talc, Diatomite, Kaolin, Bentonite, Fullers earth, Gelatin and Natural colors. [02]

**Unit-V : Tannins :** Study of tannins & tannin containing drugs like Gambier (Pale Catechu), Black Catechu, Gall and Myrobalans (Harde, Baheda, Arjuna & Ashoka). [03]

Utilization of aromatic plants & desired products will special reference to Sandalwood oil, Mentha oil, Lemon grass oil, Vetiver oil, Geranium oil & Eucalyptus oil. [03]

Role of aromatic plants in national economy.

#### **PHARM-243P**

### **PHARMACOGNOSY – II**

#### **PRACTICAL**

1. Identification of crude drugs mentioned in theory.
2. Study of fibres and pharmaceutical aids.
3. Microscopic study of seven selected drugs and their powders mentioned under the category of volatile oils in theory with their chemical tests.
4. General chemical test for Alkaloids, Glycosides, Steroids, Flavonoids & Tannins.

#### **SUGGESTED PRACTICALS**

1. Morphology of Mentha, Lemongrass, Nutmeg and chenopodium.
2. Morphology of Turmeric, Ginger, Cannabis, Eucalyptus.
3. Morphology and microscopy of Coriander and Cinnamon.
4. Morphology and microscopy of Dill and Caraway.
5. Morphology and microscopy of Cardamom and Fennel.
6. Morphology and microscopy of Clove and to study its transverse section.
7. Study of Cotton, Silk and Wool along with their chemical Tests.
8. To study the morphology and chemical tests of Talc, Diatomite, and Kaolin.

9. Morphology and microscopy of Bentonite, Gelatin and natural colours (Saffron).
10. To perform the chemical tests of Balsam (Tolu and Peru) and Asafoetida.
11. Preparation of reagents for the chemical tests of Alkaloids and to perform the chemical tests on any Alkaloid containing drug.
12. Test for identification of Glycosides (Saponin and Anthraquinone).
13. Test for identification of Tannins.
14. Tests for identification of steroids.
15. Tests for identification of flavonoids.

**PROJECT WORK :**

Utilization of Aromatic plants; ((Monograph).

**BOOKS RECOMMENDED :**

1. Trease G.E., & Evans W.C., "Pharmacognosy" Balliere Tindall East Bourne U.K.
2. Tyler V.E. et al "Pharmacognosy" Lea & febiger, Philadelphia.
3. Wallis, T.E. "Text Book of Pharmacognosy" J&A Churchill Ltd, London.
4. Kokate C.K. et al "Pharmacognosy" Nirali Prakashan, Pune.
5. Atal C.K. & Kapur BM, "Cultivation & utilization of Medicinal plant, RRL, Jammu.
6. Harborne J B, Phytochemical method, Chapman & Hall International Edition, London.
7. Mohammed Ali," Pharmacognosy & Phytochemistry".

**PHARM-244**

**PHARMACEUTICAL ANALYSIS- II**

**Unit-I :** Theoretical considerations and application in drug analysis and quality control by the following analytical techniques (assays included in the Indian Pharmacopia 1996)

**(A) Non-aqueous titrations**

**(B) Complexometric titration.** [08]

**Unit-II : (A) Miscellaneous methods of analysis :**

Diazotization titrations, Kjeldahl method of Nitrogen estimation, Karl- Fischer titration, Alcohol estimation in galenicals Potentiometry (B)Radioassays. [08]

**Unit-III : Demistrometry** – Introduction, Dielectric cell, electrode potential, Nernst equation, salt bridge, standard potential, reference and indicator electrodes, measuring the relative voltage of cell.

A. Potentiometry : General principles, instrumentation and applications.

B. Conductometry : General Principles, instrumentation and applications. [08]

**Unit-IV:** Polarography and Amperometry- General principles, Instrumentation and Applications [08]

**Unit-V :** Principle, instrumentation and pharmaceutical applications.

Paper column, Chromatography, TLC [08]

### ***PHARM-244P***

## **PHARMACEUTICAL ANALYSIS - II**

### **PRACTICAL**

- 1. Non-aqueous Titrations :** Preparation and standardization of perchloric acid and sodium/potassium methoxide solutions, Estimation of some pharmacopoeial products.
- 2. Complexometric Titrations :** Preparation and standardization of EDTA solution some exercise related to pharmacopoeial assays by Complexometric titrations.
- 3. Miscellaneous Determinations :** Exercise involving Diazotization, Kjeldahl, Karlfisher.
- 4.** Exercise based on acid base titration in aqueous and non-aqueous media, oxidation reduction titrations using potentiometric technique, determination of acid base dissociation constants and plotting of titration curves using pH meter.
- 5.** Exercises involving conductometric titrations.
- 6.** Exercises based on paper, column and thin- layer chromatography.

### **BOOKS RECOMMENDED :**

1. Beckett, A H and Stenlake, J.B, Practical Pharmaceutical Chemistry, Vol, I and II, The Athlone Press of the University of London.
2. Pharmacopoeia of India, published by The Controller of Publications, Delhi.
3. British Pharmacopoeia, Her Majesty's Stationary Office, University Press, Cambridge.
4. Mendham J, Denny RC, Barnes, J.D. Thomas M.J.K. "Vogel's Text Book of Quantitative chemical" Pearson Education Asia.
5. Connors KA, A Textbook of Pharmaceutical Analysis, Wiley Interscience, New York.
6. G.Vidya Sagar," Instrumental Methods of drug Analysis".

**PHARM-245**

**ANATOMY PHYSIOLOGY AND PATHOPHYSIOLOGY –IV**

**Unit-I – Respiratory System** – Anatomy & function of respiratory structures, Mechanism of respiration, regulation of respiration, pathophysiology of Asthma, Pneumonia, Bronchitis, Emphysema, Tuberculosis. [08]

**Unit-II – Cardiovascular System** – Functional Anatomy of heart, conducting system of heart, cardiac cycle, ECG (Electro cardiogram). Pathophysiology of hypertension, Angina, CHF, myocardial infarction, cardiac arrhythmias, Ischaemic heart disease, Arteriosclerosis. [10]

**Unit-III** – Reproductive System- Male & Female reproductive system. Menstruation, pathophysiology of sexually transmitted diseases, spermatogenesis, oogenesis, pregnancy. [08]

**Unit IV** – Endocrine System – Anatomy & Physiology of pituitary, thyroid, parathyroid, adrenal, pancreas, control of hormone secretion, pathophysiology of hypo & hyper secretion of endocrine glands & their disorders e.g.- Diabetes mellitus. [08]

**Unit-V-** Pathophysiology of Joints disorder – Arthritis, gout, myasthenia gravis, spasticity, tetany, fatigue. Pathophysiology of anaemia, AIDS, hypersensitivity, allergic conditions, psychosis, epilepsy, Parkinson & Alzheimer's diseases pathophysiology of cataract, glaucoma etc. [06]

**BOOKS RECOMMENDED**

1. Difore SH, "Atlas of Normal Histology" Lea & Febiger Philadelphia.
2. Chaurasia B.D, Human Anatomy, Regional & Applied Part I, II & III, CBS Publishers & Distributors, New Delhi.
3. Guyton AC, Hall JE., Text book of Medical Physiology, WB Saunders Company.
4. Chatterjee C.C. Human Physiology, Medical Allied Agency, Calcutta.
5. Ross & Wilson, Anatomy & Physiology in Health & Illness, Churchill Livingstone.
6. Tortora GJ, & Anagnostikos NP, Principles of Anatomy & Physiology, Harper & Row Publishers, New Delhi.
7. Parmar N.S., Health Education & Community Pharmacy CBS Publishers, Delhi.
8. Shalya Subhash, Human Physiology, CBS Publishers & Distributors.
9. Keele, C.A., Niel, E and Joels N, Samson Wright's Applied Physiology, Oxford University Press.
10. Dipiro JL, Pharmacotherapy – A Pathophysiological Approach, Elsevier.
11. Robbins SL, Kumar V, Basic Pathology, WB Saunders.

## SEMESTER -V

*PHARM-351*

### PHARMACEUTICAL CHEMISTRY – IV (BIOCHEMISTRY)

#### Unit-I :

- 1. Enzymes :** Nomenclature, enzymes-kinetics and mechanism of action, mechanism of inhibition of enzymes and isoenzymes in chemical diagnosis.
- 2. Co-enzymes:** Vitamins as co-enzymes and their significance. Metals as co-enzymes and their significance. [08]

#### Unit-II

- 3. Carbohydrate metabolism :** Glycolysis, Gluconeogenesis and Glycogenolysis. Metabolism of galactose and galactosemia. Role of sugar nucleotides in biosynthesis and pentose phosphate pathway.
- 4.** The citric acid cycle, significance, reactions and energetics of the cycle. [08]

#### Unit-III

- 5. Lipid metabolism :** Oxidation of fatty acid & energetics, Biosynthesis of ketone bodies and their utilization, Biosynthesis of saturated and unsaturated fatty acids., regulation of lipid metabolism, essential fatty acids.
- 6. Biological Oxidation :** The respiratory chain, its role in energy capture & control, Energetics of oxidative phosphorylation, mechanism of oxidative phosphorylation. [08]

#### Unit-IV

- 7.** Biosynthesis of amino acids, catabolism of amino acids and conversion of amino acids to specialized products, biosynthesis of purine and pyrimidine., formation of deoxyribonucleotides.
- 8.** Biosynthesis of RNA, DNA replication, Carcinogenesis & DNA repair mechanism. [08]

#### Unit-V

- 9.** Genetic Code and Protein synthesis, components of protein synthesis, inhibition of protein synthesis.

10. Regulation of gene expression. (Prokaryote and Eukaryote)

[08]

*PHARM- 351P*

**PHARMACEUTICAL CHEMISTRY-IV  
(BIOCHEMISTRY)**

**PRACTICAL**

1. Preparation of standard buffers (citrate, phosphate and carbonate) and measurement of pH.
2. Titration curve for amino acids.
3. Separation of amino acids by chromatography.
4. Separation of lipids by TLC.
5. Quantitative estimation of amino acids.
6. Determination of glucose by means of the enzyme glucose oxidase.
7. Enzymatic hydrolysis of glycogen by  $\alpha$  &  $\beta$  amylase.
8. Effects of temperature on the activity of alpha amylase.
9. Estimation of cholesterol in Blood.
10. Estimation of Glucose in blood & urine.
11. Estimation of Urea in blood.
12. Estimation of ketone bodies in blood.
13. Qualitative analysis of inorganic as well as organic constituents of Urine.

