

**RULES, REGULATIONS AND SYLLABUS FOR  
B.PHARM (FOUR YEAR COURSE)  
KAKATIYA UNIVERSITY, WARANGAL – 506 009**

**From the academic year 2008 – 2009 onwards**

(Applicable to the UCPSc and other Pharmacy colleges  
Affiliated to KU, Warangal)

**I. GENERAL RULES AND REGULATIONS**

**1. *Eligibility for admission:***

Candidates for admission to the Degree of Bachelor of Pharmacy shall be required to have passed the Intermediate Examination of the Board of Intermediate Education, Andhra Pradesh or an Examination recognized as equivalent there to with Physics, Chemistry and Mathematics or biology as subjects.

**OR**

The Diploma in Pharmacy Examination from an Institute in AP recognized by the Pharmacy Council of India (or a local candidate with a Diploma in Pharmacy from outside AP).

2. The degree of Bachelor of Pharmacy will be conferred on the candidates who have subsequently undergone the prescribed course of study of the Kakatiya University for a period of not less than four academic years.
3. The course and Examination for the four year shall be designated as I-B Pharm, II-B.Pharm, III-B.Pharm, IV-B.Pharm. The examination for each year shall be on the basis of the Scheme of Examination.
4. The distribution of marks shall be as indicated in the Scheme of Examination and the scope of subjects as indicated in the syllabus.
5. In every academic year there shall be one annual examination, ordinarily in April/May and one supplementary examination in October/November or on such dates as may be fixed by the University.
6. Candidates admitted to any year of the course of study shall pursue in each academic year, the regular courses of lecturers, tutorials, practicals etc, as mentioned in the Scheme of Instructions and after satisfying the conditions laid down in these ordinances will be eligible to appear for the examinations on such dates as may be fixed by the University.
7. A candidate to be eligible to take an examination specified in paragraph [4] shall prosecute a regular course of study in the course prescribed for the examination concerned, for not less than one academic year in the University College of Pharmaceutical Sciences and affiliated colleges of Kakatiya University.

8. A student shall be deemed to have pursued a regular course of study in a subject during each academic session, if he/she attended at least 75% of the classes held in each subject of examination and had produced a certificate of good conduct from the Principal of University College of Pharmaceutical Sciences/other affiliate Pharmacy colleges. Provided that the Vice-Chancellor of the university may condone shortage in attendance not exceeding 10% in each subject due to one or more of the following reasons involving absence from classes.
  - a. Participation in NCC camp duly supported by a certificate to that effect from the Officer-Commanding, NCC.
  - b. Participation in University or College team in games or cultural activities at Inter-state or Inter-University level duly supported by the certificate from the Office concerned.
  - c. Participation in Educational excursions conducted on working days certified by the principal of the College. No credit will be given for excursions conducted on holidays.
  - d. University deputation for youth festival certified by the Principal of the College.
  - e. Prolonged illness duly certified by the Medical Officer of the University Hospital or any Government Hospital.
9. In order to pass an examination, the candidate (i) shall obtain not less than 45 (forty five)% of the Marks allotted for the examination in each paper and (ii) shall obtain not less than 50 (fifty)% of all papers of examination for that particular year.
10. A candidate, who fails in four papers or less, may be promoted to next higher class. Such candidate may take the examination in the papers in which he/she failed, at the subsequent annual or supplementary examination.
11. The candidates of II, III and IV year B.Pharm, who failed in some of the I, II, or III year papers, respectively may be permitted to appear for these papers at the Annual/Supplementary examinations together with II, III or IV year examinations provided, however, that the total number of papers in which they have failed is not more than four at any time for the promotion to next higher class. However D.Pharm lateral entry students in B.Pharm II year may be promoted to III year, even if they failed in five subjects, provided if these students have to appear for more papers in total than the regular students of II year in annual exams.
12. The award of division shall be based on the aggregate marks obtained by a candidate in B.Pharm. I, II, III and IV, years examinations put together. Those who obtain 50% marks and more but less than 60% will be awarded Second Division and those who obtain 60% and above will be awarded First Division. Candidates securing 75% and the above in the aggregate of all examinations of B.Pharm. I, II, III and IV in first attempt shall be declared to have passed in First Division with Distinction. Any candidate, who carries a backlog at any stage, will not be eligible for distinction and rank.
13. A candidate shall be ranked on the basis of his/her grand total provided he/she has passed in all the papers of his/her I, II, III and IV year examinations in first attempt.

14.
  - i. A candidate who fail to secure 50% in aggregate, but has passed in all papers shall be allowed to appear at a supplementary examination in any theory papers of his/her choice of that particular year.
  - ii. A candidate who fails to secure 50% in aggregate and also fails in not more than one paper shall be allowed to appear at a supplementary examination in the paper failed and two theory papers of his/her choice.
15. The college, if possible will organize an Educational and Industrial tour for 15 days during III year B.Pharm. Students as a part of the teaching program, may take part accompanied by faculty members deputed by the college.
16. Industrial/Hospital training: It is compulsory that every student of B.Pharm shall undergo training for a period of 6 weeks during final B.Pharm (in summer vacation) in Pharmaceutical Company or in a Hospital.

## SCHEME OF INSTRUCTIONS AND EXAMINATIONS

### B.PHARM. I YEAR

#### THEORY PAPERS:

Sl.No	Subjects	Hours/Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	Dispensing & General Pharmacy	3	20	80	100	3
2	Pharmaceutical Inorganic and. Analytical chemistry	3	20	80	100	3
3	Pharmaceutical Organic Chem-1	4	20	80	100	3
4	Remedial Maths/Remedial Biology	2	20/10	80/40	100/50	3/1.5
5	Biochemistry	2	20	80	100	3
6	Communicative skills in English	2	20	80	100	3
7	Tutorials	5				
	Total	21	120/110	480/440	600/110	

#### PRACTICAL PAPERS:

Sl.No	Subjects	Hours/Week	Sessional Marks	Annual Marks	Total Marks	Exam duration (hrs)
1	Dispensing & General Pharmacy	3	20	80	100	3
2	Pharmaceutical Inorganic and Analytical chemistry	3	20	80	100	3
3	Pharmaceutical Organic Chem-1	3	20	80	100	3
4	Remedial Biology	3	10	40	50	2
5	Biochemistry	3	20	80	100	3
	Total	15	80/90	320/360	450	

## ***B.PHARM – FIRST YEAR***

### **I.T.I. DISPENSING AND GENERAL PHARMACY** (Theory) [3hrs/Week]

#### UNIT- I

**History of Pharmacy:** Development of Pharmacy Education, Industries and Research.

- a) Pharmacy literature: History of I.P., B.P., U.S.P., B.P.C, and N.F. of India and Extra Pharmacopoeia.
- b) Pharmacy Ethics: Introduction to code of Ethics of Pharmacy.

**Galenicals:** Methods of preparation, storage and packing of Infusions, Decoctions, Tinctures, Liquid extracts, Dry extracts, Study in detail of extraction processes like Maceration and Percolation.

#### UNIT - II

**Principles and various methods involved in the preparation of the following:** Solutions, Aromatic Waters, Syrups, Mucilages, Spirits, Elixirs, Magmas and Glycerines.

#### UNIT - III

**Pharmaceutical calculations (only in C.G.S system):** Percentage calculations, Proportional calculations, alligations, isotonic solutions, Proof spirits and Displacement values.

**Principles of dispensing:** The form of prescription Handling, Pricing and Refilling of prescription, Prescription containers, Labelling and Packing.

#### UNIT -IV

**Principles involved and procedures adopted in the dispensing of the following classes of Pharmaceutical preparations:** Mixtures, Emulsions, Powders, Lotions, Liniments, Ointments, Creams, Pastes and jellies, Suppositories, Pessaries, Nasal bougies, Inhalations, Eye drops, Ear drops, Throat paints and Gargles.

## **UNIT -V**

**Posology:** Calculation of doses and a general know-how of the doses.

**Incompatibility:** Scope, Classes of incompatibility, Correction of incompatibilities, Handling of incompatible prescriptions pertaining to: alkaloidal incompatibility, Incompatibility of soluble iodides, soluble salicylates and benzoates with acids, ferric salts and alkaline substances, incompatibility causing evolution of carbon dioxide of soluble barbiturates and emulsifying agents.

### **I.P.I. DISPENSING AND GENERAL PHARMACY**

(Practicals) [3hrs/Week]

**I. Preparations: A minimum 50 preparations having at least one from each class is compulsory.**

<b>Galenicals</b>	: Demonstration of maceration; Percolation; Sox halation.
<b>Solutions</b>	: Normal saline solution, Dextrose solution, Benzoic acid solution, Copper sulphate and zinc sulphate solution, Aqueous iodine solution.
<b>Aromatic waters</b>	: Chloroform Water, Camphor Water, Peppermint Water.
<b>Syrups</b>	: Simple syrup, Flavoured syrup, Artificial syrup.
<b>Elixirs</b>	: At least one
<b>Glycerine</b>	: Phenol glycerin, Tannic acid glycerin.
<b>Spirits</b>	: Chloroform spirit
<b>Emulsions</b>	: Liquid paraffin emulsion, Arachis oil emulsion
<b>Lotions</b>	: Calamine lotion, Salicylic acid lotion, compound sulphur lotion.
<b>Liniments</b>	: Methyl salicylate liniment, Camphor liniment, Turpentine oil liniment.
<b>Ointments</b>	: Sulphur ointment (Hydrocarbon base)

	Whitfield ointment (Water miscible base), Boric acid ointment
<b>Creams</b>	: Cetrimide cream, Barrier cream
<b>Pastes</b>	: Zinc oxide paste
<b>Gels</b>	: Zinc oxide gel ( Bentonite gel)
<b>Suppositories</b>	: One each with PEG and Cocoa butter as bases.
<b>Ear drops</b>	: Boric acid ear drops, Sodium bicarbonate ear drops.
<b>Eye drops</b>	: Atropine sulphate eye drops, Zinc sulphate eye drops
<b>Mouth wash</b>	: Peppermint mouth rinse, Zinc sulphate, Zinc chloride mouth wash.
<b>Inhalation</b>	: Menthol and Eucalyptus inhalation
<b>Paints</b>	: Mandle's paint
<b>Powders</b>	: Dusting powder, Divided power
<b>Gargles</b>	: Potassium chlorate gargle; Tannic acid Gargles.

## **II. Important preparations: Compulsory.**

- Soft soap
- Lysol (cresol with soap solution)
- Milk of magnesia (mixture)
- Chemical incompatibilities (Some representative examples)
- 

III. Some information regarding incompatibilities (can be a demonstration).

IV. Prescription reading (Minimum of three Prescriptions).

V. Study of some marketed preparations (Minimum of three).

## **I.T.2. PHARMACEUTICAL INORGANIC AND ANALYTICAL CHEMISTRY**

(Theory) [3 hrs/week]

## PART – A (Inorganic)

### UNIT – I

- (a) **Limit tests** for Arsenic, heavy metals, lead, Iron, chloride and Sulphate and Pharmacopoeial standards.
- (b) **Electrolytes:** Sodium, Potassium and Calcium replenishers.  
Sodium and Potassium Replenishers: Sodium chloride, compound

Sodium chloride solution (Ringer solution), Potassium chloride, ORS.

**Calcium Replenishers:** Calcium chloride, Calcium gluconate, Dibasic calcium phosphate.

- (c) **Gastro-intestinal agents:**
  - (1) **Acidifiers and Antacids:** IP: Dilute hydrochloric acid, sodium acid phosphate, sodium bicarbonate, sodium citrate, Potassium citrate, Aluminium hydroxide gel, Dried Aluminium hydroxide gel, Magnesium oxide (Magnesia), Magnesium-hydroxide mixture, Magnesium carbonate, Magnesium trisilicate, Calcium carbonate.
  - (2) **Adsorbents and related drugs:** Light kaolin, Heavy kaolin, Activated charcoal.
- (d) **Acid base Regulators:** Sodium bicarbonate, Sodium lactate, Sodium citrate/Potassium citrate, and Sodium acetate, Ammonium chloride.
- (e) **Dialysis fluids:** Haemodialysis fluids and intraperitoneal dialysis fluids.

### UNIT-II

- (a) **Mineral Nutrients/Supplements**
  - (1) **Haematinics –** Ferrous sulphate, Ferrous fumarate, Ferrous gluconate, Ferric ammonium citrate, iron and dextrose injection.
  - (2) **Halogens:** Iodine and Iodides or fluorides.
- (b) **Pharmaceutics aids:**
  - (1) **Excipients:** Dicalcium phosphate, Tricalcium phosphate, Magnesium stearate, Talc and Calcium carbonate (Precipitated chalk).
  - (2) **Suspending agents:** Bentonite, Colloidalsilica, Aluminium stearate.
  - (3) **Colourants:** Titanium oxide, Ferric oxide.

- (c) **Expectorants:** Ammonium chloride, Potassium iodide.
- (d) **Emetics:** Potassium antimony tartarate, Copper sulphate, Zinc sulphate.
- (e) **Antidotes:** Sodium thiosulphate, Sodium nitrite.

## UNIT – III

### Definition, Preparation, Properties, Assay methods, Limits and Uses

#### (a) Topical agents:

- 1) **Astringents:** Zinc sulphate, Zinc oxide, Calcium hydroxide, Copper sulphate, Bismuth sub carbonate.
- 2) **Topical protectants:** Zinc oxide, Calamine, Zinc stearate, Talc, Titanium-dioxide, Heavy kaolin and Light kaolin (only uses).
- 3) **Silicone polymers:** Activated Dimethicone.
- 4) **Anti infectives:** Hydrogen peroxide solution, Potassium permanganate, Silver nitrate (Silver protein), Iodine, (solutions of Iodine, povidone – iodine), Boric acid, Zinc – undecylenate, Mercury compounds (Yellow mercuric oxide, Ammoniated mercury), Sulphur, Selenium sulphide.

#### (b) Dental products:

- 1) **Fluorides:** Sodium fluoride, Sodium monofluorophosphate and stannous fluoride.
- 2) **Oral antiseptics and Astringents:** Hydrogen peroxide, Sodium peroxide (BP), Magnesium peroxide, Zinc peroxide and Mouth washes.
- 3) **Dentifrices:** Calcium carbonate, Dibasic calcium phosphate, Calcium phosphate, Sodium metaphosphate and Strontium chloride.
- 4) **Cements & fillers :** Zinc oxide (only uses).

#### (c) Other Medicinal agents:

- 1) **Antineoplastic agents:** Cisplatin
- 2) **Antidepressants:** Lithium carbonate
- 3) **Diagnostic agent:** Barium sulphate.
- 4) **Surgical aid:** Plaster of Paris.

## PART – B (Analytical)

## Unit – IV

- a) **Theory of Neutralization Titration:** Acidimetry, Alkalimetry, Acid-base concept, Common ion effect and Solubility product, pH, Buffers and indicators.
- b) **General Principles and theory of** oxidation-reduction methods, and precipitation methods. An account of the indicators used in these titrations.  
Application of the above methods in the analysis of drugs, as under IP 1996.

