

SEMESTER/YEAR : SEM

COURSE CODE : 15BP203

TITLE OF THE COURSE : APPLIED BIOCHEMISTRY - PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2. Identification tests for Proteins (albumin and Casein)
3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4. Qualitative analysis of urine for abnormal constituents
5. Determination of blood creatinine
6. Determination of blood sugar
7. Determination of serum total cholesterol
8. Preparation of buffer solution and measurement of pH
9. Study of enzymatic hydrolysis of starch

RECOMMENDED BOOKS (LATEST EDITIONS):

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murray, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.
4. Biochemistry by D. Satyanarayan and U.Chakrapani
5. Textbook of Biochemistry by Rama Rao.
6. Textbook of Biochemistry by Deb.
7. Outlines of Biochemistry by Conn and Stumpf
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition)
10. Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
11. Practical Biochemistry by Harold Varley.

SEMESTER/YEAR : II

COURSE CODE : 15BP273

TITLE OF THE COURSE :APPLIED BIOCHEMISTRY - THEORY

L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

COURSE OBJECTIVES: Upon completion of course student shall able to

1. Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.

2. Understand the metabolism of nutrient molecules in physiological and pathological

conditions.

3. Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

UNIT I 08 Hours

Biomolecules

Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.

Bioenergetics

Energy rich compounds; classification; biological significances of ATP and cyclic AMP

UNIT II 10 Hours

Carbohydrate metabolism

Glycolysis – Pathway, energetics and significance

Citric acid cycle- Pathway, energetics and significance

HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase (G6PD) deficiency

Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance

Hormonal regulation of blood glucose level and Diabetes mellitus

Biological oxidation

Electron transport chain (**ETC**) and its mechanism

Oxidative phosphorylation & its mechanism and substrate level phosphorylation

Inhibitors ETC and oxidative phosphorylation / Uncouplers

UNIT III 10 Hours

Lipid metabolism

β-Oxidation of saturated fatty acid (Palmitic acid)

Formation and utilization of ketone bodies; ketoacidosis

De novo synthesis of fatty acids (Palmitic acid)

Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D

Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.

Amino acid metabolism

General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, **urea cycle** and its disorders

Defination

(Phenylketonuria, Albinism, alkeptonuria, tyrosinemia)

C

hyperbilirubinemia and jaundice

UNIT IV 10 Hours

Nucleic acid metabolism and genetic information transfer

Catabolism of purine nucleotides and Hyperuricemia and Gout disease

Organization of mammalian genome

Structure of DNA and RNA and their functions DNA replication (semi conservative model)

Transcription or RNA synthesis

Genetic code, **Translation or Protein synthesis and inhibitors**

UNIT V 07 Hours

Enzymes

Introduction, properties, nomenclature and IUB classification of enzymes

Enzyme kinetics (Michaelis plot, Line Weaver Burke plot)

Enzyme inhibitors with examples

Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation

Therapeutic and diagnostic applications of enzymes and isoenzymes

Coenzymes (NAD FAD COQ) –Structure and biochemical functions

SEMESTER/YEAR : II YEAR

COURSE CODE : 15BP274

TITLE OF THE COURSE : PHARMACEUTICAL ORGANIC CHEMISTRY II – PRACTICAL

L: T/A: P: C : 0 : 0 : 3 : 1.5

Course Objectives:

1. To understand and develop skills for determination of organic compounds.
2. To carry out experiments for determination of analytical constants.

Course Outcomes:

1. Can perform different quantitative experiments for determination of functional groups.
2. To determine various analytical constants.
3. Can understand mechanism and Perform several synthetic methods

(Following experiments to be in 25 different classes)

I. Quantitative determination of organic compounds via functional groups **

1. Phenolic group by bromination method.
2. Alcoholic group by acetylation method.
3. Carbonyl group by hydroxylamine hydrochloride-pyridine method.
4. Aldehyde group by sodium sulphite-sulphuric acid procedure.
5. Carboxyl group by acid-base method.
6. Determination of acetone by sodium hypoiodide method
7. Amino group by bromination method.
8. Amino acid Formal titration method.

II. Analysis of oils and fats: (I.P. Method).

1. Acid value.
2. Saponification value.
3. Iodine value.

III. Synthesis/ preparation involving more than one step*

1. p-bromoaniline from acetanilide.
2. p-Nitroaniline from acetanilide.
3. p-Nitrophenylhydrazine from p-nitroaniline.
4. 3-methyl-1-phenyl-5-pyrazole from ethyl acetoacetate.
5. Benzilic acid from benzoin.

6. Pthalimide from benzophenone.
7. Pthalimide from phthalic acid.
8. Synthesis of 2, 3-Diphenyl quinoxaline.
9. Benzimidazole from Orthophenylene Diamine.
10. Benzoic acid from benzaldehyde. (Cannizaro's method)

0

REFERENCE BOOKS :

1. E. L. Eliel, John Wiley and Son, Stereochemistry of Organic Compounds. New York, 1993.
2. I. L. Finar, Organic Chemistry Vol. I and II, Sixth Edition, 2003, ELBS.
3. T. W. G. Solomans, Organic Chemistry, Sixth Edition, John Wiley and Son, New York, 1996.
4. Advanced Organic Chemistry- Reactions, Mechanism and Structure - Jerry March Wiley Interscience Publication, New York.
5. Reaction and reagents O P Agrawal, Goel Publishing House, Subhash Bazar, Meerut (U.P) India.

SEMESTER/YEAR : III YEAR

COURSE CODE : 15BP374

TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING – PRACTICAL

L: T/A: P: C : 0 : 0 : 3 : 1.5

COURSE OBJECTIVES:

1. To understand different unit operations used in Pharmaceutical industries.
2. To perform different processes of pharmaceutical manufacturing process.
3. To evaluate pharmaceutical packaging materials.
4. To prepare different crystals.

COURSE OUTCOMES: Upon completion of the course student shall be able:

1. To understand different unit operations used in Pharmaceutical industries.
2. To carry out different processes of pharmaceutical manufacturing process.
3. To perform evaluation test for pharmaceutical packaging materials.
4. To prepare various crystals.

1. Drying of wet granules and to plot rate of drying curves.**
2. Operation of Ball mill and to calculate Rittinger's and Kick's co-efficient.**
3. Operation of sieve shaker and sieve analysis and deriving various statistical parameters.**
4. Determination of mixing efficiency when the propeller blade is introduced in different positions during liquid-liquid mixing. **
5. Determination of mixing index of blenders for a solid mixture using salicylic acid.*
6. Factors effecting rate of filtration on i) surface area ii) viscosity iii) concentration iv) thickness v) filter aids.**
7. Determination of water vapor permeability across the packing material.*
8. Experiment to determine the leaching of contents from packing material: Ampoules and Vials.**
9. Evaluation of pharmaceutical packing materials – corrugated box.*
10. Preparation of crystals of Potassium nitrate by shock cooling technique and study of its crystal habit.*
11. Measurement of humidity using psychrometric charts (Demonstration).
12. Evaporation: factors affecting the rate of evaporation.**
 - i) Surface area.
 - ii) Concentration.
 - iii) Viscosity.

**** Major experiments * Minor experiments**

TEXT BOOKS:

- 1 . Carter SJ, Cooper and Gunn's Tutorial Pharmacy. 6th ed. New Delhi: CBS Publishers; 2000.
2. Walter L Badger , Julius T Banchero. Introduction to Chemical Engineering. 3rd ed. New York: McGraw Hill publication; 1955.
3. Rawlins EA. Bentley's Textbook of Pharmaceutics. 8th ed. New Delhi: All India Traveller Book Seller; 2002.
4. Paradkar AR. Introduction to Pharmaceutical Engineering. 6th ed. Pune: Nirali Prakashan; 2004.
5. Sambamurthy K. Pharmaceutical Engineering. ed. New Delhi: CBS publishers; 1998.
6. Subramanyam CVS, Timma Shetty J. Pharmaceutical Engineering Principles and Practices. 1st ed. New Delhi: Vallabh Prakashan; 2002.

REFERENCE BOOKS:

1. Max Peter. Elementary Chemical Engineering. 2nd ed. McGraw Hill international Book Company; 1984.
2. Don. WG, James. OM. Perry's Chemical Engineers Handbook. 6th ed. McGraw Hill Book Company; 1984.
3. Coulson JM, Richardson JF. Chemical Engineering. 2nd ed. ELBS Pergemom Press; 1977.
4. Alfonso R Gennaro. Remington: The Science and Practice of Pharmacy, 20th ed. Vol I and II, Philadelphia, USA: Lippincott Williams and Wikkins; 2000.
5. Indian Pharmacopoeia 2010
6. www.ispe.org.
7. www.who.int.

SEMESTER/YEAR : IV YEAR
COURSE CODE : 15BP404
TITLE OF THE COURSE : MEDICINAL CHEMISTRY II - THEORY
L: T/A: P: C : 3 : 0 : 0 : 3

COURSE OBJECTIVES: The subject deals with understanding of chemistry, properties and action of medicinal agents for treating various disorders, basic concepts involved in drug design.

COURSE OUTCOMES: The student will be able to understand the action of drugs in different disease condition and apply basic principles in designing of new drug molecules.

UNIT I

- A. Introduction to QSAR:** Study of hydrophobic, Electronic & Steric parameters **2 hours**
- B. Prodrugs:** Definition and examples **1 hour**
- C. Introduction to drug discovery-** Definition of lead molecule and its identification methods viz, high throughput screening, large scale screening, and fragment based lead generation, fast followers **2 hours**
- D. History and development of chemotherapeutic agents:** Structure, uses and synthesis of only those compounds that are superscripted by 's'.
1. Antifungal agents:
 - a) Antifungal antibiotics- Nystatin, Griseofulvin, Amphoterecin-B Synthetic anti fungal agents
 - b) Substituted imidazoles: Clotrimazole, Miconazole^s, Ketoconazole, oxyconazole, Intraconazole.
 - c) Miscellaneous-Zinc propionate, Sodium caprylate, Tolnaftate^s. **4 hours**
 3. Antiviral Agents
 - a) Amantidine hydrochloride, Idoxuridine, Acyclovir, Zidovidine. **2 hours**
 - b) Anti-AIDS: Aza thymidine, Suramin
 3. Antiprotozoal agents: Emetine hydrochloride, Metronidazole^s, tinidazole, arnidazole, secnidazole, Diloxanide furoate, 8-hydroxy quinoline derivatives (clioquinol, iodoquinol) Carbarsone **2 hours**
 4. Anthelmintics: Piperazine, Diethyl carbamazine, Pyrantelpamoate, Thiabendazole^s Albendazole^s, Mebendazole **2 hours**

UNIT II

E. Sulfonamides, Sulfones as antibacterial agents :

1. SAR and mode of Sulfonamides.
2. Classification of sulfonamides based on duration of action and site of action with examples. Sulfamethiazole, Sulfisoxazole^s, Sulfapyridine, Sulfamethoxazole^s, Sulfadiazine, Sulfacetamide, sulfasalazine, Phthalyl sulfathiazole.
3. Folate reductase inhibitors: Trimethoprim, Synergistic action of the combination of sulfamethoxazole and Trimethoprim^s.

4. Sulfone: **Dapsone^s** **4 hours**
5. Antitubercular drugs:
- Synthetic antitubercular agents: p-Aminosalysilic acid, **Isoniazid^s**, **Ethambutol^s**, Pyrazinamide, Ethionamide, Clofazamine, Bedaquiline
 - Antitubercular Antibiotics: Cycloserine, Viomycin sulfate, Capreomycin sulfate, Rifampicin.
 - Combination therapy for TB, DOTS **4 hours**
Urinary tract anti-infectives:
Quinolones: Nalidixic acid, Cinoxacin, Norfloxacin, Ciprofloxacin^s, Pefloxacin,
 - Ofloxacin, Sparfloxacin
 - Miscellaneous: **Nitrofurantoin^s**. **3 hours**

F. Antimalarials: Etiology of malaria, History, Mechanism and SAR

- Quinolines and analogues: 7-chloro-4-amino quinolines :Chloroquine phosphate^s, HydroxyChloroquinesulphate, Amodiaquine, 8-amino quinolines: Pamaquine, **Primaquine^s**, 9-amino acridines: Quinacrine.
- Artimicin and its derivatives: Artiether, Artimether, Artisunate
- Biguanides and Dihydrothiazines: **Chloroguanide^s**, Cycloguanil.
- Miscellaneous: Mefloquine, Pyrimethamine, Trimethoprim. **6 hours**

UNIT III

G. Antibiotics: Classification and Mechanism of action

- Beta lactam antibiotics: Pencillins – structures, chemical degradation, bacterial resistance. Penicillin G, Penicillin V, Cloxacillin sodium, Naficillin sodium, Ampicillin, Amoxicillin.
- Cephalosporins: Structure and uses of Cephalexin, Cephadrine, Cefadroxil, Cefixime, Cefapyridine, Cefutroxime
- Monolactams: Sulfazecin, Aztreonam, Tigmonam.
- Beta lactamase inhibitors: Clavulanic acid and its salts, Thienamycin.
- Aminoglycosides: Structural features and Mechanism of action, Streptomycin, Amikacin, Neomycin, Kanamycin, Gentamycin, Netilmycin
- Tetracyclines: Chemistry and **SAR**, tetracycline, Chlortetracycline, Methacycline, Demeclocycline, Oxytetracycline, Meclocycline, Doxycycline, Minocycline.
- Macrolide: Structure and specific uses of Erythromycin, Azithromycin, oleandomycin.
- Lincomycins: Lincomycin, Clindamycin.
- Polypeptides: Gramicidin, Bacitracin, Polymyxin B, Colistin.
- Miscellaneous: **Chlormphenicol^s**, Vancomycin, Novobiocin. **12 hours**

UNIT IV

H. Antineoplastic agents: Introduction, mechanism of action and classification with examples.

- Alkylating agents: Mechlorethamine, Cyclophosphomide, Melphalan, **Chlorambucil^s**, Busulfan, Lomustine,
- Antimetabolites: Mercaptopurine, Thioguanine, 5-Fluorouracil, **Methotrexate^s**,
- Antibiotics: Dactinomycin, Bleomycin, Mitomycin, Streptozocin.
- Plant products: Etoposide, Taxol, Camphothesin, Vincristine, Vinblastin.
- Harmones: Dromostanalone, Megestrol,

6. Kinase inhibitors: Imatinibmesylate
7. Miscellaneous: Asparaginase, Cisplatin, Hydroxy urea.
8. Immunotherapy: Interferon alpha 2a and 2b.

6 hours

I. Cardiovascular agents:

1. Antianginal agents and vasodilators: Chemical structure and specific uses of Amyl nitrite, Nitroglycerine, Isosorbide dinitrate.
2. Calcium antagonists: Brief introduction of calcium channels and their blockers. Chemical Structures and uses of Verapamil, Diltiazem, Nifedepine, Nimodipine, Felodipine, Dipyridamole, Cyclandelate.
3. Antiarrhythmic drugs: Structure, chemical name, and classification of antiarrhythmics with examples
 Class I- Membrane depressant drugs: Quinidine Procainamide, Phenytoin^s.
 Class II-Beta adrenergic blocking agents. Tocainide, propranolol^s
 Class III-Repolarization prolongators. Bretylium, Amiodarone
 Class IV-Calcium channel blocker. Diltiazem, Verapamil
4. Antihypertensive agents:
 Beta-blockers: Propranolol, Timolol
 ACE Inhibitors: Captopril, Enalapril
 Diuretics: Hydrochlorthiazide, Spiranolactone
 Calcium channel blockers: Nifedipine, Felodipine, Amlodipine
 α_1 -Antagonist: Prazocin
 α_2 -agonist: Clonidine^s, Guanithedine
 Angiotensin -II receptor antagonist: Losartan, Valsartan
 Miscellaneous: Reserpine, Hydralazine^s, Minoxidil

11 hours

UNIT V

1. Antihyperlipidemic agents: Structure and specific uses. Clofibrate, Lovastatin, Cholesteramine, Colestipol, Atorvastatin **3 hours**
2. Anticoagulants: Dicumorol, Warfarin^s, Phenindione **1 hour**
3. Hypoglycemic agents: Insulin and its preparations.
 Sulfonylureas-Chlorpropamide^s, Acetohexamide, Glipizide,
 Biguanides-Phenformin, Metformin
 Substituted benzoic acid derivatives - Meglitinides, Nateglinide
 Thiazolidinediones - Glitazones, Pioglitazone, Ciglitazone, Rosiglitazone
 Glipitines - Sitagliptin, Anagliptin **3 hours**
4. Thyroid hormones : L-thyroxine, L-thyronine, **1 hour**
5. Antithyroid drugs: Propylthiouracil, Methimazole. **1 hour**

J. Diuretics: Introduction

1. Carbonic anhydrase inhibitors: Acetazolamide^s, Methazolamide.
2. Thiazide and Thiazide like diuretics: Chlorthiazides, Benzthiazide^s, Xipamide, Chlorthalidone.
3. High-ceiling or loop diuretics: Furosemide^s, Ethacrynic acid^s.
4. Potassium sparing diuretics: Spironolactone, Triamterene, Amiloride.
5. Miscellaneous: Mannitol. **5 hours**

SEMESTER/YEAR: IV YEAR

COURSE CODE: 15BP406

TITLE OF THE COURSE: ADVANCED INDUSTRIAL PHARMACY

COURSE OBJECTIVES: To study the development of various sustained and controlled release formulations as well as pilot plant scale up and validation.

COURSE OUTCOMES: The student will be able to have a relevant knowledge on

- Information of the formulation aspects of Novel and controlled release dosage forms.
- Understand the concepts of pilot plant set up and validation aspects of various processes.
- Basic concepts of CGMP, ICH guidelines and Biopharmaceutical classification

UNIT I

1. **Controlled release drug delivery systems**: Principle, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on dissolution, diffusion and ion exchange principles.

Microencapsulation: Definition, applications, air suspension, coacervation and phase separation techniques.

UNIT II

2. **Novel drug delivery systems**: Concepts, advantages and disadvantages, types of drug delivery systems such as transdermal, nasal, ocular and buccal with suitable examples. Targeted drug delivery systems: Concepts and approaches, advantages and disadvantages. Preparation and applications of microspheres, liposomes, niosomes, and nanoparticles.

UNIT III

3. **Biopharmaceutical classification**, systems and methods to improve the bioavailability of poorly soluble drugs - solid dispersion and complexation techniques.
4. **Pilot Plant scale up**: General considerations - including significance of personnel requirements, space requirements, raw materials and development of Master Formula Records and Batch Manufacturing Records. Pilot plant scale up considerations for tablets.

UNIT IV

5. **Current Good Manufacturing Practices (cGMP)**: As per D&C Act, USFDA, MHRA and TGA guidelines.
6. **ICH guidelines**: Quality, efficacy and safety and stability of drugs.

UNIT V

7. Nutraceuticals: Introduction, history, classification. Probiotics and their role in prevention of diseases.
8. **Validation**: Definition, types of validation, methods for process validation of pharmaceutical operations – Mixing and compression.

SEMESTER/YEAR : IV YEAR
COURSE CODE : 15BP474
TITLE OF THE COURSE : MEDICINAL CHEMISTRY II - PRACTICAL
L: T/A: P: C : 0: 0: 3: 1.5

Assay of

1. Sulphadiazine by diazotization
2. Piperazine Citrate by non aqueous titration
3. Ascorbic acid by Iodimetry/Cerrimetry
4. Isonicotinic acid by $KBrO_3$ (Bromimetry)
5. Benzyl penicillin by Iodometry
6. Metronidazole/Mepacrine by non aqueous titration
7. Furosemide by neutralization titration
8. Diethyl carbamazine by neutralization titration

Preparation of medicinally important compounds or intermediates required for synthesis of drugs

1. PAS from p-nitro salicylic acid
2. Dichloramine T from toluene p-sulphonamide
3. Chloramine T from Dichloramine T
4. Fluorescein from phthalic anhydride
5. Eosin from Fluorescein
6. Sulphacetamide from sulphanilamide
7. Sulphanilamide from Acetanilide
8. INH from γ Picoline
9. Chlorobutanol
10. Benzotriazole
11. 2,3-Diphenyl quinoxaline
12. 2,4,5-Triphenyl imidazole from Benzoin

Green Chemistry Synthesis

1. Microwave assisted synthesis of 1,4-dihydropyridine/pyrimidine
2. Synthesis of p-bromoacetanilide from aniline using KBr

Estimation of the functional groups in medicinally important compound

1. Hydroxyl group in cholesterol
2. Ketone in camphor
3. Hydroxyl group in menthol
4. Amide in nicotinamide

MEDICINAL CHEMISTRY II REFERENCE BOOKS (PRACTICALS):

1. A.I.Vogel, Text Book of practical organic chemistry
2. A.H. Beckett and Stanlake, Practical pharmaceutical chemistry
3. J.G.Mann and Saunders, Practical organic chemistry
4. Jayaveera KN, Practical medicinal chemistry
5. All editions of IP.

SEMESTER / YEAR : I YEAR
COURSE CODE : 15PD103
TITLE OF THE COURSE : MEDICINAL BIOCHEMISTRY (Theory)
L:T:P :3:1:3

- Course objectives**
- To study the principles and pathways of various biochemical processes and to understand their role in disease processes.
- Course Outcomes**
- Student will be able to correlate the normal and abnormal biochemical pathways in assessing the health condition of individuals.

Unit - 1

26 hrs

- 1 **Introduction to biochemistry:** Cell and its biochemical organization, transport process across the cell membranes. Energy rich compounds; ATP, Cyclic AMP and their biological significance.
- 2 **Enzymes:** Definition; Nomenclature; IUB classification; Factor affecting enzyme activity; Enzyme action; enzyme inhibition. Isoenzymes and their therapeutic and diagnostic applications; Coenzymes and their biochemical role and deficiency diseases.
- 3 **Carbohydrate metabolism:** Glycolysis, Citric acid cycle (TCA cycle), HMP shunt, Glycogenolysis, gluconeogenesis, glycogenesis. Metabolic disorders of carbohydrate metabolism (diabetes mellitus and glycogen storage diseases); Glucose, Galactose tolerance test and their significance; hormonal regulation of carbohydrate metabolism.

Unit -2

10 hrs

- 4 **Lipid metabolism:** Oxidation of saturated (β -oxidation); Ketogenesis and ketolysis; biosynthesis of fatty acids, lipids; metabolism of cholesterol; Hormonal regulation of lipid metabolism. Defective metabolism of lipids (Atherosclerosis, fatty liver, hypercholesterolemia).
- 5 **Biological oxidation:** Coenzyme system involved in Biological oxidation . Electron transport chain (its mechanism in energy capture; regulation and inhibition); Uncouplers of ETC; Oxidative phosphorylation;

Unit -3

14 hrs

- 6 **Protein and amino acid metabolism:** protein turn over; nitrogen balance; Catabolism of Amino acids (Transamination, deamination & decarboxylation). Urea cycle and its metabolic disorders; production of bile pigments; hyperbilirubinemia, porphoria, jaundice. Metabolic disorder of Amino acids.
- 7 **Nucleic acid metabolism:** Metabolism of purine and pyrimidine nucleotides; Protein synthesis; Genetic code; inhibition of protein synthesis; mutation and repair mechanism; DNA replication (semiconservative /onion peel models) and DNA repair mechanism.
- 8 **Introduction to clinical chemistry: Cell;** composition; malfunction; Roll of the clinical chemistry laboratory.

Unit -4

10 hrs

- 9 **The kidney function tests:** Role of kidney; Laboratory tests for normal function includes-

- a) Urine analysis (macroscopic and physical examination, quantitative and semiquantitative tests.)
 - b) Test for NPN constituents. (Creatinine /urea clearance, determination of blood and urine creatinine, urea and uric acid)
 - c) Urine concentration test
 - d) Urinary tract calculi. (stones)
- 10 **Liver function tests:** Physiological role of liver, metabolic, storage, excretory, protective, circulatory functions and function in blood coagulation.
- 11 a) Test for hepatic dysfunction-Bile pigments metabolism.
- b) Test for hepatic function test- Serum bilirubin, urine bilirubin, and urine urobilinogen.
 - c) Dye tests of excretory function.
 - d) Tests based upon abnormalities of serum proteins. Selected enzyme tests.

Unit -5

15 hrs

- 12 **Lipid profile tests:** Lipoproteins, composition, functions. Determination of serum lipids, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides.
- 13 **Immunochemical techniques** for determination of hormone levels and protein levels in serum for endocrine diseases and infectious diseases.
Radio immuno assay (RIA) and Enzyme Linked Immuno Sorbent Assay (ELISA)
- 14 **Electrolytes:** Body water, compartments, water balance, and electrolyte distribution. Determination of sodium, calcium potassium, chlorides, bicarbonates in the body fluids.

SEMESTER / YEAR : I YEAR
COURSE CODE : 15PD175
TITLE OF THE COURSE : PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)
L:T:P : 3:1:3

- 1. Limit test (6 exercises)**
 - a. Limit test for chlorides
 - b. Limit test for sulphates
 - c. Limit test for iron
 - d. Limit test for heavy metals
 - e. Limit test for arsenic
 - f. Modified limit tests for chlorides and sulphates

 - 2. Assays (10 exercises)**
 - a. Ammonium chloride- Acid-base titration
 - b. Ferrous sulphate- Cerimetry
 - c. Copper sulphate- Iodometry
 - d. Calcium gluconate- Complexometry
 - e. Hydrogen peroxide – Permanganometry
 - f. Sodium benzoate – Nonaqueous titration
 - g. Sodium chloride – Modified volhard's method
 - h. Assay of KI – KIO_3 titration
 - i. Gravimetric estimation of barium as barium sulphate
 - j. Sodium antimony gluconate or antimony potassium tartarate

 - 3. Estimation of mixture (Any two exercises)**
 - a. Sodium hydroxide and sodium carbonate
 - b. Boric acid and Borax
 - c. Oxalic acid and sodium oxalate
-

4. Test for identity (Any three exercises)

- a. Sodium bicarbonate
- b. Barium sulphate
- c. Ferrous sulphate
- d. Potassium chloride

5. Test for purity (Any two exercises)

- a. Swelling power in Bentonite
- b. Acid neutralising capacity in aluminium hydroxide gel
- c. Ammonium salts in potash alum
- d. Adsorption power heavy Kaolin
- e. Presence of Iodates in KI

6. Preparations (Any two exercises)

- a. Boric acids
- b. Potash alum
- c. Calcium lactate
- d. Magnesium sulphate

Text Books:

1. A text book Inorganic medicinal chemistry by Surendra N. Pandeya
2. Pharmaceutical Inorganic Chemistry by GR.Chatwal
3. Inorganic Pharmaceutical Chemistry by Anand&Chetwal

Reference Books: (Latest Edition)

1. Beckett AH, Stenlake JB. Practical pharmaceutical chemistry Vol I & II. 4th ed. London;Stahlone Press of University of London.
2. Pandey OP, Bajpai DN, Giri S. Practical Chemistry. S Chand Publishers.
3. Shah, Qadry. Textbook of inorganic pharmaceutical chemistry.
4. Indian Pharmacopoeia. 3rd & 4th eds. Delhi: The Controller of Publications, Ministry of Health and Family welfare, Govt. of India;
5. USP and BP
6. Vogel's textbook of quantitative chemical analysis 5th ed.

SEMESTER / YEAR : III YEAR
COURSE CODE : 15PD305
TITLE OF THE COURSE : MEDICINAL CHEMISTRY (Theory)
L:T:P : 3:1:3

- Course objectives**
- The subject deals with the understanding of use of chemical compounds as medicinal agents.
 - It includes study of history, development fundamental principles of drug therapy and use of chemotherapeutic agents.

- Course Outcomes**
- The student will be able to understand the use of chemical agents as drugs to treat various diseases and understand their action in the physiological system.

Unit -1

1. Modern concept of rational drug design: A brief introduction to Quantitative Structure Activity Relationship (QSAR), prodrug, combinatorial chemistry and computer aided drug design (CADD) and concept of antisense molecules. **6hrs**

A study of the development of the following classes of drugs including SAR, Mechanism of action, synthesis of important compounds, chemical nomenclature, brand names of important marketed products and their side effects.

2. Anti-infective agents

- a) Local anti-infective agents
- b) Preservatives
- c) Antifungal agents
- d) Urinary tract anti-infectives
- e) Antitubercular agents
- f) Antiviral agents and Anti AIDS agents
- g) Antiprotozoal agents
- h) Anthelmintics
- i) Antiscabies and Antipedicular agents **10 hrs**

Unit - 2

3. Sulphonamides and sulphones

4. Antimalarials

5. Antineoplastic agents **15hrs**

Unit - 3

6. Antibiotics **14hrs**

Unit - 4

7. Cardiovascular agents

- a) Antihypertensive agents
- b) Antianginal agents and vasodilators
- c) Antiarrhythmic agents
- d) Antihyperlipidemic agents
- e) Coagulants and Anticoagulants
- f) Endocrine

16 hrs

Unit - 5

8. Hypoglycemic agents

9. Thyroid and Antithyroid agents

10. Diuretics

11. Diagnostic agents

12. Steroidal Hormones and Adrenocorticoids

14hrs

SEMESTER / YEAR : III YEAR
COURSE CODE : 15PD305
TITLE OF THE COURSE : MEDICINAL CHEMISTRY (Theory)
L:T:P : 3:1:3

- Course objectives**
- The subject deals with the understanding of use of chemical compounds as medicinal agents.
 - It includes study of history, development fundamental principles of drug therapy and use of chemotherapeutic agents.

- Course Outcomes**
- The student will be able to understand the use of chemical agents as drugs to treat various diseases and understand their action in the physiological system.

Unit -1

1. Modern concept of rational drug design: A brief introduction to Quantitative Structure Activity Relationship (QSAR), prodrug, combinatorial chemistry and computer aided drug design (CADD) and concept of antisense molecules. **6hrs**

A study of the development of the following classes of drugs including SAR, Mechanism of action, synthesis of important compounds, chemical nomenclature, brand names of important marketed products and their side effects.

2. Anti-infective agents

- a) Local anti-infective agents
- b) Preservatives
- c) Antifungal agents
- d) Urinary tract anti-infectives
- e) Antitubercular agents
- f) Antiviral agents and Anti AIDS agents
- g) Antiprotozoal agents
- h) Anthelmintics
- i) Antiscabies and Antipedicular agents **10 hrs**

Unit - 2

3. Sulphonamides and sulphones

4. Antimalarials

5. Antineoplastic agents **15hrs**

Unit - 3

6. Antibiotics **14hrs**

Unit - 4

7. Cardiovascular agents

- a) Antihypertensive agents
- b) Antianginal agents and vasodilators
- c) Antiarrhythmic agents
- d) Antihyperlipidemic agents
- e) Coagulants and Anticoagulants
- f) Endocrine

16 hrs

Unit - 5

8. Hypoglycemic agents

9. Thyroid and Antithyroid agents

10. Diuretics

11. Diagnostic agents

12. Steroidal Hormones and Adrenocorticoids

14hrs

HOSPITAL PHARMACY

COURSE CODE : 15PD402

Objectives: On completion of the course, the student shall be able to

- In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug dispensing, manufacturing of parenteral preparations, drug information, patient counselling, and therapeutic drug monitoring for improved patient care.
- Students will be able to do hospital pharmacy services to both inpatient and out patients like dispensing, distribution, stocking and billing
- prioritize the procurement, manufacturing and storage process of various formulations and handling of radio pharmaceuticals

Course Outcomes (COs): At completion of this course, it is expected that the students will be able to

CO 1. know various drug distribution methods

CO 2 know the professional practice management skills in hospital pharmacies

CO 3. provide unbiased drug information to the doctors

CO 4 know the manufacturing practices of various formulations in hospital set up

CO5. appreciate the practice-based research methods.

CO 6 appreciate the stores management and inventory control.

SEMESTER / YEAR : IV YEAR

COURSE CODE : 15PD402

TITLE OF THE COURSE : HOSPITAL PHARMACY (Theory)

L:T:P : 2:1:3

Unit – 1

1 Hospital - its Organisation and functions

2 Hospital pharmacy-Organisation and management

a) Organizational structure-Staff, Infrastructure & work load statistics

b) Management of materials and finance

c) Roles & responsibilities of hospital pharmacist

3 The Budget – Preparation and implementation

Unit -2

4 Hospital drug policy

a) Pharmacy and Therapeutic committee (PTC)

b) Hospital formulary

c) Hospital committees - Infection committee - Research and ethical committee

d) developing therapeutic guidelines

e) Hospital pharmacy communication - Newsletter

Unit -3

5. Hospital pharmacy services

a) Procurement & warehousing of drugs and Pharmaceuticals

b) Inventory control Definition, various methods of Inventory Control ABC, VED, EOQ, Lead time, safety stock c) Drug distribution in the hospital i) Individual prescription method ii) Floor stock method iii) Unit dose drug distribution method

d) Distribution of Narcotic and other controlled substances e) Central sterile supply services – Role of pharmacist

Unit -4

6. Manufacture of Pharmaceutical preparations

i Sterile formulations – large and small volume parenterals

ii Manufacture of Ointments, Liquids, and creams

iii Manufacturing of Tablets, granules, capsules, and powders

iv Total parenteral nutrition

Unit -5

7. Continuing professional development programs Education and training

8. Radio Pharmaceuticals – Handling and packaging

9. Professional Relations and practices of hospital pharmacist

15PD501 - CLINICAL RESEARCH

Objectives: In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug dispensing, manufacturing of parenteral preparations, drug information, patient counseling, and therapeutic drug monitoring for improved patient care.

The Primary objectives of this course are to:

1. Know the concept of new drug development process.
2. Understand the regulatory and ethical requirements.
3. Conduct the clinical trials in accordance with regulatory and ethical requirements.
4. Coordinate the clinical trials and promote quality drug trial research.

Course Outcomes:

CO 1. Throughly understand the concept of drug discovery

CO 2. Various aspects involved in drug discovery

CO 3. The standard procedures involved in drug discovery

CO 4. The governing bodies responsible for drug discovery

CO5. appreciate the practice based research methods.

1. Drug development process: Introduction Various Approaches to drug discovery

1. Pharmacological
2. Toxicological
3. IND Application
4. Drug characterization
5. Dosage form

2. Clinical development of drug:

1. Introduction to Clinical trials
2. Various phases of clinical trial.
3. Methods of post marketing surveillance
4. Abbreviated New Drug Application submission.
5. Good Clinical Practice – ICH, GCP, Central drug standard control organisation (CDSCO) guidelines
6. Challenges in the implementation of guidelines
7. Ethical guidelines in Clinical Research
8. Composition, responsibilities, procedures of IRB / IEC

9. Overview of regulatory environment in USA, Europe and India.
10. Role and responsibilities of clinical trial personnel as per ICH GCP a. Sponsor b. Investigators c. Clinical research associate d. Auditors e. Contract research coordinators f. Regulatory authority
11. Designing of clinical study documents (protocol, CRF, ICF, PIC with assignment)
12. Informed consent Process
13. Data management and its components
14. Safety monitoring in clinical trials.

References:

1. Central Drugs Standard Control Organization. Good Clinical Practices-Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.
2. International Conference on Harmonisation of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonised Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996.
3. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.
4. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons. e. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes. f. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition, Jan 2000, Wiley Publications. g. Goodman & Gilman: JG Hardman, LE Limbard, 10th Edn. McGraw Hill Publications, 2001.

1. Drug development process: Introduction Various Approaches to drug discovery

2. Clinical development of drug

CLINICAL PHARMACOKINETICS AND PHARMACOTHERAPEUTIC DRUG MONITORING -THEORY

COURSE CODE : 15PD503

Scope: This course is designed to make the students to understand and apply pharmacokinetic principles in designing / individualizing dosage regimen. Also, enable the students to interpret the plasma drug range, and hepatic / renal function in optimizing the drug therapy.

Objectives: On completion of the course, the student shall be able to

1. Design the drug therapy regimen for individual patient
2. Interpret and correlate the plasma drug concentration with patient's therapeutic outcome.
3. Recommend dosage adjustment for patients with renal/ hepatic impairment
4. Detect and manage drug-drug interactions

Course Outcomes (COs): At completion of this course it is expected that the students will be able to

CO 1 : Design the dosage regimen for the given drug based on the pharmacokinetic principles and route of administration

CO 2 : Individualize the dosage regimen for the patients with altered pharmacokinetics viz. renal / hepatic impairment, pediatrics, geriatrics, etc.

CO 3 : Interpret the results of therapeutic drug monitoring services of various drugs and give required recommendations for the dosage adjustment of those drugs, if required towards optimizing the treatment outcome.

CO 4 : Formulate protocol(s) for the therapeutic drug monitoring of drug(s) and initiate the service in collaboration with other healthcare team members.

CO 5 : Associate the genetic polymorphisms of the patients, if any with the clinical outcomes of the patients

SEMESTER / YEAR : V YEAR

COURSE CODE : 15PD503

TITLE OF THE COURSE : CLINICAL PHARMACOKINETICS & PHARMACOTHERAPEUTICS DRUG MONITORING (Theory)

L:T:P : 2:1:0

Unit -1

1. Introduction to Clinical pharmacokinetics.
2. Design of dosage regimens: Nomograms and Tabulations in designing dosage regimen, Conversion from intravenous to oral dosing, Determination of dose and dosing intervals, Drug dosing in the elderly and pediatrics and obese patients.
3. Pharmacokinetics of Drug Interaction: a. Pharmacokinetic drug interactions b. Inhibition and Induction of Drug metabolism c. Inhibition of Biliary Excretion.

Unit -2

4. Therapeutic Drug monitoring:

- a. Introduction
- b. Individualization of drug dosage regimen (Variability – Genetic, Age and Weight, disease, Interacting drugs).
- c. Indications for TDM. Protocol for TDM.

- d. Pharmacokinetic/Pharmacodynamic Correlation in drug therapy.
- e. TDM of drugs used in the following disease conditions: cardiovascular disease, Seizure disorders, Psychiatric conditions, and Organ transplantations.

Unit -3

5. Dosage adjustment in Renal and hepatic Disease. a. Renal impairment b. Pharmacokinetic considerations c. General approach for dosage adjustment in renal disease. d. Measurement of Glomerular Filtration rate and creatinine clearance. e. Dosage adjustment for uremic patients. f. Extracorporeal removal of drugs. g. Effect of Hepatic disease on pharmacokinetics.

Unit -4

6. Population Pharmacokinetics. a. Introduction to Bayesian Theory. b. Adaptive method or Dosing with feedback. c. Analysis of Population pharmacokinetic Data.

Unit -5

7. Pharmacogenetics a. Genetic polymorphism in Drug metabolism: Cytochrome P-450 Isoenzymes. b. Genetic Polymorphism in Drug Transport and Drug Targets. c. Pharmacogenetics and Pharmacokinetics / Pharmacodynamic considerations

SEMESTER/YEAR : I SEM

COURSE CODE : 17BP104

TITLE OF THE COURSE : PHARMACEUTICAL INORGANIC CHEMISTRY - THEORY

L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This subject deals with the monographs of inorganic drugs and pharmaceuticals.

COURSE OBJECTIVES: Upon completion of course student shall be able to

1. know the sources of impurities and methods to determine the impurities in inorganic drugs and pharmaceuticals
2. understand the medicinal and pharmaceutical importance of inorganic compounds

UNIT I 10 Hours

Impurities in pharmaceutical substances: History of Pharmacopoeia, Sources and types of impurities, principle involved in the limit test for Chloride, Sulphate, Iron, Arsenic, Lead and Heavy metals, modified limit test for Chloride and Sulphate

General methods of preparation, assay for the compounds superscripted with **asterisk (*)**, properties and medicinal uses of inorganic compounds belonging to the following classes

UNIT II 10 Hours

Acids, Bases and Buffers: Buffer equations and buffer capacity in general, buffers in pharmaceutical systems, preparation, stability, buffered isotonic solutions, measurements of tonicity, calculations and methods of adjusting isotonicity.

Major extra and intracellular electrolytes: Functions of major physiological ions, Electrolytes used in the replacement therapy: Sodium chloride*, Potassium chloride, Calcium gluconate* and Oral Rehydration Salt (ORS), Physiological acid base balance.

Dental products: Dentifrices, role of fluoride in the treatment of dental caries, Desensitizing agents, Calcium carbonate, Sodium fluoride, and Zinc eugenol cement.

UNIT III 10 Hours

Gastrointestinal agents

Acidifiers: Ammonium chloride* and Dil. HCl

Antacid: Ideal properties of antacids, combinations of antacids, Sodium Bicarbonate*, Aluminum hydroxide gel, Magnesium hydroxide mixture

Cathartics: Magnesium sulphate, Sodium orthophosphate, Kaolin and Bentonite

Antimicrobials: Mechanism, classification, Potassium permanganate, Boric acid, Hydrogen peroxide*, Chlorinated lime*, Iodine and its preparations

UNIT IV 08 Hours

Miscellaneous compounds

Expectorants: Potassium iodide, Ammonium chloride*. **Emetics:** Copper sulphate*, Sodium potassium tartarate **Haematinics:** Ferrous sulphate*, Ferrous gluconate

Poison and Antidote: Sodium thiosulphate*, Activated charcoal, Sodium nitrite³³³

Astringents: Zinc Sulphate, Potash Alum

UNIT V 07 Hours

Radiopharmaceuticals: Radio activity, Measurement of radioactivity, Properties of α , β , γ radiations, Half life, radio isotopes and study of radio isotopes - Sodium iodide I131, Storage conditions, precautions & pharmaceutical application of radioactive substances.

SEMESTER/YEAR : I SEM

COURSE CODE : 17BP110

TITLE OF THE COURSE : PHARMACEUTICAL INORGANIC CHEMISTRY-PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

I. Limit tests for following ions

Limit test for Chlorides and Sulphates

Modified limit test for Chlorides and Sulphates

Limit test for Iron

Limit test for Heavy metals

Limit test for Lead

Limit test for Arsenic

II. Identification test Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate

III. Test for purity

Swelling power of Bentonite

Neutralizing capacity of aluminum hydroxide gel

Determination of potassium iodate and iodine in potassium Iodide

IV. Preparation of inorganic pharmaceuticals

Boric acid Potash alum Ferrous Sulphate

RECOMMENDED BOOKS (LATEST EDITIONS) :

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition
4. M.L Schroff, Inorganic Pharmaceutical Chemistry
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry
7. Indian Pharmacopoeia

SEMESTER/YEAR : II SEM
COURSE CODE : 17BP204
TITLE OF THE COURSE : PATHOPHYSIOLOGY - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45Hours

Pathophysiology is the study of causes of diseases and reactions of the body to such disease producing causes. This course is designed to impart a thorough knowledge of the relevant aspects of pathology of various conditions with reference to its pharmacological applications, and understanding of basic pathophysiological mechanisms. Hence it will not only help to study the syllabus of pathology, but also to get baseline knowledge required to practice medicine safely, confidently, rationally and effectively.

COURSE OBJECTIVES: Upon completion of the subject student shall be able to

1. Describe the etiology and pathogenesis of the selected disease states;
2. Name the signs and symptoms of the diseases; and
3. Mention the complications of the diseases.

UNIT I

10Hours

Basic principles of Cell injury and Adaptation:

Introduction, definitions, Homeostasis, Components and Types of Feedback systems, Causes of cellular injury, Pathogenesis (Cell membrane damage, Mitochondrial damage, Ribosome damage, Nuclear damage), Morphology of cell injury – Adaptive changes (Atrophy, Hypertrophy, hyperplasia, Metaplasia, Dysplasia), Cell swelling, Intra cellular accumulation, Calcification, Enzyme leakage and Cell Death Acidosis & Alkalosis, Electrolyte imbalance

Basic mechanism involved in the process of inflammation and repair:

Introduction, Clinical signs of inflammation, Different types of Inflammation, Mechanism of Inflammation – Alteration in vascular permeability and blood flow, migration of WBC's, Mediators of inflammation, Basic principles of wound healing in the skin, Pathophysiology of Atherosclerosis

UNIT II

10Hours

Cardiovascular System:

Hypertension, congestive heart failure, ischemic heart disease (angina, myocardial infarction, atherosclerosis and arteriosclerosis)

Respiratory system: Asthma, Chronic obstructive airways diseases.

Renal system: Acute and chronic renal failure.

UNIT III

10Hours

Haematological Diseases:

Iron deficiency, megaloblastic anemia (Vit B12 and folic acid), sickle cell anemia, thalasemia, hereditary acquired anemia, hemophilia

Endocrine system: Diabetes, thyroid diseases, disorders of sex hormones

Nervous system: Epilepsy, Parkinson's disease, stroke, psychiatric disorders:

depression, schizophrenia and Alzheimer's disease.

Gastrointestinal system: Peptic Ulcer

UNIT IV

8 Hours

Inflammatory bowel diseases, jaundice, hepatitis (A,B,C,D,E,F) alcoholic liver disease.

Disease of bones and joints: Rheumatoid arthritis, osteoporosis and gout

Principles of cancer: classification, etiology and pathogenesis of cancer

Diseases of bones and joints:Rheumatoid Arthritis, Osteoporosis,Gout

Principles of Cancer: **Classification, etiology and pathogenesis of Cancer**

UNIT V

7 Hours

Infectious diseases:Meningitis,Typhoid, Leprosy, Tuberculosis

Urinary tract infections

Sexually transmitted diseases:**AIDS, Syphilis, Gonorrhoea**

RECOMMENDED BOOKS (LATEST EDITIONS):

1. Vinay Kumar, Abul K. Abas, Jon C. Aster; Robbins & Cotran Pathologic Basis of Disease; South Asia edition; India; Elsevier; 2014.
2. Harsh Mohan; Text book of Pathology; 6th edition; India; Jaypee Publications; 2010.
3. Laurence B, Bruce C, Bjorn K. ; Goodman Gilman's The Pharmacological Basis of Therapeutics; 12th edition; New York; McGraw-Hill; 2011.
4. Best, Charles Herbert 1899-1978; Taylor, Norman Burke 1885-1972; West, John B (John Burnard); Best and Taylor's Physiological basis of medical practice; 12th ed; united states;
5. William and Wilkins, Baltimore;1991 [1990 printing].
6. Nicki R. Colledge, Brian R. Walker, Stuart H. Ralston;Davidson's Principles and Practice of Medicine; 21st edition; London; ELBS/Churchill Livingstone; 2010.
7. Guyton A, John .E Hall; Textbook of Medical Physiology; 12th edition; WB Saunders Company; 2010.
8. Joseph DiPiro, Robert L. Talbert, Gary Yee, Barbara Wells, L. Michael Posey; Pharmacotherapy: A Pathophysiological Approach; 9th edition; London; McGraw-Hill Medical; 2014.
9. V. Kumar, R. S. Cotran and S. L. Robbins; Basic Pathology; 6th edition; Philadelphia;WB Saunders Company; 1997.
10. Roger Walker, Clive Edwards; Clinical Pharmacy and Therapeutics; 3rd edition; London; Churchill Livingstone publication; 2003.

RECOMMENDED JOURNALS:

1. The Journal of Pathology. ISSN: 1096-9896 (Online)
2. The American Journal of Pathology. ISSN: 0002-9440
3. Pathology. 1465-3931 (Online)
4. International Journal of Physiology, Pathophysiology and Pharmacology. ISSN: 1944-8171(Online)
5. Indian Journal of Pathology and Microbiology. ISSN-0377-4929.

SEMESTER/YEAR : II SEM
COURSE CODE : 17BP206
TITLE OF THE COURSE : ENVIRONMENTAL SCIENCES - THEORY
L: T/A: P: C : 3: 0: 0: 3

30 Hours

Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

COURSE OBJECTIVES: Upon completion of the course the student shall be able to:

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
6. Strive to attain harmony with Nature.

UNIT-I

10 Hours

The Multidisciplinary nature of environmental studies

Natural Resources

Renewable and non-renewable resources: Natural resources and associated problems

a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

UNIT-II

10 Hours

Ecosystems

Concept of an ecosystem.

Structure and function of an ecosystem.

Introduction, types, characteristic features, structure and function of the ecosystems:

Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT- III

10 Hours

Environmental Pollution: Air pollution; Water pollution; Soil pollution

RECOMMENDED BOOKS (LATEST EDITION):

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clarendon Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP304
TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

COURSE OBJECTIVES: Upon completion of the course student shall be able:

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various test to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

UNIT-I

10 Hours

Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.

Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.

Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

UNIT-II

10 Hours

Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator.

Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

UNIT- III

08 Hours

Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. Principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

UNIT-IV

08 Hours

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.

Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

UNIT- V

07 Hours

Materials of pharmaceutical plant construction, Corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Introduction to chemical engineering - Walter L Badger & Julius Banchemo, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering - McCabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices - C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

Physical Pharmaceutics – I (Practical)

4 Hrs/week

Objectives: Upon the completion of the course student shall be able to perform

1. To understand the significance of physical properties such as
 2. solubility, surface tension, partition coefficient and pKa in the design of dosage forms.
 3. To explain adsorption isotherms and determine Freundlich-Langmuir constant using activated charcoal.
 4. To apply Henderson – Hasselbalch equation for interpretation of pKa value of drugs.
 5. To determine the surface tension of sample liquids by drop count and drop weight methods
 6. To deduce the HLB value and critical micellar concentration of a surfactant.
 7. To estimate the stability constants of complexes by solubility and pH titration methods.
-
1. Determination the solubility of drug at room temperature
 2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
 3. Determination of Partition co- efficient of benzoic acid in benzene and water
 4. Determination of Partition co- efficient of Iodine in CCl₄ and water
 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
 6. Determination of surface tension of given liquids by drop count and drop weight method
 7. Determination of HLB number of a surfactant by saponification method
 8. Determination of Freundlich and Langmuir constants using activated char coal
 9. Determination of critical micellar concentration of surfactants
 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
 11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP308
TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING - ~~THEORY~~ *Practicals.*
L: T/A: P: C : 0 : 0 : 4 : 2

1. Determination of radiation constant of brass, iron, unpainted and painted glass.
2. Steam distillation - To calculate the efficiency of steam distillation.
3. To determine the overall heat transfer coefficient by heat exchanger.
4. Construction of drying curves (for calcium carbonate and starch).
5. Determination of moisture content and loss on drying.
6. Determination of humidity of air - i) From wet and dry bulb temperatures - use of Dew point method.
7. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
8. Size analysis by sieving - To evaluate size distribution of tablet granulations - Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
11. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity)
12. To study the effect of time on the Rate of Crystallization.
13. To calculate the uniformity Index for given sample by using Double Cone Blender.

SEMESTER/YEAR : IV SEM

COURSE CODE : 17BP406

TITLE OF THE COURSE : MEDICINAL CHEMISTRY – I - PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

I Preparation of drugs/ intermediates

- 1 1,3-pyrazole
- 2 1,3-oxazole
- 3 Benzimidazole
- 4 Benzotriazole
- 5 2,3- diphenyl quinoxaline
- 6 Benzocaine
- 7 Phenytoin
- 8 Phenothiazine
- 9 Barbiturate

II Assay of drugs

- 1 Chlorpromazine
- 2 Phenobarbitone
- 3 Atropine
- 4 Ibuprofen
- 5 Aspirin
- 6 Furosemide

III Determination of Partition coefficient for any two drugs

RECOMMENDED BOOKS (LATEST EDITIONS):

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1-5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel

SEMESTER/YEAR: IV SEM

COURSE CODE: 17BP407

TITLE OF THE COURSE: PHYSICAL PHARMACEUTICS-II - PRACTICAL

L: T/A: P: C: 0: 0: 4: 2

Course objective:

Upon completion students shall be able to have relevant knowledge on:

- Different states of flow
- Principles of chemical kinetics
- Fundamental properties of particles
- Rheological properties of liquid by suitable methods

Course outcome:

Upon completion students shall be able to:

- Describe the pharmaceutical significance of different states of flow to drug delivery system
 - Describe, analyse and distinguish the fundamental properties of particles
 - Know the principles of chemical kinetics and use them for stability testing and determination of expiry date of formulations
 - Understand the sedimentation behaviour of coarse dispersion and order of reaction of various first and second order reaction
 - Know the rheological properties of liquids by suitable methods
1. Determination of particle size, particle size distribution using sieving method
 2. Determination of particle size, particle size distribution using Microscopic method
 3. Determination of bulk density, true density and porosity
 4. Determine the angle of repose and influence of lubricant on angle of repose
 5. Determination of viscosity of liquid using Ostwald's viscometer
 6. Determination sedimentation volume with effect of different suspending agent
 7. Determination sedimentation volume with effect of different concentration of single suspending agent
 8. Determination of viscosity of semisolid by using Brookfield viscometer
 9. Determination of reaction rate constant first order.
 10. Determination of reaction rate constant second order
 11. Accelerated stability studies

SEMESTER/YEAR: V SEM

COURSE CODE: 17BP502

TITLE OF THE COURSE: FORMULATIVE PHARMACY - THEORY

L: T/A: P: C: 3 : 1 : 0 : 4

45 Hours

Course enables the student to understand and appreciate the influence of pharmaceutical additives and various pharmaceutical dosage forms on the performance of the drug product.

COURSE OBJECTIVES: Upon completion of the course the student shall be able to

- Know the various pharmaceutical dosage forms and their manufacturing techniques.
- Know various considerations in development of pharmaceutical dosage forms
- Formulate solid, liquid and semisolid dosage forms and evaluate them for their quality

COURSE OUTCOME

After the successful completion of the course the students will be able to

CO 1: Outline the importance of preformulation in development of pharmaceutical dosage forms and illustrate the stability studies on different dosage forms

CO 2: Annotate the formulation, formulation requirement, manufacturing techniques and evaluation of tablets and liquids.

CO 3: Analyse the role of Capsules and Pellets in Pharmaceutical industry

CO 4: Estimate the importance of formulation requirement, method of preparation and sterility of sterile dosage form.

CO 5: Recapitulate the formulation, method of preparation and evaluation of cosmetics, Pharmaceutical Aerosols and summarize the use of packaging materials.

UNIT-I

07 Hours

Preformulation Studies: Introduction to preformulation, goals and objectives, study of physicochemical characteristics of drug substances.

a. Physical properties: Physical form (crystal & amorphous), particle size, shape, flow properties, solubility profile (pKa, pH, partition coefficient), polymorphism

b. Chemical Properties: Hydrolysis, oxidation, reduction, racemisation, polymerization BCS classification of drugs & its significant.

Application of preformulation considerations in the development of solid, liquid oral and parenteral dosage forms and its impact on stability of dosage forms.

UNIT-II

10 Hours

Tablets: a. Introduction, ideal characteristics of tablets, classification of tablets. Excipients, Formulation of tablets, granulation methods, compression and processing problems. Equipments and tablet tooling. b. Tablet coating: Types of coating, coating materials, formulation of coating composition, methods of coating, equipment employed and defects in coating. c. Quality control tests: In process and finished product tests

Liquid orals: Formulation and manufacturing consideration of syrups and elixirs, suspensions and emulsions; Filling and packaging; evaluation of liquid orals official in pharmacopoeia

UNIT-III

08 Hours

Capsules: a. Hard gelatin capsules: Introduction, Production of hard gelatin capsule shells. Size of capsules, Filling, finishing and special techniques of formulation of hard gelatin capsules, manufacturing defects. In process and final product quality control tests for capsules.

b. Soft gelatin capsules: Nature of shell and capsule content, size of capsules, importance of base adsorption and minim/gram factors, production, in process and final product quality control tests. Packing, storage and stability testing of soft gelatin capsules and their applications.

Pellets: Introduction, formulation requirements, pelletization process, equipments for manufacture of pellets

UNIT-IV

10 Hours

Parenteral Products: a. Definition, types, advantages and limitations. Preformulation factors and essential requirements, vehicles, additives, importance of isotonicity. b. Production procedure, production facilities and controls, aseptic processing. c. Formulation of injections, sterile powders, large volume parenterals and lyophilized products. d. Containers and closures selection, filling and sealing of ampoules, vials and infusion fluids. Quality control tests of parenteral products.

Ophthalmic Preparations: Introduction, formulation considerations; formulation of eye drops, eye ointments and eye lotions; methods of preparation; labelling, containers; evaluation of ophthalmic preparations

UNIT-V

10 Hours

Cosmetics: Formulation and preparation of the following cosmetic preparations: lipsticks, shampoos, cold cream and vanishing cream, tooth pastes, hair dyes and sunscreens.

Pharmaceutical Aerosols: Definition, propellants, containers, valves, types of aerosol systems; formulation and manufacture of aerosols; Evaluation of aerosols; Quality control and stability studies.

Packaging Materials Science: Materials used for packaging of pharmaceutical products, factors influencing choice of containers, legal and official requirements for containers, stability aspects of packaging materials, quality control tests

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman & J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman
7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition
8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5th edition, 2005
9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107

SEMESTER/YEAR : VI SEM
COURSE CODE : 17BP601
TITLE OF THE COURSE : MEDICINAL CHEMISTRY – III - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

COURSE OBJECTIVES: Upon completion of the course student shall be able to

1. Understand the importance of drug design and different techniques of drug design.
2. Understand the chemistry of drugs with respect to their biological activity.
3. Know the metabolism, adverse effects and therapeutic value of drugs.
4. Know the importance of SAR of drugs.

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*)

UNIT – I

10 Hours

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

β-Lactam antibiotics: Penicillin, Cephalosporins, β- Lactamase inhibitors, Monobactams

Aminoglycosides: Streptomycin, Neomycin, Kanamycin

Tetracyclines: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

UNIT – II

10 Hours

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

Macrolide: Erythromycin Clarithromycin, Azithromycin.

Miscellaneous: Chloramphenicol*, Clindamycin.

Prodrugs: Basic concepts and application of prodrugs design.

Antimalarials: Etiology of malaria.

Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine.

Biguanides and dihydro triazines: Cycloguanil pamoate, Proguanil.

Miscellaneous: Pyrimethamine, Artesunate, Artemether, Atovoquone.

UNIT – III

10 Hours

Anti-tubercular Agents

Synthetic anti tubercular agents: Isoniazid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.*

Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine Streptomycin, Capreomycin sulphate.

Urinary tract anti-infective agents

Quinolones: SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin

Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine.

Antiviral agents:

Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

UNIT – IV

08 Hours

Antifungal agents:

Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin.

Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole, Tioconazole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.

Anti-protozoal Agents: Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.

Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.

Sulphonamides and Sulfones

Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxazole*, Sulphadiazine, Mefenide acetate, Sulfasalazine.

Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole.

Sulfones: Dapsone*.

UNIT – V

07 Hours

Introduction to Drug Design

Various approaches used in drug design.

Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.

SEMESTER/YEAR : VI SEM

COURSE CODE : 17BP604

TITLE OF THE COURSE : BIOPHARMACEUTICS AND PHARMACOKINETICS –
THEORY

This subject is designed to impart knowledge and skills of Biopharmaceutics and pharmacokinetics and their applications in pharmaceutical development, design of dose and dosage regimen and in solving the problems arised therein.

COURSE OBJECTIVES:

1. Understand the basic concepts in biopharmaceutics and pharmacokinetics and their significance. 2. Use of plasma drug concentration-time data to calculate the pharmacokinetic parameters to describe the kinetics of drug absorption, distribution, metabolism, excretion, elimination.
3. To understand the concepts of bioavailability and bioequivalence of drug products and their significance.
4. Understand various pharmacokinetic parameters, their significance & applications.

COURSE OUTCOME

CO1: Define the basic concepts in biopharmaceutics and pharmacokinetics

CO2: Select the correct pharmacokinetic model based on plasma level or urinary excretion data that best describes the process of drug absorption, distribution, metabolism and elimination (ADME)

CO3: Determine the effect of Pharmacokinetic (ADME) parameters on the biological effects of the drug

CO4: Carry out biopharmaceutical studies and use data so obtained in the development of new drugs or dosage forms

CO5: Calculate various pharmacokinetic parameters from plasma and urinary excretion data applying compartment modeling and model independent methods

CO6: Design dosage regimens for patients based on calculated pharmacokinetic parameters

CO7: Design Bioavailability and Bioequivalence studies of new drugs or dosage forms

UNIT- 1

Introduction Biopharmaceutics to Absorption;

Mechanisms of drug absorption through GIT, factors influencing drug absorption though GIT, absorption of drug from Non per oral extra-vascular routes, Distribution Tissue permeability of drugs, binding of drugs, apparent, volume of drug distribution, plasma and tissue protein

binding of drugs, factors affecting protein-drug binding. Kinetics of protein binding, Clinical significance of protein Elimination binding of drugs.

UNIT- II

Elimination: Drug metabolism and basic understanding metabolic pathways renal excretion of drugs, factors affecting renal excretion of drugs, renal clearance, Non renal routes of drug excretion of drugs

Bioavailability and Bioequivalence: Definition and Objectives of bioavailability, absolute and relative bioavailability, measurement of bioavailability, in-vitro drug dissolution models, in-vitro-in-vivo correlations, bioequivalence studies, methods to enhance the dissolution rates and bioavailability of poorly soluble drugs.

UNIT- III

Pharmacokinetics: Definition and introduction to Pharmacokinetics, Compartment models, Non compartment models, physiological models, One compartment open model. (a). Intravenous Injection (Bolus) (b). Intravenous infusion and (c) Extra vascular administrations. Pharmacokinetics parameters - KE , $t_{1/2}$, V_d , AUC , K_a , Cl_t and CLR definitions methods of eliminations, understanding of their significance and Application.

UNIT- IV

Multicompartment models: Two compartment open model. IV bolus Kinetics of multiple dosing, steady state drug levels, calculation of loading and maintenance doses and their significance in clinical settings.

UNIT- V

Nonlinear Pharmacokinetics: a. Introduction, b. Factors causing Non-linearity. c. Michaelis-menton method of estimating parameters, Explanation with example of drugs.

SEMESTER/YEAR : VI SEM

COURSE CODE : 17BP605

TITLE OF THE COURSE : PHARMACEUTICAL BIOTECHNOLOGY – THEORY

L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

Biotechnology has a long promise to revolutionize the biological sciences and technology. Scientific application of biotechnology in the field of genetic engineering, medicine and fermentation technology makes the subject interesting. Biotechnology is leading to new biological revolutions in diagnosis, prevention and cure of diseases, new and cheaper pharmaceutical drugs. Biotechnology has already produced transgenic crops and animals and the future promises lot more. It is basically a research-based subject.

COURSE OBJECTIVES:

Upon completion of the subject student shall be able to;

1. Understanding the importance of Immobilized enzymes in Pharmaceutical Industries
2. Genetic engineering applications in relation to production of pharmaceuticals
3. Importance of Monoclonal antibodies in Industries
4. Appreciate the use of microorganisms in fermentation technology

COURSE OUTCOMES:

1. Understand the importance of immobilised enzymes, biosensors and production of enzymes in Pharmaceutical Industry.
2. Discuss genetic engineering applications and method of preparation of various vaccines and antibiotics in relation to production of pharmaceuticals.
3. Explain protein engineering, Recombinant DNA technology, DNA Ligase, restriction endonuclease and its applications in relation to production of pharmaceuticals.
4. Develop skills to find out the importance of Immunity, PCR, Cloning vectors, Hybridoma technology and monoclonal antibodies in Industries.
5. Understand the importance of Blood products and plasma substitutes along with immunoblotting techniques (ELISA, Western and Southern Blotting) and different new technologies in fermentation

UNIT I 10 Hours

- a) Brief introduction to Biotechnology with reference to Pharmaceutical Sciences.
- b) Enzyme Biotechnology- Methods of enzyme immobilization and applications.
- c) Biosensors- Working and applications of biosensors in Pharmaceutical Industries.
- d) Brief introduction to Protein Engineering.
- e) Use of microbes in industry. Production of Enzymes- General consideration - Amylase, Catalase, Peroxidase, Lipase, Protease, Penicillinase.
- f) Basic principles of genetic engineering.

UNIT II 10 Hours

- a) Study of cloning vectors, restriction endonucleases and DNA ligase.
- b) Recombinant DNA technology. Application of genetic engineering in medicine.
- c) Application of r DNA technology and genetic engineering in the production of:
- d) Interferon ii) Vaccines- hepatitis- B iii) Hormones-Insulin.

e) Brief introduction to PCR

Unit III 10 Hours

Types of immunity- humoral immunity, cellular immunity

- a) Structure of Immunoglobulins
- b) Structure and Function of MHC
- c) Hypersensitivity reactions, Immune stimulation and Immune suppressions.
- d) General method of the preparation of bacterial vaccines, toxoids, viral vaccine, antitoxins, serum-immune blood derivatives and other products relative to immunity.
- e) Storage conditions and stability of official vaccines
- f) Hybridoma technology- Production, Purification and Applications
- g) Blood products and Plasma Substitutes.

UNIT IV 08 Hours

- a) Immuno blotting techniques- ELISA, Western blotting, Southern blotting.
- b) Genetic organization of Eukaryotes and Prokaryotes
- c) Microbial genetics including transformation, transduction, conjugation, plasmids and transposons.
- d) Introduction to Microbial biotransformation and applications.
- e) Mutation: Types of mutation/mutants.

UNIT V 07 Hours

- a) Fermentation methods and general requirements, study of media, equipments, sterilization methods, aeration process, stirring.
- b) Large scale production fermenter design and its various controls.
- c) Study of the production of - penicillins, citric acid, Vitamin B12, Glutamic acid, Griseofulvin,
- d) Blood Products: Collection, Processing and Storage of whole human blood, dried human plasma, plasma Substitutes.

RECOMMENDED BOOKS (LATEST EDITION):

1. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of Recombinant DNA: ASM Press Washington D.C.
2. RA Goldshy et. al.,: Kuby Immunology.
3. J.W. Goding: Monoclonal Antibodies.
4. J.M. Walker and E.B. Gingold: Molecular Biology and Biotechnology by Royal Society of Chemistry.
5. Zaborsky: Immobilized Enzymes, CRC Press, Degraland, Ohio.
6. S.B. Primrose: Molecular Biotechnology (Second Edition) Blackwell Scientific Publication.
7. Stanbury F., P., Whitakar A., and Hall J., S., Principles of fermentation technology, 2nd edition, Aditya books Ltd., New Delhi

SEMESTER/YEAR: VII SEM
COURSE CODE : 17BP706
TITLE OF THE COURSE : PRACTICE SCHOOL
L: T/A: P: C : 3 : 1 : 0 : 4

COURSE OBJECTIVES:

- Students will get exposure to the practical application of knowledge and skills previously learned through conventional classroom teaching and laboratory experiments.
- To provide research related training to students
- Enhancing the report writing skill

COURSE OUTCOME

- Students will gain confidence in practical aspects
- Students can think of research objective and possibilities to get solutions
- Enhance their calculation abilities and thinking aspect.

PHARMACEUTICS SYLLABUS

1. To prepare **granules** of given sample by using wet granulation.
2. To prepare 25 tablets for the given drug using wet granulation technique.
3. To formulate **albumin microparticles** of given drug.
4. To prepare **solid dispersion** of given drug with Urea/Mannitol/Eudragit by
5. fusion method.
6. To prepare and evaluate **herbal cold cream**.
7. To prepare lipstick
8. To prepare tablets by wet granulation method and perform evaluation tests.
9. To prepare **diclofenac gel**
10. To prepare **nanoparticles**.

PHARMACHEMISTRY SYLLABUS

1. **Microwave assisted synthesis of Aspirin, Paracetamol, benzimidazole and fluorescein.**
2. **Molecular docking studies**
3. Phytochemical **extractions** and estimations
4. Microbial bioconversions
5. **Bioconversion using plant metabolites**

PHARMACOGNOSY SYLLABUS

1. Herbarium
2. Extraction of plant content by Maceration
3. Coconut oil extraction
4. Hydro distillation (Clavenger apparatus)
5. Determination of acid value in oils and fats
6. Column chromatography
7. Thin layer chromatography
8. Estimation of total alkaloid content

PHARMACOLOGY SYLLABUS

1. Isolation of RNA
2. Estimation of RNA
3. Estimation of protein
4. PCR Technique Assessment Of ECG HR and BP from Rodents
5. Assessment Of Respiration Using Power lab
6. Screening Models of Analgesics
7. Alzheimer's screening Models
8. Screening Models of AntiUlcer Drugs
9. Carotid Artery Occlusion
10. Cell culture and MTT Assay
11. Whole Body Perfusion
12. Coronary Artery Occlusion

SEMESTER/YEAR : VIII SEM
COURSE CODE : 17BP804
TITLE OF THE COURSE : PHARMACEUTICAL REGULATORY SCIENCE
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

Scope: This course is designed to impart the fundamental knowledge on the regulatory requirements for approval of new drugs, and drug products in regulated markets of India & other countries like US, EU, Japan, Australia, UK etc. It prepares the students to learn in detail on the regulatory requirements, documentation requirements, and registration procedures for marketing the drug products.

Course objectives: Upon completion of the subject student shall be able to;

1. Know about the process of drug discovery and development
2. Know the regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
3. Know the regulatory approval process and their registration in Indian and international markets

UNIT I

10 Hours

New Drug Discovery and development

Stages of drug discovery, Drug development process, pre-clinical studies, non-clinical activities, clinical studies, Innovator and generics, Concept of generics, Generic drug product development.

UNIT II

10 Hours

Regulatory Approval Process

Approval processes and timelines involved in Investigational New Drug (IND), New Drug Application (NDA), Abbreviated New Drug Application (ANDA). Changes to an approved NDA / ANDA.

Regulatory authorities and agencies

Overview of regulatory authorities of India, United States, European Union, Australia, Japan, Canada (Organization structure and types of applications)

UNIT III

10 Hours

Registration of Indian drug product in overseas market

Procedure for export of pharmaceutical products, Technical documentation, Drug Master Files (DMF), Common Technical Document (CTD), electronic Common Technical Document (eCTD), ASEAN Common Technical Document (ACTD) research.

SEMESTER / YEAR	: VIII SEM
COURSE CODE	:17BP805
TITLE OF THE COURSE	:PHARMACOVIGILANCE
L: T/A: P: C	: 3 : 1 : 0 : 4

COURSE OBJECTIVES:

At completion of this course, it is expected that students will be able to:

1. Why drug safety monitoring is important?
2. History and development of pharmacovigilance
3. National and international scenario of pharmacovigilance
4. Dictionaries, coding and terminologies used in pharmacovigilance
5. Detection of new adverse drug reactions and their assessment
6. International standards for classification of diseases and drugs
7. Adverse drug reaction reporting systems and communication in pharmacovigilance
8. Methods to generate safety data during pre clinical, clinical and post approval phases of drugs' life cycle
9. Drug safety evaluation in paediatrics, geriatrics, pregnancy and lactation
10. Pharmacovigilance Program of India (PvPI) requirement for ADR reporting in India
11. ICH guidelines for ICSR, PSUR, expedited reporting, pharmacovigilance planning
12. CIOMS requirements for ADR reporting
13. Writing case narratives of adverse events and their quality

COURSE OUTCOME:

Upon completion of the course, the student shall be able to understand –

1. Detection of new adverse drug reactions and their assessment.

2. Illustrate international standards for classification of diseases and drugs.
3. Manage Adverse drug reaction reporting systems and communication in pharmacovigilance

UNIT I Introduction to Pharmacovigilance:

10 HOURS

History and development of Pharmacovigilance - Importance of safety monitoring of Medicine - WHO international drug monitoring programme - Pharmacovigilance Program of India(PvPI)

Introduction to adverse drug reactions - Definitions and classification of ADRs - Detection and reporting - Methods in Causality assessment - Severity and seriousness assessment - Predictability and preventability assessment - Management of adverse drug reactions

Basic terminologies used in pharmacovigilance - Terminologies of adverse medication related events - Regulatory terminologies

UNIT II Drug and disease classification:

10HOURS

Anatomical, therapeutic and chemical classification of drugs - International classification of diseases - Daily defined doses - International Non proprietary Names for drugs

Drug dictionaries and coding in pharmacovigilance - WHO adverse reaction terminologies - MedDRA and Standardised MedDRA queries - WHO drug dictionary - Eudravigilance medicinal product dictionary

Information resources in pharmacovigilance - Basic drug information resources - Specialised resources for ADRs

Establishing pharmacovigilance programme - Establishing in a hospital - Establishment & operation of drug safety department in industry - Contract Research Organisations (CROs) - Establishing a national programme

UNIT III

10 Hours

Vaccine safety surveillance - Vaccine Pharmacovigilance - Vaccination failure - Adverse events following immunization

Pharmacovigilance methods - Passive surveillance – Spontaneous reports and case series - Stimulated reporting - Active surveillance – Sentinel sites, drug event monitoring and registries - Comparative observational studies – Cross sectional study, case control study and cohort study - Targeted clinical investigations

Communication in pharmacovigilance - Effective communication in Pharmacovigilance - Communication in Drug Safety Crisis management - Communicating with Regulatory Agencies, Business Partners, Healthcare facilities & Media

UNIT IV

08 Hours

Safety data generation - Pre clinical phase - Clinical phase - Post approval phase (PMS)

ICH Guidelines for Pharmacovigilance - Organization and objectives of ICH - Expedited reporting - Individual case safety reports - Periodic safety update

reports - Post approval expedited reporting - Pharmacovigilance planning - Good clinical practice in pharmacovigilance studies

UNIT V

07 Hours

Pharmacogenomics of adverse drug reactions - Genetics related ADR with example focusing PK parameters.