**BOOKS RECOMMENDED :**

1. Jayaraman J., Laboratory Manual in Biochemistry, Wiley Eastern Limited.
2. Plummer, David J., An Introduction to Practical Biochemistry, Mc Graw Hill, New Delhi.
3. Singh S.P., Practical Manual to Biochemistry, CBS Publisher, New Delhi.
4. "Harpers Review of Biochemistry" Lange Medical Publication.
5. Conn E.E. & Stumph P.K., Outline of Biochemistry, John Willery & sons, New York.
6. Nelson DL & Cox MM, Lehninger Principles of Biochemistry, Macmillan Worth Publishers.
7. Stryer L., Biochemistry, WH, Freeman & Company, San Francisco.
8. Harrow B. & Mazur A., Text book of Biochemistry, W.B. Saunders Co., Philadelphia.
9. Narayanan P., Bioinformatics- A Premier, New Age International Publishers Delhi.
10. Nelson, L.David, ' Lehninger , Principles of Biochemistry'.

*PHARM-352*

**PHARMACEUTICS – V**

## (PHARMACEUTICAL TECHNOLOGY -I)

### **Unit-I : Preformulation studies :**

Study of physical properties of drug like physical form, particle size, shape, density, wetting, dielectric constant, Solubility, dissolution and organoleptic properties and their effect on formulation, stability and bioavailability. [08]

**Unit-II : Liquid Dosage Forms :** Introduction, types of additives used in formulations, vehicles, stabilizers, preservatives, suspending agents, emulsifying agents, solubilizers, colors, flavours and others, Manufacturing packaging & evaluation of clear liquids, suspensions and emulsions. [08]

**Unit-III : Semisolid Dosage Forms :** Definitions, types, mechanisms of drug penetration, factors influencing penetration, semisolid bases and their selection, General formulation of semisolids, clear gels & manufacturing procedure, evaluation and packaging. [08]

**Unit-IV : Suppositories :** Ideal requirements, bases, manufacturing procedure, packaging and evaluation.

**Pharmaceutical Aerosols:** Definition, Propellants, general formulation, manufacturing and packaging methods, pharmaceutical applications. [08]

**Unit-V : Cosmetology and cosmetic Preparations :** Structure of skin, formulation of cold cream, vanishing cream, cleansing cream, all purpose cream, protective cream, antiperspirants, deodorant, face powder. Hair structure, Shampoos, Conditioner, Shaving and after shaving products, Dentifrice & Mouthwash, Lipstick, Nail lacquer. [08]

*PHARM-352P*

**PHARMACEUTICS-V**

## (PHARMACEUTICAL TECHNOLOGY-I)

### PRACTICAL

1. Preparation of cold cream, vanishing cream, cleansing lotion and creams. Moisturising creams, Skin tonics, Hair creams, Hair Conditioners, Shampoos, Shaving creams and sticks. Tooth powder, Tooth pastes, After shave lotion and other cosmetic preparations.
2. Preparation, evaluation and packing of liquid orals like solutions, suspensions and emulsions, ointments, suppositories, eye drops, eye ointments etc.

### SUGGESTED PRACTICALS

1. Preparation, evaluation, and packing of (10 preparations =5 labs)

#### I- Liquid Orals

- a) Solutions :                    Strong Sodium salicylate oral solution BP  
   Chloral hydrate oral solution BP
- b) Suspensions : Magnesium sulphate oral suspension BP  
   Milk of magnesia IP  
   Aluminium hydroxide gel IP
- c) Emulsions : Liquid paraffin oral emulsion BP

#### II – Semi-Solids

- d) Ointments                    Salicylic acid ointment BP  
   Whitfield ointment BP  
   Compound benzoic acid ointment

#### III - Suppositories

- e) Suppositories :            Glycerin suppositories BP  
   Lactic acid suppositories BP

3. Preparation of cosmetic preparations (30 preparation = 10 labs)

- |                      |                             |
|----------------------|-----------------------------|
| 1) Cold cream        | 16) Cream shampoo           |
| 2) Vanishing cream   | 17) Clear liquid shampoo    |
| 3) Cleansing cream   | 18) Shaving cream           |
| 4) All purpose cream | 19) Brushless shaving cream |
| 5) Protective cream  | 20) After shave lotion      |
| 6) Foundation lotion | 21) Hair fixer gel          |
| 7) Sunscreen lotion  | 22) Tooth powder            |

- |                     |                           |
|---------------------|---------------------------|
| 8) Face powder      | 23) Tooth paste           |
| 9) Body powder      | 24) Mouth wash            |
| 10) Hand cream      | 25) Hair conditioner      |
| 11) Face pack       | 26) Anti dandruff shampoo |
| 12) Deodorant       | 27) Depilatory cream      |
| 13) Antiperspirant  | 28) Bleach cream          |
| 14) Shampoo- powder | 29) Hair setting lotion   |
| 15) Oily shampoo    | 30) Tooth gel             |

### **BOOKS RECOMMENDED**

1. Remington's Pharmaceutical Sciences, Vol. I & Vol. – II, Mack Publishing Co., U.S.A.
2. J.W. Cooper, & G. Gunn, Tutorial Pharmacy, Petman Books Ltd., London.
3. Lachman L., Lieberman H.A, Kanig J.L, Theory and Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia, U.S.A.
4. H.C. Ansel, Introduction to Pharmaceutical Dosage Forms, Lea & Febiger, Philadelphia, U.S.A.
- 5 R.L. Juliano, Drug Delivery Systems, Oxford University Press, Oxford.
6. Harrys Cosmetology
7. Balsam and Sagarin, Cosmetics: Science and Technology.
8. Thomssen E.G. Modern Cosmetics, Universal Publishing Corporation.
9. Mittal B.M. & Saha R.N.-a handbook of cosmetics, Vallabh Prakashan.
10. Harry G.Brittain," Polymorphin in Pharmaceuticals Solids".

### **PHARM-353**

#### **PHARMACOLOGY – I**

**Unit-I : General Pharmacology** – Introduction to pharmacology, routes of drug administration, combined effect of drugs, factors modifying drug action. Bioassay of drugs & Biological standardization. Discovery & development of new drugs. [07]

**Unit-II :** Basic Concepts of Pharmacokinetics- Absorption, Distribution, Metabolism, Excretion Pharmacodynamics ,Principles of drug action ,Mechanism of drug action , Receptors, Dose

Response curve, Therapeutics index -LD<sub>50</sub> & ED<sub>50</sub>, Adverse drug reactions & treatment of poisoning. drug interactions, [07]

### **Unit-III : Pharmacology of ANS**

Drug acting on autonomic nervous system

#### **I-Cholinergic system-**

Parasympathomimetic (Cholinergic ) drugs.

Parasympatholytic (anti Cholinergic) drugs.

Drug acting on autonomic ganglia (Stimulants and blocking agents)

#### **II-Adrenergic system**

Sympathomimetic (Adrenergic) drugs

Sympatholytic (Anti-adrenergic) drugs [08]

### **Unit-IV : Pharmacology of CNS**

General Anaesthetics, Alcohols & disulfiram, Sedative hypnotics, Psychopharmacological agents-anti anxiety agents ,antipsychotics, antidepressants. Antiepileptic drugs, Antiparkinsonism drugs, Analgesics & antagonists. [12]

### **Unit-V : Drugs acting on PNS**

Local anesthetics [06]

Skeletal muscle Relaxants Peripherally and Centrally acting muscle Relaxants

### ***PHARM-353P***

## **PHARMACOLOGY- I**

### **PRACTICAL**

1. Use of computer simulated CDs or Video cassettes for pharmacology practical where possible.
2. Preparation of different solutions for experiments. Drug dilutions, use of molar and w/v solutions in experimental pharmacology. Common laboratory animals and anesthetics used in animal studies. Commonly used instruments in experimental pharmacology. Some common and standard techniques.
3. Study of different routes of administration of drugs in mice/rats. To study the effect of hepatic microsomal enzyme inhibitors and induction on the pentobarbitone sleeping time in mice, using software alternative to use of animals.

**BOOKS RECOMMENDED :**

1. Ghosh, MN; Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
2. Grover J.K., Experiments in Pharmacy & Pharmacology, CBS Publishers, New Delhi.
3. Kulkarni S.K., Hand Book of Experimental Pharmacology, Vallabh Prakashan, Delhi.
4. Barar F.S.K: Text Book of Pharmacology, Interpoint, New Delhi.
5. Goodman & Gilman, The Pharmacological basis of Therapeutics, Editors: J.G. Hardman, L.E. Limbird, P.B. Molinos, R.W. Ruddon and A.G. Gil, Pergamon press.
6. Katzung, B.G. Basic & Clinic Pharmacology, Prentice Hall, International..
7. Rang MP, Dale MM, Riter JM, Pharmacology Churchill Livingstone.
8. Tripathi, K.D. Essentials of Medical Pharmacology, Jay Pee Publishers, New Delhi.
9. Satoskar & Bhandarkar; Pharmacology & Pharmacotherapeutics., Popular Prakashan Pvt. Ltd. Bombay.
10. Singh, Saundar, Essentials of Pharmacology; Academia Publishers, Delhi.
11. Sheffield Biocscience Programs, U.K., ISBN 1-874758-02-6

**PHARM-354**

**PHARMACEUTICAL CHEMISTRY -V  
(MEDICINAL CHEMISTRY –I)**

**Unit-I : Basic Principles of Medicinal Chemistry:** Physicochemical aspects (Optical, geometric and bioisosterism) of drug molecules and biological action. Drug-receptor interaction including transduction mechanism, concept of prodrug. [08]

**Mode of action, uses, structure activity relationship of the following classes of drugs  
(Synthetic procedures of individually mentioned drugs only)**

**Unit-II : Drugs acting at Synaptic and neuro-effector junction sites:**

Cholinergic, Anticholinergic & Anticholinesterases-Neostigmine, Physostigmine, Methacholine, Pilocarpine, Atropine. Adrenergic Drugs-Ephedrine, Amphetamine, Salbutamol, Adrenaline.[08]

**Unit-III:Drugs acting on the Central Nervous System :** [08]

General Anaesthetics-Thiopental, Ketamine, Methohexital.

Local Anaesthetics-Lignocaine, Benzocaine.  
Sedatives and Hypnotics-Phenobarbitone, Alprazolam.  
Opioid Analgesics-Pethidine, Methadone, Pentazocine.

**Unit-IV:** Antitussives-Cramiphen, Dextromethorphen. [08]

Anticonvulsants-Phenytoin, Carbamazepine, Ethosuximide, Valproic Acid.  
Antiparkinsonism drugs-Carbidopa, Levodopa.  
CNS Stimulants-Caffeine, Nikethamide.

