MODERN PHARMACEUTICAL ANALYSIS (PCL 101)

1. UV- Ultraviolet/Visible Spectroscopy and Fluorimetry

Energy level and selection rules, effect of substituents, effect of conjugation, conformation and geometry, the Woodward-Fisher rules, the Fisher-Kuhn rules, applications of UV with reference to different electronic systems. Derivative spectroscopy and its applications. Fluorescence and chemical structure, fluorescence intensity, factors affecting fluorescence, instrumentation, comparison of fluorometry with spectrophotometry, applications of fluorimetry in pharmaceutical analysis.

2. **Spectrofluorimetry**: Fluorescence, Phosphorescence, Chemiluminescence- Theory, instrumentation and applications.

3**. Infra-Red spectroscopy**:

The Hook's law and calculation of stretching frequencies for different types of bonds and their bond strengths, coupled interactions, hydrogen bonding, examination of infrared spectrum, survey of important functional groups with examples, radiation source, detectors used, sample handling, quantitative applications, qualitative applications with special reference to stereochemical aspects and hydrogen bonding, Near-IR spectroscopy, absorption and reflectance spectrophotometry, instrumentation, applications, Far Infrared spectroscopy. Introduction to FTIR and its applications. Raman spectroscopy Introduction, theory and polarization measurement, rules of selection and polarization, instrumentation, applications in pharmaceutical sciences. Comparison of Infrared and Raman spectra.

4. **Optical Rotatory Dispersion**:

a. Principle, plain curves, Cotton effect, Circular dichroism and. Measurement of rotation angle in ORD and applications.

b. Principles and application of light, Phase contrast, Scanning and Transmission electron microscopy, Cytometry and Flow cytometry.

5. Nuclear Magnetic Resonance spectroscopy:

Nuclear Magnetic Resonance Spectroscopy 1H-NMR spectroscopy Magnetic equivalence, failure of the N+1 rule, chemical shifts, local diamagnetic shielding, hybridization effects, magnetic anisotropy, mechanism of spin-spin coupling, the origin of spin-spin splitting, Pascal's triangle, the coupling constant, protons on oxygen, nitrogen and sulphur, diastereomeric protons, chemical shift reagents, long range coupling, spin decoupling methods, nuclear over Hauser

effect. Correlation NMR spectrometry: introduction to 1H -1H cosy and 1H -13C cosy and its applications. Introduction and applications of 2D NMR; solid state NMR. 13 C-NMR spectroscopy.

Introduction, peak assignments, off resonance decoupling, selective proton decoupling; chemical shift equivalence; chemical shifts; spin coupling. Spectrometry of other important nuclei Introduction to 15N, 19F, 31P, basic concepts.

Electron Spin Resonance Spectroscopy

Introduction, derivative curves, g values, hyperfine splitting, ESR instrumentation, ESR spectra of free radicals, applications.

6. Mass spectroscopy:

Basic principle and theory involved; instrumentation, type of ions; various ion sources, electron impact source, chemical ionization sources, field ionization sources, desorption sources, mass analysers, double focusing, quadripole, time of flight, ion trap analyzer, ionization, fragmentation, rearrangements, mass spectra of representative compounds, recognition of molecular ion peak, metastable peak, isotopic peaks, applications.

7. X- ray Crystallography: Production of X rays, Different X ray methods, Braggs law, Rotating crystal technique, X ray powder technique, Types of crystals, Interpretation of diffraction patterns and applications of X-ray diffraction

8. Chromatographic methods, Introduction, classifications,

a) Liquid chromatography, instrumentation, materials, column selection, resolution optimization and efficiency parameters. HPLC detectors, modes of HPLC, Ion –pair, Ion exchange, Size exclusion, Supercritical, gel-permeation, flash chromatography, applications.

b) High Performance Liquid Chromatography: Partition, adsorption, ion exchange, size exclusion; pharmaceutical applications of HPLC and LC-MS. Super critical fluid chromatography; brief introduction to HPTLC.

c) Gas Chromatography: Gas liquid chromatography, gas solid chromatography, instrumentation and applications (GC-MS and GC-FTIR). Column parameters, Resolution, Liquid Phases Derivatisation and detectors, Derivatization as a means of sampling of thermosensitive compounds.

d) Capillary electrophoresis.: Introduction, methods and applications.

9. Radio Immuno Assay and ELISA for some drugs.

10.Thermal methods: Thermo Gravimetry (TG), Differential Scanning Calorimetry (DSC), Differential Thermal Analysis (DTA).

Practical

1. Practical based on instrumental methods of analysis. A sufficient training will be given through exercises using different kinds of spectral analysis.