Drug safety evaluation in special population - Paediatrics - Pregnancy and lactation – Geriatrics

CIOMS - CIOMS Working Groups - CIOMS Form

CDSCO (India) and Pharmacovigilance - D&C Act and Schedule Y - Differences in Indian and global pharmacovigilance requirements.

RECOMMENDED BOOKS (LATEST EDITION):

1. Textbook of Pharmacovigilance: S K Gupta, Jaypee Brothers, Medical Publishers.
2. Practical Drug Safety from A to Z By Barton Cobert, Pierre Biron, Jones and Bartlett Publishers.
3. Mann's Pharmacovigilance: Elizabeth B. Andrews, Nicholas, Wiley Publishers.
4. Stephens' Detection of New Adverse Drug Reactions: John Talbot, Patrick Walle, Wiley Publishers.
5. An Introduction to Pharmacovigilance: Patrick Waller, Wiley Publishers.
6. Cobert's Manual of Drug Safety and Pharmacovigilance: Barton Cobert, Jones & Bartlett Publishers.
7. Textbook of Pharmacoepidemiology edited by Brian L. Strom, Stephen E Kimmel, Sean Hennessy, Wiley Publishers.

8. A Textbook of Clinical Pharmacy Practice -Essential Concepts and Skills: G. Parthasarathi, Karin NyfortHansen, Milap C. Nahata
9. National Formulary of India
10. Text Book of Medicine by Yashpal Munjal
11. Text book of Pharmacovigilance: concept and practice by GP Mohanta and PK Manna
12. [http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259
& mn 3=7297](http://www.whoumc.org/DynPage.aspx?id=105825&mn1=7347&mn2=7259&mn3=7297)
13. <http://www.ich.org/>
14. <http://www.cioms.ch/>
15. <http://cdsco.nic.in/>
16. http://www.who.int/vaccine_safety/en/
17. http://www.ipc.gov.in/PvPI/pv_home.html

SEMESTER/YEAR : I SEM

COURSE CODE : 17MPC105

TITLE OF THE COURSE : PHARMACEUTICAL CHEMISTRY PRACTICAL - I

Course Objectives:

- 1. To acquire knowledge about analytical instruments.**
- 2. Skill development to perform synthetic methods**

Course Outcome:

- 1. To develop skill to carry out experiments using different analytical instruments.**
- 2. To understand and perform reactions which are of significance to industry.**
- 3. To carry out degradation reactions.**

1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA & DNA estimation

2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry

3. Experiments based on Column chromatography

4. Experiments based on HPLC

5. Experiments based on Gas Chromatography

6. Estimation of riboflavin/quinine sulphate by fluorimetry

7. Estimation of sodium/potassium by flame photometry

To perform the following reactions of synthetic importance

1. Purification of organic solvents, column chromatography

2. Claisen-schmidt reaction.

3. Benzyllic acid rearrangement.

4. Beckmann rearrangement.

5. Hoffmann rearrangement

6. Mannich reaction

7. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4 experiments)

8. Estimation of elements and functional groups in organic natural compounds

9. Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.

10. Some typical degradation reactions to be carried on selected plant Constituents

SEMESTER / YEAR : I SEMESTER
COURSE CODE : 17MPC103
TITLE OF THE COURSE : **ADVANCED MEDICINAL CHEMISTRY (Theory)**
L:T:P : 4: 0:0

The subject is designed to impart knowledge about recent advances in the field of medicinal chemistry at the molecular level including different techniques for the rational drug design.

Objectives

At completion of this course it is expected that students will be able to understand

- Different stages of drug discovery
- Role of medicinal chemistry in drug research
- Different techniques for drug discovery
- Various strategies to design and develop new drug like molecules for biological targets
- Peptidomimetics

THEORY 60 Hrs

12 hrs

1. Drug discovery: Stages of drug discovery, lead discovery; identification, validation and diversity of drug targets.

Biological drug targets: Receptors, types, binding and activation, theories of drug receptor interaction, drug receptor interactions, agonists vs antagonists, artificial enzymes.

12 hrs

2 Prodrug Design and Analog design:

a) **Prodrug design**: Basic concept, Carrier linked prodrugs/ Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, **site specific drug delivery and sustained drug action**. Rationale of prodrug design and practical consideration of prodrug design.

b) **Combating drug resistance**: Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance.

c) **Analog Design**: Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.

12 hrs

3 Medicinal chemistry aspects of the following class of drugs Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs:

a) Anti-hypertensive drugs, Psychoactive drugs, Anticonvulsant drugs, H1 & H2 receptor antagonist, COX1 & COX2 inhibitors, Adrenergic & Cholinergic agents, Antineoplastic and Antiviral agents.

b) **Stereochemistry and Drug action**: Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination.

4 Rational Design of Enzyme Inhibitors 12 hrs
Enzyme kinetics & Principles of Enzyme inhibitors, Enzyme inhibitors in medicine, Enzyme inhibitors in basic research, rational design of non-covalently and covalently binding enzyme inhibitors.

5 Peptidomimetics 12 hrs
Therapeutic values of Peptidomimetics, **design of peptidomimetics by manipulation of the amino acids**, modification of the peptide backbone, incorporating conformational constraints locally or globally. Chemistry of prostaglandins, leukotrienes and thromboxones.

REFERENCES

1. Medicinal Chemistry by Burger, Vol I –VI.
2. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, 12th Edition, Lppincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.
3. Comprehensive Medicinal Chemistry – Corwin and Hansch.
4. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore
5. Introduction to Quantitative Drug Design by Y.C. Martin.
6. Principles of Medicinal Chemistry by William Foye, 7th Edition, Ippincott Williams & Wilkins, Woltess Kluwer (India) Pvt.Ltd, New Delhi.
7. Drug Design Volumes by Arienes, Academic Press, Elsevier Publishers, Noida, Uttar Pradesh..
8. Principles of Drug Design by Smith.
9. The Organic Chemistry of the Drug Design and Drug action by Richard B.Silverman, II Edition, Elsevier Publishers, New Delhi.
10. An Introduction to Medicinal Chemistry, Graham L.Patrick, III Edition, Oxford University Press, USA.
11. Biopharmaceutics and pharmacokinetics, DM.Brahmankar, Sunil B. Jaiswal II Edition, 2014, Vallabh Prakashan, New Delhi.
12. Peptidomimetics in Organic and Medicinal Chemistry by Antonio Guarna and Andrea Trabocchi, First edition, Wiley publishers.

SEMESTER/YEAR : I SEM

COURSE CODE : 17MPC104

TITLE OF THE COURSE : CHEMISTRY OF NATURAL PRODUCTS

Course Objectives :

The subject is designed to provide detail knowledge about chemistry of medicinal compounds from natural origin and general methods of structural elucidation of such compounds. It also emphasizes on isolation, purification and characterization of medicinal compounds from natural origin.

COURSE Outcomes ;

At completion of this course it is expected that students will be able to understand-

- Different types of natural compounds and their chemistry and medicinal importance
- The importance of natural compounds as lead molecules for new drug discovery
- The concept of rDNA technology tool for new drug discovery
- General methods of structural elucidation of compounds of natural origin
- Isolation, purification and characterization of simple chemical constituents from natural source

12 hrs

1. Study of Natural products as leads for new pharmaceuticals for the following class of drugs

- a) Drugs Affecting the Central Nervous System: Morphine Alkaloids
- b) Anticancer Drugs: Paclitaxel and Docetaxel, Etoposide, and Teniposide
- c) Cardiovascular Drugs: Lovastatin, Teprotide and Dicoumarol
- d) Neuromuscular Blocking Drugs: Curare alkaloids
- e) Anti-malarial drugs and Analogues
- f) Chemistry of macrolid antibiotics (Erythromycin, Azithromycin, Roxithromycin, and Clarithromycin) and β - Lactam antibiotics (Cephalosporins and Carbapenem)

2 a) Alkaloids **12 hrs**

General introduction, classification, isolation, purification, molecular modification and biological activity of alkaloids, general methods of structural determination of alkaloids, structural elucidation and stereochemistry of ephedrine, morphine, ergot, emetine and reserpine.

b) Flavonoids

Introduction, isolation and purification of flavonoids, General methods of structural determination of flavonoids; Structural elucidation of quercetin.

c) Steroids

General introduction, chemistry of sterols, sapogenin and cardiac glycosides.

Stereochemistry and nomenclature of steroids, chemistry of contraceptive agents male & female sex hormones

(Testosterone, Estradiol, Proge sterone), adrenocorticoids (Cortisone), contraceptive agents and steroids (Vit - D).

3 a) Terpenoids **12hrs** Classification, isolation, isoprene rule and general methods of structural elucidation of Terpenoids; Structural elucidation of drugs belonging to mono (citral, menthol, camphor), di (retinol, Phytol, taxol) and tri terpenoids (Squalene, Ginsenoside) carotinoids (β carotene).

b) Vitamins - Chemistry and Physiological significance of Vitamin A, B1, B2, B12, C, E, Folic acid and Niacin.

12 hrs

4 a). Recombinant DNA technology and drug discovery rDNA technology, hybridoma technology, New pharmaceuticals derived from biotechnology; Oligonucleotide therapy. Gene therapy: Introduction, Clinical application and recent advances in gene therapy, principles of RNA & DNA estimation

b). Active constituent of certain crude drugs used in Indigenous system Diabetic therapy – *Gymnema sylvestre*, *Salacia reticulata*, *Pterocarpus marsupium*, *Swertia chirata*, *Trigonella foenum graecum*; Liver dysfunction – *Phyllanthus niruri*; Antitumor – *Curcuma longa* Linn.

12 hrs

5 Structural Characterization of natural compounds Structural characterization of natural compounds using IR, $^1\text{H NMR}$, $^{13}\text{C NMR}$ and MS Spectroscopy of specific drugs e.g., Penicillin, Morphine, Camphor, Vit-D, Quercetin and Digitalis glycosides.

REFERENCES

1. Modern Methods of Plant Analysis, Peech and M.V.Tracey, Springer – Verlag, Berlin, Heidelberg.
2. Phytochemistry Vol. I and II by Miller, Jan Nostrant Rein Hld.
3. Recent advances in Phytochemistry Vol. I to IV – Scikel Runeckles, Springer Science & Business Media.
4. Chemistry of natural products Vol I onwards IWPAC.
5. Natural Product Chemistry Nakanishi Gggolo, University Science Books, California.
6. Natural Product Chemistry “A laboratory guide” – Rapheal Khan.
7. The Alkaloid Chemistry and Physiology by RHF Manske, Academic Press.
8. Introduction to molecular Phytochemistry – CHJ Wells, Chapmanstall.
9. Organic Chemistry of Natural Products Vol I and II by Gurdeep and Chatwall, Himalaya Publishing House.
10. Organic Chemistry of Natural Products Vol I and II by O.P. Agarwal, Krishan Prakashan.
11. Organic Chemistry Vol I and II by I.L. Finar, Pearson education.
12. Elements of Biotechnology by P.K. Gupta, Rastogi Publishers.
13. Pharmaceutical Biotechnology by S.P.Vyas and V.K.Dixit, CBS Publishers.
14. Biotechnology by Purohit and Mathur, Agro-Bios, 13th edition.
15. Phytochemical methods of Harborne, Springer, Netherlands.
16. Burger’s Medicinal Chemistry.

SEMESTER/YEAR : II SEM
COURSE CODE : 17MPC201
TITLE OF THE COURSE : ADVANCED SPECTRAL ANALYSIS

This subject deals with various hyphenated analytical instrumental techniques for identification, characterization and quantification of drugs. Instruments dealt are LCMS, GC-MS, ATR-IR, DSC etc.

Course Objectives

At completion of this course it is expected that students will be able to understand -
Interpretation of the NMR, Mass and IR spectra of various organic compounds

- Theoretical and practical skills of the hyphenated instruments
- Identification of organic compounds

1. UV and IR spectroscopy: **12 hrs**

Wood ward – Fieser rule for 1,3- butadienes, cyclic dienes and α , β -carbonyl compounds and interpretation compounds of enones. ATR-IR, IR Interpretation of organic compounds.

2. NMR spectroscopy: **12 hrs**

1-D and 2-D NMR, NOESY and COSY, HECTOR, INADEQUATE techniques, Interpretation of organic compounds.

3. Mass Spectroscopy **12 hrs**

Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule, Isotopic peaks, Interpretation of organic compounds.

4. Chromatography: **12 hrs**

Principle, Instrumentation and Applications of the following : a) GC-MS b) GC-AAS c) LCMS d) LC-FTIR e) LC-NMR f) CEMS g) High Performance Thin Layer chromatography h) Super critical fluid chromatography i) Ion Chromatography j) I-EC (Ion- Exclusion Chromatography) k) Flash chromatography

5. a). Thermal methods of analysis **12 hrs**

Introduction, principle, instrumentation and application of DSC, DTA and TGA.

b). Raman Spectroscopy

Introduction, Principle, Instrumentation and Applications.

c). Radio immuno assay

Biological standardization , bioassay, ELISA, Radioimmuno assay of digitalis and insulin.

REFERENCES

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.

2. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
5. Quantitative analysis of Pharmaceutical formulations by HPTLC - P D Sethi, CBS Publishers, New Delhi.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series

SEMESTER/YEAR : II SEM
COURSE CODE : 17MPC202
TITLE OF THE COURSE : ADVANCED ORGANIC CHEMISTRY - II

Scope

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Course Objectives

Upon completion of course, the student shall be able to understand

- The principles and applications of Green chemistry
- The concept of peptide chemistry.
- The various catalysts used in organic reactions
- The concept of stereochemistry and asymmetric synthesis.
-

1. Green Chemistry:

12 hrs

- a. Introduction, principles of green chemistry
- b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis
- c. Ultrasound assisted reactions: Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications

2 Chemistry of peptides

12 hrs

- a. Coupling reactions in peptide synthesis
- b. Principles of solid phase peptide synthesis, t-BOC and Fmoc protocols, various solid supports and linkers: Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides
- c. Segment and sequential strategies for solution phase peptide synthesis with any two case studies
- d. Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, overactivation and side reactions of individual amino acids.

3 Photochemical Reactions

12 hrs

Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation. Pericyclic reactions Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatropic rearrangement reactions with examples

4 Catalysis:

12 hrs

- a. Types of catalysis, heterogeneous and homogeneous catalysis, advantages and disadvantages
- b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs.
- c. Homogeneous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogeneous catalysis used in synthesis of drugs
- d. Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions
- e. Biocatalysis: Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction.
- f. Phase transfer catalysis - theory and applications

5 Stereochemistry & Asymmetric Synthesis

12 hrs

5 Stereochemistry & Asymmetric Synthesis

12 hrs

a. Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z notation.

b. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples.

REFERENCES

1. "Advanced Organic chemistry, Reaction, mechanisms and structure", J March, John Wiley and sons, New York.
2. "Mechanism and structure in organic chemistry", ES Gould, Hold Rinchart and Winston, New York.
3. "Organic Chemistry" Clayden, Greeves, Warren and Wothers., Oxford University Press 2001.
4. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Sixth ed., 1995.
5. Carey, Organic chemistry, 5th edition (Viva Books Pvt. Ltd.)
6. Organic synthesis-the disconnection approach, S. Warren, Wily India
7. Principles of organic synthesis, ROC Norman and JMCoxan, Nelson thorns
8. Organic synthesis- Special techniques VK Ahluwalia and R Aggarwal, Narosa Publishers.
9. Organic reaction mechanisms IV edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

Subject : PHARMACEUTICAL PROCESS CHEMISTRY

Subject code : 17MPC204

1. .

Objectives

At completion of this course, it is expected that students will be able to understand

The strategies of scale up process of APIs and intermediates

The various unit operations and various reactions in process chemistry

Course outcomes

1. Process chemistry is often described as scale up reactions, taking them from small quantities created in the research lab to the larger quantities that are needed for further testing and then to even larger quantities required for commercial production.
2. The goal of a process chemist is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient.
3. The subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

THEORY 60 Hrs

1. Process chemistry

Introduction, Synthetic strategy

Stages of scale up process: Bench, pilot and large scale process.

In-process control and validation of large scale process.

Case studies of some scale up process of APIs.

Impurities in API, types and their sources including genotoxic impurities

2. Unit operations

a) **Extraction**: Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction.

b) **Filtration**: Theory of filtration, pressure and vacuum filtration, centrifugal filtration,

c) **Distillation**: azeotropic and steam distillation

d) **Evaporation**: Types of evaporators, factors affecting evaporation.

e) **Crystallization**: Crystallization from aqueous, nonaqueous solutions factors affecting crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs.

3. Unit Processes - I

a) **Nitration**: Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration,

b) **Halogenation**: Kinetics of halogenations, types of

halogenations, catalytic halogenations. Case study on industrial halogenation process.

c) **Oxidation**: Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H₂O₂, sodium hypochlorite, Oxygen gas, ozonolysis.

4 Unit Processes - II

a) **Reduction**: Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.

b) **Fermentation**: Aerobic and anaerobic fermentation. Production of

i. Antibiotics; Penicillin and Streptomycin,

ii. Vitamins: B₂ and B₁₂

iii. Statins: Lovastatin, Simvastatin

c) Reaction progress kinetic analysis

i. Streamlining reaction steps, route selection,

ii. Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.

5 **Industrial Safety**

a) MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment (PPE)

b) Fire hazards, types of fire & fire extinguishers

c) Occupational Health & Safety Assessment Series 1800 (OHSAS-1800) and ISO-14001 (Environmental Management System), Effluents and its management

REFERENCES

1. Process Chemistry in the Pharmaceutical Industry: Challenges in an Ever-Changing Climate-An Overview; K. Gadamasetti, CRC Press.
2. Pharmaceutical Manufacturing Encyclopedia, 3rd edition, Volume 2.
3. Medicinal Chemistry by Burger, 6th edition, Volume 1-8.
4. W.L. McCabe, J.C Smith, Peter Harriott. Unit operations of chemical engineering, 7th edition, McGraw Hill
5. Polymorphism in Pharmaceutical Solids .Dekker Series Volume 95 Ed: H G Brittain (1999)
6. Regina M. Murphy: Introduction to Chemical Processes: Principles, Analysis, Synthesis
7. Peter J. Harrington: Pharmaceutical Process Chemistry for Synthesis: Rethinking the Routes to Scale-Up
8. P.H.Groggins: Unit processes in organic synthesis (MGH)
9. F.A.Henglein: Chemical Technology (Pergamon)
10. M.Gopal: Dryden's Outlines of Chemical Technology, WEP East-West Press

11. Clausen, Mattson: Principle of Industrial Chemistry, Wiley Publishing Co.,
12. Lowenheim & M.K. Moran: Industrial Chemicals
13. S.D. Shukla & G.N. Pandey: A text book of Chemical Technology Vol. II, Vikas Publishing House
14. J.K. Stille: Industrial Organic Chemistry (PH)
15. Shreve: Chemical Process, Mc Grawhill.
16. B.K. Sharma: Industrial Chemistry, Goel Publishing House
17. ICH Guidelines
18. United States Food and Drug Administration official website www.fda.gov

SEMESTER/YEAR : I SEM

COURSE CODE : 17MPH105

TITLE OF THE COURSE : PHARMACEUTICS PRACTICALS - I

COURSE OBJECTIVES

- To impart knowledge on various bioanalytical techniques and instruments
- To impart knowledge on the preparation of various drug delivery systems
- To impart knowledge on the evaluation of various drug delivery systems
- To impart knowledge on determination of pharmacokinetic parameters

COURSE OUTCOMES

Upon completion of the course, student shall be able to understand

- The various bioanalytical techniques and instruments
- The preparation of various drug delivery systems
- Evaluation of various drug delivery systems
- The determination of various pharmacokinetic parameters.

1. Analysis of pharmacopoeial compounds and their formulations by UV Vis spectrophotometer

2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry

3. Experiments based on HPLC

4. Experiments based on Gas Chromatography

5. Estimation of riboflavin/quinine sulphate by fluorimetry

6. Estimation of sodium/potassium by flame photometry

7. To perform In-vitro dissolution profile of CR/ SR marketed formulation

8. Formulation and evaluation of sustained release matrix tablets

9. Formulation and evaluation osmotically controlled DDS

10. Preparation and evaluation of Floating DDS- hydro dynamically balanced DDS

11. Formulation and evaluation of Muco adhesive tablets.

12. Formulation and evaluation of trans dermal patches.

13. To carry out preformulation studies of tablets.

14. To study the effect of compressional force on tablets disintegration time.

15. To study Micromeritic properties of powders and granulation.

16. To study the effect of particle size on dissolution of a tablet.

17. To study the effect of binders on dissolution of a tablet.

18. To plot Heckal plot, Higuchi and peppas plot and determine similarity factors.

SEMESTER/YEAR : II SEM

COURSE CODE : 17MPH203

TITLE OF THE COURSE : COMPUTER AIDED DRUG DEVELOPMENT

This course is designed to impart knowledge and skills necessary for computer Applications in pharmaceutical research and development who want to understand the application of computers across the entire drug research and development process. Basic theoretical discussions of the principles of more integrated and coherent use of computerized information (informatics) in the drug development process are provided to help the students to clarify the concepts.

COURSE OBJECTIVES

Upon completion of this course it is expected that students will be able to understand,

- History of Computers in Pharmaceutical Research and Development
- Computational Modeling of Drug Disposition
- Computers in Preclinical Development
- Optimization Techniques in Pharmaceutical Formulation
- Computers in Market Analysis
- Computers in Clinical Development
- Artificial Intelligence (AI) and Robotics
- Computational fluid dynamics(CFD)

COURSE OUTCOME

Students can utilize theoretical knowledge

- For preparing formulations using optimization software.
- for pharmaceutical development in the areas of prediction of 3D structures, design of compounds,
- Demonstrates thorough, effective sophisticated application of knowledge and skill
-

12 hrs

1. a. Computers in Pharmaceutical Research and Development:

A General Overview: History of Computers in Pharmaceutical Research and Development.

Statistical modeling in Pharmaceutical research and development: Descriptive versus

Mechanistic Modeling, Statistical Parameters, Estimation, Confidence Regions, Nonlinearity at the Optimum, Sensitivity Analysis, Optimal Design, Population Modeling

b. Quality-by-Design In Pharmaceutical Development:

Introduction, ICH Q8 guideline, Regulatory and industry views on QbD, Scientifically based QbD - examples of application.

2 Computational Modeling Of Drug Disposition: 12 hrs

Introduction, Modeling Techniques: Drug Absorption, Solubility, Intestinal Permeation, Drug Distribution, Drug Excretion, Active Transport; P-gp, BCRP, Nucleoside Transporters, hPEPT1, ASBT, OCT, OATP, BBB-Choline Transporter.

3 Computer-aided formulation development: 12 hrs

Concept of optimization, Optimization parameters, Factorial design, Optimization technology & Screening design. Computers in Pharmaceutical Formulation: Development of pharmaceutical emulsions, microemulsion drug carriers Legal Protection of Innovative Uses of Computers in R&D, The Ethics of Computing in Pharmaceutical Research, Computers in Market analysis.

4 a. Computer-aided biopharmaceutical characterization: 12 hrs

Gastrointestinal absorption simulation. Introduction, Theoretical background, Model construction, Parameter sensitivity analysis, Virtual trial, Fed vs. fasted state, In vitro dissolution and in vitro in vivo correlation, Biowaiver considerations

b. Computer Simulations in Pharmacokinetics and Pharmacodynamics: Introduction, Computer Simulation: Whole Organism, Isolated Tissues, Organs, Cell, Proteins and Genes.

c. **Computers in Clinical Development:** Clinical Data Collection and Management, Regulation of Computer Systems

12 hrs

5 Artificial Intelligence (AI), Robotics and Computational fluid dynamics: General overview, Pharmaceutical Automation, Pharmaceutical applications, Advantages and Disadvantages. Current Challenges and Future Directions.

REFERENCES:

1. Computer Applications in Pharmaceutical Research and Development, Sean Ekins, 2006, John Wiley & Sons.

2. Computer-Aided Applications in Pharmaceutical Technology, 1st Edition, Jelena Djuris, Woodhead Publishing
3. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James G.Boylan, Marcel Dekker Inc, New York, 1996

ADVANCED PHARMACOLOGY - I
17MPL102

COURSE OBJECTIVES

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, this subject helps the students to understand the concepts of drug action and mechanisms involved

COURSE OUTCOMES

Upon completion of the course the student shall be able to :

- Discuss the pathophysiology and pharmacotherapy of certain diseases
- Explain the mechanism of drug actions at cellular and molecular level
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

THEORY

60 Hrs

- | | | |
|--|--------------|--------|
| 1. General | Pharmacology | 12 Hrs |
| a. Pharmacokinetics: The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding. | | |
| b. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors, quantitation of drug receptors interaction and elicited effects. | | |
| | | |
| 2 Neurotransmission | | 12 Hrs |
| a. General aspects and steps involved in neurotransmission. | | |
| b. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetyl choline). | | |
| c. Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine). | | |
| d. Non adrenergic non cholinergic transmission (NANC). Co-transmission | | |

Systemic Pharmacology

A detailed study on pathophysiology of diseases, mechanism of action, pharmacology and toxicology of existing as well as novel drugs used in the following systems

Autonomic Pharmacology

Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting neuromuscular junction

- | | | |
|---|---|-----------|
| 3 | Central nervous system Pharmacology
General and local anesthetics
Sedatives and hypnotics, drugs used to treat anxiety.
Depression, psychosis, mania, epilepsy, neurodegenerative diseases.
Narcotic and non-narcotic analgesics. | 12
Hrs |
| 4 | Cardiovascular Pharmacology
Diuretics, antihypertensives, antiischemics, anti-arrhythmics, drugs for heart failure and hyperlipidemia.
Hematinics, coagulants, anticoagulants, fibrinolytics and anti-platelet drugs | 12
Hrs |
| 5 | Autocoid Pharmacology
The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids.
Pharmacology of antihistamines, 5HT antagonists. | 12
Hrs |

REFEERENCES

1. The Pharmacological Basis of Therapeutics, Goodman and Gillman's
2. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J, Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.
3. Basic and Clinical Pharmacology by B.G Katzung
4. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
6. Graham Smith. Oxford textbook of Clinical Pharmacology.
7. Avery Drug Treatment
8. Dipiro Pharmacology, Pathophysiological approach.
9. Green Pathophysiology for Pharmacists.

SEMESTER/YEAR : II SEM
COURSE CODE : 17MPL202
TITLE OF THE COURSE : PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING METHODS-II

Scope:

This subject imparts knowledge on the preclinical safety and toxicological evaluation of drug & new chemical entity. This knowledge will make the student competent in regulatory toxicological evaluation.

Course Objectives:

Upon completion of the course, the student shall be able to,

- Explain the various types of toxicity studies.
- Appreciate the importance of ethical and regulatory requirements for toxicity studies.
- Demonstrate the practical skills required to conduct the preclinical toxicity studies.
-

Course outcomes: Upon completion of the course, the student shall be able to,

C01: Explain the basics and the types of toxicology

C02: Describe the regulatory guidelines for conducting toxicological studies

C03: Explain various toxicity studies as per OECD guidelines

C04: Describe special toxicity studies

C05: Describe in detail about various methods employed in drug discovery and development

C06: Explain the concept of Safety pharmacology studies

12 hrs

1. Basic definition and types of toxicology (general, mechanistic, regulatory and descriptive)

Regulatory guidelines for conducting toxicity studies OECD, ICH, EPA and Schedule Y
OECD principles of Good laboratory practice (GLP) History, concept and its importance in drug development

12 hrs

2 Acute, sub-acute and chronic- oral, dermal and inhalational studies as per OECD guidelines. Acute eye irritation, skin sensitization, dermal irritation & dermal toxicity studies.

Test item characterization- importance and methods in regulatory toxicology studies

12 hrs

3 Reproductive toxicology studies, Male reproductive toxicity studies, female reproductive studies (segment I and segment III), teratogenicity studies (segment II) Genotoxicity studies (Ames Test, in vitro and in vivo Micronucleus and Chromosomal aberrations studies) In vivo carcinogenicity studies

12 hrs

4 IND enabling studies (IND studies)- Definition of IND, importance of IND, industry perspective, list of studies needed for IND submission.

Safety pharmacology studies- origin, concepts and importance of safety pharmacology. Tier1- CVS, CNS and respiratory safety pharmacology, HERG assay. Tier2- GI, renal and other studies

12 hrs

5 Toxicokinetics- Toxicokinetic evaluation in preclinical studies, saturation kinetics Importance and applications of toxicokinetic studies. Alternative methods to animal toxicity testing.

REFERENCES

1. Hand book on GLP, Quality practices for regulated non-clinical research and development (<http://www.who.int/tdr/publications/documents/glphandbook.pdf>).
2. Schedule Y Guideline: drugs and cosmetics (second amendment) rules, 2005, ministry of health and family welfare (department of health) New Delhi
3. Drugs from discovery to approval by Rick NG.
4. Animal Models in Toxicology, 3rd Edition, Lower and Bryan
5. OECD test guidelines.
6. Principles of toxicology by Karen E. Stine, Thomas M. Brown.
7. Guidance for Industry M3(R2) Nonclinical Safety Studies for the Conduct of Human Clinical Trials and Marketing Authorization for Pharmaceuticals (<http://www.fda.gov/downloads/drugs/guidancecomplianceregulatoryinformation/guidances/ucm073246.pdf>)

PRINCIPLES OF DRUG DISCOVERY

(17MPL203)

Scope:

The subject imparts basic knowledge of the drug discovery process. This information will make the student competent in drug discovery.

Objectives:

Upon completion of the course, the student shall be able to,

- Explain the various stages of drug discovery.
- Appreciate the importance of the role of genomics, proteomics and bioinformatics in drug discovery
- Explain various targets for drug discovery.
- Explain various lead seeking method and lead optimization
- Appreciate the importance of the role of computer aided drug design in drug discovery.

THEORY

60 Hrs

12 Hrs

1. An overview of modern drug discovery process: Target identification, target validation, lead identification and lead Optimization. Economics of drug discovery. Target Discovery and validation-Role of Genomics, Proteomics and Bioinformatics. Role of Nucleic acid microarrays, Protein microarrays, Antisense technologies, siRNAs, antisense oligonucleotides, Zinc finger proteins. Role of transgenic animals in target validation.

12 Hrs

2. Lead Identification- combinatorial chemistry & high throughput screening, in silico lead discovery techniques, Assay development for hit identification. Protein structure Levels of protein structure, Domains, motifs, and folds in protein structure. Computational prediction of protein structure: Threading and homology modeling methods. Application of NMR and X-ray crystallography in protein structure prediction.

12 Hrs

3. Rational Drug Design Traditional vs rational drug design, Methods followed in traditional drug design, High throughput screening, Concepts of Rational Drug Design, Rational Drug Design Methods: Structure and Pharmacophore based approaches Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening,.

12 Hrs

4 Molecular docking: Rigid docking, flexible docking, manual docking; Docking based screening. De novo drug design. Quantitative analysis of Structure Activity Relationship

History and development of QSAR, SAR versus QSAR, Physicochemical parameters, Hansch analysis, Fee Wilson analysis and relationship between them.

12 Hrs

5 QSAR Statistical methods – regression analysis, partial least square analysis (PLS) and other multivariate statistical methods. 3D-QSAR approaches like COMFA and COMSIA Prodrug design-Basic concept, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design.

REFERENCES

1. MouldySioud. Target Discovery and Validation Reviews and Protocols: Volume 2 Emerging Molecular Targets and Treatment Options. 2007 Humana Press Inc.
2. Darryl León. Scott Markel In. Silico Technologies in Drug Target Identification and Validation. 2006 by Taylor and Francis Group, LLC.
3. Johanna K. DiStefano. Disease Gene Identification. Methods and Protocols. Springer New York Dordrecht Heidelberg London.
4. Hugo Kubiny. QSAR: Hansch Analysis and Related Approaches. Methods and Principles in Medicinal Chemistry. Publisher Wiley-VCH
5. Klaus Gubernator, Hans-Joachim Böhm. Structure-Based Ligand Design. Methods and Principles in Medicinal Chemistry. Publisher Wiley-VCH
6. Abby L . Parrill. M . Rami Reddy. Rational Drug Design. Novel Methodology and Practical Applications. ACS Symposium Series; American Chemical Society: Washington, DC, 1999.
7. J. Rick Turner. New drug development design, methodology and, analysis. John Wiley & Sons, Inc., New Jersey

SEMESTER/YEAR : I SEM
COURSE CODE : 17MPL104
TITLE OF THE COURSE : CELLULAR AND MOLECULAR PHARMACOLOGY

Scope:

The subject imparts a fundamental knowledge on the structure and functions of cellular components and help to understand the interaction of these components with drugs. This information will further help the student to apply the knowledge in drug discovery process.

Course Objectives:

Upon completion of the course, the student shall be able to,

- Explain the receptor signal transduction processes.
- Explain the molecular pathways affected by drugs.
- Appreciate the applicability of molecular pharmacology and biomarkers in drug discovery process.
- Demonstrate molecular biology techniques as applicable for pharmacology

Course Outcomes:

CO1: Explain various cellular events, functions, pathways and transduction mechanisms and how a gene is expressed

CO2: Cell signaling pathways based on receptors and second messengers in the cell

CO3: Principles and applications of genomic, proteomic tools, gene therapy and rDNA technology

CO4: Immunotherapeutics and application of omics in clinical practice

CO5: Principles and applications of various assays, biosimilars, cell culture techniques, application of flow cytometry

1. Cell biology

12 hrs

Structure and functions of cell and its organelles Genome organization. Gene expression and its regulation, importance of siRNA and micro RNA, gene mapping and gene sequencing Cell cycles and its regulation. Cell death- events, regulators, intrinsic and extrinsic pathways of apoptosis. Necrosis and autophagy.

2 Cell signaling

12 hrs

Intercellular and intracellular signaling pathways. Classification of receptor family and molecular structure ligand gated ion channels; G-protein coupled receptors, tyrosine kinase receptors and nuclear receptors. Secondary messengers: cyclic AMP, cyclic GMP, calcium ion, inositol 1,4,5-trisphosphate, (IP3), NO, and diacylglycerol. Detailed study of following intracellular signaling pathways: cyclic AMP signaling pathway, mitogen-activated protein kinase (MAPK) signaling, Janus kinase (JAK)/signal transducer and activator of transcription (STAT) signaling pathway.

12 hrs

3 Principles and applications of genomic and proteomic tools DNA electrophoresis, PCR (reverse transcription and real time), Gene sequencing, micro array technique, SDS page, ELISA and western blotting, Recombinant DNA technology and gene therapy Basic principles of recombinant DNA technology-Restriction enzymes, various types of vectors. Applications of recombinant DNA technology. Gene therapy- Various types of gene transfer techniques, clinical applications and recent advances in gene therapy.

12 hrs

4 Pharmacogenomics Gene mapping and cloning of disease gene. Genetic variation and its role in health/ pharmacology Polymorphisms affecting drug metabolism Genetic variation in drug transporters Genetic variation in G protein coupled receptors Applications of proteomics science: Genomics, proteomics, metabolomics, functionomics, nutrigenomics Immunotherapeutics Types of immunotherapeutics, humanisation antibody therapy, Immunotherapeutics in clinical practice

5 a. Cell culture techniques

12 hrs

Basic equipments used in cell culture lab. Cell culture media, various types of cell culture, general procedure for cell cultures; isolation of cells, subculture, cryopreservation, characterization of cells and their application.

Principles and applications of cell viability assays, glucose uptake assay, Calcium influx assays Principles and applications of flow cytometry

b. Biosimilars

REFERENCES:

1. The Cell, A Molecular Approach. Geoffrey M Cooper.
2. Pharmacogenomics: The Search for Individualized Therapies. Edited by J. Licinio and M -L. Wong
3. Handbook of Cell Signaling (Second Edition) Edited by Ralph A. et.al
4. Molecular Pharmacology: From DNA to Drug Discovery. John Dickenson et.al
5. Basic Cell Culture protocols by Cheril D.Helgason and Cindy L.Miller
6. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor)
7. Animal Cell Culture: A Practical Approach by John R. Masters (Editor)
8. Current porotocols in molecular biology vol I to VI edited by Frederick M.Ausuvel et la.

SEMESTER/YEAR : II YEAR

COURSE CODE : 15BP202

TITLE OF THE COURSE : PHARMACEUTICAL MICROBIOLOGY & BIOTECHNOLOGY -

THEORY L: T/A: P: C : 3 : 1 : 0 : 3

COURSE OBJECTIVES:

- (i) Develop a thorough knowledge of application of microbiology with relevance to pharmaceutical industry which involves study of bacteria, fungi and virus.
- (ii) Provide conceptual understanding of the various aspects of aseptic techniques and production of sterile immunological products.
- (iii) Recent advances in Biotechnology.

COURSE OUTCOMES:

- (i) Students will be able to isolate and identify sources of microbial contamination in pharmaceutical products.
- (ii) Demonstrate a critical awareness of recent techniques applicable to research in pharmaceutical biotechnology and their roles in effective therapeutic treatment.
- (iii) Summarize Identification of bacteria using staining techniques, sterilization methods and microbial genetics.
- (iv) Describe immunology and immunological preparations and fermentation technology.
- (v) Summarize Animal tissue culture techniques and hybridoma technology.

UNIT - I

- 1. Introduction, history and scope of Microbiology 3 hrs
- 2. Study of Bacteria, Virus & Fungi 12 hrs
Classification, Morphology and fine structure, Growth and cultivation – factors affecting growth, Culture media and its classification, Culture techniques – Aerobes and Anaerobes, Growth Curve, Synchronous growth, batch & continuous culture, Isolation and identification of bacteria: Identification by Staining techniques and biochemical tests, Measurement of growth - Total & viable counting techniques of bacteria. Study of Fungi, Virus & other infectious agents, Morphology, Classification & cultivation.

UNIT-II

- 3. Sterilization: 10 hrs
Methods of sterilization and classification, kinetics of inactivation, sensitivity of microorganisms – dynamics, survival curve, D-value, Z-value, Bioburden determination and environmental control, validation of sterilization methods, sterility testing of pharmaceuticals, Sterile pharmaceutical products – sterilization methods and tests for sterility
- 4. Disinfection: 5 hrs
Types and Classification, Factors affecting disinfection, Evaluation of disinfectants and preservatives, Evaluation of preservatives in pharmaceutical preparations.

UNIT - III

5. Immunology and Immunological Preparations: 10 hrs
Introduction, types of immunity antigens and antibodies, Antigen-antibody reactions and their applications, Vaccines- classification, preparation, standardisation and storage of various vaccines like BCG, Cholera, DPT, Polio, Rabies and production of sera diphtheria, Immunization programme, Diagnostic tests like Schick's test, Widal, Mantoux and VDRL, Immunoblotting Techniques: ELISA, Western blot, Southern blot and Northern blot.

6. Infectious diseases: 5 hrs
Study of mode of transmission, causative agents, diagnosis, prevention, treatment and control of the following: Cholera, Tetanus, Syphilis, Typhoid, Malaria, AIDS, Hepatitis.

UNIT-IV

7. Microbial Genetics: 5 hrs
Genetic organization of Prokaryotes. Phenotypic and Genotypic changes in bacteria, mutations, genetic exchange in bacteria- transformation, transduction, conjugation. plasmids and transposons.

8. Genetic Engineering: 10 hrs
Steps involved in genetic engineering, Study of cloning vectors, restriction endonucleases and DNA ligase, Applications in the production of recombinant products like Insulin & Hepatitis-B vaccine

UNIT-V

9. Fermentation technology: 5 hrs
Introduction to fermentation technology, study, design and operation of fermenter. Production of Penicillin, Streptomycin & Vitamin B12.

10. Microbiological assays: Principles and methods of microbiological assays, antibiotic sensitivity tests. Method of assay of streptomycin. 5 hrs

11. Animal tissue culture: techniques, nutritional requirements and application - Hybridoma technology: production and application of monoclonal antibodies. 3 hrs

12. Bioinformatics: 2 hrs
Introduction, Alignment tools, Data mining

TEXT BOOKS:

1. Pelczar MJ, Chan ECS, Krieg NR (1986) Microbiology. 5th Edition. New Delhi: McGraw-Hill
2. AnathNaryan and Pannicker, Text book of microbiology, 6th ed, Orient longman, Chennai, 1995.
3. S.P. Vyas and Dixit, pharmaceutical biotechnology, 1st ed, CBS publishers and distributors, New Delhi 1998.

4. Rawlins EA (1977) Bentley's Textbook of Pharmaceutics. 8th Edition. London: Bailliere Tindall.
5. S.S.Kori, Pharmaceutical biotechnology, Fundamentals and applications, 1st ed, VallabhPrakashan, New Delhi.
6. Hugo W.B. and Russell A.D. (1998) Pharmaceutical Microbiology. 6th Edition. Blackwell Science.

REFERENCE BOOKS:

1. Carter S.J. (2005) Cooper and Gunn's Tutorial Pharmacy. 6th Edition. New Delhi: CBS Publishers.
2. Prescott LM, Harley JP, Klein DA. (1990) Microbiology. 5th Edition. USA: Wm. C. Brown Publishers.
3. Tortora, G.J., Funke, B.R. & Case C.L. (2010) Microbiology: An Introduction. 10th Edition. New York: Benjamin Cummings.
4. Frobishers, Fundamentals of microbiology, 9th ed, Toppan company ltd, Tokyo. Japan.
5. Watson J.D Recombinant DNA technology, 2nd, Scieintific American books ltd 1992.

SEMESTER/YEAR: II YEAR

COURSE CODE: 15BP271

TITLE OF THE COURSE: PHYSICAL PHARMACEUTICS – PRACTICAL

L: T/A: P: C: 0: 0: 3: 1.5

Course objective:

Upon completion students shall be able have relevant knowledge on-

- Phenomena of partition coefficient and surface tension
- Flow properties of solid and rheological properties of liquid
- Determination of pH and preparation of buffers

Course outcome:

Upon completion students shall be able to:

- 1) Understand the phenomenon of partition coefficient and surface tension.
- 2) Know the concept of flow properties of solids and rheological properties of liquid by suitable methods.
- 3) Understand the sedimentation behaviour of coarse dispersion and order of reaction of various first and second order reaction
- 4) Demonstrate the methods to determine the pH and able to prepare pharmaceutical buffers
- 5) Demonstrate the underlying principles of adsorption and determine the critical solution temperature of two component system

1. Determination of viscosity of liquids using Ostwald's viscometer.
2. Determination surface tension of liquid by drop weight method.
3. Study of flow properties of granules viz., rate of flow, angle of repose, bulk density.
4. Preparation, stabilization and evaluation of hydrophobic colloids.
5. Determination of partition coefficient of benzoic acid between benzene and water.
6. Determination of CST of phenol-water system.
7. Determination of HLB number of surfactants by Griffin's method.
8. Preparation of buffers and measurement of pH.
9. Determination of dissociation constant and pKa value.

10. Determination of rate constant for first order reactions
11. Determination of rate constant for second order reactions.
12. Study of particle size distribution by optical microscopy.
13. Determination of constants of Freundlich and Langmuir adsorption for adsorptions of acetic acid on activated charcoal.
14. Preparation of various types of suspensions and determination of their sedimentation parameters.
15. Construction of rheogram and study of rheological behaviour of biphasic systems employing multipoint viscometers. (For demonstration)

SEMESTER/YEAR : II YEAR

COURSE CODE : 15BP272

TITLE OF THE COURSE : PHARMACEUTICAL MICROBIOLOGY & BIOTECHNOLOGY -

PRACTICAL L: T/A: P: C : 0 : 0 : 3 : 1.5

COURSE OBJECTIVES:

Upon successful completion of this course the students will be able to

1. Acquire basic skills in the identification and isolation of micro-organisms.
2. Provide the students with the appropriate knowledge and skills for microbiological standardization, sterilization of Pharmaceuticals and its applications in pharmaceutical industries.

COUSE OUTCOME

C01- To understand different equipment's and processing of equipment's used in experimental microbiology.

C02- To learn different staining techniques for identification of micro-organism.

C03 -To Learn isolation of and identification of micro-organisms.

C04 -To carry out microbiological standardization of Pharmaceuticals.

C05 - To understand the importance of sterilization and learn sterility testing of pharmaceutical products.

1. Study of apparatus used in experimental microbiology.
2. Sterilization techniques – Glasswares, Media.
3. Preparation and sterilization of Media, subculture, maintenance of culture and aseptic techniques.
4. Isolation techniques– Streak plate, Pour plate, spread plate techniques
5. Staining techniques- Simple staining Gram's staining, negative staining.
6. Total and viable count of Microorganisms.
7. Motility of the microorganism by Hanging drop method.
8. Isolation of Plasmid DNA.
9. Gel electrophoresis of plasmid DNA.
10. Bacteriological analysis of water by MPN techniques.
11. Sterility testing for Pharmaceutical products.
12. Microbiological assay of antibiotics.
13. Antibiotic sensitivity test
14. Determination of MIC
15. Biochemical tests like carbohydrate, starch hydrolysis, gelatin liquefaction.

TEXT BOOKS:

1. Pelczar MJ, Chan ECS, Krieg NR (1986) Microbiology. 5th Edition. New Delhi: McGrawHill
2. AnathNaryan and Pannicker, Text book of microbiology, 6th ed, Orient longman, Chennai, 1995.
3. S.P. Vyas and Dixit, pharmaceutical biotechnology, 1st ed, CBS publishers and distributors, New Delhi 1998.

4. Rawlins EA (1977) Bentley's Textbook of Pharmaceutics. 8th Edition. London: Bailliere Tindall.
5. S.S.Kori, Pharmaceutical biotechnology, Fundamentals and applications, 1st ed, VallabhPrakashan, New Delhi.
6. Hugo W.B. and Russell A.D. (1998) Pharmaceutical Microbiology. 6th Edition. Blackwell Science.

REFERENCE BOOKS:

1. Carter S.J. (2005) Cooper and Gunn's Tutorial Pharmacy. 6th Edition. New Delhi: CBS Publishers.
2. Prescott LM, Harley JP, Klein DA. (1990) Microbiology. 5th Edition. USA: Wm. C. Brown Publishers.
3. Tortora, G.J., Funke, B.R. & Case C.L. (2010) Microbiology: An Introduction. 10th Edition. New York: Benjamin Cummings.
4. Frobishers, Fundamentals of microbiology, 9th ed, Toppan company ltd, Tokyo. Japan.
5. Watson J.D Recombinant DNA technology, 2nd, Scentific American books ltd 1992.

SEMESTER/YEAR : IV YEAR

COURSE CODE : 15BP306

TITLE OF THE COURSE : PHARMACEUTICAL MANAGEMENT & MARKETING L:

T/A: P: C : 2 : 1 : 0 : 2

Course outcomes:

1. Initiate startup and entrepreneurship programs.
2. Analyze the process in Pharma industry and community service management.
3. Acquire skills in communication for effective day to day office management.
4. Apply skills in management to efficiently and smoothly run a pharma business.

COURSE OBJECTIVES: To understand the general management and marketing principles in pharmaceutical marketing, the types of markets, competitive practices in pharmaceutical industries, pharmaceutical product and regulatory requirements.

COURSE OUTCOMES: Upon completion of the course the student shall be able to

- (i) Know pharmaceutical market.
- (ii) Understand various product strategies
- (iii) Understand the basic principles of management sciences.
- (iv) Appreciate the importance of marketing in product promotion.
- (v) Basic knowledge of regulatory requirements for marketing pharmaceuticals

UNIT I 12 HOURS

1. Marketing

- a) Definition and scope of marketing.
- b) Distinction between Marketing and Selling.
- c) The pharmaceutical market-
 - a. Quantitative and qualitative aspects,
 - b. Size and composition of the market,
 - c. Demographic descriptions and
 - d. Socio-psychological characteristics of the consumer,
 - e. Market segmentation.
- d) Analysing the market- role of market research.

e) Consumer profile-

- a. Motivation and prescribing habits of the physician,
- b. Patients' choice of physician and Retail pharmacist.

f) Emerging Concepts and Trends of Marketing: Vertical and Horizontal Marketing, Rural Marketing, Consumerism, Industrial Marketing, Global Marketing.

2.The Organization

Manufacturer-

- a. Company objectives,
- b. Influence of internal controls such as company policy on the company's operation,
- c. Effects of government regulations and controls on marketing practices.

UNIT II 12 HOURS

3.The Pharmaceutical Product

a) Market consideration in product development,

a. Marketing mix, product life cycle(PLC), effects of different elements of marketing mix at different stages of PLC,

b. Product classification,

c. Product planning,

d. Product differentiation,

e. Me- too products,

f. Modification of existing product.

b) New product development-

a. All stages from the new product idea to the stage of marketing in developed product (Bulk drugs and formulations).

c) Branding-

a. Concept of brand,

b. Different types of brand,

c. Importance and reasons for branding,

d. Packaging.

4.Competitive Practices in Pharmaceutical Industries

a) Price competition-

- a. Pricing,
- b. Objectives,
- c. Basis and strategies.
- d. Rate contracts.

b) Non-price competition:

all types of non-price competition with special emphasis on

- a. Competition through research and development,
- b. Competition through quality.

UNIT III 10 HOURS

5.Promotions

- a) Communication and its importance
- b) Different ways of promotion-

Advertising, direct mail, professionals, journals, sampling, retailing, medical exhibition, public relations, Online Promotional Techniques for OTC Products.

c) Professional sales representative-

- a. Duties of PSR,
- b. Purpose of detailing,
- c. Selection and training,
- d. Compensation and future prospects of the PSR.

6.Distribution

a) The wholesale-

- a. His role in distribution of pharmaceutical services offered to the manufacturer and the retailer,
- b. Advantages and disadvantages of distribution through wholesaler.

c) The retailer-

- a. Classification of retail institution, advantages and disadvantages of retail institution, the hospital as retail outlet.

UNIT IV 10 HOURS

7.Management

- a) Concepts of management, Nature of management, principles of management.

b) Primary functions of management- planning, organizing, staffing, directing and controlling, motivation, and entrepreneurship development.

c) Secondary functions of management: Decision- making, Leadership, innovation, delegation of authority/ responsibility.

8. Entrepreneurship

Meaning, Entrepreneurship: Concept, knowledge and skills requirement; characteristic of successful entrepreneurs; role of entrepreneurship in economic development; entrepreneurship process; factors impacting emergence of entrepreneurship; managerial vs. entrepreneurial approach and emergence of entrepreneurship.

UNIT V 6 HOURS

9. Quality Management

a) Introduction to Statistical Methods,

b) Statistical Quality Control Tools,

c) Statistical Tools for Decision Making,

d) Total Quality Management/Kaizen: Six Sigma,

e) Quality Circle and CPM (Critical Path Method)

10. Regulatory Authorities and their Guidelines

ICH, USFDA, TGA, MHRA, WHO, IPC, Worldwide pharmaceutical Regulatory Agencies

RECOMMENDED BOOKS:

1. Philip Kotler, Amstrong: Principles of Marketing, Prentice Hall Pvt Ltd., 13th edition
2. Heinz Weihrich, Harold Koontz: Management: A global Perspective, McGraw Hill International Edition, Tenth edition.
3. S.V.R. Subba Rao, Pharmaceutical Marketing in India, Asian Institute of Pharmaceutical Marketing, Hyderabad, 1998 edition.
4. Arun Kumar and N. Meenakshi: Marketing Management, Vikas Publishing, India.
5. Mickey C. Smith, Principles of Pharmaceutical Marketing, CBS publishers and distributors, New Delhi, 3rd edition.
6. C.V.S. Subrahmanyam. Pharmaceutical production and management, Vallabh Prakashan publisher, New Delhi, 2005.

7. Peter F. Drucker, Management-tasks, responsibilities, practices. Allied Publishers Pvt Ltd., Mumbai, 2003.

8. Mickey C. Smith, Pharmaceutical Marketing in the 21st Century, pharmaceutical product press, New York, USA, 1996

9. Sachin Itkar, Pharmaceutical Management, Nirali Prakashan Publishers, Pune, 2007.

WEBSITE REFERENCES:

1. www.ich.org,

2. <http://www.fda.gov/>,

3. <https://www.gov.uk>,

4. <https://www.tga.gov.au/quality-guidelines>

SEMESTER/YEAR : III YEAR

COURSE CODE : 15BP372

TITLE OF THE COURSE : PHYTOPHARMACOGNOSY –

PRACTICAL L: T/A: P: C : 0 : 0 : 3 : 1.5

1. Quantitative Microscopy

a) Leaf Constants: Stomatal Number & Stomatal Index Vein Islet Number & Vein termination Number

b) Determination of dimension of starch grains using eye piece micrometer, lycopodium spore method c) Determination of length and width of fibre using eye piece micrometer and camera lucida methods.

2. Study of Morphology of drugs. Strophanthus, Squill, Rhubarb, Cascara, Ginseng, Liquorice, Senna, Digitalis, Rauwolfia, Wild Cherry bark, Nuxvomica, Vinca, Kurchi, Ephedra, Colchicum, Fennel, Cinnamon, Coriander, Eucalyptus, Ginger.

3. Study of Powder microscopy (including mixture powder microscopy) Senna, Digitalis, Squill, Rhubarb, Cascara, Liquorice, Cinchona, Ipecac, Rauwolfia, Ephedra, Kurchi, Clove, Cinnamon, Fennel, Coriander, Ginger.

4. Determination of Ash Value

5. Determination of Extractive value

6. Determination of Moisture content

7. Production of Volatile oil.

8. Estimation of tannins.

REFERENCE BOOKS;

1. Kokate C.K. Purohit A.P. and Gokhale S.B., Text book of Pharmacognosy, 14th Ed, Nirali Prakashan, Pune, 1996.

2. Kokate C.K. Purohit A.P. and Gokhale S.B., Pharmacognosy, 22nd Ed, Nirali Prakashan, Pune, 2003.

3. Trease G.E and Evans, W.C., Pharmacognosy, 15th Ed, Bailliere Tindall, Eastbourne, U.K., 2002.

4. Wallis T.E., Text book of Pharmacognosy, 5th Ed, J.A., Churchill Limited, London., 1985.

5. Iyengar M.A. and Nayak SGK., Anatomy of crude Drugs, 8th Ed, Manipal Power Press, Manipal., 2001. 6. Kokate C.K., Practical Pharmacognosy, 3rd Ed., Vallabh Prakashan, Delhi, 1991.

7. Iyengar M.A., Study of Crude drugs, Manipal Power Press Manipal., 14th Ed, 2001.
8. Iyengar M.A., Pharmacognosy of powdered crude drugs, Manipal Power Press Manipal., 6th Ed, 2001.
9. Brain, K.R., Turner, T.D., The Practical Evaluation of Phytopharmaceuticals, wright-Scietecnica, Bristol

SEMESTER/YEAR: IV YEAR

COURSE CODE: 15BP401

**TITLE OF THE COURSE: PHARMACEUTICAL TECHNOLOGY AND
BIOPHARMACEUTICS - THEORY**

L: T/A: P: C : 3 : 0 : 0 : 3

COURSE OBJECTIVES: To study the technologies involved in the manufacturing of various dosage forms and also the biopharmaceutical aspects of drugs.

COURSE OUTCOMES:

CO 1: Outline the importance of preformulation in development of pharmaceutical dosage forms and understand the formulation, formulation requirement, manufacturing techniques and evaluation of tablets

CO 2: Annotate the formulation, formulation requirement, manufacturing techniques and evaluation of capsules and liquid

CO 3: Estimate the importance of formulation requirement, method of preparation and sterility of sterile dosage form.

CO 4: Recapitulate the formulation, method of preparation and evaluation of cosmetics, Pharmaceutical Aerosols

CO 5: Summarize the use of packaging materials and explain the role of biopharmaceutics and pharmacokinetics

UNIT I

1. Preformulation studies: Study of physicochemical properties of drug substances and their effect on formulation, stability and bioavailability. **05 hrs**

2. Tablets: Definition, advantages and disadvantages, classification of different types of tablets, excipients used for tablet preparation, granulation methods, tablet compression machines, processing problem of tablets, in process quality control and evaluation of tablets.

Tablet coating: Definition, objectives of coating, and types of coating, sugar coating, film coating, coating equipments, film defects and evaluation of coated tablets. **13 hrs**

UNIT II

3. Capsules: Hard gelatin capsules: Definition of capsule, advantages and disadvantages of capsules, materials used for preparing hard gelatin capsule, production, filling and finishing of

hard gelatin capsule, and quality control test. Soft gelatin capsules: Capsule shell and content, base adsorption and its importance, production, quality control, stability and storage. **8 hrs**

4. Liquid orals: Formulation and manufacturing, filling and packaging of liquid orals. **4 hrs**

UNIT III

5. Parenteral preparation: Definition, advantages and disadvantages, parenteral routes of administration, official types of injections, formulations, types, production of parenterals including facilities, filling, sealing of ampoules and vials, containers and closures, and quality control test.

Ophthalmic formulations: Definition, types of ophthalmic formulations, requirements, formulation of ophthalmic products such as eye drops, eye ointment and ocuserts, containers, and evaluation. **15 hrs**

UNIT IV

6. Pharmaceutical aerosols: Definition, advantages, disadvantages, propellants, containers, valves, types of aerosol systems, manufacture of aerosols, stability testing, evaluation and application of aerosols. **8 hrs**

7. Cosmetics: Formulation and preparation of cosmetic preparations such as cold cream, vanishing cream, face and talcum powder, shampoos, lipsticks, nail lacquers, hair dyes, and tooth pastes. **8 hrs**

UNIT V

8. Pharmaceutical Packaging: Materials used for packaging of pharmaceutical products, advantages, and disadvantages. **4 hrs**

9. Biopharmaceutics: Definition, applications of biopharmaceutics, drug absorption, and different types of drug transport across GIT. Factors influencing drug absorption such as biological, physico-chemical and pharmaceutical factors. Pharmacokinetics basic concepts, blood level curves for oral, intra muscular, intravenous, constant rate infusion and sustained release dosage forms. Definition for bioavailability and bioequivalence, importance of bioavailability, and bioavailability measurement. **10 hrs**

TEXT BOOKS:

1. Theory and Practice of Industrial Pharmacy – Leon Lachmann, Herbert A. Libermann and J. L. Kanig, Lea & Febiger, Philadelphia.
2. Introduction to Pharmaceutical Dosage Forms by H. C. Ansel, Lea & Febiger, Philadelphia.
3. Biopharmaceutics and Pharmacokinetics, A Treatise, D.M. Brahmankar and Sunil B. Jaiswal.

REFERENCE BOOKS:

1. Pharmaceutics – The Science of Dosage Form Design by M. E. Aulton, Churchill Livingstone.
2. Remington's Pharmaceutical Sciences, Mack Publishing Co. Easton.
3. Cosmetics – Formulation, manufacturing and quality control – P. P. Sharma.
4. Bentley's Textbook of Pharmaceutics By Rawlins CBS Publishers New Delhi.
5. Harry's Textbook of Cosmetology.
6. Pharmacopoeias: I.P., B.P., U.S.P.
7. Dispensing for Pharmaceutical Students by Cooper and Gunn, 12th Edition.
8. Modern Text Book of Pharmaceutics by Gilbert Banker and Christopher Rhodes, Informa Press.
9. Lachmann and Libermann, Pharmaceutical Dosage Form-Parenteral Medication Edited by Avis, Informa Press (Latest Edition).
10. Lachmann and Libermann, Pharmaceutical Dosage Form- Tablets Vol I, II, III (Latest Edition), Informa Press.

SEMESTER/YEAR : IV YEAR

COURSE CODE : 15BP402

TITLE OF THE COURSE : INSTRUMENTAL & BIOMEDICAL ANALYSIS - THEORY

L: T/A: P: C : 3 : 0 : 0 : 3

COURSE OBJECTIVES: To give basic knowledge on Instrumental methods of Chemical & Pharmaceutical Analysis and train students to perform practical work on real samples to get acquainted with instrumentation and equipment.

COURSE OUTCOMES:

- (i) The student shall be able to know the principle, instrumentation and application by using the above instruments.
- (ii) Shall be able to use modern instruments in the quality control and research of pharmaceuticals.

This subject is designed to impart a fundamental knowledge on the testing of drugs by various instrumental methods of analysis. This course also gives idea about modern instruments that are used for drug testing like UV, IR, HPLC, HPTLC etc.

UNIT-1

Spectroscopy:

a. **UV –Visible Spectroscopy:** Electromagnetic spectrum, Wave parameters, Electronic Transitions, Chromophores, Auxochromes, Bathochromic shift, hypsochromic shift, Hyperchromic and hypochromic effects. Beer and Lambert's law, Derivation and Deviations, Effect of solvent and pH on absorption spectra. 6 hours

Instrumentation - Sources of radiation, collimating system, sample cells, monochromators Detectors- Barrier layer cell, photo tube, photomultiplier tube, diode array. Applications- Spectrophotometric titrations, single component & multi component analysis. 7 hours

b. **Fluorimetric analysis:** Theory, concept of singlet and triplet electronic states, Internal and external conversions, intersystem crossing, factors affecting fluorescence, Quenching. Instrumentation and applications 4 hours

UNIT-II

a. **IR Spectroscopy:** Theory, Hooke's law, vibration modes of molecules, Instrumentation- Sources of radiation, Monochromators, Sample handling methods, detectors and applications. 6 hours

b. **Flame emission and atomic absorption spectrometry:** Principle, Interferences, Instrumentation and applications. 4 hours

c. **Nephelometry and Turbidimetric Analysis:** Principle, Instrumentation and applications. 2 hours

d. **NMR:** Theory, Instrumentation of ^1H NMR and applications. 2 hours

UNIT-III

Chromatography: Introduction and classification 2 hours

a. **Column chromatography:** Adsorption column chromatography, development Techniques Factors affecting column efficiency, recovery and applications. Partition Chromatography – Principle, Development techniques and applications. 3 hours

b. **Paper Chromatography:** Introduction, Principle, Development Techniques, Detection methods and applications. 2 hours

- c. **Thin layer chromatography**: Introduction, principle, techniques, detection methods and applications. 2 hours
- d. **Ion exchange chromatography**: Principle, classification of ion exchange resins, Properties of ion exchangers, mechanism of ion exchange process, factors affecting ion exchange and applications 3 hours
- e. **Size exclusion chromatography**: Theory, Instrumentation and applications 2 hours

UNIT-IV

- a. **Gas chromatography**: Introduction, types of Gas chromatography, theory, instrumentation of GLC, Derivatisation techniques, Programmed temperature gas chromatography and applications. 5 hours
- b. **HPLC**: Introduction, theory, instrumentation and applications. 4 hours
- c. **HPTLC**: Basic concepts, Instrumentation, Difference between TLC and HPTLC, applications. 2 hours
- d. **Electrophoresis**: Principles of separation, Factors affecting separation, equipment for paper and gel electrophoresis, Moving boundary electrophoresis, isoelectric focusing electrophoresis and Applications 3 hours
- e. **Mass Spectroscopy**: Basic concepts, Instrumentation and applications. 2 hours

UNIT-V

Electrometric methods:

- a. **Potentiometry**: Electrochemical cell, construction and working of reference electrode, Normal hydrogen electrode, calomel electrode, silver-silver chloride electrode, Indicator electrodes- Glass electrode, Antimony electrode, Quinhydrone electrode, Potentiometric titrations, methods of detecting end point and applications. 6 hours
- b. **Conductometry**: Introduction, conductivity cell, cell constant, conductometric titrations and applications 2 hours
- c. **Quality assurance**: Introduction, Sources of quality variation, control of quality variation, Validation methods. 4 hours
- d. **X-ray Diffraction**: Theory of X-ray diffraction and applications. 2 hours

TEXT BOOKS:

1. Instrumental methods of analysis by Hobarth Willard, Lynne L Merritt and John A Dean, 6th edition, 1986, CBC publishers, New Delhi.
2. Instrumental methods of chemical analysis by B. K. Sharma, 10th edition, GOEL publishing house, 2002.
3. Practical pharmaceutical chemistry by Beckett A. H. and Stenlake J. B., 4th edition, CBS publishers, New Delhi, 1997.
4. Spectrometric identification of organic compounds by Robert M Silverstein, G. Clayton and Terence C. Morill, 6th edition, John Wiley and Sons, 2004.
5. Organic Spectroscopy by William Kemp.
6. Quantitative analysis of drugs by D.C. Garrett.
7. Text Book of Pharmaceutical Analysis by K.A. Connors.

REFERENCE BOOKS:

1. Indian Pharmacopoeia '96 Vol I & II

2. Principles of instrumental analysis by Douglas A Skoog, F. James Holler, 5th edition, eastern press, Bangalore, 1998
3. Quantitative analysis of drugs in Pharmaceutical formulation . P. D. Sethi, 3rd edition, CBS Publishers, New Delhi, 1997.
4. TLC by Stahl, Spring Verlag, 2nd edition, 1969.
5. Applications of Absorption Spectroscopy of Organic Compounds by John R Dyer.
6. Analytical Chemistry by Garry Christian.

SEMESTER/YEAR : IV YEAR

COURSE CODE: 15BP403

TITLE OF THE COURSE: PHARMACOLOGY & TOXICOLOGY - THEORY

L: T/A: P: C : 3 : 0 : 0 : 3

COURSE OBJECTIVES:

- It deals with the effects of drugs in man and how drugs are used most effectively to treat diseases.
- The overall objectives of this course are to provide the students with scientific and practical basis of successful drug therapy.

COURSE OUTCOMES:

- After completion of the course, the student come to know the site of drug action, changes caused by drugs in the normal function of tissues and organs.
- Relationship between the doses of drugs and its effects.
- How drug reduce their effects?
- What happens the drugs once they enter the body?

UNIT 1

1. Bio Assays: Scope, General Principles and Methods

2hours

2. Drug discovery and development: a. Preclinical evaluation (Regulatory Toxicity Studies as per OECD guidelines- Genotoxicity, Mutagenicity, carcinogenicity, Reproductive and developmental toxicity) b. Clinical evaluation including pharmacovigilance, GPP, ICH & OECD guidelines with respect to toxicology.

3 hours

UNIT 2

Pharmacology of Drugs Acting on Central Nervous System : General consideration (Introduction), Alcohol, General anesthetics, Sedatives and hypnotics, Anti-Epileptics, Psychopharmacological agents, Classification and mechanism of action of drugs used in psychosis, Pharmacology of Chlorpromazine (a prototype drug), Salient features of Antipsychotics including atypical Antipsychotics. Drugs used in Parkinsonism and Alzheimer's disease. Antidepressants: Classification and mechanism of action of drugs used in Depression, Pharmacology of imipramine (a prototype TCA), Salient features of other Antidepressants, including SSRIs and atypical antidepressants, Pharmacology of Lithium and other agents used in bipolar disorder. Anxiolytics, Drug dependence and drug abuse. Brief introduction on the recent development in the CNS drugs.

19 hours

UNIT 3

4. Analgesics and anti-inflammatory agents: Pain pathway, classification and mechanism of action of centrally acting analgesics, Pharmacology of Morphine (a prototype Opioid), Salient features of other opioids including antagonists, Classification and mechanism of action of NSAIDs, Pharmacology of Aspirin (a prototype NSAID), Salient features of other NSAIDs including COX-2 inhibitors. Brief introduction on the recent development in Analgesics and anti-inflammatory drugs.

8 hours

5. Pharmacology of Drugs Acting on Gastro Intestinal Tract: Antiulcer drugs, Antacids, Laxatives and Purgatives, Emetics and Antiemetics, Appetizers, Digestants, Carminatives. Brief introduction to the role of micro-biomes in gut health.

4 hours

UNIT 4

6. Chemotherapy: Introduction and principles of chemotherapy including general mechanisms of antimicrobials, mechanism of resistance, super infections, antimicrobial combinations. Classification, mechanism of action, spectrum of activity, resistance development, adverse drug reactions and therapeutic use of the following: 1. Sulfonamides and Co-trimoxazole, 2. Penicillins and Cephalosporins, 3. Tetracyclines and Chloramphenicol, 4. Macrolides, 5. Aminoglycosides, 6. Polyene & Polypeptide antibiotics, 7. Quinolones and Fluoroquinolones, 8. Lincosamides, Glycopeptides, urinary antiseptics, 9. Antifungal agents, 10. Antiviral agents including anti-HIV, 11. Chemotherapy of Tuberculosis and Leprosy, 12. Chemotherapy of Malaria, 13. Chemotherapy of Protozoal infections (amoebiasis, Giardiasis), 14. Pharmacology of Anthelmintic drugs, 15. Chemotherapy of Cancer. Brief introduction on: (Immune oncology Eg. CTLA-4, Monoclonal antibodies in cancer therapy, Antibody drug conjugates, CAR-T.)

31 hours

UNIT 5

7. Immunopharmacology Pharmacology of immunosuppressants (Calcineurin inhibitors, cytotoxic agents, Glucocorticoids, Interleukin inhibitors, mTOR inhibitors, TNF – α inhibitors, cytokine inhibitors) and stimulants (Thymosin, Colony Stimulating Factors)

2 hours

8. Principles of Toxicology: General principles of treatment of acute toxicity and acute poisoning Signs, Symptoms and treatment of acute and chronic poisoning due to i) Barbiturates ii) Alcohols iii) Benzodiazapines iv) Antidepressants, v) Neuroleptics vi) Insecticides vii) Snake bite viii) Heavy metals (iron, lead, mercury, arsenic).

4 hours

9. Pharmacology of Local anesthetics

hours

2

SEMESTER/YEAR : IV YEAR
COURSE CODE : 15BP404
TITLE OF THE COURSE : MEDICINAL CHEMISTRY II - THEORY
L: T/A: P: C : 3 : 0 : 0 : 3

COURSE OBJECTIVES: The subject deals with understanding of chemistry, properties and action of medicinal agents for treating various disorders, basic concepts involved in drug design.

COURSE OUTCOMES: The student will be able to understand the action of drugs in different disease condition and apply basic principles in designing of new drug molecules.

UNIT I

- A. Introduction to QSAR:** Study of hydrophobic, Electronic & Steric parameters **2 hours**
- B. Prodrugs:** Definition and examples **1 hour**
- C. Introduction to drug discovery-** Definition of lead molecule and its identification methods viz, high throughput screening, large scale screening, and fragment based lead generation, fast followers **2 hours**
- D. History and development of chemotherapeutic agents:** Structure, uses and synthesis of only those compounds that are superscripted by 's'.
1. Antifungal agents:
 - a) Antifungal antibiotics- Nystatin, Griseofulvin, Amphoterecin-B Synthetic anti fungal agents
 - b) Substituted imidazoles: Clotrimazole, Miconazole^s, Ketoconazole, oxyconazole, Intraconazole.
 - c) Miscellaneous–Zinc propionate, Sodium caprylate, Tolnaftate^s. **4 hours**
 3. Antiviral Agents
 - a) Amantidine hydrochloride, Idoxuridine, Acyclovir, Zidovidine. **2 hours**
 - b) Anti-AIDS: Aza thymidine, Suramin
 3. Antiprotozoal agents: Emetine hydrochloride, Metronidazole^s, tinidazole, arnidazole, secnidazole, Diloxanide furoate, 8-hydroxy quinoline derivatives (clioquinol, iodoquinol) Carbarsone **2 hours**
 4. Anthelmintics: Piperazine, Diethyl carbamazine, Pyrantelpamoate, Thiabendazole^s Albendazole^s, Mebendazole **2 hours**

UNIT II

E. Sulfonamides, Sulfones as antibacterial agents :

1. SAR and mode of Sulfonamides.
2. Classification of sulfonamides based on duration of action and site of action with examples. Sulfamethiazole, Sulfisoxazole^s, Sulfapyridine, Sulfamethoxazole^s, Sulfadiazine, Sulfacetamide, sulfasalazine, Phthalyl sulfathiazole.
3. Folate reductase inhibitors: Trimethoprim, Synergistic action of the combination of sulfamethoxazole and Trimethoprim^s.