**Unit-V :Psychopharmacological Agents :** [08]

Antianxiety drugs- Diazepam, chlordiaze Poxide.  
Antidepressants – Imipramine, Amitriptyline Fluoxetine.  
Antispasmodic and Antiulcer drugs-Dicyclomine, Ranitidine, Omeprazole.  
Skeletal muscle Relaxants– Gallamine Mephenesin,  
Antipsychotic- Chlorpromazine, Haloperidol.

**PHARM -354P**

**PHARMACEUTICAL CHEMISTRY-V  
(MEDICINAL CHEMISTRY-I)**

**PRACTICAL**

1. Synthesis of selected drugs from the course content involving two or more steps.
2. Establishing the pharmacopoeial standards of the drugs synthesized.

**SUGGESTED PRACTICALS**

1. Synthesis of Methyl salicylate.
2. To establish pharmacopoeial standards of Methyl salicylate.
3. Synthesis of Paracetamol.
4. To establish pharmacopoeial standards of Paracetamol.
5. To synthesize Benzocaine.
6. To establish pharmacopoeial standards of Benzocaine.
7. Synthesis of Phenytoin.
8. To establish pharmacopoeial standards of Phenytoin.

9. Synthesis of Barbituric acid derivatives.
10. To establish pharmacopoeial standards.

**BOOKS RECOMMENDED :**

1. Mann P G & Saunders B C, Practical Organic Chemistry, ELBS/Longman, London.
2. Furniss B A, Hannaford A J, Smith P W G and Tatehell A R, Vogel's Textbook of Practical Organic Chemistry, The ELBS/ Longman, London.
3. Pharmacopoeia of India, Ministry of Health, Govt. of India.
4. Wolff ME. Ed. Burger's Medicinal Chemistry, John Wiley & Sons, New York.
5. Degado J.N. and Remers W A R, 10th eds., Wilson and Giswold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Lippincott, William & Wilkins.
6. Foye W C. Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
7. Singh Harkrishan and Kapoor, V.K., Organic Pharmaceutical Chemistry, Vallabh Prakashan, Delhi.
8. Nogrady T, Medicinal Chemistry – A Biochemical Approach, Oxford University Press, New York, Oxford.
9. Finar I L. Organic Chemistry, Vol I & II, ELBS/ Longman, London.
10. Lednicer, D. The Organic Chemistry of Drug Synthesis Vol. I-V, John Wiley & Sons Inc. New York.

**PHARM-355**

**PHARMACEUTICS – VI  
(PHYSICAL PHARMACY)**

**Unit-I :(A) Matter, properties of Matter :** States of matter, change in the state of matter, latent heat and vapor pressure, sublimation critical point, Eutectic mixtures, gases, relative humidity, liquid complexes, liquid crystals, glassy state, solids-crystalline, amorphous and polymorphism.

[02]

**(B) Kinetics and Drug Stability :** General considerations & concepts, Degradative pathways, half life determination, Influence of temperature, light, solvent, catalytic species and other factors, Accelerated stability study, expiration dating. ICH guidelines for stability.

[05]

**(C) Buffers:** Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting is tonicity. [02]

**Unit-II: Micromeritics and Powder rheology:** Particle size and distribution, average particle size, number and weight distribution, particle number, methods for determining particle volume, optical microscopy, sieving, sedimentation, measurement, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties. [07]

**Unit-III : Surface and Interfacial Phenomenon :** Liquid interface, surface and interfacial tension, surface free energy, measurement of surface and interfacial tension, spreading coefficient, adsorption at liquid interfaces, Surface active agents, HLB classification, solubilization, detergency, adsorption at solid interfaces, solid- gas and solid-liquid interfaces, complex films,electrical properties of interface. [08]

**Unit-IV : Viscosity and rheology :** Newtonian systems, Law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotrophy, thixotropy in formulation, determination of viscosity, capillary, falling ball, rotational viscometers.

**Complexation :** Classification of complexes, methods of preparation and analysis,applications. [08]

**Unit-V : Dispersion Systems :** Colloidal Dispersions : Definition, types, properties of colloids, protective colloids, application of colloids in pharmacy; Suspensions and Emulsions; Interfacial properties of suspended particles, settling in suspensions, theory of sedimentation, effect of Brownian movement, sedimentation of flocculated particles, sedimentation parameters, wetting of particles, controlled flocculation, flocculation in structured vehicles, rheological considerations;Emulsions-types, theories, physical stability. [08]

*PHARM-355P*

**PHARMACEUTICS – VI  
(PHYSICAL PHARMACY)**

## **PRACTICAL**

1. Determination of particle size, Particle size distribution and surface area using various methods of particle size analysis.
2. Determination of derived properties of powders like density, porosity, compressibility, angle of repose etc.
3. Determination of surface/ interfacial tension, HLB value and critical micellar concentration of surfactants.
4. Study of rheological properties of various types of systems using different Viscometers.
5. Studies of different types of colloids and their properties.
6. Preparation of various types of suspensions and determination of their sedimentation parameters.
7. Preparation and stability studies of emulsions.
8. Studies of different types of complexes and determination of their stability constants.
9. Determination of half-life, rate constant and order of reaction.
10. To study the influence of various factors on the rate of reaction.
11. Accelerated stability testing, shelf-life determination and expiration dating of pharmaceuticals.
12. Preparation of pharmaceutical buffers and determination of buffer capacity.
13. Experiments involving tonicity adjustments.

## **BOOKS RECOMMENDED :**

1. Martin A, Bustamante P. & Chun A.H.C- Physical Pharmacy, Lea & Febiger, Philadelphia.
2. Shotten E & Ridgaway K, Physical Pharmaceutics, Oxford University Press, London.
- 3 D.V.Derle ,” Essentials of Physical Pharmacy”.

## SEMESTER –VI

*PHARM –361*

### PHARMACEUTICAL CHEMISTRY-VI (MEDICINAL CHEMISTRY - II)

#### Unit-I-Drug Design

Basic concept of drug design, Introduction to Analogues based drug design, Structure based drug design, Introduction to QSAR & Computer aided drug design. [08]

#### Unit- II

Cardiac glycosides & drug used for CHF-Digitoxin

Antiarrhythmic drugs-Propranolol, Procainamide

Antianginal drugs- Isosorbide mononitrate

Antihypertensive drugs-Captopril, methyldopa, Nifedipine. [08]

Anticoagulants- Heparin, warfarin

Antihyperlipidemics- Lovastatin, Clofibrate

#### Unit-III

Anti cancer drugs

Alkylating Agents- Chlorambucil, Carmustine

Antimetabolites- Methotaxate

6. mercaptopurine

5. Fluorouracil .

[08]

**Unit-IV : Analgesics and Antipyretics** – Aspirin, Mefenamic Acid, Ibuprofen, Diclofenac, Paracetamol.

**Antibacterials** – Sulphamethoxazole, Sulphadiazine, Sulphacetamide, Nalidixic acid. [08]

**Unit-V: Diuretics** – Acetazolamide, Chlorthiazide; Furosemide, Spironolactone.

**PHARM-361P**

**PHARMACEUTICAL CHEMISTRY -VI  
(MEDICINAL CHEMISTRY-II)**

**PRACTICAL**

1. Synthesis of selected drugs from the course content involving two or more steps.
2. Establishing the pharmacopoeial standards of the drugs synthesized.
3. Spectral analysis of the drugs synthesized.

**BOOKS RECOMMENDED :**

1. Mann P G & Saunders B C, Practical Organic Chemistry, ELBS/ Longman, London.
2. Furniss B S, Hannaford A J, Smith P W G and Tathell A R, Vogel's Textbook of Practical Organic Chemistry, The ELBS/ Longman, London.
3. Pharmacopoeia of India, Ministry of Health, Govt. of India.
4. Wolff ME, Ed. Burger's Medicinal Chemistry, John Wiley & Sons, New York.
5. Delagado J N and Remers W A R, Eds., Wilson And Gisworld's Text book of Organic Medicinal and Pharmaceutical Chemistry, J. Lippincott Co., Philadelphia.
6. Foye W C, Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
7. Singh Harkishan and Kapoor, V.K., Organic Pharmaceutical Chemistry, Vallabh Prakashan, Delhi.
8. Nogrady, T, Medicinal Chemistry – A Biochemical Approach, Oxford University Press, New York, Oxford.
9. Finar I L, Organic Chemistry, Vol I & II, ELBS/ Longman, London.
10. Thomas J..Perun," Computer –aided Drug Design methods applications'.
11. Pandi Veerapandian," Structure-Based Drug Design".

**PHARM-362**

**PHARMACEUTICS-VII  
(PHARMACEUTICAL TECHNOLOGY - II)**

**Unit-I : 1. Capsules:** Advantages and disadvantages of capsule dosage form, material for production of hard gelatin capsule, size of capsules, methods of capsule filling, soft gelatin capsule shell and capsule content, importance of base adsorption and minim/gm factors in soft capsule, quality control, stability testing and storage of capsule dosage forms.

**2. Micro-encapsulation :** Types of microcapsule, importance of microencapsulation in pharmacy, microencapsulation by phase co-precipitation separation, multi orifice, spray drying, spray congealing, polymerisation, complex, formulation, emulsion, air suspension technique, coating pan and other techniques, evaluation of micro capsules. [8]

**Unit-II : Tablets : (A)** Formulation of different types of tablets, granulation technology on large-scale by various techniques, physics of tablets making, different types of tablet compression machinery and the equipments employed, evaluation of tablets.

**(B) Coating of Tablets :** Types of coating, film forming materials, formulation of coating solution, equipments for coating process, evaluation of coated tablet. Stability kinetics and quality assurance. [09]

**Unit-III : (A)** Approaches to Sustained and controlled release dosage forms. In-vitro methods of evaluation.

**(B)** Formulation and evaluation of Ophthalmic, Nasal and Ear products. [08]

**Unit-IV : Parenteral Products :**

Preformulation factors, routes of administration, water for injection, pyrogenicity, nonaqueous vehicles. Formulation details, containers and closures and their selection.

Prefilling treatment, washing of containers and closures, preparation of solution and suspensions, filling and sealing of ampoules, vial, infusion fluids, lyophilization & preparation of sterile powders, equipment for large scale manufacture and evaluation of parenteral products. [07]

**Unit-V :**

**Surgical Products :** Definition, primary wound dressing, absorbents, surgical cotton, surgical gauzes etc, bandages, adhesive type, protective cellulosic hemostasis, official dressings, absorbable and non absorbable sutures, ligatures and catguts.