#### Unit – V

- a) **Complexometric titration:** Theory, types and application in pharmaceutical analysis. Masking and demasking and their applications.
- b) **Non-aqueous Titration:** Theory, types, solvents used and application in Pharmaceutical analysis.  
Application of the above methods in the analysis of drugs, as under IP 1996 (including the latest addenda).
- c) Karl-Fisher method of estimation of water and other methods of moisture determination and Picnometry.

### I.P. 2. PHARMACEUTICAL INORGANIC AND ANALYTICAL CHEMISTRY

(Practicals) [3hrs/week]

List of experiments:

- A) Limit tests for the following as per the procedure given in Indian Pharmacopoeia (1996 – including the latest addenda)
  - 1) Chlorides
  - 2) Sulphates
  - 3) Heavy metals
  - 4) Iron
  - 5) Arsenic (demonstration)
- B)
  - 6) Balances and Weighing, Calibration of weight, Pipette and Burette.
  - 7) Preparation and standardization of Hydrochloric acid solution (0.1N).
  - 8) Preparation and standardization of Potassium permanganate solution (0.1N & 0.1M).
  - 9) Preparation of a primary standard solution of 0.1N Potassium hydrogen-phthalate.
  - 10) Preparation and standardization of 0.1N EDTA solution.
  - 11) Preparation and purification of Boric acid.
  - 12) Preparation and purification of Sodium citrate.
  - 13) Preparation and purification of Potash alum.

- 14) Preparation and purification of yellow mercuric oxide.
- 15) Preparation and purification of Ammoniated mercury.
- 16) Preparation and purification of Magnesium stearate.
- 17) Assay of sodium bicarbonate and assay of Boric acid (Neutralisation).
- 18) Assay of Calcium gluconate (or) any calcium compounds (Complexometry).
- 19) Assay of Copper sulphate (Redox titration).
- 20) Assay of Sodium acetate (Non-aqueous titration).
- 21) Assay of Ferrous sulphate (Oxidation-reduction / Redox titration).
- 22) Assay of Hydrogen peroxide solution (Permanganometry).
- 23) Exercises related assay by Gravimetric method.

### I.T. 3. PHARMACEUTICAL ORGANIC CHEMISTRY-I

(Theory) [4hrs/week]

#### Unit – I

**Structure and Activity of Organic Molecules:** Shapes of organic molecules, Bond lengths, Bond angles and Bond dissociation energies. Electronic effects in organic molecules: Inductive effect, Electromeric or Mesomeric effect, Hyper conjugation, concept of resonance; Types of organic reagents and reactions.

#### **A Study of Hydrocarbons:**

**Aliphatic/Alicyclic Hydrocarbons:** Nomenclature, Isomerism (Chain, conformational and geometrical) Relative stabilities (Heats of Combustion and Hydrogenation), Ring stabilities of cyclohexane, chair-boat conformation, Bayer's strain theory and Sachse-Mohr theory. Free radical substitution reactions (Halogenation) of Alkanes, Selectivity of Halogen.

**Alkenes:** Electrophilic addition reactions of alkenes, Markovnikov's Rule, Kharasch effect, Bayer's Oxidation (Cis-Hydroxylation, Polymerisation).

**Alkadienes:** 1,4 addition reactions.

#### **Aromatic Hydrocarbons:**

Kekule's structure of Benzene, Bond lengths, Heats of hydrogenation and stability, Molecular orbital picture of Benzene, Aromaticity, Huckel's rule, Nomenclature of Benzene derivatives, characteristic reactions of Benzene, theory of reactivity and orientation in monosubstituted benzenes.

#### Unit – II

**Halogen Compounds-Aliphatic:** Nomenclature, two major methods of preparation, characteristic nucleophilic substitution reactions, Factors that play role in SN1 and SN2, Walden inversion, elimination reaction and Saytzev's rule.

**Halogen Compounds-Aromatic:** Nomenclature, Low reactivity of halo benzenes towards nucleophilic substitution, Benzyne ion concept.

**Alcohols:** Nomenclature, classification, two important methods of preparation, physical properties, Hydrogen bonding, characteristic nucleophilic substitution reactions (replacement of -OH by -Cl), elimination reactions, Reimer Tiemann reaction and relative reactivities of 1<sup>o</sup>, 2<sup>o</sup> and 3<sup>o</sup> alcohols.

**Ethers:** Nomenclature, Williamson's synthesis, Action of HI on ethers (Ziesel's Method).

**Alkynes:** Acidity of 1-alkynes, Formation of metal acetylides. Stereo specific reduction of alkynes. Addition of hydrogen halide (HCl) addition of water and keto-enol Tautomerism.

### Unit – III

**Carbonyl Compounds:** Nomenclature, two important methods of preparation, polarity of carbonyl group, relative reactivities of carbonyl compounds, nucleophilic addition and addition-elimination reactions, oxidation-reduction reactions, aldol condensation, Cannizzaro reaction, Benzoin condensation, Perkins reactions, Reformatsky reaction.

**Phenols:** Nomenclature, two important methods of preparation, physical properties, acidity of phenols, stability of phenoxide ion, reactions of phenols, Kolbe-Schmidt reaction stability of conjugated dienes, and Fries rearrangement.

### Unit – IV

**Carboxylic acids and their derivatives:**

**Carboxylic acids:** Nomenclature, Intermolecular association, stability of carboxylate anion, Two important methods of preparation, Decarboxylation, functional groups reactions, Reduction of carboxylic acids. A note on dicarboxylic acids.

**Acid derivatives:** (Acid chlorides, anhydrides, esters and amides). Nomenclature, Reactions like hydrolysis, Reduction of esters and amides, Hofmann's degradation of amides. Brief account of Malonic and acetoacetic esters. Their importance in synthesis.

### Unit – V

**Nitrogen Compounds:**

**Nitro compounds:** Nomenclature, acidity of nitro compounds containing  $\alpha$ -hydrogens, reductive reactions of aromatic nitro compounds.

**Amines:** Nomenclature, Basicity of amines, Classification, Relative reactivity, Hinsberg method of separation, Acylation reactions

Diazotisation and Reactions of Diazonium salts.

**Nitriles and isonitriles :** Nomenclature, two methods of synthesis, reactivity and functional reactions.

**Polynuclear aromatic hydrocarbons:** Nomenclature, structure and aromatic character of Naphthalene and Anthracene. Resonance structures, electron density and reactivity. Electrophilic substitution, Oxidation and reduction reactions.

### I.P. 3. PHARMACEUTICAL ORGANIC CHEMISTRY-I

(Practicals) [3hrs/week]

**Introduction to:** Equipment & Glassware, Recrystallization method, details of M.P, B.P and distillation

I. Preparation of organic compounds (each involving a specific organic reaction covered in theory)

- |     |                                      |   |   |
|-----|--------------------------------------|---|---|
| 1.  | N-Acetylation                        | : | Preparation of Acetanilide from Aniline                                 |
| 2.  | O-Acetylation                        | : | Preparation of Aspirin from Salicylic acid                              |
| 3.  | Nuclear Bromination                  | : | Preparation of p-Bromoacetanilide from Acetanilide                      |
| 4.  | Hydrolysis                           | : | Preparation of p-Bromoaniline from p-Bromoacetanilide                   |
| 5.  | Nuclear Nitration                    | : | Preparation of m-Dinitroaniline from Benzene                            |
| 6.  | Reduction                            | : | Preparation of m-Nitroaniline from m-Dinitrobenzene                     |
| 7.  | Oxidation                            | : | Preparation of Benzoic acid from Benzyl chloride                        |
| 8.  | Esterification                       | : | Preparation of n-Butylacetate from n-Butylalcohol                       |
| 9.  | Etherification                       | : | Preparation of $\beta$ -Naphthyl methyl ether from $\beta$ -Naphthol    |
| 10. | Addition-Elimination                 | : | Preparation of Phenyl hydrozone or Oxime from benzaldehyde              |
| 11. | $\alpha$ -Halogenation-cum-Oxidation | : | Preparation of Iodoform from Ethanol or Acetone                         |
| 12. | Extensive Nuclear Bromination        | : | Preparation of Tribromophenol or Tribromoaniline from Phenol or Aniline |

II. Systematic qualitative Analysis (Identification) of Monofunctional Organic Compounds:

Avoid water-soluble compounds, and compounds containing more than one functional group.

### III. An Experimental Determination of Relative Reactivities of the Following

- a) Differentiation between Paraffinic, Olefinic and Acetylinic Hydrocarbons using
- Test for unsaturation with bromine-carbon tetrachloride and/or dil.aq. Potassium permanganate, and**
  - Ammonical silver nitrate.

- b) **Differentiation between Benzene, Toulene and Nitrobenzene (Relative aromaticity) using conc. Sulphuric acid (sulfonation).**
- c) Differentiation between Aniline ( $1^\circ$ ), N-Methylation ( $2^\circ$ ) and N, N-Dimethyl ( $3^\circ$ ) using tosyl chloride (Hinsberg's Method)
- d) Differentiation between: n-Propyl alcohol ( $1^\circ$ ), isopropyl alcohol ( $2^\circ$ ) and tert.butyl alcohol ( $3^\circ$ ) using the Lucas Reagent.
- e) Differentiation between: Formaldehyde, Acetaldehyde, and Benzaldehyde using Tollen's Reagent.

#### I.T.4. REMEDIAL MATHEMATICS

**(Only for student's admitted under B.P.C and D.Pharm streams)**  
(Theory)[2hrs/Week]

*An introductory review of elementary mathematics:*

#### **UNIT - I**

**Algebra:** Arithmetic and geometric progression. Permutations and combinations. Binomial theorem. Partial fractions. Logarithms. Matrices: types, addition, multiplication of matrices, Determinant of second and third order. Adjoint and inverse of non-singular matrix. Application of determinant to solve simultaneous equations by Cramer's rule.

#### **UNIT - II**

**Trigonometry:** Trigonometric ratios and the relation between them.  $\sin(A \pm B)$ ,  $\cos(A \pm B)$  and  $\tan(A \pm B)$  formulae only. Trigonometric ratios of multiple angles. Height and distances with simple problems only.

#### **UNIT - III**

**Analytical geometry:** Distance between two points, Area of a triangle. Coordinates of a point dividing a given segment in a given ratio. Locus. Equation to a straight line in different forms. Angle between straight lines. Point of intersection.

#### **UNIT - IV**

**Differential calculus:** Continuity and limits, differentiation, derivability and deviation, RH derivatives and LH derivatives, differential general theorems and derivation, derivatives of trigonometric functions (including reverse trigonometric functions), logarithmic differentiation, partial differentiation, maxima and minima (elemental).

**Integral calculus:** integration as reverse process of differentiation, definite integrals, integration by substitution and by parts, integration of algebraic functions, evaluation of area and volume in simple cases.

## UNIT - V

**Differential equations:** Formulation and derivation, order and degree, first order and degree, linear equation with constant co-efficiency, homogeneous linear equations (first method of solution only); simultaneous differential equations which are linear and of first order.

### I.T.4. REMEDIAL BIOLOGY

(Only for students admitted under M.P.C. stream)

(Theory)[2Hrs/Week]

#### Section – A (Botany)

## UNIT I

**Plant Cell and Tissues:** Plant cell ultra structure with special reference to plasma membrane, mitochondria and plastids. Cell inclusions. Cell division: Mitosis and Meiosis. Types of plant tissues, tissue systems, and their functions.

## UNIT - II

**Morphology and Histology:** Root, Stem, Bark, Wood, Leaf, Flower, Fruit and Seed. Modifications of roots and stems.

## UNIT -III

**Taxonomy:** Taxonomic hierarchy. Systematic position (Classification) of the following families with special references to medicinal Magnoliophyta (Angiosperms): *Fabaceae(Leguminosae)*, *Apiaceae(Umbelliferae)*, *Apocynaceae*, *Solanaceae*, *Lamiaceae(Labiatae)*, *Liliaceae* and *Zingiberaceae*.

#### Section – B (Zoology)

## UNIT - IV

**Animal cells and Tissues:** Animal cell ultra structure with special reference to endoplasmic reticulum, golgi apparatus, and ribosome. Cell division. Types of cells and tissues, and their functions.

## UNIT - V

**Study of Anatomy of frog:** A basic study of GI, nervous, cardiovascular, genito-urinary, musculo-skeletal and respiratory systems. A comparative study of gross anatomy of different organs of rabbit, mice, guinea pig and a primate.

## UNIT - VI

**Fundamentals of parasitology:** Life cycles of some animal parasites that cause human disease : Amobeasis – *Entamoeba histolytica* (Protozoa); Malaria – *Plasmodium vivax* (Protozoa); Taeniasis and cysticercosis – *Taenia solium* (Cestoda); and Filaria – *Wuchereria bancrofti* (Nematoda).

### I.P.4. REMEDIAL BIOLOGY

(For students from M.P.C stream)

(Practicals)[3Hrs/Week]

### Experiments

1. Introduction of Microscopes and their handling.
2. Morphology of various Plant parts.
3. Histological study of (Transverse sections)
  - a) Monocot Root
  - b) Monocot stem
  - c) Monocot Leaf
  - d) Dicot Root
  - e) Dicot Stem
  - f) Dicot Leaf
4. Systematic study of representatives of the following families:
  - a) *Apocynaceae*
  - b) *Solanaceae*
  - c) c, d, & e : Three sub-families of *Leguminosae*
5. Study of following systems of Frog (Dissections)
  - a) Digestive system
  - b) Respiratory system
  - c) Venous system
  - c) Arterial system

### I.T.5. BIOCHEMISTRY

(Theory) [2 Hrs/Week]

## UNIT – I

**Carbohydrate Metabolism:** Glycolysis, glycogenolysis, gluconeogenesis, Krebs' cycle, direct oxidative pathway (HMP), uronic acid pathway.

## **UNIT – II**

**Metabolism of Proteins and Amino Acids:** Essential and non-essential amino acids, general metabolic reactions of amino acids like deamination, transamination, decarboxylation, urea cycle; metabolism of the following amino acids: glycine, phenylalanine, tyrosine, cysteine, methionine, tryptophan, valine and lysine.

## **UNIT – III**

**Metabolism of Lipids:** Essential fatty acids,  $\beta$ -oxidation of fatty acids, ketogenesis, biosynthesis of fatty acids and cholesterol.

**Enzymes:** Classification, structure, mechanism of enzyme action, properties, factors influencing enzyme action, activators and deactivators of enzymes, competitive and noncompetitive inhibition with respect to drug action, coenzymes.

## **UNIT – IV**

**The principles involved and the method used in the qualitative and quantitative analysis of blood for the following constituents:** glucose, urea, cholesterol, bile salts, bile pigments, creatinine, calcium, phosphates, SGPT and SGOT.

**The principles involved and the method used in the qualitative and quantitative analysis of urine for the following constituents:** glucose, ketone bodies, bile salts, bile pigments and albumin.

## **UNIT – V**

**Role of Minerals and Water in Biochemical Processes** with emphasis on the following: calcium, sodium, potassium, magnesium, iron and phosphorous.