2. Microbial analysis of Vitamins and Anti-biotics

3. Pharmacological Bioassay of some drugs.

Reading Material Recommended

1. Willard, H.H., Merrit, L.L., Dean, J.A., Settle P.A., Instrumental Methods of Analysis, Van Nostrand.
2. Skoog, D.A., Heller, F.J., Nieman, T.A., Principles of Instrumental Analysis, WB Saunders.
3. Hunson, J.W., ed. Pharmaceutical Analysis, Modern Methods, part A & B, Marcel Dekker.
4. Schirmer, R.E., ed. Modern Methods of Pharmaceutical Analysis, Vols 1, 2. Boca Raton F.L., CRC Press.
5. Mann, C.K., et al., Instrumental Analysis Harper & Row.
6. Jaffe, H.H., Orchin M., Theory & Applications of Ultraviolet Spectroscopy, Willy.
7. Silverstein, Spectrometric identification of Organic Compounds, Willy.
8. Bovey, F., Jelinski, L., Miran, P., Nuclear Magnetic Resonance Spectroscopy, Sau: Diego Academic.
9. Stothers, J.B., Carbon-13 NMR.Spectroscopy, Academic.
10. Gordy, W., Theory & Applications of Electron Spin Resonance, Willy.
11. Haswell, S.J., ed. Atomic Absorption Spectroscopy, Elsevier.
12. Ardrey, R.E., Pharmaceutical Mass Spectra, Pharmaceutical Press, London.
13. Budzikiewicz, et al., Interpretation of Mass Spectra of Organic Compounds, Holden-Day San Francisco.
14. Beckett and Stenlake, Practical Pharmaceutical Chemistry, CBS.
15. Stahl, E., Thin Layer Chromatography- A laboratory Handbook, Springer-Verlag
16. Giddings, J.C., Principles and Theory- Dynamics of Chromatography, Marcel Dekker.
17. Sethi, P.D., Quantitative Analysis of Pharmaceutical formulations, CBS Publishers, New Delhi.
18. Kemp William, Organic spectroscopy, Pal grave, New York.
19. Kalsi, P.S., Spectroscopy of organic compounds, New age publishers, New Delhi.
20. Gross - Mass Spectrometry
21. WHO - Quality Assurance of Pharmaceuticals, Vol. I, II.
22. Sethi, P.D., HPLC, Quantitative Analysis of Pharmaceutical Formulations, CBS

Publishers, Delhi.
23. Sethi, P.D., HPTLC, Quantitative Analysis of Pharmaceutical Formulations, CBS Publishers, Delhi.
24. Haffmann, Chromatography.
25. Sethi and Charcgankar, Identification of Drugs in Pharmaceutical Formulations by TLC.
26. Robert D. Braun, Introduction to Instrumental Analysis.
27. Wilfried, M.A. Niessen- Liquid Chromatography-Mass Spectrometry.
28. Harry G. Brittain, Spectroscopy of Pharmaceutical Solids.
29. George, S., Steroid Analysis in Pharmaceutical Industry.
30. Higuchi, Pharmaceutical Analysis.
31. Bidingmeyer, Practical HPLC Methodology and Applications.
32. Hoffmann, Mass Spectrometry: Principle and Application.
33. Scott, Techniques and Practice of Chromatography.
34. Wilkins, Identification of Microorganism by Mass Spectrometry.
35. Wu, Handbook for Size Exclusion Chromatography and related Techniques.
36. Silverstein RM and Webster FX. Spectrometric Identification of Organic Compounds. John Wiley and Sons, New York. Latest Edition.
37. Chatten LG. Pharmaceutical Chemistry, Vol. I & II. Marcel Dekker, New York. Latest Edition.
38. James WD and Kenneth HT. Analytical Chemistry by Oipen Learning: Thermal Methods. John Wiley and Sons, New York. Latest Edition.
39.Abraham RJ, Fisher J and Bftus P. Introduction to NMR Spectroscopy. John Wiley and Sons, New York. Latest Edition.
40. Pavia DL, Lampman GM and Kriz GS. Introduction to Spectroscopy. Harcourt College Publishers, Orlando. Latest Edition.

ANIMAL CARE AND HANDLING (PCL 102)

1. Care, Handling and breeding techniques of laboratory animals. Regulations for laboratory animal care and ethical requirements. CPCSEA guidelines for performing experiments on animals. Alternatives to animal studies.