4. Sulfone: **Dapsone^s** **4 hours**
5. Antitubercular drugs:
- Synthetic antitubercular agents: p-Aminosalysilic acid, **Isoniazid^s**, **Ethambutol^s**, Pyrazinamide, Ethionamide, Clofazamine, Bedaquiline
 - Antitubercular Antibiotics: Cycloserine, Viomycin sulfate, Capreomycin sulfate, Rifampicin.
 - Combination therapy for TB, DOTS **4 hours**
Urinary tract anti-infectives:
Quinolones: Nalidixic acid, Cinoxacin, Norfloxacin, Ciprofloxacin^s, Pefloxacin,
 - Ofloxacin, Sparfloxacin
 - Miscellaneous: **Nitrofurantoin^s**. **3 hours**

F. Antimalarials: Etiology of malaria, History, Mechanism and SAR

- Quinolines and analogues: 7-chloro-4-amino quinolines :Chloroquine phosphate^s, HydroxyChloroquinesulphate, Amodiaquine, 8-amino quinolines: Pamaquine, **Primaquine^s**, 9-amino acridines: Quinacrine.
- Artimicin and its derivatives: Artiether, Artimether, Artisunate
- Biguanides and Dihydrothiazines: **Chloroguanide^s**, Cycloguanil.
- Miscellaneous: Mefloquine, Pyrimethamine, Trimethoprim. **6 hours**

UNIT III

G. Antibiotics: Classification and Mechanism of action

- Beta lactam antibiotics: Pencillins – structures, chemical degradation, bacterial resistance. Penicillin G, Penicillin V, Cloxacillin sodium, Naficillin sodium, Ampicillin, Amoxicillin.
- Cephalosporins: Structure and uses of Cephalexin, Cephadrine, Cefadroxil, Cefixime, Cefapyridine, Cefutroxime
- Monolactams: Sulfazecin, Aztreonam, Tigmonam.
- Beta lactamase inhibitors: Clavulanic acid and its salts, Thienamycin.
- Aminoglycosides: Structural features and Mechanism of action, Streptomycin, Amikacin, Neomycin, Kanamycin, Gentamycin, Netilmycin
- Tetracyclines: Chemistry and **SAR**, tetracycline, Chlortetracycline, Methacycline, Demeclocycline, Oxytetracycline, Meclocycline, Doxycycline, Minocycline.
- Macrolide: Structure and specific uses of Erythromycin, Azithromycin, oleandomycin.
- Lincomycins: Lincomycin, Clindamycin.
- Polypeptides: Gramicidin, Bacitracin, Polymyxin B, Colistin.
- Miscellaneous: **Chlormphenicol^s**, Vancomycin, Novobiocin. **12 hours**

UNIT IV

H. Antineoplastic agents: Introduction, mechanism of action and classification with examples.

- Alkylating agents: Mechlorethamine, Cyclophosphomide, Melphalan, **Chlorambucil^s**, Busulfan, Lomustine,
- Antimetabolites: Mercaptopurine, Thioguanine, 5-Fluorouracil, **Methotrexate^s**,
- Antibiotics: Dactinomycin, Bleomycin, Mitomycin, Streptozocin.
- Plant products: Etoposide, Taxol, Camphothesin, Vincristine, Vinblastin.
- Harmones: Dromostanalone, Megestrol,

6. Kinase inhibitors: Imatinibmesylate
7. Miscellaneous: Asparaginase, Cisplatin, Hydroxy urea.
8. Immunotherapy: Interferon alpha 2a and 2b.

6 hours

I. Cardiovascular agents:

1. Antianginal agents and vasodilators: Chemical structure and specific uses of Amyl nitrite, Nitroglycerine, Isosorbide dinitrate.
2. Calcium antagonists: Brief introduction of calcium channels and their blockers. Chemical Structures and uses of Verapamil, Diltiazem, Nifedepine, Nimodipine, Felodipine, Dipyridamole, Cyclandelate.
3. Antiarrhythmic drugs: Structure, chemical name, and classification of antiarrhythmics with examples
 Class I- Membrane depressant drugs: Quinidine Procainamide, Phenytoin^s.
 Class II-Beta adrenergic blocking agents. Tocainide, propranolol^s
 Class III-Repolarization prolongators. Bretylium, Amiodarone
 Class IV-Calcium channel blocker. Diltiazem, Verapamil
4. Antihypertensive agents:
 Beta-blockers: Propranolol, Timolol
 ACE Inhibitors: Captopril, Enalapril
 Diuretics: Hydrochlorthiazide, Spiranolactone
 Calcium channel blockers: Nifedipine, Felodipine, Amlodipine
 α_1 -Antagonist: Prazocin
 α_2 -agonist: Clonidine^s, Guanithedine
 Angiotensin -II receptor antagonist: Losartan, Valsartan
 Miscellaneous: Reserpine, Hydralazine^s, Minoxidil

11 hours

UNIT V

1. Antihyperlipidemic agents: Structure and specific uses. Clofibrate, Lovastatin, Cholesteramine, Colestipol, Atorvastatin **3 hours**
2. Anticoagulants: Dicumorol, Warfarin^s, Phenindione **1 hour**
3. Hypoglycemic agents: Insulin and its preparations.
 Sulfonylureas-Chlorpropamide^s, Acetohexamide, Glipizide,
 Biguanides-Phenformin, Metformin
 Substituted benzoic acid derivatives - Meglitinides, Nateglinide
 Thiazolidinediones - Glitazones, Pioglitazone, Ciglitazone, Rosiglitazone
 Glipitines - Sitagliptin, Anagliptin **3 hours**
4. Thyroid hormones : L-thyroxine, L-thyronine, **1 hour**
5. Antithyroid drugs: Propylthiouracil, Methimazole. **1 hour**

J. Diuretics: Introduction

1. Carbonic anhydrase inhibitors: Acetazolamide^s, Methazolamide.
2. Thiazide and Thiazide like diuretics: Chlorthiazides, Benzthiazide^s, Xipamide, Chlorthalidone.
3. High-ceiling or loop diuretics: Furosemide^s, Ethacrynic acid^s.
4. Potassium sparing diuretics: Spironolactone, Triamterene, Amiloride.
5. Miscellaneous: Mannitol. **5 hours**

SEMESTER/YEAR : IV YEAR

COURSE CODE : 15BP405

TITLE OF THE COURSE : INDUSTRIAL PHARMACOGNOSY –

THEORY L: T/A: P: C : 2 : 0 : 0 : 2

COURSE OBJECTIVES: To learn about the various standardization procedures, extraction methods of various plant drugs along with cosmetic preparations and alternative system of medicine – also about plant and enzyme biotechnology

COURSE OUTCOMES: Students will be aware of (i) Transgenic plants, tissue culture, enzyme technology. (ii) Extraction techniques, identification and characterization of herbal drugs. (iii) Herbal formulations and alternative system of medicine.

UNIT I

Secondary Metabolites: 10hrs

• Biosources, methods of isolation, identification, estimation, therapeutic uses, commercial applications of the following secondary metabolites: Gymnemic acid, Asiaticoside, Diosgenin, Quinine, Ephedrine, Digitoxin, Ca-sennosides, Glycyrrhizin , Andrographolides, Phyllanthin, caffeine.

UNIT II

A) **Herbal formulation and nutraceuticals 7 hrs**

a. Importance of herbal cosmetics. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.

b. **Preparation of herbal extracts, stability testing and formulations.**

c. **Role of Herbs in Cosmetics Hair care preparation – Soapnut, Henna, Amla, Hibiscus Skin Care preparation – Aloe vera, Turmeric, Sandalwood**

d. Nutraceuticals – Antioxidants, Spirulina, Garlic, Ginseng, Honey

B) **Traditional drugs and its marketed Products: 3 hrs**

Study of common and vernacular names, source active constituents and uses of: Shatavari, Bilva, Lehsun, Kantakari, Rasna, Punarnava, Shankapushpi, Guduchi, Chirata, Shilajit, Arjuna, Gokhru and Gymnema.

UNIT III

A) **Alternative system of medicine: 4 hrs**

a) Basic principles involved in traditional systems of medicine like Ayurveda, Siddha, Chinese, Homeopathy and Unani. b) Method of preparation of Ayurvedic preparations like Arishtas, Asavas, Gutikas, Tailas, Churnas, Leha and Bhasmas along with a few marketed products.

B) Standardization of Natural Products: 6 hrs

- Evaluation, quality control and standardization.
- WHO Guidelines – for assessment of Herbal Medicine and Cosmetics.
- Standardization of following drugs: Gymnema, Gokhru, Vasaka, Curcuma, Glycyrrhiza, Kalmegh, Brahmi, Ashwagandha, Tinospora and Phyllanthus.
- Determination of alcoholic content in ayurvedic formulations like Aristas and Asavas.

UNIT IV Plant tissue culture 10 hrs

- Historical development, nutritional requirement, growth and maintenance of tissue culture. Applications of plant tissue culture, detailed study of various types of cultures related to cell suspension culture, callus culture, hairy root culture and protoplast culture. • Applications of Transgenic plants. • Gene transfer using vectors and physical delivery methods in plants.

UNIT V

Biological preparations from Natural Products 10 hrs

- Definition, isolation and purification of enzymes and enzyme reactors.
- Immobilization of cell & enzymes and their applications.
- Biological source, preparation and uses of the following enzymes - Papain, Bromelain, Streptokinase and Urokinase.
- Allergenic extracts.
- Vaccines

TEXT BOOKS:

1. Kokate C.K., Purohit A.P and Gokhale S.B. Pharmacognosy, 45th ed., Nirali Prakashan, Pune, 2010.
2. Trease G.E. and Evans W.C., Pharmacognosy, 15th ed, Bailliere Tindall, Eastbourne, U.K., 2002.
3. Vinod D. Rangari. Pharmacognosy and Phytochemistry, 1st ed. Career publications, Nashik, 2003.
4. Ashutosh Kar. Pharmacognosy and Pharmacobiotechnology, 1st ed. New Age International Publishers, New Delhi, 2003.
5. Vyas S.P & Dixit. Pharmaceutical Biotechnology, 1st ed. CBS Publishers & distributors, New Delhi, 1998.

REFERENCES:

1. Pulok Mukherjee. Quality control of herbal drugs, 1st ed. Business horizons, New Delhi, 2002.
2. Peach K., and Tracey M.V, Modern Methods of Plant Analysis, 1-4, Narosa publishing house, New Delhi.
3. Rajpal V. Standardisation of Botanicals, 1st ed. Eastern publishers, New Delhi, 2002.
4. Indian Herbal Pharmacopoeia, Vol I & Vol II. Government of India, Ministry of Health. A Joint Publication of RRL, Jammu and IDMA, Mumbai, 1998 & 1999.

SEMESTER/YEAR: IV YEAR

COURSE CODE: 15BP471

**TITLE OF THE COURSE: PHARMACEUTICAL TECHNOLOGY AND
BIOPHARMACEUTICS - PRACTICAL**

L: T/A: P: C: 0 : 0 : 3 : 1.5

Course Objective:

After the successful completion of the course the students will be able to

- Understand the importance of preformulation in preparation of tablets
- Formulate various dosage forms and cosmetic preparations
- Understand the significance of formulation of liquid orals

Course Outcome:

After the successful completion of the course the students will be able to

CO 1: Enumerate the principles and applications of preformulation studies in various dosage form

CO 2: Prepare, compress and evaluate tablets by different granulation methods

CO 3: Prepare and sealing of ampoules

CO 4: Formulate liquid oral preparations

CO 5: Formulate creams and ointments

1. Manufacture of tablets

- a. Tablets prepared by wet granulation.
- b. Preformulation studies on granules
- b. Tablets prepared by direct compression.
- c. Mouth dissolving tablet.
- d. Chewable tablet

2. Evaluation of tablets

3. Manufacture of parenteral

- a. Ascorbic acid injection
- b. Calcium gluconate injection

- c. Sodium chloride injection
- d. Dextrose injection
- 4. **Cosmetic preparations**
 - a. Lipsticks
 - b. Cold cream and vanishing cream
 - c. Clear liquid shampoo
 - d. Tooth paste and tooth powders
 - e. Sunscreens
- 5. Formulation of liquid orals
 - a. Paracetamol syrup
 - b. Antacid suspensions- magnesium hydroxide and aluminum hydroxide gel
- 6. Demonstration of tablet coating
- 7. Demonstration of microencapsulation technique and matrix tablets.

TEXT BOOKS:

1. Theory and Practice of Industrial Pharmacy – Leon Lachmann, Herbert A. Libermann and J. L. Kanig, Lea & Febiger, Philadelphia.
2. Introduction to Pharmaceutical Dosage Forms by H. C. Ansel, Lea & Febiger, Philadelphia.
3. Biopharmaceutics and Pharmacokinetics, A Treatise, D.M.Brahmankar and Sunil B. Jaiswal.

REFERENCE BOOKS:

1. Pharmaceutics – The Science of Dosage Form Design by M. E. Aulton, Churchill Livingstone.
2. Remington's Pharmaceutical Sciences, Mack Publishing Co. Easton.
3. Cosmetics – Formulation, manufacturing and quality control – P. P. Sharma.
4. Bentley's Textbook of Pharmaceutics By Rawlins CBS Publishers New Delhi.
5. Harry's Textbook of Cosmetology.
6. Pharmacopoeias: I.P., B.P., U.S.P.
7. Dispensing for Pharmaceutical Students by Cooper and Gunn, 12th Edition.
8. Modern Text Book of Pharmaceutics by Gilbert Banker and Christopher Rhodes, Informa Press.

9. Lachmann and Libermann, Pharmaceutical Dosage Form-Parenteral Medication Edited by Avis, Informa Press (Latest Edition).

10. Lachmann and Libermann, Pharmaceutical Dosage Form- Tablets Vol I, II, III (Latest Edition), Informa Press.

SEMESTER/YEAR : IV YEAR

COURSE CODE : 15BP472

TITLE OF THE COURSE : INSTRUMENTAL & BIOMEDICAL ANALYSIS- PRACTICAL

L: T/A: P: C : 0 : 0 : 3 : 1.5

Course Objectives:

Students will learn the various Analytical instruments. Perform experiments related to analysis using UV, IR, Fluorimetry, flame photometry and HPLC and TLC.

Course Outcomes: Student will able to handle different sophisticated instruments practically and gain interpretation skills.

Note: At least 15 experiments to be covered from the following list

1. Separation & identification of amino acids by Ascending paper chromatography*.
2. Separation & identification of amino acids by Radial paper chromatography*.
3. Separation & identification of alkaloids by TLC*.
4. Determination of absorption maxima for a given solution of the drug*.
5. Colorimetric estimation of Sulphanilamide using BM Reagent**.
6. Colorimetric estimation of Ferrous ions using 1,10 Phenanthroline**.
7. Colorimetric estimation of Paracetamol*.
8. UV spectrophotometric determination of Paracetamol tablets*.
9. UV spectrophotometric determination of Ibuprofen tablets*.
10. Determination of Ibuprofen and Paracetamol by simultaneous equation method**.
11. Determination of pKa using pH meter*.
12. Conductometric titration of mixture of strong acids with a strong base**.
13. Potentiometric titration of strong acid with a strong base**.
14. Estimation of Quinine sulphate by Spectrofluorimetry**.
15. Study of quenching effect in Spectrofluorimetry*.
16. Determination of Sodium/Potassium by flame photometry*.
17. Determination of chloride and sulphates by Nepheloturbidimetric method**.
18. IR interpretation of samples with different functional groups*.
19. Demonstration of HPLC*.
20. IR interpretation of any two organic compounds**.

Major experiment (Experiment indicated by **) Minor experiment (Experiment indicated by *)

TEXT BOOKS:

1. Instrumental methods of analysis by Hobarth Willard, Lynne L Merritt and John A Dean, 6th edition, 1986, CBC publishers, New Delhi.
2. Instrumental methods of chemical analysis by B. K. Sharma, 10th edition, GOEL publishing house, 2002.
3. Practical pharmaceutical chemistry by Beckett A. H. and Stenlake J. B., 4th edition, CBS publishers, New Delhi, 1997.
4. Spectrometric identification of organic compounds by Robert M Silverstein, G. Clayton and Terence C. Morill, 6th edition, John Wiley and Sons, 2004.
5. Organic Spectroscopy by William Kemp.
6. Quantitative analysis of drugs by D.C. Garrett.
7. Text Book of Pharmaceutical Analysis by K.A. Connors.

SEMESTER/YEAR : IV YEAR

COURSE CODE : 15BP473

TITLE OF THE COURSE : PHARMACOLOGY & TOXICOLOGY - PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

Course objectives:

- This course will offer practical exposure to the virtual platform by utilizing suitable software to attain the desired results or experiments mentioned in the list of experiments.
- To understand the mechanism of action of different drugs on different therapeutic areas using simulated experiments.

Course outcomes:

- Students will be able to demonstrate and understand the effects of different drugs on different therapeutic areas using simulated experiments.
- Students will be able to demonstrate the different analytical methods to determine the concentration of drug substance in tissues.
- Students will have knowledge on principles and procedure involved in the animal toxicology studies and bioassay.

List of Experiments:

1. To record the dose response curve of Histamine using isolated chick/rat/guinea pig ileum preparation.**
2. To carry out bioassay of Histamine using isolated chick/rat/guinea pig ileum preparation by matching method.**
3. To carry out bioassay of Histamine using isolated chick/rat/guinea pig ileum preparation by interpolation method.**
4. To carry out bioassay of Histamine using isolated chick/rat/guinea pig ileum preparation by three point method.**
5. To record the dose response curve of Acetylcholine using isolated ileum preparation.**
6. To carry out bioassay of Ach using isolated chick/rat/guinea pig ileum preparation by interpolation method.**
7. To carry out bioassay of Acetylcholine using isolated ileum preparation by matching method.**
8. To carry out bioassay of Acetylcholine using isolated ileum preparation by three point method.**
9. To carry out MAO inhibitory activity using chick/rat liver homogenate.*
10. To carry out amylase/ α -glucosidase inhibitory activity using in vitro technique.*

11. Study of principle, procedure involved and interpretation of given results for analgesic property of drug using analgesiometer*
12. Study of principle, procedure involved and interpretation of given results for Anti-inflammatory effect of drugs using rat-paw edema method.*
13. Study of principle, procedure involved and interpretation of given results for Anti convulsant activity of drugs using MES method.*
14. Study of principle, procedure involved and interpretation of given results for Anti convulsant activity of drugs using pentylenetetrazole method.*
15. Study of principle, procedure involved and interpretation of given results for antidepressant activity of drugs using pole climbing apparatus.*
16. Study of principle, procedure involved and interpretation of given results for hypnotic and sedative property using Pentobarbitone induced sleeping time method.*
17. Study of principle, procedure involved and interpretation of given results for locomotor activity evaluation of drugs using Actophotometer.*
18. Study of principle, procedure involved and interpretation of given results for evaluation of muscle grip strength/relaxant effect of drugs using rotarod.*
19. Study of principle, procedure involved and evaluation of anthelmintic activity of drugs using earthworm as a model.*
20. To determine the clastogenic potential of test compound by assessing in-vitro micronuclease formation.

Note: ** Denotes major experiments * Denotes minor experiments

SEMESTER/YEAR : IV YEAR
COURSE CODE : 15BP474
TITLE OF THE COURSE : MEDICINAL CHEMISTRY II - PRACTICAL
L: T/A: P: C : 0: 0: 3: 1.5

Assay of

1. Sulphadiazine by diazotization
2. Piperazine Citrate by non aqueous titration
3. Ascorbic acid by Iodimetry/Cerrimetry
4. Isonicotinic acid by $KBrO_3$ (Bromimetry)
5. Benzyl penicillin by Iodometry
6. Metronidazole/Mepacrine by non aqueous titration
7. Furosemide by neutralization titration
8. Diethyl carbamazine by neutralization titration

Preparation of medicinally important compounds or intermediates required for synthesis of drugs

1. PAS from p-nitro salicylic acid
2. Dichloramine T from toluene p-sulphonamide
3. Chloramine T from Dichloramine T
4. Fluorescein from phthalic anhydride
5. Eosin from Fluorescein
6. Sulphacetamide from sulphanilamide
7. Sulphanilamide from Acetanilide
8. INH from γ Picoline
9. Chlorobutanol
10. Benzotriazole
11. 2,3-Diphenyl quinoxaline
12. 2,4,5-Triphenyl imidazole from Benzoin

Green Chemistry Synthesis

1. Microwave assisted synthesis of 1,4-dihydropyridine/pyrimidine
2. Synthesis of p-bromoacetanilide from aniline using KBr

Estimation of the functional groups in medicinally important compound

1. Hydroxyl group in cholesterol
2. Ketone in camphor
3. Hydroxyl group in menthol
4. Amide in nicotinamide

MEDICINAL CHEMISTRY II REFERENCE BOOKS (PRACTICALS):

1. A.I.Vogel, Text Book of practical organic chemistry
2. A.H. Beckett and Stanlake, Practical pharmaceutical chemistry
3. J.G.Mann and Saunders, Practical organic chemistry
4. Jayaveera KN, Practical medicinal chemistry
5. All editions of IP.

SEMESTER/YEAR : IV YEAR

COURSE CODE : 15BP475

TITLE OF THE COURSE : INDUSTRIAL PHARMACOGNOSY –

PRACTICAL L: T/A: P: C : 0 : 0 : 3 : 1.5

1. Isolation of some selected phytoconstituents studied in theory and their chromatographic profiles.** Glycyrrhizin from Liquorice Hesperidin from Orange peel Quinine from Cinchona Caffeine from Tea leaves Andrographolide from Kalmegh
2. Studies of traditional drugs, common vernacular names, botanical sources, morphology, chemical nature of chief constituents, pharmacological and common uses of the drugs studied in theory.*
3. Estimation of some of the isolated phytoconstituents :** Caffeine, Curcumin and Quinine
4. Chromatography* Thin layer chromatography of alkaloids Paper chromatography of amino acids
5. Estimation of bitters in Kalmegh*
6. Determination of swelling index in mucilage containing drugs*
7. Determination of alcoholic content in Aristas and Asavas.*
8. Immobilization of enzymes like amylase and yeast cells and determination of their activity.*
9. Tissue culture: Initiation of callus culture.

* ** Major experiment: -

Isolation of phytoconstituents from plant source.

Estimation of phytoconstituents

* Minor experiment: - Morphology Powder microscopy Chromatography Immobilization Alcohol content determination Tissue culture

TEXT BOOKS:

1. Kokate C.K., Purohit A.P and Gokhale S.B. Pharmacognosy, 45th ed., Nirali Prakashan, Pune, 2010.
2. Trease G.E. and Evans W.C., Pharmacognosy, 15th ed, Bailliere Tindall, Eastbourne, U.K., 2002.
3. Vinod D. Rangari. Pharmacognosy and Phytochemistry, 1st ed. Career publications, Nashik, 2003.
4. Ashutosh Kar. Pharmacognosy and Pharmacobiotechnology, 1st ed. New Age International Publishers, New Delhi, 2003.

5. Vyas S.P & Dixit. Pharmaceutical Biotechnology, 1st ed. CBS Publishers & distributors, New Delhi, 1998.

REFERENCES:

1. Pulok Mukherjee. Quality control of herbal drugs, 1st ed. Business horizons, New Delhi, 2002.
2. Peach K., and Tracey M.V, Modern Methods of Plant Analysis, 1-4, Narosa publishing house, New Delhi.
3. Rajpal V. Standardisation of Botanicals, 1st ed. Eastern publishers, New Delhi, 2002.
4. Indian Herbal Pharmacopoeia, Vol I & Vol II. Government of India, Ministry of Health. A Joint Publication of RRL, Jammu and IDMA, Mumbai, 1998 & 1999.

SEMESTER / YEAR : I YEAR

COURSE CODE : 15PD104

TITLE OF THE COURSE : PHARMACEUTICAL ORGANIC CHEMISTRY (Theory)

L:T:P :3:1:3

Course objectives : To study different chain of organic compounds with respect to their synthesis and mechanism.

Course Outcomes :

Upon completion of the course the student shall be able to

1. Write the structure, name and the type of isomerism of the organic compound
2. Write the reaction, name the reaction and orientation of reactions
3. Account for reactivity/stability of compounds,
4. identify/confirm the identification of organic compound
5. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

Unit -1

1. General organic chemistry: 8 hrs

(a) Scope, definition and classification.

(b) IUPAC Nomenclature of aliphatic and aromatic organic compounds belonging to the following classes: alkanes, cycloalkanes, alkenes, alkynes, alcohols, aldehydes, ketones, amides, Amines, phenols, alkyl halides, Ethers, carboxylic acids, esters, acid chlorides and acid anhydrides.

2. Structure and physical properties: 4 hrs

a) Polarity and Dipole moment, Hydrogen bonding and its applications, sp^3 , sp^2 and sp Hybridization, Inductive effect, Mesomeric effect, Resonance effect, Protic and aprotic solvents.

b) An introduction to Isomerism- Definition, Classification of structural and stereo isomerism

c) Definition of Electrophiles and Nucleophiles with examples.

3. a) Definition, formation, classification and stability of free radicals 3 hrs

b) Free radical chain reactions of alkanes and their mechanism, relative reactivity and stability.

Unit -2

4. a) Definition, formation, classification and stability of carbocations, Preparation methods of Alkyl halides 8 hrs

b) **Nucleophilic aliphatic substitution** mechanism: Nucleophiles and leaving groups, kinetics of first and second order reaction. Mechanism, Stereochemistry of SN_2 and SN_1 reaction, Rearrangement of carbocation, N_2 versus SN_1 reactions, Factors Affecting SN_2 and SN_1 reaction

5. Elimination reactions: 7 hrs

Dehydrohalogenation of alkyl halides: 1, 2 elimination, kinetics, **E_2 and E_1 mechanisms**, E_2 versus E_1 , elimination versus substitution. Dehydration of alcohols and its mechanism, orientation and reactivity in E_1 and E_2 reactions. Saytzeff's and Hoffman's elimination.

Unit -3

6. a) Alicyclic compounds: Preparation of cycloalkanes like propane, Butane, Pentane and Hexane. Bayer's strain theory, theory of Strainless ring, molecular orbital concept.

4 hrs

7. **Electrophilic addition**: Reactions at carbon-carbon double bond, hydrogenation and its mechanism Markovnikov's rule, addition of hydrogen halides, Addition of hydrogen bromides-peroxide effect. Electrophilic addition mechanism. **6 hrs**

b) Definition, formation, classification and stability of carbenes, Mechanism of cycloaddition reactions with examples. Addition of carbenes to alkenes, Diel's Alder reaction. **1 hr**

8. (a) conjugated dienes, mechanisms of 1,2 and 1,4-additions with examples, effect of temperature on 1, 2 and 1,4 addition

(b) Formation and orbital picture of allyl radical, Free radical substitution in alkenes.

2 hrs

Unit -4

9. Electrophilic aromatic substitution; Aromaticity of Benzene, Huckels rule. Effect of substituent groups, determination of orientation, and relative reactivity, classification of substituent groups. Theory of reactivity, Theory of orientation. Mechanism of nitration, sulphonation, halogenation, Friedel Craft's alkylation and Friedel Craft's acylation, Orientation in disubstituted benzenes **10 hrs**

10. a) Definition, formation, classification and stability of carbanions. **7 hrs**

b) **Nucleophilic additions** in aldehydes and ketones, mechanisms with examples. Reactions of Grignard reagent. Aldol and crossed Aldol condensation, Claisen condensation, Cannizzaro and crossed Cannizzaro reaction, Benzoin's, Perkins, Knoevenagels and Reformatsky reaction

Unit -5

11. Carboxylic acids - Ionization of carboxylic acids, acidity of constant, acidity of carboxylic acids, structure of carboxylate ion, effect of substituent on acidity of carboxylic acids, Conversion of carboxylic acids into acid chloride, ester, amide and anhydrides. **6 hrs**

12. Amines -

a) Basicity of Amines, effect of substituents on basicity of aliphatic and Aromatic amine

1 hrs

b) Definition, formation, classification, stability and reactivity of nitrenes.

3 hrs

Hofmann's, Beckmanns, Curtius, Smith, rearrangement with their mechanism

c) Diazotisation and its mechanism, Significance of intermediates in synthetic chemistry. Sandmeyer's and Gattermann reaction, coupling reaction of Diazonium salts with phenols and amines **2 hrs**

13. Phenols - Acidity of phenols, effect of substituent on acidity of phenols. Kolbe's reaction,

Reimer - Tiemann reaction, Fries rearrangement and Williamson's synthesis

2 hrs

SEMESTER / YEAR : I YEAR
COURSE CODE : 15PD101
TITLE OF THE COURSE : HUMAN ANATOMY AND PHYSIOLOGY-I (Theory)
L:T:P : 3:1:3

Course Objectives To study the fundamental knowledge on structure and functions of various systems in the human body.

Course Outcomes Students will be able to understand both homeostasis mechanisms and imbalances of various systems in the human body

1. Define different terminologies, structure and organization of cell and different organs.
2. Describe about the disorders of all systems of the human body.

Unit -1

1. Scope of anatomy, physiology and basic terminology. 1 hr

2. i) Structure of the Cell: 4 hrs

Structure & function of plasma membrane, cell cycle and transport of substances across cell membrane

ii) Cell physiology:

Different type of cells

Development of action potential

Cell stimulation and neuronal functions.

3. Tissues: 2 hrs

Epithelial, connective, muscular and nervous tissues, their types and characteristics.

4. Skeletal Muscles 2 hrs

Electrophysiology of muscle contraction

Properties of skeletal muscles

Muscles in exercise

Disorders: Muscular dystrophy, Myasthenia gravis

5. Blood: 6 hrs

Composition and functions of blood

Blood grouping and its significance

Mechanism of coagulation

Disorders: Anaemias, Polycythaemia, Leukopenia, Leukocytosis, Leukaemia,

Thrombocytopenia, Thrombosis & Haemophilia

Unit -2

6. Bones and Joints: 4 hrs

Structure and function of skeleton & types of joints.

Disorders: Osteoporosis, Arthritis, Rickets & Gout

7. Lymph & Lymphatic system:**3 hrs**

Formation of lymph and its composition Structure & functions of lymph node, spleen and thymus gland **Disorders:** Lymphoedema & Splenomegaly

8. Cardiovascular system:**8 hrs**

Structure of blood vessels

Anatomy and physiology of heart:

Blood circulation - systemic, hepatic, pulmonary, fetal and circle of Willis

Conduction system of the heart, heart rate, Electrophysiology of cardiac muscle, cardiac cycle.

Blood pressure and its regulation, ECG and heart sounds.

Disorders: Congestive Heart Failure, Cardiac Arrhythmias, Angina Pectoris, Myocardial Infarction, Atherosclerosis, Rheumatic Heart Disease, Cardiac Hypertrophy, Left Ventricular Hypertrophy, Hypertension & Hypotension

Unit -3**9. Digestive system:****6 hrs**

Gross anatomy of the gastro-intestinal tract and its physiology with special reference Salivary gland, Liver, Gall bladder and Pancreas.

Digestion & absorption of nutrients in GIT

Movements of intestine

Disorders: Peptic Ulcer, GERD, Constipation, Diarrhea, Liver Cirrhosis, Hepatitis & Anorexia.

10. Respiratory system:**5 hrs**

Anatomy & functions of respiratory tract, Mechanism of respiration,

Lung volumes & capacities, Hypoxia and Resuscitation, Transport of oxygen and carbon dioxide.

Disorders: Asthma, COPD, Tuberculosis, Pneumonia, Cyanosis and Caisson's disease.

11. Endocrine system:**5 hrs**

Basic structure, secretions & functions of:

Hypothalamus & Pituitary gland, Thyroid & Parathyroid gland, Adrenal gland & Pancreatic Islets

Disorders: Gigantism, Acromegaly, Diabetes insipidus, Dwarfism Hypothyroidism, Hyperthyroidism, Cushing's syndrome, Addison's disease, Diabetes Mellitus & Pheochromocytoma

Unit -4**12. Urinary system:****5 hrs**

Structure and functions of kidney & urinary tract. Physiology of urine formation & acid-base balance. Micturition reflex, Renal function Test

Disorders: Renal Calculi, Cystitis, Glomerulonephritis & Renal Fibrosis

13. Reproductive system:**7 hrs**

Structure and functions of male and female reproductive systems, Sex hormones
Physiology of menstruation, Spermatogenesis and oogenesis, Pregnancy and parturition, Oral contraceptives

Disorders: Infertility, Polycystic Ovarian Disease, Erectile Dysfunction & AIDS

14. Sense organs: **3 hrs**

Anatomy & Physiology of

i) Eye

ii) Taste & Smell

Disorders: Glaucoma, Cataract, Conjunctivitis

Unit - 5

15. Sense organs: **3 hrs**

Anatomy & Physiology of

i) Ear

ii) Skin

Disorders: Otitis, Psoriasis & Tinnitus

16. Nervous system: **8 hrs**

Classification of nervous system

i) Central nervous system:

Structure & functions of brain, Functional areas of brain: Cerebrum, Cerebellum, Pons & Medulla, Thalamus & Hypothalamus and Basal ganglia, Cerebrospinal fluid and its functions, meninges, Cranial nerves & their functions, Structure of spinal cord, Reflex arc

ii) Autonomic nervous system: **2 hrs**

Anatomy, physiology and divisions of ANS Motor and sensory pathways

iii) Somatic Nervous System **1hr**

iv) Disorders: Epilepsy, Parkinson's Disease, Depression, Insomnia, Anxiety, Schizophrenia, Migraine & Alzheimer's Disease

TEXT BOOKS :

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
4. Text book of Medical Physiology- Arthur C, Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.

7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi. R.K. Goyal and N.M. Patel, Practical Anatomy Physiology and Biochemistry, B.S. Shah Prakashan, 11th Ed 2008.

REFERENCES :

1. Inderbir Singh, Text Book of Human Histology with Colour Atlas, Jaypee Brothers Medical Publishers, 6th Ed, 2011.
2. Thakaore Bhai, P. Gandhi and Harit R. Derasari, Elements of Human Anatomy Physiology and Health Education, B.S. Shah Publishers, 12th Ed, 2004.
3. Douglas E. Kelly, Richard L. Wood and Allen C. Enders, Bailey's Text Book of Microscopic Anatomy, Williams & Wilkins Publishers, 18th Ed, 1984.

Course code : 15PD102
Course title : PHARMACEUTICS
Sem / Year : I Year

COURSE OBJECTIVES:

- To impart a fundamental knowledge on the art and science of formulating dosage forms.
- To introduce basic principle of preparing various dosage forms.
- To distinguish different pharmaceutical calculation involved in formulation

COURSE OUTCOMES:

1. Illustrate the different parts of a prescription with their significance and various operational aspects in compounding and dispensing of a prescription.
2. Critique on different pharmaceutical calculation involved in formulation and explore the rules to prepare and dispense of various types of powders
3. Elucidate the various excipients used in liquid orals and enumerate the identification, precautions on instabilities of biphasic liquids
4. Estimate the percentage of solutions by allegation method, Convert the solutions to proof spirit, find out the isotonicity of solutions.
5. Designate various causes of incompatibility and their remedies with suitable example.

COURSE CONTENT:

MODULE 1

9Hrs

1. a. Introduction to dosage forms - classification and definitions
b. **Prescription**: definition, parts and handling
c. **Posology**: Definition, Factors affecting dose selection. Calculation of children and infant doses.

MODULE 2

9Hrs

2. Historical back ground and development of profession of pharmacy and pharmaceutical industry in brief.
3. **Powders and Granules**: Classification advantages and disadvantages, Preparation of simple, compound powders, Insufflations, Dusting powders, Eutectic and Explosive powders, Tooth powder and effervescent powders and granules.
4. Galenicals: Definition, equipment for different extraction processes like infusion, Decoction, Maceration and Percolation, methods of preparation of spirits, tinctures and extracts.

MODULE 3

14Hrs

5. **Monophasic Dosage forms: Theoretical aspects of formulation including adjuvant like stabilizers, colorants, flavours with examples**. Study of Monophasic liquids like gargles, mouth washes, Throat paint, Ear drops, Nasal drops, Liniments and lotions, Enemas and collodions.

6. **Biphasic dosage forms: Suspensions and emulsions**, Definition, advantages and disadvantages, classification, test for the type of emulsion, **formulation, stability and evaluation.**

MODULE 4

10Hrs

7. Development of Indian Pharmacopoeia and introduction to other Pharmacopoeias such as BP, USP, European Pharmacopoeia, Extra pharmacopoeia and Indian national formulary.

8. Weights and measures, **Calculations involving percentage solutions, allegation, proof spirit, isotonic solutions etc.**

9. Suppositories and pessaries: Definition, advantages and disadvantages, types of bases, method of preparation, Displacement value and evaluation.

MODULE 5

8Hrs

10. **Pharmaceutical calculations.**

11. Surgical aids: Surgical dressings, absorbable gelatin sponge, sutures, ligatures and medicated bandages.

12. **Incompatibilities: Introduction, classification and methods to overcome the incompatibilities.**

Text Books:

1. Carter S.J, Cooper, Gunn's - Dispensing for Pharmaceutical Students, 12th ed. CBS Publishers, New Delhi: 2000.

2. E.A.Rawlins. Bentley's text book of Pharmaceutics, 8th ed. 1997.

Reference Books:

1. L.V Allen, N.G Popovich, H.C. Ansel. Pharmaceutical Dosage form and Drug delivery system, Lippincott Williams and Wilkins, 9th ed. 2nd Indian reprint, Wolters Kluwer (India) Pvt. Ltd., New Delhi: 2011.

2. M.E. Aulton, K. Taylor. Pharmaceutics: The Science & Dosage Form Design, 2nd ed. Churchill Livingstone, Edinburgh: 2002.

3. Alfonso R. Gennaro Remington. The science and practice of pharmacy, Vol I and Vol II, 22nd edition. Edited by Allen L V, Adeboye A, Shane P D, Linda A F, Jointly published by Pharmaceutical Press and Philadelphia College of Pharmacy at University of the Sciences; 2012

SEMESTER / YEAR : I YEAR
COURSE CODE : 15PD103
TITLE OF THE COURSE : MEDICINAL BIOCHEMISTRY (Theory)
L:T:P :3:1:3

- Course objectives**
- To study the principles and pathways of various biochemical processes and to understand their role in disease processes.
- Course Outcomes**
- Student will be able to correlate the normal and abnormal biochemical pathways in assessing the health condition of individuals.

Unit - 1

26 hrs

- 1 **Introduction to biochemistry:** Cell and its biochemical organization, transport process across the cell membranes. Energy rich compounds; ATP, Cyclic AMP and their biological significance.
- 2 **Enzymes:** Definition; Nomenclature; IUB classification; Factor affecting enzyme activity; Enzyme action; enzyme inhibition. Isoenzymes and their therapeutic and diagnostic applications; Coenzymes and their biochemical role and deficiency diseases.
- 3 **Carbohydrate metabolism:** Glycolysis, Citric acid cycle (TCA cycle), HMP shunt, Glycogenolysis, gluconeogenesis, glycogenesis. Metabolic disorders of carbohydrate metabolism (diabetes mellitus and glycogen storage diseases); Glucose, Galactose tolerance test and their significance; hormonal regulation of carbohydrate metabolism.

Unit -2

10 hrs

- 4 **Lipid metabolism:** Oxidation of saturated (β -oxidation); Ketogenesis and ketolysis; biosynthesis of fatty acids, lipids; metabolism of cholesterol; Hormonal regulation of lipid metabolism. Defective metabolism of lipids (Atherosclerosis, fatty liver, hypercholesterolemia).
- 5 **Biological oxidation:** Coenzyme system involved in Biological oxidation . Electron transport chain (its mechanism in energy capture; regulation and inhibition); Uncouplers of ETC; Oxidative phosphorylation;

Unit -3

14 hrs

- 6 **Protein and amino acid metabolism:** protein turn over; nitrogen balance; Catabolism of Amino acids (Transamination, deamination & decarboxylation). Urea cycle and its metabolic disorders; production of bile pigments; hyperbilirubinemia, porphoria, jaundice. Metabolic disorder of Amino acids.
- 7 **Nucleic acid metabolism:** Metabolism of purine and pyrimidine nucleotides; Protein synthesis; Genetic code; inhibition of protein synthesis; mutation and repair mechanism; DNA replication (semiconservative /onion peel models) and DNA repair mechanism.
- 8 **Introduction to clinical chemistry: Cell;** composition; malfunction; Roll of the clinical chemistry laboratory.

Unit -4

10 hrs

- 9 **The kidney function tests:** Role of kidney; Laboratory tests for normal function includes-

- a) Urine analysis (macroscopic and physical examination, quantitative and semiquantitative tests.)
 - b) Test for NPN constituents. (Creatinine /urea clearance, determination of blood and urine creatinine, urea and uric acid)
 - c) Urine concentration test
 - d) Urinary tract calculi. (stones)
- 10 **Liver function tests:** Physiological role of liver, metabolic, storage, excretory, protective, circulatory functions and function in blood coagulation.
- 11 a) Test for hepatic dysfunction-Bile pigments metabolism.
- b) Test for hepatic function test- Serum bilirubin, urine bilirubin, and urine urobilinogen.
 - c) Dye tests of excretory function.
 - d) Tests based upon abnormalities of serum proteins. Selected enzyme tests.

Unit -5

15 hrs

- 12 **Lipid profile tests:** Lipoproteins, composition, functions. Determination of serum lipids, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides.
- 13 **Immunochemical techniques** for determination of hormone levels and protein levels in serum for endocrine diseases and infectious diseases.
Radio immuno assay (RIA) and Enzyme Linked Immuno Sorbent Assay (ELISA)
- 14 **Electrolytes:** Body water, compartments, water balance, and electrolyte distribution. Determination of sodium, calcium potassium, chlorides, bicarbonates in the body fluids.

SEMESTER / YEAR : I YEAR
COURSE CODE : 15PD171
TITLE OF THE COURSE : HUMAN ANATOMY AND PHYSIOLOGY-I (Practical)
L:T:P : 3:1:3

Course objectives:

1. To understand the fundamental knowledge on structure and functions of various systems in the human body.
2. To learn the different common laboratory techniques.

Course outcomes:

1. Students will be able to know the gross morphology and structure of different system models in the human body.
2. Students would be able to identify the different types of bones in human body.
3. Students identify various tissues and their histology.
4. To learn about the various experimental techniques related to physiology.
5. Students will learn the various techniques like blood group determination, blood pressure measurement, blood cells counting

List of Experiments:

1. Study of tissues of human body (a) Epithelial tissue (b) Muscular tissue
2. Study of tissues of human body (a) Connective tissue (b) Nervous tissue
3. Study of appliances used in hematological experiments.
4. Determination of W.B.C. count of blood.
5. Determination of R.B.C. count of blood.
6. Determination of differential count of blood.
7. Determination of
 - (a) Erythrocyte Sedimentation Rate.
 - (b) Hemoglobin content of Blood.
 - (c) Bleeding time & Clotting time.
8. Determination of (a) Blood Pressure (b) Blood group
9. Study of various systems with the help of charts, models & specimens
 - (a) Skeleton system part I-axial skeleton.
 - (b) Skeleton system part II- appendicular skeleton.
 - (c) Cardiovascular system.
 - (d) Respiratory system.
 - (e) Digestive system.
 - (f) Urinary system.
 - (g) Nervous system.
 - (h) Special senses.
 - (i) Reproductive system.
10. Study of different family planning appliances.
11. To perform pregnancy diagnosis test.
12. Study of appliances used in experimental physiology.
13. To record simple muscle curve using gastrocnemius sciatic nerve preparation.

14. To record simple summation curve using gastrocnemius sciatic nerve preparation.
15. To record simple effect of temperature using gastrocnemius sciatic nerve preparation.
16. To record simple effect of load & after load using gastrocnemius sciatic nerve preparation.
17. To record simple fatigue curve using gastrocnemius sciatic nerve preparation.

Text Books:

1. R.K. Goyal and N.M. Patel, Practical Anatomy Physiology and Biochemistry, B.S. Shah Prakashan, 11th Ed 2008.

Reference Books:

1. Inderbir Singh, Text Book of Human Histology with Colour Atlas, Jaypee Brothers Medical Publishers, 6th Ed, 2011.
2. Thakaore Bhai, P. Gandhi and Harit R. Derasari, Elements of Human Anatomy Physiology and Health Education, B.S. Shah Publishers, 12th Ed, 2004.
3. Douglas E. Kelly, Richard L. Wood and Allen C. Enders, Bailey's Text Book of Microscopic Anatomy, Williams & Wilkins Publishers, 18th Ed, 1984.

Course code : 15PD172
Course title : PHARMACEUTICS PRACTICAL
Sem / Year : I Year

Course objective:

- Understand the basic aspects of preparing different pharmaceutical dosage forms
- Criteria for packaging and labelling.

Course outcome: Students will be able to have relevant skills in

- Formulating the various dosage forms.
- Calculate the working formula from the official master formula.
- Designing the label with appropriate product information and dispensing in appropriate container.

List of Laboratory/Practical Experiments activities to be conducted (if any) :

1. Syrups

- a. Simple Syrup I.P
- b. Syrup of Ephedrine HCl NF
- c. Syrup Vasaka IP
- d. Syrup of ferrous Phosphate IP
- e. Orange Syrup

2. Elixir

- a. Piperizine citrate elixir BP
- b. Cascara elixir BPC
- c. Paracetamol elixir BPC

3. Linctus

- a. Simple Linctus BPC
- b. Paediatric simple Linctus BPC

4. Solutions

- a. Solution of cresol with soap IP
- b. Strong solution of ferric chloride BPC
- c. Aqueous Iodine Solution IP
- d. Strong solution of Iodine IP
- e. Strong solution of ammonium acetate IP

5. Liniments

- a. Liniment of turpentine IP*
- b. Liniment of camphor IP

6. Suspensions*

- a. Calamine lotion
- b. Magnesium Hydroxide mixture BP

7. Emulsions*

- a. Cod liver oil emulsion
- b. Liquid paraffin emulsion

8. Powders*

- a. Eutectic powder

- b. Explosive powder
- c. Dusting powder
- d. Insufflations

9. Suppositories*

- a. Boric acid suppositories
- b. Chloral suppositories

10. Incompatibilities

- a. Mixtures with Physical
- b. Chemical & Therapeutic incompatibilities

SEMESTER / YEAR : I YEAR

COURSE CODE : 15PD173

TITLE OF THE COURSE : MEDICINAL BIOCHEMISTRY (Practical)

L:T:P :3:1:3

Course objectives

- This subject helps them to analyse the normal metabolites / constituents present in the body.

Course Outcome

- To learn the quantification of normal constituents in body like carbohydrate, proteins and lipid content.
- To analyse the normal constituent and abnormal constituents in the urine.

Title of the Experiment:

1. Qualitative analysis of normal constituents of urine.
- * 2 Qualitative analysis of abnormal constituents of urine.
- * 3 Quantitative estimation of urine sugar by Benedict's reagent method.
- ** 4 Quantitative estimation of urine chlorides by Volhard's method.
- ** 5 Quantitative estimation of urine creatinine by Jaffe's method.
- ** 6 Quantitative estimation of urine calcium by precipitation method.
- ** 7 Quantitative estimation of serum cholesterol by Libermann Burchard's method.
- ** 8 Preparation of Folin Wu filtrate from blood.
- * 9 Quantitative estimation of blood creatinine.
- ** 10 Quantitative estimation of blood sugar Folin-Wu tube method.
- ** 11 Estimation of SGOT in serum.
- ** 12 Estimation of SGPT in serum.
- ** 13 Estimation of Urea in Serum.
- ** 14 Estimation of Proteins in Serum.
- ** 15 Determination of serum bilirubin
- ** 16 Determination of Glucose by means of Glucoseoxidase.
- ** 17 Enzymatic hydrolysis of Glycogen/Starch by Amylases.
- ** 18 Study of factors affecting Enzyme activity. (pH & Temp.)
- ** 19 Preparation of standard buffer solutions and its pH measurements (any two)

* 20 Experiment on lipid profile tests

** 21 Determination of sodium, calcium and potassium in serum.

** ** indicate major experiments & * indicate minor experiments

Reference Books:

- a. Principles of biochemistry – Lehninger
- b. Text book of biochemistry -- Ramarao
- c. Practical Biochemistry-David T.Plummer.
- d. Practical Biochemistry-Pattabhiraman.

SEMESTER / YEAR : I YEAR

COURSE CODE : 15PD174

TITLE OF THE COURSE : PHARMACEUTICAL ORGANIC CHEMISTRY (Practical)

L:T:P :3:1:3

Course Objectives:

- 1. The student will learn the Techniques which can be used for the Synthesis of compounds.**
- 2. The student will learn the Qualitative analysis technique for the organic compounds.**

Course Outcome:

1. Illustrates Different methodologies involved for the synthesis of Pharmaceutically important Compounds.
2. Describes Various Aspects and applications of Important reaction mechanisms involved during synthesis.
3. Demonstrates various tools like melting point and boiling point.

Introduction to the various laboratory techniques through demonstration involving synthesis of the following compounds (at least 8 compounds to be synthesised):

1. Acetanilide / aspirin (Acetylation)
2. Benzanilide / Phenyl benzoate (Benzoylation)
3. P-bromo acetanilide / 2,4,6 – tribromo aniline (Bromination)
4. Dibenzylidene acetone (Condensation)
5. 1-Phenylazo-2-naphthol (Diazotisation and coupling)
6. Benzoic acid / salicylic acid (Hydrolysis of ester)
7. M-dinitro benzene (Nitration)
8. 9, 10 – Anthraquinone (Oxidation of anthracene) / preparation of benzoic acid from toluene or benzaldehyde
9. M-phenylene diamine (Reduction of M-dinitrobenzene) / Aniline from

nitrobenzene

10. Benzophenone oxime

11. Nitration of salicylic acid

12. Preparation of picric acid

13. Preparation of O-chlorobenzoic acid from O-chlorotoluene

14. Preparation of cyclohexanone from cyclohexanol

II. Identification of organic compounds belonging to the following classes by

Systematic qualitative organic analysis including preparation of derivatives Phenols, amides, carbohydrates, amines, carboxylic acids, aldehyde and ketones, Alcohols, esters, hydrocarbons, anilides, nitrocompounds.

III. Introduction to the use of stereo models:

Methane, Ethane, Ethylene, Acetylene, Cis alkene, Trans alkene, inversion of configuration.

Text Books:

1. T.R.Morrison and R.Boyd, Text of Organic Chemistry, 6th edition Prentice Hall of India Pvt. Ltd., New Delhi.

2. A text book of organic chemistry by Arun Bhal & B.S. Bhal, S.Chand & Company Pvt Ltd. revised edition

Reference Books:

1. I. L. Finar Organic Chemistry, the Fundamentals of Chemistry. Lingman Publishers Vol-1, 6th edition.

2. Bentley and Driver's textbook of Pharmaceutical Chemistry. L.M. Atherden, 8th edition.

3. T.W.Graham Solomons, Fundamentals of Organic Chemistry, John Wiley & Sons Inc., USA, 5th edition.

1. Acetanilide / aspirin (Acetylation)
 2. Benzanilide / Phenyl benzoate (Benzoylation)
 3. P-bromo acetanilide / 2,4,6 – tribromo aniline (Bromination)
 4. Dibenzylidene acetone (Condensation)
 5. 1-Phenylazo-2-naphthol (Diazotisation and coupling)
 6. Benzoic acid / salicylic acid (Hydrolysis of ester)
 7. M-dinitro benzene (Nitration)
 8. 9, 10 – Anthraquinone (Oxidation of anthracene) / preparation of benzoic acid from toluene or benzaldehyde
 9. M-phenylene diamine (Reduction of M-dinitrobenzene) / Aniline from nitrobenzene
 10. Benzophenone oxime
 11. Nitration of salicylic acid
 12. Preparation of picric acid
 13. Preparation of O-chlorobenzoic acid from O-chlorotoluene
 14. Preparation of cyclohexanone from cyclohexanol
- II. Identification of organic compounds belonging to the following classes by

Systematic qualitative organic analysis including preparation of derivatives Phenols, amides, carbohydrates, amines, carboxylic acids, aldehyde and ketones, Alcohols, esters, hydrocarbons, anilides, nitrocompounds.

III. Introduction to the use of stereo models:

Methane, Ethane, Ethylene, Acetylene, Cis alkene, Trans alkene, inversion of configuration.

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2. A text book of organic chemistry by Arun Bhal & B.S. Bhal, S.Chand & Company Pvt Ltd. revised edition

Reference Books:

1. I. L. Finar Organic Chemistry, the Fundamentals of Chemistry. Lingman Publishers Vol-1, 6th edition.
2. Bentley and Driver's textbook of Pharmaceutical Chemistry. L.M. Atherden, 8th edition.
3. T.W.Graham Solomons, Fundamentals of Organic Chemistry, John Wiley & Sons Inc., USA, 5th edition.

SEMESTER / YEAR: II YEAR

COURSE CODE: 15PD201

TITLE OF THE COURSE: PHARMACOLOGY-I (Theory)

L: T:P: 3:1:3

Course objectives

- Students will provide an opportunity to learn about the drug with regard to classification, pharmacodynamic and pharmacokinetic aspects, adverse effects, uses, dose, route of administration, precautions, contraindications, and interaction with other drugs.
- Drugs acting on the autonomic nervous system, cardiovascular system, central nervous system, blood and blood-forming agents and the renal system will be taught.
- the basic practical knowledge relevant to therapeutics will be imparted

Course Outcomes

- understand the pharmacological aspects of drugs falling under the above-mentioned chapters;
- appreciate the importance of pharmacology subject as a basis of therapeutics;
- correlate and apply the knowledge therapeutically.

Unit – 1

38 hrs

1. **General Pharmacology** a) Introduction, definitions and scope of pharmacology b) Routes of administration of drugs c) Pharmacokinetics (absorption, distribution, metabolism and excretion) d) Pharmacodynamics e) Factors modifying drug effects f) Drug toxicity - Acute, sub- acute and chronic toxicity. g) Pre-clinical evaluations h) Drug interactions

Unit -2

6 hrs

Pharmacology of drugs acting on ANS a) Adrenergic and antiadrenergic drugs b) Cholinergic and anticholinergic drugs c) Neuromuscular blockers d) Mydriatics and miotics e) Drugs used in myasthenia gravis f) Drugs used in Parkinsonism

Unit – 3

8 hrs

3. **Pharmacology of drugs acting on cardiovascular system** a) Antihypertensives b) Anti-anginal drugs c) Anti-arrhythmic drugs d) Drugs used for therapy of Congestive Heart Failure e) Drugs used for hyperlipidaemias

Unit -4

8 hrs

4. Pharmacology of drugs acting on Central Nervous System a) General anesthetics b) Sedatives and hypnotics c) Anticonvulsants d) Analgesic and anti-inflammatory agents e) Psychotropic drugs f) Alcohol and methyl alcohol g) CNS stimulants and cognition enhancers h) Pharmacology of local anaesthetics 5. Pharmacology of Drugs acting on Respiratory tract a) Bronchodilators b) Mucolytics c) Expectorants d) Antitussives e) Nasal Decongestants

Unit -5

15 hrs

6. Pharmacology of Hormones and Hormone antagonists a) Thyroid and Antithyroid drugs b) Insulin, Insulin analogues and oral hypoglycemic agents c) Sex hormones and oral contraceptives d) Oxytocin and other stimulants and relaxants 7. Pharmacology of autocooids and their antagonists a) Histamines and Antihistaminics b) 5-Hydroxytryptamine and its antagonists c) Lipid derived autocooids and platelet activating factor

SEMESTER / YEAR : II YEAR
COURSE CODE : 15PD203
TITLE OF THE COURSE : PHARMACOGNOSY & PHYTOPHARMACEUTICALS
(Theory)
L:T:P :3:1:3

Course objectives □ Students will be aware of medicinal uses of various naturally occurring drugs its history, sources, distribution, method of cultivation, active constituents, medicinal uses, identification tests, preservation methods, substitutes and adulterants.

Course Outcomes □ understand the basic principles of cultivation, collection and storage of crude drugs;

- know the source, active constituents and uses of crude drugs; and
- appreciate the applications of primary and secondary metabolites of the plant.

Unit -1 **10 hrs**

- 1 Introduction.
- 2 Definition, history and scope of Pharmacognosy.
- 3 Classification of crude drugs.

Unit -2 **15 hrs**

- 4 Cultivation, collection, processing and storage of crude drugs.
- 5 Detailed method of cultivation of crude drugs.
- 6 Study of cell wall constituents and cell inclusions.

Unit -3 **20 hrs**

- 7 Microscopical and powder Microscopical study of crude drugs.
- 8 Study of natural pesticides.

Unit -4 **20 hrs**

- 9 Detailed study of various cell constituents.
- 10 Carbohydrates and related products.
- 11 Detailed study carbohydrates containing drugs.(11 drugs)

- 12 Definition sources, method extraction, chemistry and method of analysis of lipids.
- 13 Detailed study of oils.

Unit -5

10 hrs

- 14 Definition, classification, chemistry and method of analysis of protein.
- 15 Study of plants fibers used in surgical dressings and related products.
- 16 Different methods of adulteration of crude drugs.

Text Books:

- a. Pharmacognosy by G.E. Trease & W.C.Evans.
- b. Pharmacognosy by C.K.Kokate,Gokhale & A.C.Purohit.

Reference Books:

- a. Pharmacognosy by Brady & Tyler.E.
- b. Pharmacognosy by T.E.Wallis.
- c. Pharmacognosy by C.S. Shah & Qadery.
- d. Pharmacognosy by M.A. Iyengar.

SEMESTER / YEAR : II YEAR

COURSE CODE : 15PD204

TITLE OF THE COURSE : COMMUNITY PHARMACY (Theory)

L:T:P :2:1:0

Course objectives

• Students will be learning various skills such as dispensing of drugs, responding to minor ailments by providing suitable safe medication, patient counselling, health screening services for improved patient care in the community set up.

Course Outcomes

- know pharmaceutical care services;
- know the business and professional practice management skills in community pharmacies;
- do patient counselling & provide health screening services to public in community pharmacy;
- respond to minor ailments and provide appropriate medication;
- show empathy and sympathy to patients; and
- appreciate the concept of Rational drug therapy

Unit -1

7 hrs

1. Definition, scope, of community pharmacy, Roles and responsibilities of Community pharmacist
2. **Community Pharmacy Management** a) Selection of site, Space layout, and design b) Staff, Materials- coding, stocking c) Legal requirements d) Maintenance of various registers e) Use of Computers: Business and health care soft wares.

Unit – 2

5 hrs

3. Prescriptions – **parts of prescription, legality & identification of medication related problems** like drug interactions. 4. Inventory control in community pharmacy Definition, various methods of Inventory Control ABC, VED, EOQ, Lead time, safety stock

Unit -3

10 hrs

5. **Pharmaceutical care** Definition and Principles of Pharmaceutical care.
6. **Patient counselling** Definition, outcomes, various stages, barriers, Strategies to overcome barriers Patient information leaflets- content, design, & layouts, advisory labels Patient

medication adherence Definition, Factors affecting medication adherence, role of pharmacist in improving the adherence.

7. **Health screening services** Definition, importance, methods for screening Blood pressure/ blood sugar/ lung function and Cholesterol testing

Unit -4

15 hrs

8. **OTC Medication**- Definition, OTC medication list & Counselling

9. **Health Education** WHO Definition of health, and health promotion, care for children, pregnant & breast feeding women, and geriatric patients. **Commonly occurring Communicable Diseases**, causative agents, Clinical presentations and prevention of communicable diseases – Tuberculosis, Hepatitis, Typhoid, Amoebiasis, Malaria, Leprosy, Syphilis, Gonorrhoea and AIDS Balance diet, and treatment & prevention of deficiency disorders Family planning – role of pharmacist.

Unit –5

13 hrs

10. **Responding to symptoms of minor ailments** Relevant pathophysiology, common drug therapy to Pain, GI disturbances (Nausea, Vomiting, Dyspepsia, diarrhea, constipation), Pyrexia, Ophthalmic symptoms, worms infestations.

11. **Essential Drugs concept and Rational Drug Therapy Role of community pharmacist**

12. **Code of ethics for community pharmacists**

Text Books:

- a. Health Education and Community Pharmacy by N.S.Parmar.
- b. WHO consultative group report.
- c. Drug store & Business management by Mohammed Ali & Jyoti.

Reference Books:

- a. Handbook of pharmacy – health care. Edt. Robin J Harman. The Pharmaceutical press.
- b. Comprehensive Pharmacy Review – Edt. Leon Shargel. Lippincott Williams & Wilkins.

PATHOPHYSIOLOGY

Objectives: On completion of the course, the student shall be able to

1. Apply principles of normal anatomy and physiology of human body systems to the pathophysiological processes of common health problems.
2. Identify concepts, principles, and responses related to pathophysiological processes that result in disease.
3. Discuss clinical manifestations of selected disease processes and health problems

Course Outcomes (COs): At completion of this course, it is expected that the students will be able to

- CO 1. Describe the aetiology and pathogenesis of the selected disease states
- CO 2. Demonstrate a basic understanding of the concepts and elements of disease
- CO 3. Name the signs and symptoms of the diseases
- CO 4. Mention the complications of the diseases
- CO5. Distinguish environmental factors, physical, psychosocial, and cognitive characteristics of various diseases and conditions.
- CO 6. Identify implications of therapeutic interventions for diseases and conditions.
- CO 7. Discuss common laboratory and diagnostic tests

Unit – 1

Cell Injury, Inflammation & Shock

16 hrs

- A
- i) Definition of pathology, health and disease. Terminologies used in pathology.
 - ii) Basic principles of cell injury and adaptation: Causes, pathogenesis and morphology of cell injury, Cellular adaptation's - physiologic and pathologic adaptations, Cellular ageing and death, Antioxidant enzymes-superoxide dismutase, catalase and glutathione peroxidase.

B Inflammation:

- i) Definition, causes, signs, types of inflammation and chemical-mediators.
- ii) Pathogenesis of acute inflammation (vascular events, Cellular events, transdate, exudate, edema, phagocytosis). iii) Pathogenesis of chronic-inflammation and difference between acute and chronic inflammation. iv) Tissue renewal and repair: regeneration healing and fibrosis v) Wound healing: process of wound healing, types of cells, factors influencing healing of wounds. Mechanism of repair

C Shock: Types, mechanism, stages and Management

Unit -2

A. Diseases of Immunity & Hypersensitivity

12 hrs

Components of the immune system:

- i) Cells involved in immune response- T and B cells, Macrophages, dendritic cells and Natural killer cells.
- ii) MHC proteins or transplantation antigens.
- iii) Immune Tolerance.
 - B. Auto-immunity:
 - i.) Mechanism of Autoimmunity.
 - ii.) Classification of autoimmune diseases in man.
 - iii.) Transplantation rejection (types and mechanisms).
 - C. Acquired Immune Deficiency Syndrome (AIDS)

D. Hypersensitivity: i) Hypersensitivity type I, II, III, IV ii) Biological significance of hypersensitivity. iii) Allergy due to food, chemicals and drugs.

Unit – 3

A. Environmental Factors & Cancer:

15 hrs

i.) General aspects of neoplasia, Definition, terminology, Differences between benign and malignant tumors

ii.) Etiology and pathogenesis of cancer

iii.) General biology and classification of malignant tumors

iv.) Invasions and metastasis of cancer

B. Biological effects of radiation: Introduction on radiation, strength of radiation, mechanism of action of ionizing and non-ionizing radiations and their toxic effects.

C. Environment and Nutritional diseases:

i) Obesity

ii) Malnutrition

iii) Pathogenesis of deficiency diseases with special reference to vitamins and minerals

iv) Air pollution and smoking — SO₂, NO and CO

Unit- 4

A. Pathophysiology of non-infectious diseases (aetiology, pathogenesis, signs and symptoms)

i) Peptic ulcer and inflammatory bowel disease

ii) Gastritis

iii) Hypertension

iv) Angina

v) Myocardial Infarction

vi) Congestive cardiac failure

vii) Atherosclerosis

viii) Stroke (Ischemic and Haemorrhage)

ix) Diabetes Mellitus

x) Hypo and hyperthyroidism 16 hrs

xi) Cirrhosis and Alcoholic liver diseases

xii) Asthma and chronic obstructive airway diseases

xiii) Parkinsonism

xiv) Schizophrenia, Depression and Mania

xv) Alzheimer's disease

xvi) Acute and chronic renal failure

Unit - 5

16 hrs

Genetics & Infectious disorders Pathophysiology (causative organisms, mode of transmission, pathogenesis, signs and symptoms)

A. Hepatitis - infective hepatitis, Sexually transmitted diseases (Syphilis, Gonorrhoea), Pneumonia, Typhoid, Urinary tract infections, Tuberculosis, Leprosy, Malaria, Dysentery (Bacterial and amoebic), Dengue and Chikungunya.

B. Genetics and chromosomal disorders: Mendelian disorders, Cytogenetic disorders (Karyotypic abnormalities)

SEMESTER / YEAR : II YEAR

COURSE CODE : 15PD206

TITLE OF THE COURSE : PHARMACOTHERAPEUTICS I (Theory)

L:T:P :3:1:3

Course objectives

- to impart knowledge and skills necessary for contribution to the quality use of medicines.
- cover briefly the pathophysiology and mostly therapeutics of various diseases.
- Students will be able to understand the pathophysiology of common diseases and their management.

Course Outcomes

1. Comprehend and retrieve the etiopathogenesis and pharmacotherapy of cardiovascular illnesses.
2. Highlight and infer the diagnostic parameters involved in the management of respiratory diseases and various therapeutic options for the management of endocrine diseases.
3. Illustrate and utilize patient-centered treatment by adopting evidence-based medicine to diverse patient population
4. Outline the pathophysiological approach and management involved in ophthalmologic illnesses
5. Summarize and demonstrate the role of pharmacist in essential and rational drug use

Syllabus

Etiopathogenesis and pharmacotherapy of diseases associated with following systems/ diseases

Unit-1 **30 hrs**

Cardiovascular system: Hypertension, Congestive cardiac failure, Angina Pectoris, Myocardial infarction, Hyperlipidaemias, Electrophysiology of heart and Arrhythmias

Unit - 2 **23 hrs**

Respiratory system : Introduction to Pulmonary function test, Asthma, Chronic obstructive airways disease, Drug induced pulmonary diseases **Endocrine system**: Diabetes, Thyroid diseases, Oral contraceptives, Hormone replacement therapy, Osteoporosis

Unit - 3 **17 hrs**

General **prescribing guidelines** for a. **Paediatric** patients b. **Geriatric** patients c. **Pregnancy and breast feeding**

Unit - 4 **6 hrs**

Ophthalmology: Glaucoma, Conjunctivitis- viral & bacterial

Unit -5**9 hrs**

Introduction to rational drug use Definition, Role of pharmacist Essential drug concept Rational drug formulations

Text Books:

a. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication. b. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appleton & Lange.

Reference Books: a. Pathologic basis of disease - Robins SL, W.B.Saunders publication.

b. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice - Green and Harris, Chapman and Hall publication.

c. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication.

d. Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA

e. Avery's Drug Treatment, 4th Edn, 1997, Adis International Limited.

f. Relevant review articles from recent medical and pharmaceutical literature.

SEMESTER / YEAR : II YEAR
COURSE CODE : 15PD271
TITLE OF THE COURSE : PHARMACOGNOSY & PHYTOPHARMACEUTICALS
(Practical)
L:T:P : 3:1:3

Objectives:

1. The key goals of this course is to discuss the fundamentals of pharmacognosy & phytopharmaceuticals,
2. Recognize the morphological, microscopical and powdered characteristic features of drugs from natural origin.
3. Assist the students in comprehending the required chemical tests for the drug identification.
4. Have a thorough understanding of the various evaluation techniques for determining the purity of the medications and identifying adulterants.

Course Outcomes:

The course will enable the students to:

- CO 1:** Recognize the Pharmacognosy laboratory and experiments.
CO 2: Perform the transverse section of plant parts to comprehend the configuration of tissue and cell.
CO 3: Examine the tissue system in order to gauge the drug's purity.
CO 4: Conduct chemical analyses to check the quality of pharmaceuticals and understand the types of chemical components present in it.
CO 5: Be familiar with the various drug evaluation techniques.

List of experiments:

Introduction of Pharmacognosy laboratory and experiments.

- 1 Study of cell wall constituents and cell inclusions.
- 2 Macro, powder and microscopic study of Datura.
- 3 Macro, powder and microscopic study of Senna.
- 4 Macro, powder and microscopic study of Cassia.cinnamon.
- 5 Macro, powder and microscopic study of Cinchona.
- 6 Macro, powder and microscopic study of Ephedra.
- 7 Macro, powder and microscopic study of Quassia.
- 8 Macro, powder and microscopic study of Clove
- 9 Macro, powder and microscopic study of Fennel.
- 10 Macro, powder and microscopic study of Coriander.
- 11 Macro, powder and microscopic study of Isapgol.
- 12 Macro, powder and microscopic study of Nux vomica.
- 13 Macro, powder and microscopic study of Rauwolfia.

- 14 Macro, powder and microscopic study of Liquorice.
- 15 Macro, powder and microscopic study of Ginger.
- 16 Macro, powder and microscopic study of Podophyllum.
- 17 Determination of Iodine value.
- 18 Determination of Saponification value and unsaponifiable matter.
- 19 Determination of ester value.
- 20 Determination of Acid value.
- 21 Chemical tests for Acacia.
- 22 Chemical tests for Tragacanth.
- 23 Chemical tests for Agar.
- 24 Chemical tests for Starch.
- 25 Chemical tests for Lipids.(castor oil,sesame oil, shark liver oil,bees wax)
- 26 Chemical tests for Gelatin.

Text Books:

- a. Pharmacognosy by G.E. Trease&W.C.Evans.
- b. Pharmacognosy by C.K.Kokate,Gokhale&A.C.Purohit.

Reference Books:

- a. Pharmacognosy by Brady &Tyler.E.
- b. Pharmacognosy by T.E.Wallis.
- c. Pharmacognosy by C.S. Shah &Qadery.
- d. Pharmacognosy by M.A. Iyengar.

SEMESTER / YEAR : II YEAR
COURSE CODE : 15PD272
TITLE OF THE COURSE : PHARMACEUTICAL MICROBIOLOGY (Practical)
L:T:P :3:1:3

Title of the Experiment:

- 1 Study of apparatus used in experimental microbiology*.
- 2 Sterilisation of glass ware's. Preparation of media and sterilisation.*
- 3 Staining techniques – Simple staining Gram's staining ; Negative staining** 4 Study of motility characters*.
- 4 Enumeration of micro-organisms (Total and Viable)*
- 5 Study of the methods of isolation of pure culture.*
- 6 Bio chemical testing for the identification of micro*-organisms.
- 7 Cultural sensitivity testing for some micro-organisms.*
- 8 Sterility testing for powders and liquids.*
- 9 Determination of minimum inhibitory concentration.*
- 10 Microbiological assay of antibiotics by cup plate method.*
- 11 Microbiological assay of vitamins by Turbidometric method**
- 12 Determination of RWC.**
- 13 Diagnostic tests for some common diseases, Widal, malarial parasite.** * Indicate minor experiment & ** indicate major experiment

SEMESTER / YEAR : II YEAR

COURSE CODE : 15PD273

TITLE OF THE COURSE : PHARMACOTHERAPEUTICS I (Practical)

L:T:P :3:1:3

Course Objective- Students will be aware of the etiopathogenesis, clinical manifestations, diagnosis, and management of various diseases including the Cardiovascular System, Endocrine System, Respiratory System, and Ophthalmology. Students also acquire knowledge on the rational use of medicines along with the role of a pharmacist.

Course Outcome

- Provide practical case presentations and discussions on various diseases.
- Involvement in ward-round participation
- Outline the clinical progress and selection of drug therapy.
- Participation in patient counselling and providing knowledge on accurate drug therapy.

Practicals: Hospital postings in various departments designed to complement the lectures by providing practical clinical discussion; attending ward rounds; follow up the progress and changes made in drug therapy in allotted patients; case presentation upon discharge. Students are required to maintain a record of cases presented and the same should be submitted at the end of the course for evaluation. A minimum of 20 cases should be presented and recorded covering most common diseases.