**Nucleic acid metabolism:** Structure of DNA and RNA, Biosynthesis of purines and pyrimidines, Biosynthesis of DNA and RNA.

**Biological oxidation:** Introduction, brief account on the role of oxidases, dehydrogenases, hydroperoxidases and oxygenases in biological oxidation.

### **I.P.5. BIOCHEMISTRY**

(Practicals) [3 Hrs/Week]

## **Experiments:**

1. Identification of Carbohydrates
2. Preparation of Osazones
3. Identification of Amino acids
4. Identification of Proteins
5. Colour reactions of Cholesterol
6. Analysis of urine.
7. Analysis of urine for abnormal constituents
8. Estimation of Chlorides in Urine
9. Estimation of Glucose in Urine
10. Estimation of Uric acid in Urine
11. Estimation of Creatinine in Urine
12. Estimation of Glucose in blood by Folin-Wu method.
13. Estimation of glucose in blood by glucose oxidase method
14. Estimation of serum cholesterol (Enzymatic method)
15. Estimation of Urea in Blood
16. Estimation of Creatinine in blood
17. Estimation of Serum protein
18. Estimation of Urobilinogen in Blood
19. Estimation of Bile pigments in Serum
20. Estimation of alkaline phosphatase in Serum

## **I.T.6. COMMUNICATIVE SKILLS IN ENGLISH**

(Theory) [2hrs/Week]

### **UNIT-I**

Role and importance of communication, Verbal and non-verbal communication, Group communication, effective communication, barriers to communication, communication media, participating in discussions, conduct of seminars, conferences etc., making presentations through collection, evaluation, organizing the information, interacting with learners and teachers, Role of wit and humor in communication.

### **UNIT-II**

Spoken english Vs Written English, reading method, formal /informal English (one way /two way); British/American/Indian Englishes; how to introduce one self and others; how to tender apology; how to thank in different ways; greetings, some polite expressions; agreement and disagreements; how to use a dictionary; how to use a thesaurus; vocabulary development; synonyms and antonyms; one word substitutes; comprehension.

### **UNIT-III**

Communication through letters; official and personal letters; letters of complaint; letters of enquiries; and responses; writing memos, circulars and notices; what to avoid while writing; paragraph writing; scientific/technical report writing; drafting and delivering a speech, resume writing and interview techniques.

#### UNIT-IV

Grammar: Sequence of tenses, voice, articles, direct and indirect speech; degrees of comparison; common errors in English made by Indian learners of English. Concepts of learning and listening: types and methods of learning and listening; learning and listening of knowledge, attitudes, skills, and practices.

#### UNIT-V

The following four essays from "*Selections from Modern English*" prose Edited by Haladhar Panda are prescribed:

- |                                |                           |
|--------------------------------|---------------------------|
| 1. <b>Our Own Civilization</b> | <b>-C.E.M.Joad</b>        |
| 2. <b>Andrew Carnegie</b>      | <b>-E.H Carter</b>        |
| 3. <b>The Secret of work</b>   | <b>-Swami Vivekananda</b> |
| 4. <b>The Generation Gap</b>   | <b>-Benjamin Spock</b>    |

### B.PHARM II YEAR

#### 2.1. Semester

#### THEORY PAPERS:

S.No	Subjects	Hours/Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	Biostatistics & Computer Applications	4	20	80	100	3
2	Pharm. Engineering	4	20	80	100	3
3	Pharm. Org. Chemistry-II	3	20	80	100	3
4	Human Anatomy & Physiology - I	3	20	80	100	3
5	Pharm. Microbiology & Immunology-I	3	20	80	100	3
6	Tutorial	1				
	<b>Total</b>	<b>18</b>	<b>100</b>	<b>400</b>	<b>500</b>	

**PRATICAL PAPERS:**

S.No	Subjects	Hours/Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	Pharm Engineering	6	20	80	100	3
2	Biostatistics & computer Applications	6	20	80	100	3
3	Pharm. Microbiology & Immunology-I	6	20	80	100	4
	Total	18	60	240	300	

@ Two sessional examinations will be conducted and their average will be taken

**2.1.T.1. BIO-STATISTICS AND COMPUTER APPLICATIONS**

(Theory)[4/Week]

**Section – A: Bio-statistics****UNIT – I**

**Data collection and treatment:** Significant digits and rounding of numbers, data collection, random and non-random sampling methods, sample size, data organization, diagrammatic representation of data, bar, pie, 2-D and 3-D diagrams, standard deviation and standard error of means, co-efficient of variation, confidence (fiducial) limits, probability and events.

**Probability and Distributions:** Bayer's theorem, probability theorem, probability distribution, elements of binomial and poison distribution, normal distribution curve and properties, kurtosis and skewness.

**UNIT-II**

**Regression:** Correlation and regression analysis, method of least squares, non-linear regression.

**Statistical inference:** Common parametric and non-parametric tests employed in testing of significance in biological/pharmaceutical experiments and elements of ANOVA (One way and two way).

### UNIT – III

**Design of experiments:** Basic concepts of CRD, RBD and Latin square designs.

**Sampling and Quality Control:** Concept of Random sampling, Statistical QC Charts. Applications of statistical concepts in pharmaceutical sciences.

#### Section – B: Computer Applications

### UNIT – IV

**Concept:** History of computers, simple model of computer and working parts of the computer, CPU, memory, input/output devices, computer languages and their hierarchal machine language, assembly language, high level language, comparison of high level and low level languages especially C, C++, PASCAL etc.

Introduction to microcomputers and concepts of operating systems: Elements of DOS, UNIX, etc., introduction of computer networks.

### UNIT – V

**Database management:** Spread sheets (like MS-EXCEL, ACCESS), concepts and objectives of database and database management system, advantages and disadvantages of the database management system and examples of DBMS packages (like DBASE III).

**Flow chart and algorithm development:** Definition and properties of the algorithm, Flow chart symbols and their uses, Examples of efficient algorithm and flow-chart, conversion of algorithm/flow-chart to high-level languages.

### UNIT –VI

**Introduction to computer programming:** C language: Constant and string variables, expressions, functions, structures, repetition statements (loops), nested loop, definite and indefinite loop and arrays. Concepts of files. Sequential files and random access files, Simple program writing for bio-statistical methods.

**Computer application in pharmaceutical and clinical studies.**

### 2.1.P.1. BIO-STATISTICS AND COMPUTER APPLICATIONS

(Practicals)[6hrs/Week]

1. Solving of biostatistical problems related to inference, sampling, graphical representation of data etc., with the help of calculators and software programmes like Graph pad.
2. **Sample programs in C:** Program to calculate simple and complex arithmetic expressions, program using structures, program using loops and nested loops, program using functions and simple programs using arrays.
3. Operating systems like WINDOWS, UNIX, etc.

Software packages like MS-WORD, EXCEL, ACCESS, POWER POINT.

### 2.1. T.2. PHARMACEUTICAL ENGINEERING

(Theory) [4 Hrs/week]

#### UNIT – I

**Introduction:** Fundamental concept of material and energy balances, Definitions of Unit-operation, unit process and chemical technology, stoichiometry, laboratory scale, pilot scale and industrial scale operations.

**Flow of Fluids:** Concepts of fluid statics and dynamics, construction of simple and differential manometers. Reynolds's number, Bernoulli's theorem, Study of orifice meter, venturimeter, pitot tube and rotameter.

**Transportation of Solids:** Construction details, advantages and disadvantages of belt conveyor, screw conveyor and pneumatic conveyor, bucket elevator.

**Transportation of Fluids:** Cocks, valves- gate valve, check valve, pump-centrifugal pump.

**Humidity:** Definitions of humidity relative humidity, percentage humidity, dew point, humidity chart, adiabatic saturation temperature. and method of determination of humidity.

#### UNIT - II

**Mixing:** Mixing of liquids and liquids, design of impellers, construction and application of dry mixer, v-type mixer, power consumption of mixer, impellers, kneading machine, and colloidal mill.

**Size reduction and separation:** Theory of size reduction, factors influencing size reduction, energy aspects in size reduction construction details, advantages

and disadvantages of hammer mill, ball mill, fluid energy mill. Principles of size separation, construction details of shaking and vibrating screens, cyclone separator, bag filter. Scrubber, sedimentation theory.

**Flow of Heat:** Concept of heat flow: Conduction fouriers law, Natural and forced convection, radiation, Stefan-Boltzmann law, temperature drop in parallel and counter current heat exchangers. construction, operation and applications of heat exchangers, interchangers and finned tubes

### UNIT – III

**Evaporation:** Theory of evaporation, heat and material balances, construction details, advantages and disadvantages of steam jacketed kettle, horizontal vertical tube evaporator, forced circulation evaporator, falling film and climbing film evaporators. Capacity of multiple effect evaporator.

**Distillation:** Concept of distillation of binary miscible, immiscible mixtures. Rectification, azeotropic distillation, distillation under reduced pressure, steam distillation, simple distillation, extractive and fractional distillation, and molecular distillation,

### UNIT – IV

**Drying:** Theory of drying, drying curves, shrinkage of materials, construction, operation and application of different dryers, atmospheric and vacuum compartment dryer, rotary dryer, spray dryer, freeze dryer and fluidized bed dryer.

**Crystallization:** Mier's theory, its limitations, crystal growth, nucleation, caking of crystals, material and energy balances in crystallization, construction, operation and application of batch crystallizer, agitated tank crystallizer, krystal crystallizer and vacuum crystallizer.

### UNIT – V

**Centrifugation:** Theory, Classification of centrifuges, Principle, Construction and Working of the Centrifuges Viz., Perforated basket centrifuge, Horizontal continuous centrifuge, super centrifuge, and Conical disc centrifuge.

**Filtration:** Theory of filtration, filter media, construction and operation of filter press, metafilter, disc filter, rotary vacuum filter. Filtration of air- Mechanism and equipment.

**Extraction:** Theory of extraction, equipment, Podbielniak extractor, counter current extraction, leaching of solids.

### **2.1.P.2. PHARMACEUTICAL ENGINEERING**

(Practicals) [6Hrs/week]

1. Determination of Reynold's number for a liquid flowing through a pipe.
2. Determination of Humidity - i. Dew point method  
ii. Psychrometric method
3. Ball mill / Effect of Ball charge (or) Effect of time of operation on size reduction.
4. Sieve analysis of given sample of granular powder.
5. Determination of Radiation constant for Iron.
6. Determination of Radiation constant for Brass
7. Determination of Radiation constant for Unpainted glass
8. Steam distillation
9. Identification of Azeotropic and Zeotropic mixture
10. Drying rate curve
11. Effect of Filter aid on rate of filtration
12. Factors effecting rate of filtration (pressure, slurry concentration, cake thickness)
13. Study of crystallization process
14. Verification of Stoke's law
15. Comparison of Extraction efficiencies of single and multiple stage extractions
16. Effect of nature of liquid on rate of evaporation.
17. Fluidised bed drier (demonstration)
18. Filter Press (demonstration)

### **2.1.T.3. PHARMACEUTICAL ORGANIC CHEMISTRY – II**

(Theory) [3 Hrs/Week]

#### **UNIT - I**

**Carbohydrates:** Definition, Classification, Nomenclature, Relative Configuration of some important monosaccharides, Study of glucose/fructose structure , open chain structure of glucose, fructose, ribose, deoxy ribose, reactions of glucose/fructose, Oxidation-reduction reactions, Action of Barium hydroxide, Osazone formation, acetylations, Epimerization, , Lobry de Bruyn – van Ekenstein reaction, stereoisomerisims of glucose:nomenclature of aldose derivatives. Lengthening carbon chain of aldose, ruffdegradation, epimers: conversion of an aldose into its epimers: D and L configuraton:cyclic and ring structure of D(+) Glucose, Mutarotation, anomers and formation of glucosides/fructosides ( structure elucidation excluded)

#### **Unit-II**

Structure of the disaccharides: sucrose and lactose, Glycosidic linkage, Non-reducing nature of sucrose, A brief account of starch and cellulose. A brief account on pharmaceutical importance of carbohydrates: starch, cellulose and derivatives, Glucose, lactose , sucrose, sorbitol, mannitol

**Glycosides:** Definition, and  $\alpha$ ,  $\beta$  – glycosidic linkages, chemical and Enzymatic hydrolysis, examples of c-glycosides, N-glycosides, S –glycosides, O –glycosides, ester glycosides and uses glycosides (physiological/ pharmaceutical importance.)

### UNIT - III

**Amino acids:** Definition, Classification, Essential amino acids, configuration, Three important methods of preparation of amino acids, physical properties. Zwitter ionic nature, isoelectric point, peptide synthesis and important reactions of amino acids.

### Unit -IV

**Polypeptides and proteins:** Definition, Classification of proteins, Denaturation of proteins, Isoelectric point, C-terminal and N-terminal concept end group analysis peptide synthesis, Brief account of primary, secondary and tertiary structure. A brief account of the Pharmaceutical importance of amino acids, polypeptides and proteins.

### UNIT - V

**Stereochemistry of Carbon compounds (with only one Chiral centre):** Optical rotation, plane polarized light, optical activity, chirality, Notations (Assignment of Configuration), Relative Configuration (Fischer D, L configuration), Absolute configuration, Sequence rules (with examples), Enantiomers, Meso Compounds, Racemic Mixture.

**Stereochemistry of Alkenes** – cis-trans isomerism, Concept of E & Z configurations. Importance of stereochemistry in biological activity/drug action

## 2.1 T.4.HUMAN ANATOMY AND PHYSIOLOGY-I (Theory: 3hrs/week)

### UNIT – I

An introduction to human body, the tissue level organization of human body, Fundamentals of anatomy of different systems of human body – Skeletal system, Nervous system, Muscular system, Joints.

### UNIT- II

**Control system of the human body:** The special senses-sense of smell and taste, vision, hearing and equilibrium, skin, Disorders of vision and hearing

### UNIT-III

**Haemopoietic system:** Composition, functions and properties of blood, formation of blood cells-RBC, WBC and platelets, blood clotting mechanism ,factors effecting blood clottong,disorders of platelets and coagulation, blood groups and their significance

**Lymphatic system:** structure and functions of lymphatic system-lymph vessels and lymph circulation, lymph organs and tissue-thymus, lymph nodes, spleen, lymph nodules, disorders of lymph and lymphatic system

#### **UNIT-IV**

**Respiratory system:** Anatomy of respiratory system, mechanism and regulation of respiration-exchange and transport of oxygen and carbon di oxide, control of respiration; lung volumes and capacities, respiratory disorders

#### **UNIT-V**

**Digestive system:** Anatomy and functions of GIT-peritoneum, mouth, pharynx, esophagus, stomach, pancreas, liver&gall bladder, small intestine and large intestine, Mechanical ,chemical digestion and absorption of food in small intestine and large intestine, nerves innervation of GIT,different types of GI motility. Knowledge on emesis, pyloric stenosis, peptic&duodenalulcers, dispepsis, constipation, diarrhea, piles, jaundice, cirrhosis.