**Packaging of Pharmaceutical Products :** Packaging component types, specifications and methods of evaluation, stability aspects of packaging equipments, factors influencing choice of containers, legal and other official requirements for containers, package testing. [08]

**PHARMACEUTICS-VII**  
**(PHARMACEUTICAL TECHNOLOGY - II)**

**PRACTICAL**

1. Experiments to illustrate preparation, stabilization & physical evaluation of pharmaceutical products like powders, capsules, tablets, parenterals & microcapsules.
2. Evaluation of Materials used in pharmaceutical packaging.

**SUGGESTED PRACTICALS**

**I** – Preparation, Evaluation, Packing of the following dosage forms.

- a) Capsules : Chloramphenicol capsules IP
- b) Microcapsules : Coacervation Phase separation (Temperature change)
- c) Tablets : Uncoated – Paracetamol tablets IP
- d) Tablets : Film coated – Ibuprofen tablets IPs
- e) Tablets : Enteric coated – Aspirin tablets
- f) Parenteral : Disodium EDTA injection IP (vials)
- g) Parenteral : Dextrose – NaCl IV infusion IP (Infusion boilers)
- h) Parenterals : Water for infection IP (Ampoule)
- i) Eye drops : Zinc sulphate IP
- j) Eye ointment : Sulphacetamide Sodium IP

**II** - Formulation and evaluation of sustained release dosage forms – Aspirin Extended release (Matrix embedding method, Granules USP/NF coating of granules)

**III** - Evaluation of packages – containers & closures.

**BOOKS RECOMMENDED**

1. Remington: The Science and Practice of Pharmacy Pharmaceutical Sciences Vol. I & III, Mack Publishing Company, U.S.A.
2. R.E. Avis, Pharmaceutical Dosage Forms : Parenteral Medication, Vol-I, Marcel Dekker-Inc, New York & Basel.
3. H.C. Ansel, Introduction to Pharmaceutical Dosage Forms, Lea & Febiger, Philadelphia, U.S.A.

4. R.C. Juliano, Drug Delivery Systems, Oxford University Press, Oxford.
5. Herbert A. Liebermann & Leon Lachman, Theory & Practice of Industrial Pharmacy, Lea & Febiger, Philadelphia, U.S.A.
6. Manohar A.Potdar, 'C,GMP for Pharmaceuticals'.

**PHARM-363**

**PHARMACOLOGY-II**

**Unit-I :**

**Pharmacology of CVS:** Cardiac glycosides, Antihypertensive drugs, Antianginal drugs, Antiarrhythmics, Antihyperlipidemics, [09]

**Unit-II :**

**Drugs Acting on Haemopoietic System**

Haematinics, Vit. K & anticoagulants, Fibrinolytics & antiplatelet drugs, Plasma Volume expanders.

**Drugs Acting on Respiratory System**

Anti-asthmatic drugs, Anti-tussives & Expectorants, Respiratory Stimulants. [08]

**Unit-III : NSAIDS & Anti-gout Drugs.Diuretics** [08]

**Unit-IV : Autocoids:** Histamine, 5HT and their antagonists, Prostaglandins, Thromboxane, Leukotrienes, Angiotensin and Bradykinin [08]

**Unit-V : Drugs acting on GIT**

Antacids and Antiulcer drugs, Laxatives and antidiarrhoeal Agents, Emetics and antiemetics [07]

**PHARM-363P**

**PHARMACOLOGY-II**

**PRACTICAL**

1. To record the dose response curve (DRC) of Acetylcholine using ileum of Chicken ileum.
2. To study the parallel shift of DRC in presence of competitive antagonist on DRC of Ach using Chicken ileum.
3. To study effect of physostigmine on DRC of each on Chicken ileum.
4. To study the CRC of histamine on guinea pig on ileum preparation & study the effect of Antihistaminics using software.

### **BOOKS RECOMMENDED :**

1. Ghosh, MN; Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
2. Grover J.K., Experiments in Pharmacy & Pharmacology, CBS Publishers, New Delhi.
3. Kulkarni S.K., Hand Book of Experimental Pharmacology, Vallabh Prakashan, Delhi.
4. Barar FSK : Text Book of Pharmacology, Interprint, New Delhi.
5. Goodman & Gilman, The Pharmacological basis of Therapeutics, Editors:-JG Hardman, Le Limbird,PB Molinoss, RW Ruddon & AG Gil, Pergamon Press.
6. Katzung, B.G. Basic & Clinical Pharmacology, Prentice Hall, International.
7. Laurence, DR & Bannet PN; Clinical Pharmacology, Churchill Livingstone.
8. Rang MP, Date MM, Riter JM, Pharmacology Churchill Livingstone.
9. Tripathi, K.D. Essentials of Medical Pharmacology, Jay Pee Publishers, New Delhi.
10. Satoskar & Bhandarkar; Pharmacology & Pharmacotherapeutics, Popular Prakashan Pvt. Ltd., Bombay.
11. Craig, C.R. and Stitzel, R.R., Modern Pharmacology, Little Brown and Co., 1994.
12. Sheffield Bioscience Programms, U.K., ISBN,1-874758-02-6

### ***PHARM--364***

#### **PHARMACOGNOSY – III**

**Unit-I : (A)** Study of the biological sources, Commercial varieties cultivation, collection adulterants, uses, diagnostic macroscopic and microscopic features n, chemical constituents, substitutes and specific chemical tests of following groups of drugs containing.

#### **Glycosides :**

1. **Saponins :** Liquorice, Ginseng, Dioscorea, Coleus species. [04]
2. **Cardioactive sterols :** Digitalis, Squill, Stropanthus & Thevetia [03]
3. **Anthraquinone Cathartics :** Aloe, Senna, Rhubarb & Cascara. [03]

**Unit-II : Others :** Psoralea, Ammi majus, Ammi visnaga, Gentian, Saffron, Chirata, Quassia and Andrographis paniculata. [03]

**(B)** Production and Utilization of phytoconstituents such as calcium sennsoides, Diosgenin, Solasodine & Podophyllotoxins [03]

**Unit- III : Studies on traditional drugs :** Common Vernacular name, Biological sources,

morphology, chemical nature of chief constituents, pharmacology, categories and common uses and toxicological activity of marketed formulations of following indigenous drugs : Amla, Kantkari, Satavari, Tylophora, Bhilwa, Kalijiri, Vach, Rasna.

[07]

**Unit-IV :** Punarnava, Chitrak, Apamarg, Gokhru, Shankhpushpi, Brahmi, Methi, Lehsun, Palash, Guggul, Gymnema, Shilajit, Tulsi, Nagarmotha, Majith, Malkanguni and Neem. [08]

**Unit-V :** Brief Introduction and principles of Ayurvedic, Unani , Siddha and Homeopathic systems of medicines. Introduction to Herbal Pharmacopoeia with special reference to. Arishtas, Asavas, Gutikas, Tailas, Churnas, Lehyas and Bhasmas. [07]

### ***PHARM-364 P***

### **PHARMACOGNOSY - III**

#### **PRACTICAL**

11

1. Identification of crude drugs listed in theory
2. Microscopic study of some important glycoside containing drugs as outlined above, Study of powdered drugs.
3. Standardization of some traditional drug formulations.

#### **SUGGESTED PRACTICALS**

1. Morphology and microscopy (powder) of Liquorice along with its chemical tests.
2. Morphology of Aloe and chemical tests on Aloe-extracts.
3. Morphology and microscopy (powder) of Rhubarb
4. Morphology of Psoralea, Ammimaius, Saffron and Chirata.
5. Morphology of Amla, Kantkari, Shatavari and Vach.
6. Morphology of Punarnava, Apamarg, Gokhru, and Shankhpushpi.
7. Morphology of Brahmi, Methi, Lehsun and Palash.
8. a) Morphology of Nagarmotha and Neem.  
b) Identification Tests for Guggul lipids.
9. To study the following standards)  
Loss on drying.  
b) Extractive values.

c) Ash values.

d) pH of 1% solution, in water and alcohol of any Ayurvedic formulation (solid) available in the market.

10. To perform above studies (exp. 10) in any liquid Ayurvedic formulation.

11. Preparation of medicated oil.

### **PROJECT WORK**

A report on marketed preparations based on traditional drugs mentioned in theory.

### **BOOKS RECOMMENDED :**

1. Kokate C.K. "Practical Pharmacognosy" Vallabh Prakashan, New Delhi.
2. Wallis T.E. "Analytical Microscopy" J&A Churchill Ltd., London.
3. Trease, G.E., & Evans, W.C., Evans, W.C., "Pharmacognosy" Bailliere Tindall east Baorne, U.K.
4. Tyler V.E. et al : "Pharmacognosy" Lea & Febiger, Philadelphia.
5. Wallis. T.E. "Text Book of Pharmacognosy" J&A Churchill Ltd. London.
6. Qadry J.S., "Pharmacognosy" B.S.Shah Prakashan.
7. Medicinal plants of India I&II, Indian council of Medical Reasearch, New Delhi.
8. Nadkarni A.K. Indian Materia Medica 1-2, Popular Prakashan (P) Ltd. Bombay.
9. Atal C.K. & Kapur BM. "Cultivation & utilization of Medicinal plants, RRL, Jammu.
10. Indian Herbal Pharmacopoeia, vol. I&II, ICMR & RRL, Jammu.
11. The wealth of India, Raw Materials (All volumes) Council of Scientific & Industrial Research, New Delhi.
12. Compendium of Indian Medicinal Plants I-IV, Rastogi & Malhotra.
13. Indian Ayurvedic Pharmacopoeia, Govt. of India.
14. Kokate CK, Gokhale AS, Gokhale SB, Cultivation of Medicinal Plants, Nirali Prakashan.
15. Mohammed Ali," Pharmacognosy & Plant Cultivation"
17. Indian Pharmacopoeia.

**PROFESSIONAL COMMUNICATION-II**

**Unit-I**

1. Written skills:

Proposal writings formats.

Report writings

Business letters

Applications

Covering letters.

Curriculum Vitae Designing [10]

**Unit-II**

2. Productivity, Time Management simulation exercise

3. Leadership Skills.

4. Team work 'BSC' – Boss, Subordinates & Colleagues [06]

**Unit-III**

5. Group Discussions (G.D)

Tips

GD [08]

**Unit-IV**

6. Corporate behaviour, corporate expectation, office etiquettes.

7. Extempore [06]

**Unit-V**

8. Interview Tips:-

What student is supposed to do before the interview, during the interview, after the interview & on the day of interview.

Various questions that may be asked in an interview.