Text Books:

a. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication. b. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appleton & Lange.

Reference Books: a. Pathologic basis of disease - Robins SL, W.B.Saunders publication.

b. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice - Green and Harris, Chapman and Hall publication.

c. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication.

d. Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA

e. Avery's Drug Treatment, 4th Edn, 1997, Adis International Limited.

f. Relevant review articles from recent medical and pharmaceutical literature.

SEMESTER / YEAR : III YEAR
COURSE CODE : 15PD302
TITLE OF THE COURSE : PHARMACEUTICAL ANALYSIS (Theory)
L:T:P :3:1:3

Course objectives This subject is designed to impart fundamental knowledge on the testing of drugs by various instrumental methods of analysis. This course is to give thorough understanding of the spectroscopy and chromatographic techniques.

Course Outcomes To understand the component and working of various analytical instruments. Shall be able to analyze the drugs by using above instruments.

Unit-1

1.Spectroscopy:

Theoretical aspects, instrumentation, elements of interpretation of data/spectra and application of analytical techniques be discussed on:

a. Absorption Spectroscopy:

Theory of electronic, atomic and molecular spectra. Fundamental laws of photometry, Beer Lambert's Law, application and its deviation, limitation of Beer law, application of the law to single and multiple component analysis, measurement of equilibrium constant and rate constant by spectroscopy. Spectra of isolated chromophores, auxochromes, bathochromic shift, hypsochromic shift, hyperchromic and hypochromic effect, effect of solvent on absorption spectra, molecular structure and infrared spectra.

Instrumentation – Photometer, U.V.-Visible spectrophotometer –sources of U.V.-Visible radiations, collimating systems, monochromators, samples cells and following detectors Photocell, Barrier layer cell, Phototube, Diode array, applications of U.V.-Visible spectroscopy in pharmacy and spectrophotometric titrations.

b. Infrared Spectroscopy:

Vibrational transitions, frequency – structure correlations, Infrared absorption bands, Instrumentation–IR spectrometer– sources of IR, Collimating systems, monochromators, sample cells, sample handling in IR spectroscopy and detectors–Thermocouple, Golay Cells, Thermistor, Bolometer, Pyroelectric detector, Applications of IR in pharmacy.

Unit - 2

2.Chromatography:

Introduction, history, classification, **separation techniques**, choice of methods. The following techniques be discussed with relevant examples of pharmaceutical products involving principles and techniques of separation of drugs from excipients.

- a. **Column Chromatography**: Adsorption column chromatography, Operational technique, frontal analysis and elution analysis. Factors affecting column efficiency, **applications** and partition chromatography.
- b. **TLC**: Introduction, principle, techniques, Rf value and **applications**.
- c. **PC**: Introduction, principle, types of paper chromatography, preparation techniques, development techniques, **applications**.
- d. **Gas Chromatography**: Introduction, theory, **instrumentation-carrier gases, types of columns, stationary phases in GLC & GSC. Detectors-Flame ionization detectors**, electron capture detector, thermal conductivity detector. Typical gas chromatogram, derivatisation techniques, programmed temperature gas chromatography, applications.
- e. **Electrophoresis**: Principles of separation, equipment for paper and gel electrophoresis, and application.
- f. **HPLC**: Introduction, theory, instrumentation, and **applications**.
- g. **HPTLC**: Introduction, theory, instrumentation, and **applications**.

Unit - 3

- 3.a. **Fluorimetric Analysis**: Theory, luminescence, factors affecting fluorescence, quenching. Instrumentation, **Applications**, fluorescent indicators, **study of pharmaceutically important compounds estimated by fluorimetry**.
- b. **Flame Photometry**: Theory, nebulisation, flame and flame temperature, interferences, flame spectrometric techniques and **instrumentation and pharmaceutical applications**.
- c. **Atomic Absorption Spectrometry**: Introduction, Theory, types of electrodes, instrumentation and **applications**.
- d. **Atomic Emission Spectroscopy**: Spectroscopic sources, atomic emission spectrometers, photographic and photoelectric detection.
- e. **NMR & ESR (introduction only)**: Introduction, theoretical aspects and applications.
- f. **Mass Spectroscopy: (Introduction only)** – Fragmentation, types of ions produced mass spectrum and applications.
- g. **Polarimetry: (Introduction only)** – Introduction to optical rotatory dispersion, circular dichroism, polarimeter.
- h. **X-RAY Diffraction: (Introduction only)** – Theory, reciprocal lattice concept, diffraction patterns and applications

Unit - 4

4. Electrometric Methods:

Theoretical aspects, instrumentation, **interpretation of data/spectra** and analytical applications be discussed on the following topics.

- a. **Potentiometry**: Electrical potential, electrochemical cell, reference electrodes, indicator electrodes, measurement of potential and pH, construction and working of electrodes, Potentiometric titrations, methods of detecting end point, Karl Fischer titration.
- b. **Conductometry**: Introduction, conductivity cell, conductometric titrations and applications.
- c. **Polarography**: Instrumentation, DME, residual current, diffusion current and limiting current, polarographic wave, Ilkovic's equation, Effect of oxygen on polarographic wave, Polarographic maxima and suppressors and applications.
- d. **Amperometric Titrations**: Introduction, types of electrodes used, reference and indicator electrode, instrumentation, titration procedure, advantages and disadvantages of Amperometry over potentiometry. Pharma applications.

Unit - 5

5. i Quality Assurance:

Introduction, sources of quality variation, control of quality variation. a.

Concept of statistical quality control.

- b. **Validation methods- quality of equipment, validation of equipment and validation of analytical instruments and calibration.**
- c. GLP, ISO 9000.
- d. **Total quality management, quality review and documentation.**
- e. **ICH- international conference for harmonization-guidelines.**
- f. Regulatory control. ii. **Ion-exchange chromatography**: Introduction, principles, types of ion exchange synthetic resins, physical properties, factors affecting ion exchange, methodology and applications.
- iii. **Gel filtration and affinity chromatography**: Introduction, technique, applications. iv. **Thermal Analysis**: Introduction, instrumentation, applications, and DSC and DTA.

Reference Books:

1. Undergraduate Instrumental Analysis by James. E., CBS Publishers.
2. Instrumental Analysis by Willard and Merritt, EWP, East West Press Ltd., Delhi/Madras.
3. Pharm Analysis by Skoog and West, Sounders Manipal College Publishing.
4. Textbook of Pharm. Analysis (Practical) by Beckett & Stenlake, CBS Publishers, Delhi.
5. Textbook of Drug Analysis by P.D. Sethi., CBS Publishers, Delhi.
6. Spectroscopy by Silverstein, John & Wiley & Sons. Inc., Canada & Singapore.
7. How to practise GMP-A Plan for total quality control by P.P. Sharma, Vandana Publications, Agra.
8. TLC by Stahl, Spring Verlay.
9. Spectroscopy by William Kemp, ELBS with Macmillan Press, Hampshire.
10. I.P.-1996, The Controller of Publications, New Delhi.
11. BPC- Dept. of Health, U.K. for HMSO.
12. USP - Mack Publishing Co., Easton, PA.

SEMESTER / YEAR : III YEAR

COURSE CODE : 15PD303

TITLE OF THE COURSE : PHARMACOTHERAPEUTICS II (Theory)

L:T:P :3:1:3

COURSE OBJECTIVES:

This course is designed to impart knowledge and skills necessary for contribution to rational use of medicines. This will enable the student to understand the pathophysiology of common diseases and their management.

COURSE OUTCOMES

- know the various therapeutic approach to management of these diseases
- know the importance of preparation of individualised therapeutic plans based on diagnosis; and monitoring the therapy(side effects, ADR, drug interactions)

Unit – 1 (17hrs)

Bacterial Infectious disease: Guidelines for the rational use of antibiotics and surgical Prophylaxis, Tuberculosis, Meningitis, Respiratory tract infections, Gastroenteritis, Endocarditis, Septicemia, Urinary tract infections

Unit – 2 (15hrs)

Protozoal infectious disease - Malaria, HIV & Opportunistic infections, Fungal infections, Viral infections, Gonorrhoea and Syphilis

Unit -3 (9+6hrs)

Musculoskeletal disorders: Rheumatoid arthritis, Osteoarthritis, Gout, Spondylitis, Systemic lupus erythematosus

Dermatological disorders: Psoriasis, Scabies, Eczema, Impetigo.

Unit – 4 (13hrs)

Renal system : Acute Renal Failure, Chronic Renal Failure, Renal Dialysis, Drug induced renal disorders

UNIT – 5

(15hrs)

Oncology: Basic principles of Cancer therapy, General introduction to cancer chemotherapeutic agents, Chemotherapy of breast cancer, leukemia.
Management of chemotherapy nausea and emesis

SEMESTER / YEAR: III YEAR

COURSE CODE: 15PD304

TITLE OF THE COURSE: PHARMACEUTICAL JURISPRUDENCE (Theory)

L: T:P :2:1:0

Course Objectives

- a. Practice the Professional ethics;
- b. Understand the various concepts of the pharmaceutical legislation in India
- c. Know the various parameters in the Drug and Cosmetic Act and rules
- d. Know the Drug policy, DPCO, Patent and design act;
- e. Understand the labeling requirements and packaging guidelines for drugs and cosmetics
- f. be able to understand the concepts of Dangerous Drugs Act, Pharmacy Act and Excise duties Act; and
- g. other laws as prescribed by the Pharmacy Council of India from time to time including International Laws.

Course Outcomes

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

Syllabus

Unit- 1

10 hrs

1. Pharmaceutical Legislations – A brief review. 2 hrs
2. **Principle and Significance of professional ethics**. Critical study of the code of pharmaceutical ethics drafted by PCI. 3 hrs
3. **Pharmacy Act –1948**. Objectives Legal Definitions, General Study, Constitution and Functions of State & Central Council, Registration & Procedure, ER. 5hrs

Unit 2

15hrs

4. **Drugs and Cosmetics Act, 1940 and its rules 1945**. Objectives, Legal definition, Study of Schedule's with reference to Schedule B, C&C1, D, E1, F&F1, F2, F3, FF, G, H, J, K, M, N, P, R, V, W, X, Y. Sales, Import, labeling and packaging of Drugs And Cosmetics Provisions Relating to Indigenous Systems. Constitution and Functions of DTAB, DCC, CDL. Qualification and duties –Govt. analyst and Drugs Inspector.

Unit- 3

8 hr

5. Medicinal and Toilet Preparation Act –1955. Objectives, Legal Definitions, Licensing, Bonded and Non Bonded Laboratory, Ware Housing, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. 3 hrs

6. Prevention Of Cruelty to animals Act-1960. 3 hrs

7. Patents & design Act-1970. 2 hrs

UNIT- 4

9 hrs

8. Narcotic Drugs and Psychotropic substances Act-1985 and Rules. Objectives, Legal Definitions, General Study, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and regulations, Schedules to the Act. 6 hrs

9. Brief study of prescription and Non-prescription Products. 3 hrs

UNIT- 5

8 hrs

10. Study of Salient Features of Drugs and magic remedies Act and its rules. 3 hrs

11. Study of essential Commodities Act Relevant to drugs price control Order. 3 hrs

12. Drug Price control Order & National Drug Policy (Current). 2 hrs

Text books (Theory)

Mithal , B M. Textbook of Forensic Pharmacy. Calcutta :National; 1988.

Reference books (Theory)

a. Singh, KK, editor. Beotra's the Laws of Drugs, Medicines & cosmetics. Allahabad: Law Book House; 1984.

b. Jain, NK. A Textbook of forensic pharmacy. Delhi: Vallabh prakashan ; 1995.

c. Reports of the Pharmaceutical enquiry Committee

d. I.D.M.A., Mumbai. DPCO 1995

e. Various reports of Amendments.

f. Deshapande, S.W. The drugs and magic remedies act 1954 and rules 1955. Mumbai: Susmit Publications; 1998.

g. Eastern Book Company .The narcotic and psychotropic substances act 1985, Lucknow: Eastern; 1987.

SEMESTER / YEAR : III YEAR
COURSE CODE : 15PD305
TITLE OF THE COURSE : MEDICINAL CHEMISTRY (Theory)
L:T:P : 3:1:3

- Course objectives**
- The subject deals with the understanding of use of chemical compounds as medicinal agents.
 - It includes study of history, development fundamental principles of drug therapy and use of chemotherapeutic agents.

- Course Outcomes**
- The student will be able to understand the use of chemical agents as drugs to treat various diseases and understand their action in the physiological system.

Unit -1

1. Modern concept of rational drug design: A brief introduction to Quantitative Structure Activity Relationship (QSAR), prodrug, combinatorial chemistry and computer aided drug design (CADD) and concept of antisense molecules. **6hrs**

A study of the development of the following classes of drugs including SAR, Mechanism of action, synthesis of important compounds, chemical nomenclature, brand names of important marketed products and their side effects.

2. Anti-infective agents

- a) Local anti-infective agents
- b) Preservatives
- c) Antifungal agents
- d) Urinary tract anti-infectives
- e) Antitubercular agents
- f) Antiviral agents and Anti AIDS agents
- g) Antiprotozoal agents
- h) Anthelmintics
- i) Antiscabies and Antipedicular agents **10 hrs**

Unit - 2

3. Sulphonamides and sulphones

4. Antimalarials

5. Antineoplastic agents **15hrs**

Unit - 3

6. Antibiotics **14hrs**

Unit - 4

7. Cardiovascular agents

- a) Antihypertensive agents
- b) Antianginal agents and vasodilators
- c) Antiarrhythmic agents
- d) Antihyperlipidemic agents
- e) Coagulants and Anticoagulants
- f) Endocrine

16 hrs

Unit - 5

8. Hypoglycemic agents

9. Thyroid and Antithyroid agents

10. Diuretics

11. Diagnostic agents

12. Steroidal Hormones and Adrenocorticoids

14hrs

SEMESTER / YEAR : III YEAR
COURSE CODE : 15PD306
TITLE OF THE COURSE : PHARMACEUTICAL FORMULATIONS (Theory)
L:T:P : 2:1:3

Course Objectives Subject deals with the formulation and evaluation of various pharmaceutical dosage forms.

Course Outcomes Upon completion of the subject student shall be able to (Know, do, appreciate) –
a. understand the principle involved in formulation of various pharmaceutical dosage forms;
b. prepare various pharmaceutical formulation;
c. perform evaluation of pharmaceutical dosage forms; and
d. understand and appreciate the concept of bioavailability and bioequivalence, their role in clinical situations.

Unit - 1 **12hrs**

1. Pharmaceutical dosage form- concept and classification

2. Tablets: Formulation of different types of tablets, tablet excipients, granulation techniques quality control and evaluation of tablets. Tablet coating, Type of coating, quality control tests for coated tablet.

Unit - 2 **8hrs**

1. Capsules; Production and filling of hard gelatin capsules, Raw material for shell, finishing, quality control tests for capsules. Production and filling of soft gelatine capsules, quality control tests for soft gelatin capsules.

UNIT -3 **14hrs**

1. Liquid orals: Formulation and evaluation of suspensions, emulsions and solutions.
Stability of these preparations

2. Ophthalmic preparations (Semi - Solids): Introduction and classification Factors affecting absorption and anatomy of skin Packaging storage and labeling, Ointments. Types of Ointment Base Preparation of ointment, Jellies Types of jellies Formulation of jellies Suppositories, Method of preparation, Types Packaging.

Unit - 4 **8hrs**

5. Parenterals Introduction Containers used for Parenterals (including official tests) Formulation of large and small volume Parenterals Sterilization

Unit - 5

8hrs

7. Definition and concept of **Controlled and novel Drug delivery systems** with available examples, viz. parenteral, trans dermal, buccal, rectal, nasal, implants, ocular

SEMESTER / YEAR: III YEAR

COURSE CODE: 15PD371

TITLE OF THE COURSE: PHARMACOLOGY II (Practical) L:T:P :3:1:3

Objective

- To understand the concept of receptor associated drug response.
- To understand the importance of animal handling.
- To demonstrate the different routes of administration.
- To perform the effect of drug acting on CNS using simulation methods/techniques.

Course outcomes

- Compare pharmacological aspects of drugs acting on Central nervous system.
- Evaluate the dose response curve of different drugs and to learn their action on living cells.
- To learn the basic concept of experimental pharmacology.

List of Experiments:

1. Study of laboratory animals and their handling (a. Frogs, b. Mice, c. Rats, d. Guinea pigs, e. Rabbits).
2. Study of **physiological salt solutions** used in experimental pharmacology.
3. Study of **laboratory appliances used in experimental pharmacology**.
4. Study of use of anesthetics in laboratory animals.
5. To record the dose response curve of Ach using isolated ileum/rectus abdominis muscle preparation.
6. To carry out bioassay of Ach using isolated ileum/rectus abdominis muscle preparation by interpolation method.
7. To carry out bioassay of Ach using isolated ileum/rectus abdominis muscle preparation by three point method.
8. To record the dose response curve of Histamine using isolated guinea-pig ileum preparation.
9. Study of agonistic and antagonistic effects of drugs using isolated guinea pig ileum preparation.
10. To carry out bioassay of Histamine using isolated guinea-pig ileum preparation by interpolation method.
11. To carry out bioassay of Histamine using guinea-pig ileum preparation by three point method.
12. To study the routes of administration of drugs in animals (Rats, Mice, Rabbits).
13. **Study of theory, principle, procedure involved and interpretation of given results** for the following experiments:
 - a) Analgesic property of drug using analgesiometer.
 - b) **Antiinflammatory effect of drugs** using rat-paw edema method.
 - c) Anticonvulsant activity of drugs using maximal electroshock and pentylene tetrazole methods.
 - d) **Antidepressant activity** of drugs using pole climbing apparatus and pentobarbitone induced sleeping time methods.
 - e) Locomotor activity evaluation of drugs using actophotometer and rotorod.
 - f) Cardiotonic activity of drugs using isolated frog heart and mammalian heart preparations.

SEMESTER / YEAR : III YEAR

COURSE CODE : 15PD372

TITLE OF THE COURSE : PHARMACEUTICAL ANALYSIS (Practicals)

L:T:P :3:1:3

Course Objectives:

The students will learn various instrumental techniques. Students will gain interpretation skill and expose to different analytical data practically

Course Outcomes:

- To develop basic practical skills by handling the instruments like UV-Visible, Fluorimetry, IR and Chromatographic techniques.
- Analysis of drugs and excipients using various instrumentation techniques.
- Comparing various methods of analysis and their outcomes.

List of Experiments:

1. Separation and identification of Amino Acids by Paper Chromatography.
2. Separation and identification of Sulpha drugs by TLC technique.
3. Effect of pH and solvent on the UV spectrum of given compound.
4. Comparison of the UV spectrum of a compound with that of its derivatives.
5. Determination of dissociation constant of indicators using UV-Visible spectroscopy.
6. Conductometric titration of mixture of acids with a strong base.
7. Potentiometric titration of an acid with a strong base.
8. Estimation of drugs by Fluorimetric technique.
9. Study of quenching effect in fluorimetry.
10. Colourimetric estimation of Sulpha drugs using BMR reagent.
11. Simultaneous estimation of two drugs present in given formulation.
12. Assay of Salicylic Acid by colourimetry.
13. Determination of Chlorides and Sulphates in Calcium gluconate by Nepheloturbidimetric Method.
14. Determination of Na/K by Flame Photometry.
15. Determination of pKa using pH meter.
16. Determination of specific rotation.
17. Comparison of the IR spectrum of a compound with that of its derivatives.
18. Demonstration of HPLC.
19. Demonstration of HPTLC.
20. Demonstration of GC-MS.
21. Demonstration of DSC.
22. Interpretation of NMR spectra of any one compound.

Reference Books:

1. Undergraduate Instrumental Analysis by James. E., CBS Publishers.
2. Instrumental Analysis by Willard and Merritt, EWP, East West Press Ltd., Delhi/Madras.
3. Pharm Analysis by Skoog and West, Sounders Manipl College Publishing.
4. Textbook of Pharm. Analysis (Practical) by Beckett & Stenlake, CBS Publishers, Delhi.
5. Textbook of Drug Analysis by P.D. Sethi., CBS Publishers, Delhi.
6. Spectroscopy by Silverstein, John & Wiley & Sons. Inc., Canada & Singapore.
7. How to practise GMP-A Plan for total quality control by P.P. Sharma, Vandana Publications, Agra.

8. TLC

SEMESTER / YEAR	: III YEAR
COURSE CODE	: 15PD373
TITLE OF THE COURSE	: PHARMACOTHERAPEUTICS III (Practical)
L:T:P	: 3:1:3

Course Objective:

- Students will be aware of etiopathogenesis, clinical Presentation, Diagnosis and Management of various diseases including infectious diseases, musculoskeletal disorders, renal diseases, and dermatological diseases.
- Students will also gain knowledge on the basic principles of cancer therapy.

Course Outcome:

- Provide Practical case presentation and Discussion on various diseases.
- Involvement in Ward round participation .
- Outline the clinical progress and selection of drug therapy.
- Participation in Patient Counselling and providing accurate knowledge regarding the therapy.

Practicals:

Hospital postings in various departments designed to complement the lectures by providing practical clinical discussion; attending ward rounds; follow up the progress and changes made in drug therapy in allotted patients; case presentation upon discharge. Students are required to maintain a record of cases presented and the same should be submitted at the end of the course for evaluation.

Text Books

- a. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication
- b. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appleton & Lange

Reference Books

- a. Pathologic basis of disease - Robins SL, W.B.Saunders publication

- b. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice - Green and Harris, Chapman and Hall publication
- c. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA
- d. Avery's Drug Treatment, 4th Edn, 1997, Adis International Limited.
- e. Relevant review articles from recent medical and pharmaceutical literature.

Reference

Books

- a. Pathologic basis of disease - Robins SL, W.B.Saunders publication
- b. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice - Green and Harris, Chapman and Hall publication
- c. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA
- d. Avery's Drug Treatment, 4th Edn, 1997, Adis International Limited.
- e. Relevant review articles from recent medical and pharmaceutical literature.

SEMESTER / YEAR : III YEAR

COURSE CODE : 15PD374

TITLE OF THE COURSE : MEDICINAL CHEMISTRY (Practical)

L:T:P : 3:1:3

Course objectives

- To Learn the drug profile, methods of preparation and methods involved to analyse the drugs.

Course Outcome

- To Assays of important class of drugs with various methods like redox titration, non-Aqueous titration.
- To prepare the medicinal active compounds.
- To do monograph analysis of medicinal Drugs.
- To analyse the Physico-chemical properties and QSAR properties of Medicinal agents.

Experiments :

1. Assays of important drugs from the course content.
2. Preparation of medicinally important compounds or intermediates required for synthesis of drugs.
3. Monograph analysis of important drugs.
4. Determination of partition coefficients, dissociation constants and molar refractivity of compounds for QSAR analysis.

SEMESTER / YEAR : III YEAR
COURSE CODE : 15PD375
TITLE OF THE COURSE : PHARMACEUTICAL FORMULATIONS (Practical)
L:T:P :2:1:3

List of Experiments :

1. **Manufacture of Tablets**
 - a. Ordinary compressed tablet-wet granulation
 - b. Tablets prepared by direct compression.
 - c. Soluble tablet.
 - d. Chewable tablet.

2. **Formulation and filling of hard gelatin capsules**

3. **Manufacture of parenterals**
 - a. Ascorbic acid injection
 - b. Calcium gluconate injection
 - c. Sodium chloride infusion.
 - d. Dextrose and Sodium chloride injection/ infusion.

4. **Evaluation of Pharmaceutical formulations (QC tests)**
 - a. Tablets
 - b. Capsules
 - c. Injections

5. **Formulation of two liquid oral preparations and evaluation by assay**
 - a. Solution: Paracetamol Syrup
 - b. Antacid suspensions- Aluminum hydroxide gel

6. **Formulation of semisolids and evaluation by assay**
 - a. Salicylic acid and benzoic acid ointment
 - b. Gel formulation Diclofenac gel

7. **Cosmetic preparations**
 - a. Lipsticks
 - b. Cold cream and vanishing cream
 - c. Clear liquid shampoo
 - d. Tooth paste and tooth powders.

8. **Tablet coating (demonstration)**

Text books (Theory)

- a. Pharmaceutical dosage forms, Vol, I,II and III by lachman
- b. Rowlings Text book of Pharmaceutics

SEMESTER / YEAR : III YEAR

COURSE CODE : 15PD391

TITLE OF THE COURSE: Intellectual Property Rights

L:T:P :2:

Course Objectives:

1. To Acquire Knowledge about Law and Legal system.
2. To Understand the Principles of Trademark, Copyrights, Law of Patents

Course Out comes:

1. Will explain The Law and Legal System.
2. Will Enumerates Different Terminologies such as Patents, Copyrights, Trade secrets, Trademarks, Geographical Indication, Industrial Designs.
3. Will Give a Framework of Copy rights, Authorship and Ownership.
4. Introduction to Indian Patent System.

Unit I :

☞ Introduction to intellectual property rights. General introduction to Law and Legal system. Types of intellectual property rights, Patents, Copyrights, Trade secrets, Trademarks, Geographical Indication, Industrial Designs, etc., Theoretical justifications for intellectual property rights.

unit: II-Law of Copyrights

☞ Introduction to Copyright and its principles. Historical origin of copyright. Indian Scenario and International framework for Copy rights. Authorship and Ownership.

Unit III- Law of Trademark and Geographical Indication

☞ Principles of Trademark, Procedure for Obtaining Registration of Trademark, Rights of the Owner of Trademarks, Infringement of Trademark and Action for Passing Off, Domain Name Protection, Protection of Geographical Indication.

Justification for protection. International & Indian position for geographical indication.

Unit IV- Law of Patents

☐ Introduction to Indian Patent System.

☐ Patent Applications, Patentable Subject Matter, Disclosure Requirements, Novelty, Inventive Step, Utility, Industrial Application, Oppositions and revocations, Infringement, Exceptions to infringement, and Remedies for infringement, Patents and Public Health

unit V- Intellectual Property Rights in various streams and biotechnological inventions:

☐ Introduction to designs. Intellectual Property rights in various industrial domains: Pharmacy, Agriculture, food and nutrition, biotech etc., Remedies, Civil Remedies, Criminal Remedies& Administrative Remedies

☐ Concept of Novelty in biotechnological inventions, microorganisms as biotechnological inventions. Criteria for protection of plant varieties. Protection of traditional knowledge. Protection of Plant Varieties and Farmers Rights. The holders of traditional knowledge. Emerging issues in Intellectual Property Rights and infringement law suits.

SEMESTER / YEAR: IV YEAR

COURSE CODE: 15PD403

TITLE OF THE COURSE: CLINICAL PHARMACY (Theory)

L: T:P : 3:1:3

Objectives of the Subject:

Upon completion of the subject student shall be able to (Know, do, appreciate) –

- a. monitor drug therapy of patient through medication chart review and clinical review
- b. Obtain medication history interview and counsel the patients;
- c. Identify and resolve drug related problems;
- d. Detect, assess and monitor adverse drug reaction;
- e. Interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states; and
- f. Retrieve, analyse, interpret and formulate drug or medicine information

Course Outcome:

- Summarize and highlight the scope of clinical pharmacy and implement daily activities of clinical pharmacist.
- Interpret and illustrate the selected laboratory results (as monitoring parameters in therapeutics) of specific disease and attributing patient data by interviewing the patients
- Annotate and execute drugs and poison information services.
- Identify, assess and monitor adverse drug reactions.
- Integrate patient counselling techniques, medication history interviews and pharmaceutical care, and moderate biomedical literature and medication errors

Syllabus:

Unit – 1

38 hrs

1. Definitions, development and scope of clinical pharmacy
2. **Introduction to daily activities of a clinical pharmacist**
 - a. Drug therapy monitoring (medication chart review, clinical review, pharmacist interventions)
 - b. Ward round participation
 - c. Adverse drug reaction management
 - d. Drug information and poisons information
 - e. Medication history
 - f. Patient counseling
 - g. Drug utilization evaluation (DUE) and review (DUR)
 - h. Quality assurance of clinical pharmacy services

Unit -2

6 hrs

3. Patient data analysis
The patient's case history, its structure and use in evaluation of drug therapy & Understanding common medical abbreviations and terminologies used in clinical practices.

4. Clinical laboratory tests used in the evaluation of disease states, and interpretation of test results

- a. Haematological, Liver function, Renal function, thyroid function tests
- b. Tests associated with cardiac disorders
- c. Fluid and electrolyte balance
- d. Microbiological culture sensitivity tests
- e. Pulmonary Function Tests

Unit – 3

8 hrs

5. Drug & Poison information

- a. Introduction to drug information resources available
- b. Systematic approach in answering DI queries
- c. Critical evaluation of drug information and literature
- d. Preparation of written and verbal reports
- e. Establishing a Drug Information Centre
- f. Poisons information- organization & information resources

Unit -4

8 hrs

6. Pharmacovigilance

- a. Scope, definition and aims of pharmacovigilance
- b. Adverse drug reactions - Classification, mechanism, predisposing factors, causality assessment [different scales used]
- c. Reporting, evaluation, monitoring, preventing & management of ADRs
- d. Role of pharmacist in management of ADR.

Unit -5

15hrs

7. Communication skills, including patient counselling techniques, medication history interview, presentation of cases.
8. Pharmaceutical care concepts
9. Critical evaluation of biomedical literature
10. Medication errors

Text books (Theory)

- a. Practice Standards and Definitions - The Society of Hospital Pharmacists of Australia.
- b. Basic skills in interpreting laboratory data - Scott LT, American Society of Health System Pharmacists Inc.
- c. Biopharmaceutics and Applied Pharmacokinetics - Leon Shargel, Prentice Hall publication.
- d. A text book of Clinical Pharmacy Practice; Essential concepts and skills, Dr.G.Parthasarathi etal, Orient Orient Langram Pvt.Ltd. ISSN8125026

References

- a. Australian drug information -Procedure manual. The Society of Hospital Pharmacists of Australia.
- b. Clinical Pharmacokinetics - Rowland and Tozer, Williams and Wilkins Publication.
- c. Pharmaceutical statistics. Practical and clinical applications. Sanford Bolton, Marcel Dekker, Inc

SEMESTER / YEAR: IV YEAR

COURSE CODE: 15PD403

TITLE OF THE COURSE: CLINICAL PHARMACY (Theory)

L: T:P : 3:1:3

Objectives of the Subject:

Upon completion of the subject student shall be able to (Know, do, appreciate) –

- a. monitor drug therapy of patient through medication chart review and clinical review
- b. Obtain medication history interview and counsel the patients;
- c. Identify and resolve drug related problems;
- d. Detect, assess and monitor adverse drug reaction;
- e. Interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states; and
- f. Retrieve, analyse, interpret and formulate drug or medicine information

Course Outcome:

- Summarize and highlight the scope of clinical pharmacy and implement daily activities of clinical pharmacist.
- Interpret and illustrate the selected laboratory results (as monitoring parameters in therapeutics) of specific disease and attributing patient data by interviewing the patients
- Annotate and execute drugs and poison information services.
- Identify, assess and monitor adverse drug reactions.
- Integrate patient counselling techniques, medication history interviews and pharmaceutical care, and moderate biomedical literature and medication errors

Syllabus:

Unit – 1

38 hrs

1. Definitions, development and scope of clinical pharmacy
2. **Introduction to daily activities of a clinical pharmacist**
 - a. Drug therapy monitoring (medication chart review, clinical review, pharmacist interventions)
 - b. Ward round participation
 - c. Adverse drug reaction management
 - d. Drug information and poisons information
 - e. Medication history
 - f. Patient counseling
 - g. Drug utilization evaluation (DUE) and review (DUR)
 - h. Quality assurance of clinical pharmacy services

Unit -2

6 hrs

3. Patient data analysis
The patient's case history, its structure and use in evaluation of drug therapy & Understanding common medical abbreviations and terminologies used in clinical practices.

4. Clinical laboratory tests used in the evaluation of disease states, and interpretation of test results

- a. Haematological, Liver function, Renal function, thyroid function tests
- b. Tests associated with cardiac disorders
- c. Fluid and electrolyte balance
- d. Microbiological culture sensitivity tests
- e. Pulmonary Function Tests

Unit – 3

8 hrs

5. Drug & Poison information

- a. Introduction to drug information resources available
- b. Systematic approach in answering DI queries
- c. Critical evaluation of drug information and literature
- d. Preparation of written and verbal reports
- e. Establishing a Drug Information Centre
- f. Poisons information- organization & information resources

Unit -4

8 hrs

6. Pharmacovigilance

- a. Scope, definition and aims of pharmacovigilance
- b. Adverse drug reactions - Classification, mechanism, predisposing factors, causality assessment [different scales used]
- c. Reporting, evaluation, monitoring, preventing & management of ADRs
- d. Role of pharmacist in management of ADR.

Unit -5

15hrs

- 7. Communication skills, including patient counselling techniques, medication history interview, presentation of cases.
- 8. Pharmaceutical care concepts
- 9. Critical evaluation of biomedical literature
- 10. Medication errors

Text books (Theory)

- a. Practice Standards and Definitions - The Society of Hospital Pharmacists of Australia.
- b. Basic skills in interpreting laboratory data - Scott LT, American Society of Health System Pharmacists Inc.
- c. Biopharmaceutics and Applied Pharmacokinetics - Leon Shargel, Prentice Hall publication.
- d. A text book of Clinical Pharmacy Practice; Essential concepts and skills, Dr.G.Parthasarathi etal, Orient Orient Langram Pvt.Ltd. ISSN8125026

References

- a. Australian drug information -Procedure manual. The Society of Hospital Pharmacists of Australia.
- b. Clinical Pharmacokinetics - Rowland and Tozer, Williams and Wilkins Publication.
- c. Pharmaceutical statistics. Practical and clinical applications. Sanford Bolton, Marcel Dekker, Inc

SEMESTER / YEAR: IV YEAR

COURSE CODE: 15PD406

TITLE OF THE COURSE: CLINICAL TOXICOLOGY (Theory)

L:T:P: 2:1:0

Course Objectives – Students will be aware of the general management of poisoning along with a better understanding of the clinical manifestations and management associated with acute and chronic poisoning of substances. Students will also acquire knowledge about various substance abuse and dependence and management of the same.

Course Outcomes

- 1) Highlight and demonstrate the general working knowledge of clinical toxicology's concepts and techniques.
- 2) Illustrate the clinical manifestations and management of acute poisoning with agents.
- 3) Demonstrate and utilize knowledge of fundamental concepts in general toxicology and clinical management involved in snake bites and heavy metals.
- 4) Comprehend and identify possible preventative measures to decrease accidental poisonings.
- 5) Outline and build the ability to contribute as a part of the medical team in situations involving substance abuse and dependence.

15PD406: CLINICAL TOXICOLOGY – THEORY

Unit -1

13 hrs

1. General principles involved in the **management of poisoning**
2. **Antidotes** and their clinical **applications.**
3. **Supportive care** in clinical Toxicology.
4. **Gut Decontamination.**
5. **Elimination Enhancement.**
6. **Toxicokinetics.**

Unit -2

14 hrs

7. Clinical symptoms and **management of acute poisoning with the following agents**

- a) Pesticide poisoning: organophosphorous compounds, carbamates, organochlorines, pyrethroids.

- b) Opiates overdose.
- c) Antidepressants
- d) Barbiturates and benzodiazepines.
- e) Alcohol: ethanol, methanol.
- f) Paracetamol and salicylates.
- g) Non-steroidal anti-inflammatory drugs.
- h) Hydrocarbons: Petroleum products and PEG.
- i) Caustics: inorganic acids and alkali.
- j) Radiation poisoning

Unit -3

10 hrs

8. Clinical symptoms and management of chronic poisoning with the following agents –

Heavy metals: Arsenic, lead, mercury, iron, copper

9. **Venomous snake bites:** Families of venomous snakes, clinical effects of venoms, general management as first aid, early manifestations, complications and snake bite injuries.

Unit - 4

7 hrs

10. **Plants poisoning:** Mushrooms, Mycotoxins.

11. **Food poisonings**

12. Envenomations – Arthropod bites and stings.

Unit - 5

6 hrs

Substance abuse:

Signs and symptoms of **substance abuse and treatment of dependence**

- a) CNS stimulants :amphetamine
- b) Opioids
- c) CNS depressants
- d) Hallucinogens: LSD
- e) Cannabis group
- f) Tobacco

References:

a. Matthew J Ellenhorn. ELLENHORNS MEDICAL TOXICOLOGY – DIAGNOSIS AND TREATMENT OF POISONING. Second edition. Williams and Wilkins publication, London

b. V V Pillay. HANDBOOK OF FORENSIC MEDICINE AND TOXICOLOGY. Thirteenth edition 2003
Paras Publication, Hyderabad

SEMESTER / YEAR: IV YEAR

COURSE CODE: 15PD471

TITLE OF THE COURSE: PHARMACOTHERAPEUTICS III (Practical)

L:T:P : 3:1:3

Course Objective:

- Students will be aware of etiopathogenesis, clinical Presentation, Diagnosis and Management of various diseases including the following Systems like Gastrointestinal system, Haematological system, Nervous system, Psychiatry disorders and Pain management.
- Students also gain Knowledge on Evidence Based Medicine

Course Outcome:

- Provide Practical case presentation and Discussion on various diseases.
- Involvement in Ward round participation .
- Outline the clinical progress and selection of drug therapy.
- Participation in Patient Counselling and providing accurate knowledge regarding the therapy.

Practicals: Hospital postings for a period of at least 50 hours is required to understand the principles and practice involved in **ward round participation** and **clinical discussion on selection of drug therapy**. Students are required to maintain a record of 15 cases observed in the ward and the same should be submitted at the end of the course for evaluation. Each student should present at least two medical cases they have observed and followed in the wards.

Text Books

- a. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication
- b. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appleton & Lange

Reference Books

- a. Pathologic basis of disease - Robins SL, W.B.Saunders publication
- b. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice - Green and Harris, Chapman and Hall publication
- c. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication
Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA
- d. Avery's Drug Treatment, 4th Edn, 1997, Adis International Limited.
- e. Relevant review articles from recent medical and pharmaceutical literature.

Hospital Pharmacy -Practical

Scope: This course is designed to impart knowledge and skills necessary for maintaining the Hospital pharmacy and how to become a responsible hospital pharmacist. This course provides an in-depth understanding for the student regarding the various committees regulating the hospital pharmacy, preparation of budget, procurement and warehousing of drugs and pharmaceuticals, handling of radio pharmaceuticals which helps the students to clarify the theoretical understanding when they face real world scenario as hospital pharmacists.

Objectives: The primary objectives of this course are to

1. Discuss the fundamentals of hospital setup and hospital pharmacy
2. Understand how drugs are procured, inventory control and dispensed.
3. Acquaint the students to understand the important committees working within the hospital
4. Execute the activities related to hospital formulary and pharmacy and therapeutics committee

Course Outcomes (COs): At completion of this course, it is expected that the students will be able to

CO 1: Define the basic concepts in Hospital pharmacy

CO 2 : Critically interpret and apply Inventory control methods

CO 3 : Execute professional responsibilities of hospital pharmacist by intervening the drug interactions.

CO 4 : Provide professional services like drug information.

CO 5 : Equip the students in manufacturing of few commonly used Pharmaceutical Preparations.

SEMESTER / YEAR : IV YEAR COURSE CODE : 15PD472

TITLE OF THE COURSE : HOSPITAL PHARMACY (Practical)

L:T:P : 2:1:3

1. Assessment of drug interactions in the given prescriptions
2. Manufacture of parenteral formulations, powders.
3. Drug information queries.
4. Inventory control

SEMESTER / YEAR: IV YEAR

COURSE CODE: 15PD473

TITLE OF THE COURSE: CLINICAL PHARMACY (Practical)

L: T:P : 3:1:3

Objectives of the Subject:

Upon completion of the subject student shall be able to (Know, do, appreciate) –

- To create awareness in patients by counselling them on various diseases and drugs using clinical knowledge and communication skills.
- To interpret laboratory results of specific disease states mentioned and correlating with patient drug therapy while monitoring disease progression.
- To conduct comprehensive and meticulous medication history interview for the preparation of individualized pharmaceutical care plan.
- To provide response to a drug and poison information queries using modified systemic approach by critically appraising the biomedical literature.

Course Outcome:

- Annotate and execute drug information services by using various drug information services
- Integrate Patient counseling services by the help of good communication skills and patient counselling aids
- Interpret and illustrate case studies related to laboratory investigations and presentation of cases
- Plan and execute patient medication history interviews for the better pharmaceutical care

Students are expected to perform 15 practical's in the following areas covering the topics dealt in theory class.

- a. Answering drug information questions (4 Nos)
- b. Patient medication counselling (4 Nos)
- c. Case studies related to laboratory investigations (4 Nos)
- d. Patient medication history interview (3 Nos)

Text books (Theory)

- a. Practice Standards and Definitions - The Society of Hospital Pharmacists of Australia.
- b. Basic skills in interpreting laboratory data - Scott LT, American Society of Health System Pharmacists Inc.
- c. Biopharmaceutics and Applied Pharmacokinetics - Leon Shargel, Prentice Hall publication.
- d. A text book of Clinical Pharmacy Practice; Essential concepts and skills, Dr.G.Parthasarathi etal, Orient Orient Langram Pvt.Ltd. ISSN8125026

References

- a. Australian drug information -Procedure manual. The Society of Hospital Pharmacists of Australia.
- b. Clinical Pharmacokinetics - Rowland and Tozer, Williams and Wilkins Publication.
- c. Pharmaceutical statistics. Practical and clinical applications. Sanford Bolton, Marcel Dekker, Inc

CLINICAL RESEARCH

Objectives: In the changing scenario of pharmacy practice in India, for successful practice of Hospital Pharmacy, the students are required to learn various skills like drug distribution, drug dispensing, manufacturing of parenteral preparations, drug information, patient counseling, and therapeutic drug monitoring for improved patient care.

The Primary objectives of this course are to:

1. Know the concept of new drug development process.
2. Understand the regulatory and ethical requirements.
3. Conduct the clinical trials in accordance with regulatory and ethical requirements.
4. Coordinate the clinical trials and promote quality drug trial research.

Course Outcomes:

- CO 1. Thoroughly understand the concept of drug discovery
- CO 2. Various aspects involved in drug discovery
- CO 3. The standard procedures involved in drug discovery
- CO 4. The governing bodies responsible for drug discovery
- CO5. appreciate the practice based research methods.

1. Drug development process: Introduction Various Approaches to drug discovery

1. Pharmacological
2. Toxicological
3. IND Application
4. Drug characterization
5. Dosage form

2. Clinical development of drug:

1. Introduction to Clinical trials
2. Various phases of clinical trial.
3. Methods of post marketing surveillance
4. Abbreviated New Drug Application submission.
5. Good Clinical Practice – ICH, GCP, Central drug standard control organisation (CDSCO) guidelines
6. Challenges in the implementation of guidelines
7. Ethical guidelines in Clinical Research
8. Composition, responsibilities, procedures of IRB / IEC
9. Overview of regulatory environment in USA, Europe and India.
10. Role and responsibilities of clinical trial personnel as per ICH GCP a. Sponsor b. Investigators c. Clinical research associate d. Auditors e. Contract research coordinators f. Regulatory authority
11. Designing of clinical study documents (protocol, CRF, ICF, PIC with assignment)
12. Informed consent Process
13. Data management and its components
14. Safety monitoring in clinical trials.

References :

- a. Central Drugs Standard Control Organization. Good Clinical Practices-Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health; 2001.
- b. International Conference on Harmonisation of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonised Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996.
- c. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.
- d. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons. e. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes. f. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition, Jan 2000, Wiley Publications. g. Goodman & Gilman: JG Hardman, LE Limbard, 10th Edn. McGraw Hill Publications, 2001.

SEMESTER / YEAR : V YEAR

COURSE CODE : 15PD502

TITLE OF THE COURSE : PHARMACOEPIDEMIOLOGY & PHARMACOECONOMICS (Theory)

L:T:P : 3:1:0

Course Objectives- Students will be aware of various pharmacoepidemiologic study designs along with their merits and demerits and the parameters associated with them. They also will acquire knowledge on the appropriate selection of various pharmacoeconomic evaluations to be used for research.

Course Outcomes

- a) Assessing the versatile ranges, various units of measurement, and patient adherence to medication doses with regard to prevalence, incidence, and incidence rate.
- b) Comprehensive rating of different pharmacoepidemiologic risks, concepts for gathering diverse case studies/reports, their analysis, and their record-keeping procedures.
- c) Gaining statistical interpreting knowledge of the data system's unique applications based on risk management and medication safety.
- d) Implementing a wealth of knowledge about efficient Pharmacoeconomic assessment and judgments based on community pharmacy through a variety of approaches and hands-on study of diverse methods using case studies.
- e) Executing software applications that the student could interpret case studies based on them.

SYLLABUS

Unit - 1

14 hrs

Pharmacoepidemiology : Definition and scope: Origin and evaluation of pharmacoepidemiology need for pharmacoepidemiology, aims and applications.

Measurement of outcomes in pharmacoepidemiology Outcome measure and drug use measures Prevalence, incidence and incidence rate. Monetary units, number of prescriptions, units of drugs dispensed, defined daily doses and prescribed daily doses, medication adherence measurement

Unit -2

26 hrs

Concept of risk in pharmacoepidemiology Measurement of risk, attributable risk and relative risk, time-risk relationship and odds ratio

Pharmacoepidemiological methods Includes theoretical aspects of various methods and practical study of various methods with the help of case studies for individual methods

Drug utilization review, case reports, case series, surveys of drug use, cross – sectional studies, cohort studies, case control studies, case –cohort studies, meta – analysis studies, spontaneous reporting, prescription event monitoring and record linkage system.

Unit -3**12 hrs**

Sources of data for pharmacoepidemiological studies Ad Hoc data sources and automated data systems.

Selected special applications of pharmacoepidemiology Studies of vaccine safety, hospital pharmacoepidemiology, pharmacoepidemiology and risk management, drug induced birth defects.

Unit -4**19 hrs**

Pharmacoeconomics: Definition, history, needs of **pharmacoeconomic evaluations**

Role in formulary management decisions

Pharmacoeconomic evaluation Outcome assessment and types of evaluation

Includes theoretical aspects of various methods and practical study of various methods with the help of case studies for individual methods: Cost – minimization, cost- benefit, cost – effectiveness, cost utility.

Unit -5**4 hrs**

Applications of Pharmacoeconomics Software and case studies

CLINICAL PHARMACOKINETICS AND PHARMACOTHERAPEUTIC DRUG MONITORING -THEORY

Scope: This course is designed to make the students to understand and apply pharmacokinetic principles in designing / individualizing dosage regimen. Also, enable the students to interpret the plasma drug range, and hepatic / renal function in optimizing the drug therapy.

Objectives: On completion of the course, the student shall be able to

1. Design the drug therapy regimen for individual patient
2. Interpret and correlate the plasma drug concentration with patient's therapeutic outcome.
3. Recommend dosage adjustment for patients with renal/ hepatic impairment
4. Detect and manage drug-drug interactions

Course Outcomes (COs): At completion of this course it is expected that the students will be able to

CO 1 : Design the dosage regimen for the given drug based on the pharmacokinetic principles and route of administration

CO 2 : Individualize the dosage regimen for the patients with altered pharmacokinetics viz. renal / hepatic impairment, pediatrics, geriatrics, etc.

CO 3 : Interpret the results of therapeutic drug monitoring services of various drugs and give required recommendations for the dosage adjustment of those drugs, if required towards optimizing the treatment outcome.

CO 4 : Formulate protocol(s) for the therapeutic drug monitoring of drug(s) and initiate the service in collaboration with other healthcare team members.

CO 5 : Associate the genetic polymorphisms of the patients, if any with the clinical outcomes of the patients

Unit -1

1. Introduction to Clinical pharmacokinetics.
2. Design of dosage regimens: Nomograms and Tabulations in designing dosage regimen, Conversion from intravenous to oral dosing, Determination of dose and dosing intervals, Drug dosing in the elderly and pediatrics and obese patients.
3. Pharmacokinetics of Drug Interaction: a. Pharmacokinetic drug interactions b. Inhibition and Induction of Drug metabolism c. Inhibition of Biliary Excretion.

Unit -2

4. Therapeutic Drug monitoring:
 - a. Introduction
 - b. Individualization of drug dosage regimen (Variability – Genetic, Age and Weight, disease, Interacting drugs).
 - c. Indications for TDM. Protocol for TDM.
 - d. Pharmacokinetic/Pharmacodynamic Correlation in drug therapy.
 - e. TDM of drugs used in the following disease conditions: cardiovascular disease, Seizure disorders, Psychiatric conditions, and Organ transplantations.

Unit -3

5. Dosage adjustment in Renal and hepatic Disease. a. Renal impairment b. Pharmacokinetic considerations c. General approach for dosage adjustment in renal disease. d. Measurement of

Glomerular Filtration rate and creatinine clearance. e. Dosage adjustment for uremic patients. f. Extracorporeal removal of drugs. g. Effect of Hepatic disease on pharmacokinetics.

Unit -4

6. Population Pharmacokinetics. a. Introduction to Bayesian Theory. b. Adaptive method or Dosing with feedback. c. Analysis of Population pharmacokinetic Data.

Unit -5

7. Pharmacogenetics a. Genetic polymorphism in Drug metabolism: Cytochrome P-450 Isoenzymes. b. Genetic Polymorphism in Drug Transport and Drug Targets. c. Pharmacogenetics and Pharmacokinetics / Pharmacodynamic considerations

CLINICAL PHARMACOKINETICS AND PHARMACOTHERAPEUTIC DRUG MONITORING -THEORY

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Unit -4

6. Population Pharmacokinetics. a. Introduction to Bayesian Theory. b. Adaptive method or Dosing with feedback. c. Analysis of Population pharmacokinetic Data.

Unit -5

7. Pharmacogenetics a. Genetic polymorphism in Drug metabolism: Cytochrome P-450 Isoenzymes. b. Genetic Polymorphism in Drug Transport and Drug Targets. c. Pharmacogenetics and Pharmacokinetics / Pharmacodynamic considerations

SEMESTER / YEAR : VI YEAR PHARM D

COURSE CODE : 15PD681

TITLE OF THE COURSE : INTERNSHIP

Scope: Internship is a phase of training wherein a student is expected to conduct actual practice of pharmacy and health care and acquires skills under the supervision so that he or she may become capable of functioning independently.

Objectives: The primary objectives of this course are to

1. Critically analyze the prescriptions providing pharmacist interventions pertaining to the prescription.
2. Should be able to serve drug information, drug-drug interactions, adverse drug reactions, beside patient counselling.
3. Discuss the past, current and future plan of the patient's health to perform Medical Reconciliation
4. Should perform the pharmaco-economic study like cost-minimization in the respective department of a hospital.
5. Shall Perform Prescription Audits, Medication History Interview and Pharmaco-metric studies appropriate to the different wards of hospital.

Course Outcomes (COs): At completion of this course, it is expected that the students will be able to

1. To interpret the results of the laboratory tests in terms of the related pathophysiology..
2. To relate the clinical knowledge in ward rounds for case analysis.
3. To interview the patient to provide better patient care by critical analysis..
4. To analyse each case to identify the drug related problems and overcome the burden on patients.
5. To take a part of health care team to bring better patient outcomes and drug information services.
6. To build an ability to choose critical area where interventions required for better pharmaceutical care.

Syllabus:

Students will be able to do

1. Critical analysis of prescriptions providing pharmacist interventions,
 2. Drug information services,
 3. Assessment of drug-drug interactions,
 4. Adverse drug reactions
 5. Bed side patient counselling
- The pharmacotherapy case presentations has a specific format i.e. SOAP (subjective, objective, assessment and plan) Oral presentation about the real time cases will give knowledge to make patient specific decisions to produce better outcome and to increase the quality of life of patients.

- Every student shall be posted in constituent hospital for a period of not less than fifty hours to be covered in not less than 200 working days in each of second, third & fourth year course.
- Each student shall submit report duly certified by the preceptor and duly attested by the Head of the Department or Institution as prescribed. In the fifth year, every student shall spend half a day in the morning hours attending ward rounds on daily basis as a part of clerkship.
- Promote health improvement, wellness, and disease prevention in co-operation with patients, communities, at-risk population, and other members of an interprofessional team of health care providers.
- Demonstrate skills in monitoring of the National Health Programmes and schemes, oriented to provide preventive and promotive health care services to the community.

Semester: I

Course Code: 17BP102

Title of the Course: Pharmaceutical Analysis -Theory

OBJECTIVES OF THE SUBJECT:

Upon completion of the course student shall be able to

1. understand the principles of volumetric and electro chemical analysis
2. carryout various volumetric and electrochemical titrations
3. develop analytical skills
 1. Preparation and standardization of various molar and normal solutions
 2. Electrochemical methods of analysis by using conductometry,polarography,potentiometry etc
 3. Principles of Acid Base titration, non-aqueous titration, complexometric titration, precipitation titrations, gravimetric analysis and Redox titration.

Outcome:

1. Learning this subject content will develop the ideas with the fundamental of analytical chemistry.
2. Comprehend basic concepts involved in errors and to know the sources of impurities and methods to determine the impurities.
3. Illuminate need and basic principles of Acid Base titration, non-aqueous titration, complexometric titration, precipitation titrations, gravimetric analysis and Redox titration.
4. Demonstrate Previous types of electrodes, instrumentation and applications of Potentiometry, Conductometry and Polarography

UNIT-I 10 Hours

- (a) Pharmaceutical analysis-** Definition and scope i) Different techniques of analysis
ii) Methods of expressing concentration iii) Primary and secondary standards.
iv) **Preparation and standardization of various molar and normal solutions-**
Oxalic acid, sodium hydroxide, hydrochloric acid, sodium thiosulphate, sulphuric acid, potassium permanganate and ceric ammonium sulphate
- (b) Errors:** Sources of errors, types of errors, methods of minimizing errors, accuracy, precision and significant figures
- (c) Pharmacopoeia,** Sources of impurities in medicinal agents, limit tests.

UNIT-II 10 Hours

Acid base titration: Theories of acid base indicators, classification of acid base titrations and theory involved in titrations of strong, weak, and very weak acids and bases, neutralization curves

Non aqueous titration: Solvents, acidimetry and alkalimetry titration and estimation of Sodium benzoate and Ephedrine HCl

UNIT-III 10 Hours

Precipitation titrations: Mohr's method, Volhard's, Modified Volhard's, Fajans method, estimation of sodium chloride.

Complexometric titration: Classification, metal ion indicators, masking and demasking reagents, estimation of Magnesium sulphate, and calcium gluconate.

Gravimetry: Principle and steps involved in gravimetric analysis. Purity of the precipitate: co-precipitation and post precipitation, Estimation of barium sulphate.
Basic Principles, methods and application of diazotisation titration.

UNIT-IV 08 Hours

Redox titrations

(a) Concepts of oxidation and reduction

(b) Types of redox titrations (Principles and applications)

Cerimetry, Iodimetry, Iodometry, Bromatometry, Dichrometry, Titration with potassium iodate

UNIT-V 07 Hours

Electrochemical methods of analysis

Conductometry- Introduction, Conductivity cell, Conductometric titrations, applications.

Potentiometry - Electrochemical cell, construction and working of reference (Standard hydrogen, silver chloride electrode and calomel electrode) and indicator electrodes (metal electrodes and glass electrode), methods to determine end point of potentiometric titration and applications.

Polarography - Principle, Ilkovic equation, construction and working of dropping mercury electrode and rotating platinum electrode, applications

SEMESTER/YEAR: I SEM

COURSE CODE: 17BP103

TITLE OF THE COURSE: PHARMACEUTICS- I – THEORY

COURSE OBJECTIVES: Upon completion of this course the student should be able to:

1. Know the history of profession of pharmacy
2. Understand the basics of different dosage forms, pharmaceutical incompatibilities and pharmaceutical calculations
3. Understand the professional way of handling the prescription
4. Preparation of various conventional dosage forms

COURSE OUTCOME: Students will be able to have the relevant knowledge on

- 1 Information of history and development of Pharmacy profession in India, Pharmacopeia. Illustrate the different parts of a prescription with their significance. Study the application of posology. Introduction of various dosage forms.
- 2 Understand the basic concepts of fundamental calculations and their application in designing of dosage form.
- 3 Elucidate the various excipients used in liquid orals and enumerate the identification, precautions on instabilities of biphasic liquids.
- 4 Acquire knowledge about suppositories, its method of preparation and application. Understand the significance of incompatibilities and their influence on stability of dosage form.
5. Classification, formulation and dispensing of different semisolid dosage forms.

UNIT – I

Historical background and development of profession of pharmacy: History of profession of Pharmacy in India in relation to pharmacy education, industry and organization, Pharmacy as a career, **Pharmacopoeias: Introduction to IP, BP, USP and Extra Pharmacopoeia.**

Dosage forms: Introduction to dosage forms, classification and definitions

Prescription: Definition, Parts of prescription, handling of Prescription and Errors in prescription.

Posology: Definition, Factors affecting posology. **Pediatric dose calculations based on age, body weight and body surface area.**

UNIT – II

Pharmaceutical calculations: Weights and measures – Imperial & Metric system,

Calculations involving percentage solutions, alligation, proof spirit and isotonic solutions based on freezing point and molecular weight.

Powders: Definition, classification, advantages and disadvantages, Simple & compound powders – official preparations, dusting powders, effervescent, efflorescent and hygroscopic powders, eutectic mixtures. Geometric dilutions.

Liquid dosage forms: Advantages and disadvantages of liquid dosage forms.

Excipients used in formulation of liquid dosage forms. Solubility enhancement techniques

UNIT – III

Monophasic liquids: Definitions and preparations of Gargles, Mouthwashes, Throat Paint, Eardrops, Nasal drops, Enemas, Syrups, Elixirs, Liniments and Lotions.

Biphasic liquids:

Suspensions: Definition, advantages and disadvantages, classifications, Preparation of suspensions; Flocculated and Deflocculated suspension & stability problems and methods to overcome.

Emulsions: Definition, classification, emulsifying agent, test for the identification of type of Emulsion, Methods of preparation & stability problems and methods to overcome.

UNIT – IV

Suppositories: Definition, types, advantages and disadvantages, types of bases, methods of preparations. Displacement value & its calculations, evaluation of suppositories.

Pharmaceutical incompatibilities: Definition, classification, physical, chemical and therapeutic incompatibilities with examples.

UNIV – V

Semisolid dosage forms: Definitions, classification, mechanisms and factors influencing dermal penetration of drugs. Preparation of ointments, pastes, creams and gels. Excipients used in semi solid dosage forms. Evaluation of semi solid dosages forms

SEMESTER/YEAR : I SEM
COURSE CODE : 17BP107
TITLE OF THE COURSE : HUMAN ANATOMY AND PHYSIOLOGY I – PRACTICAL
L: T/A: P: C : 0 : 0 : 4 : 2

COURSE OBJECTIVES

- Fundamentals of Anatomy & Physiology provides students with in-depth knowledge of the human body's order, structures, and processes.
- Students will learn the terms, anatomy and physiology, pathology, and interrelationships of each bodily system in order to sustain equilibrium.

COURSE OUTCOMES

Upon the completion of the course student will be able to:

- CO1. Use the microscope effectively for microscopic examination of different organs.
CO2. Recognize the axial and appendicular bones of the human spine.
CO3. Describe the gross morphology, structure, and roles of different human bodily organs.
CO4. Recognize various cells and parts of the human body's various systems.
CO5: Conduct haematological tests such as blood cell count, hemoglobin calculation, bleeding/clotting time, blood group determination, and so on.
CO6. Measure your blood pressure, heart rate, pulse rate, and respiration rate, as well as your vital capacity.

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

1. Study of compound microscope.
2. Microscopic study of epithelial and connective tissue
3. Microscopic study of muscular and nervous tissue
4. Identification of axial bones
5. Identification of appendicular bones
6. Introduction to hemocytometry.
7. Enumeration of white blood cell (WBC) count
8. Enumeration of total red blood corpuscles (RBC) count
9. Determination of bleeding time
10. Determination of clotting time
11. Estimation of hemoglobin content
12. Determination of blood group.
13. Determination of erythrocyte sedimentation rate (ESR).
14. Determination of heart rate and pulse rate.
15. Recording of blood pressure.

RECOMMENDED BOOKS (LATEST EDITIONS):

- 1) Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
- 2) Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
- 3) Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview,MI USA
- 4) Text book of Medical Physiology- Arthur C, Guyton and John.E. Hall. Miamisburg, OH, U.S.A.
- 5) Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
- 6) Textbook of Human Histology by Inderbir Singh, Jaypee brother's medical

- publishers, New Delhi.
- 7) Textbook of Practical Physiology by C.L. Ghai, Jaypee brother's medical publishers, New Delhi.
 - 8) Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

REFERENCE BOOKS (LATEST EDITIONS):

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
2. Text book of Medical Physiology- Arthur C, Guyton and John. E. Hall. Miamisburg, OH, U.S.A.
3. Human Physiology (vol 1 and 2) by Dr. C.C. Chatterrje, Academic Publishers Kolkata

SEMESTER/YEAR : I SEM
COURSE CODE : 17BP107
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L: T/A: P: C : 0 : 0 : 4 : 2

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SEMESTER/YEAR : I SEM

COURSE CODE : 17BP108

TITLE OF THE COURSE : PHARMACEUTICAL ANALYSIS – PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

I Limit Test of the following

1. Chloride
2. Sulphate
3. Iron
4. Arsenic

II Preparation and standardization of

1. Sodium hydroxide
2. Sulphuric acid
3. Sodium thiosulfate
4. Potassium permanganate
5. Ceric ammonium sulphate

III Assay of the following compounds along with Standardization of Titrant

1. Ammonium chloride by acid base titration
2. Ferrous sulphate by Cerimetry
3. Copper sulphate by Iodometry
4. Calcium gluconate by complexometry
5. Hydrogen peroxide by Permanganometry
6. Sodium benzoate by non-aqueous titration
7. Sodium Chloride by precipitation titration

IV Determination of Normality by electro-analytical methods

1. Conductometric titration of strong acid against strong base
2. Conductometric titration of strong acid and weak acid against strong base
3. Potentiometric titration of strong acid against strong base

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry
5. John H. Kennedy, Analytical chemistry principles
6. Indian Pharmacopoeia.

SEMESTER/YEAR : I SEM

COURSE CODE : 17BP108

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3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry
4. Bentley and Driver's Textbook of Pharmaceutical Chemistry
5. John H. Kennedy, Analytical chemistry principles
6. Indian Pharmacopoeia.

SEMESTER/YEAR: I SEM

COURSE CODE: 17BP109

TITLE OF THE COURSE: PHARMACEUTICS- I – PRACTICAL

Course objective:

- Understand the basic aspects of preparing different pharmaceutical dosage forms
- Criteria for packaging and labelling.

Course outcome: Students will be able to have relevant skills in

- Formulating the various dosage forms.
- Calculate the working formula from the official master formula.
- Designing the label with appropriate product information and dispensing in appropriate container.

1. Syrups

a) Syrup IP'66

b) Compound syrup of Ferrous Phosphate BPC'68

2. Elixirs

a) Piperazine citrate elixir

b) Paracetamol pediatric elixir

3. Linctus

a) Terpin Hydrate Linctus IP'66

b) Iodine Throat Paint (Mandles Paint)

4. Solutions

a) Strong solution of ammonium acetate

b) Cresol with soap solution

c) Lugol's solution

5. Suspensions

a) Calamine lotion

b) Magnesium Hydroxide mixture

c) Aluminium Hydroxide gel

6. Emulsions

a) Turpentine Liniment

b) Liquid paraffin emulsion

7. Powders and Granules

a) ORS powder (WHO)

b) Effervescent granules

c) Dusting powder

d) Divided powders

8. Suppositories

a) Glycero gelatin suppository

b) Cocoa butter suppository

c) Zinc Oxide suppository

9. Semisolids

a) Sulphur ointment

b) Non staining-iodine ointment with methyl salicylate

c) Carbopal gel

10. Gargles and Mouthwashes

a) Iodine gargle

b) Chlorhexidine mouthwash

SEMESTER/YEAR : I SEM

COURSE CODE : 17BP110

TITLE OF THE COURSE : PHARMACEUTICAL INORGANIC CHEMISTRY-PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

I. Limit tests for following ions

Limit test for Chlorides and Sulphates

Modified limit test for Chlorides and Sulphates

Limit test for Iron

Limit test for Heavy metals

Limit test for Lead

Limit test for Arsenic

II. Identification test

Magnesium hydroxide Ferrous sulphate Sodium bicarbonate Calcium gluconate Copper sulphate

III. Test for purity

Swelling power of Bentonite

Neutralizing capacity of aluminum hydroxide gel

Determination of potassium iodate and iodine in potassium Iodide

IV. Preparation of inorganic pharmaceuticals

Boric acid Potash alum Ferrous Sulphate

RECOMMENDED BOOKS (LATEST EDITIONS) :

1. A.H. Beckett & J.B. Stenlake's, Practical Pharmaceutical Chemistry Vol I & II, Stahlone Press of University of London, 4th edition.
2. A.I. Vogel, Text Book of Quantitative Inorganic analysis
3. P. Gundu Rao, Inorganic Pharmaceutical Chemistry, 3rd Edition
4. M.L Schroff, Inorganic Pharmaceutical Chemistry
5. Bentley and Driver's Textbook of Pharmaceutical Chemistry
6. Anand & Chatwal, Inorganic Pharmaceutical Chemistry
7. Indian Pharmacopoeia

17BP202
PHARMACEUTICAL ORGANIC CHEMISTRY – I - THEORY
3 : 1 : 0 : 4

45 Hours

This subject deals with classification and nomenclature of simple organic compounds, structural isomerism, intermediates forming in reactions, important physical properties, reactions and methods of preparation of these compounds. The syllabus also emphasizes on mechanisms and orientation of reactions.

COURSE OBJECTIVES: Upon completion of the course the student shall be able to

1. Write the structure, name and the type of isomerism of the organic compound
2. Write the reaction, name the reaction and orientation of reactions
3. Account for reactivity/stability of compounds,
4. identify/confirm the identification of organic compound
5. General methods of preparation and reactions of compounds superscripted with asterisk (*) to be explained
6. To emphasize on definition, types, classification, principles/mechanisms, applications, examples and differences

UNIT-I

07 Hours

Classification, nomenclature and isomerism

Classification of Organic Compounds

Common and IUPAC systems of nomenclature of organic compounds

(up to 10 Carbons open chain and carbocyclic compounds) Structural isomerisms in organic compounds

UNIT-II

10 Hours

Alkanes*, Alkenes* and Conjugated dienes*

SP³ hybridization in alkanes, Halogenation of alkanes, uses of paraffins. Stabilities of alkenes, SP² hybridization in alkenes

E1 and E2 reactions – kinetics, order of reactivity of alkyl halides, rearrangement of carbocations, Saytzeffs orientation and evidences. E1 verses E2 reactions, Factors affecting E1 and E2 reactions.

Ozonolysis, **electrophilic addition reactions** of alkenes, Markownikoff's orientation, free radical addition reactions of alkenes, Anti Markownikoff's orientation.

Stability of conjugated dienes, Diel-Alder, electrophilic addition, free radical addition reactions of conjugated dienes, allylic rearrangement

UNIT-III

10 Hours

Alkyl halides*

SN1 and SN2 reactions - kinetics, order of reactivity of alkyl halides, stereochemistry and rearrangement of carbocations.

SN1 versus SN2 reactions, Factors affecting SN1 and SN2 reactions

Structure and uses of ethylchloride, Chloroform, trichloroethylene, tetrachloroethylene, dichloromethane, tetrachloromethane and iodoform.

Alcohols*- Qualitative tests, Structure and uses of Ethyl alcohol, Methyl alcohol, chlorobutanol, Cetosteryl alcohol, Benzyl alcohol, Glycerol, Propylene glycol

UNIT-IV

10 Hours

Carbonyl compounds* (Aldehydes and ketones)

Nucleophilic addition, Electromeric effect, aldol condensation, Crossed Aldol condensation, Cannizzaro reaction, Crossed Cannizzaro reaction, Benzoin condensation, Perkin condensation, qualitative tests, Structure and uses of Formaldehyde, Paraldehyde, Acetone, Chloral hydrate, Hexamine, Benzaldehyde, Vanilin, Cinnamaldehyde.

UNIT-V

08 Hours

Carboxylic acids*

Acidity of carboxylic acids, effect of substituents on acidity, inductive effect and qualitative tests for carboxylic acids, amide and ester

Structure and Uses of Acetic acid, Lactic acid, Tartaric acid, Citric acid, Succinic acid. Oxalic acid, Salicylic acid, Benzoic acid, Benzyl benzoate, Dimethyl phthalate, Methyl salicylate and Acetyl salicylic acid

Aliphatic amines* - Basicity, effect of substituent on Basicity. Qualitative test, Structure and uses of Ethanolamine, Ethylenediamine, Amphetamine.

SEMESTER/YEAR : II SEM
COURSE CODE : 17BP203
TITLE OF THE COURSE : **BIOCHEMISTRY - THEORY**
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

Objectives:

Biochemistry deals with complete understanding of the molecular levels of the chemical process associated with living cells. The scope of the subject is providing biochemical facts and the principles to understand metabolism of nutrient molecules in physiological and pathological conditions. It is also emphasizing on genetic organization of mammalian genome and hetero & autocatalytic functions of DNA.

COURSE OBJECTIVES: Upon completion of course student shall able to

1. Understand the catalytic role of enzymes, importance of enzyme inhibitors in design of new drugs, therapeutic and diagnostic applications of enzymes.
2. Understand the metabolism of nutrient molecules in physiological and pathological conditions.
3. Understand the genetic organization of mammalian genome and functions of DNA in the synthesis of RNAs and proteins.

UNIT I

08 Hours

Biomolecules

Introduction, classification, chemical nature and biological role of carbohydrate, lipids, nucleic acids, amino acids and proteins.

Bioenergetics

Concept of free energy, endergonic and exergonic reaction, Relationship between free energy, enthalpy and entropy; Redox potential.

Energy rich compounds; classification; biological significances of ATP and cyclic AMP

UNIT II

10 Hours

Carbohydrate metabolism

Glycolysis – Pathway, energetics and significance

Citric acid cycle- Pathway, energetics and significance

HMP shunt and its significance; Glucose-6-Phosphate dehydrogenase

(G6PD) deficiency

Glycogen metabolism Pathways and glycogen storage diseases (GSD) Gluconeogenesis- Pathway and its significance

Hormonal regulation of blood glucose level and Diabetes mellitus

Biological oxidation

Electron transport chain (ETC) and its mechanism

Oxidative phosphorylation & its mechanism and substrate level phosphorylation Inhibitors

ETC and oxidative phosphorylation / Uncouplers

UNIT III

10 Hours

Lipid metabolism

β -Oxidation of saturated fatty acid (Palmitic acid)

Formation and utilization of ketone bodies; ketoacidosis

De novo synthesis of fatty acids (Palmitic acid)

Biological significance of cholesterol and conversion of cholesterol into bile acids, steroid hormone and vitamin D

Disorders of lipid metabolism: Hypercholesterolemia, atherosclerosis, fatty liver and obesity.

Amino acid metabolism

General reactions of amino acid metabolism: Transamination, deamination & decarboxylation, urea cycle and its disorders

Catabolism of phenylalanine and tyrosine and their metabolic disorders (Phenylketonuria, Albinism, alpeptonuria, tyrosinemia)

Synthesis and significance of biological substances; 5-HT, melatonin, dopamine, noradrenaline, adrenaline

Catabolism of heme; hyperbilirubinemia and jaundice

UNIT IV

10 Hours

Nucleic acid metabolism and genetic information transfer

Biosynthesis of purine and pyrimidine nucleotides

Catabolism of purine nucleotides and Hyperuricemia and Gout disease

Organization of mammalian genome

Structure of DNA and RNA and their functions DNA replication (semi conservative model)

Transcription or RNA synthesis

Genetic code, Translation or Protein synthesis and inhibitors

UNIT V

07 Hours

Enzymes

Introduction, properties, nomenclature and IUB classification of enzymes

Enzyme kinetics (Michaelis plot, Line Weaver Burke plot)

Enzyme inhibitors with examples

Regulation of enzymes: enzyme induction and repression, allosteric enzymes regulation

Therapeutic and diagnostic applications of enzymes and isoenzymes

Coenzymes –Structure and biochemical functions

RECOMMENDED BOOKS (LATEST EDITIONS):

1. Principles of Biochemistry by Lehninger.
2. Harper's Biochemistry by Robert K. Murry, Daryl K. Granner and Victor W. Rodwell.
3. Biochemistry by Stryer.