### **2.1.T.5 PHARMACEUTICAL MICROBIOLOGY AND IMMUNOLOGY - I**

(Theory) 3 hrs/ week]

#### **UNIT – I**

Scope and Introduction to Pharmaceutical Microbiology.

Study of morphology, broad classification of bacteria, yeasts, actinomycetes, protozoa, fungi and viruses.

Identification of Bacteria, theory of staining, simple, Gram`s, acid fast, negative, flagella and spore staining methods.

#### **UNIT - II**

Culture media, different types, Preparation, Media for bacterial, fungal & actinomycetes cultures.

Culture methods – aerobic and anaerobic cultures.

Pure culture, Different methods of isolating pure cultures, methods of preservation of microbial cultures.

### **UNIT - III**

Study of bacterial growth. Effect of UV light, ultrasonic waves, temperature, pH, osmotic pressure, salt concentration and metal ions. An outline of theories of antimicrobial action of drugs and chemicals.

Dynamics of disinfection, merits and demerits of different disinfectants, commonly used disinfectants, their mechanism of action. Evaluation of disinfectants.

### **UNIT - IV**

Study of sterilization by moist and dry heat, construction and operation of autoclave, sterilization by filtration, sterilization by radiation and gases. Sterilization monitors.

Concept of asepsis. Maintenance of aseptic conditions.

### **UNIT - V**

Introduction to microbiology of air, water and milk. Methods of quantitative evaluation of microbial contamination.

Microbial limit tests official in I.P.

### ***2.1. P.3. PHARMACEUTICAL MICROBIOLOGY AND IMMUNOLOGY-I***

(Practicals) [6 Hrs/Week;]

- 1) Introduction to equipment and Glassware used in Microbiology Laboratory.
- 2) Simple Staining
- 3) Gram Staining
- 4) Negative Staining
- 5) Acid fast Staining
- 6) Aseptic Transfer
- 7) Enumeration of Bacteria by Pour Plate Technique.
- 8) Enumeration of Bacteria by Direct Microscopic Count
- 9) Isolation of pure Cultures by Streak Plate Method
- 10) Oligodynamic Action of Heavy Metals
- 11) Observation of Colony Characteristics
- 12) Microbiology of Air-Settling Plate Technique
- 13) Microbiology of Water – Presumptive, Confirmed & Completed tests
- 14) Biochemical Reactions:
  - i) Indole test
  - ii) Methyl Red Test
  - iii) Voges Proskauer Test
  - iv) Citrate Utilization Test

- v) Starch Hydrolysis Test
  - vi) Gelatin Liquefaction Test
  - vii) Fermentation of Carbohydrates
  - viii) H<sub>2</sub>S Production Test
- 15) Morphology of Molds  
 16) Morphology of Yeasts  
 17) Microbial Limit Tests – Viable Count  
 18) Microbial Limit Tests for *E. coli*, *Proteus*, *Pseudomonas*, etc.  
 Minimum no of experiments to be performed: At least 5 bio chemical tests, at least 14 other experiments.  
 Scheme for practical examinations- 3 experiments + spotting (minimum 5 )

## B.PHARM II YEAR

### 2.2. Semester

#### THEORY PAPERS:

S.No	Subjects	Hours/Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	Pharm. Org. Chemistry-III	4	20	80	100	3
2	Human Anatomy & Physiology-II	4	20	80	100	3
3	Pharm. Microbiology & Immunology-II	4	20	80	100	3
4	Environmental sciences	4	20	80	100	3
5	PHARMACY MANAGEMENT	4	20	80	100	3
6.	tutorials	4				
	Total	24	100	400	500	

#### PRATICAL PAPERS:

S.No	Subjects	Hours/Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	Pharm. Org. Chemistry-II	6	20	80	100	4
2	Human Anatomy & Physiology	6	20	80	100	4
	Total	12	40	160	200	

@ Two sessional exams will be conducted and their average will be taken

## 2.2.T.1. PHARMACEUTICAL ORGANIC CHEMISTRY – III

(Theory) [4 Hrs/Week]

### Unit-I

**Lipids (oils and fats):** Definition, fatty acids, characterization of lipids (Saponification value, Acid value and Iodine value), Hydrogenation and Rancidity of oils and fats.

### Unit-II

**A study of the mechanism and application in synthesis of the following named reactions:**

- A. Beckmann rearrangement
- B. Fries rearrangement
- C. Phillips condensation reaction
- D. Mannich reaction
- E. Michael addition reaction

### Unit-III

Study of some reagents: Preparation and some synthetic applications of

- A) n-Bromo succinamide
- B) diazomethane
- C)  $\text{LiAlH}_4$
- D)  $\text{NaBH}_4$
- E) Aluminium isopropoxide and potassium tertiary butoxide
- F) Wittig reagent
- G) DCC reagent (NN Diacyclohexyl carbodiimide)

### Unit-IV

**A Study of Some Simple Heterocyclic Systems containing one heteroatom:**

**Five membered with one hetero atom:** Furan, Pyrrole, Thiophene and Pyridine. Structure, source, electrophilic substitution, reactivity and orientation, reduction

**six membered ring systems with one hetero atoms:**, Pyridine, Structure, source, electrophilic and nucleophilic substitution, basicity, reduction

### Unit-V

Definition, Nomenclature, Structure, aromaticity, reactivity, acidity, basicity and characteristic reactions of some fused ring systems: Indole, benzimidazole, benzothiazole, quinoline, isoquinoline and phenothiazine

Structures names and numbering of the following compounds: pyrazole, imidazole, oxazole, isoxazole, thiazole, pyridazine, pyrimidine, pyrazine, indole, benzimidazole, benzothiazole, triazole, tetrazole

Structure of some drugs or compounds with biological activity containing these ring systems

## 2.2. P. 1. PHARMACEUTICAL ORGANIC CHEMISTRY-II

(Practicals) [6hrs/week]

### I. Synthesis of some simple Heterocyclic Compounds.

- i) 2,5-Dimethylpyrrole from Acetylacetone.
- ii) 2,5-Dimethylthiophene from Acetylacetone.
- iii) 2,5-Dimethylfuran from Acetylacetone.
- iv) 3,5-Dimethylpyrazole from Acetylacetone.
- v) 3,5-Dimethylisoxazole from Acetylacetone.
- vi) 4,5-Diphenylimidazole from Benzil.
- vii) Benzoxazole from o-Aminophenol.
- viii) 2,5-Dioxopiperazine from Glycine.
- ix) Oxazolone from Benzoylglycine.

### II. Molecular Rearrangements and Named Reactions

- a) Mannich Base from Acetophenone (Mannich Reaction).
- b) Benzimidazole from o-phenylene diamine (Phillip's Reaction).
- c) O-hydroxyacetophenone from phenyl acetate (Fries migration)
- d) Benzanilide from benzophenone oxime (Beckmann's rearrangement)  
(to be avoided from examination)

### III. Systematic Analysis of Organic Binary Mixtures

- a) Avoid the water-soluble compounds
- b) Avoid the binary mixtures having a risk of chemical interaction.

### IV. Analysis of Oils & Fats

- a) Determination of Acid value of fixed oils.
- b) Determination of Saponification value of a fixed oil.
- c) Determination of Iodine value of a fixed oil.
- d) Determination of Acetyl value of a fixed oil.

## **2.2.T.2 PHARMACEUTICAL MICROBIOLOGY AND IMMUNOLOGY -II**

(Theory) [4 hrs/week]

### **UNIT - I**

Genetic recombination- bacterial conjugation, transformation and transduction. Mutation, Mutagens, Mechanism of mutation, types of mutations, isolation of nutritional and antibiotic resistant mutants. Ames test for mutagenicity testing.

### **UNIT - II**

Infection, classification of Infectious diseases, methods of transmission of communicable and infectious diseases, carriers, vectors and reservoirs.

Principles of Immunology, Immunity, Classification of Immunity, Natural and Acquired Immunity.

Non specific defenses of host Complement system, phagocytosis, Inflammatory response, Interferons, Natural Killer Cells.

### **UNIT - III**

Specific defenses of host Immune system, anatomy and development, Immune response, Cells involved in Immune response, Antigens, Sources, Antibody, structure and function, Classification of Antibodies, Humoral Immunity, Recognition of bacterial components, Role of Antibody and Complement, Antibody diversity.

Cell Mediated Immunity, types and functions of T- Cells.

Hypersensitivity – types,

### **UNIT - IV**

Immunity to Viruses: T- cell recognition of viral antigen role of interferon's, Viral defense mechanisms against host.

General methods of immunization against diseases.

Fundamentals of serology, the lattice theory, neutralization, agglutination, precipitation, opsonization and complement fixation.

### **UNIT - V**

Study of etiology, diagnosis, sources of infection, mode of transmission, immunization methods, prevention and control of the following diseases:

Bacillary dysentery, diphtheria, tuberculosis, leprosy, cholera, typhoid, syphilis, gonorrhoea, tetanus, food poisoning, amoebiasis, infective hepatitis. AIDS (HIV).

### **II.2.2.T.3 ENVIRONMENTAL SCIENCES**

(Theory) [2hrs/week]

#### **UNIT-I**

##### **The Multidisciplinary nature of environmental studies:**

##### **Definition, scope and importance.**

##### **Natural Resources:**

- a) *Forest resources:* Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
- b) *Water resources:* Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
- c) *Mineral resources:* Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
- d) *Food resources:* World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies
- e) *Energy resources:* Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources, case studies.  
*Land resources:* Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources.

Equitable use of resources for sustainable lifestyles.

#### **UNIT-II**

##### **Ecosystems**

Concept of an ecosystem. Structure and function of an ecosystem. Producers, Consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem:

- a) Forest ecosystem
- b) Grassland ecosystem,
- c) Desert ecosystem,
- d) Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

#### **UNIT-III**

##### **Biodiversity and its conservation**

Introduction- Definition: genetic, species and ecosystem diversity.

Biogeographically, classification of India. Value of biodiversity: consumptive use, productive use, and social, ethical, aesthetic and option values, Biodiversity at global, National and local levels. India as a mega-diversity nation. Hot spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ conservation of biodiversity

## **UNIT-IV**

### **Environmental Pollution**

Definition, causes, effects and control measures of:

- a) Air pollution, b) Water pollution, c) Soil pollution, d) Marine pollution, e) Noise pollution, f) Thermal pollution and g) Nuclear hazards solid waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies. Disaster management: floods, earthquake, cyclone and landslides.

## **UNIT-V**

### **Social Issues and the Environment**

From unsustainable to sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management Resettlement and rehabilitation of people; its problems and concerns. Case studies. Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear Accidents and holocaust.

*Case studies:* Wasteland reclamation. Consumerism and waste products. Environment protection Act. Air (prevention and Control of pollution) Act. Water (prevention and control of pollution) Act, Wildlife protection Act, and Forest conservation Act, Issues involved in enforcement of environmental legislation. Public awareness.

Human population and the Environment

Population growth, variation among nations. Population explosion – Family welfare programme. Environment and human health, Human Rights. Value Education. HIV / AIDS Women and child welfare, Role of Information, Technology in Environment and human health. Case studies.

## 2.2 T.4.HUMAN ANATOMY AND PHYSIOLOGY-II (Theory: 4hrs/week)

### UNIT-I

**Central nervous system:** Classification of nerves, their origin, innervation, transmission and functions – spinal nerves and cranial nerves, electrical signals in neurons, signal transmission at synapses, introduction to neurotransmitters, physiology of different parts of brain and spinal cord

### Unit-II

**Autonomous nervous system:** ANS neurotransmitters, physiological effects of ANS neurotransmitters, autonomic reflexes

### Unit-III

**Cardio vascular system:** Anatomy of heart, heart valves and circulation of blood, cardiac muscle tissue and cardiac conduction system, cardiac cycle, cardiac output, disorders of cardiac rhythm.

Knowledge on hypertension, myocardial ischemia and infarction and congestive heart failure.

Structure and functions of blood vessels, capillary exchange, factors effecting blood flow, control of B.P and blood flow.

### UNIT-IV

**Endocrine system:** Principles of hormone activity and mechanism of hormone action control of hormone secretion, hypothalamus&pitutory gland, thyroid gland, parathyroid gland, adrenal gland, pancreatic islets.

Hormonal regulation of metabolism, growth development, testicular fuction, ovary, fertilization, pregnenecy and lactation.

### UNIT – V

**Body fluids and renal function:** Anatomy of kidneys, nephron and their functions.

Fluid compartments and fluid balance, electrolyte in body fluid and their balance.

Acid-base balance.

## II. 2.2.P.2. HUMAN ANATOMY ANDPHYSIOLOGY

(Practicals) [6Hrs/week]

- 1) Introduction to instruments used in physiology lab.
- 2) Study of compound microscope.
- 3) Study of different tissues.
- 4) Determination of blood groups.
- 5) Determination of Bleeding time and clotting time.
- 6) Estimation of Hemoglobin
- 7) Determination ESR
- 8) Estimation of RBC
- 9) Estimation of WBC
- 10) Determination of Differential Count
- 11) Recording of normal HR and Effect of Exercise on HR
- 12) Recording of BP and Effect of Exercise on BP
- 13) Recording of Vital capacity
- 14) Study of Reflexes (Knee Jerk and Light Reflexes)
- 15) Recording of Strength of Stimulus
- 16) Recording of Simple Muscle Curve
- 17) Recording of Beneficial Effect
- 18) Recording of Effect of Fatigue
- 19) Recording of Normal Cardiogram of Frog Heart
- 20) Recording of Effect f Temperature on Heart
- 21) Recording the Effect of Drugs on Heart.

## II.2.2.T.5. PHARMACY MANAGEMENT

(Theory) [4hrs/Week]

### UNIT –I

#### **Pharmaceutical Industrial administration:**

Principles of Pharmaceutical Industrial Management in relation to the Introduction to forms of Business Organization.

Manufacturing Management: Plant location, factory building lay-out, production management goals and organization, operating problems, production policy, initiation of production, purchasing and inventory control, works lay-out and plant management.

### UNIT -II

**Workman Safety:** measures to health hazards and prevention of environmental pollution.

**Organization of Distribution and Marketing:** Factors in distributions, Sales organization and sales promotions. General principles of medical detailing. Export and Import trade. GATT,WTO- New product development.

### **UNIT -III**

#### **Indian pharmaceutical industry:**

Pharmaceutical industry in India, milestones in the development of pharmaceutical industry, current status and its role in national economy and national health.

Structure of the industry, organized sector, small sector, manufacture of pharmaceuticals in public sector.

Progress in the manufacture of basic drugs – synthetic and drugs of vegetable origin.

### **UNIT -IV**

Export and import of drugs and pharmaceuticals –knowledge of PHRMEXIL.

Various types of insurances including marine insurance.

Pharmaceutical associations and societies, statutory councils governing the profession.

#### **Principle of Drug store and community pharmacy administration:**

Drug store management: Drug store planning and lay – out, sales promotion and salesmanship in drug store. Accounting records in drug stores.

### **UNIT -V**

**Elements of industrial accounting accountancy:** Elements of double entry, books of accounts, journal, ledger and cashbook. The balance sheet, profit and loss account. Principles of costing and estimating.