Model interview (Video-shooting & displaying optional)

9. Exit Interview [10]

**BOOKS RECOMMENDED**

1. Raman, Meenakshi & Sharma Sangeeta, Technical Communications- Principles & Practice, Oxford University Press.

2. Sharma R.C. & Krishna Mohan, Business Correspondence & Report Writing, Tata Mc Graw Hill Co.

3. Lesikar RV, Lesikar's Basic Business Communication.

**PHARM- 366 :**

**ENVIRONMENT & ECOLOGY**

**Unit-I**

**Environment studies**

A- Definition, scope & importance

B- Natural Resources – renewable & non renewable

C- Use, utilization, exploitation and associated problems of forests, Water resources, Mineral resources, Food resources, Energy resources, Land resources.

D- Equitable use of resources for sustainable life style, role of an individual in conservation.

**Unit-II**

**Ecosystems**

A. Introduction, types features & functions of difference ecosystems- Forest Grassland, Desert and Aquatic.

B. Biodiversity & its conservation with special reference to India.

**Unit-III**

Environmental pollution- Air, Water, Soil, Marine, Noise, Thermal, Nuclear- Introduction causes and control measures.

**Unit IV**

Law related to Environmental Protection

Air (Prevention and Control of pollution )Act 1987

Water prevention & Control of Pollution Act. 1974

**Unit-V**

**Environmental Protection Act -1986**

Noise Pollution

Hazardous Wastes

Hazardous Chemical

Hazardous Microorganism

Biomedical Waste

Provisions applicable to drugs and cosmetic.

### **Reference**

1. Principles of Environmental Studies, C. Manoharachary, P. Jyaranama Reddy, Pharma Book Syndicate, Hyderabad.
2. Handbook of Environmental Laws, Acts, Guidelines, Compliances & Standards Vol. I & II. R.K.Trivedy, Pharma Book Syndicate, Hyderabad
3. Relevant Acts & Rules published by Govt. of India with latest amendments.
4. Reddy, M.Anji , ‘ Text Book of Environmental Sciences & Techgnology”.

## **SEMESTER –VII**

### ***PHAR M–471***

### **PHARMACEUTICAL ANALYSIS -III**

#### **Unit-I :**

Colorimetric Method- Chemistry, Instrumentation and applications

Ultra violet and Visible- Electronic excitation, Spectrophotometry, quantitative laws, deviation from Beer’s law, instrumentation, single and double beam spectrophotometry. [08]

#### **Unit-II-**

Infra-Red spectrophotometry-Theory, instrumentations, Interpretation of IR , spectra of simple compounds, FTIR, applications in pharmaceutical analysis.

Fluorimetric Analysis- Theory, Instrumentation and applications.

#### **Unit-III**

NMR Spectroscopy- Theory of <sup>1</sup>H.NMR, chemical shift, Shielding & Desheilding, spin spin coupling, spin spin splitting spectra of CH<sub>3</sub>-CH<sub>2</sub>-OH, CH<sub>3</sub>-CHO, CH<sub>3</sub>-(CH<sub>2</sub>)<sub>4</sub> CH<sub>3</sub>, C<sub>6</sub> H<sub>6</sub>, CH<sub>3</sub> C<sub>6</sub> H<sub>5</sub>. Mass Spectroscopy –Theory, Instrumentation & Applications, mass spectra of some simple compounds. [10]

#### **Unit-IV**

Flame photometry-Theory , instrumentation and applications. Atomic absorption spectroscopy, instrumentation and applications [08]

#### **Unit-V**

Basic Principles. Instrumentation and application of GLC & HPLC. [06]

***PHARM-471P***

**PHARMACEUTICAL ANALYSIS -III**

**PRACTICAL**

1. Assay of at least 10 official formulation containing single and more active ingredients using instrumental techniques.
2. Interpretation of a few spectra.

**BOOKS RECOMMENDED**

1. Pharmacopoeia of India, Ministry of Health, Govt of India.
2. Becket A.H. and Stenlake J.B. Practical Pharmaceutical Chemistry Vol. I and II, The Athlone Press of the University of London.
3. Chatten L.G. A text book of Pharmaceutical Chemistry Vol. I & II Marcel, Dekker, New York.
4. Willard H.H. and Merrit L. Jr and Dean J.A., Instrumental methods of analysis Van Nostrand Renhold, New York.
5. Obonson J.W.R. Undergraduate Instrumental Analysis, Marcel Dekker Inc, New York, 1970.
6. Parikh V.H. Absorption Spectroscopy of Organic Molecules Addison-Wesley Publishing Co., London 1974.
7. Silver stein RM & Webster FX, Spectrometric Identification of Organic Compounds, John Wiley & Sons.
8. Skoog V, Principles of Instrumental Analysis, Holler-Neimen

***PHAR M- 472***

**PHARMACEUTICS -VIII**

**(BIOPHARMACEUTICS & PHARMACOKINETICS)**

**Unit-1** :Introduction to Biopharmaceutics and Pharmacokinetics and their role in formulation development and clinical setting.

**Biopharmaceutics :**

(A) Passage of drugs across biological barrier (passive diffusion, active transport, facilitated diffusion and pinocytosis).

(B) Factors influencing absorption – Physicochemical, physiological and pharmaceutical.

(C) Drug distribution in the body, plasma protein binding. [08]

**Unit-II : Pharmacokinetics :**

(A) Significance of plasma drug concentration measurement.

(B) Compartment model and Non-compartment model. Definition and Scope.

(C) Pharmacokinetics of drug absorption – zero order and first order absorption rate constant using Wagner – Nelson, Loo-Reigelman method. [08]

**Unit-III:**(A) Volume of distribution and distribution coefficient.

(B) Compartment kinetics – One compartment and Preliminary information of multicompartment models. Determination of pharmacokinetic parameters from plasma and urine data after drug administration by intravascular and oral route.

(C) Clinical Pharmacokinetics : Definition and scope [08]

**Unit-IV:**

(A) Dosage adjustment in patients with and without renal and hepatic failure.

(B) Pharmacokinetic drug interactions and their significance in combination therapy.

**Unit-V :Bioavailability and Bioequivalence :**

(A) Measures of bioavailability, C-max, and area under the curve (AUC).

(B) Review of regulatory requirements for conduction of bioequivalent studies. [08]

**PHARM-472P**

**PHARMACEUTICS-VIII**

**(BIOPHARMACEUTICS & PHARMACOKINETICS)**

**PRACTICAL**

1. Experiments designed for the estimation of various pharmacokinetic parameters with given data.
2. In *vitro* evaluation of different dosage forms for drug release.
3. Absorption studies – in vitro.
4. Statistical treatment of pharmaceutical data.

## **SUGGESTED PRACTICALS**

1. In-vitro drug release study of the given powder dosage form using various dissolution media.
2. In-vitro drug release study of the given uncoated tablet dosage form using different dissolution media.
3. In-vitro drug release study of the given capsule dosage form using various dissolution media.
4. In-vitro drug release study of the given film coated dosage form using various dissolution media.
5. In-vitro dissolution study of the given sustained release dosage form.
6. In-vitro dissolution study of the given fast release (M.D, Dispersible etc.) dosage form.
7. To study the effect of hardness of tablet on dissolution rate.
8. To study the effect of various diluents on dissolution rate of dosage form (Tablets, Capsules, Ointment etc.).
9. To study the effect of formulation on drug release (powder, suspension etc.).
10. To determine the % protein binding of the given drugs.
11. To determine the effect of protein binding on drug bioavailability.
12. To calculate various Pharmacokinetic parameters from the given zero order drug release data.
13. To calculate various Pharmacokinetic parameters from the given first order drug release data.
14. To calculate the various Pharmacokinetic parameters from the given blood data of I.V bolus injection (one compartment model).
15. To calculate various Pharmacokinetic parameters from the given urinary excretion data of I.V bolus.injection using both methods (Rate of elimination & sigma minus method one compartment model).
16. To study the in-vitro drug- drug interaction.
17. To study the passive diffusion of the given drug using cellophane membrane.
18. To study the passive diffusion of the given drug using egg or goat membrane.
19. To determine the various Pharmacokinetic parameters from the given blood data of oral administration of dosage form.

## **DEMONSTRATION EXPERIMENTS**

1. Dissolution Apparatus.
2. Preparation of Buffers & membranes.
3. Use of semilog paper.
4. Operation of colorimeter & U.V spectrophotometer.

### **BOOKS RECOMMENDED :**

1. Notari, R.E, Biopharmaceutics and Pharmacokinetics – An introduction Marcel Dekker Inc. N.Y.
2. Rowland M, and Tozer T.N. Clinical Pharmacokinetics, Lea and Febriger, N.Y.
3. Wagner J.G. Fundamentals of Clinical Pharmacokinetics, Drugs Intelligence Publishers, Hamilton.
4. Wagner J.G. Pharmacokinetics for the Pharmaceutical Scientist, Technomic Publishing A.G. Basel, Switzerland.
5. Gibaldi, Milo' Biopharmaceutics & Clinical pharmacokinetics".
6. Robert , Rodriguezdiaz," Analytical Techniques for Biopharmaceuticals Development".
7. John. G.Wagner," Pharmacokinetics for the Pharmaceutical Scientist".
8. Curry, StephenH., " Drug Disposition & Pharmacokinetics".

***PHAR M- 473***

### **PHARMACOLOGY –III**

#### **Unit-I : Pharmacology of Endocrine System**

Hypothalamic & pituitary hormones, Thyroid hormones & Thyroid Drugs, Parathormone, Calcitonin & Vitamin D, Insulin, oral hypoglycemic agents & glucagon. [07]

**Unit-II :** ACTH & Cortico steroids, Androgens & anabolic steroids, Estrogens, Progesterone & Oral Contraceptives, Drugs acting on uterus. [08]

#### **Unit-III : Chemotherapy**

General Principles of Chemotherapy, Sulfonamides, Cotrimoxazole, Quinolones, Antibiotics – Penicillins, Cephalosporins, Chloramphenicol, Tetracyclines, Macrolides. [08]

**Unit-IV :** Chemotherapy of Parasitic infections, Tuberculosis, Leprosy, Malaria, Fungal infections, Viral diseases, Introduction to Immunomodulators and Chemotherapy of Cancer. [10]

#### **Unit-V : Principles of Toxicology**

Definition of poison, general principles of treatment of poisoning with particular reference to barbiturates, opioids, organophosphorous & atropine poisoning, Heavy metal Antagonists. [07]

**PHAR-473P**

**PHARMACOLOGY- III**

**PRACTICAL**

1. To calculate the pA<sub>2</sub> value of Atropine & chlorpheniramine.
2. Bioassay of Ach, histamine & oxytocin on suitable isolated preparations using matching assay, bracketing assay, three point assay & four point assay.
3. Bioassay of histamine and acetylcholine using matching and interpolation method on rat guinea pig . All experiments will be conducted using software wherever possible.