2. Preclinical evaluation of following categories of drugs

- Sedatives, hypnotics, anxiolytics, antidepressant, antipsychotics, antiparkinsonism agent, analgesics, antipyretics.
- Anti-inflammatory agents, Anticonvulsants, local anaesthetics, CNS stimulants.
- Antiulcer agents, laxatives, bronchodilators, antitussives, Diuretics, Histamine antagonists
- Muscle relaxants, Anticholinesterases, anticholinergics, adrenolytics.
- Hypoglycemics, antifertility agent, androgens.
- Antithyroid agent, Dermatological agents, antitumor agents.
- Anthelmintics, Antimalarials, Antileprotics.

3. In vitro testing of drugs. Animal cell lines and their uses. Limitations of in vitro testing of drugs.

Practical

1. Effects of Drugs on Rabbit Eye
2. Bioassay of Histamine on the Ileum of Guinea Pig
3. Effect of Drugs on Ciliary Motility of Frog Oesophagus
4. Effect of Drugs on Isolated Frog Heart
5. Effect of Drugs on Blood Pressure (BP) and Heart Rate (HR) of Dog
6. Effect of Drugs on Isolated and Perfused Frog Heart
7. DRC of Acetylcholine on Frog Rectus Abdominis Muscle
8. DRC of Histamine on Guinea Pig Ileum
9. Effect of Physostigmine on the DRC of Acetylcholine on Frog Rectus Abdominis Muscle
10. Effect of Atropine on the DRC of the Acetylcholine on Rat Ileum
11. Effects of Spasmogens and Spasmolytics on the Rabbit Jejunum
12. Determination of PD2 of Serotonin on Rat Stomach Strip Preparation
13. Determination of PA2 of Atropine using Isolated Rat Ileum preparation (by Schild's Plot Method)
14. Determination of PA2 of Prazosin on Rat Anococcygeous Muscle Preparation (by Schild Plot Method)
15. Determination of PD2 of Acetylcholine on Frog Rectus Abdominis

16. Determination of PD2 of Histamine on Guinea Pig Ileum
17. Bioassay of Oxytocin by Interpolation Method using Isolated Rat Uterus Preparation
18. Bioassay of Serotonin on Rat Stomach Strip by Three Point Assay Method
19. Bioassay of Atropine (an Antagonist) by Interpolation Method
20. Bioassay of Acetylcholine on Rat Ileum by Three Point Assay Method
21. Bioassay of Adrenaline by Interpolation Method using Isolated Rabbit Jejunum Preparation
22. Effect of Drugs on Locomotor Activity in Mice using Actophotometer
23. Demonstration of Analgesic Activity of Drug in Mice using Eddy's Hot Plate
24. Determination of the Anticonvulsant Effect of Phenytoin in Mice using Electroconvulsiometer
25. Screening of Effect of CNS Depressant and Skeletal Muscle Relaxant Drugs using Rota-rod Apparatus
26. Routes of Drug Administration
27. Experimental Animals Routinely used in Pharmacological Research
28. Euthanasia in Experimental Animals

Book and Reference Recommended

1. Kulkarni, S.K. Handbook of Experimental Pharmacology, (Vallabh Prakashan, Delhi).

2. Gohsh, M.N. Fundamentals of Experimental Pharmacology, (Scientific Book Agency, Calcutta).

3. Sheth, U.K., Dadkar, N.K. and Kamat, U.G. Selected Topics in Experimental Pharmacology, (Kothari Book Depot, Bombay)

4. Perry, W.L.M. Pharmacological Experiments on Isolated Preparations, (E & S Livingstone, London)

5. Lawarence, D.R. and Bacharach, A.L. Evaluation of Drug Activities: Pharmacometrics, (Academic Press, London)

6. Turner, R.A. Screening Methods in Pharmacology, (Academic Press, London)

7. Thompson, E.B. Drug Bioscreening, (VCH, New York)

8. Vogel, H.G. and Vogel W.H. Drug Discovery and Evaluation Pharmacological assay, (Springer New York)

9. Burn, J.H. Practical Pharmacology, (Blackwell Scientific Co. Oxford).

PHARMACOTHERAPEUTICS (PCL 103)

1**. Clinical evaluation** of New Drugs. Organization, Ethics and Protocol for Clinical trials. Drug Registration.

2. **General Principles of Toxicology:** General Reproductive Toxicology, Carcinogenicity, Mutagenicity, Teratogenicity and Immunotoxicology.