### B.PHARM III YEAR

#### 3.1. Semester

##### THEORY PAPERS:

S.No	Subjects	Hours/ Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	PHARMACEUTICAL INSTRUMENTAL ANALYSIS	6	20	80	100	3
2	PHYSICAL PHARMACY	6	20	80	100	3
3	COSMETIC TECHNOLOGY	4	20	80	100	3
4	Tutorials	2				
		18	100	400	500	

##### PRATICAL PAPERS:

S.No	Subjects	Hours/ Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	PHARMACEUTICAL INSTRUMENTAL ANALYSIS	6	20	80	100	4
2	PHYSICAL PHARMACY	6	20	80	100	4
3	COSMETIC TECHNOLOGY	6	20	80	100	4
	Total	18	60	240	300	

### **3.1. Semester B.PHARM – THIRD YEAR**

#### **3.1. T.1. PHARMACEUTICAL INSTRUMENTAL ANALYSIS**

(Theory) [6 hrs/week]

##### **UNIT-I**

A Detailed account of the theory, instrumentation and pharmaceutical applications of:

Visible, UV & I.R. Spectrophotometry

##### **UNIT-II**

A Detailed account of the theory, instrumentation and pharmaceutical applications of:

Fluorimetry  
Flame photometry  
Refractometry  
Polarimetry and Spectropolarimetry

##### **UNIT-III**

A brief account of the theory, instrumentation and applications of the following techniques:

1. Nephelometry & turbidometry
2. Potentiometry & pH metry (include specific ion electrons)
3. Conductometry
4. Polarography

##### **UNIT-IV**

A brief account of the theory, instrumentation and applications of the following techniques:

5. Differential thermal analysis
6. Paper, thin layer and column chromatographies, GC & HPLC
7. Electrophoresis
8. RIA & ELISA

## UNIT-V

Analysis of the following drugs/compounds by different techniques:

### Vitamins:

Vitamin A – Colorimetric methods (Carr-Price method and glycerol-1,3-dichlorohydrin method).

Vitamin B1 – Thiochrome flurometric method and silicotungstic acid – gravimetric methods.

Vitamin B2 – Fluorimetric method, colorimetric and polarographic methods.

Vitamin B6 – Colorimetric and spectrophotometric methods.

Vitamin B12 – Spectrophotometric and counter current distribution methods.

Vitamin D – Colorimetric (antimony trichloride) method.

### Antibiotics:

Pencillins – Colorimetric (hydroxamic acid) method and U.V. methods.

Streptomycin – Fluorimetric and polarographic methods.

Tetracyclines – Spectrophotometric and fluorimetric methods.

Erythromycin – I.R. method.

### Steroids:

Progesterone – Colorimetric (2,4 DNP) method.

Estrogens – UV, IR and polarographic methods.

### Alkaloids:

Quinine – Fluorimetric and nephelometric methods.

Codeine – I.R. method.

Reserpine – Paper chromatographic method.

Ergometrine – Column chromatographic method.

### Synthetic drugs:

Sulpha drugs – Colorimetric and polarographic methods.

Barbiturates – Spectrophotometric and paper chromatographic methods.

Xanthines – Theophylline – Spectrophotometric and gravimetric methods.

Aspirin and its combinations – Spectrophotometric and I.R. methods.

### 3.1.P.1. PHARMACEUTICAL INSTRUMENTAL ANALYSIS

(Practical) [36hrs/week]

#### Practical experiments

1. Ascending paper chromatography.
2. Radial paper chromatography.
3. Thin layer chromatography.
4. Column chromatography \* (demonstration only).
5. Conductometric titration.
6. Potentiometric titration.
7. Determination of  $\lambda$ - max of a drug\*
8. Determination of concentration of glycerine by Abbe's refractometer.
9. Assay of ibuprofen - UV-spectro photometry.
10. Assay of paracetamol - UV-spectro photometry.
11. Assay of riboflavin - Colorimetric method.
12. Assay of rifampicin - Colorimetric method.
13. Flame photometric determination of sodium.
14. Nephelometric determination of sulfate.
15. Fluorimetric estimation of quinine.
16. Paper electrophoresis of amino acids.
17. Gel electrophoresis\* (demonstration only).
18. HPLC\* (demonstration only).
19. PAGE\* (demonstration only).
20. Kinematic viscosity\*.
21. IR- Analysis\* - related problems (demonstration only).

Note. \*Not for examinations

### 3.1. T.2. PHYSICAL PHARMACY

(Theory)[6hrs/week]

#### UNIT – I

**Buffers and Isotonic Solutions:** Buffer equation, buffer capacity, buffers in pharmacy and biological systems, buffered isotonic solutions and methods of adjusting tonicity and pH.

**Solubility:** Solutions of solids/liquids, rate of solution. Energetics of solubility concept. Factors influencing solubility of solids/liquids, liquids/liquids and gases/liquids. Mechanism of solute-solvent interactions. Distribution phenomena, True and apparent distribution and application.

#### UNIT – II

**Interfacial Phenomena:** Concept of adhesive and cohesive forces, and their influence on surface and interfacial tensions. Spreading coefficient and its applications. Adsorption isotherms: Mathematical concept of adsorption at solid/gas, solid/liquid and liquid/liquid interfaces. Biological and pharmaceutical applications of adsorption phenomenon. Electrokinetics of interfaces, knowledge of HLB scales to aid the dispersion stabilization. Methods to determine HLB & CMC and their applications in Pharmacy.

#### UNIT – III

**Colloids:** Study of their optical, kinetic and electrical properties by giving special emphasis of their applications towards pharmaceutical product formulation. Stability of colloids: Electro kinetic stabilization, sensitization, protection and solubilization mechanisms.

**Suspensions:** Basic concept of particle-particle interactions, sedimentation of suspension, derived sedimentation parameters. Control of suspension stability through zeta-potential and structured vehicles.

**Emulsions:** Concept of free energy of surfaces and its effects on emulsion stability. Theories of emulsification and emulsion stability, concept of critical HLB. Mechanisms of emulsion stability. Factors influencing emulsion stability. Non-aqueous emulsions and micro-emulsions and their formation mechanisms.

#### UNIT – IV

**Rheology:** Hagen-Poiseulli's equation, Newtonian and non-Newtonian systems, Mathematical concept of viscosity coefficient. Factors influencing viscosity and measurement of viscosity. Thixotropy and its applicants. Factors influencing viscosity and measurement of viscosity. Thixotropy and its application towards formulation design of pharmaceutical systems.

**Micromeritics:** Particle size measurement. Statistical approach towards the particle size measurement in heterogenous pharmaceutical systems. Porosity, density and packing arrangements of particles. Flow properties of powders and their effect on solid dosage form processing.

## UNIT – V

**Chemical kinetics :** Introduction to the concept of kinetics and their application towards Pharmacy. Mathematical concept of zero order, first order and pseudo first order reactions. Determination of reaction order. Half-life, period 90% and their usefulness. Influence of temperature on reaction rate, Arrhenius theory. Accelerated stability testing of drug compounds and determination of shelf life period.

**Complexation and protein binding:** Classification of complexes, mechanism of complex formation, advantages of complexations, stoichiometry of complexations, detection methods and protein binding.

### 3.1. P.2. PHYSICAL PHARMACY

(Practicals)[6hrs/Week]

#### Minimum 15 experiments to be completed

1. Determination of bulk density, true density and percentage porosity.
2. Effect of particle size and effect of glidant on angle of repose.
3. Microscopic size analysis.
4. Phase diagram - Phenol – Water, Effect of Impurities.
5. Ternary phase diagram.
6. Cloud point – nonionic surfactant-water system.
7. Surface and Interfacial tension using Stalagmometer.
8. Viscosity – by Ostwald Viscomete.
9. Determination of CMC of a surfactant.
10. Adsorption Isotherm.
11. Partition coefficient – Effect of Additives.
12. Determination of sedimentation volume and degree of flocculation.
13. Determination of Order of reaction – First order.
14. Second order Reaction.
15. Determination of Spreading Coefficient.
16. Buffers (Preparation and testing buffer capacity).
17. Effect of co-solvent on solubility.
18. Effect of temperature on solubility of solid in liquid.
19. Preparation of Multiple emulsion - Demonstration.
20. Preparation of Micro emulsion - Demonstration.
21. Determination of Zeta potential - Demonstration.

### **3.1. T.3. COSMETIC TECHNOLOGY**

(Theory) [4Hrs/Week]

#### UNIT – I

**Introduction:** Definition of cosmetic. Basic knowledge of the skin, classification of cosmetics.

**General aspects of cosmetic preparations:** Coloring agents in cosmetics, preservatives, antioxidants and perfumes used in cosmetics.

#### UNIT – II

Ideal requirement, raw materials, formulation, manufacture and evaluation of following classes of cosmetic products.

**Preparations for the face:** Foundation and moisturizing creams, cleansing creams, face powders, lipsticks, sunscreen products.

#### UNIT – III

**Preparation for hands:** Hand creams and lotions, nail lacquers and nail polish removers.

**Body cosmetics:** Deodorants and antiperspirants, talcum and dusting powders, and bleaching preparations.

#### UNIT – IV

**Preparations for the hair:** Shampoos, hair creams, hair tonics, hair dyes and depilatories (hair removers).

**Dental Preparations:** Tooth powders and pastes, mouth washes.

#### UNIT – V

**Shaving preparations:** Pre-shave and after shave lotions shaving creams and shaving soaps.

**Baby specialities:** Baby powder, baby oils and lotions.

### **3.1. P.3. COSMETIC TECHNOLOGY**

(Practical) [6Hrs/Week]

Preparations of following cosmetic Products and their Possible evaluation.

#### **The Preparations of the following are compulsory:**

- |                                    |                              |
|------------------------------------|------------------------------|
| 1. Vanishing / Foundation Cream    | 2. Cold Cream                |
| 3. Moisturizing Cream              | 4. Hand Cream                |
| 5. Talcum Powder                   | 6. Face Powder               |
| 7. Lotion Shampoo                  | 8. Antidandruff shampoo      |
| 9. Hair Cream                      | 10. Depilatory Paste / Cream |
| 11. Tooth Paste                    | 12. Tooth Powder             |
| 13. Mouth Wash / Liquid dentifrice | 14. Nail Lacquer Remover     |
| 15. Baby Powder                    | 16. Lather Shaving Cream     |
| 17. After Shave Lotion             | 18. Antiperspirant Lotion    |

#### **The Preparation of the following cosmetic products are optional**

- |                        |                                  |
|------------------------|----------------------------------|
| 1. Barrier Cream       | 2. Hair dye (Metallic/Vegetable) |
| 3. Deodorant Powder    | 4. Baby Lotion                   |
| 5. Makeup Powder       | 6. Brush less Shaving Cream      |
| 7. Coconut Oil Shampoo | 8. Conditioner Shampoo           |
| 9. After Shave Powder  |                                  |

#### **Demonstration of preparation of the following products**

- |                   |             |
|-------------------|-------------|
| 1. Nail Lacquer   | 2. Lipstick |
| 3. Depilatory Wax | 4. Styptic  |

### 3.2. Semester B.PHARM III YEAR

#### THEORY PAPERS:

S.No	Subjects	Hours/ Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	MEDICINAL CHEMISTRY – I (Natural Products)	5	20	80	100	3
2	PHARMACOGNOSY – I	5	20	80	100	3
3	PHARMACOLOGY – I	4	20	80	100	3
4.	Pharmaceutical Jurisprudence	4	20	80	100	3
		18	100	400	500	

#### PRATICAL PAPERS:

S.No	Subjects	Hours/ Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	MEDICINAL CHEMISTRY – I (Natural Products)	6	20	80	100	4
2	PHARMACOGNOSY – I	6	20	80	100	4
3	Pharmacology -I	6	20	80	100	4
	Total	18	60	240	300	

### 3.2. T.1. MEDICINAL CHEMISTRY – I

(Natural Products)  
(Theory) [5Hrs/week]

#### UNIT – I

**Antibiotics:** Brief historical background, definition, requirements for a substance to be considered as an antibiotic and classification of antibiotics.

**Penicillins:** Historical background and biological sources. Structures of different penicillins.

**Nomenclature:** Numbering and naming according to the CA and USP systems, as derivatives of penam, penicillanic acid and as penicillins (trivial system).

**Reactions:** Hydrolysis of penicillin by cold and hot dilute mineral acid, alkali, enzymatic hydrolysis with Penicillinase, amidase and methanolysis followed by aqueous mercuric chloride.

Based on the route of administration- **Classification:** Oral and parenteral, based on spectrum of activity and resistance to  $\beta$ -lactamase, as natural, biosynthetic and semi-synthetic.

General method of synthesis of penicillins from 6-APA, SAR, mechanism of action, therapeutic uses, toxicity. A note on  $\beta$ -lactamase inhibitors.

**Cephalosporins:** Historical background and biological sources. Structures of some important Cephalosporins and Cephameycins. Acid hydrolysis of Cephalosporin C. Comparison of 6-APA and 7-ACA, penam and cepham.

**Classification:** Generations of cephalosporins Oral and parenteral, SAR and Advantages over penicillins, therapeutic uses and toxicity.

**Tetracyclins:** Biological sources, structures of the important tetracyclines, important structural units and the three acidity constants in the tetracycline

molecule, Amphoteric nature, epimerisation, chelation with metals, mechanism of action, spectrum of activity, SAR, therapeutic uses and toxicity.

**Aminoglycosides:** Structure of streptomycin, acid hydrolysis, mechanism of action, therapeutic uses and toxicity. Dihydrostreptomycin and its importance. A mention of other aminoglycoside antibiotics.

A brief account of **chloramphenicol**, **macrolide** and **polypeptide** antibiotics and **Rifampicin** (Structures not included).

## UNIT – II

**Vitamins:** Introduction and Classification.

Fat-soluble vitamins: Vitamins A<sub>1</sub> and A<sub>2</sub> – Structures, Physiological role and uses, Tretinoin (Retinoic acid), Isotretinoin.

Vit D – Structures – Physiological role and uses, preparation of ergocalciferol from ergosterol, and cholecalciferol from 7-dehydrocholesterol.

Vit E – Structures of  $\alpha$ ,  $\beta$  and  $\gamma$  - tocopherols – Physiological role and uses.

Vitamin Ks – Vit K<sub>1</sub>, K<sub>2</sub>, K<sub>3</sub> and K<sub>4</sub> – Structures – Physiological role and uses.

Water soluble vitamins: Structures, physiological role and uses of Vit B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, B<sub>12</sub>, Nicotinic acid and amide, Cyanocobalamin, folic acid and Ascorbic acid.

Some important reactions of water soluble vitamins like: The oxidation of thiamine to thiochrome, the oxidation of nicotine to nicotinic acid, the amidation of nicotinic acid to nicotinamide, the degradation of riboflavine to lumiflavine and lumichrome, the reduction of folic acid to dihydro and tetrahydro folic acids in the biological system, the oxidation of Ascorbic acid to dehydroascorbic acid and related compounds

## UNIT – III

**Steroids:**

Introduction: Brief history of development of steroid industry. Sources of steroidal drugs – diosgenin, cholesterol, stigmasterol and ergosterol – their structures. Marker's synthesis of progesterone. Nomenclature of steroids, stereochemistry and numbering the ring system. Colour reactions of steroids. Selenium distillation of steroids.