**BOOKS RECOMMENDED :**

1. Ghosh M.N. Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta.
2. Grover J.K., Experiments in Pharmacy & Pharmacology, CBS Publishers, New Delhi.
3. Kulkarni S.K., Hand Book of Experimental Pharmacology, Vallabh Prakashan, Delhi.
4. Barar F.S.K : Text Book of Pharmacology, Interprint, New Delhi.
5. Goodman & Gilman, The Pharmacological basis of Therapeutics, Pergamon Press.
6. Editors :- J.G. Hardman, Le Limbird, PB Molinoss, RW Ruddon & AG Gil, Pergamon Press.
7. Katzung, B.G. Basic & Clinical Pharmacology, Prentice Hall, International.
8. Laurene, DR & Bennet PN; Clinical Pharmacology, Churchill Livingstone.
9. Rang MP, Dale MM, Riter JM, Pharmacology Churchill Livingstone.
10. Tripathi, K.D. Essentials of Medical Pharmacology, Jay Pee Publishers, New Delhi.
11. Satoskar & Bhandarkar : Pharmacology & Pharmacotherapeutics, Popular Prakashan Pvt. Ltd., Bombay.
12. Paul. L., Principles of Pharmacology, Chapman and Hall.
13. Singh, Surender; Essentials of Pharmacology, Academia Publishers, Delhi.
14. Sheffield Bioscience Programs, U.K., ISBN. 1-874758-02-6.

**PHARM –474**

**PHARMACEUTICAL CHEMISTRY –VI**

**(MEDICINAL CHEMISTRY - III)**

Mode of action, uses , structure-activity relationship of the following classes of drug (Synthetic procedures of individually mentioned drugs only).

**Unit-I :**

**1. Steroids and related drugs :** Introduction, Classification, Nomenclature, Stereochemistry  
(A) Androgens and Anabolic steroids – Testosterone, Stanazolol.  
(B) Estrogens and Progestogens – Progesterone, Estradiol.  
(C) Adrenocorticoids – Prednisolone, Dexamethasone, Betamethasone. [08]

**Unit-II :**

**Antibiotics**-Penicillin, Semi-synthetic penicillins, streptomycin, tetracyclines, Cephalosporins, Chloramphenicol, Fluroquinolones.

**Antimycobacterial Agents:**PAS, Ethambutol, Isoniazid, Dapsone

**Antimalarials:** Cholroquine, Primaquine, Pyrimethamine.

**Antiamoebics:** Metronidazole, Tinidazole, Diloxanide

**Antiseptics & Disinfectants** – Benzalkonium chloride

**Anthelmintics**- Mebendazole

**Antifungals :- Griseoflain and Clotrimazole** [08]

**Unit-IV : –**

Anti- HIV agents-Zidovudine, Zalcitabine,Saquinavir.

**Antivirals** –Amantadine, Acyclovir, Lamivudine.

Prostaglandins –Misoprostol, Carboprost. [08]

**Unit-V :-**Thyroid and Antithyroids – Carbimazole, Levothyroxine, Propylthiouracil,  
Methimazole. Hypoglycaemics - Insulin Chlorpropamide, Metformin,  
Tolbutamide,Glibenclamide. [08]

**BOOKS RECOMMENDED :**

1. Pharmacopoeia of India, Ministry of Health, Govt. of India.
2. Wolff ME, Ed. Burger's Medicinal Chemistry, John Wiley & Sons, New York.
3. Delgado J N and Remers W A R, Eds., Wilson And Gisworld's Text book of Organic Medicinal and Pharmaceutical Chemistry, J. Lippincott Co., Philadelphia.
4. Foye W C, Principles of Medicinal Chemistry, Lea & Febiger, Philadelphia.
5. Singh Harkrishan and Kapoor, V.K., Organic Pharmaceutical Chemistry, Vallabh Prakashan, Delhi.

6. Nogrady T, Medicinal Chemistry – A Biochemical Approach, Oxford University Press, New York, Oxford.
7. Finar I L, Organic Chemistry, Vol. I & II, ELBS/ Longman, London.
8. Hanch C, Comprehensive Medicinal Chemistry, Vol. IV, Quantitative Drug Design, Pergamon Press, Oxford.

**PHARM-475**

### **PHARMACOGNOSY-IV**

**Unit-1 : 1.** Systematic study of source, cultivation, collection, processing, commercial varieties, chemical constituents, substitutes adulterants, uses, diagnostic macroscopic & microscopic features & specific chemical tests of following alkaloid containing drugs.

- (A) **Pyridine-piperidine** : Tobacco, Areca & Lobelia.
- (B) **Tropane** : Belladonna, Hyoscyamus, Datura, Coca & Withania.
- (C) **Quinoline & Isoquinoline** : Cinchona, Ipecac & Opium..
- (D) **Indole** : Ergot, Rauwolfia, Catharanthus & Nux-vomica. [08]

**Unit-II :**

- (E) **Imidazole** : Pilocarpus.
- (F) **Steroid** : Veratrum & Kurchi.
- (G) **Alkaloidal amine** : Ephedra & Colchicum.
- (H) **Glycoalkaloid** : Solanum.
- (I) **Purines** : Coffee & Tea
- (J) **Quinazoline** : Vasaka.

Utilization & production of phytoconstituents such as – Tropane Alkaloids, Isoquinoline & Quinoline Alkaloids. [08]

**Unit-III**

**(A) World wide trade in Medicinal plants & derived product. Tropane alkaloids containing drugs, Cinchona, Ipecac, Rauwolfia, Taxol. Diosgenin, Digitalis, Liquorice, Papain, Ginseng, Aloe, Valerian, & plant laxatives.**

(B) Role of Medicinal & aromatic plants in National Economy. [08]

#### **Unit-IV**

**Biological sources, preparation, Identification tests and uses of following enzymes –**

Diastase, papain, Penicillinase, Hyalluronidase, Streptokinase.

Plant Bitters & Sweeteners. [08]

**Unit-V :**Introduction, classification & study of different chromatographic methods. Application of chromatographic techniques in evaluation of herbal drugs.

Historical development of plant tissue culture, type of culture, Nutritional requirement, growth & their maintenance. Application of plant tissue culture in pharmacognosy. [08]

#### **PHARM-475P**

### **PHARMACOGNOSY -IV**

#### **PRACTICAL**

1. Identificaiton of crude drugs listed above.
2. Microscopic study of characters of any 8 selected drugs given in theory in entire and powder form.
3. Chemical evaluation of powdered drugs & Enzymes.
4. Chromatographic studies of some herbal constituents.
5. Some experiments in plant tissue culture.

#### **SUGGESTED PRACTICALS**

1. To study the morphology and microscopy of Datura and Withania.
2. To study the morphology and microscopy of Ipecac and Rauwolfia.
3. To study the morphology and microscopy of Catharanthus and Nux-vomica.
4. To study the morphology and microscopy of Ephedra and Kurchi.
5. To study the morphology and microscopy of Solanum and Vasaka.
6. a) Morphology of Areca, Colchicum.  
b) Transverse section of Catharanthus leaf and Kurchi bark.
7. To study the TLC profile of Catharanthus leaf.
8. To study the TLC profile of Withania root.
9. Chemical test of Tea, Tobacco, Datura and Withania.
10. Chemical test of Nux-vomica, Ephedra, and Kurchi.
11. Introduction of plant-tissue culture techniques on laboratory scale.

**BOOKS RECOMMENDED :**

1. Kokate, C.K. Practical Pharmacognosy, Vallabh Prakashan, Delhi.
2. Wallis T.E. Analytical Microscopy, J&A Churchill Ltd, London.
3. Ganborg & Wetter, Plant Tissue Culture Methods, National Research Council of Canada, Saskatchewan.
4. Clarke ECG, Isolation & Identification of drugs. The Pharmaceutical Press, London.
5. Trease, G.E. & Evans, W.C. "Pharmacognosy" Bailliere Tindall East Bourne, U.K.
6. Tyler V.E. etal Pharmacognosy, Lea & Febiger Phjadelphia.
7. Wallis T.E. Text book of Pharmacognosy" J&A Churchill Ltd. London.
8. Qadry J.S., " Pharmacognosy" B.S.Shah Prakashan."
9. Atal & Kapur, Cultivation & Utilization of Medicinal Plants, RRL, Jammu.
10. Stahl. E, Thin Layer Chromatography. A laboratory handbook, Springer Verlog, Berlin.
11. Henry TA. The Plant Alkaloids, McGraw Hill, New York.
12. Dixit, V.K., Vyas. S.P. Pharmaceutical Biotechnology, CBS Publication, ND.
13. Street H.E. Tissue Culture & Plant Science, Academic Press, London.
14. Kokate, C.K. Gokhale AS, Gokhale SB, Cultivation of Medicinal Plants, Nirali Prakashan.
15. Mohammed Ali," Pharmacognosy & Plant Cultivation".
16. Mohammed Ali," Pharmacognosy & Phytochemistry".
17. Indian Pharmacopoeia.

## SEMESTER – VIII

*PHARM –481*

### PHARMACEUTICAL BIOTECHNOLOGY

#### **Unit-I : Immunology and Immunological preparations :**

Principles, Antigen and haptens, immune system, Cellular, and humoral immunity, immunological tolerance, antigen-antibody reactions and their applications, standardization and storage of BCG. [08]

#### **Unit-II : Genetic Recombination**

Transformation, conjugation, transduction, protoplast fusion and gene cloning and their applications, development of hybridoma for monoclonal antibodies, study of drugs produced by biotechnology such as Activase, Insulin, Somatotropin. [08]

#### **Unit-III : Antibiotics :**

Historical development of antibiotics, Screening of soil for organisms producing antibiotics Antimicrobial spectrum and methods used for their standardization. Fermentor, its design and control of different parameters. Isolation of mutants and factors affecting mutation. [08]

#### **Unit-IV : Microbial Transformation :**

Introduction, types of reactions mediated by microorganisms, Design of Bio-transformation process, selection of organisms, biotransformation processes and its improvements with special reference to steroids. [08]

#### **Unit-V : Enzyme immobilization :**

Techniques of immobilization of enzymes, factors affecting enzyme kinetics, study of enzymes such as hyaluronidase, penicillinase, streptokinase and streptodaranse, amylases and proteases Immobilization of Bacteria and plant cells. [08]

#### **BOOKS RECOMMENDED :**

1. S.P. Vyas and V.K. Dixit, Pharmaceutical Biotechnology, CBS Publication, New Delhi.
2. Prescott and Dunn's Industrial Microbiology, 4th Ed, 1987, CBS Publishers and Distributors, Delhi.
3. P.F. Stanbury & A. Ahhtar Principles of Fermentation Technology.