4. Biochemistry by D. Satyanarayan and U.Chakrapani
5. Textbook of Biochemistry by Rama Rao.
6. Textbook of Biochemistry by Deb.
7. Outlines of Biochemistry by Conn and Stumpf
8. Practical Biochemistry by R.C. Gupta and S. Bhargavan.
9. Introduction of Practical Biochemistry by David T. Plummer. (3rd Edition) 10.
Practical Biochemistry for Medical students by Rajagopal and Ramakrishna.
11. Practical Biochemistry by Harold Varley.

SEMESTER/YEAR : II SEM
COURSE CODE : 17BP207
TITLE OF THE COURSE : HUMAN ANATOMY AND PHYSIOLOGY-II - PRACTICAL
L: T/A: P: C : 0 : 0 : 4 : 2

COURSE OBJECTIVES

The subject is intended to provide basic understanding of the structure and functions of the human body's different systems. It also aids in the comprehension of both homeostasis processes. The topic offers the fundamental information needed to comprehend the different branches of pharmacy.

COURSE OUTCOMES

Upon the completion of the course student will be able to:

- CO1. Evaluate the body temperature.
- CO2. Recognize the Vital capacity and tidal volume of the lungs by Spirometer.
- CO3. Describe the gross morphology, structure, and roles of different human bodily organs.
- CO4. Recognize visual acuity and reflex activity of the human body.
- CO5: Analyze urine for Normal and abnormal components.
- CO6. Using computer tools, demonstrate the muscular curve.

Practical physiology is complimentary to the theoretical discussions in physiology. Practicals allow the verification of physiological processes discussed in theory classes through experiments on living tissue, intact animals or normal human beings. This is helpful for developing an insight on the subject.

1. To study the integumentary and special senses using specimen, models, etc.,
2. To study the nervous system using specimen, models, etc.,
3. To study the endocrine system using specimen, models, etc
4. To demonstrate the general neurological examination
5. To demonstrate the function of olfactory nerve
6. To examine the different types of taste.
7. To demonstrate the visual acuity
8. To demonstrate the reflex activity
9. Recording of body temperature
10. To demonstrate positive and negative feedback mechanism.
11. Determination of tidal volume and vital capacity.
12. Study of digestive, respiratory, cardiovascular systems, urinary and reproductive systems with the help of models, charts and specimens.
13. Recording of basal mass index.
14. Study of family planning devices and pregnancy diagnosis test.
15. Demonstration of total blood count by cell analyser
16. Permanent slides of vital organs and gonads.

RECOMMENDED BOOKS (LATEST EDITIONS) :

1. Essentials of Medical Physiology by K. Sembulingam and P. Sembulingam. Jaypee brothers medical publishers, New Delhi.
2. Anatomy and Physiology in Health and Illness by Kathleen J.W. Wilson, Churchill Livingstone, New York
3. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA
4. Text book of Medical Physiology- Arthur C, Guyton and John.E. Hall. Miamisburg, OH,

U.S.A.

5. Principles of Anatomy and Physiology by Tortora Grabowski. Palmetto, GA, U.S.A.
6. Textbook of Human Histology by Inderbir Singh, Jaypee brothers medical publishers, New Delhi.
7. Textbook of Practical Physiology by C.L. Ghai, Jaypee brothers medical publishers, New Delhi.
8. Practical workbook of Human Physiology by K. Srinageswari and Rajeev Sharma, Jaypee brother's medical publishers, New Delhi.

REFERENCE BOOKS:

1. Physiological basis of Medical Practice-Best and Tailor. Williams & Wilkins Co, Riverview, MI USA

SEMESTER/YEAR : II SEM

COURSE CODE : 17BP208

TITLE OF THE COURSE : PHARMACEUTICAL ORGANIC CHEMISTRY –I PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

Course Objectives

- 1. Will develop skills to analyse an organic compound.**
- 2. Will acquire knowledge about mechanisms and reactions of synthetic pathway**

Course out come:

1. Illustrates Different methodologies involved for the Synthesis of Pharmaceutically important Compounds.
2. Illustrates the techniques for systematic analysis of Known Organic compounds like Elementary analysis, Solubility and Functional group analysis.
3. Demonstrates various tools like melting point and boiling point.

1. Systematic qualitative analysis of unknown organic compounds like
 - a. Preliminary test: Color, odour, aliphatic/aromatic compounds, saturation and unsaturation, etc.
 - b. Detection of elements like Nitrogen, Sulphur and Halogen by Lassaigne's test
 - c. Solubility test
 - d. Functional group test like Phenols, Amides/ Urea, Carbohydrates, Amines, Carboxylic acids, Aldehydes and Ketones, Alcohols, Esters, Aromatic and Halogenated Hydrocarbons,

Nitro compounds and Anilides.

- e. Melting point/Boiling point of organic compounds
 - f. Identification of the unknown compound from the literature using melting point/ boiling point.
 - g. Preparation of the derivatives and confirmation of the unknown compound by melting point/ boiling point.
 - h. Minimum 5 unknown organic compounds to be analysed systematically.
2. Preparation of suitable solid derivatives from organic compounds
 3. Construction of molecular models

RECOMMENDED BOOKS (LATEST EDITIONS) :

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical

SEMESTER/YEAR : II SEM

COURSE CODE : 17BP209

TITLE OF THE COURSE : BIOCHEMISTRY - PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

Course objectives

- They can analyse the typical metabolites and bodily constituents with the aid of this subject.

Course Outcome

- To learn the quantification of normal constituents in body like carbohydrate, proteins and lipid content.
- To analyse the normal constituent and abnormal constituents in the urine.

1. Qualitative analysis of carbohydrates (Glucose, Fructose, Lactose, Maltose, Sucrose and starch)
2. Identification tests for Proteins (albumin and Casein)
3. Quantitative analysis of reducing sugars (DNSA method) and Proteins (Biuret method)
4. Qualitative analysis of urine for abnormal constituents
5. Determination of blood creatinine
6. Determination of blood sugar
7. Determination of serum total cholesterol
8. Preparation of buffer solution and measurement of pH
9. Study of enzymatic hydrolysis of starch
10. Determination of Salivary amylase activity
11. Study the effect of Temperature on Salivary amylase activity.
12. Study the effect of substrate concentration on salivary amylase activity.

17BP210
COMPUTER APPLICATIONS IN PHARMACY - PRACTICAL
0 : 0 : 2 : 1

Objectives:

- To give basic understanding of functions of MS word
 - To acquaint students with creating tables, DI storage, information retrieval
 - To understand tables export, import, creating query related forms etc.
1. Design a questionnaire using a word processing package to gather information about a particular disease.
 2. Create a HTML web page to show personal information.
 3. Retrieve the information of a drug and its adverse effects using online tools
 4. Creating mailing labels Using Label Wizard, generating label in MS WORD
 5. Create a database in MS Access to store the patient information with the required fields Using access
 6. Design a form in MS Access to view, add, delete and modify the patient record in the database
 7. Generating report and printing the report from patient database
 8. Creating invoice table using – MS Access
 9. Drug information storage and retrieval using MS Access
 10. Creating and working with queries in MS Access
 11. Exporting Tables, Queries, Forms and Reports to web pages
 12. Exporting Tables, Queries, Forms and Reports to XML pages

RECOMMENDED BOOKS (LATEST EDITION):

1. Computer Application in Pharmacy – William E.Fassett –Lea and Febiger, 600 South Washington Square, USA, (215) 922-1330.
2. Computer Application in Pharmaceutical Research and Development –Sean Ekins – Wiley-Interscience, A John Willey and Sons, INC., Publication, USA
3. Bioinformatics (Concept, Skills and Applications) – S.C.Rastogi-CBS Publishers and Distributors, 4596/1- A, 11 Darya Gani, New Delhi – 110 002(INDIA)
4. Microsoft office Access - 2003, Application Development Using VBA, SQL Server, DAP and Infopath – Cary N.Prague – Wiley Dreamtech India (P) Ltd., 4435/7, Ansari Road, Daryagani, New Delhi – 110002

SEMESTER/YEAR : III SEM

COURSE CODE : 17BP303

TITLE OF THE COURSE : PHARMACEUTICAL MICROBIOLOGY - THEORY

L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

Study of all categories of microorganisms especially for the production of alcohol antibiotics, vaccines, vitamins enzymes etc.,

COURSE OBJECTIVES: Upon completion of the subject student shall be able to;

1. Understand methods of identification, cultivation and preservation of various microorganisms
2. To understand the importance and implementation of sterilization in pharmaceutical processing and industry
3. Learn sterility testing of pharmaceutical products.
4. Carried out microbiological standardization of Pharmaceuticals.
5. Understand the cell culture technology and its applications in pharmaceutical industries.

COURSE OUTCOME:

1. Explain the anatomy, identification, growth factors of microorganisms which include bacteria, virus, and fungus. Also discuss quantitative measurement of bacterial growth (total & viable count) with Study of different types of microscopy.
2. Summarize Identification of bacteria using staining techniques and sterilization methods.
3. Sterility testing of products, bactericidal & Bacteriostatic Study.
4. Explain different methods for standardization of pharmaceutical products.
5. Summarize, assessment and Preservation of microbial contamination of pharmaceutical products

UNIT I 10 Hours

Introduction, history of microbiology, its branches, scope and its importance.

Introduction to Prokaryotes and Eukaryotes

Study of ultra-structure and morphological classification of bacteria, nutritional requirements, raw materials used for culture media and physical parameters for growth, growth curve, isolation and preservation methods for pure cultures, cultivation of anaerobes, quantitative measurement of bacterial growth (total & viable count).

Study of different types of phase contrast microscopy, dark field microscopy and electron microscopy.

UNIT II 10 Hours

Identification of bacteria using staining techniques (simple, Gram's & Acid fast staining) and biochemical tests (IMViC).

Study of principle, procedure, merits, demerits and applications of physical, chemical gaseous, radiation and mechanical method of sterilization.

Evaluation of the efficiency of sterilization methods.

Equipments employed in large scale sterilization. Sterility indicators.

UNIT III 10 Hours

Study of morphology, classification, reproduction/replication and cultivation of Fungi and Viruses. Classification and mode of action of disinfectants. Factors influencing disinfection, antiseptics and their evaluation. For bacteriostatic and bactericidal actions Evaluation of bactericidal & Bacteriostatic. Sterility testing of products (solids, liquids, ophthalmic and other sterile products) according to IP, BP and USP.

UNIT IV 08 Hours

Designing of aseptic area, laminar flow equipments; study of different sources of contamination in an aseptic area and methods of prevention, clean area classification. Principles and methods of different microbiological assay. Methods for standardization of antibiotics, vitamins and amino acids. Assessment of a new antibiotic.

UNIT V 07 Hours

Types of spoilage, factors affecting the microbial spoilage of pharmaceutical products, sources and types of microbial contaminants, assessment of microbial contamination and spoilage. Preservation of pharmaceutical products using antimicrobial agents, evaluation of microbial stability of formulations.

Growth of animal cells in culture, general procedure for cell culture, Primary, established and transformed cell cultures.

Application of cell cultures in pharmaceutical industry and research.

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP305

TITLE OF THE COURSE : PHARMACEUTICAL ORGANIC CHEMISTRY-II-PRACTICAL L:
T/A: P: C : 0: 0: 4: 2

Course Objectives:

- 1. The student will learn the Techniques which can be used for the Synthesis of compounds.**
- 2. The student will learn the Qualitative analysis technique for the organic compounds.**

COURSE OUTCOMES:

1. Illustrates Different methodologies involved for the synthesis of Pharmaceutically important Compounds.

2. Describes Various Aspects and applications of Important reaction mechanisms involved during synthesis.

Illustrates the techniques for systematic analysis of Known organic compounds like Elementary analysis, Solubility and Functional group analysis.

I. Experiments involving laboratory techniques

Recrystallization

Steam distillation

II. Determination of following oil values (including standardization of reagents)

Acid value

Saponification value

Iodine value

III Preparation of compounds

Benzanilide/Phenyl benzoate/Acetanilide from Aniline/ Phenol/Aniline by acylation reaction.

2,4,6-Tribromo aniline/Para bromo acetanilide from Aniline/ Acetanilide by halogenation (Bromination) reaction.

5-Nitro salicylic acid/Meta di nitro benzene from Salicylic acid / Nitro benzene by nitration reaction.

Benzoic acid from Benzyl chloride by oxidation reaction.

Benzoic acid/ Salicylic acid from alkyl benzoate/ alkyl salicylate by hydrolysis reaction.

1-Phenyl azo-2-naphthol from Aniline by diazotization and coupling reactions.

Benzil from Benzoin by oxidation reaction.

Dibenzal acetone from Benzaldehyde by Claisen Schmidt reaction

Cinnamic acid from Benzaldehyde by Perkin reaction

P-Iodo benzoic acid from *P*-amino benzoic acid

RECOMMENDED BOOKS (LATEST EDITIONS):

1. Organic Chemistry by Morrison and Boyd
2. Organic Chemistry by I.L. Finar , Volume-I
3. Textbook of Organic Chemistry by B.S. Bahl & Arun Bahl.
4. Organic Chemistry by P.L.Soni
5. Practical Organic Chemistry by Mann and Saunders.
6. Vogel's text book of Practical Organic Chemistry
7. Advanced Practical organic chemistry by N.K.Vishnoi.
8. Introduction to Organic Laboratory techniques by Pavia, Lampman and Kriz.

SEMESTER/YEAR : III SEM

COURSE CODE : 17BP307

TITLE OF THE COURSE : PHARMACEUTICAL MICROBIOLOGY - PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

COURSE OBJECTIVES:

Upon successful completion of this course the students will be able to

1. Acquire basic skills in the identification and isolation of micro-organisms.
2. Provide the students with the appropriate knowledge and skills for microbiological standardization, sterilization of Pharmaceuticals and its applications in pharmaceutical industries.

COUSE OUTCOME

CO1- To understand different equipment's and processing of equipment's used in experimental microbiology.

CO2- To learn different staining techniques for identification of micro-organism.

CO3 -To Learn isolation of and identification of micro-organisms.

CO4 -To carry out microbiological standardization of Pharmaceuticals.

CO5 - To understand the importance of sterilization and learn sterility testing of pharmaceutical products.

1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.

2. Sterilization of glassware, preparation and sterilization of media.

3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.

4. Staining methods- Simple, Grams staining and acid-fast staining (Demonstration with practical).

5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.

6. Microbiological assay of antibiotics by cup plate method and other methods

7. Motility determination by Hanging drop method.

8. Sterility testing of pharmaceuticals.

9. Bacteriological analysis of water

10. Biochemical test.

RECOMMENDED BOOKS (LATEST EDITION):

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Pepler: Microbial Technology.
9. I.P., B.P., U.S.P.- latest editions.
10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
11. Edward: Fundamentals of Microbiology.
12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

SEMESTER/YEAR : III SEM

COURSE CODE : 17BP307

TITLE OF THE COURSE : PHARMACEUTICAL MICROBIOLOGY - PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

COURSE OBJECTIVES:

Upon successful completion of this course the students will be able to

1. Acquire basic skills in the identification and isolation of micro-organisms.
2. Provide the students with the appropriate knowledge and skills for microbiological standardization, sterilization of Pharmaceuticals and its applications in pharmaceutical industries.

COUSE OUTCOME

CO1- To understand different equipment's and processing of equipment's used in experimental microbiology.

CO2- To learn different staining techniques for identification of micro-organism.

CO3 -To Learn isolation of and identification of micro-organisms.

CO4 -To carry out microbiological standardization of Pharmaceuticals.

CO5 - To understand the importance of sterilization and learn sterility testing of pharmaceutical products.

1. Introduction and study of different equipments and processing, e.g., B.O.D. incubator, laminar flow, aseptic hood, autoclave, hot air sterilizer, deep freezer, refrigerator, microscopes used in experimental microbiology.

2. Sterilization of glassware, preparation and sterilization of media.

3. Sub culturing of bacteria and fungus. Nutrient stabs and slants preparations.

4. Staining methods- Simple, Grams staining and acid-fast staining (Demonstration with practical).

5. Isolation of pure culture of micro-organisms by multiple streak plate technique and other techniques.

6. Microbiological assay of antibiotics by cup plate method and other methods

7. Motility determination by Hanging drop method.

8. Sterility testing of pharmaceuticals.

9. Bacteriological analysis of water

10. Biochemical test.

RECOMMENDED BOOKS (LATEST EDITION):

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Pepler: Microbial Technology.
9. I.P., B.P., U.S.P.- latest editions.
10. Ananthnarayan : Text Book of Microbiology, Orient-Longman, Chennai
11. Edward: Fundamentals of Microbiology.
12. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
13. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company

SEMESTER/YEAR : IV SEM
COURSE CODE : 17BP401
TITLE OF THE COURSE : PHARMACEUTICAL ORGANIC CHEMISTRY III - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This subject imparts knowledge on stereo-chemical aspects of organic compounds and organic reactions, important named reactions, chemistry of important hetero cyclic compounds. It also emphasizes on medicinal and other uses of organic compounds.

COURSE OBJECTIVES: At the end of the course, the student shall be able to

1. understand the methods of preparation and properties of organic compounds
2. explain the stereo chemical aspects of organic compounds and stereo chemical reactions
3. know the medicinal uses and other applications of organic compounds

Note: To emphasize on definition, types, mechanisms, examples, uses/applications

UNIT-I **10 Hours**

Stereo isomerism

Optical isomerism –

Optical activity, **enantiomerism**, **diastereoisomerism**, **meso** compounds

Elements of symmetry, chiral and achiral molecules

DL system of nomenclature of optical isomers, sequence rules, RS system of nomenclature of optical isomers

Reactions of chiral molecules

Racemic modification and resolution of racemic mixture.

Asymmetric synthesis: partial and absolute

UNIT-II **10 Hours**

Geometrical isomerism

Nomenclature of **geometrical isomers** (Cis Trans, EZ, Syn Anti systems)

Methods of determination of configuration of geometrical isomers.

Conformational isomerism in Ethane, n-Butane and Cyclohexane.

Stereo isomerism in biphenyl compounds (Atropisomerism) and conditions for optical activity.

Stereospecific and stereoselective reactions

UNIT-III **10 Hours**

Heterocyclic compounds:

Nomenclature and classification

Synthesis, reactions and medicinal uses of following compounds/derivatives

Pyrrole, Furan, and Thiophene

Relative aromaticity and reactivity of Pyrrole, Furan and Thiophene

UNIT-IV

8 Hours

Synthesis, reactions and medicinal uses of following compounds/derivatives
Pyrazole, Imidazole, Oxazole and Thiazole.

Pyridine, Quinoline, Isoquinoline, Acridine and Indole. Basicity of pyridine

Synthesis and medicinal uses of Pyrimidine, Purine, azepines and their derivatives

UNIT-V

07 Hours

Reactions of synthetic importance

Metal hydride reduction (NaBH_4 and LiAlH_4), Clemmensen reduction, Birch reduction, Wolff Kishner reduction.

Oppenauer-oxidation and Dakin reaction.

Beckmanns rearrangement and Schmidt rearrangement.

Claisen-Schmidt condensation

RECOMMENDED BOOKS (LATEST EDITIONS):

1. Organic chemistry by I.L. Finar, Volume-I & II.
2. A text book of organic chemistry – Arun Bahl, B.S. Bahl.
3. Heterocyclic Chemistry by Raj K. Bansal
4. Organic Chemistry by Morrison and Boyd
5. Heterocyclic Chemistry by T.L. Gilchrist

SEMESTER/YEAR : IV SEM

COURSE CODE : 17BP402

TITLE OF THE COURSE : MEDICINAL CHEMISTRY – I - THEORY

COURSE OBJECTIVES:

Upon completion of the course the student shall be able to

1. Understand the chemistry of drugs with respect to their pharmacological activity
2. Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. Know the Structural Activity Relationship (SAR) of different class of drugs
4. Write the chemical synthesis of some drugs

Course out come

Understand history and basic principles of Medicinal Chemistry.

Learn classification, mechanism of action, structure activity relationship and uses of drugs acting on Autonomic nervous system.

Study of classification, mechanism of action, Structure activity relationship and uses of drugs acting on Central Nervous System

Study of centrally and peripherally acting analgesic drugs.

UNIT- I 10 Hours

Introduction to Medicinal Chemistry

History and development of medicinal chemistry

Physicochemical properties in relation to biological action

Ionization, Solubility, Partition Coefficient, Hydrogen bonding, Protein binding, Chelation, Bioisosterism, Optical and Geometrical isomerism.

Drug metabolism

Drug metabolism principles- Phase I and Phase II.

Factors affecting drug metabolism including stereo chemical aspects.

UNIT- II 10 Hours

Drugs acting on Autonomic Nervous System

Adrenergic Neurotransmitters:

Biosynthesis and catabolism of catecholamine.

Adrenergic receptors (Alpha & Beta) and their distribution.

Sympathomimetic agents: SAR of Sympathomimetic agents

Direct acting: Nor-epinephrine, Epinephrine, Phenylephrine*, Dopamine, Methyl dopa, Clonidine, Dobutamine, Isoproterenol, Terbutaline,

Salbutamol*, Bitolterol, Naphazoline, Oxymetazoline and Xylometazoline.

Indirect acting agents: Hydroxyamphetamine, Pseudoephedrine, Propylhexedrine.

Agents with mixed mechanism: Ephedrine, Metaraminol.

Adrenergic Antagonists:

Alpha adrenergic blockers: Tolazoline*, Phentolamine,

Phenoxybenzamine, Prazosin, Dihydroergotamine, Methysergide.

Beta adrenergic blockers: SAR of beta blockers, Propranolol*,

Metibranolol, Atenolol, Betazolol, Bisoprolol, Esmolol, Metoprolol, Labetolol, Carvedilol.

UNIT-III 10 Hours

Cholinergic neurotransmitters:

Biosynthesis and catabolism of acetylcholine.

Cholinergic receptors (Muscarinic & Nicotinic) and their distribution.

Parasympathomimetic agents: SAR of Parasympathomimetic agents

Direct acting agents: Acetylcholine, Carbachol*, Bethanechol, Methacholine, Pilocarpine.

Indirect acting/ Cholinesterase inhibitors (Reversible & Irreversible):

Physostigmine, Neostigmine*, Pyridostigmine, Edrophonium chloride, Tacrine hydrochloride, Ambenonium chloride, Isoflurophate, Echothiophate iodide, Parathione, Malathion.

Cholinesterase reactivator: Pralidoxime chloride.

Cholinergic Blocking agents: SAR of cholinolytic agents

Solanaceous alkaloids and analogues: Atropine sulphate, Hyoscyamine, sulphate, Scopolamine hydrobromide, Homatropine hydrobromide, Ipratropium bromide*.

Synthetic cholinergic blocking agents: Tropicamide, Cyclopentolate hydrochloride, Clidinium bromide, Dicyclomine hydrochloride*, Glycopyrrolate, Methantheline bromide, Propantheline bromide, Benztropine mesylate, Orphenadrine citrate, Biperidine hydrochloride, Procyclidine hydrochloride*, Tridihexethyl chloride, Isopropamide iodide, Ethopropazine hydrochloride.

UNIT- IV 08 Hours

Drugs acting on Central Nervous System

A. Sedatives and Hypnotics:

Benzodiazepines: SAR of Benzodiazepines, Chlordiazepoxide, Diazepam*, Oxazepam, Chlorazepate, Lorazepam, Alprazolam, Zolpidem

Barbiturtes: SAR of barbiturates, Barbitol*, Phenobarbital, Mephobarbital, Amobarbital, Butobarbital, Pentobarbital, Secobarbital

Miscellaneous:

Amides & imides: Glutethimide.

Alcohol & their carbamate derivatives: Meproboamate, Ethchlorvynol.

Aldehyde & their derivatives: Triclofos sodium, Paraldehyde.

B. Antipsychotics

Phenothiazines: SAR of Phenothiazines - Promazine hydrochloride, Chlorpromazine hydrochloride*, Triflupromazine, Thioridazine hydrochloride, Piperacetazine hydrochloride, Prochlorperazine maleate, Trifluoperazine hydrochloride.

Ring Analogues of Phenothiazines: Chlorprothixene, Thiothixene, Loxapine succinate, Clozapine.

Fluro buterophenones: Haloperidol, Droperidol, Risperidone.

Beta amino ketones: Molindone hydrochloride.

Benzamides: Sulpieride.

C. Anticonvulsants: SAR of Anticonvulsants, mechanism of anticonvulsant action

Barbiturates: Phenobarbitone, Methabarbitol. **Hydantoins:**

Phenytoin*, Mephenytoin, Ethotoin **Oxazolidine diones:**

Trimethadione, Paramethadione **Succinimides:**

Phensuximide, Methsuximide, Ethosuximide*

Urea and monoacylureas: Phenacemide, Carbamazepine*

Benzodiazepines: Clonazepam

Miscellaneous: Primidone, Valproic acid, Gabapentin, Felbamate

UNIT – V 07 Hours

Drugs acting on Central Nervous System

General Anesthetics:

Inhalation anesthetics: Halothane*, Methoxyflurane, Enflurane, Sevoflurane, Isoflurane, Desflurane.

Ultra short acting barbiturates: Methohexital sodium*, Thiethylal sodium, Thiopental sodium.

Dissociative anesthetics: Ketamine hydrochloride.*

Narcotic and non-narcotic analgesics

Morphine and related drugs: SAR of Morphine analogues, Morphine sulphate, Codeine, Meperidine hydrochloride, Anileridine hydrochloride, Diphenoxylate hydrochloride, Loperamide hydrochloride, Fentanyl citrate*, Methadone hydrochloride*, Propoxyphene hydrochloride, Pentazocine, Levorphanol tartarate.

Narcotic antagonists: Nalorphine hydrochloride, Levallorphan tartarate, Naloxone hydrochloride.

Anti-inflammatory agents: Sodium salicylate, Aspirin, Mefenamic acid*, Meclofenamate, Indomethacin, Sulindac, Tolmetin, Zomepirac, Diclofenac, Ketorolac, Ibuprofen*, Naproxen, Piroxicam, Phenacetin, Acetaminophen, Antipyrine, Phenylbutazon

SEMESTER/YEAR: IV SEM

COURSE CODE: 17BP403

TITLE OF THE COURSE: PHYSICAL PHARMACEUTICS-II - THEORY

L: T/A: P: C: 3: 1: 0: 4

COURSE OBJECTIVES:

Upon the completion of the course student shall be able to -

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms

Course outcome:

Upon completion of the subject student will be able to have relevant knowledge regarding the following topics -

1. Classification and detailed characterization of colloidal dispersions with their applications.
2. Applications of rheology in flow of liquids and deformation of solids.
3. Exemplify various theories of emulsions and suspensions with their classification and applications
4. Enumerate the fundamental and derived properties of powders and the methods to determine them.
5. Outline the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.

UNIT-I

Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action.

UNIT-II

Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers

Deformation of solids: Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus

UNIT-III

Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.

UNIT-IV

Micromeritics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

UNIT-V

Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention.

SEMESTER/YEAR: IV SEM

COURSE CODE: 17BP403

TITLE OF THE COURSE: PHYSICAL PHARMACEUTICS-II - THEORY

L: T/A: P: C: 3: 1: 0: 4

COURSE OBJECTIVES:

Upon the completion of the course student shall be able to -

1. Understand various physicochemical properties of drug molecules in the designing the dosage forms
2. Know the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations
3. Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms

Course outcome:

Upon completion of the subject student will be able to have relevant knowledge regarding the following topics -

1. Classification and detailed characterization of colloidal dispersions with their applications.
2. Applications of rheology in flow of liquids and deformation of solids.
3. Exemplify various theories of emulsions and suspensions with their classification and applications
4. Enumerate the fundamental and derived properties of powders and the methods to determine them.
5. Outline the principles of chemical kinetics & to use them for stability testing and determination of expiry date of formulations.

UNIT-I

Colloidal dispersions: Classification of dispersed systems & their general characteristics, size & shapes of colloidal particles, classification of colloids & comparative account of their general properties. Optical, kinetic & electrical properties. Effect of electrolytes, coacervation, peptization & protective action.

UNIT-II

Rheology: Newtonian systems, law of flow, kinematic viscosity, effect of temperature, non-Newtonian systems, pseudoplastic, dilatant, plastic, thixotropy, thixotropy in formulation, determination of viscosity, capillary, falling Sphere, rotational viscometers

Deformation of solids: Plastic and elastic deformation, Heckel equation, Stress, Strain, Elastic Modulus

UNIT-III

Coarse dispersion: Suspension, interfacial properties of suspended particles, settling in suspensions, formulation of flocculated and deflocculated suspensions. Emulsions and theories of emulsification, microemulsion and multiple emulsions; Stability of emulsions, preservation of emulsions, rheological properties of emulsions and emulsion formulation by HLB method.

UNIT-IV

Micromeritics: Particle size and distribution, mean particle size, number and weight distribution, particle number, methods for determining particle size by different methods, counting and separation method, particle shape, specific surface, methods for determining surface area, permeability, adsorption, derived properties of powders, porosity, packing arrangement, densities, bulkiness & flow properties.

UNIT-V

Drug stability: Reaction kinetics: zero, pseudo-zero, first & second order, units of basic rate constants, determination of reaction order. Physical and chemical factors influencing the chemical degradation of pharmaceutical product: temperature, solvent, ionic strength, dielectric constant, specific & general acid base catalysis, Simple numerical problems. Stabilization of medicinal agents against common reactions like hydrolysis & oxidation. Accelerated stability testing in expiration dating of pharmaceutical dosage forms. Photolytic degradation and its prevention.

SEMESTER/YEAR : IV SEM
COURSE CODE : 17BP404
TITLE OF THE COURSE : PHARMACOLOGY-I - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4 **45 Hours**

COURSE OBJECTIVES:

The main purpose of the subject is to understand what drugs do to the living organisms and how their effects can be applied to therapeutics. The subject covers the information about the drugs like, mechanism of action, physiological and biochemical effects (pharmacodynamics) as well as absorption, distribution, metabolism and excretion (pharmacokinetics) along with the adverse effects, clinical uses, interactions, doses, contraindications and routes of administration of different classes of drugs.

COURSE OUTCOMES: Upon completion of this course the student should be able to

1. Understand the pharmacological actions of different categories of drugs
2. Explain the mechanism of drug action at organ system/sub cellular/ macromolecular levels.
3. Apply the basic pharmacological knowledge in the prevention and treatment of various diseases.
4. Observe the effect of drugs on animals by simulated experiments
5. Appreciate correlation of pharmacology with other bio medical sciences.

UNIT-I

08 hours

1. General Pharmacology

- a. Introduction to Pharmacology- Definition, historical landmarks and scope of pharmacology, nature and source of drugs, essential drugs concept and routes of drug administration, Agonists, antagonists(competitive and non competitive), spare receptors, addiction, tolerance, dependence, tachyphylaxis, idiosyncrasy, allergy.
- b. Pharmacokinetics- Membrane transport, absorption, distribution, metabolism and excretion of drugs .Enzyme induction, enzyme inhibition, kinetics of elimination

UNIT-II

12 Hours

General Pharmacology

- a. Pharmacodynamics- Principles and mechanisms of drug action. Receptor theories and classification of receptors, regulation of receptors. drug receptors interactions signal transduction mechanisms, G-protein-coupled receptors, ion channel receptor, transmembrane enzyme linked receptors, transmembrane JAK-STAT binding receptor and receptors that regulate transcription factors, dose response relationship, therapeutic index, combined effects of drugs and factors modifying drug action.
- b. Adverse drug reactions.
- c. Drug interactions (pharmacokinetic and pharmacodynamic)
- d. Drug discovery and clinical evaluation of new drugs -Drug discovery phase, preclinical evaluation phase, clinical trial phase, phases of clinical trials and pharmacovigilance.

UNIT-III

10 Hours

2. Pharmacology of drugs acting on peripheral nervous system

- Organization and function of ANS.
- Neurohumoral transmission, co-transmission and classification of neurotransmitters.
- Parasympathomimetics, Parasympatholytics, Sympathomimetics, sympatholytics.
- Neuromuscular blocking agents and skeletal muscle relaxants (peripheral).
- Local anesthetic agents.
- Drugs used in myasthenia gravis and glaucoma

UNIT-IV

08 Hours

3. Pharmacology of drugs acting on central nervous system

- Neurohumoral transmission in the C.N.S. special emphasis on importance of various neurotransmitters like with GABA, Glutamate, Glycine, serotonin, dopamine.
- General anesthetics and pre-anesthetics.
- Sedatives, hypnotics and centrally acting muscle relaxants.
- Anti-epileptics
- Alcohols and disulfiram

UNIT-V

07 Hours

3. Pharmacology of drugs acting on central nervous system

- Psychopharmacological agents: Antipsychotics, antidepressants, anti-anxiety agents, anti-manics and hallucinogens.
- Drugs used in Parkinsons disease and Alzheimer's disease.
- CNS stimulants and nootropics.
- Opioid analgesics and antagonists
- Drug addiction, drug abuse, tolerance and dependence.

RECOMMENDED BOOKS (LATEST EDITIONS):

- Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
- Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
- Goodman and Gilman's, The Pharmacological Basis of Therapeutics
- Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.
- Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated Reviews Pharmacology.
- K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
- Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
- Modern Pharmacology with clinical Applications, by Charles R.Craig & Robert.
- Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan

SEMESTER/YEAR : IV SEM

COURSE CODE : 17BP405

TITLE OF THE COURSE : PHARMACOGNOSY AND PHYTOCHEMISTRY I - THEORY

L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

The subject involves the fundamentals of Pharmacognosy like scope, classification of crude drugs, their identification and evaluation, phytochemicals present in them and their medicinal properties.

COURSE OBJECTIVES: Upon completion of the course, the student shall be able

1. to know the techniques in the cultivation and production of crude drugs
2. to know the crude drugs, their uses and chemical nature
3. know the evaluation techniques for the herbal drugs
4. to carry out the microscopic and morphological evaluation of crude drugs

COURSE OUTCOMES:

1. Summarizes introduction of Pharmacognosy. Explain Sources, classification and quality control of crude drugs.
2. Describe cultivation, collection, processing and storage of drugs of natural origin.
3. Explain plant tissue culture with its application in pharmacognosy.
4. Describe various system of medicine and classification of secondary metabolites with examples.
5. Summarizes different plant products, marine drugs and information on primary metabolites.

UNIT-I 10 Hours

Introduction to Pharmacognosy:

- (a) Definition, history, scope and development of Pharmacognosy
- (b) Sources of Drugs – Plants, Animals, Marine & Tissue culture
- (c) Organized drugs, unorganized drugs (dried latex, dried juices, dried extracts, gums and mucilages, oleoresins and oleo- gum -resins).

Classification of drugs:

Alphabetical, morphological, taxonomical, chemical, pharmacological, chemo and sero taxonomical classification of drugs

Quality control of Drugs of Natural Origin:

Adulteration of drugs of natural origin. Evaluation by organoleptic, microscopic, physical, chemical and biological methods and properties.

Quantitative microscopy of crude drugs including lycopodium spore method, leaf constants, camera lucida and diagrams of microscopic objects to scale with camera lucida.

UNIT-II 10 Hours

Cultivation, Collection, Processing and storage of drugs of natural origin:

Cultivation and Collection of drugs of natural origin

Factors influencing cultivation of medicinal plants.

Plant hormones and their applications.

Polyploidy, mutation and hybridization with reference to medicinal plants

Conservation of medicinal plants

UNIT-III 07 Hours

Plant tissue culture:

Historical development of plant tissue culture, types of cultures, Nutritional requirements, growth and their maintenance.

Applications of plant tissue culture in pharmacognosy.

Edible vaccines

UNIT IV 10 Hours

Pharmacognosy in various systems of medicine:

Role of Pharmacognosy in allopathy and traditional systems of medicine namely, Ayurveda, Unani, Siddha, Homeopathy and Chinese systems of medicine.

Introduction to secondary metabolites:

Definition, classification, properties and test for identification of Alkaloids, Glycosides, Flavonoids, Tannins, Volatile oil and Resins

UNIT V 08 Hours

Study of biological source, chemical nature and uses of drugs of natural origin containing following drugs

Plant Products:

Fibers - Cotton, Jute, Hemp

Hallucinogens, Teratogens, Natural allergens

Primary metabolites:

General introduction, detailed study with respect to chemistry, sources, preparation, evaluation, preservation, storage, therapeutic used and commercial utility as

Pharmaceutical Aids and/or Medicines for the following Primarymetabolites:

Carbohydrates: Acacia, Agar, Tragacanth, Honey

Proteins and Enzymes : Gelatin, casein, proteolytic enzymes (Papain, bromelain, serratiopeptidase, urokinase, streptokinase, pepsin).

Lipids(Waxes, fats, fixed oils) : Castor oil, Chaulmoogra oil, Wool Fat, Bees Wax

Marine Drugs:

Novel medicinal agents from marine sources

SEMESTER/YEAR : IV SEM

COURSE CODE : 17BP408

TITLE OF THE COURSE : PHARMACOLOGY-I - PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

Course objectives:

-) This course will offer practical exposure to the virtual platform by utilizing suitable software to attain the desired results or experiments mentioned in the list of experiments.
-) To understand the mechanism of action of different drugs on different therapeutic areas using simulated experiments.

Course outcomes:

-) Students will be able to understand the usage of instruments used in laboratory, common laboratory animals used in experimental pharmacology and to maintain animal house as per the CPCSEA guidelines.
-) Students will learn the common laboratory techniques like routes of administration, blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
-) Students will be able to demonstrate and understand the effects of different drugs on different therapeutic areas using simulated experiments.

List of Experiments:

1. Introduction to experimental pharmacology.
2. Commonly used instruments in experimental pharmacology.
3. Study of common laboratory animals.
4. Maintenance of laboratory animals as per CPCSEA guidelines.
5. Common laboratory techniques. Blood withdrawal, serum and plasma separation, anesthetics and euthanasia used for animal studies.
6. Study of different routes of drugs administration in mice/rats.
7. Study of effect of hepatic microsomal enzyme inducers on the phenobarbitone sleeping time in mice.
8. Effect of drugs on ciliary motility of frog oesophagus
9. Effect of drugs on rabbit eye.
10. Effects of skeletal muscle relaxants using rota-rod apparatus.
11. Effect of drugs on locomotor activity using actophotometer.
12. Anticonvulsant effect of drugs by MES and PTZ method.
13. Study of stereotype and anti-catatonic activity of drugs on rats/mice.
14. Study of anxiolytic activity of drugs using rats/mice.
15. Study of local anesthetics by different methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos.

SEMESTER/YEAR: IV SEM

COURSE CODE: 17BP409

**TITLE OF THE COURSE: PHARMACOGNOSY AND PHYTOCHEMISTRY I-
PRACTICAL**

L: T/A: P: C: 0: 0: 4: 2

COURSE OBJECTIVES:

1. To acquire basic skills in the microscopic and morphological evaluation of crude drugs.
2. Provide the students with the appropriate knowledge and skills for physical, chemical and quantitative methods of evaluation.

COUSE OUTCOME

CO1- To perform different laboratory procedures for morphological and microscopical evaluation of crude drugs.

CO2- To understand the cellular structure for the study of crude drugs.

CO3 -To evaluate the crude drugs by quantitative evaluation methods and its social relevance.

CO4 -To carry out e the crude drugs by physical methods of evaluation.

CO5 -To evaluate the crude drugs by chemical methods of evaluation.

1. Analysis of crude drugs by chemical tests: (i)Tragacanth (ii) Acacia (iii)Agar (iv)

Gelatin (v) starch (vi) Honey (vii) Castor oil

2. Determination of stomatal number and index

3. Determination of vein islet number, vein islet termination and palisade ratio.

4. Determination of size of starch grains, calcium oxalate crystals by eye piece micrometer

5. Determination of Fiber length and width

6. Determination of number of starch grains by Lycopodium spore method

7. Determination of Ash value

8. Determination of Extractive values of crude drugs

9. Determination of moisture content of crude drugs

10. Determination of swelling index and foaming

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Tyler, V.E., Brady, L.R. and Robbers, J.E., Pharmacognosy, 9th Edn., Lea and Febiger, Philadelphia, 1988.
3. Text Book of Pharmacognosy by T.E. Wallis
4. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
5. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
6. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
7. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
8. Practical Pharmacognosy: C.K. Kokate, Purohit, Gokhlae
9. Anatomy of Crude Drugs byM.A. Iyengar

SEMESTER/YEAR : V SEM
COURSE CODE : 17BP501
TITLE OF THE COURSE : MEDICINAL CHEMISTRY – II - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasizes on structure activity relationships of drugs, importance of physicochemical properties and metabolism of drugs. The syllabus also emphasizes on chemical synthesis of important drugs under each class.

COURSE OBJECTIVES: Upon completion of the course the student shall be able to

1. Understand the chemistry of drugs with respect to their pharmacological activity
2. Understand the drug metabolic pathways, adverse effect and therapeutic value of drugs
3. Know the Structural Activity Relationship of different class of drugs
4. Study the chemical synthesis of selected drugs

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted (*)

UNIT- I

10 Hours

Antihistaminic agents: Histamine, receptors and their distribution in the humanbody

H1-antagonists: Diphenhydramine hydrochloride*, Dimenhydrinate, Doxylamines succinate, Clemastine fumarate, Diphenylpyraline hydrochloride, Tripelenamine hydrochloride, Chlorcyclizine hydrochloride, Meclizine hydrochloride, Buclizine hydrochloride, Chlorpheniramine maleate, Triprolidine hydrochloride*, Phenidamine tartarate, Promethazine hydrochloride*, Trimeprazine tartrate, Cyproheptadine hydrochloride, Azatidine maleate, Astemizole, Loratadine, Cetirizine, Levocetazine Cromolyn sodium

H2-antagonists: Cimetidine*, Famotidine, Ranitidin.

Gastric Proton pump inhibitors: Omeprazole, Lansoprazole, Rabeprazole, Pantoprazole

Anti-neoplastic agents:

Alkylating agents: Meclorethamine*, Cyclophosphamide, Melphalan, Chlorambucil, Busulfan, Thiotepa

Antimetabolites: Mercaptopurine*, Thioguanine, Fluorouracil, Floxuridine, Cytarabine, Methotrexate*, Azathioprine

Antibiotics: Dactinomycin, Daunorubicin, Doxorubicin, Bleomycin

Plant products: Etoposide, Vinblastin sulphate, Vincristin sulphate

Miscellaneous: Cisplatin, Mitotane.

UNIT - II

10 Hours

Anti-anginal:

Vasodilators: Amyl nitrite, Nitroglycerin*, Pentaerythritol tetranitrate, Isosorbide dinitrite*, Dipyridamole.

Calcium channel blockers: Verapamil, Bepridil hydrochloride, Diltiazem hydrochloride, Nifedipine, Amlodipine, Felodipine, Nicardipine, Nimodipine.

Diuretics:

Carbonic anhydrase inhibitors: Acetazolamide*, Methazolamide, Dichlorphenamide.

Thiazides: Chlorthiazide*, Hydrochlorothiazide, Hydroflumethiazide, Cyclothiazide,

Loop diuretics: Furosemide*, Bumetanide, Ethacrynic acid.

Potassium sparing Diuretics: Spironolactone, Triamterene, Amiloride.

Osmotic Diuretics: Mannitol

Anti-hypertensive Agents: Timolol, Captopril, Lisinopril, Enalapril, Benazepril hydrochloride, Quinapril hydrochloride, Methyldopate hydrochloride*, Clonidine hydrochloride, Guanethidine monosulphate, Guanabenz acetate, Sodium nitroprusside, Diazoxide, Minoxidil, Reserpine, Hydralazine hydrochloride.

UNIT- III

10 Hours

Anti-arrhythmic Drugs: Quinidine sulphate, Procainamide hydrochloride, Disopyramide phosphate*, Phenytoin sodium, Lidocaine hydrochloride, Tocainide hydrochloride, Mexiletine hydrochloride, Lorcaïnide hydrochloride, Amiodarone, Sotalol.

Anti-hyperlipidemic agents: Clofibrate, Lovastatin, Cholesteramine and Cholestipol

Coagulant & Anticoagulants: Menadione, Acetomenadione, Warfarin*, Anisindione, clopidogrel

Drugs used in Congestive Heart Failure: Digoxin, Digitoxin, Nesiritide, Bosentan, Tezosentan.

UNIT- IV

08 Hours

Drugs acting on Endocrine system

Nomenclature, Stereochemistry and metabolism of steroids

Sex hormones: Testosterone, Nandralone, Progestrones, Oestriol, Oestradiol, Oestrione, Diethyl stilbestrol.

Drugs for erectile dysfunction: Sildenafil, Tadalafil.

Oral contraceptives: Mifepristone, Norgestrel, Levonorgestrol

Corticosteroids: Cortisone, Hydrocortisone, Prednisolone, Betamethasone, Dexamethasone

Thyroid and antithyroid drugs: L-Thyroxine, L-Thyronine, Propylthiouracil, Methimazole.

UNIT - V

07 Hours

Antidiabetic agents:

Insulin and its preparations

Sulfonyl ureas: Tolbutamide*, Chlorpropamide, Glipizide, Glimperide.

Biguanides: Metformin. Thiazolidinediones: Pioglitazone, Rosiglitazone.
Meglitinides: Repaglinide, Nateglinide.
Glucosidase inhibitors: Acarbose, Voglibose.

Local Anesthetics: SAR of Local anesthetics

Benzoic Acid derivatives; Cocaine, Hexylcaine, Meprylcaine, Cyclomethycaine, Piperocaine.

Amino Benzoic acid derivatives: Benzocaine*, Butamben, Procaine*, Butacaine, Propoxycaine, Tetracaine, Benoxinate.

Lidocaine/Anilide derivatives: Lignocaine, Mepivacaine, Prilocaine, Etidocaine.

Miscellaneous: Phenacaine, Dipiperodon, Dibucaine.*

RECOMMENDED BOOKS (LATEST EDITIONS):

1. Wilson and Giswold's Organic medicinal and Pharmaceutical Chemistry.
2. Foye's Principles of Medicinal Chemistry.
3. Burger's Medicinal Chemistry, Vol I to IV.
4. Introduction to principles of drug design- Smith and Williams.
5. Remington's Pharmaceutical Sciences.
6. Martindale's extra pharmacopoeia.
7. Organic Chemistry by I.L. Finar, Vol. II.
8. The Organic Chemistry of Drug Synthesis by Lednicer, Vol. 1 to 5.
9. Indian Pharmacopoeia.
10. Text book of practical organic chemistry- A.I.Vogel.

COMPUTER SCIENCE (THEORY)- 15PD293

Course objective:

Students can think critically, reason analytically and solve problems creatively. Effectively communicate statistical ideas and arguments.

Course outcome:

1. Apply algorithmic, mathematical and scientific reasoning to a variety of computational problems.
2. Design, correctly implement and document solutions to significant computational problems.
3. Helping computer scientists make informed decisions about their data and improve the efficiency and accuracy of their algorithms.

PART A: STATISTICS

1. Definition, data frequency, distribution, classification of data, General graphical representation of the data: histogram, frequency curve and frequency polygon and Ogive. Semilog line graph. Use of semilog scale examples.
2. Measures of central tendency: Arithmetic mean, geometric mean and harmonic mean. Median, mean, mode, calculation of quartiles and percentiles and centiles.
3. Measures of dispersion: Range, quartile deviation, mean deviation, standard deviation, variance, coefficient of variation, skewness and curtosis.
4. Correlation and regression: Linear correlation, coefficient of correlation: Karl Pearson's formula, Spearman's rank method, curve fitting by the method of least squares, Fitting a straight line $y=a+bx$, Fitting a power curve $y=ax^b$, fitting an exponential curve $y=abx$, $y=aebx$, regression analysis for lines.
5. Definition of probability: Random experiment, sample space, Addition and multiplication laws of probability (without proof), probability distribution: binomial, poisson's normal and chi-square, student test and pharmaceutical examples.

PART B: COMPUTER SCIENCE (25 hours)

1. a) Computer Fundamentals

6 hours; & marks

Introduction, Classification of Computers (Based on all Criteria), Functional Units, Evaluation of Computer Languages, Assembler, Compiler, Interpreter.

b) Number Systems

4 hours; 4 marks

Introduction to Number Systems - Numeric and Non-Numeric Representation of Data, Decimal, Binary (Addition, Subtraction, Multiplication, Division) and Hexadecimal Number Systems

2. a) Introduction to Networks

3 hours; 3 marks

i) Network Topologies - Linear, Ring, Star, Mesh, Hybrid, Types of Network - Lan, Man, Wan

ii) Internet and Intranet, Protocols (TCP, IP, SMTP, FTP, HTTP etc.),

iii) Web pages, Browsers, Search Engines

b) Introduction to DBMS

5 hours; 6 marks

Data and Information, Database Users, Characteristics of the Database Approach, Advantages of using DBMS, Data Models, Schemas and Instances, Database Languages(DML, DDL)

3. a) Introduction to OS

2 hours; 2 marks

Definition and Types of Operating Systems (Unix, Windows, Mac OS)

b) Introduction to Office Packages

6 hours; 7 marks

Microsoft Word, Microsoft Excel, Microsoft PowerPoint

COMPUTER SCIENCE REFERENCE BOOKS

1. Thomas CBW Digital Computer fundamentals. Tata Mc Graw Hill Publishing
2. Sinha. Fundamentals of Computers.
3. Ramez E, Shamkanth BN. Fundamentals of Data Base system
4. IVAN Bayross, SQL, PL/SQL The programming Language of Oracle.

SEMESTER / YEAR : III YEAR

COURSE CODE : 15PD301

TITLE OF THE COURSE : PHARMACOLOGY II (Theory)

L:T:P :3:1:3 Course Objectives

This subject will provide an opportunity for the student to learn about the drug with regard to classification, pharmacodynamic and pharmacokinetic aspects, adverse effects, uses, dose, route of administration, precautions, contraindications and interaction with other drugs. In this subject, drugs acting on autacoids, respiratory system, GIT, immune system and hormones, and pharmacology of autacoids and hormones will be concentrated. In addition, pharmacology of chemotherapeutic agents, vitamins, essential minerals and principles of toxicology are also taught. In addition to theoretical knowledge, the basic practical knowledge relevant to therapeutics will be imparted.

Course Outcomes

- a. understand the pharmacological aspects of drugs falling under the above mentioned chapters,
- b. carry out the animal experiments confidently,
- c. appreciate the importance of pharmacology subject as a basis of therapeutics, and
- d. correlate and apply the knowledge therapeutically.

Unit - 1

Chemotherapy

- a. Introduction
- b. Sulphonamides and Co-trimoxazole
- c. Penicillins and Cephalosporins
- d. Tetracyclines and Chloramphenicol
- e. Macrolides, Aminoglycosides, Glyenones and Polypeptides antibiotics
- f. Quinolones and Fluroquinolones
- g. Antifungal antibiotics
- h. Antiviral agents
- i. Chemotherapy of Malaria
- j. Chemotherapy of Protozoal infections (Amoebiasis, Giardiasis)
- k. Pharmacology of Anthelmintic drugs
- l. Chemotherapy of Cancer

UNIT - 2

Pharmacology of drugs acting on Blood and Blood forming agents

- a. Anticoagulants
- b. Thrombolytics and antiplatelet agents

c. Haemopoietics and plasma expanders

Pharmacology of drugs acting on Renal system

a. Diuretics

b. Antidiuretics

Immunopharmacology

Pharmacology of Immunosuppressants and stimulants

UNIT -3

Principles of Animal toxicology: Acute, Subacute and Chronic toxicity.

The dynamic cell: The structure and functions of the components of the cell

a. **Cell and macromolecules:** Cellular classification, subcellular organelles, macromolecules, large macromolecular assemblies

b. **Chromosome structure:** Pro and eukaryotic chromosome structures, chromatin structure, genome complexity, the flow of genetic information.

c. **DNA replication:** General, bacterial and eukaryotic DNA replication.

d. **The cell cycle:** Restriction point, cell cycle regulators and modifiers.

e. **Cell signaling:** Communication between cells and their environment, ion channels, signal transduction pathways (MAP kinase, P38 kinase, JNK, Ras and P13-kinase pathways, **Single transducer and activation of Transcription (STAT) signaling pathway**, biosensors.

Unit - 4

The Gene: Genome structure and function:

a. Gene structure: Organization and elucidation of genetic code.

b. The Gene expression: Expression systems (pro and eukaryotic), genetic elements that control gene expression (nucleosomes, histone, acetylation, HDACS, DNA binding protein families).

c. **Transcription and Transcription factors:** Basic principles of transcription in pro and eukaryotes.

Unit - 5

RNA processing: rRNA, tRNA and mRNA processing.

Protein synthesis: Mechanism of protein synthesis, initiation in eukaryotes, translation control and post- translation events.

Altered gene functions: Mutations, deletions, amplifications, LOH, translocations, trinucleotide repeats and other genetic abnormalities. Oncogenes and tumor suppressor genes. The gene sequencing, mapping and cloning of human disease genes. Introduction to gene therapy and targeting.

Recombinant DNA technology: **Principles, processes** (gene transfer technology) and applications.

SEMESTER / YEAR : IV YEAR

COURSE CODE : 15PD401

TITLE OF THE COURSE : PHARMACOTHERAPEUTICS III (Theory)

L:T:P : 3:1:3

Course Objectives:

- a. the pathophysiology of selected disease states and the rationale for drug therapy;
- b. the therapeutic approach to management of these diseases;
- c. the controversies in drug therapy;
- d. the importance of preparation of individualised therapeutic plans based on diagnosis;
- e. needs to identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects);
- f. describe the pathophysiology of selected disease states and explain the rationale for drug therapy;
- g. to summarize the therapeutic approach to management of these diseases including reference to the latest available evidence;
- h. to discuss the controversies in drug therapy;
- i. to discuss the preparation of individualised therapeutic plans based on diagnosis; and
- j. identify the patient-specific parameters relevant in initiating drug therapy, and monitoring therapy (including alternatives, time-course of clinical and laboratory indices of therapeutic response and adverse effects).

Course Outcomes:

- a) Design the dosage regimen for diseases;
- b) Illustrate the preparation of individualized therapeutic plans based on diagnosis;
- c) Identify and determine the patient-specific parameters relevant to initiating drug therapy,
- d) Summarize the therapeutic approach to manage the diseases condition e) Assess the rationality of drug therapy

Syllabus

Etiopathogenesis and pharmacotherapy of diseases associated with following systems/diseases:

Title of the topic

1. Gastrointestinal system: Peptic ulcer disease, Gastro Esophageal Reflux Disease, Inflammatory bowel disease, Liver disorders - Alcoholic liver disease, Viral hepatitis including jaundice, and Drug induced liver disorders.

2. Haematological system: Anaemias, Venous thromboembolism, Drug induced blood disorders.

3. Nervous system: Epilepsy, Parkinsonism, Stroke, Alzheimer's disease,

4. Psychiatry disorders: Schizophrenia, Affective disorders, Anxiety disorders, Sleep disorders, Obsessive Compulsive disorders.

5. Pain management including Pain pathways, neuralgias, headaches.

6. Evidence Based Medicine.

Text Books

- a. Clinical Pharmacy and Therapeutics - Roger and Walker, Churchill Livingstone publication
- b. Pharmacotherapy: A Pathophysiologic approach - Joseph T. Dipiro et al. Appleton & Lange Reference Books
- a. Pathologic basis of disease - Robins SL, W.B.Saunders publication.

Reference Books

- a. Pathologic basis of disease - Robins SL, W.B.Saunders publication
- b. Pathology and therapeutics for Pharmacists: A Basis for Clinical Pharmacy Practice - Green and Harris, Chapman and Hall publication.
- c. Clinical Pharmacy and Therapeutics - Eric T. Herfindal, Williams and Wilkins Publication
Applied Therapeutics: The clinical Use of Drugs. Lloyd Young and Koda-Kimble MA
- d. Avery's Drug Treatment, 4th Edn, 1997, Adis International Limited. e. Relevant review articles from recent medical and pharmaceutical literature.

SEMESTER / YEAR : IV PHARM D
COURSE CODE : 15PD474
TITLE OF THE COURSE : BIOPHARMACEUTICS AND PHARMACOKINETICS

COURSE OUTCOMES

This course is designed to impart knowledge on the dissolution profile of various pharmaceuticals and the calculations involved in the determination of various pharmacokinetic parameters.

COURSE OBJECTIVES

- Applications of basics of pharmacokinetics
 - The use of raw data and derive the pharmacokinetic parameters
 - The critical evaluation of biopharmaceutical studies involving drug product
1. Improvement of dissolution characteristics of slightly soluble drugs by some methods.
 2. Comparison of dissolution studies of two different marketed products of same drug.
 3. Influence of polymorphism on solubility and dissolution.
 4. Protein binding studies of a highly protein bound drug and poorly protein bound drug. 5. Extent of plasma-protein binding studies on the same drug (i.e. highly and poorly protein bound drug) at different concentrations in respect of constant time.
 6. Bioavailability studies of some commonly used drugs on animal/human model.
 7. Calculation of K_a , K_e , $t_{1/2}$, C_{max} , AUC, AUMC, MRT etc. from blood profile data.
 8. Calculation of bioavailability from urinary excretion data for two drugs.
 9. Calculation of AUC and bioequivalence from the given data for two drugs.
 10. In vitro absorption studies.
 11. Bioequivalency studies on the different drugs marketed.(eg) Tetracycline, Sulphamethoxazole, Trimethoprim, Aspirin etc., on animals and human volunteers.
 12. Absorption studies in animal inverted intestine using various drugs.
 13. Effect on contact time on the plasma protein binding of drugs.
 14. Studying metabolic pathways for different drugs based on elimination kinetics data.
 15. Calculation of elimination half-life for different drugs by using urinary elimination data and blood level data.
 16. Determination of renal clearance.

15PD504 - CLERKSHIP

Course Objectives: The primary objectives of this course are to

1. Post student in constituent hospital for a period of about 50 hours and covered for 200 working days
2. Expose them to the environment and understand the disease assessment
3. Discuss about the past, current and future plan of the patient's health
4. Develop good Rapport with hospital personnel for better understanding of treatment plan
5. Participate and contribute to the management from the knowledge obtained and practical exposure

Course Outcomes (COs): At completion of this course, it is expected that the students will be able to

- To elicit the patient's chief complaints, history of present illness, past medical history, social, family and occupational histories, complete review of systems for case study analysis
- To build effective and empathetical skills in counselling the patients on their medications and life style modifications
- To examine and demonstrate a new patient's case in a focused manner, chronologically developing the present illness, summarizing the pertinent positive and negative findings as well as the differential diagnosis and plans for further testing and treatment
- To estimate factors that frequently alter the effects of medications, including drug interactions and compliance problems
- To develop an ability to compile an assessment and plan for an individual patient organized by problem, discussing the likely diagnosis and plan of treatment

Syllabus

This training aims to introduce the fundamentals of clinical pharmacy services, pharmaceutical care planning and therapeutics to acquire the vital skills necessary for evaluation of therapeutic options in the management of diseases and in the interpretation of medication errors

Every student shall spend half a day in the morning hours attending ward rounds on daily basis as a part of clerkship. Clerkship examination – Oral examination shall be conducted

after the completion of clerkship of students. An external and an internal examiner will evaluate the student. Students may be asked to present the allotted medical cases followed by discussion. Students' capabilities in delivering clinical pharmacy services, pharmaceutical care planning and knowledge of therapeutics shall be assessed.

List of documentation need to be followed in 12months duration:

1. Patient Profile Form
2. Drug Intervention Form
3. Drug Interaction Form
4. Patient Counselling Form
5. Cost Analysis Form
6. Medication History Interview Form
7. Clinical Treatment Chart Review Form
8. Prescription Audit Form
9. Drug Information Query Form
10. Suspected Adverse Drug Reaction
11. Journal Club Presentation
12. Discussing Possible Innovations
13. Clinical activities Discussion

SEMESTER/YEAR : I SEM
COURSE CODE : 17BP101

TITLE OF THE COURSE : HUMAN ANATOMY AND PHYSIOLOGY I – THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

COURSE OBJECTIVES: This subject is intended to provide basic understanding of the structure and functions of the human body's different systems. It also aids in the comprehension of both homeostasis processes. This subject offers the fundamental information needed to comprehend the different branches of pharmacy.

COURSE OUTCOMES:

Upon completion of this course the student should be able to:

- (i) Explain the gross morphology, structure, and roles of different human parts of the body.
- (ii) Describe the different homeostatic processes and the imbalances that they cause.
- (iii) Recognize the various tissues and organs of the human body's numerous processes.
- (iv) Carry out different tests involving unique senses and the nervous system.
- (v) Recognize the coordinated functioning structure of each system's various parts.

45 Hours

UNIT I

10 Hours

Introduction to human body

Definition and scope of anatomy and physiology, levels of structural organization and body systems, basic life processes, homeostasis, basic anatomical terminology.

Cellular level of organization

Structure and functions of cell, transport across cell membrane, cell division, cell junctions. General principles of cell communication, intracellular signaling pathway activation by extracellular signal molecule, Forms of intracellular signaling: a) Contact-dependent b) Paracrine c) Synaptic d) Endocrine

Tissue level of organization

Classification of tissues, structure, location and functions of epithelial, muscular and nervous and connective tissues.

UNIT II

10 Hours

Integumentary system

Structure and functions of skin

Skeletal system

Divisions of skeletal system, types of bone, salient features and functions of bones of axial and appendicular skeletal system. Organization of skeletal muscle, physiology of muscle contraction, neuromuscular junction

Joints Structural and functional classification, types of joints movements and its articulation

UNIT III

10 Hours

- **Body fluids and blood**

Body fluids, composition and functions of blood, hemopoiesis, formation of hemoglobin, anemia, mechanisms of coagulation, blood grouping, Rh factors, transfusion, its significance and disorders of blood, Reticulo endothelial system.

- **Lymphatic system**

Lymphatic organs and tissues, lymphatic vessels, lymph circulation and functions of lymphatic system

UNIT IV

08 Hours

Peripheral nervous system:

Classification of peripheral nervous system: Structure and functions of sympathetic and parasympathetic nervous system.

Origin and functions of spinal and cranial nerves.

Special senses Structure and functions of eye, ear, nose and tongue and their disorders.

UNIT V

07 Hours

Cardiovascular system

Heart – anatomy of heart, blood circulation, blood vessels, structure and functions of artery, vein and capillaries, elements of conduction system of heart and heart beat, its regulation by autonomic nervous system, cardiac output, cardiac cycle. Regulation of blood pressure, pulse, electrocardiogram and disorders of heart.

SEMESTER/YEAR : II SEM
COURSE CODE : 17BP201
TITLE OF THE COURSE : HUMAN ANATOMY AND PHYSIOLOGY-II -
THEORYL: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This subject is designed to impart fundamental knowledge on the structure and functions of the various systems of the human body. It also helps in understanding both homeostatic mechanisms. The subject provides the basic knowledge required to understand the various disciplines of pharmacy.

COURSE OBJECTIVES: Upon completion of this course the student should be able to:

1. Explain the gross morphology, structure and functions of various organs of the humanbody.
2. Describe the various homeostatic mechanisms and their imbalances.
3. Identify the various tissues and organs of different systems of human body.
4. Perform the hematological tests like blood cell counts, haemoglobin estimation, bleeding/clotting time etc and also record blood pressure, heart rate, pulse and respiratory volume.
5. Appreciate coordinated working pattern of different organs of each system
6. Appreciate the interlinked mechanisms in the maintenance of normal functioning (homeostasis) of human body.

COURSE OUTCOMES:

After completing the course, students will be able to:

CO1. Explain the structure and physiology of the digestive system and associated diseases.

CO2. Explain the structure and biochemistry of the nervous system and ANS factors.

CO3. Describe the structure, physiology, and characteristics of the urinary system.

CO4 Describe the anatomy of the endocrine system.

CO5.Explain the morphology, physiology, and characteristics associated with the reproductive system.

UNIT I

10 hours

Nervous system

Organization of nervous system, neuron, neuroglia, classification and properties of nerve fibre, electrophysiology, action potential, nerve impulse, receptors, synapse, neurotransmitters.

Central nervous system: Meninges, ventricles of brain and cerebrospinal fluid.structure

and functions of brain (cerebrum, brain stem, cerebellum), spinal cord (gross structure, functions of afferent and efferent nerve tracts, reflex activity)

UNIT II

06 hours

Digestive system

Anatomy of GI Tract with special reference to anatomy and functions of stomach, (Acid production in the stomach, regulation of acid production through parasympathetic nervous system, pepsin role in protein digestion) small intestine and large intestine, anatomy and functions of salivary glands, pancreas and liver, movements of GIT, digestion and absorption of nutrients and disorders of GIT.

Energetics

Formation and role of ATP, Creatinine Phosphate and BMR.

UNIT III

10 hours

Respiratory system

Anatomy of respiratory system with special reference to anatomy of lungs, mechanism of respiration, regulation of respiration

Lung Volumes and capacities transport of respiratory gases, artificial respiration, and resuscitation methods.

Urinary system

Anatomy of urinary tract with special reference to anatomy of kidney and Nephrons, functions of kidney and urinary tract, physiology of urine formation, micturition reflex and role of kidneys in acid base balance, role of RAS in kidney and disorders of kidney.

UNIT IV

10 hours

Endocrine system

Classification of hormones, mechanism of hormone action, structure and functions of pituitary gland, thyroid gland, parathyroid gland, adrenal gland, pancreas, pineal gland, thymus and their disorders.

UNIT V

09 hours

Reproductive system

Anatomy of male and female reproductive system, Functions of male and female reproductive system, sex hormones, physiology of menstruation, fertilization, spermatogenesis, oogenesis, pregnancy and parturition

Introduction to genetics

Chromosomes, genes and DNA, protein synthesis, genetic pattern of inheritance

SEMESTER/YEAR : II SEM
COURSE CODE : 17BP206
TITLE OF THE COURSE : ENVIRONMENTAL SCIENCES - THEORY
L: T/A: P: C : 3: 0: 0: 3

30 Hours

Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

COURSE OBJECTIVES: Upon completion of the course the student shall be able to:

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
6. Strive to attain harmony with Nature.

UNIT-I

10 Hours

The Multidisciplinary nature of environmental studies

Natural Resources

Renewable and non-renewable resources: Natural resources and associated problems

a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

UNIT-II

10 Hours

Ecosystems

Concept of an ecosystem.

Structure and function of an ecosystem.

Introduction, types, characteristic features, structure and function of the ecosystems:

Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT- III

10 Hours

Environmental Pollution: Air pollution; Water pollution; Soil pollution

RECOMMENDED BOOKS (LATEST EDITION):

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clarendon Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP304
TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

COURSE OBJECTIVES: Upon completion of the course student shall be able:

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various test to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

UNIT-I

10 Hours

Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.

Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.

Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

UNIT-II

10 Hours

Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator.

Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

UNIT- III

08 Hours

Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. Principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

UNIT-IV

08 Hours

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.

Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

UNIT- V

07 Hours

Materials of pharmaceutical plant construction, Corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Introduction to chemical engineering - Walter L Badger & Julius Banchemo, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering - McCabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices - C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

Physical Pharmaceutics – I (Practical)

4 Hrs/week

Objectives: Upon the completion of the course student shall be able to perform

1. To understand the significance of physical properties such as
 2. solubility, surface tension, partition coefficient and pKa in the design of dosage forms.
 3. To explain adsorption isotherms and determine Freundlich-Langmuir constant using activated charcoal.
 4. To apply Henderson – Hasselbalch equation for interpretation of pKa value of drugs.
 5. To determine the surface tension of sample liquids by drop count and drop weight methods
 6. To deduce the HLB value and critical micellar concentration of a surfactant.
 7. To estimate the stability constants of complexes by solubility and pH titration methods.
-
1. Determination the solubility of drug at room temperature
 2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
 3. Determination of Partition co- efficient of benzoic acid in benzene and water
 4. Determination of Partition co- efficient of Iodine in CCl₄ and water
 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
 6. Determination of surface tension of given liquids by drop count and drop weight method
 7. Determination of HLB number of a surfactant by saponification method
 8. Determination of Freundlich and Langmuir constants using activated char coal
 9. Determination of critical micellar concentration of surfactants
 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
 11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP308
TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING - ~~THEORY~~ *Practicals.*
L: T/A: P: C : 0 : 0 : 4 : 2

1. Determination of radiation constant of brass, iron, unpainted and painted glass.
2. Steam distillation - To calculate the efficiency of steam distillation.
3. To determine the overall heat transfer coefficient by heat exchanger.
4. Construction of drying curves (for calcium carbonate and starch).
5. Determination of moisture content and loss on drying.
6. Determination of humidity of air - i) From wet and dry bulb temperatures - use of Dew point method.
7. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
8. Size analysis by sieving - To evaluate size distribution of tablet granulations - Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
11. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity)
12. To study the effect of time on the Rate of Crystallization.
13. To calculate the uniformity Index for given sample by using Double Cone Blender.

SEMESTER/YEAR : V SEM
COURSE CODE : 17BP503
TITLE OF THE COURSE : PHARMACOLOGY-II
L: T/A: P: C : 0 : 0 : 4 : 2

This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on different systems of body and in addition, emphasis on the basic concepts of bioassay

COURSE OBJECTIVES: Upon completion of this course the student should be able to

1. Understand the mechanism of drug action and its relevance in the treatment of different diseases
2. Demonstrate isolation of different organs/tissues from the laboratory animals by simulated experiments
3. Demonstrate the various receptor actions using isolated tissue preparation
4. Appreciate correlation of pharmacology with related medical sciences

UNIT- I

10 Hours

1. Pharmacology of drugs acting on cardio vascular system

- a. Introduction to hemodynamic and electrophysiology of heart.
- b. Drugs used in congestive heart failure
- c. Anti-hypertensive drugs.
- d. Anti-anginal drugs.
- e. Anti-arrhythmic drugs.
- f. Anti-hyperlipidemic drugs.

UNIT-II

10 Hours

1. Pharmacology of drugs acting on cardio vascular system

- a. Drug used in the therapy of shock.
- b. Hematinics, coagulants and anticoagulants.
- c. Fibrinolytics and anti-platelet drugs
- d. Plasma volume expanders

2. Pharmacology of drugs acting on urinary system

- a. Diuretics
- b. Anti-diuretics.

UNIT-III

10 Hours

3. Autocoids and related drugs

- a. Introduction to autocoids and classification
- b. Histamine, 5-HT and their antagonists.
- c. Prostaglandins, Thromboxanes and Leukotrienes.
- d. Angiotensin, Bradykinin and Substance P.
- e. Non-steroidal anti-inflammatory agents

- f. Anti-gout drugs
- g. Antirheumatic drugs

UNIT-IV

08 Hours

4. Pharmacology of drugs acting on endocrine system

- a. Basic concepts in endocrine pharmacology.
- b. Anterior Pituitary hormones- analogues and their inhibitors.
- c. Thyroid hormones- analogues and their inhibitors.
- d. Hormones regulating plasma calcium level- Parathormone, Calcitonin and Vitamin-D.
- e. Insulin, Oral Hypoglycemic agents and glucagon.
- f. ACTH and corticosteroids.

UNIT-V

07 Hours

5. Pharmacology of drugs acting on endocrine system

- a. Androgens and Anabolic steroids.
- b. Estrogens, progesterone and oral contraceptives.
- c. Drugs acting on the uterus.