Steroidal Anti-Inflammatory drugs: Classification, structures, SAR, uses & toxicity.

Cardiac glycosides: structures of glycosides from Digitalis, Strophanthus, Squill and Bufo. Enzymatic and acid hydrolytic reactions of the glycosides. Mechanism of action, SAR, therapeutic uses and toxicity.

Bile acids: Names, structures and functions.

Hormones:

Sex Hormones: Male and female sex hormones.

Estrogens – estradiol, estrone, estriol. Structures and their interconversion.

Structures of synthetic estrogens. Therapeutic uses and side effects.

Progesterone and selected progestins – structures, uses and side-effects. Preparation of progesterone from diosgenin. A note on Steroid contraceptive agents and regimens.

Androgens – Testosterone and derivatives. Structure and biological activities & uses

Adrenal Cortex Hormones:

Mineralocorticoids: Aldosterone, Deoxycorticosterone, Fludrocortisone – structures, biological activity and uses. Aldosterone antagonist Spiranolactone.

Glucocorticoids: Cortisone & Hydrocortisone – Structure, biological actions, uses.

Hormones of Pancreas:

Insulin – introduction, structural features – some sequence differences in insulins of some species like humans, pork, beef. Metabolic effects of insulin. A note on insulin preparations. Glucagon – Structure and Physiological role.

Hormones of Thyroid: Thyroxine and triiodothyronine – structure and functions.

#### UNIT – IV

Alkaloids:

Definition of alkaloids, pseudoalkaloids and protoalkaloids. General methods of extraction and isolation. Properties of alkaloids. Tests for alkaloids.

Opium alkaloids: Structural features of Morphine molecule – Peripheral groups. Modification of structure and effect on analgesic activity – SAR of morphine and morphine-like analgesics. Narcotic antagonists: Nalorphine, Levallorphan, nalaxone, nalthribose. Anti-tussive agents: Dextromethorphan. Smooth muscle relaxants: Papaverine and related compounds like ethaverine, Dioxyline. Structures and uses of these compounds.

Tropane alkaloids: Structures of Atropine/hyoscyamine, Hyoscine, Hydrolytic products of these – Tropine and Scopine. Relationship between tropine & pseudotropine. Biological actions and uses of tropane alkaloids. Homatropine.

Rauwolfia alkaloids: Structures and uses of Reserpine, Rescinnamine,. Hydrolysis of reserpine and rescinnamine. Mechanism of action of reserpine.

Ergot alkaloids: Classification, structures, hydrolytic products, pharmacological actions, therapeutic uses and toxicity. Synthetic derivatives: Methylergonovine (Methylergometrine), L S D, Methysergide.

## UNIT – V

Terpenoids:

Volatile oils: Definition of terpenoids, Classification, isoprene, special isoprene and gem-dialkyl rules.

Citrals: Sources and structures, isomerism in citral, citral-a (Geranial), citral-b (Neral). Reduction of citral to citronellal, citronellol, geraniol and nerol. Oxidation of citral to geranic acid. Cyclodehydration of citral to p-cymene. Conversion of citrals – a and b into alfa-terpeneol and ionones.

Alfa – Terpeniol: Sources and structure. Conversion into p-cymene, 1,8 – terpin, terpinolene, dipentene, dipentene dihydrochloride. Preparation of alfa-terpeneol from limonene/dipentene, 1,8-Terpin and pinene.

Carvone: Sources and structure. Conversion into Carvacrol. Reduction of Carvone with different reagents. Synthesis from Limonene/Dipentene and alfa – Terpeneol.

Menthol and menthone: Sources, structures and uses. Oxidation of menthol to menthone. Conversion of menthol into thymol.

1,8-cineole: Sources and structure. Preparation from Cis-terpin. Mention of 1,4-cineole.

Camphor: Source, properties, commercial method of preparation from  $\alpha$ -pinene and uses. Oxidation to camphoric acid and camphoronic acids, conversion into p-cymene. Reduction of camphor to Borneol & isoborneol. Source, structures, uses of borneol. Oxidation of borneols to camphor.

NOTE:

1. Structure elucidation of compounds is not included in the syllabus.
2. Structural features like the basic nucleus, presence of substituent groups shall be discussed.
3. Simple reactions like hydrolysis, selenium dehydrogenation, oxidation, reduction etc., shall be taught wherever applicable.

### 3.2. P.1. MEDICINAL CHEMISTRY – I

#### (Natural Products)

(Practical) [6 Hrs/week]

1. Preparation of different Alkaloid testing reagents like Dragendorff, Mayer's Wagner's, etc. and testing some alkaloids and Plant extracts using these reagents.
2. Identification of Alkaloids by specific colour tests.
3. Tests for steroids, steroidal glycosides and cardiac glycosides. Liberman-Burchard test, Salkowski reaction, Kedde reaction, etc.
4. Tests for flavanoids and their glycosides. Shinoda Test (Mg /Hcl test), FeCl<sub>3</sub> test.
5. TLC Examination of Alkaloids, Steroids, Steroidal Glycosides and Cardiac Glycosides.
6. Identification of natural products.
7. Isolation of phytochemicals:
  - a. Diosgenin - from Fenugreek or Dioscorea Yams.
  - b. Strychnine & Brucine - from Nux-vomica seeds.
8. Estimations of the following.
9. Ascorbic acid(Raw materila, tablets and injections)
10. Vitamin B1(Gravimetry).
11. Penicillin(alkalimetry).
12. Alkaloid (by gravimetry).
13. Eugenol content in Clove oil.
14. Citral by Hydroxylamine hydrochloride.
15. Assay of camphor by gravimetry (hydroxylamine method)
16. organoleptic testing of terpenoids and terpenoid containing materials

### 3.2. T.2. PHARMACOGNOSY – I

(Theory)[5 hrs/week]

#### UNIT – I

A) Definition, History, and Scope of Pharmacognosy.

Crude drugs: Organized and unorganized crude drugs, Classification of crude drugs.

Scheme for pharmacognostic study of crude drugs.

Cultivation, Collection, Processing of Crude drugs:

Merits and demerits of cultivation of crude drugs. Exogenous factors affecting cultivation. A brief account of pests and methods of pest control. A brief introduction to plant growth regulators. Collection and processing of crude drugs.

Quality Control of Crude Drugs: Crude drug adulteration; Types of adulterants, evaluation of a crude drug and methods of evaluation.

## **UNIT – II**

Biogenesis of natural products:

- A) A brief introduction to biosynthesis.
- B) A brief account of primary and secondary metabolite's production from carbon metabolism in plants.
- C) Production of amino acid by shikimic acid pathway.
- D) Biogenesis of Atropine, Morphine, Isoprenoid compounds and cardiac glycosides.

## **UNIT – III**

- A) A brief introduction to Ayurveda and to its preparation like Arishtas, Asavas, Gutikas, Tailas, Churnas, Lehyas and Bhasmas.
- B) A brief account phytopharmaceuticals of commercial significance.

## **UNIT – IV**

- A) General introduction to carbohydrates, lipids, enzymes and proteins and tannins.
- B) Systematic pharmacognostic study of agar and isapgol.
- C) Biological source, collection, preparation, chemical constituents, tests for identification and uses of following.  
Guargum, Gum acacia, Honey, Pectin, Starch, Sterculia and Tragacanth, Almond oil, Bees wax, Castor oil, Cocoa butter, Cod-liver, Hydnocarpus oil, Kokum butter, Lard, Linseed oil, Olive oil, Shark liver oil and Wool fat, Diastase, Papain, Pepsin, Trypsin, Pancreatin and Gelatin, Pale catechu, Black catechu, Gall and Myrobalan.

## **UNIT – V**

1. Study of mineral drugs; Bentonite, Kaolin, Kieselguhr and Talc.

2. Study of fibers used in pharmacy; Asbestos, Cotton, Glass-wool, Nylon, Polyester, Silk and Wool.
3. A brief introduction to plant bitters and sweeteners.
4. A brief introduction to natural colors and dyes.
5. An introduction to potential cardio-vascular, anticancer/cytotoxic and antibiotic drugs from marine sources.

### 3.2. P. 2. PHARMACOGNOSY –I

(Practical)[6hrs/week]

#### List of experiments:

1. Measurement of Starch grains in powdered crude drug.
2. Measurement of Phloem fibers in powdered crude drug.
3. Identification of Cinnamon by Linear measurement technique (by measuring the diameter of starch grains and width of Phloem fibers).
4. Measurement of Calcium oxalate crystals in powdered crude drug.
- 5&6. Determination of Stomatal number and Stomatal index of two dicot leaf drugs.
- 7&8. Determination of Vein islet number and Vein-let termination number of two dicot leaf drugs.
- 9&10. Determination of Palisade ratio of two dicot leaf drugs.
11. Detection of carbohydrates in crude drug by chemical tests.
12. Detection of proteins in crude drugs.
13. Detection of lipids in crude drugs.
14. Detection of tannins in crude drugs.
15. Identification of fibers by chemical tests.
16. Determination of ash values of vegetable crude drugs.
17. Determination of extractive values of vegetable crude drugs.
18. Determination of swelling factors.
19. Determination of foreign organic matter.
20. Spotting of Crude drugs: Minimum 20 Crude drugs belonging to Carbohydrates, Proteins, Lipids and Tannins.

### 3.2. T.3. PHARMACOLOGY – I

(Theory)[6hrs/week]

#### UNIT – I

**General Pharmacology:** Definitions, scope and branches of pharmacology. Concept of pharmacokinetics, pharmacodynamics and their interrelationship. Molecular mechanisms and factors affecting the drug action. Concept of receptors, ion-channels, enzymes and carrier systems. Dose effect relationship. Brief description of cellular signaling systems.

#### UNIT – II

**Pharmacology of drugs acting on autonomic nervous system:** Organization and functions of ANS. ANS (cholinergic & adrenergic) transmission and co-transmission. Pharmacology of parasympathomimetic, anti-cholinesterase, anti-cholinergic drugs. Pharmacology of adrenergic drugs, alpha, beta adrenoceptor blockers, adrenergic neuron blockers. Drugs acting on autonomic ganglia: stimulants and blockers. Neuromuscular blocking agents.

## UNIT –III

**Drugs acting on cardiovascular system:** Cardiac rate and rhythm, disturbances in rhythm. Mechanism of action and therapeutic uses of antiarrhythmic, cardiotonic and anti-anginal drugs. Vascular smooth muscle and role of endothelium in controlling it. Vasoconstrictor and dilator drugs. Pharmacology of drugs used in hypertension.

Pharmacology of drugs affecting blood formation, coagulation, thrombolysis and platelet aggregation.

**Pharmacology of drugs acting on kidney:** Water and electrolyte balances, diuretics and urinary pH modifying agents.

## UNIT – IV

**Pharmacology of drugs acting on gastrointestinal tract:** Laxatives-antidiarrhoeals, emetics-anti-emetics, prokinetic agents, antiulcer drugs.

**Hormones and related drugs:** Study of hormones of different endocrine glands (adrenal, thyroid, pituitary and gonadal), antithyroid drugs, corticosteroids, antiestrogens, antiprogestogens, oral contraceptives and drugs regulating calcium homeostasis. Pancreatic hormones and their actions, Role of insulin and oral hypoglycaemic agents in diabetes mellitus.

## UNIT – V

**Basics of cell and molecular biology:** Structural organization of life. Surface architecture, cell membrane: Structure and functions, nucleus and cytoplasmic matrix, cell growth and division, Molecular organization and Genome, DNA Replication and Transcription. Mechanism of protein synthesis, Genetic recombination, Molecular basis of protein synthesis. Genetic recombination, Molecular basis of mutation and variations, types of mutations.

### 3.2.P.3 PHARMACOLOGY – I ( 6 per week)

1. Common laboratory animals and anesthetics used in animal studies. Some common and standard techniques of bleeding, intravenous injection, intra-gastric administration, procedures for rendering animal unconscious and chemical euthanasia, separation of plasma and serum.

2. Study of different routes of administration of drugs in mice/rats. To study the effect of hepatic microsomal enzyme inhibitors and inducers on the phenobarbitone sleeping time in mice.

**3. Experiments on isolated preparations:**

- Study of different physiological salt solutions used in experimental Pharmacology
- Study on basic concept of *in vitro* experimental pharmacology. Commonly used instruments in experimental pharmacology- organ bath, levers, balancing, mounting procedures to be followed in *in vitro* measurements.
- Study on different tissues, agonists, antagonists and receptors employed in *in vitro* evaluation.
- Dose response curve (cumulative and non-cumulative) and ED 50 measurement of agonist in different tissues like skeletal muscles and smooth muscles (rat fundus, rat colon, rat seminal vesicle, rat uterus, rat vas deference, rat anococcygeus muscle, guinea pig ileum, rabbit jejunum)
- Study on isolated heart preparation with different agonist and antagonist.
- Blocking of agonist response using appropriate antagonist in isolated tissue preparation
- Study of potentiating response of different drugs in isolated tissue preparation

4. Effect of autonomic drugs on rabbit's eye.

5. Statistical calculations in Pharmacology

- a. Student's - t test
- b. ANOVA
- C. Chi-square test

6. Experiments based on computer models like Ex Pharm.

### **3.2. T.4. PHARMACEUTICAL JURISPRUDENCE**

(Theory) [4Hrs\week]

#### **UNIT - I**

Development of Pharmaceutical and drug legislation in India.

Legislation to regulate the import, manufacture, distribution and sale of drugs and cosmetics. The Drugs and Cosmetic Act, 1940 and Drugs and Cosmetics Rules, 1945, as corrected up to-date.

Legislation to regulate the profession of pharmacy. The Pharmacy Act, 1948.

#### **UNIT - II**

Legislation to control the advertisements, excise duties and prices of drugs.

- a) The Drugs and Magic Remedies (Objectionable Advertisement) Act.
- b) The Medicinal and Toilet Preparations (Excise duties) Act, and Rule of 1956.
- c) Drugs (Prices Control) Order, as corrected up to –date.

#### **UNIT – III**

Legislations to control the operations regulating the Dangerous Drugs, Poisons and Opium, the Narcotic Drugs and Psychotropic Substances Act, 1985.

#### **UNIT – IV**

Legislations affecting Pharmaceutical and Food Industry.

Industries (Development and Regulations) Act, 1951.

#### **UNIT – V**

- a) The India Patents and Design Act, 1970 with reference to the Drugs and Pharmaceutical, only.
- b) Prevention of Food Adulteration Act.
- c) The factories act 1948 and the amendments
- d) Consumer protection act 1986
- e) Intellectual property rights – a brief introduction to various IPRs.
- f) Case histories involving different Acts.

Note: The Students are expected to be acquainted with amendments to the above Acts.