4. K. Kieslich Ed. Biotechnology Vol. 69 Verlag Chernie Switzerland 1984.
5. P.F. Standury & A. Whitaker & Hall S.J. Principles of Fermentation, Aditya Book Private Limited, New Delhi.
6. Crueger W. & Crueger A, Biotechnology-A Textbook of Industrial Microbiology, Panima Publishing Corporation, Delhi.
7. Johan, D.Souza," Biotechnology & Fermentation"

**PHAR M-482**

## **NATURAL PRODUCTS**

### **Unit-I :**

1. Chemical & Spectral approaches to simple molecules of natural origin.
2. Biogenetic Investigations and basic metabolic pathways, (alkaloids, terpenes, steroids) Brief introduction to biogenesis of secondary metabolites of Pharmaceutical importance. [08]

### **Unit-II**

Extraction, Isolation & Chemistry of –

i) **Glycosides** - Digitoxin, Digoxin, Hecogenin, Diosgenin & Sarasapogenin

ii) **Lignans**

iii) **Quassinoids**

iv) **Flavonoids (Quercetin)** [08]

### **Unit-III :**

**Alkaloids** – Atropine & related compounds, quinine, reserpine, morphine, papaverine, ephedrine, ergot, and Vinca Alkaloids.

Natural Allergens, Photosensitizing agents and fungal toxins. [08]

### **Unit-IV:**

Extraction, Isolation & Characterisation of –

Terpenoids- Camphor, Menthol, Citral,  $\beta$ - Carotene,  $\alpha$  -Tocopherol,  $\alpha$ -Pinene. [03]

### **Unit-V**

Herbal Cosmetics and their formulation. [02]

Recent developments of natural products used as anticancer agents, antidiabetics and immunomodulators.

**NATURAL PRODUCTS**

**PRACTICAL**

1. Laboratory experiments on Isolation, separation, purification of various groups of chemical Constituents of Pharmaceutical significance.
2. Exercises on paper & thin layer chromatographic evaluations of herbal drug constituents.
3. Extraction of volatile oils & theirs chromatographic profiles.

**SUGGESTED PRACTICALS**

1. Isolation of caffeine from Tea leaves.
2. Isolation of piperine from Black Pepper.
3. Isolation of Hesperidin from Orange Peel.
4. Isolation of Clove oil from clove.
5. Isolation of Caraway oil from caraway.
6. Isolation of cumin oil from cumin.
7. To study the TLC profile of extracted oils.
8. To perform the column chromatography of herbal drug.
9. To study the paper chromatographic profile of glycone portion separated from senna.
10. To Isolate the active constituent of any available drug with the help of preparative TLC.
11. Quantitative determination of Ascorbic acid present in Amla. (Fresh/ Dry).

**BOOKS RECOMMENDED**

1. Brain, K.R., & Turner T.D, The Practical evaluation of phytopharmaceutical, Wright, Bristol.
2. Sim, Medicinal Plant Alkaloids & Glycosides.
3. Kokate C.K., "Practical Pharmacognosy" Vallabh Prakashan, New Delhi.
4. Stahl E. "Thin layer chromatography" A Laboratory Hand Book, Springer Verlag, Berlin.
5. Harborne, J.B. Phytochemical Methods Chapman & Hall, International Ed, London.
6. Pharmacopoeia of India.
7. I.L. Finar "Organic chemistry" Vol. I & II ELBS, London.
8. O.P. Agarwal, "Chemistry of Organic Natural Product" Vol. I & II Goel Pub. House, Meerut.
9. Trease G.E. & Evan, W.C., "Pharmacognosy" Bailleire tindall East bourne, U.K.
10. Tyler V.E. etal "Pharmacognosy" Lea & Febiger Philadelphia.
11. Qadry, J.S.," Pharmaconosy "B.S.Shah Prakashan.

12. Pridham JB & Swain T. Biosynthetic pathway Higher plants, Academic Press, New York.
13. Sharma PP, Cosmetics formulation, Manufacturing & Quality control, 3<sup>rd</sup> Ed., Vandana Publishers, Delhi.
14. Abraham DJ, Berger's Medicinal Chemistry & Drug Discibery, John Wiley & Sons, New Jersey.
15. Indian Pharmacopoeia.

**PHARM- 483**

**PHARMACEUTICAL INDUSTRIAL MANAGEMENT**

**Unit-I :**

**1. Concept of Management :** Administrative Management (Planning, Organising Staffing Directing and Controlling). Entrepreneurship development, Operative Management (Personnel, Materials, Production, Financial, Marketing, Time/space, Margin/ Morale) Principles of Management (Coordination, Communication, Motivation, Decision making, leadership, Innovation Creativity, Delegation of Authority / Responsibility. Record Keeping), Identification of key points to give maximum thrust for development and perfection. [12]

**Unit-II**

**Economics :** Principles of economics with special reference to the Laws of demand and supply, demand schedule, demand curves labor welfare, general principles of insurance and inland and foreign trade, procedure of exporting and importing goods. [03]

**Accountancy :** Principles of Accountancy, Ledger posting and book entries preparation of trial balance, columns of a cash book, Bank reconciliation statement, rectification of errors, profits and loss account, balance sheet, purchase, keeping and pricing of stocks, treatment of cheques bills of exchange, promissory notes and bundles documentary bills. [04]

**Unit-III**

**3. Pharmaceutical Marketing :** Functions, buying, selling, transportation, storage financed feedback information, channels of distribution, wholesale, retail, department store, multiple shop and mail order business. [04]

**4. Salesmanship :** Principle of sales promotion, advertising, ethics of sales, merchandising, literature, detailing, Recruitment, training, evaluation , compensation to the pharmacist. [04]

#### **Unit-IV**

##### **5. Market Research**

**(A) Measuring & Forecasting Market Demand** - Major concept in demand measurement, Estimating current demand Geo-demo-graphic analysis. Estimating industry sales, Market share and future demand.

**(B) Market segmentation & Market targeting.** [06]

#### **Unit-V**

**6. Materials Management** : A brief exposure of basic principles of management major areas, scope, purchase, stores, inventory control and evaluation of materials management. [04]

**7. Production Management** : A brief exposure of the different aspects of Production Management  
– Visible and Invisible inputs, Methodology of Activities Performance Evaluation Technique  
Process –Flow, Process Know-how, Maintenance Management. [03]

#### **BOOKS RECOMMENDED :**

1. Beri, Market Research – Tata Mc Graw Hill
2. Chary S.N, Production and Operative Management / Tata Mc Graw Hill.
3. Datta A.K., Material Management / PHI.
4. Chadwick Leslie, The essence of management accounting / PHI.
5. Massie L. Joseph Essentials of Management / PHI.
6. Barthwal R.R, Industrial Economics –. / New Age International.
7. Shreenivasan K.R., An Introduction to Industrial Management –/ Vikas.
8. Daver Rustam S. Salesmanship and Publicity –/ Vikas.
9. Mukopadhyay Sekhar, Pharmaceutical Selling, Sterling Publishers.
10. Koontz H, Weihrich H, Essentials of Management, Tata Mc Graw Hill.
11. Vidya sagar Pharmaceutical Industrial Management, Pharma Book Syndicate
12. G.Vidya Sagar,” Pharmaceutical Industrial Management”.

**HOSPITAL PHARMACY**

**Unit-I: Organization and Structure:** Organization of a hospital and hospital pharmacy, Responsibilities of a hospital pharmacist. Pharmacy and therapeutic committee, Budget preparation and implementation.

**Hospital Formulary:** Contents, preparation and revision of hospital formulary.

**Unit-II : Drug Store Management and Inventory Control:** Organization of drug., Types of materials stocked, storage conditions.

**Purchase and Inventory control:** Principles, purchase procedures, purchase order, procurement and stocking.

**Unit-III : Central Sterile Supply Unit and their Management:** Types of materials for sterilization, packing of materials prior to sterilization, sterilization equipments, Supply of sterile materials.

**Manufacture of Sterile and Nonsterile Products:** Policy making of manufacturable items, demand and costing, personnel requirements, manufacturing practice, Master formula record , Production control, Manufacturing records.

**Unit-IV: Drug information service:** Sources of information on drugs, treatment schedules, procurement of information, computerized services (e.g. MEDLINE), Retrieval of information, Medication error.

**Records and Reports :** Prescription filling drug profile, Patient medication profile, case on drug interaction & adverse reactions, idiosyncratic cases etc.

**Unit-V: Drug distribution systems in Hospitals :** Out-patient dispensing, methods adopted, Dispensing of drugs to in-patients. Types of drug distribution systems Charging Policy, labeling, Dispensing of drugs to ambulatory patients, Dispensing of controlled drugs.

**Nuclear Pharmacy :** Introduction to Radiopharmaceutics- radio-active half life, Units of radioactivity. Production of radio pharmaceuticals, methods of isotonic tagging, preparation of radioisotopes in laboratory using radiation dosimetry, radio-isotope generators, permissible radiation dose level, Radiation hazards and their prevention, specifications for radio-active laboratory.

### **BOOKS RECOMMENDED**

1. Hasan, Hospital Pharmacy, Lea & Febiger, Philadelphia.
2. Merchant H.S. and Qadry J.S. Text Book of Hospital Pharmacy, B.S. Shah Prakashan, Ahmedabad.

### ***PHARM –485***

#### **ELECTIVE**

**Any one of the following:**

- (A) Standardization of herbal drugs.**
- (B) Drug design.**
- (C) Clinical; Pharmacy and Drug interactions**
- (D) Pharmaceutical marketing.**
- (E) Pharmaceutical Packaging**
- (f) Novel drug delivery system**
- (G) GMP, Quality Assurance & Validation**

#### **(A) STANDARDISATION OF HERBAL DRUGS**

**Unit I** – Commerce and quality control of natural medicinal plants products, organoleptic, microscopical,

physical & chemical evaluation of crude drugs. [08]

**Unit-II** - Standardisation of plant material as per WHO guidelines. [08]

**Unit-III** -Methods of extraction and modern techniques for the isolation, purification, separation estimation and characterisation of active plant constituents. [08]

**Unit-IV** -Analysis of official formulations derived from crude drugs including some ayurvedic preparations. [08]

**Unit-V** -General methods of screening of natural products for following biological activity:

- a) Anti-inflammatory b) Hypoglycaemic c) Antibacterial

d) Antifertility e) Psychopharmacological [08]

**BOOK RECOMMENDED**

1. Trease, G.E. Evans W.C., Pharmacognosy ELBS.
2. Tyler Varro. E., Brady Lynn. R. Robbers J.E. Pharmacognosy
3. Wallis T.E., Text book of Pharmacognosy
4. Harborne Phytochemical methods of chemical analysis .
5. Pharmacopoeial standards for Ayurvedic formulations CCRAS, Delhi.
6. Vapoorte, Swendson Chromatography of alkaloids.
7. Lala P.K., Elements of chromatography
8. Mottal.A.C. Clerk's isolation & identifications of drugs
9. Dhavan B.N. & Srimal R.C, The use of pharmacological techniques for evaluation of natural products. CDRI Lucknow.
  