3. Clinical pharmacology of drugs used in the treatment of following diseases

a. CVS diseases: Hypertension, Congestive cardiac failure, Angina Pectoris, Acute Myocardial Infarction, Cardiac Arrhythmia, Atherosclerosis, Peripheral Vascular disorders, Coagulation disorders.

b. Pain management, Pain pathways, NSAIDS, Local anesthetics, Prostaglandins, Leukotrienes and Platelet Activating Factor.

c. Immunopharmacology: AIDS, Drug Allergy, Tissue transplantation, Immunostimulants, Immunosuppressants, vaccines and Sera.

d. Gastrointestinal diseases: Peptic Ulcer, Nausea and Vomiting, diarrhea and Constipation.

e. Renal disease: Acute and Chronic Renal failure

f. Respiratory disease: Asthma, Chronic Obstructive Pulmonary Edema, Pulmonary Embolism.

g. Hepatic disorder: Cirrhosis, Hepatitis.

h. Infectious Disease: General guidelines for rational use of antibiotics. Resistance to antibiotics. Respiratory tract infections, Meningitis, Gastroentritis, Pneumonia, Bacterial Endocarditis, Septicemia, Otitis media, Urinary tract infection, Tuberculosis, Leprosy, Protozoal infection, HIV and Opportunistic infections, Fungal Infections.

i. Neoplastic disorders: General principles of Cancer chemotherapy, Chemotherapy of Lung, Breast, Head and Neck Cancer, Leukemia, Liver and Prostate cancer.

Book and Reference Recommended

1. Roger and Walker, Clinical Pharmacy and Therapeutics. Churchill Livingston Publication.

2. Dipiro, J.L. Pharmacotherapy: A Pathopysiological Approach. (Elsevier).

3. Russle, T.G. Pathology and Therapeutics for Pharmacists: A basis for Clinical Pharmacy Practice. (Chapman and Hall Publication).

4. Herfindal, E.T. and Hirschman, J.L. Clinical Pharmacy and Therapeutics. Williams & Wilkins, London.

5. Davidson's Principles and Practice of Medicine. Churchill Livingston Eighteenth Edition.

6. Harrisons Principles of Internal Medicine. Vol. I & II 14th Edn. Int. McGraw Hills.

7. Oxford Medicine, Blackwell Science

8. Panda, U.N. Textbook of Medicine, CBS.

9. Niesink, R.J.M., De Vries, J. and Hollingers, M.A. Toxicology, Principles and Applications, CRC Press 1996.

10. Amdur, M.O., Duol, J. and Klassen, C.D. Casarett and Doull's Toxicology.

11. Gupta, P.K. and Salunkhe, D.K. Modern Toxicology, Vol–I, II and III (Metropolitan, New Delhi)

12. James Crossland. Lewis Pharmacology, Churchill Livingston, London.

13. Goodman and Gilman. The Pharmacological basis of Therapeutics, Pergamon Press, New York.

PHARMACOLOGICAL RECEPTORS (PCL-104)

1. Molecular mechanism of drug action. Receptor Occupancy and Cellular Signaling systems, such as G-Proteins, Cyclic nucleotides, Calcium and Phosphatidyl inositol, Ionic channel and their modulators.

2. Endogenous bioactive molecules as TNF-α, Interleukins, Process of Apoptosis, Arachidonic acid metabolites, COX-2 regulators and their role in inflammation.

3. Recent trends on different classes of receptors and drug acting on them.

a) Cholinergic receptors

b) Dopamine receptors

c) Serotonin receptors

d) Hormone receptors

e) GABA receptors

f) Opioid receptors

g) Purinergic receptors

h) Glutamate receptors

4. Neurosteroids, Nitric Oxide

5. Endothelium derived vascular substances (NO, endothelins) and their modulators. Pharmacology of Atrial Peptides, Reactive Oxygen intermediates, Anti oxidants and their therapeutic implications.

6. Fc receptors on T and B-lymphocytes, Antibody Dependent and Cellular Cytotoxicity.

7. Concept of gene therapy and recent development in the treatment of various hereditary diseases. Transgenic mouse and its applications. Human genome mapping and its potential in drug research.

8. General Principles of Clinical Laboratory tests.

Book and Reference Recommended:

1. Katzung, B.G. Basic and Clinical Pharmacology (Lange Medical Publication, California)

2. Barar, F.S.K. Essentials of Pharmacotherapeutics (S. Chand & Co, New Delhi)

3. Bowman, W.C. and Rand, M.J. Textbook of Pharmacology (Blackwell, Oxford)

4. Craig, C.R. and Stitzel, B.E. Modern Pharmacology (Little Brown & Co. Boston)

5. Drill, V.A. Pharmacology in Medicine (McGraw Hill Co. New York)

6. Goodman and Gilman. Pharmacological Basis of Therapeutics (Mc Graw Hill)

7. Rang, H.P. and Dale, M.M. Pharmacology (Churchill Livingston, U.K.)

8. Bacq, Z.M. and Capek. Fundamentals of Biochemical Pharmacology

9. Melmon, K.L. and Morelli. Clinical Pharmacology Basic Principles of Therapeutics (Macmillan New York).