#### 4.1. Semester B.PHARM IV YEAR

##### THEORY PAPERS:

S.No	Subjects	Hours/ Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	PHARMACEUTICAL TECHNOLOGY-I (Dosage forms)	6	20	80	100	3
2	PHARMACOGNOSY – II	6	20	80	100	3
3	PHARMACOLOGY – II AND TOXICOLOGY	6	20	80	100	3
		18	60	240	300	

##### PRATICAL PAPERS:

S.No	Subjects	Hours/ Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	PHARMACEUTICAL TECHNOLOGY-I (Dosage forms)	6	20	80	100	4
2	PHARMACOGNOSY – II	6	20	80	100	4
3	Pharmacology –II and TOXICOLOGY	6	20	80	100	4
	Total	18	60	240	300	

**4.1. T.1. PHARMACEUTICAL TECHNOLOGY**  
**(Dosage forms)**  
(Theory)[6Hrs/Week]

**UNIT – I**

**Preformulation:** Objectives, Brief study of solubility, Pka, Partition- coefficient, Dissolution and Solid-state properties.

**Packing:** Materials of packing ( plastic, glass, Tin, Aluminum), Packaging of all formulations, package testing.

**Liquid orals:**

Formulation technology and evaluation of:

(a) Solutions, (b) Suspensions (c) Emulsions and d) Dry syrups.

**UNIT – II**

**Parenteral preparations:** Definitions, classification, formulation, vehicles, containers, filling, sealing and testing, design of aseptic filling area, quality control of parenterals.

**UNIT - III**

**Solid dosage forms:**

- a) Compressed Tablets: Additives: diluents, binders, disintegrating agents, lubricants, colours, flavors and sweeteners. Formulation and manufacture of tablets, quality control of tablets. Coating – sugar, film, press and enteric coating methods.
- b) Capsules-Hard and Soft: Formulation and manufacture and their quality control.

**UNIT – IV**

**Concept of sustained action dosage forms:** Dosage calculations, methods adopted in release controlling, micro encapsulation techniques. Quality control.

**Control release:** Concept, Definitions, and types of targeting. Applications of control release in Gastro retentive drug delivery systems and Transdermal drug delivery systems.

**Semi-solid dosage forms:** Classification of bases, formulation, preparation, packaging, storage and quality control of ophthalmic ointments, creams and suppositories.

## UNIT – V

**Aerosols:** Classification, propellants, advantages and disadvantages, formulation and manufacture. Pressurized packaging and applications. Quality control of aerosols.

**Radiopharmaceuticals:** Definition, Radioactivity, A short list of radiopharmaceuticals, production of Tc99m injection, quality control and applications.

**Basic concepts of** GMP, validation and types of validation.

### IV.P.1. PHARMACEUTICAL TECHNOLOGY (Dosage forms) (Practicals)[3 Hrs/Week]

#### A) Compulsory (fifteen)

**Formulation and evaluation of the following:**

1. Solution
2. Dry syrup
3. Suspension
4. Solid dispersion
5. Effervescent granules
6. Emulsion

**Preparation and evaluation of the following:**

1. Paracetamol tablets (wet granulation procedure).
2. Diclofenac sodium tablets.
3. Chewable tablets.
4. Aspirin tablets.
5. Capsule filling.
6. Micro encapsulation.
7. Dip coating.
8. Ampoule sealing – Parenteral injection.
9. Drug release from different ointment bases.

#### B) Optional (seven)

**Preparation and evaluation of the following**

1. Enteric coating of tablets
2. Drug loading on to pellets
3. Preparation of films for Transdermal delivery
4. Suppository
5. Soluble tablets
6. Effervescent tablets

7. Matrix sustained release tablets

**4.1. T.2. PHARMACOGNOSY-II**  
(Theory) [6hrs/week]

**UNIT – I**

General introduction to Volatile Oils and Resins.

Systematic pharmacognostic study of following: Cardamom, Cinnamon, Cassia, Clove and Nutmeg, Capsicum, Ginger and Turmeric.

Biological source, collection and preparation, chemical constituents and tests for identification, uses, Substitutes and adulterants of following:

Chenopodium, Eucalyptus oil, Gaultheria, Lemon peel, Lemon grass oil, Oil of citronella, Orange peel, Mentha oil, Musk, palmarosa and Sandalwood.

Asafoetida, Balsam of Tolu, Balsam of Peru, Benzoin, Guggul, Myrrh, Podophyllum and Storax.

General pharmacognostic features of Umbelliferous fruit (Fennel, Dill, Coriander, Caraway) and their biological sources, chemical constituents, uses and adulterants / substituents (if any).

**UNIT – II**

General introduction to Alkaloids.

Systematic pharmacognostic study of following:

Cinchona, Ergot, Ephedra, Ipecac, Kurchi, Rauwolfia and Vasaka.

Biological source, diagnostic features, chemical constituents and Tests for identification, uses, adulterants and substituents of following:

Belladonna, Catharanthus, Coca, Cola, Coffee, Colchicum, Datura, Duboisia, Hyosyamus, Lobelia, Opium, Nux-vomica, Pilocarpus, Solanum, Tobacco, Tea and Withania.

**UNIT – III**

General introduction to Glycosides.

Systematic pharmacognostic study of following:

Aloe, Ammi majus, Digitalis, Liquorice, Senna and Saffron.

Biological source, diagnostic features, chemical constituents and tests for identification, uses, adulterants and substitutes of following:

Ammi visnaga, Cascara, Chirata, Dioscoria, Gentian, Ginseng, Squill, Strophanthus and Quassia.

## UNIT – IV

Historical development of plant tissue culture: Types of cultures, Nutritional requirements, growth and their maintenance. Applications of plant tissue culture in production of pharmaceutically important secondary metabolites.

## UNIT – V

Source, structure, commercial significance and uses of novel biochemicals – Artemisinin, Asiaticosides, Bacoposides, Camptothecin, Gymnemic acid, Neem derivatives and taxol.

### 4.1.P.2. PHARMACOGNOSY – II

(Practicals) [6hrs/week]

#### List of experiments

1. Isolation of starch from potatoes.
2. Preparation of cetyl alcohol from Spermaceti.
3. Isolation of Piperine from black pepper.
4. Isolation of Bixin.
5. Isolation of Curcuminoids.
6. TLC profile of nux vomica / cinchona alkaloids.
7. TLC of glycosides
8. TLC profile of peppermint oil.
9. Detection of alkaloids by chemical tests.
10. Detection of glycosides.
11. Detection of steroidal compounds.
12. Detection of flavonoids.
13. Identification of following powdered crude drugs and their combinations with the help of organoleptic, microscopic, micro chemical and chemical methods (if any).

a. Senna	b. Vasaka.	c. Cinchona.	d. Consia.
e. Kurchi.	f. Quassia.	G. Ipecac.	h. Rauwolfia.
i. Squill.	J. Ginger	k. Fennel/ Coriander	
l. Nux Vomica.	m. Clove.		

And some exercises on powdered crude drug mixtures

14. Anatomy of following crude drugs.

a. Senna.	b. Cassia/ Cinnamon	c. Clove.
d. Ephedra.	E. Fennel.	f. Linseed/nux vomica.
g. Ipecac.	h. Quassia	I. Ginger.
15. Spotting of crude drugs mentioned in theory (minimum 30 crude drugs).

## 4.2. T.3. PHARMACOLOGY – II AND TOXICOLOGY

(Theory) [6 Hrs./Week]

### UNIT - I

**Pharmacology of drugs acting on central nervous system:** Organization and functions of CNS. CNS transmission and study of distribution and functions of different neurotransmitters.

Pharmacology of drugs used in Parkinson's disease, Schizophrenia, Mental Depression, Epilepsy, and Dementia & Alzheimer disease, Anxiety, Insomnia.

Pharmacology of drugs used in pain: Opioids and related drugs.  
Pharmacology of agents used in general and local anesthesia. Pharmacology of cortical and medullary stimulants.

### UNIT – II

#### **Bioethics and bioassay of some selective drugs**

Principles of Bioethics, Bioethics of Animals used in Bioassay studies: Designs of bioassays, Principles of Bioassays, Official Bioassays of Insulin, Vasopressin, Oxytocin, Acetyl Choline, Adrenaline, d-Tubocurarine, corticotrophin, Digitalis, Histamine, Heparin, Gonado tropins, Cholera vaccine, Polio vaccine.

### UNIT – III

**Drugs acting on respiratory system:** Drugs affecting respiration and drugs used in disorders of respiratory function.

**Drugs acting in atherosclerosis.** Lipid lowering drugs.

**Local hormones, inflammation and allergy:** Acute inflammatory reaction, unwanted immune responses and mediators of inflammation and allergy. Antiallergic drugs and Non-steroidal analgesic, antipyretic and anti-inflammatory drugs.

**Peptides and proteins as mediators:** Regulation of peptides and peptide antagonists, proteins and peptides as drugs.

**Peripheral mediators:** 5-Hydroxytryptamine and purines.

### UNIT – IV

**Chemotherapy of infections and malignant disease:** basic principles, study of antibacterial, antifungal, antiviral, antihelminthic, antimalarial, antiamebic and anticancer drugs.

Pharmacology of immunosuppressants and stimulants. Drug dependence and drug abuse: Nicotine, Ethanol and cannabis.

## UNIT – V

### Principles of Toxicology

Acute, Sub acute and Chronic toxicities.

General principles of treatment of acute toxicity and poisoning-Signs, symptoms and treatment of poisoning due to:

OP and non OP pesticides (Organophosphorus and Non Organophosphorus)

Barbiturates, Benzodiazepines and opioids.

Neuroleptics and antidepressants.

Heavy metals like lead, Iron, mercury, Arsenic.

Alcohol

Snake and Scorpion venoms.

### IV.P.4. PHARMACOLOGY – II

(Practicals) [3hrs/week]

1. Introduction to different equipment used in Pharmacology lab.
2. Introduction to different Physiological Solutions used in Pharmacology lab.
2. Effect of Routes of Administration on the Action of Drugs.
3. Determination of ED<sub>50</sub> using isolated tissue preparations.
4. Effect of Drugs on Rabbit eye.
5. Effect of drugs on Ciliary Movements in frog's oesophagus.
6. Recording of Dose response curve of Acetylcholine on Frog Rectus Abdominis Muscle.
7. Recording of Dose response curve of Acetylcholine in presence of Physostigmine on Rectus Abdominis Muscle.
8. Recording of Dose response curve of Acetylcholine in presence of d-tubocurarine on Rectus Abdominis Muscle.
9. Effect of different Electrolytes / Drugs on Isolated frog's Heart by Syme's technique.
10. Recording of the effect of Venous Pressure on Isolated frogs Heart by Syme's technique.
11. To demonstrate the presence of Cholinesterase in Blood.
12. To record the Cumulative Dose Response of ACh on frog and the influence of Physostigmine and etc.
13. To demonstrate the effect of Drugs on frog rectum.
  - i. Effect of Ach, Adr, Isoprenaline and Nicotine.
  - ii. Effect of Atropine in presence of Ach.
  - iii. Effect of Adrenaline in presence of Propranolol.
14. Demonstration of Local Anaesthetic Activity on Rabbit eye.
15. Demonstration of Local Anaesthetic Activity on Frog's Hind-limb Withdrawal.

16. Bio-assay of Acetylcholine on Frog Rectus Abdominus Muscle by different Methods.
17. Recording of DRC of Histamine on Guinea-pig ileum.
18. Bioassay of Histamine on Guinea pig ileum.
19. Demonstration of difference between Cardiac Stimulants and Cardiotonic Agents (DEMONSTRATION).
20. Drug Interaction studies ACh X SCh, ACh X Pilocarpine.
21. Study of Different types of Antagonism in from rectus abdominis / Rat Colon.
22. Demonstration of Effect of local Anaesthetics on Isolated preparation like rectus abdominus or rat intestine or frog rectum. Demonstration of type of antagonism by local anaesthetics.
23. Demonstration of effect of drugs on coronary blood vessels (DEMONSTRATION).

#### 4.2. Semester B.PHARM IV YEAR

##### THEORY PAPERS:

S.No	Subjects	Hours/Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	PHARMACEUTICAL BIOTECHNOLOGY	6	20	80	100	3
2	BIOPHARMACEUTICS AND PHARMACOKINETICS	4	20	80	100	3
3	MEDICINAL CHEMISTRY – II (Synthetic)	6	20	80	100	3
4	Hospital and clinical Pharmacy	4	60	240	300	

##### PRATICAL PAPERS:

S.No	Subjects	Hours/Week	Sessional Marks	Annual Marks	Total Marks	Exam Duration (hrs)
1	PHARMACEUTICAL BIOTECHNOLOGY	6	20	80	100	4
2	BIOPHARMACEUTICS AND PHARMACOKINETICS	6	20	80	100	4
3	MEDICINAL CHEMISTRY – II (Synthetic)	6	20	80	100	4
	Total	18	60	240	300	

## 4.2. T.1. PHARMACEUTICAL BIOTECHNOLOGY

(Theory) [6hrs/Week]

### UNIT – I

#### **Fermentation Technology:**

- 1) Screening Methods for bioactive metabolites.
- 2) Introduction to fermenter and its accessories.
- 3) Anaerobic and aerobic fermentations; Surface, submerged and solid-state fermentations.
- 4) Manufacture of the following: Study of culture, media, production conditions, extraction and purifications of:
  - i) Antibiotics-Penicillin and Streptomycin.
  - ii) Acids-lactic acid.
  - iii) Enzymes-Fungal diastase.
  - iv) Vitamins- Vitamin B12.
  - v) Polysccharides-Dextran.

### UNIT - II

#### **Animal, blood and immunological products.**

##### **Animal Products:**

- i) Insulin-extraction, purification and types of formulations.
- ii) Pepsin (iii) Heparin I.P

**Blood products:** Whole human blood, Plasma, dried plasma, fibrin, thrombin, Normal human immunoglobulin injection, Ideal characters of plasma substitutes, Dextran formulations (Preparations, uses and storage).

**Immunological preparations:** Definition and classification of immunoloical preparations. Manufacture and standardization of:

Bacterial	-	Cholera, BCG Vaccine.
Viral	-	Polio and Rabies.
Toxoids	-	Diphtheria.
Antitoxins	-	Tetanus antitoxin
Diagnostic agents	-	Purified protein derivatives for Tuberculin test.

### UNIT – III

#### **Testing methods:**

**Test for sterility:** Sterility testing, media, sampling, neutralization of various antimicrobial substances in dosage forms. Conducting these tests for injections, surgical sutures (cat gut) & cotton.

Principles of microbiological assays and detailed assays for Vitamin. B12 and Penicillin.

### UNIT – IV

#### **Enzymes and animal cell biotechnology:**

**Enzymes:** Sources. Applications in pharmaceutical industry, therapeutics and clinical analysis.

Immobilization of enzymes, advantages and limitations of immobilization and brief study of gel entrapment, adsorption methods of immobilization.

**Microbial transformation of steroids:** Introduction, types of transformation and uses.

Brief account of animal cell culture and its applications.