6. Bioassay

- a. Principles and applications of bioassay.
- b. Types of bioassay
- c. Bioassay of insulin, oxytocin, vasopressin, ACTH, d-tubocurarine, digitalis, histamine and 5-HT

RECOMMENDED BOOKS (LATEST EDITIONS):

1. Rang H. P., Dale M. M., Ritter J. M., Flower R. J., Rang and Dale's Pharmacology, Churchill Livingstone Elsevier
2. Katzung B. G., Masters S. B., Trevor A. J., Basic and clinical pharmacology, Tata Mc Graw-Hill.
3. Goodman and Gilman's, The Pharmacological Basis of Therapeutics
4. Marry Anne K. K., Lloyd Yee Y., Brian K. A., Robbin L.C., Joseph G. B., Wayne A. K., Bradley R.W., Applied Therapeutics, The Clinical use of Drugs, The Point Lippincott Williams & Wilkins.
5. Mycek M.J, Gelnet S.B and Perper M.M. Lippincott's Illustrated ReviewsPharmacology.
6. K.D.Tripathi. Essentials of Medical Pharmacology, , JAYPEE Brothers Medical Publishers (P) Ltd, New Delhi.
7. Sharma H. L., Sharma K. K., Principles of Pharmacology, Paras medical publisher
8. Modern Pharmacology with clinical Applications, by Charles R.Craig& Robert.
9. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata.
10. Kulkarni SK. Handbook of experimental pharmacology. Vallabh Prakashan

SEMESTER/YEAR : V SEM COURSE

CODE : 17BP504

**TITLE OF THE COURSE : PHARMACOGNOSY AND PHYTOCHEMISTRY II –
THEORY L: T/A: P: C : 3 : 1 : 0 : 4**

45 Hours

COURSE OBJECTIVES

The main purpose of subject is to impart the students the knowledge of how the secondary metabolites are produced in the crude drugs, how to isolate and identify and produce them industrially. Also this subject involves the study of producing the plants and phytochemicals through plant tissue culture, drug interactions and basic principles of traditional system of medicine

COURSE OUTCOME: Upon completion of the course, the student shall be able,

1. Know the modern extraction techniques, characterization and identification of the herbal drugs and phytoconstituents
2. Understand the preparation and development of herbal formulation.
3. Understand the herbal drug interactions
4. Carryout isolation and identification of phytoconstituents

UNIT-I

7 Hours

Metabolic pathways in higher plants and their determination

- a) Brief study of basic metabolic pathways and formation of different secondary metabolites through these pathways- Shikimic acid pathway, Acetate pathways and Amino acid pathway.
- b) Study of utilization of radioactive isotopes in the investigation of Biogenetic studies.

UNIT-II

14 Hours

General introduction, composition, chemistry & chemical classes, biosources, therapeutic uses and commercial applications of following secondary metabolites:

Alkaloids: Vinca, Rauwolfia, Belladonna, Opium,

Phenylpropanoids and Flavonoids: Lignans, Tea, Ruta

Steroids, Cardiac Glycosides & Triterpenoids: Liquorice, Dioscorea, Digitalis

Volatile oils: Mentha, Clove, Cinnamon, Fennel, Coriander,

Tannins: Catechu, Pterocarpus Resins: Benzoin, Guggul, Ginger, Asafoetida, Myrrh, Colophony

Glycosides: Senna, Aloes, Bitter Almond

Iridoids, Other terpenoids & Naphthaquinones: Gentian, Artemisia, taxus, carotenoids

UNIT-III

06 Hours

Isolation, Identification and Analysis of Phytoconstituents

a) Terpenoids: Menthol, Citral, Artemisin

b) Glycosides: Glycyrrhetic acid & Rutin

c) Alkaloids: Atropine, Quinine, Reserpine, Caffeine

d) Resins: Podophyllotoxin, Curcumin

UNIT-IV

10 Hours

Industrial production, estimation and utilization of the following phyto constituents:

Forskolin, Sennoside, Artemisinin, Diosgenin, Digoxin, Atropine, Podophyllotoxin, Caffeine, Taxol, Vincristine and Vinblastine

UNIT V

08 Hours

Basics of Phytochemistry Modern methods of extraction, application of latest techniques like Spectroscopy, chromatography and electrophoresis in the isolation, purification and identification of crude drugs.

SEMESTER/YEAR : V SEM
COURSE CODE : 17BP505
TITLE OF THE COURSE : PHARMACEUTICAL JURISPRUDENCE - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

COURSE OBJECTIVES:

Upon completion of the course, the student shall be able to understand:

1. The Pharmaceutical legislations and their implications in the development and marketing of pharmaceuticals.
2. Various Indian pharmaceutical Acts and Laws
3. The regulatory authorities and agencies governing the manufacture and sale of pharmaceuticals
4. The code of ethics during the pharmaceutical practice

COURSE OUTCOME:

Upon completion of the course, the student shall be able to understand –

1. Practice the Professional ethics;
2. Retrieve the various concepts of the pharmaceutical legislation in India;
3. Estimate the various parameters in the Drug and Cosmetic Act and rules;
4. Summarize the Drug policy, DPCO, Patent and design act;
5. Choose the labelling requirements and packaging guidelines for drugs and cosmetics;
6. Gather the concepts of Dangerous Drugs Act, Pharmacy Act and Excise duties Act; and
7. Interpret other laws as prescribed by the Pharmacy Council of India from time to time including International Laws.

UNIT-I Drugs and Cosmetics Act, 1940 and its rules 1945:**10 Hours**

Objectives, Definitions, Legal definitions of schedules to the Act and Rules Import of drugs – Classes of drugs and cosmetics prohibited from import, Import under license or permit. Offences and penalties. Manufacture of drugs – Prohibition of manufacture and sale of certain drugs, Conditions for grant of license and conditions of license for manufacture of drugs, Manufacture of drugs for test, examination and analysis, manufacture of new drug, loan license and repacking license.

UNIT-II Drugs and Cosmetics Act, 1940 and its rules 1945.**10 Hours**

Detailed study of Schedule G, H, M, N, P,T,U, V, X, Y, Part XII B, Sch F & DMR (OA) Sale of Drugs – Wholesale, Retail sale and Restricted license. Offences and penalties

Labeling & Packing of drugs- General labeling requirements and specimen labels for drugs and cosmetics, List of permitted colors. Offences and penalties.

Administration of the Act and Rules – Drugs Technical Advisory Board, Central drugs Laboratory, Drugs Consultative Committee, Government drug analysts, Licensing authorities, controlling authorities, Drugs Inspectors

UNIT-III Pharmacy Act –1948:**10 Hours**

Objectives, Definitions, Pharmacy Council of India; its constitution and functions, Education Regulations, State and Joint state pharmacy councils; constitution and functions, Registration of Pharmacists, Offences and Penalties

Medicinal and Toilet Preparation Act –1955:

Objectives, Definitions, Licensing, Manufacture In bond and Outside bond, Export of alcoholic preparations, Manufacture of Ayurvedic, Homeopathic, Patent & Proprietary Preparations. Offences and Penalties.

Narcotic Drugs and Psychotropic substances Act-1985 and Rules:

Objectives, Definitions, Authorities and Officers, Constitution and Functions of narcotic & Psychotropic Consultative Committee, National Fund for Controlling the Drug Abuse, Prohibition, Control and Regulation, opium poppy cultivation and

production of poppy straw, manufacture, sale and export of opium, Offences and Penalties

UNIT-IV Study of Salient Features of Drugs and Magic Remedies Act and its rules: 08 Hours.

Objectives, Definitions, Prohibition of certain advertisements, Classes of Exempted advertisements, Offences and Penalties

Prevention of Cruelty to animals Act-1960:

Objectives, Definitions, Institutional Animal Ethics Committee, CPCSEA guidelines for Breeding and Stocking of Animals, Performance of Experiments, Transfer and acquisition of animals for experiment, Records, Power to suspend or revoke registration, Offences and Penalties

National Pharmaceutical Pricing Authority:

Drugs Price Control Order (DPCO)- 2013. Objectives, Definitions, Sale prices of bulk drugs, Retail price of formulations, Retail price and ceiling price of scheduled formulations, National List of Essential Medicines (NLEM)

UNIT-V Pharmaceutical Legislations – A brief review: 07 hours

Introduction, Study of drugs enquiry committee, Health survey and development committee, Hathi committee and Mudaliar committee

Code of Pharmaceutical ethics:

Definition, Pharmacist in relation to his job, trade, medical profession and his profession, Pharmacist's oath

Medical Termination of Pregnancy Act

Right to Information Act

Introduction to Intellectual Property Rights (IPR)

RECOMMENDED BOOKS: (LATEST EDITION):

1. Forensic Pharmacy by B. Suresh

2. Text book of Forensic Pharmacy by B.M. Mithal
3. Hand book of drug law-byM.L. Mehra
4. A text book of Forensic Pharmacy by N.K. Jain
5. Drugs and Cosmetics Act/Rules by Govt. of India publications.
6. Medicinal and Toilet preparations act 1955 by Govt. of India publications.
7. Narcotic drugs and psychotropic substances act by Govt. of India publications
8. Drugs and Magic Remedies act by Govt. of India publication
9. Bare Acts of the said laws published by Government. Reference books (Theory)

SEMESTER/YEAR: V SEM

COURSE CODE: 17BP506

TITLE OF THE COURSE: FORMULATIVE PHARMACY - PRACTICAL

L: T/A: P: C: 0 : 0 : 4 : 2

Course Objective:

After the successful completion of the course the students will be able to

- Understand the importance of preformulation in preparation of tablets
- Formulate various dosage forms
- Understand the importance of Quality control test of tablets and capsules

Course Outcome:

After the successful completion of the course the students will be able to

CO 1: Enumerate the principles and applications of preformulation studies in various dosage form

CO 2: Prepare, compress and evaluate tablets

CO 3: Prepare and sealing of ampoules

CO 4: Perform Quality control test for marketed tablets and capsules

CO 5: Formulate creams and ointments

1. Preformulation studies on paracetamol/aspirin/or any other drug

2. Preparation and evaluation of Paracetamol tablets

3. Preparation and evaluation of Aspirin tablets

4. Coating of tablets- film coating of tables/granules

5. Preparation and evaluation of Tetracycline capsules

6. Preparation of Calcium Gluconate injection

7. Preparation of Ascorbic Acid injection

8. Quality control test of (as per IP) marketed tablets and capsules

9. Preparation of Eye drops/ and Eye ointments

10. Preparation of Creams (cold / vanishing cream)

11. Evaluation of Glass containers (as per IP)

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Pharmaceutical dosage forms - Tablets, volume 1 -3 by H.A. Liberman, Leon Lachman & J.B.Schwartz
2. Pharmaceutical dosage form - Parenteral medication vol- 1&2 by Liberman & Lachman
3. Pharmaceutical dosage form disperse system VOL-1 by Liberman & Lachman
4. Modern Pharmaceutics by Gilbert S. Banker & C.T. Rhodes, 3rd Edition
5. Remington: The Science and Practice of Pharmacy, 20th edition Pharmaceutical Science (RPS)
6. Theory and Practice of Industrial Pharmacy by Liberman & Lachman
7. Pharmaceutics- The science of dosage form design by M.E.Aulton, Churchill livingstone, Latest edition
8. Introduction to Pharmaceutical Dosage Forms by H. C.Ansel, Lea &Febiger, Philadelphia, 5th edition, 2005
9. Drug stability - Principles and practice by Cartensen & C.J. Rhodes, 3rd Edition, Marcel Dekker Series, Vol 107

SEMESTER/YEAR : V SEM

COURSE CODE : 17BP507

TITLE OF THE COURSE : PHARMACOLOGY-II - PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

Course objectives:

-) This course will demonstrate / provide hands-on experience in the virtual platform using appropriate software on the following outcomes/List of Experiments.
-) To understand the mechanism of action of different drugs on different therapeutic areas using simulated experiments.

Course outcomes:

-) Students will be able to demonstrate and understand the effects of different drugs on different therapeutic areas using simulated experiments.
-) Through simulated experiments, students will be able to demonstrate the isolation of different organs and tissues from laboratory animals.
-) Through the isolated tissues, students will be able to demonstrate the various effects/functions of receptors through simulated experiments.
-) Students will be able to understand the effects/pharmacology of drugs and correlate with related therapeutic area and medical sciences.

List of Experiments:

1. Introduction to *in-vitro* pharmacology and physiological salt solutions.
2. Effect of drugs on isolated frog heart.
3. Effect of drugs on blood pressure and heart rate of dog.
4. Study of diuretic activity of drugs using rats/mice.
5. DRC of acetylcholine using frog rectus abdominis muscle.
6. Effect of physostigmine and atropine on DRC of acetylcholine using frog rectus abdominis muscle and rat ileum respectively.
7. Bioassay of histamine using guinea pig ileum by matching method.
8. Bioassay of oxytocin using rat uterine horn by interpolation method.
9. Bioassay of serotonin using rat fundus strip by three point bioassay.
10. Bioassay of acetylcholine using rat ileum/colon by four point bioassay.
11. Determination of PA₂ value of prazosin using rat anococcygeus muscle (by Schilds plot method).
12. Determination of PD₂ value using guinea pig ileum.
13. Effect of spasmogens and spasmolytics using rabbit jejunum.
14. Anti-inflammatory activity of drugs using carrageenan induced paw-edema model.
15. Analgesic activity of drug using central and peripheral methods

Note: All laboratory techniques and animal experiments are demonstrated by simulated experiments by softwares and videos

SEMESTER/YEAR : V SEM

COURSE CODE : 17BP508

TITLE OF THE COURSE : PHARMACOGNOSY & PHYTOCHEMISTRY II

PRACTICAL L: T/A: P: C : 0 : 0 : 4 : 2

Course objective:

1. Students will impart the knowledge how the secondary metabolites are organized and distributed in the plant parts. Students will understand how secondary metabolites are isolated industrially and how isolated secondary metabolites can analyzed qualitative and quantitative methods.

Course outcome:

1. Carrying out the modern extraction techniques, characterization and identification of the herbal drugs and phyto constituents
 2. Understanding the preparation and development of herbal formulation.
 3. Understanding the concept of herbal drug interactions
 4. Know the isolation and identification methods of phyto constituents
-
1. Morphology, histology and powder characteristics & extraction & detection of: Cinchona, Cinnamon, Senna, Clove, Ephedra, Fennel and Coriander
 2. Exercise involving isolation & detection of active principles
 - a. Caffeine - from tea dust.
 - b. Diosgenin from Dioscorea
 - c. Atropine from Belladonna
 - d. Sennosides from Senna
 3. Separation of sugars by Paper chromatography
 4. TLC of herbal extract
 5. Distillation of volatile oils and detection of phytoconstitutes by TLC
 6. Analysis of crude drugs by chemical tests: (i) Asafoetida (ii) Benzoin (iii) Colophony (iv) Aloes (v) Myrrh

List of References

1. W.C.Evans, Trease and Evans Pharmacognosy, 16th edition, W.B. Saunders & Co., London, 2009.
2. Mohammad Ali. Pharmacognosy and Phytochemistry, CBS Publishers & Distribution, New Delhi.
3. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae (2007), 37th Edition, Nirali Prakashan, New Delhi.
4. Herbal drug industry by R.D. Choudhary (1996), Ist Edn, Eastern Publisher, New Delhi.
5. Essentials of Pharmacognosy, Dr.SH.Ansari, IInd edition, Birla publications, New Delhi, 2007
6. Herbal Cosmetics by H.Pande, Asia Pacific Business press, Inc, New Delhi.
7. A.N. Kalia, Textbook of Industrial Pharmacognosy, CBS Publishers, New Delhi, 2005.
8. R Endress, Plant cell Biotechnology, Springer-Verlag, Berlin, 1994.
9. Pharmacognosy & Pharmacobiotechnology. James Bobbers, Marilyn KS, VE Tylor.
10. The formulation and preparation of cosmetic, fragrances and flavours.
11. Remington's Pharmaceutical sciences.
12. Text Book of Biotechnology by Vyas and Dixit.
13. Text Book of Biotechnology by R.C. Dubey.

SEMESTER/YEAR : VI SEM
COURSE CODE : 17BP602
TITLE OF THE COURSE : PHARMACOLOGY-III - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

Course objectives:

- This subject is intended to impart the fundamental knowledge on various aspects (classification, mechanism of action, therapeutic effects, clinical uses, side effects and contraindications) of drugs acting on respiratory and gastrointestinal system, infectious diseases, immuno-pharmacology.
- To study the principles of toxicology (acute, subacute and chronic toxicity, genotoxicity, carcinogenicity, teratogenicity and mutagenicity, principles of treatment of poisoning)
- To study the importance of principles of toxicology and chronopharmacology.

Course outcomes: Upon completion of this course the student will be able to:

- Understand the mechanism of drug action and its relevance in the treatment of different infectious diseases
- Comprehend the principles of toxicology and treatment of various poisonings
- Appreciate correlation of pharmacology with related medical sciences.

UNIT-I

10 Hours

1. Pharmacology of drugs acting on Respiratory system

- a. Anti -asthmatic drugs
- b. Drugs used in the management of COPD
- c. Expectorants and antitussives
- d. Nasal decongestants
- e. Respiratory stimulants

2. Pharmacology of drugs acting on the Gastrointestinal Tract

- a. Antiulcer agents.
- b. Drugs for constipation and diarrhoea.
- c. Appetite stimulants and suppressants.
- d. Digestants and carminatives.
- e. Emetics and anti-emetics.

UNIT-II

10 Hours

3. Chemotherapy

a. General principles of chemotherapy.

b. Sulfonamides and cotrimoxazole.

c. Antibiotics- Penicillins, cephalosporins, chloramphenicol, macrolides, quinolones and fluoroquinolones, tetracycline and aminoglycosides

UNIT- III

10 Hours

3. Chemotherapy

a. Antitubercular agents

b. Antileprotic agents

c. Antifungal agents

d. Antiviral drugs

e. Anthelmintics

f. Antimalarial drugs

g. Antiamoebic agents

UNIT-IV

08 Hours

3. Chemotherapy

a. Urinary tract infections and sexually transmitted diseases.

b. Chemotherapy of malignancy.

4. Immunopharmacology

a. Immunostimulants

b. Immunosuppressant

Protein drugs, monoclonal antibodies, target drugs to antigen, biosimilars

UNIT-V

07 Hours

5. Principles of toxicology

a. Definition and basic knowledge of acute, subacute and chronic toxicity.

b. Definition and basic knowledge of genotoxicity, carcinogenicity, teratogenicity and mutagenicity

c. General principles of treatment of poisoning

d. Clinical symptoms and management of barbiturates, morphine, organophosphorus compound and lead, mercury and arsenic poisoning.

6. Chronopharmacology

a. Definition of rhythm and cycles.

b. Biological clock and their significance leading to chronotherapy.

SEMESTER/YEAR : VI SEM
COURSE CODE : 17BP603
TITLE OF THE COURSE : HERBAL DRUG TECHNOLOGY - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This subject gives the student the knowledge of basic understanding of herbal drug industry, the quality of raw material, guidelines for quality of herbal drugs, herbal cosmetics, natural sweeteners, nutraceutical etc. The subject also emphasizes on Good Manufacturing Practices (GMP), patenting and regulatory issues of herbal drugs

COURSE OBJECTIVES: Upon completion of this course the student should be able to:

1. Understand raw material as source of herbal drugs from cultivation to herbal drug product
2. Know the WHO and ICH guidelines for evaluation of herbal drugs
3. Know the herbal cosmetics, natural sweeteners, nutraceuticals
4. Appreciate patenting of herbal drugs, GMP .

UNIT-I

11 Hours

Herbs as raw materials

Definition of herb, herbal medicine, herbal medicinal product, herbal drug preparation
Source of Herbs

Selection, identification and authentication of herbal materials Processing of herbal raw material

Biodynamic Agriculture

Good agricultural practices in cultivation of medicinal plants including Organic farming.
Pest and Pest management in medicinal plants: Biopesticides/Bioinsecticides.

Indian Systems of Medicine

- a) Basic principles involved in Ayurveda, Siddha, Unani and Homeopathy
- b) Preparation and standardization of Ayurvedic formulations viz Aristas and Asawas, Ghutika, Churna, Lehya and Bhasma.

UNIT-II

7 Hours

Nutraceuticals

General aspects, Market, growth, scope and types of products available in the market. Health benefits and role of Nutraceuticals in ailments like Diabetes, CVS diseases, Cancer, Irritable bowel syndrome and various Gastro intestinal diseases.

Study of following herbs as health food: Alfaalfa, Chicory, Ginger, Fenugreek, Garlic, Honey, Amla, Ginseng, Ashwagandha, Spirulina

Herbal-Drug and Herb-Food Interactions: General introduction to interaction and classification. Study of following drugs and their possible side effects and interactions: Hypercium, kava-kava, Ginkobiloba, Ginseng, Garlic, Pepper & Ephedra.

UNIT-III

10 Hours

Herbal Cosmetics

Sources and description of raw materials of herbal origin used via, fixed oils, waxes, gums colours, perfumes, protective agents, bleaching agents, antioxidants in products such as skin care, hair care and oral hygiene products.

Herbal excipients:

Herbal Excipients – Significance of substances of natural origin as excipients – colorants, sweeteners, binders, diluents, viscosity builders, disintegrants, flavors & perfumes.

Herbal formulations:

Conventional herbal formulations like syrups, mixtures and tablets and Novel dosage forms like phytosomes

UNIT- IV

10 Hours

Evaluation of Drugs WHO & ICH guidelines for the assessment of herbal drugs Stability testing of herbal drugs.

Patenting and Regulatory requirements of natural products:

a) Definition of the terms: Patent, IPR, Farmers right, Breeder's right, Bioprospecting and Biopiracy

b) Patenting aspects of Traditional Knowledge and Natural Products. Case study of Curcuma & Neem.

Regulatory Issues - Regulations in India (ASU DTAB, ASU DCC), Regulation of manufacture of ASU drugs - Schedule Z of Drugs & Cosmetics Act for ASU drugs.

UNIT-V

07 Hours

General Introduction to Herbal Industry

Herbal drugs industry: Present scope and future prospects. A brief account of plant based industries and institutions involved in work on medicinal and aromatic plants in India.

Schedule T – Good Manufacturing Practice of Indian systems of medicine

Components of GMP (Schedule – T) and its objectives Infrastructural requirements, working space, storage area, machinery and equipments, standard operating procedures, health and hygiene, documentation and records.

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy & Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

VI SEM
17BP606
PHARMACEUTICAL QUALITY ASSURANCE - THEORY
3 : 1 : 0 : 4

45 Hours

This course deals with the various aspects of quality control and quality assurance aspects of pharmaceutical industries. It deals with the important aspects like cGMP, QC tests, documentation, quality certifications and regulatory affairs.

Objectives: Upon completion of the course student shall be able to:

1. Understand the cGMP aspects in a pharmaceutical industry
2. Appreciate the importance of documentation
3. Understand the scope of quality certifications applicable to pharmaceutical Industries
4. Understand the responsibilities of QA & QC departments

UNIT - I

10 Hours

Quality Assurance and Quality Management concepts: Definition and concept of Quality control, Quality assurance and GMP

Total Quality Management (TQM): Definition, elements, philosophies

ICH Guidelines: purpose, participants, process of harmonization, Brief overview of QSEM,

with special emphasis on Q-series guidelines, ICH stability testing guidelines

Quality by design (QbD): Definition, overview, elements of QbD program, tools

ISO 9000 & ISO14000: Overview, Benefits, Elements, steps for registration

NABL accreditation: Principles and procedures

UNIT - II

10 Hours

Organization and personnel: Personnel responsibilities, training, hygiene and personal records.

Premises: Design, construction and plant layout, maintenance, sanitation, environmental control, utilities and maintenance of sterile areas, control of contamination.

Equipments and raw materials: Equipment selection, purchase specifications, maintenance, purchase specifications and maintenance of stores for raw materials.

UNIT - III

10 Hours

Quality Control: Quality control test for containers, rubber closures and secondary packing materials.

Good Laboratory Practices: General Provisions, Organization and Personnel, Facilities, Equipment, Testing Facilities Operation, Test and Control Articles, Protocol for Conduct of a Nonclinical Laboratory Study, Records and Reports, Disqualification of Testing

Complaints: Complaints and evaluation of complaints, Handling of return good, recalling and waste disposal.

Document maintenance in pharmaceutical industry: Batch Formula Record, Master Formula Record, SOP, Quality audit, Quality Review and Quality documentation, Reports and documents, distribution records.

UNIT - V

07 Hours

Calibration and Validation: Introduction, definition and general principles of calibration, qualification and validation, importance and scope of validation, types of validation, validation master plan. Calibration of pH meter, Qualification of UV-Visible spectrophotometer, General principles of Analytical method Validation.

Warehousing: Good warehousing practice, materials management

RECOMMENDED BOOKS: (LATEST EDITION):

1. Quality Assurance Guide by organization of Pharmaceutical Products of India.
2. Good Laboratory Practice Regulations, 2nd Edition, Sandy Weinberg Vol. 69.
3. Quality Assurance of Pharmaceuticals- A compendium of Guide lines and Related materials Vol I WHO Publications.
4. A guide to Total Quality Management- Kushik Maitra and Sedhan K Ghosh
5. How to Practice GMP's - P P Sharma.
6. ISO 9000 and Total Quality Management - Sadhan G Ghosh
7. The International Pharmacopoeia - Vol I, II, III, IV- General Methods of Analysis and Quality specification for Pharmaceutical Substances, Excipients and Dosage forms
8. Good laboratory Practices - Marcel Dekker Series
9. ICH guidelines, ISO 9000 and 14000 guidelines

SEMESTER/YEAR: VI SEM

COURSE CODE: 17BP607

TITLE OF THE COURSE: MEDICINAL CHEMISTRY – III - PRACTICAL

Course Outcomes

1. Understand the importance of drug design and different techniques of drug design.
2. Understand the chemistry of drugs with respect to their biological activity.
3. Know the synthesis and medical importance of drug
4. Provides a significant thinking and helps in solving evidence-based problem in the synthesis of drug and to estimate the amount of substance in the given compound.

Objectives

1. Well familiar with Quantitative structure-activity relationship (QSAR), Virtual screening & docking and computer aided drug design (CADD).
2. Medicinal chemists, as the entrepreneurs and innovators of remedial agents, the most significant armor of health care, play a significant role in supporting the drug discovery and development process.

I Preparation of drugs and intermediates

- 1 Sulphanilamide
- 2 7-Hydroxy, 4-methyl coumarin
- 3 Chlorobutanol
- 4 Triphenyl imidazole
- 5 Tolbutamide
- 6 Hexamine

II Assay of drugs

- 1 Isonicotinic acid hydrazide
- 2 Chloroquine
- 3 Metronidazole
- 4 Dapsone
- 5 Chlorpheniramine maleate
- 6 Benzyl penicillin

III Preparation of medicinally important compounds or intermediates by Microwave irradiation technique

IV Drawing structures and reactions using chem draw®

V Determination of physicochemical properties such as logP, clogP, MR, Molecular weight, Hydrogen bond donors and acceptors for class of drugs course content using drug design software Drug likeness screening (Lipinskies R05)

SEMESTER/YEAR : VI SEM

COURSE CODE : 17BP608

TITLE OF THE COURSE : PHARMACOLOGY-III - PRACTICAL

L: T/A: P: C : 0 : 0 : 4 : 2

Course objectives:

Upon completion of this course the student should be able to:

1. Understand the dosage regimen and its relevance in the formulation of solutions and vehicles.
2. Comprehend the principles of toxicology and observation
3. Appreciate correlation of pharmacology with preclinical studies.

Course outcomes:

- Students will learn about basic instruments, dosage forms and calculations used in experimental pharmacology and to organize animal houses as per the CPCSEA guidelines.
- Students will learn the Ex pharm software techniques like screening models, evaluation of parameters and biostatistical calculations used for animal studies.
- Students will learn the effects of different drugs on different therapeutic areas using simulated experiments.

List of Experiments:

1. Dose calculation in pharmacological experiments
2. Antiallergic activity by mast cell stabilization assay
3. Study of anti-ulcer activity of a drug using pylorus ligand (SHAY) rat model and NSAIDS induced ulcer model.
4. Study of effect of drugs on gastrointestinal motility
5. Effect of agonist and antagonists on guinea pig ileum
6. Estimation of serum biochemical parameters by using semi- autoanalyzer
7. Effect of saline purgative on frog intestine
8. Insulin hypoglycemic effect in rabbit
9. Test for pyrogens (rabbit method)
10. Determination of acute oral toxicity (LD50) of a drug from a given data
11. Determination of acute skin irritation / corrosion of a test substai of acute eye irritation / corrosion of a test substai pharmacokinetic parameters from a given data
14. Biostatistics methods in experimental pharmacology(student's t test, ANOVA)
15. Biostatistics methods in experimental pharmacology (Chi square test, Wilcoxon Signed Rank test)

*Experiments are demonstrated by simulated experiments/videos

SEMESTER/YEAR : VI SEM
COURSE CODE : 17BP609
TITLE OF THE COURSE : HERBAL DRUG TECHNOLOGY – PRACTICAL
L: T/A: P: C : 0 : 0 : 4 : 2 1.

Course Objectives: This course provides the student with a fundamental grasp of the herbal drug industry, the quality of raw materials, and standards for the quality of herbal medicines, herbal cosmetics, natural sweeteners, and nutraceuticals, among other things. Also, the topic places a strong emphasis on Good Manufacturing Practices (GMP), herbal medication patenting, and regulatory concerns.

Course Outcomes:

The student should be able to:

1. Comprehend raw materials as sources of herbal medications from agriculture to herbal drug product after completing this course.
2. Be familiar with the WHO and ICH criteria for evaluating herbal medicines
3. Be familiar with natural sweeteners, nutraceuticals, and herbal cosmetics
4. Respect GMP and the patenting of natural medicines.

1. To perform preliminary phytochemical screening of crude drugs.
2. Determination of the alcohol content of Asava and Arista
3. Evaluation of excipients of natural origin
4. Incorporation of prepared and standardized extract in cosmetic formulations like creams, lotions and shampoos and their evaluation.
5. Incorporation of prepared and standardized extract in formulations like syrups, mixtures and tablets and their evaluation as per Pharmacopoeial requirements.
6. Monograph analysis of herbal drugs from recent Pharmacopoeias
7. Determination of Aldehyde content
8. Determination of Phenol content
9. Determination of total alkaloids

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Textbook of Pharmacognosy by Trease & Evans.
2. Textbook of Pharmacognosy by Tyler, Brady & Robber.
3. Pharmacognosy by Kokate, Purohit and Gokhale
4. Essential of Pharmacognosy by Dr.S.H.Ansari
5. Pharmacognosy & Phytochemistry by V.D.Rangari
6. Pharmacopoeal standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homeopathy)
7. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.

VII SEM
17BP701
INSTRUMENTAL METHODS OF ANALYSIS - THEORY
3 : 1 : 0 : 4

45 Hours

This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart a fundamental knowledge on the principles and instrumentation of spectroscopic and chromatographic technique. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Objectives: Upon completion of the course the student shall be able to

1. Understand the interaction of matter with electromagnetic radiations and its applications in drug analysis
2. Understand the chromatographic separation and analysis of drugs.
3. Perform quantitative & qualitative analysis of drugs using various analytical instruments.

UNIT -I

10 Hours

UV Visible spectroscopy

Electronic transitions, chromophores, auxochromes, spectral shifts, solvent effect on absorption spectra, **Beer and Lambert's law**, Derivation and deviations.

Instrumentation - Sources of radiation, wavelength selectors, sample cells, detectors- Photo tube, Photomultiplier tube, Photo voltaic cell, Silicon Photodiode.

Applications - Spectrophotometric titrations, Single component and multi component analysis

Fluorimetry

Theory, Concepts of singlet, doublet and triplet electronic states, internal and external conversions, factors affecting fluorescence, quenching, instrumentation and applications

UNIT -II

10 Hours

IR spectroscopy

Introduction, fundamental modes of vibrations in poly atomic molecules, sample handling, factors affecting vibrations Instrumentation - Sources of radiation, wavelength selectors, detectors - Golay cell,

Bolometer, Thermocouple, Thermister, Pyroelectric detector and applications

Flame Photometry-Principle, interferences, instrumentation and applications

Atomic absorption spectroscopy- Principle, interferences, instrumentation and applications

Nepheloturbidometry- Principle, instrumentation and applications

UNIT -III

10 Hours

Introduction to chromatography

-Methodology, advantages, disadvantages and applications.

Thin layer chromatography- Introduction, Principle, Methodology, R_f values, advantages, disadvantages and applications.

Paper chromatography-Introduction, methodology, development techniques, advantages, disadvantages and applications

Electrophoresis- Introduction, factors affecting electrophoretic mobility, Techniques of paper, gel, capillary electrophoresis, applications

UNIT -IV

08 Hours

Gas chromatography - Introduction, theory, instrumentation, derivatization, temperature programming, advantages, disadvantages and applications

High performance liquid chromatography (HPLC)-Introduction, theory, instrumentation, advantages and applications.

UNIT -V

07 Hours

Ion exchange chromatography- Introduction, classification, ion exchange resins, properties, mechanism of ion exchange process, factors affecting ion exchange, methodology and applications

Gel chromatography- Introduction, theory, instrumentation and applications

Affinity chromatography- Introduction, theory, instrumentation and applications

SEMESTER/YEAR: VII SEM

COURSE CODE: 17BP702

TITLE OF THE COURSE: INDUSTRIAL PHARMACY – THEORY

L: T/A: P: C: 3: 1: 0: 4

Course objectives: Upon completion of the course, the student shall be able to:

1. Know the process of pilot plant and scale up of pharmaceutical dosage forms
2. Understand the process of technology transfer from lab scale to commercial batch
3. Know different Laws and Acts that regulate pharmaceutical industry
4. Understand the approval process and regulatory requirements for drug products

Course outcome:

Students will be able to have the relevant knowledge on:

1. Demonstrating the general considerations and the operational steps of pilot plant scale up techniques
2. Explaining the different laws and acts that regulate pharmaceutical industry
3. Recognizing the steps involved in technology transfer from R&D to production.
4. Illustrating the common measures use in quality
5. Categorizing the general requirements for submission of application for issue of Certificate of Pharmaceutical Product

UNIT-I

Pilot plant scale up techniques: General considerations - including significance of personnel requirements, space requirements, raw materials, Pilot plant scale up considerations for solids, liquid orals, semi solids and relevant documentation, SUPAC guidelines, Introduction to platform technology

UNIT-II

Technology development and transfer: WHO guidelines for Technology Transfer(TT): Terminology, Technology transfer protocol, Quality risk management, Transfer from R & D to production (Process, packaging and cleaning), Granularity of TT Process (API, excipients, finished products, packaging materials) Documentation, Premises and equipments, qualification and validation, quality control, analytical method transfer, Approved regulatory bodies and agencies, Commercialization - practical aspects and problems (case studies), TT agencies in India - APCTD, NRDC, TIFAC, BCIL, TBSE / SIDBI; TT related documentation - confidentiality agreement, licensing, MoUs, legal issues

UNIT-III

Regulatory affairs: Introduction, Historical overview of Regulatory Affairs, Regulatory authorities, Role of Regulatory affairs department, Responsibility of Regulatory Affairs Professionals

Regulatory requirements for drug approval: Drug Development Teams, Non-Clinical Drug Development, Pharmacology, Drug Metabolism and Toxicology, General considerations of Investigational New Drug (IND) Application, Investigator's Brochure (IB) and New Drug Application (NDA), Clinical research / BE studies, Clinical Research

Protocols, Biostatistics in Pharmaceutical Product Development, Data Presentation for FDA Submissions, Management of Clinical Studies.

UNIT-IV

Quality management systems: Quality management & Certifications: Concept of Quality, Total Quality Management, Quality by Design (Qbd), Six Sigma concept, Out of Specifications (OOS), Change control, Introduction to ISO 9000 series of quality systems standards, ISO 14000, NABL, GLP

UNIT-V

Indian Regulatory Requirements: Central Drug Standard Control Organization (CDSCO) and State Licensing Authority: Organization, Responsibilities, Certificate of Pharmaceutical Product (COPP), Regulatory requirements and approval procedures for New Drugs.

SEMESTER/YEAR : VII SEM
COURSE CODE : 17BP703
TITLE OF THE COURSE : PHARMACY PRACTICE – THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

COURSE OBJECTIVES :

Upon completion of the course, the student shall be able to

1. Know various drug distribution methods in a hospital
2. Appreciate the pharmacy stores management and inventory control
3. Monitor drug therapy of patient through medication chart review and clinical review
4. Obtain medication history interview and counsel the patients
5. Identify drug related problems
6. Detect and assess adverse drug reactions
7. Interpret selected laboratory results (as monitoring parameters in therapeutics) of specific disease states
8. Know pharmaceutical care services
9. Do patient counseling in community pharmacy
10. Appreciate the concept of Rational drug therapy.

COURSE OUTCOME:

Upon completion of the course the student shall be able to –

1. Categorize and choose various drug distribution methods in a hospital
2. Preparing for the pharmacy stores management and inventory control
3. Monitor drug therapy of patient through medication chart review and clinical review
4. Obtain & interpret the medication history interview and present the counseling to the patients
5. Expressing drug-related problems & assessing the adverse drug reactions

6. Associating selected laboratory results (as monitoring parameters in therapeutics) for specific disease states
7. Building the pharmaceutical care services by promoting the concept of rational drug therapy

UNIT I

10 Hours

- a) **Hospital and its organization:** Definition, Classification of hospital- Primary, Secondary and Tertiary hospitals, Classification based on clinical and non- clinical basis, Organization Structure of a Hospital, and Medical staffs involved in the hospital and their functions.
- b) **Hospital pharmacy and its organization:** Definition, functions of hospital pharmacy, Organization structure, Location, Layout and staff requirements, and Responsibilities and functions of hospital pharmacists.
- c) **Adverse drug reaction:** Classifications - Excessive pharmacological effects, secondary pharmacological effects, idiosyncrasy, allergic drug reactions, genetically determined toxicity, toxicity following sudden withdrawal of drugs, Drug interaction- beneficial interactions, adverse interactions, and pharmacokinetic drug interactions, Methods for detecting drug interactions, spontaneous case reports and record linkage studies, and Adverse drug reaction reporting and management.
- d) **Community Pharmacy:** Organization and structure of retail and wholesale drug store, types and design, Legal requirements for establishment and maintenance of a drug store, Dispensing of proprietary products, maintenance of records of retail and wholesale drug store.

UNIT II

10 Hours

- a) **Drug distribution system in a hospital:** Dispensing of drugs to inpatients, types of drug distribution systems, charging policy and labelling, Dispensing of drugs to ambulatory patients, and Dispensing of controlled drugs.
- b) **Hospital formulary :** Definition, contents of hospital formulary, Differentiation of hospital formulary and Drug list, preparation and revision, and addition and deletion of drug from hospital formulary.

c) **Therapeutic drug monitoring**: Need for Therapeutic Drug Monitoring, Factors to be considered during the Therapeutic Drug Monitoring, and Indian scenario for Therapeutic Drug Monitoring.

d) **Medication adherence**: Causes of medication non-adherence, pharmacist role in the medication adherence, and monitoring of patient medication adherence.

e) **Patient medication history interview**: Need for the patient medication history interview, medication interview forms.

f) **Community pharmacy management**: Financial, materials, staff, and infrastructure requirements.

UNIT III

10 Hours

a) **Pharmacy and therapeutic committee**: Organization, functions, Policies of the pharmacy and therapeutic committee in including drugs into formulary, inpatient and outpatient prescription, automatic stop order, and emergency drug list preparation.

b) **Drug information services**: Drug and Poison information centre, Sources of drug information, Computerised services, and storage and retrieval of information.

c) **Patient counseling**: Definition of patient counseling; steps involved in patient counseling, and Special cases that require the pharmacist

d) **Education and training program in the hospital**: Role of pharmacist in the education and training program, Internal and external training program, Services to the nursing homes/clinics, Code of ethics for community pharmacy, and Role of pharmacist in the interdepartmental communication and community health education.

e) **Prescribed medication order and communication skills**: Prescribed medication order- interpretation and legal requirements, and Communication skills- communication with prescribers and patients.

UNIT IV

08 Hours a)

Budget preparation and implementation: Budget preparation and implementation

b) **Clinical Pharmacy**: Introduction to Clinical Pharmacy, Concept of clinical pharmacy, functions and responsibilities of clinical pharmacist, Drug therapy

monitoring - medication chart review, clinical review, pharmacist intervention, Ward round participation, Medication history and Pharmaceutical care. Dosing pattern and drug therapy based on Pharmacokinetic & disease pattern.

c) **Over the counter (OTC)** : sales Introduction and sale of over the counter, and Rational use of common over the counter medications.

UNIT V

07 Hours

a) **Drug store management and inventory control** : Organization of drug store, types of materials stocked and storage conditions, Purchase and inventory control: principles, purchase procedure, purchase order, procurement and stocking, Economic order quantity, Reorder quantity level, and Methods used for the analysis of the drug expenditure

b) **Investigational use of drugs** Description, principles involved, classification, control, identification, role of hospital pharmacist, advisory committee.

c) **Interpretation of Clinical Laboratory Tests** Blood chemistry, hematology, and urinalysis

RECOMMENDED BOOKS (LATEST EDITION):

1. Merchant S.H. and Dr. J.S.Quadry. A textbook of hospital pharmacy, 4th ed. Ahmadabad: B.S. Shah Prakakshan; 2001.
2. Parthasarathi G, Karin Nyfort-Hansen, Milap C Nahata. A textbook of Clinical Pharmacy Practice- essential concepts and skills, 1st ed. Chennai: Orient Longman Private Limited; 2004.
3. William E. Hassan. Hospital pharmacy, 5th ed. Philadelphia: Lea & Febiger; 1986.
4. Tipnis Bajaj. Hospital Pharmacy, 1st ed. Maharashtra: Career Publications; 2008.
5. Scott LT. Basic skills in interpreting laboratory data, 4thed. American Society of Health System Pharmacists Inc; 2009.
6. Parmar N.S. Health Education and Community Pharmacy, 18th ed. India: CBS Publishers and Distributers; 2008.

JOURNALS:

1. Therapeutic drug monitoring. ISSN: 0163-4356
2. Journal of pharmacy practice. ISSN : 0974-8326
3. American journal of health system pharmacy. ISSN: 1535-2900 (online)
4. Pharmacy times (Monthly magazine)

SEMESTER/ YEAR: VII SEM

COURSE CODE: 17BP704

TITLE OF THE COURSE: NOVEL DRUG DELIVERY SYSTEM – THEORY

L: T/A: P: C: 3 : 1 : 0 : 4

45 Hours

Course objectives: Upon completion of the course student shall be able

- To understand various approaches for development of novel drug delivery systems.
- To understand the criteria for selection of drugs and polymers for the development of Novel drug delivery systems, their formulation and evaluation

Course Outcome:

After the successful completion of the course the students will be able to

CO 1: Annotate the importance of controlled drug delivery system and role of polymers in preparation of novel drug delivery systems.

CO 2: Recapitulate the method of preparation of micro preparations, mucosal drug delivery and implants

CO 3: Interpret the significance of transdermal, gastro retentive and nasopulmonary drug delivery system

CO 4: Analyse the role of targeted drug delivery system

CO 5: Outline the prominence of ocular and intra uterine drug delivery system

UNIT-I

10 Hours

Controlled drug delivery systems: Introduction, terminology/definitions and rationale, advantages, disadvantages, selection of drug candidates. Approaches to design controlled release formulations based on diffusion, dissolution and ion exchange principles. Physicochemical and biological properties of drugs relevant to controlled release formulations

Polymers: Introduction, classification, properties, advantages and application of polymers in formulation of controlled release drug delivery systems.

UNIT-II

10 Hours

Microencapsulation: Definition, advantages and disadvantages, microspheres/microcapsules, microparticles, methods of microencapsulation, applications

Mucosal Drug Delivery system: Introduction, Principles of bioadhesion / mucoadhesion, concepts, advantages and disadvantages, transmucosal permeability and formulation considerations of buccal delivery systems

Implantable Drug Delivery Systems: Introduction, advantages and disadvantages, concept of implants and osmotic pump

UNIT-III

10 Hours

Transdermal Drug Delivery Systems: Introduction, **Permeation through skin**, factors affecting permeation, permeation enhancers, basic components of TDDS, **formulation approaches**

Gastroretentive drug delivery systems: Introduction, advantages, disadvantages, **approaches for GRDDS – Floating, high density systems, inflatable and gastroadhesive systems** and their applications

Nasopulmonary drug delivery system: Introduction to Nasal and Pulmonary routes of drug delivery, **Formulation of Inhalers (dry powder and metered dose), nasal sprays, nebulizers**

UNIT-IV

08 Hours

Targeted drug Delivery: Concepts and approaches advantages and disadvantages, introduction to **liposomes, niosomes, nanoparticles, monoclonal antibodies and their applications**

UNIT-V

07 Hours

Ocular Drug Delivery Systems: Introduction, intra ocular barriers and methods to overcome –Preliminary study, **ocular formulations and ocuserts**

Intrauterine Drug Delivery Systems: Introduction, advantages and disadvantages, **development of intra uterine devices (IUDs) and applications**

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of Controlled Delivery. Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and Sons, Inc, New York. Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P. Vyas and R.K. Khar, Controlled Drug Delivery -concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002.

JOURNALS:

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian Drugs (IDMA)
3. Journal of Controlled Release (Elsevier Sciences)
4. Drug Development and Industrial Pharmacy (Marcel & Decker)
5. International Journal of Pharmaceutics (Elsevier Sciences)

VII SEM
17BP705
INSTRUMENTAL METHODS OF ANALYSIS - PRACTICAL
0 : 0 : 4 : 2

Objectives:

- Handle the various sophisticated analytical instruments
- Perform experiments related to analysis using UV, IR, Fluorimetry, flame photometry and HPLC and TLC

1. Determination of absorption maxima and effect of solvents on absorption maxima of organic compounds
2. Estimation of dextrose by colorimetry
3. Estimation of sulfanilamide by colorimetry
4. Simultaneous estimation of ibuprofen and paracetamol by UV spectroscopy
5. Assay of paracetamol by UV- Spectrophotometry
6. Estimation of quinine sulfate by fluorimetry
7. Study of quenching of fluorescence
8. Determination of sodium by flame photometry
9. Determination of potassium by flame photometry
10. Determination of chlorides and sulphates by nephelo turbidometry
11. Separation of amino acids by paper chromatography
12. Separation of sugars by thin layer chromatography
13. Separation of plant pigments by column chromatography
14. Demonstration experiment on HPLC
15. Demonstration experiment on Gas Chromatography

SEMESTER/YEAR : VIII SEM

COURSE CODE 17BP801

TITLE OF THE COURSE : BIostatistics AND RESEARCH METHODOLOGY

Course objectives : Upon completion of the course the student shall be able to

1. Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)
2. Know the various statistical techniques to solve statistical problems
3. Appreciate statistical techniques in solving the problems.

Course outcome:

Acquire necessary hands-on experience in using M.S excel, SPSS, Minitab, DOE to be used in daily office computing and for practical experimentation purpose.

Analyze the type of research data and to use appropriate tools in research study.

Identify the type of statistical tool to be used to interpret and analyze the research data.

Developed the capability to design experiments and to solve problems using the appropriate statistical tools.

SEMESTER/YEAR : VIII SEM

COURSE CODE 17BP801

TITLE OF THE COURSE BIostatistics AND RESEARCH METHODOLOGY

L: T/A: P: C 3 : 1 : 0 : 4

45 Hours

Scope: To understand the applications of Biostatistics in Pharmacy. This subject deals with descriptive statistics, Graphics, Correlation, Regression, logistic regression Probability theory, Sampling technique, Parametric tests, Non Parametric tests, ANOVA, Introduction to Design of Experiments, Phases of Clinical trials and Observational and Experimental studies, SPSS, R and MINITAB statistical software's, analyzing the statistical data using Excel.

Course objectives : Upon completion of the course the student shall be able to

1. Know the operation of M.S. Excel, SPSS, R and MINITAB®, DoE (Design of Experiment)
2. Know the various statistical techniques to solve statistical problems
3. Appreciate statistical techniques in solving the problems.

UNIT-I 10 Hours

Introduction: Statistics, Biostatistics, Frequency distribution

Measures of central tendency: Mean, Median, Mode- Pharmaceutical examples

Measures of dispersion: Dispersion, Range, standard deviation, Pharmaceutical problems

Correlation: Definition, Karl Pearson's coefficient of correlation, Multiple correlation - Pharmaceuticals examples

UNIT-II 10 Hours

Regression: Curve fitting by the method of least squares, fitting the lines $y = a + bx$ and $x = a + by$, Multiple regression, standard error of regression – Pharmaceutical Examples

Probability: Definition of probability, Binomial distribution, Normal distribution, Poisson's distribution, properties – problems Sample, Population, large sample, small sample, Null hypothesis, alternative hypothesis, sampling, essence of sampling, types of sampling, Error-I type, Error-II type, Standard error of mean (SEM) - Pharmaceutical examples

Parametric test: t-test(Sample, Pooled or Unpaired and Paired) , ANOVA, (One way and Two way), Least Significance difference

13

UNIT-III 10 Hours

Non Parametric tests: Wilcoxon Rank Sum Test, Mann-Whitney U test, Kruskal-Wallis test, Friedman Test

Introduction to Research: Need for research, Need for design of Experiments,

Experiential Design Technique, plagiarism

Graphs: Histogram, Pie Chart, Cubic Graph, response surface plot, Counter Plot graph

Designing the methodology: Sample size determination and Power of a study, Report writing and presentation of data, Protocol, Cohorts studies, Observational studies,

Experimental studies, Designing clinical trial, various phases.

UNIT-IV 08 Hours

Blocking and confounding system for Two-level factorials

Regression modeling: Hypothesis testing in Simple and Multiple regression models

Introduction to Practical components of Industrial and Clinical Trials Problems:

Statistical Analysis Using Excel, SPSS, MINITAB®, DESIGN OF EXPERIMENTS, R - Online

Statistical Software's to Industrial and Clinical trial approach

UNIT-V 07 Hours

Design and Analysis of experiments:

Factorial Design: Definition, 22, 23design. Advantage of factorial design

Response Surface methodology: Central composite design, Historical design,

Optimization Techniques

RECOMMENDED BOOKS (LATEST EDITION):

1. Pharmaceutical statistics- Practical and clinical applications, Sanford Bolton, publisher Marcel Dekker Inc. NewYork.
2. Fundamental of Statistics – Himalaya Publishing House- S.C.Guptha
3. Design and Analysis of Experiments –PHI Learning Private Limited, R. Pannerselvam,
4. Design and Analysis of Experiments – Wiley Students Edition, Douglas and C. Montgomery

SEMESTER/YEAR : VIII SEM

COURSE CODE :17BP802

TITLE OF THE COURSE : SOCIAL AND PREVENTIVE PHARMACY

L: T/A: P: C : 3 : 1 : 0 : 4

Course objectives:

- Acquire high consciousness/realization of current issues related to health and pharmaceutical problems within the country and worldwide.
- Have a critical way of thinking based on current healthcare development.
- Evaluate alternative ways of solving problems related to health and pharmaceutical issues.

Course Outcomes:

- Present alternative ways of solving problems related to health
- Ability to apply general principles of prevention and control of disease.
- Highlight the objective, functioning and outcomes of national health programs
- Summarize the principles of National Health Intervention programs
- Ability to provide community services in rural, urban and school health

UNIT I

10 Hours

- **Concept of health and disease:** Definition, concepts and evaluation of public health. Understanding the concept of prevention and control of disease, social causes of diseases and social problems of the sick.
- **Social and health education:** Food in relation to nutrition and health, Balanced diet, Nutritional deficiencies, Vitamin deficiencies, Malnutrition and its prevention.
- **Sociology and health:** Socio cultural factors related to health and disease, Impact of urbanization on health and disease, Poverty and health.
- **Hygiene and health:** personal hygiene and health care; avoidable habits

UNIT II

10 Hours

Preventive medicine: General principles of prevention and control of diseases such as cholera, SARS, Ebola virus, influenza, acute respiratory infections, malaria, chicken guinea, dengue, lymphatic filariasis, pneumonia, hypertension, diabetes mellitus, cancer, drug addiction-drug substance abuse.

UNIT III

10 Hours

National health programs, its objectives, functioning and outcome of the following: HIV AND AIDS control programme, TB, Integrated disease surveillance program (IDSP), National leprosy control programme, National mental health program, National programme for prevention and control of deafness, Universal immunization programme, National programme for control of blindness, Pulse polio programme.

UNIT IV

08 Hours

National health intervention programme for mother and child, National family welfare programme, National tobacco control programme, National Malaria Prevention Program, National programme for the health care for the elderly, Social health programme; role of WHO in Indian national program

UNIT V

07 Hours

Community services in rural, urban and school health: Functions of PHC, Improvement in rural sanitation, national urban health mission, Health promotion and education in school.

RECOMMENDED BOOKS (LATEST EDITION):

1. Short Textbook of Preventive and Social Medicine, Prabhakara GN, 2nd Edition, 2010, ISBN: 9789380704104, JAYPEE Publications
2. Textbook of Preventive and Social Medicine (Mahajan and Gupta), Edited by Roy Rabindra Nath, Saha Indranil, 4th Edition, 2013, ISBN: 9789350901878, JAYPEE Publications
3. Review of Preventive and Social Medicine (Including Biostatistics), Jain Vivek, 6th Edition, 2014, ISBN: 9789351522331, JAYPEE Publications
4. Essentials of Community Medicine—A Practical Approach, Hiremath Lalita D, Hiremath Dhananjaya A, 2nd Edition, 2012, ISBN: 9789350250440, JAYPEE Publications
5. Park Textbook of Preventive and Social Medicine, K Park, 21st Edition, 2011, ISBN-14: 9788190128285, BANARSIDAS BHANOT PUBLISHERS.
6. Community Pharmacy Practice, Ramesh Adepu, BSP publishers, Hyderabad

RECOMMENDED JOURNALS:

1. Research in Social and Administrative Pharmacy, Elsevier, Ireland

SEMESTER/YEAR : VIII SEM

COURSE CODE : 17BP803

TITLE OF THE COURSE : PHARMA MARKETING MANAGEMENT

L: T/A: P: C : 3 : 1 : 0 : 4

Course outcomes:

1. Initiate startup and entrepreneurship programs.
2. Analyze the process in Pharma industry and community service management.
3. Acquire skills in communication for effective day to day office management.
4. Apply skills in management to efficiently and smoothly run a pharma business.

Scope: The pharmaceutical industry not only needs highly qualified researchers, chemists and technical people, but also requires skilled managers who can take the industry forward by managing and taking the complex decisions which are imperative for the growth of the industry. The Knowledge and Know-how of marketing management groom the people for taking a challenging role in Sales and Product management.

Course objectives : The course aims to provide an understanding of marketing concepts and techniques and their applications in the pharmaceutical industry.

UNIT I 10 Hours

Marketing:

Definition, general concepts and scope of marketing; Distinction between marketing & selling; Marketing environment; Industry and competitive analysis; Analyzing consumer buying behavior; industrial buying behavior.

Pharmaceutical market:

Quantitative and qualitative aspects; size and composition of the market; demographic descriptions and socio-psychological characteristics of the consumer; market segmentation & targeting. Consumer profile; Motivation and prescribing habits of the physician; patients' choice of physician and retail pharmacist. Analyzing the Market; Role of market research.

UNIT II 10 Hours

Product decision:

Classification, product line and product mix decisions, product life cycle, product portfolio analysis; product positioning; New product decisions; Product branding, packaging and

labeling decisions, Product management in pharmaceutical industry.

UNIT III 10 Hours

Promotion:

Methods, determinants of promotional mix, promotional budget; An overview of personal selling, advertising, direct mail, journals, sampling, retailing, medical exhibition, public relations, online promotional techniques for OTC Products

17

UNIT IV 10 Hours

Pharmaceutical marketing channels:

Designing channel, channel members, selecting the appropriate channel, conflict in channels, physical distribution management: Strategic importance, tasks in physical distribution management.

Professional sales representative (PSR):

Duties of PSR, purpose of detailing, selection and training, supervising, norms for customer calls, motivating, evaluating, compensation and future prospects of the PSR.

UNIT V 10 Hours

Pricing:

Meaning, importance, objectives, determinants of price; pricing methods and strategies, issues in price management in pharmaceutical industry. An overview of DPCO (Drug Price Control Order) and NPPA (National Pharmaceutical Pricing Authority).

Emerging concepts in marketing:

Vertical & Horizontal Marketing; Rural Marketing; Consumerism; Industrial Marketing; Global Marketing.

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Philip Kotler and Kevin Lane Keller: Marketing Management, Prentice Hall of India, New Delhi
2. Walker, Boyd and Larreche: Marketing Strategy- Planning and Implementation, Tata MC GrawHill, New Delhi.
3. Dhruv Grewal and Michael Levy: Marketing, Tata MC Graw Hill
4. Arun Kumar and N Menakshi: Marketing Management, Vikas Publishing, India
5. Rajan Saxena: Marketing Management; Tata MC Graw-Hill (India Edition)

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

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

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

17BP806

QUALITY CONTROL & STANDARDIZATION OF HERBALS

3 : 1 : 0 : 4

In this subject the student learns about the various methods and guidelines for evaluation and standardization of herbs and herbal drugs. The subject also provides an opportunity for the student to learn cGMP, GAP and GLP in traditional system of medicines.

COURSE OBJECTIVES: Upon completion of the subject student shall be able to;

1. Know WHO guidelines for quality control of herbal drugs
2. Know Quality assurance in herbal drug industry
3. Know the regulatory approval process and their registration in Indian and international markets
4. Appreciate EU and ICH guidelines for quality control of herbal drugs

UNIT I

10 Hours

Basic tests for drugs – Pharmaceutical substances, Medicinal plants materials and dosage forms

WHO guidelines for quality control of herbal drugs.

Evaluation of commercial crude drugs intended for use

UNIT II

10 Hours

Quality assurance in herbal drug industry of cGMP, GAP, GMP and GLP in traditional system of medicine.

WHO Guidelines on current good manufacturing Practices (cGMP) for Herbal Medicines

WHO Guidelines on GACP for Medicinal Plants.

UNIT III

10 Hours

EU and ICH guidelines for quality control of herbal drugs. Research Guidelines for Evaluating the Safety and Efficacy of Herbal Medicines

UNIT IV

08 Hours

Stability testing of herbal medicines. Application of various chromatographic techniques in standardization of herbal products.

Preparation of documents for new drug application and export registration GMP requirements and Drugs & Cosmetics Act provisions.

UNIT V

07 Hours

Regulatory requirements for herbal medicines.

WHO guidelines on safety monitoring of herbal medicines in pharmacovigilance systems

Comparison of various Herbal Pharmacopoeias.

Role of chemical and biological markers in standardization of herbal products

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Pharmacognosy by Trease and Evans
2. Pharmacognosy by Kokate, Purohit and Gokhale
3. Rangari, V.D., Text book of Pharmacognosy and Phytochemistry Vol. I , Carrier Pub., 2006.
4. Aggrawal, S.S., Herbal Drug Technology. Universities Press, 2002.
5. EMEA. Guidelines on Quality of Herbal Medicinal Products/Traditional Medicinal Products,
6. Mukherjee, P.W. Quality Control of Herbal Drugs: An Approach to Evaluation of Botanicals. Business Horizons Publishers, New Delhi, India, 2002.
7. Shinde M.V., Dhalwal K., Potdar K., Mahadik K. Application of quality control principles to herbal drugs. International Journal of Phytomedicine 1(2009); p. 4-8.
8. WHO. Quality Control Methods for Medicinal Plant Materials, World Health Organization, Geneva, 1998. WHO. Guidelines for the Appropriate Use of Herbal Medicines. WHO Regional Publications, Western Pacific Series No 3, WHO Regional office for the Western Pacific, Manila, 1998.
9. WHO. The International Pharmacopeia, Vol. 2: Quality Specifications, 3rd edn. World Health Organization, Geneva, 1981.
10. WHO. Quality Control Methods for Medicinal Plant Materials. World Health Organization, Geneva, 1999.
11. WHO. WHO Global Atlas of Traditional, Complementary and Alternative Medicine. 2 vol. set. Vol. 1 contains text and Vol. 2, maps. World Health Organization, Geneva, 2005.
12. WHO. Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants. World Health Organization, Geneva, 2004.

17BP807
COMPUTER AIDED DRUG DESIGN
3 : 1 : 0 : 4

45 Hours

This subject is designed to provide detailed knowledge of rational drug design process and various techniques used in rational drug design process.

COURSE OBJECTIVES: Upon completion of the course, the student shall be able to understand

- (i) Design and discovery of lead molecules
- (ii) The role of drug design in drug discovery process
- (iii) The concept of QSAR and docking
- (iv) Various strategies to develop new drug like molecules.
- (v) The design of new drug molecules using molecular modeling software

UNIT-I

10 Hours

Introduction to Drug Discovery and Development

Stages of drug discovery and development

Lead discovery and Analog Based Drug Design

Rational approaches to lead discovery based on traditional medicine, Random screening, Non-random screening, serendipitous drug discovery, lead discovery based on drug metabolism, lead discovery based on clinical observation.

Analog Based Drug Design: Bioisosterism, Classification, Bioisosteric replacement. Any three case studies

UNIT-II

10 Hours

Quantitative Structure Activity Relationship (QSAR)

SAR versus QSAR, History and development of QSAR, Types of physicochemical parameters, experimental and theoretical approaches for the determination of physicochemical parameters such as Partition coefficient, Hammett's substituent constant and Taft's steric constant.

Hansch analysis, Free Wilson analysis, 3D-QSAR approaches like COMFA and COMSIA.

UNIT-III

10 Hours

Molecular Modeling and virtual screening techniques

Virtual Screening techniques: Drug likeness screening, Concept of pharmacophore mapping and pharmacophore based Screening,

Molecular docking: Rigid docking, flexible docking, manual docking, Docking based screening. *De novo* drug design.

UNIT-IV

08 Hours

Informatics & Methods in drug design

Introduction to Bioinformatics, chemoinformatics. ADME databases, chemical, biochemical and pharmaceutical databases.

UNIT-V

07 Hours

Molecular Modeling: Introduction to molecular mechanics and quantum mechanics. Energy Minimization methods and Conformational Analysis, global conformational minima determination.

RECOMMENDED BOOKS (LATEST EDITIONS):

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Park Press Baltimore.
2. Martin YC. "Quantitative Drug Design" Dekker, New York.
3. Delgado JN, Remers WA eds "Wilson & Gisvold's Text Book of Organic Medicinal & Pharmaceutical Chemistry" Lippincott, New York.
4. Foye WO "Principles of Medicinal chemistry" Lea & Febiger.
5. Koro Ikovas A, Burckhalter JH. "Essentials of Medicinal Chemistry" Wiley Interscience.
6. Wolf ME, ed "The Basis of Medicinal Chemistry, Burger's Medicinal Chemistry" John Wiley & Sons, New York.
7. Patrick Graham, L., An Introduction to Medicinal Chemistry, Oxford University Press.
8. Smith HJ, Williams H, eds, "Introduction to the principles of Drug Design" Wright Boston.
9. Silverman R.B. "The organic Chemistry of Drug Design and Drug Action" Academic Press New York.

SEMESTER/YEAR: VIII SEM

COURSE CODE: 17BP808

TITLE OF THE COURSE: CELL AND MOLECULAR BIOLOGY L: T/A:

P: C : 3 : 1 : 0 : 4

45 Hour

Cell biology is a branch of biology that studies cells – their physiological properties, their structure, the organelles they contain, interactions with their environment, their life cycle, division, death and cell function. This is done both on a microscopic and molecular level. Cell biology research encompasses both the great diversity of single-celled organisms like bacteria and protozoa, as well as the many specialized cells in multi-cellular organisms such as humans, plants, and sponges.

Course Objectives:

Upon completion of the subject student shall be able to;

- (i) Summarize cell and molecular biology history.
- (ii) Summarize cellular functioning and composition.
- (iii) Describe the chemical foundations of cell biology.
- (iv) Summarize the DNA properties of cell biology.
- (v) Describe protein structure and function.
- (vi) Describe cellular membrane structure and function.
- (vii) Describe basic molecular genetic mechanisms. (viii) Summarize the Cell Cycle

Course Outcomes

Upon completion of the course, the student shall be able to understand –

1. Explain cell and molecular biology history.
2. Understand cellular functioning and composition.
3. Describe the chemical foundations of cell biology.
4. Summarize the DNA properties of cell biology.
5. Estimate protein structure and function.
6. Explore cellular membrane structure and function.
7. Describe basic molecular genetic mechanisms and summarize the Cell Cycle

UNIT I

10 Hours

- a) Cell and Molecular Biology: Definitions theory and basics and Applications.
- b) Cell and Molecular Biology: History and Summation.
- c) Properties of cells and cell membrane.
- d) Prokaryotic versus Eukaryotic
- e) Cellular Reproduction f) Chemical Foundations – an Introduction and Reactions (Types)

UNIT II

10

Hours

- a) **DNA and the Flow of Molecular Information**
- b) DNA Functioning
- c) DNA and RNA
- d) Types of RNA

e) Transcription and Translation

UNIT III

10

Hours

- a) Proteins: Defined and Amino Acids
- b) Protein Structure
- c) Regularities in Protein Pathways
- d) Cellular Processes
- e) Positive Control and significance of Protein Synthesis

UNIT IV

08 Hours

- a) Science of Genetics
- b) Transgenics and Genomic Analysis
- c) Cell Cycle analysis
- d) Mitosis and Meiosis
- e) Cellular Activities and Checkpoints

UNIT V

07

Hours

- a) Cell Signals: Introduction
- b) Receptors for Cell Signals
- c) Signaling Pathways: Overview
- d) Misregulation of Signaling Pathways
- e) Protein-Kinases: Functioning

RECOMMENDED BOOKS (LATEST EDITION):

1. W.B. Hugo and A.D. Russel: Pharmaceutical Microbiology, Blackwell Scientific publications, Oxford London.
2. Prescott and Dunn., Industrial Microbiology, 4th edition, CBS Publishers & Distributors, Delhi.
3. Pelczar, Chan Kreig, Microbiology, Tata McGraw Hill edn.
4. Malcolm Harris, Balliere Tindall and Cox: Pharmaceutical Microbiology.
5. Rose: Industrial Microbiology.
6. Probisher, Hinsdill et al: Fundamentals of Microbiology, 9th ed. Japan
7. Cooper and Gunn's: Tutorial Pharmacy, CBS Publisher and Distribution.
8. Pepler: Microbial Technology.
9. Edward: Fundamentals of Microbiology.
10. N.K.Jain: Pharmaceutical Microbiology, Vallabh Prakashan, Delhi
11. Bergeys manual of systematic bacteriology, Williams and Wilkins- A Waverly company
12. B.R. Glick and J.J. Pasternak: Molecular Biotechnology: Principles and Applications of RecombinantDNA: ASM Press Washington D.C. 13. RA Goldshy et. al., : Kuby Immunology.

SEMESTER/YEAR: VIII SEM

COURSE CODE: 17BP809

TITLE OF THE COURSE: COSMETIC SCIENCE

L: T/A: P: C: 3: 1 : 0 : 4

45Hours

COURSE OBJECTIVES :

- To understand the basic of cosmetics, cosmeceutical products and Analytical Cosmetics.
- To empower the students to understand the principles of skin, hair and oral care products.
- To enable the students to comprehend the role of herbs in cosmetics.

COURSE OUTCOMES :

After the successful completion of the course the students will be able to

CO 1: Define the cosmetics according to various regulatory bodies, Classify cosmetic excipients, Explain the basic structure and function of skin, hair growth cycle and problems associated with teeth and gums

CO 2: Explain principles of formulation and building blocks of skin care, hair care and oral care products and give the applications of skin care products

CO 3: Analyze cosmetics according to BIS Specification

CO 4: Annotate the measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties

CO 5: Explain the problems associated with hair and scalp

UNIT I

10 Hours

Classification of cosmetic and cosmeceutical products. Definition of cosmetics as per Indian and EU regulations, Evolution of cosmeceuticals from cosmetics, cosmetics as quasi and OTC drugs

Cosmetic excipients: Surfactants, rheology modifiers, humectants, emollients, preservatives.

Classification and application Skin: Basic structure and function of skin. Hair: Basic structure of hair. Hair growth cycle. Oral Cavity: Common problem associated with teeth and gums.

UNIT II

10 Hours

Principles of formulation and building blocks of skin care products:

Face wash, Moisturizing cream, Cold Cream, Vanishing cream and their advantages and disadvantages. Application of these products in formulation of cosmeceuticals.

Antiperspirants & deodorants- Actives & mechanism of action.

Principles of formulation and building blocks of Hair care products: Conditioning shampoo, Hair conditioner, anti-dandruff shampoo. Hair oils. Chemistry and formulation of Para-phenylene diamine based hair dye.

Principles of formulation and building blocks of oral care products: Toothpaste for bleeding gums, sensitive teeth. Teeth whitening, Mouthwash.

UNIT III

10 Hours

Sun protection, Classification of Sunscreens and SPF.

Role of herbs in cosmetics: Skin Care: Aloe and turmeric Hair care: Henna and amla. Oral care: Neem and clove

Analytical cosmetics: BIS specification and analytical methods for shampoo, skin cream and toothpaste.

UNIT IV

08 Hours.

Principles of Cosmetic Evaluation: Principles of sebumeter, corneometer. Measurement of TEWL, Skin Color, Hair tensile strength, Hair combing properties Soaps, and syndet bars. Evolution and skin benefits.

UNIT V

07 Hours

Oily and dry skin, causes leading to dry skin, skin moisturization. Basic understanding of the terms Comedogenic, dermatitis.

Cosmetic problems associated with Hair and scalp: Dandruff, Hair fall causes

Cosmetic problems associated with skin: blemishes, wrinkles, acne, prickly heat and body odor.

Antiperspirants and Deodorants- Actives and mechanism of action

REFERENCES:

- 1) Harry's Cosmeticology, Wilkinson, Moore, Seventh Edition, George Godwin.
- 2) Cosmetics – Formulations, Manufacturing and Quality Control, P.P. Sharma, 4th Edition,

Vandana Publications Pvt. Ltd., Delhi.

3) Text book of cosmelicology by Sanju Nanda & Roop K. Khar, Tata Publishers.

SEMESTER/YEAR: VIII SEM

COURSE CODE: 17BP810

TITLE OF THE COURSE: EXPERIMENTAL PHARMACOLOGY

L: T/A: P: C: 3: 1: 0: 4

45 Hours

This subject is designed to impart the basic knowledge of preclinical studies in experimental animals including design, conduct and interpretations of results.

COURSE OBJECTIVES: Upon completion of the course the student shall be able to,

- (i) Appreciate the applications of various commonly used laboratory animals.
- (ii) Appreciate and demonstrate the various screening methods used in preclinical research
- (iii) Appreciate and demonstrate the importance of biostatistics and research methodology
- (iv) Design and execute a research hypothesis independently

Course Outcome:

- Summarize and highlight the scope of experimental pharmacology and design of experiments
- Interpret and illustrate the selected preclinical screening models
- Annotate and execute the statistical calculations in the methodology part
- Identify, assess and monitor the observation and evaluation in preclinical screening

UNIT – I 08 Hours

Laboratory Animals:

Study of CPCSEA and OECD guidelines for maintenance, breeding and conduct of experiments on laboratory animals, Common lab animals: Description and applications of different species and strains

of animals. Popular transgenic and mutant animals.

Techniques for collection of blood and common routes of drug administration in laboratory animals, **Techniques of blood collection and euthanasia.**

UNIT – II 10 Hours

Preclinical screening models

a. Introduction: **Dose selection, calculation and conversions, preparation of drug solution/suspensions, grouping of animals and importance of sham negative and positive control groups. Rationale for selection of animal species and sex for the study.**

b. **Study of screening animal models for**

Diuretics, nootropics, anti-Parkinson's, antiasthmatics,

Preclinical screening models: for CNS activity- analgesic, antipyretic, anti-inflammatory, general anaesthetics, sedative and hypnotics, antipsychotic, antidepressant, antiepileptic, antiparkinsonism, alzheimer's disease

UNIT – III 10 Hours

Preclinical screening models: for ANS activity, sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics, skeletal muscle relaxants, drugs acting on eye, local anaesthetics

UNIT –IV 10 Hours

Preclinical screening models: for CVS activity- antihypertensives, diuretics, antiarrhythmic, antidyslipidemic, anti aggregatory, coagulants, and anticoagulants antiparkinsonian

Preclinical screening models for other important drugs like antiulcer, antidiabetic, anticancer and antiasthmatics.

UNIT - V 07 Hours

Research methodology and Bio-statistics

Selection of research topic, review of literature, research hypothesis and study design

Pre-clinical data analysis and interpretation using Students 't' test and One-way ANOVA.