10. Brain K.R. and Turner T.D, The practical evaluation of phytopharmaceuticals
11. Peach K. & Tracey MV, Modern methods of plant analysis
12. British herbal pharmacopocia.
13. Indian herbal pharmacopocia.
14. Chaudhary.R.R., Herbal drug industry

**(B) DRUG DESIGN**

**Unit-I**

Introduction to Drug Design, Lead Discovery, Interactions(Forces) involved in drug receptor complex, Physiochemical properties in relation to biological action, Stereochemical aspects in drug design, Bioisosterism. [08]

**Unit-II**

Drug metabolism-Phase I & Phase II Metabolic Reactions, Prodrugs & Soft drug concepts [08]

**Unit-III**

Analogous based drug design concept with suitable examples  
Structure Based drug design concept with examples. [08]

#### **Unit-IV**

Combinatorial chemistry-Introduction, Parallel and Split & Mixed synthesis. [08]

Computer Aided Drug Design-Introduction & Softwares used in CADD

#### **Unit-V QSAR**

Introduction, parameters, Quantitative models- Hansch method & Soft ware's in QSAR. [08]

#### **BOOKS RECOMMEDED:**

1. E.J, Ariens: Drug Design, Academic Press, New York (1975).
2. S.H. Salkovisky, A.A. Sinkula and S.C. Valvani, Physical Chemical Properties of Drugs, Marcel Dekker Inc. New York.
3. M.E. Wolff, Burger's Medical Chemistry, John Willey and Sons, New York.
4. R.F, Doerge, Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, J. Lippincott Co, Philadelphia.
5. Olson, Edward C "Computer Assisted Drug Design (American Chemical Society).
6. Burger A "A guide to chemical basis of Drug Design "John Wiley & Sons".
7. Thomas J.Perun <' Computer aided Drug Design methods Applications".
8. Pandi Veerapandian," Structure Based Drug Design".

### **(C) CLINICAL PHARMACY AND DRUG INTERACTIONS**

#### **Unit-I**

#### **INTRODUCTION TO CLINICAL PHARMACY**

*Definition, development and scope*

#### **Unit-II**

#### **PATIENT DATA ANALYSIS**

The patient's case history, its structure and use in evaluation of drug therapy, Communication skills including patient medication history interview, patient counseling. Hematological, Liver function, renal function, Tests associated with cardiac disorders. Adverse drug reaction- Epidemiology, Classification, Risk factors, Monitoring an detecting adverse drug reactions, Assessing causality, Reporting adverse drug reactions.

### **Unit-III**

#### **DAILY ACTIVITIES OF CLINICAL PHARMACISTS**

Drug therapy monitoring (Medication chart view, clinical review, *TDM* pharmacist interventions. Ward round participation Drug utilization evaluation (DUE) and review (DRU).Quality assurance of clinical Pharmacy services.

### **Unit-IV**

**RESEARCH DESIGN AND CONDUCT OF CLINICAL TRIALS** Research support including planning and execution of clinical trials. Guidelines for good clinical research practice and ethical requirements. Various phases of clinical trials. Categories of Phase IV studies.

### **Unit- V**

#### **CLINICAL PHARMACOKINETICS**

Physiological determinants of drug clearance and volumes of distribution. Renal and non-renal clearance.Estimation and determinants of bioavailability.*Calculation of loading and maintenance doses.Dose adjustment in renal failure, hepatic dysfunction, geriatric and paediatric patients.*

#### **REFERENCES**

1. Basic skills in interpreting laboratory data- Scott LT, American Society of Health System Pharmacists, Inc., USA.
2. Practice Standrds and Definitions- The Society of Hospital Pharmacists of Australia, 1997.
3. Clinical Pharmacokinetics-Rowland and Tozer, Williams and Wilkins Publication.
4. Biopharmaceutics and Applied Pharmacokinetics-Leon Shargel, Prentice Hall publication.
5. Relevant review articles from recent medical and pharmaceutical literature.
6. Parthasarathi G, Nyfort-Hansen K, Nahata M.C., A Text book of Clinical Pharmacy Practice –Essential Concepts and Skills, Orient Longman.
7. Davisson’s Prnciples and Practice of Medicine, ELBS/Churchill Livingstone.
8. Herfindal E.T. and Hirashman J.L., Clinical Pharmacy and Therapeutics Williams and Wilkins
9. John g.Wagner, ” Pharmacokinetics for the Pharmaceutical Scientist”.

10. Gibaldi, Milo,” Biopharmaceutics& clinical pharmacokinatics’.

11. Curry, Stephen,H. “ Drug Disposition & Pharmacokinetics”.

#### **(D) PHARMACEUTICAL MARKETING**

**Unit-I** Principles of marketing management, Introduction to pharmaceutical marketing, Identification of the marketing, Market behaviour, Prescribing habits of physician, Patient motivation, Market analysis. [08]

**Unit-II** Drug development and the marketing research interface, Diversification and specialisation, Marketing generic drugs. [08]

**Unit-III** Economic and competitive aspects of pharmaceutical industry- Advertising, Detailing, Retail competition, International marketing. [08]

**Unit-IV** Distribution channels in pharmaceutical marketing – Manufacturer, Wholesaler, Retailer, Hospital & Government agencies, Selection of stockists and distributors. [08]

**Unit-V** Controls- Internal control and external control. [08]

#### **BOOKS RECOMMENDED**

1. Smith, Mickey C, “Principles of pharmaceutical marketing”, CBS Publishers & Distributors.
2. Kotler, Philip “Marketing Management”. Pearson Education Asia.

#### **(E) PHARMACEUTICAL PACKAGING**

##### **Unit-I**

1. New concepts in pharmaceutical packaging.
2. Package systems, package design research. [08]

##### **Unit-II**

3. Packaging materials with special reference to polymers, metals, glass and plastics, control of packaging materials.
4. Blister and strip packaging. [08]

##### **Unit-III**

5. Testing of containers & closures, Pharmacopoeial tests and specifications, Defects in packages.
6. Stability of package and packaging material.
7. Ancillary materials used in packaging. [08]

#### **Unit-IV**

8. Sterilization of packaging materials.
9. Packaging of Parenterals, Ophthalmic and aerosols. [08]

#### **Unit-V**

10. Corrugated fibre board materials, Pointing requirements, label and leaflets preparation, Legal requirement. [08]

#### **BOOKS RECOMMENDED:**

1. Ross, Packaging of Pharmaceuticals.
2. Joseph D.O. Brien, Medical Device Packaging Handbook.
3. Griffin, Drug and cosmetic Packaging.
4. Barail, Packaging Engineering.
5. Harburn, Quality-Control of Packaging Materials in Pharmaceutical Industry.
6. Kac Chensney, Packaging of Cosmetics and Toiletries.

#### **(F) NOVEL DRUG DELIVERY SYSTEM**

##### **Unit-I**

1. Theory of controlled release drug delivery systems.
2. Release and diffusion of drugs from C.D.D.S., General methods of design and evaluation of C.D.D.S. [08]

##### **Unit-II**

3. Carriers for drug delivery systems, Prodrugs, Physical, chemical and biomedical engineering approach to achieve controlled drug delivery.
4. Microencapsulation: Methods, kinetics of drug release from microcapsules technology and applications. [08]

##### **Unit-III**

5. Transdermal drug delivery systems: Theory, formulation and evaluation, iontophoresis.
6. Implants and inserts: Types, design and evaluation methods, Osmotic pumps. [08]

#### **Unit-IV**

7. Targeted Drug delivery systems: Concept of drug targeting, importance in therapeutics, methods in drug targeting, drug immobilization techniques, nanoparticles, liposomes, neosomes, pharmacosomes and erythrocytes. [08]

#### **Unit-V**

8. Advances in drug delivery systems. An Introduction to buccal, nasal, ocular, pulmonary colonic delivery, etc. [08]

#### **BOOKS RECOMMENDED**

1. Roiche, Design of Biopharmaceutical Properties Through Prodrugs and Analogs.
2. Jolles and Wooldbridge, Drug Design: Facts or Fantasy.
3. Julian, Drug Delivery Systems.
4. Robinson and Vincent, Controlled Drug Delivery.
5. Robinson, Sustained and Controlled Drug Delivery Systems.
6. Noxon, Microencapsulation.
7. Chien, Novel Drug Delivery Systems.
8. Deasy, Microencapsulation and Related Processes.
9. Gutcho, Microencapsulation and Related Processes.
10. Lisbeth, Illum & Davis, Polymers in Controlled Drug Delivery.
11. Ghosh, Premamoy, 'Polymer Science & Technology'.

#### **(G) GMP, QUALITY ASSURANCE & VALIDATION**

##### **Unit-I**

1. Requirements of GMP, CGMP, GLP, USFDA, WHO guidelines and ISO 9000 series. [08]

##### **Unit-II**

2. Documentation- Protocols, Forms and maintenance of records in Pharmaceutical industry.
3. Preparation of documents for new drug approval and export registration. [08]

##### **Unit-III**

4. Basic concept of quality assurance, Quality assurance systems, Sources and control of quality variation- raw materials, containers, closures, personnel, environment etc [08]

##### **Unit-IV**

5. Concepts in validation, validation of manufacturing and analytical equipment, Process validation in manufacturing dosage formulations, applications of process validation.

**Unit-V**

6. In process quality control tests, IPQC problems in pharmaceutical industries.
7. Sampling plans, Sampling and operating characteristics curves. [08]

**BOOKS RECOMMENDED:**

1. Willing, Tuckerman and Hitchings, Good Manufacturing Practices for Pharmaceuticals.
2. OPPI, Quality Assurance.
3. Loftus and Nash, Pharmaceutical Process Validation.
4. Florey, Analytical Profile of Drugs (All volumes).
5. Indian Pharmacopoeia.
6. United States Pharmacopoeia.
7. British Pharmacopoeia.
8. Garfield, Quality Assurance Principles for Analytical Laboratories.
9. Manohar A. Potdar, "C.GMP for Pharmaceuticals".

**PHAR-485 P****Project on Elective**