**Monoclonal antibodies:** Preparation and applications.

#### UNIT – V

**r-DNA (recombinant DNA) technology and applications.**

**Fundamentals of genetic engineering:** Definition of **rDNA** technology, Brief knowledge of **RNA** and **DNA** structures, prokaryotic and eukaryotic gene organization, basic techniques like agarose-gel electrophoresis, Southern blotting and Northern blotting.

**Plasmids as cloning vehicles:** Basic properties of plasmids, purification of plasmid **DNA**. Desirable properties of plasmid cloning vectors & **PBR 322**.

**Cutting and joining of DNA molecules:** Cutting of **DNA** molecules, restriction endonucleases and their nomenclature, target sites and joining of **DNA** molecules, **cDNA**, **DNA** manipulations with the help of enzymes like Alkaline phosphatase, S1 nuclease, exonuclease, **DNA** polymerase and reverse transcriptase. **DNA** ligase, double linkers, adapters and homopolymer tailing.

**Introduction in to host cell:** Transfection with recombinant phage DNA, E.coli transformation with plasmid **DNA**. Recombinant selection by genetic, immunochemical, and nucleic acid hybridization methods and Expression of cloned genes.

**Applications of genetic engineering:** Simple steps to construct the rDNA for production of Human insulin, interferon, somatostatin, hepatitis B vaccine (no process details). A short list of products obtained through genetic engineering.

#### IV.P.2. PHARMACEUTICAL BIOTECHNOLOGY

(Practicals) [4 Hrs\week]

(3hr on the same day and 1hr in the next day morning)

1. Preparation of killed bacterial vaccine
2. Sterility testing of injections, powders
3. Preparation of antiserum from rabbit (demo)
4. Estimation of lactic acid produced by *Lactobacillus sporogenes*.
5. Production of alcohol and estimation of alcohol (Anaerobic fermentation).
6. Microbiological assay of antibiotics by agar diffusion method.
7. Microbiological assay of antibiotics by turbidimetry method.
8. Production of an antibiotic (Aerobic fermentation).
9. Estimation of diastase activity.
10. Gel electrophoresis of nucleic acid (demo).
11. Isolation of plasmid **DNA** from bacterial cells.
12. Transformation of *E. coli* (Demonstration).
13. Detection of antibiotics by Bioautography technique.
14. Determination of **MIC** of antibacterial substances (phenol).
15. Heparin bio-assay (demo).
16. Immobilization of enzymes (Gel entrapment).

17. Determination of Additive/synergistic effect of combination of drugs.
18. Pyrogen testing – **LAL** test (demo)
19. Antigen – Antibody reaction diffusion method.
20. RIA/ESLISA test. (Demo).

#### **4.2.T.2. BIOPHARMACEUTICS AND PHARMACOKINETICS**

(Theory) [4 Hrs/Week]

##### **UNIT – I**

###### **INTRODUCTION TO BIOPHARMACEUTICS:**

Introduction

The Concept of Biopharmaceutics

###### **ABSORPTION OF DRUGS:**

ABSORPTION OF DRUGS FROM GASTROINTESTINAL TRACT

Introduction, Rate Limiting Step in Bioavailability, Anatomical and Physiological Considerations of the Gastrointestinal Tract (GIT), Mechanisms of Drug Absorption, Factors Governing Gastrointestinal Drug Absorption:

Physiological Factors, Physicochemical Factors, Oil/Water Partition Coefficient (Lipid solubility), Drug Dissociation Constant and Gastrointestinal pH, pH-Partition Hypothesis, Metabolic Factors, and Formulation Factors.

Advantages and disadvantages of various routes of administration.

##### **UNIT – II**

###### **DISSOLUTION:**

Mechanisms of Dissolution, Factors Affecting the Rate of Dissolution, Measurement of Dissolution Rates, Official Methods of Dissolution, Unofficial Methods of Dissolution, Control of Variables in Dissolution Testing, In-vitro and In-vivo correlation's, Limitations of Dissolution Test.

Sink condition in dissolution. Methods used to achieve sink condition.

Bioavailability and Bio equivalence studies: Designing of bioavailability studies, and interpretation of results.

##### **UNIT – III**

###### **DRUG DISTRIBUTION:**

Physicochemical Properties of the Drug, Organ/Tissue Size, Blood Flow to the Organ, Physiological Barriers to the Diffusion of Drugs, Drug Binding in Blood, Drug Binding to Tissue and Other Macromolecules and Apparent Volume of distribution.

## **DRUG ELEMINATION:**

Renal Excretion, Renal Blood Flow, Renal Clearance, Hepatic Elimination of Drugs, Drug Metabolism, Phase-I Reactions, Phase-II Reactions, Induction and Inhibition of Drug Metabolizing Enzymes, Hepatic Clearance, Pharmacological Activity of Metabolites, Disposition of Metabolites, First Pass Effect, Biliary Excretion, Enterohepatic Circulation, Extrahepatic Metabolism and Minor Pathways of Drug Excretion

## **UNIT – IV**

### **INTRODUCTION TO PHARMACOKINETICS:**

Mathematical Model, Drug levels in blood, Introduction to Pharmacokinetic Models, Pharmacokinetic Study,

### **ONE COMPARTMENT OPEN MODEL**

#### **INTRAVENOUS INJECTION (BOLUS)**

I.V. Bolus-Unchanged Drug in Blood Plasma, Apparent volume of distribution, Elimination Rate Constant, Biological Half-life, Area under the curve (AUC) and Clearance.

I.V. Bolus-Unchanged Drug in Urine, Calculation of Pharmacokinetic Parameters, Excretion rate Method, Sigma-Minus Method and Comparison of the two methods.

## **UNIT – V**

Concept of Nonlinear pharmacokinetics.

Basic concepts of Non compartment models.

**Tests of significance:** T-Test, Paired T-Test, ANOVA, multiple ANOVA, Practical applications of these in solving bioavailability and bioequivalence problems.

### IV.P.3. BIOPHARMACEUTICS AND PHARMACOKINETICS

(Practicals) [3 Hrs/Week]

#### I. Determination of disintegration time of tablets

#### II. *In-vitro* dissolution studies:

1. a) Construction of standard graph of a drug.  
b) Dissolution of uncoated tablets of the drug.
2. a) Construction of diclofenac sodium standard graph by spectroscopic method.  
b) Dissolution of enteric coated tablets. (Diclofenac sodium)
3. Dissolution of sustained release tablets –diclofenac sodium
4. *In-vitro* ointment release studies

#### III. Protein binding studies

- 1) Equilibrium dialysis method-demonstration of protein binding.
- 2) Equilibrium dialysis method –demonstration of drug- drug interaction at protein bind sites.

### PHARMACOKINETICS

#### IV. Theoretical problems

1. One compartment open model-I.V.(bolus)
  - a) Unchanged drug in blood
  - b) Unchanged drug in urine
    - i) Rate excretion method
    - ii) Sigma minus method
2. One compartment open model-extra vascular administration.
  - b) Unchanged drug in blood
  - c) Unchanged drug in urine
    - i) Rate excretion method
    - ii) Sigma minus method.

### 4.2.T.3. MEDICINAL CHEMISTRY – II (Synthetic)

(Theory) [6 Hrs/Week]

#### UNIT – I

Basic considerations of Drug activity:

Introduction, Factors affecting bioactivity,

- a) Physicochemical Properties such as solubility, partition coefficients, and ionization.
- b) Chemical structure parameters such as Resonance, Inductive effect, Types of bonding and Isosterism.
- c) Spatial considerations: Molecular dimensions, Interatomic distances and Stereochemistry.

Theories of drug activity,

Occupancy Theory, Rate Theory, Induced fit Theory, Macromolecular perturbation Theory.

A brief account of quantitative aspects of drug action and Receptor concept of drug action mechanism.

**Mechanisms of Drug action:** Introduction, Enzyme stimulation, Enzyme inhibition, Sulfonamides and Membrane – active drugs

**Drug metabolism and inactivation:** Introduction, Biotransformations, Metabolic reactions, Conjugation reactions

## UNIT – II

A study of the following classes of drugs including introduction, classification, structures, general method of synthesis (if any), mechanism of action and SAR. Synthesis of compounds specified against each class is to be studied.

### **Drugs acting on CNS:**

A brief study of the chemistry of **neurotransmitters**.

**Hypnotics and Anxiolytics** – Phenobarbital, Diazepam, Alprazolam.

**Antipsychotics** – Chlorpromazine, Haloperidol

**Antiepileptics** – Phenytoin, Valproic acid

**Antidepressants** – Imipramine Fluoxetine (No synthesis)

**General and Local anesthetic agents:**

Definition, Introduction, chemical classification, SAR, mechanism of action and synthesis of Benzocaine and Lidocaine, Halothane and Ketamine.

## UNIT – III

A study of the following classes of drugs including introduction, classification, structures, mechanism of action and SAR. Synthesis of compounds specified against each class is to be studied.

Drugs affecting adrenergic mechanism:

Introduction,  
Adrenergic receptors, catabolism  
Direct acting sympathomimetics Phenylephrine, Xylometazoline  
Indirect acting sympathomimetics: Amphetamine

Drugs affecting cholinergic mechanism:

Introduction – some aspects of cholinergic system  
Cholinergics – Carbachol  
Anticholinesterase – Neostigmine  
Antidotes for Ach Inhibitors:- PAM (Pralidoxime)  
Cholinergic blockers: Propantheline  
Neuromuscular blockers: Galamine

## UNIT – IV

A study of the following classes of drugs including introduction, classification with examples structures, mechanism of action and SAR. Synthesis of compounds specified against each class is to be studied.

Drugs and Cardio-vascular diseases:

General account of cardiovascular diseases  
Antihypertensives – Methyl Dopa, Amlodipine, Captopril, Losartan (No Synthesis)  
Anti-arrhythmics – Procainamide  
Diuretics – Acetazolamide, Hydrochlorothiazide, Furosemide  
Anticoagulants, anti-anginals, and coronary vasodilators – Isosorbide dinitrate, Verapamil, Diltiazem,  
Antihyperlipidemics (Hypocholesteremic drugs): Clofibrate, Atorvastatin, (No Synthesis) simvastatin (No Synthesis).  
General account on pancreatic and thyroid hormonal malfunctions. A brief account on statins  
Antidiabetics – Metformin, Glipizide including a brief account on PPAR  $\alpha$  inhibitors  
Drugs affecting Thyroid Function: Methimazole, Propylthiouracil

## UNIT – V

Analgesics and NSAIDS (Non-steroidal anti-inflammatory agents):

a) Introduction and types of pain and inflammation, b) classification and systematic development of analgesics of morphine, mild analgesics and strong analgesics : meperidine and methadone, c) NSAIDS – aspirin, paracetamol, ibuprofen diclofenac d) A brief account on COX-2 inhibitors and nimesulide.

**Chemotherapeutic Agents:**

Definition Chemical Classification, SAR and mechanism of action and synthesis of the specified drugs in the following:

<b>Sulpha drugs</b>	:	Sulphamethoxazole, Sulphameter
<b>Anti tuberculars</b>	:	Isonicotinic acid hydrazide and ethambutol
<b>Anti leprotics</b>	:	Dapsone
<b>Antiamoebics</b>	:	Metronidazole, Diloxanide furoate
<b>Anthelmintics</b>	:	Diethylcarbamazine citrate, pyrantel pamoate, mebendazole.
<b>Antimalarial Drugs</b>	:	Chloroquine, Primaquine and pyrimethamine
<b>Anticancer Drugs</b>	:	Chlorambucil, Busulphan, Procarbazine, Carmustine, 5-Flurourasil, 5-Mercaptopurine and Methotrexate.
<b>Anti viral Drugs</b>	:	Aciclovir, Zidovudine
<b>Antifungal Agents</b>	:	Clotrimazole and Ketoconazole.

#### 4.2. T.4. HOSPITAL AND CLINICAL PHARMACY

(Theory) [4Hrs/Week]

##### SECTION – A: Hospital Pharmacy

##### UNIT – I

###### **Introduction to hospitals and hospital pharmacy**

**Hospital pharmacy:** Objectives and functions, organization, planning and administration of modern hospital pharmacy services, location, layout, personal, qualifications, requirements, abilities and evaluation of hospital pharmacist, workload and remuneration of hospital pharmacist.

**Pharmacy and therapeutic committee** – Purpose, organization and functions.

**Hospital formulary** – Organization, formulary content, preparation and distribution. Pharmacy procedural manual preparation and publication.

**Hospital committees** – Infection control committee, Antibiotic committee and Research and ethics committee.

Role of hospital pharmacist in hospital committees and practice of Rational Drug Therapy . Drug exchange program.

##### UNIT – II

**Hospital manufacturing:** Economical considerations and estimation of demands lay out, raw materials, production, planning, requirements, manpower requirements and quality assurance, manufacturing of (including repacking and

prepacking ) sterile products (small and large volume Parenteral), non sterile products, total parenteral nutrition and intravenous additives.

**Drug distribution:** Outpatient and Inpatient services, unit dose drug distribution systems, floor ward stock systems, satellite pharmacy services, central sterile services and bedside pharmacy.

**Radiopharmaceuticals:** Radioisotope committee, role of hospital pharmacist in isotope and non-isotope pharmacy.

### **SECTION – B: Clinical Pharmacy**

#### **UNIT - III**

Definition, scope, history and development of clinical pharmacy.

**Professional activities of the clinical pharmacist:** Drug therapy monitoring (medication chart review, clinical review, TDM and pharmacist interventions), drug interactions, adverse drug reaction management, medication history review and patient counseling.

**Patient data analysis:** Clinical laboratory tests used in the evaluation of common disease states, interpretation of test results of liver function tests, pulmonary function tests, haemogram and renal function tests.

**Drug and poison information services:** Introduction of drug information, resources available, design of literature searches, critical evaluation of drug information and literature, preparation of written and verbal reports, development of a drug information data base and emergency treatment of poisoning.

#### **UNIT – IV**

**Pathophysiology, drug therapy and critical analysis of rational use of drugs in the following disorders:**

**Cardiovascular disorders:** Hypertension, congestive cardiac failure, ischemic heart disease.

**Respiratory disorders:** Asthma and chronic obstructive airways disease.

**Renal disorders:** Acute and chronic renal failure.

**Hematological disorders:** Anemia.

**Endocrine disorders:** Diabetes mellitus.

**Bone & Joint disorders:** Rheumatoid arthritis, Osteoarthritis, Gout.

**Ophthalmic disorders:** Glaucoma.

#### **UNIT – V**

**Pathophysiology, drug therapy and critical analysis of rational use of drugs in the following disorders:**

**Nervous diseases:** Epilepsy and Parkinson's disease.

**Psychiatric disorders:** Schizophrenia, depression and anxiety.

**Gastrointestinal disorders:** Peptic ulcer disease, inflammatory bowel diseases and hepatitis.

**Infectious disease:** Respiratory tract infections, Typhoid, Urinary tract infections, tuberculosis, leprosy and AIDS.

**Oncological disorders:** Leukaemia, Hodgkin's disease.