Graphical representation of data

RECOMMENDED BOOKS (LATEST EDITION):

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh
2. Hand book of Experimental Pharmacology-S.K.Kulakarni
3. CPCSEA guidelines for laboratory animal facility.
4. Drug discovery and Evaluation by Vogel H.G.
5. Drug Screening Methods by Suresh Kumar Gupta and S. K. Gupta
6. Introduction to biostatistics and research methods by PSS Sundar Rao and J Richard

SEMESTER/YEAR : VIII
COURSE CODE : 17BP811
TITLE OF THE COURSE : ADVANCED INSTRUMENTATION TECHNIQUES
L:T/A: P:C : 3 : 1 : 0 : 4

45 Hours

Course Objectives: This subject deals with the application of instrumental methods in qualitative and quantitative analysis of drugs. This subject is designed to impart advanced knowledge on the principles and instrumentation of spectroscopic and chromatographic hyphenated techniques. This also emphasizes on theoretical and practical knowledge on modern analytical instruments that are used for drug testing.

Course Outcomes: Upon completion of the course the student shall be able to (i) understand the advanced instruments used and its applications in drug analysis (ii) understand the chromatographic separation and analysis of drugs. (iii) understand the calibration of various analytical instruments (iv) know analysis of drugs using various analytical instruments.

UNIT-I **10 Hours**

Nuclear Magnetic Resonance spectroscopy

Principles of H-NMR and C-NMR, chemical shift, factors affecting chemical shift, coupling constant, Spin - spin coupling, relaxation, instrumentation and applications

Mass Spectrometry- Principles, Fragmentation, Ionization techniques – Electron impact, chemical ionization, MALDI, FAB, Analyzers-Time of flight and Quadrupole, instrumentation, applications

UNIT-II **10 Hours**

Thermal Methods of Analysis: Principles, instrumentation and applications of Thermogravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC)

X-Ray Diffraction Methods: Origin of X-rays, basic aspects of crystals, X-ray Crystallography, rotating crystal technique, single crystal diffraction, powder diffraction, structural elucidation and applications.

UNIT-III **10 Hours**

Calibration and validation-as per ICH and USFDA guidelines

Calibration of following Instruments

Electronic balance, UV-Visible spectrophotometer, IR spectrophotometer, Fluorimeter, Flame Photometer, HPLC and GC

UNIT-IV **08 Hours**

Radio immune assay: Importance, various components, Principle, different methods, Limitation and Applications of Radio immuno assay

Extraction techniques: General principle and procedure involved in the solid phase extraction and liquid-liquid extraction

UNIT-V**07 Hours****Hyphenated techniques-LC-MS/MS, GC-MS/MS, HPTLC-MS.****RECOMMENDED BOOKS (LATEST EDITIONS):**

1. Instrumental Methods of Chemical Analysis by B.K Sharma
2. Organic spectroscopy by Y.R Sharma
3. Text book of Pharmaceutical Analysis by Kenneth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein

17BP812

TITLE OF THE COURSE **DIETARY SUPPLEMENTS AND NUTRACEUTICALS L:**

T/A: P: C **3 : 1 : 0 : 4**

45 Hours

This subject covers foundational topics that are important for understanding the need and requirements of dietary supplements among different groups in the population.

COURSE OBJECTIVE: This module aims to provide an understanding of the concepts behind the theoretical applications of dietary supplements. By the end of the course, students should be able to:

1. Understand the need of supplements by the different group of people to maintain healthy life.
2. Understand the outcome of deficiencies in dietary supplements.
3. Appreciate the components in dietary supplements and the application.
4. Appreciate the regulatory and commercial aspects of dietary supplements including health claims.

UNIT I

07 Hours

a. Definitions of Functional foods, Nutraceuticals and Dietary supplements. Classification of Nutraceuticals, Health problems and diseases that can be prevented or cured by Nutraceuticals i.e. weight control, diabetes, cancer, heart disease, stress, osteoarthritis, hypertension etc.

b. Public health nutrition, maternal and child nutrition, nutrition and ageing, nutrition education in community.

c. Source, Name of marker compounds and their chemical nature, Medicinal uses and health benefits of following used as nutraceuticals/functional foods: Spirulina, Soyabean, Ginseng, Garlic, Broccoli, Gingko, Flaxseeds

UNIT II

15 Hours

Phytochemicals as nutraceuticals: Occurrence and characteristic features (chemical nature medicinal benefits) of following

- a) Carotenoids- α and β -Carotene, Lycopene, Xanthophylls, lutein
- b) Sulfides: Diallyl sulfides, Allyl trisulfide.
- c) Polyphenolics: Resveratrol
- d) Flavonoids- Rutin, Naringin, Quercetin, Anthocyanidins, catechins, Flavones
- e) Prebiotics / Probiotics: Fructo oligosaccharides, Lacto bacillum
- f) Phyto estrogens: Isoflavones, daidzein, Genistein, lignans
- g) Tocopherols
- h) Proteins, vitamins, minerals, cereal, vegetables and beverages as functional foods: oats, wheat bran, rice bran, sea foods, coffee, tea and the like.

UNIT III**07 Hours**

- a) Introduction to free radicals: Free radicals, reactive oxygen species, production of free radicals in cells, damaging reactions of free radicals on lipids, proteins, Carbohydrates, nucleic acids.
- b) Dietary fibres and complex carbohydrates as functional food ingredients..

UNIT IV**10 Hours**

- a) Free radicals in Diabetes mellitus, Inflammation, Ischemic reperfusion injury, Cancer, Atherosclerosis, Free radicals in brain metabolism and pathology, kidney damage, muscle damage. Free radicals involvement in other disorders. Free radicals theory of ageing.
- b) Antioxidants: Endogenous antioxidants – enzymatic and nonenzymatic antioxidant defence, Superoxide dismutase, catalase, Glutathione peroxidase, Glutathione Vitamin C, Vitamin E, α - Lipoic acid, melatonin Synthetic antioxidants: Butylated hydroxy Toluene, Butylated hydroxy Anisole.
- c) Functional foods for chronic disease prevention

UNIT V**06 Hours**

- a) Effect of processing, storage and interactions of various environmental factors on the potential of nutraceuticals.
- b) Regulatory Aspects; FSSAI, FDA, FPO, MPO, AGMARK. HACCP and GMPs on Food Safety. Adulteration of foods.
- c) Pharmacopoeial Specifications for dietary supplements and nutraceuticals.

SEMESTER/YEAR : VIII SEM
COURSE CODE : 17BP813
TITLE OF THE COURSE : Project Work

Objectives:

1. MC-CADD: To understand the applications of CADD in the design lead compounds. To know the proprieties of chemicals and reagents involved in organic synthesis.
2. CMB: To know the drug metabolic pathways, adverse effect and therapeutic value of drugs through in vivo and in vitro pharmacological experiments.
3. F&D: To appreciate the physicochemical properties of excipients.
4. HDC: To recognize the medicinal value of herbal plant products.

Outcomes:

1. MC-CADD: Demonstrate and the applications of CADD and design lead compounds. The lead compounds designed to be chemical synthesized and characterized.
2. CMB: Demonstrate the drug metabolic pathways, adverse effect and therapeutic value of drugs through in vivo and in vitro pharmacological experiments.
3. F&D: Demonstrate use of physicochemical properties in the formulation development and evaluation of dosage forms.
4. HDD: To carryout isolation and identification of phytoconstituents

The student can take up projects on any one of the following four project areas and pursue research work.

Medicinal Chemistry- Computer aided drug design (MC-CADD):

Understand the structural properties of a molecule and its influence on pharmacological properties. Learn the computer aided drug design and its tools such as QSAR, SBDD, and MD in developing *in silico* evidence for druggable molecule. A strategy to be developed for the chemical synthesis of the designed compounds.

Pharmacology-Cell and Molecular Biology (CMB):

Undertand the mechanism of action, therapeutic effects, therapeutic uses, adverse reactions and contraindications of drugs/novel chemical entities that to act on acting on respiratory and gastrointestinal system, infectious diseases, and immuno-pharmacology.

Pharmaceutics-Formulation and development (F&D): Understand the physicochemical properties, and principles involved in dosage forms/formulations. Adopt formulation research and development in designing the pharmaceutical dosage forms. Parameters involved stability studies of those formulated dosage forms.

Pharmacognosy-Herbal drug development (HDD): To gain the knowledge medicinal properties of active constituents of plant materials. Extraction and isolation active constituents of plant materials. Analytical characterization and pharmacological evaluation of isolated active constituents.

SEMESTER/YEAR: I SEM

COURSE CODE: 17MPH101

TITLE OF THE COURSE: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

Course Objective

This subject deals with various advanced analytical instrumental techniques for identification, characterization and quantification of drugs and to impart knowledge on Instruments like NMR, Mass spectrometer, IR, HPLC, GC etc.

Course Outcomes

- The analysis of various drugs in single and combination dosage forms
- Theoretical and practical skills of the instruments.
- Apply the concepts and interpret the compound to elucidate the structure.

UNIT – I

11 hrs

- a. UV-Visible spectroscopy: Introduction, Theory, Laws, **Instrumentation** associated with UV-Visible spectroscopy, Choice of solvents and solvent effect and **Applications of UV Visible spectroscopy.**
- b. IR spectroscopy: Theory, **Modes of Molecular vibrations, Sample handling, Instrumentation** of Dispersive and Fourier - Transform IR Spectrometer, Factors affecting vibrational frequencies and **Applications of IR spectroscopy**
- c. Spectro fluorimetry: Theory of Fluorescence, Factors affecting fluorescence, Quenchers, **Instrumentation** and **Applications of fluorescence spectrophotometer.**
- d. Flame emission spectroscopy and Atomic absorption spectroscopy: **Principle, Instrumentation, Interferences and Applications.**

UNIT – II

11 hrs

NMR spectroscopy: Quantum numbers and their role in NMR, **Principle, Instrumentation, Solvent requirement in NMR, Relaxation process, NMR signals in various compounds, Chemical shift, Factors influencing chemical shift, Spin-Spin coupling, Coupling constant, Nuclear magnetic double resonance, Brief outline of principles of FT-NMR and ¹³C NMR. Applications of NMR spectroscopy.**

UNIT – III

11 hrs

Mass Spectroscopy: **Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, APCI, ESI, APPI Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Meta stable ions, Isotopic peaks and Applications of Mass spectroscopy**

UNIT - IV**11 hrs**

Chromatography: Principle, apparatus, instrumentation, chromatographic parameters, factors affecting resolution and applications of the following:

- a) Paper chromatography b) Thin Layer chromatography c) Ion exchange chromatography d) Column chromatography e) Gas chromatography f) High Performance Liquid chromatography g) Affinity chromatography

UNIT - V**11 hrs**

a. **Electrophoresis: Principle, Instrumentation, Working** conditions, factors affecting **separation and applications** of the following:

- a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis
d) Zone electrophoresis e) Moving boundary electrophoresis f) Iso electric focusing

b. X ray Crystallography: Production of X rays, Different X ray diffraction methods, Bragg's law, Rotating crystal technique, X ray powder technique, Types of crystals and **applications of Xray diffraction.**

UNIT - VI**5 hrs**

6 **Immunological assays** : RIA (Radio immuno assay), ELISA, Bioluminescence assays.

REFERENCES:

1. Spectrometric Identification of Organic compounds - Robert M Silverstein, Sixth edition, John Wiley & Sons, 2004.
2. Principles of Instrumental Analysis - Douglas A Skoog, F. James Holler, Timothy A. Nieman, 5th edition, Eastern press, Bangalore, 1998.
3. Instrumental methods of analysis – Willards, 7th edition, CBS publishers.
4. Practical Pharmaceutical Chemistry – Beckett and Stenlake, Vol II, 4th edition, CBS Publishers, New Delhi, 1997.
5. Organic Spectroscopy - William Kemp, 3rd edition, ELBS, 1991.
6. Quantitative Analysis of Drugs in Pharmaceutical formulation - P D Sethi, 3rd Edition, CBS Publishers, New Delhi, 1997.
7. Pharmaceutical Analysis- Modern methods – Part B - J W Munson, Volume 11, Marcel Dekker Series

SEMESTER/YEAR : I SEM

COURSE CODE : 17MPH102

TITLE OF THE COURSE : DRUG DELIVERY SYSTEMS

This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

COURSE OBJECTIVES

- To understand the various approaches used for development of novel drug delivery systems.
- To understand the criteria for the selection of drugs and polymers for the development of drug delivery system
- To understand the formulation and evaluation of Novel drug delivery systems.

COURSE OUTCOMES

Upon completion of the course, student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of delivering system
- The formulation and evaluation of Novel drug delivery systems.

10 hrs

1. Sustained Release(SR) and Controlled Release (CR) formulations: Introduction & basic concepts, advantages/ disadvantages, factors influencing, Physicochemical & biological approaches for SR/CR formulation, Mechanism of Drug Delivery from SR/CR formulation.

Polymers: introduction, definition, classification, properties and application Dosage Forms for Personalized Medicine: Introduction, Definition, Pharmacogenetics, Categories of Patients for Personalized Medicines: Customized drug delivery systems, Bioelectronic Medicines, 3D printing of pharmaceuticals, Telepharmacy.

10 hrs

2. Rate Controlled Drug Delivery Systems: Principles & Fundamentals, Types, Activation; Modulated Drug Delivery Systems; Mechanically activated, pH activated, Enzyme activated, and Osmotic activated Drug Delivery Systems Feedback regulated Drug Delivery Systems; Principles & Fundamentals.

10 hrs

3 Gastro-Retentive Drug Delivery Systems: Principle, concepts advantages and disadvantages, Modulation of GI transit time approaches to extend GI transit. Buccal Drug Delivery Systems: Principle of muco adhesion, advantages and disadvantages, Mechanism of drug permeation, Methods of formulation and its evaluations.

6 hrs

4 Ocular Drug Delivery Systems: Barriers of drug permeation, Methods to overcome barriers.

10 hrs

5 Transdermal Drug Delivery Systems: Structure of skin and barriers, Penetration enhancers, Transdermal Drug Delivery Systems, Formulation and evaluation.

8 hrs

6. Protein and Peptide Delivery: Barriers for protein delivery. Formulation and Evaluation of delivery systems of proteins and other macromolecules.

6 hrs

7. Vaccine delivery systems: Vaccines, uptake of antigens, single shot vaccines, mucosal and transdermal delivery of vaccines.

REFERENCES:

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. Robinson, J. R., Lee V. H. L, Controlled Drug Delivery Systems, Marcel Dekker, Inc., New York, 1992.
3. Encyclopedia of controlled delivery, Editor- Edith Mathiowitz, Published by WileyInterscience Publication, John Wiley and Sons, Inc, New York! Chichester/Weinheim
4. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, New Delhi, First edition 1997 (reprint in 2001).
5. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, Vallabh Prakashan, New Delhi, First edition 2002

JOURNALS

1. Indian Journal of Pharmaceutical Sciences (IPA)
2. Indian drugs (IDMA)
3. Journal of controlled release (Elsevier Sciences) desirable
4. Drug Development and Industrial Pharmacy (Marcel & Decker) desirable

SEMESTER/YEAR : I SEM
COURSE CODE : 17MPH103
TITLE OF THE COURSE : MODERN PHARMACEUTICS

Course designed to impart advanced knowledge and skills required to learn various aspects and concepts at pharmaceutical industries

COURSE OBJECTIVES

- Upon completion of the course, student shall be able to understand
- The elements of preformulation studies.
 - The Active Pharmaceutical Ingredients and Generic drug Product development
 - Industrial Management and GMP Considerations.
 - Optimization Techniques & Pilot Plant Scale Up Techniques
 - Stability Testing, sterilization process & packaging of dosage forms.

COURSE OUTCOMES :

- C01 Elucidate the preliminary evaluation test and elements required for Preformulation studies.
- C02 Explain ICH & WHO guidelines for calibration and validation of equipments.
- C03 Discuss the key parts of Industrial management and policies of cGMP
- C04 Discuss the physics of tablet making, giving special emphasis on distribution and measurement of forces involved in it.
- C05 Study of various consolidation parameters.

10 hrs

1. a. **Preformation Concepts** – Drug Excipient interactions - different methods, kinetics of stability, Stability testing. Theories of dispersion and pharmaceutical Dispersion (Emulsion and Suspension, SMEDDS) preparation and stability Large and small volume parental – physiological and formulation consideration, Manufacturing and evaluation.

10 hrs

- b. Optimization techniques in Pharmaceutical Formulation: Concept and parameters of optimization, Optimization techniques in pharmaceutical formulation and processing. Statistical design, Response surface method, Contour designs, Factorial designs and application in formulation

10 hrs

2. Validation : Introduction to Pharmaceutical Validation, Scope & merits of Validation, Validation and calibration of Master plan, **ICH & WHO guidelines for calibration and validation of equipments**, Validation of specific dosage form, Types of validation. Government regulation, Manufacturing Process Model, URS, DQ, IQ, OQ & P.Q. of facilities.

10 hrs

3. **cGMP & Industrial Management**: Objectives and policies of current good manufacturing practices, layout of buildings, services, equipments and their maintenance Production management: Production organization, materials

management, handling and transportation, inventory management and control, production and planning control, Sales forecasting, budget and cost control, industrial and personal relationship. Concept of Total Quality Management.

10 hrs

4. **Compression and compaction:** Physics of tablet compression, compression, consolidation, effect of friction, distribution of forces, compaction profiles. Solubility

10 hrs

5. **Study of consolidation parameters;** Diffusion parameters, Dissolution parameters and Pharmacokinetic parameters, Heckel plots, Similarity factors – f_2 and f_1 , Higuchi and Peppas plot, Linearity Concept of significance, Standard deviation , Chi square test, students T-test , ANOVA test.

REFERENCES

1. Theory and Practice of Industrial Pharmacy By Lachmann and Libermann
2. Pharmaceutical dosage forms: Tablets Vol. 1-3 by Leon Lachmann.
3. Pharmaceutical Dosage forms: Disperse systems, Vol, 1-2; By Leon Lachmann.
4. Pharmaceutical Dosage forms: Parenteral medications Vol. 1-2; By Leon Lachmann.
5. Modern Pharmaceutics; By Gillbert and S. Banker.
6. Remington's Pharmaceutical Sciences.
7. Advances in Pharmaceutical Sciences Vol. 1-5; By H.S. Bean & A.H. Beckett.
8. Physical Pharmacy; By Alfred martin
9. Bentley's Textbook of Pharmaceutics – by Rawlins.
10. Good manufacturing practices for Pharmaceuticals: A plan for total quality control, Second edition; By Sidney H. Willig.
11. Quality Assurance Guide; By Organization of Pharmaceutical producers of India.
12. Drug formulation manual; By D.P.S. Kohli and D.H.Shah. Eastern publishers, New Delhi.
13. How to practice GMPs; By P.P.Sharma. Vandhana Publications, Agra.
14. Pharmaceutical Process Validation; By Fra. R. Berry and Robert A. Nash.
15. Pharmaceutical Preformulations; By J.J. Wells.
16. Applied production and operations management; By Evans, Anderson, Sweeney and Williams.
17. Encyclopaedia of Pharmaceutical technology, Vol I – III.

SEMESTER/YEAR: Semester

COURSE CODE: **17MPH104**

TITLE OF THE COURSE: **Regulatory Affairs**

Course designed to impart advanced knowledge and skills required to learn the concept of generic drug and their development, various regulatory filings in different countries, different phases of clinical trials and submitting regulatory documents : filing process of IND, NDA and ANDA

COURSE OBJECTIVES

- To know the approval process of
- To know the chemistry, manufacturing controls and their regulatory importance
- To learn the documentation requirements for - To learn the importance and Objectives:

COURSE OUTCOMES

Upon completion of the course, it is expected that the students will be able to Understand

- The Concepts of innovator and generic drugs, drug development process
- The Regulatory guidance's and guidelines for filing and approval process
- Preparation of Dossiers and their submission to regulatory agencies in different countries
- Post approval regulatory requirements for actives and drug products
- Submission of global documents in CTD/ eCTD formats
- Clinical trials requirements for approvals for conducting clinical trials - Pharmacovigilance and process of monitoring in clinical trials.

12 hrs

1. a. Documentation in Pharmaceutical industry: Master formula record, DMF (Drug Master File), distribution records. Generic drugs product development Introduction , Hatch- Waxman act and amendments, CFR (CODE OF FEDERAL REGULATION) ,drug product performance, in-vitro, ANDA regulatory approval process, NDA approval process, BE and drug product assessment, in -vivo, scale up process approval changes, post marketing surveillance, outsourcing BA and BE to CRO.

b. Regulatory requirement for product approval: API, biologics, novel, therapies obtaining NDA, ANDA for generic drugs ways and means of US registration for foreign drugs

12 hrs

2 CMC, post approval regulatory affairs. Regulation for combination products and medical devices. CTD and ECTD format, industry and FDA liaison. ICH - Guidelines of ICH-Q, S E, M. Regulatory requirements of EU, MHRA, TGA and ROW countries.

12 hrs 3 3.

3. Non clinical drug development: Global submission of IND, NDA, ANDA. Investigation of medicinal products dossier, dossier (IMPD) and investigator brochure (IB).

12 hrs

4. Clinical trials: Developing clinical trial protocols. Institutional review board/independent ethics committee Formulation and working procedures informed Consent process and procedures. HIPAA- new, requirement to clinical study process, pharmacovigilance safety monitoring in clinical trials.

REFERENCES

1. Generic Drug Product Development, Solid Oral Dosage forms, Leon Shargel and IsaderKaufer,Marcel Dekker series, Vol.143
2. The Pharmaceutical Regulatory Process, Second Edition Edited by Ira R. Berry and Robert P.Martin, Drugs and the Pharmaceutical Sciences,Vol.185, Informa Health care Publishers.
3. New Drug Approval Process: Accelerating Global Registrations By Richard A Guarino, MD,5th edition, Drugs and the Pharmaceutical Sciences,Vol.190.
4. Guidebook for drug regulatory submissions / Sandy Weinberg. By John Wiley & Sons.Inc.
5. FDA regulatory affairs: a guide for prescription drugs, medical devices, and biologics/edited By Douglas J. Pisano, David Mantus.
6. Clinical Trials and Human Research: A Practical Guide to Regulatory Compliance By Fay A.Rozovsky and Rodney K. Adams
7. www.ich.org/
8. www.fda.gov/
9. europa.eu/index_en.htm
10. <https://www.tga.gov.au/tga-basics>

SEMESTER/YEAR : II SEM

COURSE CODE : 17MPH201

TITLE OF THE COURSE : MOLECULAR PHARMACEUTICS (NANO TECHNOLOGY & TARGETED DDS) (NTDS)

Scope

This course is designed to impart knowledge on the area of advances in novel drug delivery systems.

COURSE OBJECTIVES

- To understand the various approaches for development of novel drug delivery systems.
- To understand the criteria for selection of drugs and polymers for the development of NTDS
- To understand the formulation and evaluation of novel drug delivery systems.

COURSE OUTCOMES

Upon completion of the course student shall be able to understand

- The various approaches for development of novel drug delivery systems.
- The criteria for selection of drugs and polymers for the development of NTDS
- The formulation and evaluation of novel drug delivery systems.

12 hrs

1. Targeted Drug Delivery Systems: Concepts, Events and biological process involved in drug targeting. **Tumor targeting and Brain specific delivery.**

12 hrs

2 Targeting Methods: introduction **preparation and evaluation. Nano Particles & Liposomes: Types, preparation and evaluation.**

12 hrs

3 Micro Capsules / Micro Spheres: Types, preparation and evaluation, **Monoclonal Antibodies ; preparation and application, preparation and application of Niosomes, Aquasomes, Phytosomes, Electrosomes.**

12 hrs

4 Pulmonary Drug Delivery Systems : Aerosols, propellents, Containers Types, preparation and evaluation, **Intra Nasal Route Delivery systems; Types, preparation and evaluation.**

12 hrs

5 Nucleic acid based therapeutic delivery system : Gene therapy, introduction (ex-vivo & in-vivo gene therapy). **Potential target diseases for gene therapy (inherited disorder and cancer).** Gene expression systems (viral and nonviral gene transfer). **Liposomal gene delivery systems. Biodistribution and Pharmacokinetics.** knowledge of therapeutic antisense molecules and aptamers as drugs of future.

REFERENCES

1. Y W. Chien, Novel Drug Delivery Systems, 2nd edition, revised and expanded, Marcel Dekker, Inc., New York, 1992.
2. S.P.Vyas and R.K.Khar, Controlled Drug Delivery - concepts and advances, VallabhPrakashan, New Delhi, First edition 2002.
3. N.K. Jain, Controlled and Novel Drug Delivery, CBS Publishers & Distributors, NewDelhi, First edition 1997 (reprint in 2001).

SEMESTER/YEAR : II SEM

COURSE CODE : 17MPH202

TITLE OF THE COURSE : ADVANCED BIOPHARMACEUTICS & PHARMACOKINETICS

COURSE OBJECTIVES

- Upon completion of this course, it is expected that students will be able understand, -
- The basic concepts in biopharmaceutics and pharmacokinetics.
 - The use raw data and derive the pharmacokinetic models and parameters the
 - best describe the process of drug absorption, distribution, metabolism and elimination.
 - The critical evaluation of biopharmaceutic studies involving drug product equivalency.
 - The design and evaluation of dosage regimens of the drugs using pharmacokinetic and biopharmaceutic parameters.
 - The potential clinical pharmacokinetic problems and application of basics of pharmacokinetic

COURSE OUTCOMES :

1. Describe the mechanism of medication absorption and the many elements that impact it. Learn various method of dissolution testing.
2. Learn about the numerous biopharmaceutical factors that affect the bioavailability of drugs. *In vitro*–*in vivo* correlation dissolution data
3. Recognize the fundamental pharmacokinetic model considerations. Recognize various compartment models and non-compartment models. Learn about various medication interactions that affect pharmacokinetics, such as interactions between drugs and proteins or tissues.
4. Bioequivalence and bioavailability studies of novel medications or dose forms with a complex design.
5. Examine how biotechnology-derived medications are used in pharmacokinetics and pharmacodynamics.

12 hrs

1. Drug Absorption from the Gastrointestinal Tract: Gastrointestinal tract, Mechanism of drug absorption, Factors affecting drug absorption, pH-partition theory of drug absorption. Formulation and physicochemical factors: Dissolution rate, Dissolution process, Noyes-Whitney equation and drug dissolution, Factors affecting the dissolution rate. Gastrointestinal absorption: role of the dosage form: Solution (elixir, syrup and solution) as a dosage form, Suspension as a dosage form, Capsule as a dosage form, Tablet as a dosage form, Dissolution methods, Formulation and processing factors, Correlation of in vivo data

with in vitro dissolution data. Transport model: Permeability-Solubility-Charge State and the pH Partition Hypothesis, Properties of the Gastrointestinal Tract (GIT), Ph Microclimate Intracellular pH Environment, Tight-Junction Complex.

12 hrs

2 **Biopharmaceutic considerations in drug product design and In Vitro Drug Product Performance**: Introduction, biopharmaceutic factors affecting drug bioavailability, rate-limiting steps in drug absorption, physicochemical nature of the drug formulation factors affecting drug product performance, in vitro: dissolution and drug release testing, compendial methods of dissolution, alternative methods of dissolution testing, meeting dissolution requirements, problems of variable control in dissolution testing performance of drug products. **In vitro-in vivo correlation, dissolution profile comparisons**, drug product stability, considerations in the design of a drug product.

12 hrs

3 Pharmacokinetics: Basic considerations, **pharmacokinetic models, compartment modeling: one compartment model- IV bolus, IV infusion, extra-vascular**. Multi compartment model: two compartment - model in brief, non-linear pharmacokinetics: cause of non-linearity, Michaelis – Menten equation, estimation of k_{max} and v_{max} . Drug interactions: introduction, **the effect of protein binding interactions, the effect of tissue-binding interactions, cytochrome p450-based drug interactions, drug interactions linked to transporters**.

12 hrs

4 Drug Product Performance, In Vivo: **Bioavailability and Bioequivalence: drug product performance**, purpose of bioavailability studies, relative and absolute availability. Methods for assessing bioavailability, bioequivalence studies, **design and evaluation of bioequivalence studies, study designs, crossover study designs**, evaluation of the data, bioequivalence example, study submission and drug review process. Biopharmaceutics classification system, methods. Permeability: In-vitro, in-situ and In-vivo methods. Generic biologics (biosimilar drug products), clinical significance of bioequivalence studies, special concerns in bioavailability and bioequivalence studies, generic substitution.

12 hrs

5 **Application of Pharmacokinetics: Modified-Release Drug Products, Targeted Drug Delivery Systems and Biotechnological Products**. Introduction to Pharmacokinetics and pharmacodynamic, drug interactions. Pharmacokinetics and pharmacodynamics of biotechnology drugs. Introduction, Proteins and peptides, Monoclonal antibodies, Oligonucleotides, Vaccines (immunotherapy), Gene therapies.

REFERENCES

1. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi, 4th edition, Philadelphia, Lea and Febiger, 1991
2. Biopharmaceutics and Pharmacokinetics, A. Treatise, D .M. Brahmankar and Sunil B. Jaiswal., VallabPrakashan, Pitampura, Delhi
3. Applied Biopharmaceutics and Pharmacokinetics by Shargel. Land YuABC, 2nd edition, Connecticut Appleton Century Crofts, 1985
4. Textbook of Biopharmaceutics and Pharmacokinetics, Dr. Shobha Rani R. Hiremath, Prism Book
5. Pharmacokinetics by Milo Gibaldi and D. Perrier, 2nd edition, Marcel Dekker Inc., New York, 1982

6. Current Concepts in Pharmaceutical Sciences: Biopharmaceutics, Swarbrick. J, Lea and Febiger, Philadelphia, 1970
7. Clinical Pharmacokinetics, Concepts and Applications 3rd edition by Malcolm Rowland and Thomas N. Tozer, Lea and Febiger, Philadelphia, 1995
8. Dissolution, Bioavailability and Bioequivalence, Abdou. H.M, Mack Publishing Company, Pennsylvania 1989
9. Biopharmaceutics and Clinical Pharmacokinetics, An Introduction, 4th edition, revised and expanded by Robert. E. Notari, Marcel Dekker Inc, New York and Basel, 1987.
10. Biopharmaceutics and Relevant Pharmacokinetics by John. G Wagner and M. Pamarowski, 1st edition, Drug Intelligence Publications, Hamilton, Illinois, 1971.
11. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. G. Boylan, Marcel Dekker Inc, New York, 1996.
12. Basic Pharmacokinetics, 1st edition, Sunil S Jambhekar and Philip J Breen, pharmaceutical press, RPS Publishing, 2009.
13. Absorption and Drug Development- Solubility, Permeability, and Charge State, Alex Avdeef, John Wiley & Sons, Inc, 2003.

SEMESTER/YEAR: Semester

COURSE CODE: **17MPH204**

TITLE OF THE COURSE: **COSMETICS AND COSMECEUTICALS**

This course is designed to impart knowledge and skills necessary for the fundamental need for cosmetic and cosmeceutical products.

COURSE OBJECTIVES

Upon completion of the course, the students shall be able to understand -

Key ingredients used in cosmetics and cosmeceuticals.

- Key building blocks for various formulations.
- Current technologies in the market
- Various key ingredients and basic science to develop cosmetics and cosmeceuticals
- Scientific knowledge to develop cosmetics and cosmeceuticals with desired Safety, stability, and efficacy.

12 hrs

1. Cosmetics – Regulatory : Definition of cosmetic products as per Indian regulation. Indian regulatory requirements for labeling of cosmetics Regulatory provisions relating to import of cosmetics., Misbranded and spurious cosmetics. Regulatory provisions relating to manufacture of cosmetics – Conditions for obtaining license, prohibition of manufacture and sale of certain cosmetics, loan license, offences and penalties.

12 hrs

- 2 Cosmetics - Biological aspects : Structure of skin relating to problems like dry skin, acne, pigmentation, prickly heat, wrinkles and body odor. Structure of hair and hair growth cycle. Common problems associated with oral cavity. Cleansing and care needs for face, eye lids, lips, hands, feet, nail, scalp, neck, body and under-arm.

12 hrs

- 3 Formulation Building blocks: Building blocks for different product formulations of cosmetics/cosmeceuticals.

Surfactants – Classification and application. Emollients, rheological additives: classification and application. Antimicrobial used as preservatives, their merits and demerits. Factors affecting microbial preservative efficacy. Building blocks for formulation of a moisturizing cream, vanishing cream, cold cream, shampoo and toothpaste. Soaps and syndet bars.

Perfumes; Classification of perfumes. Perfume ingredients listed as allergens in EU regulation.

Controversial ingredients: Parabens, formaldehyde liberators, dioxane.

12 hrs

4 Design of cosmeceutical products: Sun protection, sunscreens classification and regulatory aspects. Addressing dry skin, acne, sun-protection, pigmentation, prickly heat, wrinkles, body odor, dandruff, dental cavities, bleeding gums, mouth odor and sensitive teeth through cosmeceutical formulations.

12 hrs

5 Herbal Cosmetics : Herbal ingredients used in Hair care, skin care and oral care. Review of guidelines for herbal cosmetics by private bodies like cosmos with respect to preservatives, emollients, foaming agents, emulsifiers and rheology modifiers. Challenges in formulating herbal cosmetics.

REFERENCES

1. Harry's Cosmeticology. 8th edition.
2. Poucher's perfume cosmetics and Soaps, 10th edition.
3. Cosmetics - Formulation, Manufacture and quality control, P.P. Sharma, 4th edition
4. Handbook of cosmetic science and Technology A.O. Barel, M. Paye and H.I. Maibach. 3rd edition
5. Cosmetic and Toiletries recent suppliers catalogue.
6. CTFA directory.

SEMESTER/YEAR : II SEM

COURSE CODE : 17MPH205

TITLE OF THE COURSE : PHARMACEUTICS PRACTICALS - II

COURSE OBJECTIVES

- To impart knowledge on the preparation of various novel drug delivery systems
- To impart knowledge on the evaluation of various novel drug delivery systems
- To impart knowledge on quality by design and Design Expert
- To impart knowledge on preparation of various cosmetics

COURSE OUTCOMES

Upon completion of the course, student shall be able to understand

- Preparation of various novel drug delivery systems
- Evaluation of various novel drug delivery systems
- Usage of softwares like Design Expert
- Preparation and evaluation of various cosmetics

1. To study the effect of temperature change , non solvent addition, incompatible polymer addition in microcapsules preparation
2. Preparation and evaluation of Alginate beads
3. Formulation and evaluation of gelatin /albumin microspheres
4. Formulation and evaluation of liposomes/niosomes
5. Formulation and evaluation of spherules
6. Improvement of dissolution characteristics of slightly soluble drug by Solid dispersion technique.
7. Comparison of dissolution of two different marketed products /brands
8. Protein binding studies of a highly protein bound drug & poorly protein bound drug
9. Bioavailability studies of Paracetamol in animals.
10. Pharmacokinetic and IVIVC data analysis by WinnolineR software
11. In vitro cell studies for permeability and metabolism
12. DoE Using Design Expert® Software
13. Formulation data analysis Using Design Expert® Software
14. Quality-by-Design in Pharmaceutical Development
15. Computer Simulations in Pharmacokinetics and Pharmacodynamics
16. Computational Modeling Of Drug Disposition
17. To develop Clinical Data Collection manual
18. To carry out Sensitivity Analysis, and Population Modeling.
19. Development and evaluation of Creams
20. Development and evaluation of Shampoo and Toothpaste base
21. To incorporate herbal and chemical actives to develop products
22. To address Dry skin, acne, blemish, Wrinkles, bleeding gums and Dandruff

ADVANCED PHARMACOLOGY - I

(MPL 102T)

Scope

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, this subject helps the students to understand the concepts of drug action and mechanisms involved

Objectives

Upon completion of the course the student shall be able to :

- Discuss the pathophysiology and pharmacotherapy of certain diseases
- Explain the mechanism of drug actions at cellular and molecular level
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

THEORY

60 Hrs

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|----|-------------------|---|--------|
| 1. | General | Pharmacology | 12 Hrs |
| | a. | Pharmacokinetics: The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding. | |
| | b. | Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors, quantitation of drug receptors interaction and elicited effects. | |
| 2 | Neurotransmission | | 12 Hrs |
| | a. | General aspects and steps involved in neurotransmission. | |
| | b. | Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetyl choline). | |
| | c. | Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine). | |
| | d. | Non adrenergic non cholinergic transmission (NANC). Co-transmission | |

Systemic Pharmacology

A detailed study on pathophysiology of diseases, mechanism of action, pharmacology and toxicology of existing as well as novel drugs used in the following systems

Autonomic Pharmacology

Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting neuromuscular junction

- | | | |
|---|---|-----------|
| 3 | Central nervous system Pharmacology
General and local anesthetics
Sedatives and hypnotics, drugs used to treat anxiety.
Depression, psychosis, mania, epilepsy, neurodegenerative diseases.
Narcotic and non-narcotic analgesics. | 12
Hrs |
| 4 | Cardiovascular Pharmacology
Diuretics, antihypertensives, antiischemics, anti-arrhythmics, drugs for heart failure and hyperlipidemia.
Hematinics, coagulants, anticoagulants, fibrinolytics and anti-platelet drugs | 12
Hrs |
| 5 | Autocoid Pharmacology
The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids.
Pharmacology of antihistamines, 5HT antagonists. | 12
Hrs |

REFEERENCES

1. The Pharmacological Basis of Therapeutics, Goodman and Gillman's
2. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J, Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.
3. Basic and Clinical Pharmacology by B.G Katzung
4. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
6. Graham Smith. Oxford textbook of Clinical Pharmacology.
7. Avery Drug Treatment
8. Dipiro Pharmacology, Pathophysiological approach.
9. Green Pathophysiology for Pharmacists.

SEMESTER/YEAR : I SEM

COURSE CODE : 17MPL103

TITLE OF THE COURSE : PHARMACOLOGICAL AND TOXICOLOGICAL SCREENING

METHODS - I

Scope

This subject is designed to impart the knowledge on preclinical evaluation of drugs and recent experimental techniques in the drug discovery and development. The subject content helps the student to understand the maintenance of laboratory animals as per the guidelines, basic knowledge of various in-vitro and in-vivo preclinical evaluation processes

Course Objectives

Upon completion of the course the student shall be able to,

- Appraise the regulations and ethical requirement for the usage of experimental animals.
- Describe the various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experimental animals
- Describe the various newer screening methods involved in the drug discovery

Process

Course outcomes

- Justify the regulations and ethical requirements for the usage of experimental animals.
- Illustrate the various animals used in the drug discovery process and good laboratory practices in maintenance and handling of experimental animals
- Evaluate various in-vitro and in-vivo preclinical evaluation processes

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Syllabus

1. Laboratory Animals 12 hrs

Common laboratory animals: Description, handling and applications of different species and strains of animals. Transgenic animals: Production, maintenance and applications
Anaesthesia and euthanasia of experimental animals. Maintenance and breeding of laboratory animals. CPCSEA guidelines to conduct experiments on animals Good laboratory practice.

Bioassay-Principle, scope and limitations and methods

12 hrs

2 Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. General principles of preclinical screening. CNS Pharmacology: behavioral and muscle coordination, CNS stimulants and depressants, anxiolytics, anti-psychotics, anti epileptics and nootropics. Drugs for neurodegenerative diseases like Parkinsonism, Alzheimers and multiple sclerosis. Drugs acting on Autonomic Nervous System.

12 hrs

3 Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Respiratory Pharmacology: anti asthmatics, drugs for COPD and anti allergics. Reproductive Pharmacology:

Aphrodisiacs and antifertility agents Analgesics, antiinflammatory and antipyretic agents. Gastrointestinal drugs: anti ulcer, anti -emetic, antidiarrheal and laxatives.

12 hrs

4 Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Cardiovascular Pharmacology: antihypertensives, antiarrhythmics, antianginal, antiatherosclerotic agents and diuretics. Drugs for metabolic disorders like anti-diabetic, antidyslipidemic agents. Anti cancer agents. Hepatoprotective screening methods.

12 hrs

5 Preclinical screening of new substances for the pharmacological activity using in vivo, in vitro, and other possible animal alternative models. Immunomodulators,

Immunosuppressants and immunostimulants. General principles of immunoassay:

theoretical basis and optimization of immunoassay, heterogeneous and homogenous immunoassay systems. Immunoassay methods evaluation; protocol outline, objectives and preparation. Immunoassay for digoxin and insulin Limitations of animal experimentation and alternate animal experiments. Extrapolation of in vitro data to preclinical and preclinical to humans

REFERENCES

1. Biological standardization by J.H. Burn D.J. Finney and I.G. Goodwin
2. Screening methods in Pharmacology by Robert Turner. A
3. Evaluation of drugs activities by Laurence and Bachrach
4. Methods in Pharmacology by Arnold Schwartz.
5. Fundamentals of experimental Pharmacology by M.N.Ghosh
6. Pharmacological experiment on intact preparations by Churchill Livingstone
7. Drug discovery and Evaluation by Vogel H.G.
8. Experimental Pharmacology by R.K.Goyal.
9. Preclinical evaluation of new drugs by S.K. Guta
10. Handbook of Experimental Pharmacology, SK.Kulkarni
11. Practical Pharmacology and Clinical Pharmacy, SK.Kulkarni, 3rd Edition.
12. David R.Gross. Animal Models in Cardiovascular Research, 2nd Edition, Kluwer Academic Publishers, London, UK.
13. Screening Methods in Pharmacology, Robert A.Turner.
14. Rodents for Pharmacological Experiments, Dr.Tapan Kumar chatterjee.
15. Practical Manual of Experimental and Clinical Pharmacology by Bikash Medhi (Author), Ajay Prakash (Author

CELLULAR AND MOLECULAR PHARMACOLOGY
(MPL 104T)

Scope:

The subject imparts a fundamental knowledge on the structure and functions of cellular components and help to understand the interaction of these components with drugs. This information will further help the student to apply the knowledge in drug discovery process.

Objectives:

Upon completion of the course, the student shall be able to,

- Explain the receptor signal transduction processes.
- Explain the molecular pathways affected by drugs.
- Appreciate the applicability of molecular pharmacology and biomarkers in drug discovery process.
- Demonstrate molecular biology techniques as applicable for pharmacology

THEORY

60 Hrs

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|----|--|-----------|
| 1. | Cell biology
Structure and functions of cell and its organelles
Genome organization. Gene expression and its regulation, importance of siRNA and micro RNA, gene mapping and gene sequencing
Cell cycles and its regulation.
Cell death- events, regulators, intrinsic and extrinsic pathways of apoptosis.
Necrosis and autophagy. | 12
Hrs |
| 2 | Cell signaling
Intercellular and intracellular signaling pathways.
Classification of receptor family and molecular structure ligand gated ion channels; G-protein coupled receptors, tyrosine kinase receptors and nuclear receptors.
Secondary messengers: cyclic AMP, cyclic GMP, calcium ion, inositol 1,4,5-trisphosphate, (IP3), NO, and diacylglycerol.
Detailed study of following intracellular signaling pathways: cyclic AMP signaling pathway, mitogen-activated protein kinase (MAPK) signaling, Janus kinase (JAK)/signal transducer and activator of transcription (STAT) signaling pathway. | 12
Hrs |

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|---|--|-----------|
| 3 | <p>Principles and applications of genomic and proteomic tools
 DNA electrophoresis, PCR (reverse transcription and real time),
 Gene sequencing, micro array technique, SDS page, ELISA and
 western blotting,
 Recombinant DNA technology and gene therapy
 Basic principles of recombinant DNA technology-Restriction
 enzymes, various types of vectors. Applications of recombinant
 DNA technology.
 Gene therapy- Various types of gene transfer techniques, clinical
 applications and recent advances in gene therapy.</p> | 12
Hrs |
| 4 | <p>Pharmacogenomics
 Gene mapping and cloning of disease gene.
 Genetic variation and its role in health/ pharmacology
 Polymorphisms affecting drug metabolism
 Genetic variation in drug transporters
 Genetic variation in G protein coupled receptors
 Applications of proteomics science: Genomics, proteomics,
 metabolomics, functionomics, nutrigenomics
 Immunotherapeutics
 Types of immunotherapeutics, humanisation antibody therapy,
 Immunotherapeutics in clinical practice</p> | 12
Hrs |
| 5 | <p>a. Cell culture techniques
 Basic equipments used in cell culture lab. Cell culture media,
 various types of cell culture, general procedure for cell cultures;
 isolation of cells, subculture, cryopreservation, characterization of
 cells and their application.
 Principles and applications of cell viability assays, glucose uptake
 assay, Calcium influx assays
 Principles and applications of flow cytometry</p> <p>b. Biosimilars</p> | 12
Hrs |

REFERENCES:

1. The Cell, A Molecular Approach. Geoffrey M Cooper.
2. Pharmacogenomics: The Search for Individualized Therapies. Edited by J. Licinio and M-L. Wong
3. Handbook of Cell Signaling (Second Edition) Edited by Ralph A. et.al
4. Molecular Pharmacology: From DNA to Drug Discovery. John Dickenson et.al
5. Basic Cell Culture protocols by Cheril D.Helgason and Cindy L.Miller
6. Basic Cell Culture (Practical Approach) by J. M. Davis (Editor)
7. Animal Cell Culture: A Practical Approach by John R. Masters (Editor)
8. Current protocols in molecular biology vol I to VI edited by Frederick M.Ausuvel et la.

SEMESTER/YEAR : I SEM

COURSE CODE : 17MPL105

TITLE OF THE COURSE : PHARMACOLOGICAL PRACTICAL – I

Course objectives:

1. To Perform the analysis of various drugs in single and combination dosage forms
2. To acquire practical skills of the analytical instruments
3. To maintain laboratory animals as per the guidelines and acquire basic knowledge of various in-vitro and in-vivo preclinical evaluation processes
4. Explain the mechanism of drug actions at cellular and molecular level.
5. To demonstrate molecular biology techniques

Course outcomes

1. Understand the basic knowledge on assay of single and multiple component pharmaceuticals by using various analytical instruments
2. Develop basic practical skills using instrumentation techniques
3. The students would appreciate the knowledge gained on preclinical evaluation of drugs and recent experimental techniques in the drug discovery and development.
4. They would have learnt to demonstrate molecular biology techniques as applicable for pharmacology.

1. Analysis of pharmacopoeia compounds and their formulations by UV Vis spectrophotometer

2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry

3. Experiments based on HPLC

4. Experiments based on Gas Chromatography

5. Estimation of riboflavin/quinine sulphate by fluorimetry

6. Estimation of sodium/potassium by flame photometry

7. -Handling of laboratory animals.

8. Various routes of drug administration.

9. Techniques of blood sampling, anesthesia and euthanasia of experimental animals.

10. Functional observation battery tests (modified Irwin test)

11. Evaluation of CNS stimulant, depressant, anxiogenics and anxiolytic, anticonvulsant activity.
12. Evaluation of analgesic, anti-inflammatory, local anesthetic, mydriatic and miotic activity.
13. Evaluation of diuretic activity.
14. Evaluation of antiulcer activity by pylorus ligation method.
15. Oral glucose tolerance test.
16. Isolation and identification of DNA from various sources (Bacteria, Cauliflower, onion, Goat liver).
17. Isolation of RNA from yeast
18. Estimation of proteins by Bradford/Lowry's in biological samples.
19. Estimation of RNA/DNA by UV Spectroscopy
20. Gene amplification by PCR.
21. Protein quantification Western Blotting.
22. Enzyme based in-vitro assays (MPO, AChEs, α amylase, α glucosidase).
23. Cell viability assays (MTT/Trypan blue/SRB).
24. DNA fragmentation assay by agarose gel electrophoresis.
25. DNA damage study by Comet assay.
26. Apoptosis determination by fluorescent imaging studies.
27. Pharmacokinetic studies and data analysis of drugs given by different routes of administration using softwares
28. Enzyme inhibition and induction activity
29. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (UV)
30. Extraction of drug from various biological samples and estimation of drugs in biological fluids using different analytical techniques (HPLC)

REFERENCES

1. CPCSEA, OECD, ICH, USFDA, Schedule Y, EPA guidelines,
2. Fundamentals of experimental Pharmacology by M.N.Ghosh
3. Handbook of Experimental Pharmacology by S.K. Kulkarni.
4. Drug discovery and Evaluation by Vogel H.G

SEMESTER/YEAR: II SEM

COURSE CODE: 17MPL201

TITLE OF THE COURSE: ADVANCED PHARMACOLOGY - II

Scope

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases.

In addition, the subject helps the student to understand the concepts of drug action and mechanism involved

Course Objectives

Upon completion of the course the student shall be able to:

- To understand the mechanism of drug actions at cellular and molecular level
- To understand the Pathophysiology and pharmacotherapy of certain diseases
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

Course outcomes

- Explain the mechanism of drug actions at cellular and molecular level.
- Knowledge in the Pathophysiology and pharmacotherapy of certain diseases including drug interactions is imparted
- Interpret the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases.
- Apply the current knowledge of pharmacology in the best interest of patients and the community.

1. Endocrine Pharmacology

12 hrs

Molecular and cellular mechanism of action of hormones such as growth hormone, prolactin, thyroid, insulin and sex hormones Anti-thyroid drugs, Oral hypoglycemic agents, Oral contraceptives, Corticosteroids. Drugs affecting calcium regulation

2 Chemotherapy 12 hrs

Cellular and molecular mechanism of actions and resistance of antimicrobial agents

such as β -lactams, aminoglycosides, quinolones, Macrolide antibiotics. Antifungal, antiviral, and anti-TB drugs.

3 Chemotherapy 12 hrs

Drugs used in Protozoal Infections

Drugs used in the treatment of Helminthiasis

Chemotherapy of cancer

Immunopharmacology

Cellular and biochemical mediators of inflammation and immune response. Allergic or hypersensitivity reactions. Pharmacotherapy of asthma and COPD.

Immunosuppressants and Immunostimulants

4 GIT Pharmacology 12 hrs

Antiulcer drugs, Prokinetics, antiemetics, anti-diarrheals and drugs for constipation and irritable bowel syndrome.

Chronopharmacology

Biological and circadian rhythms, applications of chronotherapy in various diseases like cardiovascular disease, diabetes, asthma and peptic ulcer

5 Free radicals Pharmacology 12 hrs

Generation of free radicals, role of free radicals in etiopathology of various diseases such as diabetes, neurodegenerative diseases and cancer. Protective activity of certain important antioxidant

Recent Advances in Treatment:

Alzheimer's disease, Parkinson's disease, Cancer, Diabetes mellitus

REFERENCES

1. The Pharmacological basis of therapeutics- Goodman and Gill man's
2. Principles of Pharmacology. The Pathophysiologic basis of drug therapy by David E Golan et al.
3. Basic and Clinical Pharmacology by B.G -Katzung
4. Pharmacology by H.P. Rang and M.M. Dale.
5. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.
6. Text book of Therapeutics, drug and disease management by E T. Herfindal and Gourley.
7. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.

8. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism
for Industrial Scientists

9. Robbins & Cortan Pathologic Basis of Disease, 9th Ed. (Robbins Pathology)

10. A Complete Textbook of Medical Pharmacology by Dr. S.K Srivastava published by
APC Avichal Publishing Company.

11. KD.Tripathi. Essentials of Medical Pharmacology

12. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E

Golan, Armen H, Tashjian Jr, Ehrin J, Armstrong, April W, Armstrong, Wolters, Kluwer Lippincott
Williams & Wilkins Publishers

SEMESTER/YEAR : II SEM COURSE CODE : 17MPL205 TITLE OF THE COURSE : PHARMACOLOGICAL PRACTICAL - II L: T/A:P: C : 3 :1 : 0 : 3

Course objectives:

1. Demonstrate the various types of toxicity studies.
2. Demonstrate the practical skills required to conduct the preclinical toxicity
3. Appreciate the importance of the role of computer aided drug design in drug discovery
4. Demonstrate the types of clinical trial designs
5. Perform the adverse drug reaction reporting systems and communication in Pharmacovigilance

Course outcomes:

1. They would have studied the practical skills required to conduct the preclinical toxicity studies.
2. They would appreciate the use of experimental animals for the different toxicological studies.
3. They would have learnt the importance of the role of computer aided drug design in drug discovery.
4. They would get a better understanding in the regulatory requirements for conducting clinical trial.
5. They would have an understand on the safety monitoring, reporting principles of Pharmacovigilance

Syllabus

1. To record the DRC of agonist using suitable isolated tissues preparation.
2. To study the effects of antagonist/potentiating agents on DRC of agonist using suitable isolated tissue preparation.
3. To determine to the strength of unknown sample by matching bioassay by using suitable tissue preparation.
4. To determine to the strength of unknown sample by interpolation bioassay by using suitable tissue preparation
5. To determine to the strength of unknown sample by bracketing bioassay by using suitable tissue preparation
6. To determine to the strength of unknown sample by multiple point bioassay by using

suitable tissue preparation.

7. Estimation of PA₂ values of various antagonists using suitable isolated tissue preparations.

8. To study the effects of various drugs on isolated heart preparations

9. Recording of rat BP, heart rate and ECG.

10. Recording of rat ECG

11. Drug absorption studies by averted rat ileum preparation.

12. Acute oral toxicity studies as per OECD guidelines.

13. Acute dermal toxicity studies as per OECD guidelines.

14. Repeated dose toxicity studies- Serum biochemical, haematological, urine analysis, functional observation tests and histological studies.

15. Drug mutagenicity study using mice bone-marrow chromosomal aberration test.

16. Protocol design for clinical trial.(3 Nos.)

17. Design of ADR monitoring protocol.

18. In-silico docking studies. (2 Nos.)

19. In-silico pharmacophore based screening.

20. In-silico QSAR studies.

21. ADR reporting

REFERENCES

1. Fundamentals of experimental Pharmacology-by M.N.Ghosh
2. Hand book of Experimental Pharmacology-S.K.Kulakarni
3. Text book of in-vitro practical Pharmacology by Ian Kitchen
4. Bioassay Techniques for Drug Development by Atta-ur-Rahman, Iqbal choudhary and William Thomsen
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
6. Handbook of Essential Pharmacokinetics, Pharmacodynamics and Drug Metabolism for Industrial Scientists

SEMESTER / YEAR : IV SEMESTER

COURSE CODE : 17MPR403

TITLE OF THE COURSE : Research work and Colloquium

Course objectives

1. Apply ability to prepare more focused and professional slides which will enhance the credibility.
2. Understand how to present scientific evidences clearly and effectively.
- 3: Develop confidence to present the right thing, in the right way, to the persons.
- 4: Discuss research problem with team and peers for solution.
- 5: Evaluate the research problems.
- 6: Develop a protocol report on the critically appraised research problem

Course outcomes

Upon completion of this course the student should be able to:

- 1: Prepare and present a research proposal.
- 2: Conduct research to achieve research objectives.
- 3: Analyze and propose new ideas/ methodologies or procedures for further improvement of the Research problem.
- 4: Create research document of the findings.
- 5: Make presentations that create maximum impact.
- .6: Defend the research findings in front of scholarly audience.

Semester III

17MPR301 - Research Methodology & Biostatistics

Course Objectives: The course teaches students how to write research articles and how to analyze statistical findings. It can be a first course in biostatistics for students who intend to use the information they gain to learn more complex techniques in future statistical and biostatistical course work.

Course outcomes:

At the end of the course students will be able to...

CO1: Improve the ability to implement methods while working on a research assignment.

CO2: Describe the necessary statistical techniques for a specific study plan.

CO3: Select a suitable research design and create an appropriate research hypothesis for research endeavour,.

CO4: Create a suitable framework for study projects.

UNIT – I

General Research Methodology: Research, objective, requirements, practical difficulties, review of literature, study design, types of studies, strategies to eliminate errors/bias, controls, randomization, crossover design, placebo, blinding techniques.

UNIT – II

Biostatistics: Definition, application, sample size, importance of sample size, factors influencing sample size, dropouts, statistical tests of significance, type of significance tests, parametric tests (students "t" test, ANOVA, Correlation coefficient, regression), non-parametric tests (wilcoxon rank tests, analysis of variance, correlation, chi square test), null hypothesis, P values, degree of freedom, interpretation of P values.

UNIT – III

Medical Research: History, values in medical ethics, autonomy, beneficence, non-maleficence, double effect, conflicts between autonomy and beneficence/non-maleficence, euthanasia, informed consent, confidentiality, criticisms of orthodox medical ethics, importance of communication, control resolution, guidelines, ethics committees, cultural concerns, truth telling, online business practices, conflicts of interest, referral, vendor relationships, treatment of family members, sexual relationships, fatality.

UNIT – IV

CPCSEA guidelines for laboratory animal facility: Goals, veterinary care, quarantine, surveillance, diagnosis, treatment and control of disease, personal hygiene, location of animal facilities to laboratories, anesthesia, euthanasia, physical facilities, environment, animal husbandry, record keeping, SOPs, personnel and training, transport of lab animals.

UNIT – V

Declaration of Helsinki: History, introduction, basic principles for all medical research, and additional principles for medical research combined with medical care.

17MPR302-JOURNAL CLUB

Course objectives: The student will be responsible for developing queries, interpreting data, disseminating knowledge among doctors, and applying it to the patient community.

Course outcomes: *The student will be to*

1. Describe critical literary evaluation abilities.
2. Discuss about issues
3. Enhance the therapeutic practice
4. Create study concepts for the future.

- A journal club is an educational gathering in which a group of people debate published articles, giving a venue for a group endeavor to stay current with the literature.
- The majority of journal club tasks required to locate an article from a "quality, reliable, and reputable journal." It is up to the student make this determination, and it is recommended to use Google to find the journal's homepage and examine material about the journal.
- Journal groups are a popular way for healthcare workers, including pharmacists, to analyze and apply research to therapeutic practice.
- The goal of this study is to see if involvement in student-led journal clubs affects students' knowledge and trust in evaluating literature.
- Encourage and Improve Graduate Education and Exposure
- Familiarize members with emerging trends in the Pharmacology and pharmaceutical industries to help with analytical interpretations and constructive criticism.
- Make a Cohesive Learning Environment

SEMESTER / YEAR: III SEMESTER

COURSE CODE: 17MPR303

TITLE OF THE COURSE: DISCUSSION/PRESENTATION (PROPOSAL PRESENTATION)

Syllabus

In its most basic form, it contains a title, initial and end dates, objectives, goals and the overall main achievement pursued at completion of the project.

Objective:

- To understand the concept of problem.
- To understand research gap.
- To understand nobility and outcomes of the research.

Couser outcomes

Upon the completion of course student shall be able to

- Present problem statement and solution.
- To present the ideas and innovation of the research.
- To review the summery and other technical concept of the research.

Parts of a project proposal

- Key Elements of a Complete Proposal
- Cover
- Table of Contents
- Abstract
- Project Description
- Budget Explanation
- Other Support

Presentation slides must include information about:

1. Problem description
2. Solution
3. Innovation
4. Objectives and Goals
5. Socioeconomic benefits
6. Outcome of the project
7. Start and end dates
8. Conclusion
9. Summery
10. Future outcomes
11. References
12. Index.

SEMESTER / YEAR: IV SEMESTER
COURSE CODE: 17MPR304
TITLE OF THE COURSE: RESEARCH WORK

Syllabus

Research work

Definition: it is the creation of new knowledge and/or the use of existing knowledge in a new and creative way so as to generate new concepts, methodologies and understandings.

Objective:

- To understand the concept of research methodology.
- To understand the process of research.
- To understand the research utility.

Couser outcomes

Upon the completion of course student shall

- To review the research output.
- To evaluate the results using statistical methods.
- To find out the research collaborators.

Types of research

There are four main types of Quantitative research: Descriptive, Correlational, Causal-Comparative/Quasi-Experimental, and **Experimental Research**. attempts to establish cause-effect relationships among the variables.

Purpose of research work

The purpose of research is to enhance society by advancing knowledge through scientific theories, **concepts and ideas**. A research purpose is met through forming hypotheses, collecting data, analysing, etc.

Research process

To conduct effective research must understand the research process steps and follow them which includes literature survey introduction, objective, **research monadology**, statistical calculation, **result and discussion**.

SEMESTER / YEAR : IV SEMESTER

COURSE CODE : 17MPR402

TITLE OF THE COURSE : Discussion presentation

Course objectives

1. To develop protocol writing and hypothesis setting skills in project preparations with professional slides.
2. To develop scientific writing skills
3. Ability to Present the research findings
4. To perform statistical analysis and interpret the results of the research work

Course outcomes

Upon completion of this course the student should be able to:

- 1: Apply ability to prepare more focused and professional slides which will enhance the credibility.
2. Discuss research problem with a team and enhance scientific writing skills.
- 3: Evaluate the research problems.
- 4: Develop a protocol report on the critically appraised research problem

SEMESTER/YEAR : II SEM
COURSE CODE : 17MPL204
TITLE OF THE COURSE : CLINICAL RESEARCH AND PHARMACOVIGILANCE

Scope:

This subject will provide a value addition and current requirement for the students in clinical research and pharmacovigilance. It will teach the students on conceptualizing, designing, conducting, managing and reporting of clinical trials. This subject also focuses on global scenario of Pharmacovigilance in different methods that can be used to generate safety data. It will teach the students in developing drug safety data in Pre-clinical, Clinical phases of Drug development and post market surveillance.

Course Objectives:

Upon completion of the course, the student shall be able to,

- Explain the regulatory requirements for conducting clinical trial
- Demonstrate the types of clinical trial designs
- Explain the responsibilities of key players involved in clinical trials
- Execute safety monitoring, reporting and close-out activities
- Explain the principles of Pharmacovigilance
- Detect new adverse drug reactions and their assessment
- Perform the adverse drug reaction reporting systems and communication in Pharmacovigilance

Course outcomes:

CO1: The students will be capable of explaining the regulatory requirement for conducting clinical trial

CO2: The students will be able to demonstrate the type of clinical trial design

CO3: The students will understand the responsibilities of key players in clinical trials

CO4: The students will understand principles of pharmacovigilance and safety monitoring system

CO5: The students will understand Pharmcoepidemiology & economics

1. Regulatory Perspectives of Clinical Trials:

12 hrs

Origin and Principles of International Conference on Harmonization - Good Clinical Practice (ICH-GCP) guidelines

Ethical Committee: Institutional Review Board, Ethical Guidelines for Biomedical Research and Human Participant- Schedule Y, ICMR Informed Consent Process: Structure and content of an Informed Consent Process Ethical principles governing informed consent process

2 Clinical Trials: Types and Design

12 hrs

Experimental Study- RCT and Non RCT, Observation Study: Cohort, Case Control, Cross sectional Clinical Trial Study Team Roles and responsibilities of Clinical Trial Personnel: Investigator, Study Coordinator, Sponsor, Contract Research Organization and its management

12 hrs

3 Clinical Trial Documentation- Guidelines to the preparation of documents, Preparation of protocol, Investigator Brochure, Case Report Forms, Clinical Study Report Clinical Trial Monitoring- Safety Monitoring in CT Adverse Drug Reactions: Definition and types. Detection and reporting methods. Severity and seriousness

assessment. Predictability and preventability assessment, Management of adverse drug reactions; Terminologies of ADR.

4 Basic aspects, terminologies and establishment of pharmacovigilance **12 hrs**

History and progress of pharmacovigilance, Significance of safety monitoring, Pharmacovigilance in India and international aspects, WHO international drug monitoring programme, WHO and Regulatory terminologies of ADR, evaluation of medication safety, Establishing pharmacovigilance centres in Hospitals, Industry and National programmes related to pharmacovigilance. Roles and responsibilities in Pharmacovigilance

5 Methods, ADR reporting and tools used in Pharmacovigilance **12 hrs**

International classification of diseases, International Nonproprietary names for drugs, Passive and Active surveillance, Comparative observational studies, Targeted clinical investigations and Vaccine safety surveillance. Spontaneous reporting system and Reporting to regulatory authorities, Guidelines for ADRs reporting. Argus, Aris G Pharmacovigilance, VigiFlow, Statistical methods for evaluating medication safety data.

6 Pharmacoepidemiology, pharmacoconomics, safety pharmacology

REFERENCES

1. Central Drugs Standard Control Organization- Good Clinical Practices, Guidelines for Clinical Trials on Pharmaceutical Products in India. New Delhi: Ministry of Health;2001.
2. International Conference on Harmonization of Technical requirements for registration of Pharmaceuticals for human use. ICH Harmonized Tripartite Guideline. Guideline for Good Clinical Practice.E6; May 1996.
3. Ethical Guidelines for Biomedical Research on Human Subjects 2000. Indian Council of Medical Research, New Delhi.
4. Textbook of Clinical Trials edited by David Machin, Simon Day and Sylvan Green, March 2005, John Wiley and Sons.
5. Clinical Data Management edited by R K Rondels, S A Varley, C F Webbs. Second Edition, Jan 2000, Wiley Publications.
6. Handbook of clinical Research. Julia Lloyd and Ann Raven Ed. Churchill Livingstone.
7. Principles of Clinical Research edited by Giovanna di Ignazio, Di Giovanna and Haynes.

SEMESTER/YEAR : IV YEAR
COURSE CODE : 15BP404
TITLE OF THE COURSE : MEDICINAL CHEMISTRY II - THEORY
L: T/A: P: C : 3 : 0 : 0 : 3

COURSE OBJECTIVES: The subject deals with understanding of chemistry, properties and action of medicinal agents for treating various disorders, basic concepts involved in drug design.

COURSE OUTCOMES: The student will be able to understand the action of drugs in different disease condition and apply basic principles in designing of new drug molecules.

UNIT I

- A. Introduction to QSAR:** Study of hydrophobic, Electronic & Steric parameters **2 hours**
- B. Prodrugs:** Definition and examples **1 hour**
- C. Introduction to drug discovery-** Definition of lead molecule and its identification methods viz, high throughput screening, large scale screening, and fragment based lead generation, fast followers **2 hours**
- D. History and development of chemotherapeutic agents:** Structure, uses and synthesis of only those compounds that are superscripted by 's'.
1. Antifungal agents:
 - a) Antifungal antibiotics- Nystatin, Griseofulvin, Amphoterecin-B Synthetic anti fungal agents
 - b) Substituted imidazoles: Clotrimazole, Miconazole^s, Ketoconazole, oxyconazole, Intraconazole.
 - c) Miscellaneous-Zinc propionate, Sodium caprylate, Tolnaftate^s. **4 hours**
 3. Antiviral Agents
 - a) Amantidine hydrochloride, Idoxuridine, Acyclovir, Zidovidine. **2 hours**
 - b) Anti-AIDS: Aza thymidine, Suramin
 3. Antiprotozoal agents: Emetine hydrochloride, Metronidazole^s, tinidazole, arnidazole, secnidazole, Diloxanide furoate, 8-hydroxy quinoline derivatives (clioquinol, iodoquinol) Carbarsone **2 hours**
 4. Anthelmintics: Piperazine, Diethyl carbamazine, Pyrantelpamoate, Thiabendazole^s Albendazole^s, Mebendazole **2 hours**

UNIT II

E. Sulfonamides, Sulfones as antibacterial agents :

1. SAR and mode of Sulfonamides.
2. Classification of sulfonamides based on duration of action and site of action with examples. Sulfamethiazole, Sulfisoxazole^s, Sulfapyridine, Sulfamethoxazole^s, Sulfadiazine, Sulfacetamide, sulfasalazine, Phthalyl sulfathiazole.
3. Folate reductase inhibitors: Trimethoprim, Synergistic action of the combination of sulfamethoxazole and Trimethoprim^s.

4. Sulfone: **Dapsone^s** **4 hours**
5. Antitubercular drugs:
- Synthetic antitubercular agents: p-Aminosalysilic acid, **Isoniazid^s**, **Ethambutol^s**, Pyrazinamide, Ethionamide, Clofazamine, Bedaquiline
 - Antitubercular Antibiotics: Cycloserine, Viomycin sulfate, Capreomycin sulfate, Rifampicin.
 - Combination therapy for TB, DOTS **4 hours**
Urinary tract anti-infectives:
Quinolones: Nalidixic acid, Cinoxacin, Norfloxacin, Ciprofloxacin^s, Pefloxacin,
 - Ofloxacin, Sparfloxacin
 - Miscellaneous: **Nitrofurantoin^s**. **3 hours**

F. Antimalarials: Etiology of malaria, History, Mechanism and SAR

- Quinolines and analogues: 7-chloro-4-amino quinolines :Chloroquine phosphate^s, HydroxyChloroquinesulphate, Amodiaquine, 8-amino quinolines: Pamaquine, **Primaquine^s**, 9-amino acridines: Quinacrine.
- Artemicin and its derivatives: Artiether, Artemether, Artisunate
- Biguanides and Dihydrothiazines: **Chloroguanide^s**, Cycloguanil.
- Miscellaneous: Mefloquine, Pyrimethamine, Trimethoprim. **6 hours**

UNIT III

G. Antibiotics: Classification and Mechanism of action

- Beta lactam antibiotics: Pencillins – structures, chemical degradation, bacterial resistance. Penicillin G, Penicillin V, Cloxacillin sodium, Nafcillin sodium, Ampicillin, Amoxicillin.
- Cephalosporins: Structure and uses of Cephalexin, Cephadrine, Cefadroxil, Cefixime, Cefaprydine, Cefutroxime
- Monolactams: Sulfazecin, Aztreonam, Tigmonam.
- Beta lactamase inhibitors: Clavulanic acid and its salts, Thienamycin.
- Aminoglycosides: Structural features and Mechanism of action, Streptomycin, Amikacin, Neomycin, Kanamycin, Gentamycin, Netilmycin
- Tetracyclines: Chemistry and **SAR**, tetracycline, Chlortetracycline, Methacycline, Demeclocycline, Oxytetracycline, Meclocycline, Doxycycline, Minocycline.
- Macrolide: Structure and specific uses of Erythromycin, Azithromycin, oleandomycin.
- Lincomycins: Lincomycin, Clindamycin.
- Polypeptides: Gramicidin, Bacitracin, Polymyxin B, Colistin.
- Miscellaneous: **Chlormphenicol^s**, Vancomycin, Novobiocin. **12 hours**

UNIT IV

H. Antineoplastic agents: Introduction, mechanism of action and classification with examples.

- Alkylating agents: Mechlorethamine, Cyclophosphomide, Melphalan, **Chlorambucil^s**, Busulfan, Lomustine,
- Antimetabolites: Mercaptopurine, Thioguanine, 5-Fluorouracil, **Methotrexate^s**,
- Antibiotics: Dactinomycin, Bleomycin, Mitomycin, Streptozocin.
- Plant products: Etoposide, Taxol, Camphothesin, Vincristine, Vinblastin.
- Harmones: Dromostanalone, Megestrol,

6. Kinase inhibitors: Imatinibmesylate
7. Miscellaneous: Asparaginase, Cisplatin, Hydroxy urea.
8. Immunotherapy: Interferon alpha 2a and 2b.

6 hours

I. Cardiovascular agents:

1. Antianginal agents and vasodilators: Chemical structure and specific uses of Amyl nitrite, Nitroglycerine, Isosorbide dinitrate.
2. Calcium antagonists: Brief introduction of calcium channels and their blockers. Chemical Structures and uses of Verapamil, Diltiazem, Nifedepine, Nimodipine, Felodipine, Dipyridamole, Cyclandelate.
3. Antiarrhythmic drugs: Structure, chemical name, and classification of antiarrhythmics with examples
 Class I- Membrane depressant drugs: Quinidine Procainamide, Phenytoin^s.
 Class II-Beta adrenergic blocking agents. Tocainide, propranolol^s
 Class III-Repolarization prolongators. Bretylium, Amiodarone
 Class IV-Calcium channel blocker. Diltiazem, Verapamil
4. Antihypertensive agents:
 Beta-blockers: Propranolol, Timolol
 ACE Inhibitors: Captopril, Enalapril
 Diuretics: Hydrochlorthiazide, Spiranolactone
 Calcium channel blockers: Nifedipine, Felodipine, Amlodipine
 α_1 -Antagonist: Prazocin
 α_2 -agonist: Clonidine^s, Guanithedine
 Angiotensin –II receptor antagonist: Losartan, Valsartan
 Miscellaneous: Reserpine, Hydralazine^s, Minoxidil

11 hours

UNIT V

1. Antihyperlipidemic agents: Structure and specific uses. Clofibrate, Lovastatin, Cholesteramine, Colestipol, Atorvastatin **3 hours**
2. Anticoagulants: Dicumorol, Warfarin^s, Phenindione **1 hour**
3. Hypoglycemic agents: Insulin and its preparations.
 Sulfonylureas–Chlorpropamide^s, Acetohexamide, Glipizide,
 Biguanides-Phenformin, Metformin
 Substituted benzoic acid derivatives – Meglitinides, Nateglinide
 Thiazolidinediones – Glitazones, Pioglitazone, Ciglitazone, Rosiglitazone
 Glipitines – Sitagliptin, Anagliptin **3 hours**
4. Thyroid hormones : L-thyroxine, L-thyronine, **1 hour**
5. Antithyroid drugs: Propylthiouracil, Methimazole. **1 hour**

J. Diuretics: Introduction

1. Carbonic anhydrase inhibitors: Acetazolamide^s, Methazolamide.
2. Thiazide and Thiazide like diuretics: Chlorthiazides, Benzthiazide^s, Xipamide, Chlorthalidone.
3. High-ceiling or loop diuretics: Furosemide^s, Ethacrynic acid^s.
4. Potassium sparing diuretics: Spironolactone, Triamterene, Amiloride.
5. Miscellaneous: Mannitol. **5 hours**

SEMESTER / YEAR : I YEAR
COURSE CODE : 15PD103
TITLE OF THE COURSE : MEDICINAL BIOCHEMISTRY (Theory)
L:T:P :3:1:3

- Course objectives**
- To study the principles and pathways of various biochemical processes and to understand their role in disease processes.
- Course Outcomes**
- Student will be able to correlate the normal and abnormal biochemical pathways in assessing the health condition of individuals.

Unit - 1

26 hrs

- 1 **Introduction to biochemistry:** Cell and its biochemical organization, transport process across the cell membranes. Energy rich compounds; ATP, Cyclic AMP and their biological significance.
- 2 **Enzymes:** Definition; Nomenclature; IUB classification; Factor affecting enzyme activity; Enzyme action; enzyme inhibition. Isoenzymes and their therapeutic and diagnostic applications; Coenzymes and their biochemical role and deficiency diseases.
- 3 **Carbohydrate metabolism:** Glycolysis, Citric acid cycle (TCA cycle), HMP shunt, Glycogenolysis, gluconeogenesis, glycogenesis. Metabolic disorders of carbohydrate metabolism (diabetes mellitus and glycogen storage diseases); Glucose, Galactose tolerance test and their significance; hormonal regulation of carbohydrate metabolism.

Unit -2

10 hrs

- 4 **Lipid metabolism:** Oxidation of saturated (β -oxidation); Ketogenesis and ketolysis; biosynthesis of fatty acids, lipids; metabolism of cholesterol; Hormonal regulation of lipid metabolism. Defective metabolism of lipids (Atherosclerosis, fatty liver, hypercholesterolemia).
- 5 **Biological oxidation:** Coenzyme system involved in Biological oxidation . Electron transport chain (its mechanism in energy capture; regulation and inhibition); Uncouplers of ETC; Oxidative phosphorylation;

Unit -3

14 hrs

- 6 **Protein and amino acid metabolism:** protein turn over; nitrogen balance; Catabolism of Amino acids (Transamination, deamination & decarboxylation). Urea cycle and its metabolic disorders; production of bile pigments; hyperbilirubinemia, porphoria, jaundice. Metabolic disorder of Amino acids.
- 7 **Nucleic acid metabolism:** Metabolism of purine and pyrimidine nucleotides; Protein synthesis; Genetic code; inhibition of protein synthesis; mutation and repair mechanism; DNA replication (semiconservative /onion peel models) and DNA repair mechanism.
- 8 **Introduction to clinical chemistry: Cell;** composition; malfunction; Roll of the clinical chemistry laboratory.

Unit -4

10 hrs

- 9 **The kidney function tests:** Role of kidney; Laboratory tests for normal function includes-

- a) Urine analysis (macroscopic and physical examination, quantitative and semiquantitative tests.)
 - b) Test for NPN constituents. (Creatinine /urea clearance, determination of blood and urine creatinine, urea and uric acid)
 - c) Urine concentration test
 - d) Urinary tract calculi. (stones)
- 10 **Liver function tests:** Physiological role of liver, metabolic, storage, excretory, protective, circulatory functions and function in blood coagulation.
- 11 a) Test for hepatic dysfunction-Bile pigments metabolism.
- b) Test for hepatic function test- Serum bilirubin, urine bilirubin, and urine urobilinogen.
 - c) Dye tests of excretory function.
 - d) Tests based upon abnormalities of serum proteins. Selected enzyme tests.

Unit -5

15 hrs

- 12 **Lipid profile tests:** Lipoproteins, composition, functions. Determination of serum lipids, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides.
- 13 **Immunochemical techniques** for determination of hormone levels and protein levels in serum for endocrine diseases and infectious diseases.
Radio immuno assay (RIA) and Enzyme Linked Immuno Sorbent Assay (ELISA)
- 14 **Electrolytes:** Body water, compartments, water balance, and electrolyte distribution. Determination of sodium, calcium potassium, chlorides, bicarbonates in the body fluids.

SEMESTER / YEAR : I YEAR
COURSE CODE : 15PD175
TITLE OF THE COURSE : PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)
L:T:P : 3:1:3

- 1. Limit test (6 exercises)**
 - a. Limit test for chlorides
 - b. Limit test for sulphates
 - c. Limit test for iron
 - d. Limit test for heavy metals
 - e. Limit test for arsenic
 - f. Modified limit tests for chlorides and sulphates

 - 2. Assays (10 exercises)**
 - a. Ammonium chloride- Acid-base titration
 - b. Ferrous sulphate- Cerimetry
 - c. Copper sulphate- Iodometry
 - d. Calcium gluconate- Complexometry
 - e. Hydrogen peroxide – Permanganometry
 - f. Sodium benzoate – Nonaqueous titration
 - g. Sodium chloride – Modified volhard's method
 - h. Assay of KI – KIO_3 titration
 - i. Gravimetric estimation of barium as barium sulphate
 - j. Sodium antimony gluconate or antimony potassium tartarate

 - 3. Estimation of mixture (Any two exercises)**
 - a. Sodium hydroxide and sodium carbonate
 - b. Boric acid and Borax
 - c. Oxalic acid and sodium oxalate
-

4. Test for identity (Any three exercises)

- a. Sodium bicarbonate
- b. Barium sulphate
- c. Ferrous sulphate
- d. Potassium chloride

5. Test for purity (Any two exercises)

- a. Swelling power in Bentonite
- b. Acid neutralising capacity in aluminium hydroxide gel
- c. Ammonium salts in potash alum
- d. Adsorption power heavy Kaolin
- e. Presence of Iodates in KI

6. Preparations (Any two exercises)

- a. Boric acids
- b. Potash alum
- c. Calcium lactate
- d. Magnesium sulphate

Text Books:

1. A text book Inorganic medicinal chemistry by Surendra N. Pandeya
2. Pharmaceutical Inorganic Chemistry by GR.Chatwal
3. Inorganic Pharmaceutical Chemistry by Anand&Chetwal

Reference Books: (Latest Edition)

1. Beckett AH, Stenlake JB. Practical pharmaceutical chemistry Vol I & II. 4th ed. London;Stahlone Press of University of London.
2. Pandey OP, Bajpai DN, Giri S. Practical Chemistry. S Chand Publishers.
3. Shah, Qadry. Textbook of inorganic pharmaceutical chemistry.
4. Indian Pharmacopoeia. 3rd & 4th eds. Delhi: The Controller of Publications, Ministry of Health and Family welfare, Govt. of India;
5. USP and BP
6. Vogel's textbook of quantitative chemical analysis 5th ed.

SEMESTER / YEAR : III YEAR
COURSE CODE : 15PD305
TITLE OF THE COURSE : MEDICINAL CHEMISTRY (Theory)
L:T:P : 3:1:3

- Course objectives**
- The subject deals with the understanding of use of chemical compounds as medicinal agents.
 - It includes study of history, development fundamental principles of drug therapy and use of chemotherapeutic agents.

- Course Outcomes**
- The student will be able to understand the use of chemical agents as drugs to treat various diseases and understand their action in the physiological system.

Unit -1

1. Modern concept of rational drug design: A brief introduction to Quantitative Structure Activity Relationship (QSAR), prodrug, combinatorial chemistry and computer aided drug design (CADD) and concept of antisense molecules. **6hrs**

A study of the development of the following classes of drugs including SAR, Mechanism of action, synthesis of important compounds, chemical nomenclature, brand names of important marketed products and their side effects.

2. Anti-infective agents

- a) Local anti-infective agents
- b) Preservatives
- c) Antifungal agents
- d) Urinary tract anti-infectives
- e) Antitubercular agents
- f) Antiviral agents and Anti AIDS agents
- g) Antiprotozoal agents
- h) Anthelmintics
- i) Antiscabies and Antipedicular agents **10 hrs**

Unit - 2

3. Sulphonamides and sulphones

4. Antimalarials

5. Antineoplastic agents **15hrs**

Unit - 3

6. Antibiotics **14hrs**

Unit - 4

7. Cardiovascular agents

- a) Antihypertensive agents
- b) Antianginal agents and vasodilators
- c) Antiarrhythmic agents
- d) Antihyperlipidemic agents
- e) Coagulants and Anticoagulants
- f) Endocrine

16 hrs

Unit - 5

8. Hypoglycemic agents

9. Thyroid and Antithyroid agents

10. Diuretics

11. Diagnostic agents

12. Steroidal Hormones and Adrenocorticoids

14hrs

SEMESTER/YEAR : II SEM
COURSE CODE : 17BP206
TITLE OF THE COURSE : ENVIRONMENTAL SCIENCES - THEORY
L: T/A: P: C : 3: 0: 0: 3

30 Hours

Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

COURSE OBJECTIVES: Upon completion of the course the student shall be able to:

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
6. Strive to attain harmony with Nature.

UNIT-I

10 Hours

The Multidisciplinary nature of environmental studies

Natural Resources

Renewable and non-renewable resources: Natural resources and associated problems

a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

UNIT-II

10 Hours

Ecosystems

Concept of an ecosystem.

Structure and function of an ecosystem.

Introduction, types, characteristic features, structure and function of the ecosystems:

Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT- III

10 Hours

Environmental Pollution: Air pollution; Water pollution; Soil pollution

RECOMMENDED BOOKS (LATEST EDITION):

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP304
TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

COURSE OBJECTIVES: Upon completion of the course student shall be able:

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various test to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

UNIT-I

10 Hours

Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.

Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.

Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

UNIT-II

10 Hours

Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator.

Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

UNIT- III

08 Hours

Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. Principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

UNIT-IV

08 Hours

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.

Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

UNIT- V

07 Hours

Materials of pharmaceutical plant construction, Corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Introduction to chemical engineering - Walter L Badger & Julius Banchemo, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering - McCabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices - C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

Physical Pharmaceutics – I (Practical)

4 Hrs/week

Objectives: Upon the completion of the course student shall be able to perform

1. To understand the significance of physical properties such as
 2. solubility, surface tension, partition coefficient and pKa in the design of dosage forms.
 3. To explain adsorption isotherms and determine Freundlich-Langmuir constant using activated charcoal.
 4. To apply Henderson – Hasselbalch equation for interpretation of pKa value of drugs.
 5. To determine the surface tension of sample liquids by drop count and drop weight methods
 6. To deduce the HLB value and critical micellar concentration of a surfactant.
 7. To estimate the stability constants of complexes by solubility and pH titration methods.
-
1. Determination the solubility of drug at room temperature
 2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
 3. Determination of Partition co- efficient of benzoic acid in benzene and water
 4. Determination of Partition co- efficient of Iodine in CCl₄ and water
 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
 6. Determination of surface tension of given liquids by drop count and drop weight method
 7. Determination of HLB number of a surfactant by saponification method
 8. Determination of Freundlich and Langmuir constants using activated char coal
 9. Determination of critical micellar concentration of surfactants
 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
 11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP308
TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING - ~~THEORY~~ *Practicals.*
L: T/A: P: C : 0 : 0 : 4 : 2

1. Determination of radiation constant of brass, iron, unpainted and painted glass.
2. Steam distillation - To calculate the efficiency of steam distillation.
3. To determine the overall heat transfer coefficient by heat exchanger.
4. Construction of drying curves (for calcium carbonate and starch).
5. Determination of moisture content and loss on drying.
6. Determination of humidity of air - i) From wet and dry bulb temperatures - use of Dew point method.
7. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
8. Size analysis by sieving - To evaluate size distribution of tablet granulations - Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
11. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity)
12. To study the effect of time on the Rate of Crystallization.
13. To calculate the uniformity Index for given sample by using Double Cone Blender.

SEMESTER/YEAR : VI SEM
COURSE CODE : 17BP601
TITLE OF THE COURSE : MEDICINAL CHEMISTRY – III - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

COURSE OBJECTIVES: Upon completion of the course student shall be able to

1. Understand the importance of drug design and different techniques of drug design.
2. Understand the chemistry of drugs with respect to their biological activity.
3. Know the metabolism, adverse effects and therapeutic value of drugs.
4. Know the importance of SAR of drugs.

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*)

UNIT – I

10 Hours

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

β-Lactam antibiotics: Penicillin, Cephalosporins, β- Lactamase inhibitors, Monobactams

Aminoglycosides: Streptomycin, Neomycin, Kanamycin

Tetracyclines: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

UNIT – II

10 Hours

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

Macrolide: Erythromycin Clarithromycin, Azithromycin.

Miscellaneous: Chloramphenicol*, Clindamycin.

Prodrugs: Basic concepts and application of prodrugs design.

Antimalarials: Etiology of malaria.

Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine.

Biguanides and dihydro triazines: Cycloguanil pamoate, Proguanil.

Miscellaneous: Pyrimethamine, Artesunate, Artemether, Atovoquone.

UNIT – III

10 Hours

Anti-tubercular Agents

Synthetic anti tubercular agents: Isoniazid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.*

Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine Streptomycin, Capreomycin sulphate.

Urinary tract anti-infective agents

Quinolones: SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin

Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine.

Antiviral agents:

Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

UNIT – IV

08 Hours

Antifungal agents:

Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin.

Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole, Tioconazole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.

Anti-protozoal Agents: Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.

Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.

Sulphonamides and Sulfones

Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxazole*, Sulphadiazine, Mefenide acetate, Sulfasalazine.

Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole.

Sulfones: Dapsone*.

UNIT – V

07 Hours

Introduction to Drug Design

Various approaches used in drug design.

Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.

SEMESTER / YEAR : I SEMESTER
COURSE CODE : 17MPC102
TITLE OF THE COURSE : ADVANCED ORGANIC CHEMISTRY I (Theory)
L:T:P : 4:0:0

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Objectives

Upon completion of course, the student shall be to understand

- The principles and applications of retrosynthesis
- The mechanism & applications of various named reactions
- The concept of disconnection to develop synthetic routes for small target molecule.
- The various catalysts used in organic reactions
- The chemistry of heterocyclic compounds

THEORY 60 Hrs

12 hrs

1. Basic Aspects of Organic Chemistry:

1. Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications.
2. Types of reaction mechanisms and methods of determining them
3. Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations.

Addition reactions

- a) Nucleophilic uni- and bimolecular reactions (SN1 and SN2)
- b) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule)
- c) Rearrangement reaction

12 hrs

2 Study of mechanism and synthetic applications of following named Reactions:

Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeier-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction

12 hrs

3 Synthetic Reagents & Applications:

Aluminiumisopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodiimide, Wilkinson reagent, Wittig reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, Benzotriazol-1-yloxy) tris (dimethylamino) phosphonium hexafluoro-phosphate (BOP). Protecting groups

a. Role of protection in organic synthesis

b. Protection for the hydroxyl group, including 1,2-and 1,3-diols: ethers, esters, carbonates, cyclic acetals & ketals

c. Protection for the Carbonyl Group: Acetals and Ketals

- d. Protection for the Carboxyl Group: amides and hydrazides, esters
- e. Protection for the Amino Group and Amino acids: carbamates and amides

12 hrs

4 Heterocyclic Chemistry:

Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused heterocyclics such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis.

Synthesis of few representative drugs containing these heterocyclic nucleus such as Ketoconazole, Metronidazole, Miconazole, celecoxib, antipyrin, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochlorperazine, Promazine, Chlorpromazine, Theophylline, Mercaptopurine and Thioguanine.

5 Synthons approach and retrosynthesis applications

12 hrs

- i. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconversion and addition (FGI and FGA)
- ii. C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-, 1,4-, 1,5-, 1,6-difunctionalized compounds
- iii. Strategies for synthesis of three, four, five and six-membered ring.

REFERENCES

1. "Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.
2. "Mechanism and Structure in Organic Chemistry", ES Gould, Hold Rinchart and Winston, New York.
3. "Organic Chemistry" Clayden, Greeves, Warren and Wothers., Oxford University Press 2001.
4. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Pearson Education Ltd, Dorling Kindersley (India) Pvt. Ltd.,
5. A guide to mechanisms in Organic Chemistry, Peter Skyes (Orient Longman, New Delhi).
6. Reactive Intermediates in Organic Chemistry, Tandon and Gowel, Oxford & IBH Publishers.
7. Combinational Chemistry – Synthesis and applications – Stephen R Wilson & Anthony W Czarnik, Wiley – Blackwell.
8. Carey, Organic Chemistry, 5th Edition (Viva Books Pvt. Ltd.)
9. Organic Synthesis - The Disconnection Approach, S. Warren, Wiley India
10. Principles of Organic Synthesis, ROC Norman and JM Coxan, Nelson Thorns.
11. Organic Synthesis - Special Techniques. VK Ahluwalia and R Agarwal, Narosa Publishers.
12. Organic Reaction Mechanisms IVth Edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

SEMESTER/YEAR : II SEM
COURSE CODE : 17MPC202
TITLE OF THE COURSE : ADVANCED ORGANIC CHEMISTRY - II

Scope

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Course Objectives

Upon completion of course, the student shall able to understand

- The principles and applications of Green chemistry
- The concept of peptide chemistry.
- The various catalysts used in organic reactions
- The concept of stereochemistry and asymmetric synthesis.
-

1. Green Chemistry:

12 hrs

- a. Introduction, principles of green chemistry
- b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis
- c. Ultrasound assisted reactions: Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications

2 Chemistry of peptides

12 hrs

- a. Coupling reactions in peptide synthesis
- b. Principles of solid phase peptide synthesis, t-BOC and Fmoc protocols, various solid supports and linkers: Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides
- c. Segment and sequential strategies for solution phase peptide synthesis with any two case studies
- d. Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, overactivation and side reactions of individual amino acids.

3 Photochemical Reactions

12 hrs

Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation. Pericyclic reactions Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatropic rearrangement reactions with examples

4 Catalysis:

12 hrs

- a. Types of catalysis, heterogeneous and homogeneous catalysis, advantages and disadvantages
- b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs.
- c. Homogeneous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogeneous catalysis used in synthesis of drugs
- d. Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions
- e. Biocatalysis: Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction.
- f. Phase transfer catalysis - theory and applications

5 Stereochemistry & Asymmetric Synthesis

12 hrs

5 Stereochemistry & Asymmetric Synthesis

12 hrs

a. Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z notation.

b. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples.

REFERENCES

1. "Advanced Organic chemistry, Reaction, mechanisms and structure", J March, John Wiley and sons, New York.
2. "Mechanism and structure in organic chemistry", ES Gould, Hold Rinchart and Winston, New York.
3. "Organic Chemistry" Clayden, Greeves, Warren and Wothers., Oxford University Press 2001.
4. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Sixth ed., 1995.
5. Carey, Organic chemistry, 5th edition (Viva Books Pvt. Ltd.)
6. Organic synthesis-the disconnection approach, S. Warren, Wily India
7. Principles of organic synthesis, ROC Norman and JMCoxan, Nelson thorns
8. Organic synthesis- Special techniques VK Ahluwalia and R Aggarwal, Narosa Publishers.
9. Organic reaction mechanisms IV edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

Subject : PHARMACEUTICAL CHEMISTRY PRACTICALS – II

Subject code:(MPC 205P)

Objective of the subject:

At completion of this course, it is expected that students will be able to Understand

The strategies of scale up process of intermediates the various unit operations and various reactions in process chemistry

Out come :

Know the interpretation of synthesis compounds by IR,Mass,NMR

Process chemistry is often described as scale up reactions, taking them from small quantities created in the research lab

Knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

1. Synthesis of organic compounds by adapting different approaches involving (3 experiments)

a) Oxidation

b) Reduction/hydrogenation

c) Nitration

2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)

3. Assignments on regulatory requirements in API (2 experiments)

4. Comparison of absorption spectra by UV and Wood ward – Fieser rule

5. Interpretation of organic compounds by FT-IR

6. Interpretation of organic compounds by NMR

7. Interpretation of organic compounds by MS

8. Determination of purity by DSC in pharmaceuticals

9. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra

10. To carry out the preparation of following organic compounds

11. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).

12. Preparation of 4-iodotoluene from p-toluidine.

13. NaBH₄ reduction of vanillin to vanillyl alcohol

14. Preparation of umbelliferone by Pechhman reaction

15. Preparation of triphenyl imidazole

16. To perform the Microwave irradiated reactions of synthetic importance (Any two)

17. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using software

18. Calculation of ADMET properties of drug molecules and its analysis using softwares

Pharmacophore modeling

19. 2D-QSAR based experiments

20. 3D-QSAR based experiments

21. Docking study based experiment

22. Virtual screening based experiment

ADVANCED PHARMACOLOGY - I
17MPL102

COURSE OBJECTIVES

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, this subject helps the students to understand the concepts of drug action and mechanisms involved

COURSE OUTCOMES

Upon completion of the course the student shall be able to :

- Discuss the pathophysiology and pharmacotherapy of certain diseases
- Explain the mechanism of drug actions at cellular and molecular level
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

THEORY	60 Hrs
1. General	Pharmacology 12 Hrs
a. Pharmacokinetics: The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding.	
b. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors, quantitation of drug receptors interaction and elicited effects.	
2. Neurotransmission	12 Hrs
a. General aspects and steps involved in neurotransmission.	
b. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetyl choline).	
c. Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine).	
d. Non adrenergic non cholinergic transmission (NANC). Co-transmission	

Systemic Pharmacology

A detailed study on pathophysiology of diseases, mechanism of action, pharmacology and toxicology of existing as well as novel drugs used in the following systems

Autonomic Pharmacology

Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting neuromuscular junction

- | | | |
|---|---|-----------|
| 3 | Central nervous system Pharmacology
General and local anesthetics
Sedatives and hypnotics, drugs used to treat anxiety.
Depression, psychosis, mania, epilepsy, neurodegenerative diseases.
Narcotic and non-narcotic analgesics. | 12
Hrs |
| 4 | Cardiovascular Pharmacology
Diuretics, antihypertensives, antiischemics, anti-arrhythmics, drugs for heart failure and hyperlipidemia.
Hematinics, coagulants, anticoagulants, fibrinolytics and anti-platelet drugs | 12
Hrs |
| 5 | Autocoid Pharmacology
The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids.
Pharmacology of antihistamines, 5HT antagonists. | 12
Hrs |

REFEERENCES

1. The Pharmacological Basis of Therapeutics, Goodman and Gillman's
2. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J, Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.
3. Basic and Clinical Pharmacology by B.G Katzung
4. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
6. Graham Smith. Oxford textbook of Clinical Pharmacology.
7. Avery Drug Treatment
8. Dipiro Pharmacology, Pathophysiological approach.
9. Green Pathophysiology for Pharmacists.

SEMESTER/YEAR : IV YEAR
COURSE CODE : 15BP404
TITLE OF THE COURSE : MEDICINAL CHEMISTRY II - THEORY
L: T/A: P: C : 3 : 0 : 0 : 3

COURSE OBJECTIVES: The subject deals with understanding of chemistry, properties and action of medicinal agents for treating various disorders, basic concepts involved in drug design.

COURSE OUTCOMES: The student will be able to understand the action of drugs in different disease condition and apply basic principles in designing of new drug molecules.

UNIT I

- A. Introduction to QSAR:** Study of hydrophobic, Electronic & Steric parameters **2 hours**
- B. Prodrugs:** Definition and examples **1 hour**
- C. Introduction to drug discovery-** Definition of lead molecule and its identification methods viz, high throughput screening, large scale screening, and fragment based lead generation, fast followers **2 hours**
- D. History and development of chemotherapeutic agents:** Structure, uses and synthesis of only those compounds that are superscripted by 's'.
1. Antifungal agents:
 - a) Antifungal antibiotics- Nystatin, Griseofulvin, Amphoterecin-B Synthetic anti fungal agents
 - b) Substituted imidazoles: Clotrimazole, Miconazole^s, Ketoconazole, oxyconazole, Intraconazole.
 - c) Miscellaneous-Zinc propionate, Sodium caprylate, Tolnaftate^s. **4 hours**
 3. Antiviral Agents
 - a) Amantidine hydrochloride, Idoxuridine, Acyclovir, Zidovidine. **2 hours**
 - b) Anti-AIDS: Aza thymidine, Suramin
 3. Antiprotozoal agents: Emetine hydrochloride, Metronidazole^s, tinidazole, arnidazole, secnidazole, Diloxanide furoate, 8-hydroxy quinoline derivatives (clioquinol, iodoquinol) Carbarsone **2 hours**
 4. Anthelmintics: Piperazine, Diethyl carbamazine, Pyrantelpamoate, Thiabendazole^s Albendazole^s, Mebendazole **2 hours**

UNIT II

E. Sulfonamides, Sulfones as antibacterial agents :

1. SAR and mode of Sulfonamides.
2. Classification of sulfonamides based on duration of action and site of action with examples. Sulfamethiazole, Sulfisoxazole^s, Sulfapyridine, Sulfamethoxazole^s, Sulfadiazine, Sulfacetamide, sulfasalazine, Phthalyl sulfathiazole.
3. Folate reductase inhibitors: Trimethoprim, Synergistic action of the combination of sulfamethoxazole and Trimethoprim^s.

4. Sulfone: **Dapsone^s** **4 hours**
5. Antitubercular drugs:
- Synthetic antitubercular agents: p-Aminosalysilic acid, **Isoniazid^s**, **Ethambutol^s**, Pyrazinamide, Ethionamide, Clofazamine, Bedaquiline
 - Antitubercular Antibiotics: Cycloserine, Viomycin sulfate, Capreomycin sulfate, Rifampicin.
 - Combination therapy for TB, DOTS **4 hours**
Urinary tract anti-infectives:
Quinolones: Nalidixic acid, Cinoxacin, Norfloxacin, Ciprofloxacin^s, Pefloxacin,
 - Ofloxacin, Sparfloxacin
 - Miscellaneous: **Nitrofurantoin^s**. **3 hours**

F. Antimalarials: Etiology of malaria, History, Mechanism and SAR

- Quinolines and analogues: 7-chloro-4-amino quinolines :Chloroquine phosphate^s, HydroxyChloroquinesulphate, Amodiaquine, 8-amino quinolines: Pamaquine, **Primaquine^s**, 9-amino acridines: Quinacrine.
- Artimicin and its derivatives: Artiether, Artimether, Artisunate
- Biguanides and Dihydrothiazines: **Chloroguanide^s**, Cycloguanil.
- Miscellaneous: Mefloquine, Pyrimethamine, Trimethoprim. **6 hours**

UNIT III

G. Antibiotics: Classification and Mechanism of action

- Beta lactam antibiotics: Pencillins – structures, chemical degradation, bacterial resistance. Penicillin G, Penicillin V, Cloxacillin sodium, Nafcillin sodium, Ampicillin, Amoxicillin.
- Cephalosporins: Structure and uses of Cephalexin, Cephadrine, Cefadroxil, Cefixime, Cefaprydine, Cefutroxime
- Monolactams: Sulfazecin, Aztreonam, Tigmonam.
- Beta lactamase inhibitors: Clavulanic acid and its salts, Thienamycin.
- Aminoglycosides: Structural features and Mechanism of action, Streptomycin, Amikacin, Neomycin, Kanamycin, Gentamycin, Netilmycin
- Tetracyclines: Chemistry and **SAR**, tetracycline, Chlortetracycline, Methacycline, Demeclocycline, Oxytetracycline, Meclocycline, Doxycycline, Minocycline.
- Macrolide: Structure and specific uses of Erythromycin, Azithromycin, oleandomycin.
- Lincomycins: Lincomycin, Clindamycin.
- Polypeptides: Gramicidin, Bacitracin, Polymyxin B, Colistin.
- Miscellaneous: **Chlormphenicol^s**, Vancomycin, Novobiocin. **12 hours**

UNIT IV

H. Antineoplastic agents: Introduction, mechanism of action and classification with examples.

- Alkylating agents: Mechlorethamine, Cyclophosphomide, Melphalan, **Chlorambucil^s**, Busulfan, Lomustine,
- Antimetabolites: Mercaptopurine, Thioguanine, 5-Fluorouracil, **Methotrexate^s**,
- Antibiotics: Dactinomycin, Bleomycin, Mitomycin, Streptozocin.
- Plant products: Etoposide, Taxol, Camphothesin, Vincristine, Vinblastin.
- Harmones: Dromostanalone, Megestrol,

6. Kinase inhibitors: Imatinibmesylate
7. Miscellaneous: Asparaginase, Cisplatin, Hydroxy urea.
8. Immunotherapy: Interferon alpha 2a and 2b.

6 hours

I. Cardiovascular agents:

1. Antianginal agents and vasodilators: Chemical structure and specific uses of Amyl nitrite, Nitroglycerine, Isosorbide dinitrate.
2. Calcium antagonists: Brief introduction of calcium channels and their blockers. Chemical Structures and uses of Verapamil, Diltiazem, Nifedepine, Nimodipine, Felodipine, Dipyridamole, Cyclandelate.
3. Antiarrhythmic drugs: Structure, chemical name, and classification of antiarrhythmics with examples
 Class I- Membrane depressant drugs: Quinidine Procainamide, Phenytoin^s.
 Class II-Beta adrenergic blocking agents. Tocainide, propranolol^s
 Class III-Repolarization prolongators. Bretylium, Amiodarone
 Class IV-Calcium channel blocker. Diltiazem, Verapamil
4. Antihypertensive agents:
 Beta-blockers: Propranolol, Timolol
 ACE Inhibitors: Captopril, Enalapril
 Diuretics: Hydrochlorthiazide, Spiranolactone
 Calcium channel blockers: Nifedipine, Felodipine, Amlodipine
 α_1 -Antagonist: Prazocin
 α_2 -agonist: Clonidine^s, Guanithedine
 Angiotensin -II receptor antagonist: Losartan, Valsartan
 Miscellaneous: Reserpine, Hydralazine^s, Minoxidil

11 hours

UNIT V

1. Antihyperlipidemic agents: Structure and specific uses. Clofibrate, Lovastatin, Cholesteramine, Colestipol, Atorvastatin **3 hours**
2. Anticoagulants: Dicumorol, Warfarin^s, Phenindione **1 hour**
3. Hypoglycemic agents: Insulin and its preparations.
 Sulfonylureas-Chlorpropamide^s, Acetohexamide, Glipizide,
 Biguanides-Phenformin, Metformin
 Substituted benzoic acid derivatives - Meglitinides, Nateglinide
 Thiazolidinediones - Glitazones, Pioglitazone, Ciglitazone, Rosiglitazone
 Glipitines - Sitagliptin, Anagliptin **3 hours**
4. Thyroid hormones : L-thyroxine, L-thyronine, **1 hour**
5. Antithyroid drugs: Propylthiouracil, Methimazole. **1 hour**

J. Diuretics: Introduction

1. Carbonic anhydrase inhibitors: Acetazolamide^s, Methazolamide.
2. Thiazide and Thiazide like diuretics: Chlorthiazides, Benzthiazide^s, Xipamide, Chlorthalidone.
3. High-ceiling or loop diuretics: Furosemide^s, Ethacrynic acid^s.
4. Potassium sparing diuretics: Spironolactone, Triamterene, Amiloride.
5. Miscellaneous: Mannitol. **5 hours**

SEMESTER / YEAR : I YEAR
COURSE CODE : 15PD103
TITLE OF THE COURSE : MEDICINAL BIOCHEMISTRY (Theory)
L:T:P :3:1:3

- Course objectives**
- To study the principles and pathways of various biochemical processes and to understand their role in disease processes.
- Course Outcomes**
- Student will be able to correlate the normal and abnormal biochemical pathways in assessing the health condition of individuals.

Unit - 1

26 hrs

- 1 **Introduction to biochemistry:** Cell and its biochemical organization, transport process across the cell membranes. Energy rich compounds; ATP, Cyclic AMP and their biological significance.
- 2 **Enzymes:** Definition; Nomenclature; IUB classification; Factor affecting enzyme activity; Enzyme action; enzyme inhibition. Isoenzymes and their therapeutic and diagnostic applications; Coenzymes and their biochemical role and deficiency diseases.
- 3 **Carbohydrate metabolism:** Glycolysis, Citric acid cycle (TCA cycle), HMP shunt, Glycogenolysis, gluconeogenesis, glycogenesis. Metabolic disorders of carbohydrate metabolism (diabetes mellitus and glycogen storage diseases); Glucose, Galactose tolerance test and their significance; hormonal regulation of carbohydrate metabolism.

Unit -2

10 hrs

- 4 **Lipid metabolism:** Oxidation of saturated (β -oxidation); Ketogenesis and ketolysis; biosynthesis of fatty acids, lipids; metabolism of cholesterol; Hormonal regulation of lipid metabolism. Defective metabolism of lipids (Atherosclerosis, fatty liver, hypercholesterolemia).
- 5 **Biological oxidation:** Coenzyme system involved in Biological oxidation . Electron transport chain (its mechanism in energy capture; regulation and inhibition); Uncouplers of ETC; Oxidative phosphorylation;

Unit -3

14 hrs

- 6 **Protein and amino acid metabolism:** protein turn over; nitrogen balance; Catabolism of Amino acids (Transamination, deamination & decarboxylation). Urea cycle and its metabolic disorders; production of bile pigments; hyperbilirubinemia, porphoria, jaundice. Metabolic disorder of Amino acids.
- 7 **Nucleic acid metabolism:** Metabolism of purine and pyrimidine nucleotides; Protein synthesis; Genetic code; inhibition of protein synthesis; mutation and repair mechanism; DNA replication (semiconservative /onion peel models) and DNA repair mechanism.
- 8 **Introduction to clinical chemistry: Cell;** composition; malfunction; Roll of the clinical chemistry laboratory.

Unit -4

10 hrs

- 9 **The kidney function tests:** Role of kidney; Laboratory tests for normal function includes-

- a) Urine analysis (macroscopic and physical examination, quantitative and semiquantitative tests.)
 - b) Test for NPN constituents. (Creatinine /urea clearance, determination of blood and urine creatinine, urea and uric acid)
 - c) Urine concentration test
 - d) Urinary tract calculi. (stones)
- 10 **Liver function tests:** Physiological role of liver, metabolic, storage, excretory, protective, circulatory functions and function in blood coagulation.
- 11 a) Test for hepatic dysfunction-Bile pigments metabolism.
- b) Test for hepatic function test- Serum bilirubin, urine bilirubin, and urine urobilinogen.
 - c) Dye tests of excretory function.
 - d) Tests based upon abnormalities of serum proteins. Selected enzyme tests.

Unit -5

15 hrs

- 12 **Lipid profile tests:** Lipoproteins, composition, functions. Determination of serum lipids, total cholesterol, HDL cholesterol, LDL cholesterol and triglycerides.
- 13 **Immunochemical techniques** for determination of hormone levels and protein levels in serum for endocrine diseases and infectious diseases.
Radio immuno assay (RIA) and Enzyme Linked Immuno Sorbent Assay (ELISA)
- 14 **Electrolytes:** Body water, compartments, water balance, and electrolyte distribution. Determination of sodium, calcium potassium, chlorides, bicarbonates in the body fluids.

SEMESTER / YEAR : I YEAR
COURSE CODE : 15PD175
TITLE OF THE COURSE : PHARMACEUTICAL INORGANIC CHEMISTRY (Practical)
L:T:P : 3:1:3

1. Limit test (6 exercises)

- a. Limit test for chlorides
- b. Limit test for sulphates
- c. Limit test for iron
- d. Limit test for heavy metals
- e. Limit test for arsenic
- f. Modified limit tests for chlorides and sulphates

2. Assays (10 exercises)

- a. Ammonium chloride- Acid-base titration
- b. Ferrous sulphate- Cerimetry
- c. Copper sulphate- Iodometry
- d. Calcium gluconate- Complexometry
- e. Hydrogen peroxide – Permanganometry
- f. Sodium benzoate – Nonaqueous titration
- g. Sodium chloride – Modified volhard's method
- h. Assay of KI – KIO_3 titration
- i. Gravimetric estimation of barium as barium sulphate
- j. Sodium antimony gluconate or antimony potassium tartarate

3. Estimation of mixture (Any two exercises)

- a. Sodium hydroxide and sodium carbonate
 - b. Boric acid and Borax
 - c. Oxalic acid and sodium oxalate
-

4. Test for identity (Any three exercises)

- a. Sodium bicarbonate
- b. Barium sulphate
- c. Ferrous sulphate
- d. Potassium chloride

5. Test for purity (Any two exercises)

- a. Swelling power in Bentonite
- b. Acid neutralising capacity in aluminium hydroxide gel
- c. Ammonium salts in potash alum
- d. Adsorption power heavy Kaolin
- e. Presence of Iodates in KI

6. Preparations (Any two exercises)

- a. Boric acids
- b. Potash alum
- c. Calcium lactate
- d. Magnesium sulphate

Text Books:

1. A text book Inorganic medicinal chemistry by Surendra N. Pandeya
2. Pharmaceutical Inorganic Chemistry by GR.Chatwal
3. Inorganic Pharmaceutical Chemistry by Anand&Chetwal

Reference Books: (Latest Edition)

1. Beckett AH, Stenlake JB. Practical pharmaceutical chemistry Vol I & II. 4th ed. London;Stahlone Press of University of London.
2. Pandey OP, Bajpai DN, Giri S. Practical Chemistry. S Chand Publishers.
3. Shah, Qadry. Textbook of inorganic pharmaceutical chemistry.
4. Indian Pharmacopoeia. 3rd & 4th eds. Delhi: The Controller of Publications, Ministry of Health and Family welfare, Govt. of India;
5. USP and BP
6. Vogel's textbook of quantitative chemical analysis 5th ed.

SEMESTER / YEAR : III YEAR
COURSE CODE : 15PD305
TITLE OF THE COURSE : MEDICINAL CHEMISTRY (Theory)
L:T:P : 3:1:3

- Course objectives**
- The subject deals with the understanding of use of chemical compounds as medicinal agents.
 - It includes study of history, development fundamental principles of drug therapy and use of chemotherapeutic agents.

- Course Outcomes**
- The student will be able to understand the use of chemical agents as drugs to treat various diseases and understand their action in the physiological system.

Unit -1

1. Modern concept of rational drug design: A brief introduction to Quantitative Structure Activity Relationship (QSAR), prodrug, combinatorial chemistry and computer aided drug design (CADD) and concept of antisense molecules. **6hrs**

A study of the development of the following classes of drugs including SAR, Mechanism of action, synthesis of important compounds, chemical nomenclature, brand names of important marketed products and their side effects.

2. Anti-infective agents

- a) Local anti-infective agents
- b) Preservatives
- c) Antifungal agents
- d) Urinary tract anti-infectives
- e) Antitubercular agents
- f) Antiviral agents and Anti AIDS agents
- g) Antiprotozoal agents
- h) Anthelmintics
- i) Antiscabies and Antipedicular agents **10 hrs**

Unit - 2

3. Sulphonamides and sulphones

4. Antimalarials

5. Antineoplastic agents **15hrs**

Unit - 3

6. Antibiotics **14hrs**

Unit - 4

7. Cardiovascular agents

- a) Antihypertensive agents
- b) Antianginal agents and vasodilators
- c) Antiarrhythmic agents
- d) Antihyperlipidemic agents
- e) Coagulants and Anticoagulants
- f) Endocrine

16 hrs

Unit - 5

8. Hypoglycemic agents

9. Thyroid and Antithyroid agents

10. Diuretics

11. Diagnostic agents

12. Steroidal Hormones and Adrenocorticoids

14hrs

SEMESTER/YEAR : II SEM
COURSE CODE : 17BP206
TITLE OF THE COURSE : ENVIRONMENTAL SCIENCES - THEORY
L: T/A: P: C : 3: 0: 0: 3

30 Hours

Environmental Sciences is the scientific study of the environmental system and the status of its inherent or induced changes on organisms. It includes not only the study of physical and biological characters of the environment but also the social and cultural factors and the impact of man on environment.

COURSE OBJECTIVES: Upon completion of the course the student shall be able to:

1. Create the awareness about environmental problems among learners.
2. Impart basic knowledge about the environment and its allied problems.
3. Develop an attitude of concern for the environment.
4. Motivate learner to participate in environment protection and environment improvement.
5. Acquire skills to help the concerned individuals in identifying and solving environmental problems.
6. Strive to attain harmony with Nature.

UNIT-I

10 Hours

The Multidisciplinary nature of environmental studies

Natural Resources

Renewable and non-renewable resources: Natural resources and associated problems

a) Forest resources; b) Water resources; c) Mineral resources; d) Food resources; e) Energy resources; f) Land resources: Role of an individual in conservation of natural resources.

UNIT-II

10 Hours

Ecosystems

Concept of an ecosystem.

Structure and function of an ecosystem.

Introduction, types, characteristic features, structure and function of the ecosystems:

Forest ecosystem; Grassland ecosystem; Desert ecosystem; Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

UNIT- III

10 Hours

Environmental Pollution: Air pollution; Water pollution; Soil pollution

RECOMMENDED BOOKS (LATEST EDITION):

1. Y.K. Sing, Environmental Science, New Age International Pvt, Publishers, Bangalore
2. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
3. Bharucha Erach, The Biodiversity of India, Mapin Pu blishing Pvt. Ltd., Ahmedabad – 380 013, India,
4. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
5. Clark R.S., Marine Pollution, Clanderson Press Oxford
6. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 1196p
7. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
8. Down of Earth, Centre for Science and Environment

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP304
TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This course is designed to impart a fundamental knowledge on the art and science of various unit operations used in pharmaceutical industry.

COURSE OBJECTIVES: Upon completion of the course student shall be able:

1. To know various unit operations used in Pharmaceutical industries.
2. To understand the material handling techniques.
3. To perform various processes involved in pharmaceutical manufacturing process.
4. To carry out various test to prevent environmental pollution.
5. To appreciate and comprehend significance of plant lay out design for optimum use of resources.
6. To appreciate the various preventive methods used for corrosion control in Pharmaceutical industries.

UNIT-I

10 Hours

Flow of fluids: Types of manometers, Reynolds number and its significance, Bernoulli's theorem and its applications, Energy losses, Orifice meter, Venturimeter, Pitot tube and Rotometer.

Size Reduction: Objectives, Mechanisms & Laws governing size reduction, factors affecting size reduction, principles, construction, working, uses, merits and demerits of Hammer mill, ball mill, fluid energy mill, Edge runner mill & end runner mill.

Size Separation: Objectives, applications & mechanism of size separation, official standards of powders, sieves, size separation Principles, construction, working, uses, merits and demerits of Sieve shaker, cyclone separator, Air separator, Bag filter & elutriation tank.

UNIT-II

10 Hours

Heat Transfer: Objectives, applications & Heat transfer mechanisms. Fourier's law, Heat transfer by conduction, convection & radiation. Heat interchangers & heat exchangers.

Evaporation: Objectives, applications and factors influencing evaporation, differences between evaporation and other heat process. principles, construction, working, uses, merits and demerits of Steam jacketed kettle, horizontal tube evaporator, climbing film evaporator, forced circulation evaporator, multiple effect evaporator & Economy of multiple effect evaporator.

Distillation: Basic Principles and methodology of simple distillation, flash distillation, fractional distillation, distillation under reduced pressure, steam distillation & molecular distillation

UNIT- III

08 Hours

Drying: Objectives, applications & mechanism of drying process, measurements & applications of Equilibrium Moisture content, rate of drying curve. Principles, construction, working, uses, merits and demerits of Tray dryer, drum dryer spray dryer, fluidized bed dryer, vacuum dryer, freeze dryer.

Mixing: Objectives, applications & factors affecting mixing, Difference between solid and liquid mixing, mechanism of solid mixing, liquids mixing and semisolids mixing. Principles, Construction, Working, uses, Merits and Demerits of Double cone blender, twin shell blender, ribbon blender, Sigma blade mixer, planetary mixers, Propellers, Turbines, Paddles & Silverson Emulsifier,

UNIT-IV

08 Hours

Filtration: Objectives, applications, Theories & Factors influencing filtration, filter aids, filter medias. Principle, Construction, Working, Uses, Merits and demerits of plate & frame filter, filter leaf, rotary drum filter, Meta filter & Cartridge filter, membrane filters and Seidtz filter.

Centrifugation: Objectives, principle & applications of Centrifugation, principles, construction, working, uses, merits and demerits of Perforated basket centrifuge, Non-perforated basket centrifuge, semi continuous centrifuge & super centrifuge.

UNIT- V

07 Hours

Materials of pharmaceutical plant construction, Corrosion and its prevention: Factors affecting during materials selected for Pharmaceutical plant construction, Theories of corrosion, types of corrosion and there prevention. Ferrous and nonferrous metals, inorganic and organic non metals, basic of material handling systems.

RECOMMENDED BOOKS: (LATEST EDITIONS):

1. Introduction to chemical engineering - Walter L Badger & Julius Banchemo, Latest edition.
2. Solid phase extraction, Principles, techniques and applications by Nigel J.K. Simpson- Latest edition.
3. Unit operation of chemical engineering - McCabe Smith, Latest edition.
4. Pharmaceutical engineering principles and practices - C.V.S Subrahmanyam et al., Latest edition.
5. Remington practice of pharmacy- Martin, Latest edition.
6. Theory and practice of industrial pharmacy by Lachmann., Latest edition.
7. Physical pharmaceutics- C.V.S Subrahmanyam et al., Latest edition.
8. Cooper and Gunn's Tutorial pharmacy, S.J. Carter, Latest edition.

Physical Pharmaceutics – I (Practical)

4 Hrs/week

Objectives: Upon the completion of the course student shall be able to perform

1. To understand the significance of physical properties such as
 2. solubility, surface tension, partition coefficient and pKa in the design of dosage forms.
 3. To explain adsorption isotherms and determine Freundlich-Langmuir constant using activated charcoal.
 4. To apply Henderson – Hasselbalch equation for interpretation of pKa value of drugs.
 5. To determine the surface tension of sample liquids by drop count and drop weight methods
 6. To deduce the HLB value and critical micellar concentration of a surfactant.
 7. To estimate the stability constants of complexes by solubility and pH titration methods.
-
1. Determination the solubility of drug at room temperature
 2. Determination of pKa value by Half Neutralization/ Henderson Hasselbalch equation.
 3. Determination of Partition co- efficient of benzoic acid in benzene and water
 4. Determination of Partition co- efficient of Iodine in CCl₄ and water
 5. Determination of % composition of NaCl in a solution using phenol-water system by CST method
 6. Determination of surface tension of given liquids by drop count and drop weight method
 7. Determination of HLB number of a surfactant by saponification method
 8. Determination of Freundlich and Langmuir constants using activated char coal
 9. Determination of critical micellar concentration of surfactants
 10. Determination of stability constant and donor acceptor ratio of PABA-Caffeine complex by solubility method
 11. Determination of stability constant and donor acceptor ratio of Cupric-Glycine complex by pH titration method

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP308
TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING - ~~THEORY~~ *Practicals.*
L: T/A: P: C : 0 : 0 : 4 : 2

1. Determination of radiation constant of brass, iron, unpainted and painted glass.
2. Steam distillation - To calculate the efficiency of steam distillation.
3. To determine the overall heat transfer coefficient by heat exchanger.
4. Construction of drying curves (for calcium carbonate and starch).
5. Determination of moisture content and loss on drying.
6. Determination of humidity of air - i) From wet and dry bulb temperatures - use of Dew point method.
7. Description of Construction working and application of Pharmaceutical Machinery such as rotary tablet machine, fluidized bed coater, fluid energy mill, de humidifier.
8. Size analysis by sieving - To evaluate size distribution of tablet granulations - Construction of various size frequency curves including arithmetic and logarithmic probability plots.
9. Size reduction: To verify the laws of size reduction using ball mill and determining Kicks, Rittinger's, Bond's coefficients, power requirement and critical speed of Ball Mill.
10. Demonstration of colloid mill, planetary mixer, fluidized bed dryer, freeze dryer and such other major equipment.
11. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity)
12. To study the effect of time on the Rate of Crystallization.
13. To calculate the uniformity Index for given sample by using Double Cone Blender.

SEMESTER/YEAR : III SEM
COURSE CODE : 17BP308
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11. Factors affecting Rate of Filtration and Evaporation (Surface area, Concentration and Thickness/ viscosity)
12. To study the effect of time on the Rate of Crystallization.
13. To calculate the uniformity Index for given sample by using Double Cone Blender.

SEMESTER/YEAR : VI SEM
COURSE CODE : 17BP601
TITLE OF THE COURSE : MEDICINAL CHEMISTRY – III - THEORY
L: T/A: P: C : 3 : 1 : 0 : 4

45 Hours

This subject is designed to impart fundamental knowledge on the structure, chemistry and therapeutic value of drugs. The subject emphasis on modern techniques of rational drug design like quantitative structure activity relationship (QSAR), Prodrug concept, combinatorial chemistry and Computer aided drug design (CADD). The subject also emphasizes on the chemistry, mechanism of action, metabolism, adverse effects, Structure Activity Relationships (SAR), therapeutic uses and synthesis of important drugs.

COURSE OBJECTIVES: Upon completion of the course student shall be able to

1. Understand the importance of drug design and different techniques of drug design.
2. Understand the chemistry of drugs with respect to their biological activity.
3. Know the metabolism, adverse effects and therapeutic value of drugs.
4. Know the importance of SAR of drugs.

Study of the development of the following classes of drugs, Classification, mechanism of action, uses of drugs mentioned in the course, Structure activity relationship of selective class of drugs as specified in the course and synthesis of drugs superscripted by (*)

UNIT – I

10 Hours

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

β-Lactam antibiotics: Penicillin, Cephalosporins, β- Lactamase inhibitors, Monobactams

Aminoglycosides: Streptomycin, Neomycin, Kanamycin

Tetracyclines: Tetracycline, Oxytetracycline, Chlortetracycline, Minocycline, Doxycycline

UNIT – II

10 Hours

Antibiotics

Historical background, Nomenclature, Stereochemistry, Structure activity relationship, Chemical degradation classification and important products of the following classes.

Macrolide: Erythromycin Clarithromycin, Azithromycin.

Miscellaneous: Chloramphenicol*, Clindamycin.

Prodrugs: Basic concepts and application of prodrugs design.

Antimalarials: Etiology of malaria.

Quinolines: SAR, Quinine sulphate, Chloroquine*, Amodiaquine, Primaquine phosphate, Pamaquine*, Quinacrine hydrochloride, Mefloquine.

Biguanides and dihydro triazines: Cycloguanil pamoate, Proguanil.

Miscellaneous: Pyrimethamine, Artesunate, Artemether, Atovoquone.

UNIT – III

10 Hours

Anti-tubercular Agents

Synthetic anti tubercular agents: Isoniazid*, Ethionamide, Ethambutol, Pyrazinamide, Para amino salicylic acid.*

Anti tubercular antibiotics: Rifampicin, Rifabutin, Cycloserine Streptomycin, Capreomycin sulphate.

Urinary tract anti-infective agents

Quinolones: SAR of quinolones, Nalidixic Acid, Norfloxacin, Enoxacin, Ciprofloxacin*, Ofloxacin, Lomefloxacin, Sparfloxacin, Gatifloxacin, Moxifloxacin

Miscellaneous: Furazolidine, Nitrofurantoin*, Methanamine.

Antiviral agents:

Amantadine hydrochloride, Rimantadine hydrochloride, Idoxuridine trifluoride, Acyclovir*, Gancyclovir, Zidovudine, Didanosine, Zalcitabine, Lamivudine, Loviride, Delavirding, Ribavirin, Saquinavir, Indinavir, Ritonavir.

UNIT – IV

08 Hours

Antifungal agents:

Antifungal antibiotics: Amphotericin-B, Nystatin, Natamycin, Griseofulvin.

Synthetic Antifungal agents: Clotrimazole, Econazole, Butoconazole, Oxiconazole, Tioconazole, Miconazole*, Ketoconazole, Terconazole, Itraconazole, Fluconazole, Naftifine hydrochloride, Tolnaftate*.

Anti-protozoal Agents: Metronidazole*, Tinidazole, Ornidazole, Diloxanide, Iodoquinol, Pentamidine Isethionate, Atovaquone, Eflornithine.

Anthelmintics: Diethylcarbamazine citrate*, Thiabendazole, Mebendazole*, Albendazole, Niclosamide, Oxamniquine, Praziquantal, Ivermectin.

Sulphonamides and Sulfones

Historical development, chemistry, classification and SAR of Sulfonamides: Sulphamethizole, Sulfisoxazole, Sulphamethizine, Sulfacetamide*, Sulphapyridine, Sulfamethoxazole*, Sulphadiazine, Mefenide acetate, Sulfasalazine.

Folate reductase inhibitors: Trimethoprim*, Cotrimoxazole.

Sulfones: Dapsone*.

UNIT – V

07 Hours

Introduction to Drug Design

Various approaches used in drug design.

Physicochemical parameters used in quantitative structure activity relationship (QSAR) such as partition coefficient, Hammett's electronic parameter, Taft's steric parameter and Hansch analysis. Pharmacophore modeling and docking techniques.

Combinatorial Chemistry: Concept and applications of combinatorial chemistry: solid phase and solution phase synthesis.

SEMESTER / YEAR : I SEMESTER
COURSE CODE : 17MPC102
TITLE OF THE COURSE : ADVANCED ORGANIC CHEMISTRY I (Theory)
L:T:P : 4:0:0

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Objectives

Upon completion of course, the student shall be to understand

- The principles and applications of retrosynthesis
- The mechanism & applications of various named reactions
- The concept of disconnection to develop synthetic routes for small target molecule.
- The various catalysts used in organic reactions
- The chemistry of heterocyclic compounds

THEORY 60 Hrs

12 hrs

1. Basic Aspects of Organic Chemistry:

1. Organic intermediates: Carbocations, carbanions, free radicals, carbenes and nitrenes. Their method of formation, stability and synthetic applications.
2. Types of reaction mechanisms and methods of determining them
3. Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations.

Addition reactions

- a) Nucleophilic uni- and bimolecular reactions (SN1 and SN2)
- b) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule)
- c) Rearrangement reaction

12 hrs

2 Study of mechanism and synthetic applications of following named Reactions:

Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner-Miller Reaction, Sandmeyer Reaction, Mitsunobu reaction, Mannich reaction, Vilsmeier-Haack Reaction, Sharpless asymmetric epoxidation, Baeyer-Villiger oxidation, Shapiro & Suzuki reaction, Ozonolysis and Michael addition reaction

12 hrs

3 Synthetic Reagents & Applications:

Aluminiumisopropoxide, N-bromosuccinamide, diazomethane, dicyclohexylcarbodiimide, Wilkinson reagent, Wittig reagent. Osmium tetroxide, titanium chloride, diazopropane, diethyl azodicarboxylate, Triphenylphosphine, Benzotriazol-1-yloxy) tris (dimethylamino) phosphonium hexafluoro-phosphate (BOP). Protecting groups

a. Role of protection in organic synthesis

b. Protection for the hydroxyl group, including 1,2-and 1,3-diols: ethers, esters, carbonates, cyclic acetals & ketals

c. Protection for the Carbonyl Group: Acetals and Ketals

- d. Protection for the Carboxyl Group: amides and hydrazides, esters
- e. Protection for the Amino Group and Amino acids: carbamates and amides

12 hrs

4 Heterocyclic Chemistry:

Organic Name reactions with their respective mechanism and application involved in synthesis of drugs containing five, six membered and fused heterocyclics such as Debus-Radziszewski imidazole synthesis, Knorr Pyrazole Synthesis Pinner Pyrimidine Synthesis, Combes Quinoline Synthesis, Bernthsen Acridine Synthesis, Smiles rearrangement and Traube purine synthesis.

Synthesis of few representative drugs containing these heterocyclic nucleus such as Ketoconazole, Metronidazole, Miconazole, celecoxib, antipyrin, Metamizole sodium, Terconazole, Alprazolam, Triamterene, Sulfamerazine, Trimethoprim, Hydroxychloroquine, Quinine, Chloroquine, Quinacrine, Amsacrine, Prochlorperazine, Promazine, Chlorpromazine, Theophylline, Mercaptopurine and Thioguanine.

5 Synthons approach and retrosynthesis applications

12 hrs

- i. Basic principles, terminologies and advantages of retrosynthesis; guidelines for dissection of molecules. Functional group interconversion and addition (FGI and FGA)
- ii. C-X disconnections; C-C disconnections – alcohols and carbonyl compounds; 1,2-, 1,3-, 1,4-, 1,5-, 1,6-difunctionalized compounds
- iii. Strategies for synthesis of three, four, five and six-membered ring.

REFERENCES

1. "Advanced Organic chemistry, Reaction, Mechanisms and Structure", J March, John Wiley and Sons, New York.
2. "Mechanism and Structure in Organic Chemistry", ES Gould, Hold Rinchart and Winston, New York.
3. "Organic Chemistry" Clayden, Greeves, Warren and Wothers., Oxford University Press 2001.
4. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Pearson Education Ltd, Dorling Kindersley (India) Pvt. Ltd.,
5. A guide to mechanisms in Organic Chemistry, Peter Skyes (Orient Longman, New Delhi).
6. Reactive Intermediates in Organic Chemistry, Tandon and Gowel, Oxford & IBH Publishers.
7. Combinational Chemistry – Synthesis and applications – Stephen R Wilson & Anthony W Czarnik, Wiley – Blackwell.
8. Carey, Organic Chemistry, 5th Edition (Viva Books Pvt. Ltd.)
9. Organic Synthesis - The Disconnection Approach, S. Warren, Wiley India
10. Principles of Organic Synthesis, ROC Norman and JM Coxan, Nelson Thorns.
11. Organic Synthesis - Special Techniques. VK Ahluwalia and R Agarwal, Narosa Publishers.
12. Organic Reaction Mechanisms IVth Edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

SEMESTER/YEAR : II SEM
COURSE CODE : 17MPC202
TITLE OF THE COURSE : ADVANCED ORGANIC CHEMISTRY - II

Scope

The subject is designed to provide in-depth knowledge about advances in organic chemistry, different techniques of organic synthesis and their applications to process chemistry as well as drug discovery.

Course Objectives

Upon completion of course, the student shall able to understand

- The principles and applications of Green chemistry
- The concept of peptide chemistry.
- The various catalysts used in organic reactions
- The concept of stereochemistry and asymmetric synthesis.
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1. Green Chemistry:

12 hrs

- a. Introduction, principles of green chemistry
- b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis
- c. Ultrasound assisted reactions: Types of sonochemical reactions, homogenous, heterogeneous liquid-liquid and liquid-solid reactions, synthetic applications

2 Chemistry of peptides

12 hrs

- a. Coupling reactions in peptide synthesis
- b. Principles of solid phase peptide synthesis, t-BOC and Fmoc protocols, various solid supports and linkers: Activation procedures, peptide bond formation, deprotection and cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides
- c. Segment and sequential strategies for solution phase peptide synthesis with any two case studies
- d. Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, overactivation and side reactions of individual amino acids.

3 Photochemical Reactions

12 hrs

Basic principles of photochemical reactions. Photo-oxidation, photo-addition and photo-fragmentation. Pericyclic reactions Mechanism, Types of pericyclic reactions such as cyclo addition, electrocyclic reaction and sigmatropic rearrangement reactions with examples

4 Catalysis:

12 hrs

- a. Types of catalysis, heterogeneous and homogeneous catalysis, advantages and disadvantages
- b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs.
- c. Homogeneous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogeneous catalysis used in synthesis of drugs
- d. Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions
- e. Biocatalysis: Use of enzymes in organic synthesis, immobilized enzymes/cells in organic reaction.
- f. Phase transfer catalysis - theory and applications

5 Stereochemistry & Asymmetric Synthesis

12 hrs

5 Stereochemistry & Asymmetric Synthesis

12 hrs

a. Basic concepts in stereochemistry – optical activity, specific rotation, racemates and resolution of racemates, the Cahn, Ingold, Prelog (CIP) sequence rule, meso compounds, pseudo asymmetric centres, axes of symmetry, Fischers D and L notation, cis-trans isomerism, E and Z notation.

b. Methods of asymmetric synthesis using chiral pool, chiral auxiliaries and catalytic asymmetric synthesis, enantiopure separation and Stereo selective synthesis with examples.

REFERENCES

1. "Advanced Organic chemistry, Reaction, mechanisms and structure", J March, John Wiley and sons, New York.
2. "Mechanism and structure in organic chemistry", ES Gould, Hold Rinchart and Winston, New York.
3. "Organic Chemistry" Clayden, Greeves, Warren and Wothers., Oxford University Press 2001.
4. "Organic Chemistry" Vol I and II. I.L. Finar. ELBS, Sixth ed., 1995.
5. Carey, Organic chemistry, 5th edition (Viva Books Pvt. Ltd.)
6. Organic synthesis-the disconnection approach, S. Warren, Wily India
7. Principles of organic synthesis, ROC Norman and JMCoxan, Nelson thorns
8. Organic synthesis- Special techniques VK Ahluwalia and R Aggarwal, Narosa Publishers.
9. Organic reaction mechanisms IV edtn, VK Ahluwalia and RK Parashar, Narosa Publishers.

Subject : PHARMACEUTICAL CHEMISTRY PRACTICALS – II

Subject code:(MPC 205P)

Objective of the subject:

At completion of this course, it is expected that students will be able to Understand

The strategies of scale up process of intermediates the various unit operations and various reactions in process chemistry

Out come :

Know the interpretation of synthesis compounds by IR,Mass,NMR

Process chemistry is often described as scale up reactions, taking them from small quantities created in the research lab

Knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.

1. Synthesis of organic compounds by adapting different approaches involving (3 experiments)

a) Oxidation

b) Reduction/hydrogenation

c) Nitration

2. Comparative study of synthesis of APIs/intermediates by different synthetic routes (2 experiments)

3. Assignments on regulatory requirements in API (2 experiments)

4. Comparison of absorption spectra by UV and Wood ward – Fieser rule

5. Interpretation of organic compounds by FT-IR

6. Interpretation of organic compounds by NMR

7. Interpretation of organic compounds by MS

8. Determination of purity by DSC in pharmaceuticals

9. Identification of organic compounds using FT-IR, NMR, CNMR and Mass spectra

10. To carry out the preparation of following organic compounds

11. Preparation of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).

12. Preparation of 4-iodotoluene from p-toluidine.

13. NaBH₄ reduction of vanillin to vanillyl alcohol

14. Preparation of umbelliferone by Pechhman reaction

15. Preparation of triphenyl imidazole

16. To perform the Microwave irradiated reactions of synthetic importance (Any two)

17. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using software

18. Calculation of ADMET properties of drug molecules and its analysis using softwares

Pharmacophore modeling

19. 2D-QSAR based experiments

20. 3D-QSAR based experiments

21. Docking study based experiment

22. Virtual screening based experiment

ADVANCED PHARMACOLOGY - I
17MPL102

COURSE OBJECTIVES

The subject is designed to strengthen the basic knowledge in the field of pharmacology and to impart recent advances in the drugs used for the treatment of various diseases. In addition, this subject helps the students to understand the concepts of drug action and mechanisms involved

COURSE OUTCOMES

Upon completion of the course the student shall be able to :

- Discuss the pathophysiology and pharmacotherapy of certain diseases
- Explain the mechanism of drug actions at cellular and molecular level
- Understand the adverse effects, contraindications and clinical uses of drugs used in treatment of diseases

THEORY

60 Hrs

- | | | |
|--|--------------|-----------|
| 1. General | Pharmacology | 12
Hrs |
| a. Pharmacokinetics: The dynamics of drug absorption, distribution, biotransformation and elimination. Concepts of linear and non-linear compartment models. Significance of Protein binding. | | |
| b. Pharmacodynamics: Mechanism of drug action and the relationship between drug concentration and effect. Receptors, structural and functional families of receptors, quantitation of drug receptors interaction and elicited effects. | | |
| | | |
| 2 Neurotransmission | | 12
Hrs |
| a. General aspects and steps involved in neurotransmission. | | |
| b. Neurohumoral transmission in autonomic nervous system (Detailed study about neurotransmitters- Adrenaline and Acetyl choline). | | |
| c. Neurohumoral transmission in central nervous system (Detailed study about neurotransmitters- histamine, serotonin, dopamine, GABA, glutamate and glycine). | | |
| d. Non adrenergic non cholinergic transmission (NANC). Co-transmission | | |

Systemic Pharmacology

A detailed study on pathophysiology of diseases, mechanism of action, pharmacology and toxicology of existing as well as novel drugs used in the following systems

Autonomic Pharmacology

Parasympathomimetics and lytics, sympathomimetics and lytics, agents affecting neuromuscular junction

- | | | |
|---|---|-----------|
| 3 | Central nervous system Pharmacology
General and local anesthetics
Sedatives and hypnotics, drugs used to treat anxiety.
Depression, psychosis, mania, epilepsy, neurodegenerative diseases.
Narcotic and non-narcotic analgesics. | 12
Hrs |
| 4 | Cardiovascular Pharmacology
Diuretics, antihypertensives, antiischemics, anti-arrhythmics, drugs for heart failure and hyperlipidemia.
Hematinics, coagulants, anticoagulants, fibrinolytics and anti-platelet drugs | 12
Hrs |
| 5 | Autocoid Pharmacology
The physiological and pathological role of Histamine, Serotonin, Kinins Prostaglandins Opioid autocoids.
Pharmacology of antihistamines, 5HT antagonists. | 12
Hrs |

REFEERENCES

1. The Pharmacological Basis of Therapeutics, Goodman and Gillman's
2. Principles of Pharmacology. The Pathophysiologic basis of drug Therapy by David E Golan, Armen H, Tashjian Jr, Ehrin J, Armstrong, April W, Armstrong, Wolters, Kluwer-Lippincott Williams & Wilkins Publishers.
3. Basic and Clinical Pharmacology by B.G Katzung
4. Hand book of Clinical Pharmacokinetics by Gibaldi and Prescott.
5. Applied biopharmaceutics and Pharmacokinetics by Leon Shargel and Andrew B.C.Yu.
6. Graham Smith. Oxford textbook of Clinical Pharmacology.
7. Avery Drug Treatment
8. Dipiro Pharmacology, Pathophysiological approach.
9. Green Pathophysiology for Pharmacists.

SEMESTER/YEAR : III YEAR
COURSE CODE : 15BP304
TITLE OF THE COURSE : PHARMACEUTICAL ENGINEERING –
THEORY L: T/A: P: C : 3 : 1 : 0 : 3

COURSE OBJECTIVES:

- (i) This course is planned to impart a fundamental knowledge on art and science of various equipment's used in pharma industries.
- (ii) This subject mainly focuses on unit operations, material handling, pharma plant construction, corrosion, industrial pollution and its control.

COURSE OUTCOMES: The prime outcome is to know the operation of various equipments used in pharma industry; also know the corrosion, industrial hazards and its control, layout of pharma industry.

UNIT I

- 1. Stoichiometry** **2Hrs**
Unit processes, material and energy balances, units and their conversions, dimensional formulae, dimensionless equations.
- 2. Heat transfer** **5 Hrs**
Concept of heat flow by conduction, convection and radiation. Fourier's law and its application, Forced and natural convection, surface co-efficient, study of single, multi pass heat exchangers and liquid-liquid heat interchangers, radiations, black body, Stefan-Boltzmann equation.
- 3. Evaporation** **5 Hrs**
Classification of evaporators, factor affecting evaporation, evaporators–film evaporators, single effect and multiple effect evaporators, forced circulation evaporation, material and energy balance, economy of multiple effect evaporator.

UNIT II

- 4. Drying** **5 Hrs**
Theory of drying, Classification and types of dryers - Principle construction and working of tray dryer, fluidized bed dryer, drum dryer, freeze dryer, and spray dryer.
- 5. Distillation** **5 Hrs**
Raoult's law, Dalton's law, volatility, Rayleigh's equation, real and ideal solutions, boiling point curves, simple, steam, molecular and flash distillations. Rectification and fractional columns, brief study on principle of azeotropic, molecular and extractive distillation.

6. Size reduction**6 Hrs**

Definition, objectives, factors affecting size reduction, laws governing energy and power requirement of a mill, stress strain relationship of deformation in solids. Types of mills, construction and working of ball mill, hammer mill, fluid energy mill, cutter mill, roller mill, edge runner and end runner mill.

UNIT III**7. Size separation****4 Hrs**

Definition and objectives of size separation, particle size distribution, standard sieves as per IP. Mechanical sieve shakers, sedimentation tanks, cyclone separators, air separators, bag filter.

8. Mixing**7 Hrs**

Theory of mixing, solid-solid, solid-liquid and liquid-liquid mixing. Equipments- V-cone, double cone and ribbon blenders, sigma blade and planetary mixer. Liquid Mixing devices: propellers, turbines, paddles, and baffles. Vortex formation and prevention. Homogenization and study on Silverson, Rapisonic and colloid mill.

9. Material handling systems**5 Hrs**

Transportation of solids-construction and working of belt conveyor, screw, pneumatic conveyors, pharmaceutical applications.

UNIT IV**10. Flow of fluids****5 Hrs**

Reynolds experiment and its significance, Bernoulli's Theorem. Flow meters- venturi meter, orifice meter and pitot tube.

11. Filtration and centrifugation**7 Hrs**

Study of Poiseuille's, Darcy's and Kozeny - Carman equation and study of filter aids and filter medium. Construction and working of filter press, filter leaf, meta filter and candle filter. Theory and principle of centrifugation, industrial centrifuges- basket, tubular bowl, conical disk centrifuges.

12. Crystallization**5 Hrs**

Definition and applications, characteristics- crystal forms, crystal habits. Mechanism of crystallization – super saturation, nucleation, crystal growth. Solubility curves, Mier's super-saturation theory, construction and working of agitated batch crystallizer, Swenson Walker crystallizer, Krystal crystallizer and vacuum crystallizers. Caking of crystals and its prevention.

UNIT V

13. Humidification and air conditioning

5 Hrs

Definition of humidity, humid heat, humid volume. Study of psychrometric charts, wet bulb theory. Applications of humidity. Theory of airconditioning, Refrigeration
- coefficient of performance.

14. **Materials of construction**

6 Hrs

Factors affecting material selection, classification, chemical and mechanical properties of important materials such as steel, plastic, rubber and glass, their uses, advantages and disadvantages.

15. Corrosion

3 Hrs

Definition, types, theories, prevention and control of corrosion.

TEXT BOOKS:

1. Carter SJ. Cooper and Gunn's Tutorial Pharmacy. 6th ed. New Delhi: CBS Publishers; 2000.
2. Walter L Badger , Julius T Banchero. Introduction to Chemical Engineering. 3rd ed. New York: McGraw Hill publication; 1955.
3. Rawlins EA. Bentley's Textbook of Pharmaceutics. 8th ed. New Delhi: All India Traveller Book Seller; 2002.
4. Paradkar AR. Introduction to Pharmaceutical Engineering. 6th ed. Pune: Nirali Prakashan; 2004.
5. Sambamurthy K. Pharmaceutical Engineering. ed. New Delhi: CBS publishers; 1998.
6. Subramanyam CVS, Timma Shetty J. Pharmaceutical Engineering Principles and Practices. 1st ed. New Delhi: Vallabh Prakashan; 2002.

REFERENCE BOOKS:

1. Max Peter. Elementary Chemical Engineering. 2nd ed. McGraw Hill international Book Company; 1984.
2. Don. WG, James. OM. Perry's Chemical Engineers Handbook. 6th ed. McGraw Hill Book Company; 1984.
3. Coulson JM, Richardson JF. Chemical Engineering. 2nd ed. ELBS Pergemom Press; 1977.
4. Alfonso R Gennaro. Remington: The Science and Practice of Pharmacy, 20th ed. Vol I and II, Philadelphia, USA: Lippincott Williams and Wikkins; 2000.
5. Indian Pharmacopoeia 2010
6. www.ispe.org.
7. www.who.int.