# Course Structure and Syllabus for M. Pharm- Pharmacology

## for affiliated Pharmacy Colleges 2009-10

## I YEAR  I SEMESTER

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours/Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modern Pharmaceutical Analytical Techniques</td>
<td>4</td>
</tr>
<tr>
<td>Biostatistics, Intellectual property rights and regulatory affairs</td>
<td>4</td>
</tr>
<tr>
<td>Advanced Pharmacology</td>
<td>4</td>
</tr>
<tr>
<td>Advanced Pharmacology &amp; Toxicology</td>
<td>4</td>
</tr>
<tr>
<td>Modern Pharmaceutical Analysis -Practical</td>
<td>6</td>
</tr>
<tr>
<td>Advanced Pharmacology &amp; Toxicology - Practical</td>
<td>6</td>
</tr>
<tr>
<td>Mini-project- I</td>
<td>3</td>
</tr>
</tbody>
</table>

## I YEAR  II SEMESTER

<table>
<thead>
<tr>
<th>Subject</th>
<th>Hours/Week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biopharmaceutics and Pharmacokinetics</td>
<td>4</td>
</tr>
<tr>
<td>Cell and Molecular biology</td>
<td>4</td>
</tr>
<tr>
<td>Clinical Pharmacology &amp; Pharmacotherapeutics</td>
<td>4</td>
</tr>
<tr>
<td>Screening methods in Pharmacology and clinical research</td>
<td>4</td>
</tr>
<tr>
<td>Clinical Pharmacology &amp; Molecular Biology</td>
<td>6</td>
</tr>
<tr>
<td>Screening Methods in Pharmacology &amp; Clinical Research</td>
<td>6</td>
</tr>
<tr>
<td>Mini-project- II</td>
<td>3</td>
</tr>
</tbody>
</table>

## II YEAR  (III & IV Semesters)

<table>
<thead>
<tr>
<th>SUBJECTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seminar</td>
</tr>
<tr>
<td>Project work</td>
</tr>
</tbody>
</table>
MODERN PHARMACEUTICAL ANALYSIS


b) OPTICAL ROTATORY DISPERSION: Fundamental principles of ORD, cotton effect curves, their characteristics and interpretation. Octant rule and its application with examples. Circular dichroism and its relation to ORD.

3. NMR SPECTROSCOPY: Fundamental principles of NMR (Magnetic properties of nuclei, applied field and precession; absorption and transition; frequency). Chemical shifts concept: Isotopic nuclei, Reference standards: Proton magnetic spectra, their characteristics, presentation terms used in describing spectra and their interpretation (Signal No., Position, Intensity). Brief outline of instrumental arrangements and some practical details. Signal multiplicity phenomenon in high resolution PMR. Spin-spin coupling. Application of Signal split and coupling constant data to interpretation of spectra. De-coupling and shift reagent methods. Brief outline of principles of FT-NMR with reference to 13CNMR. Spin-spin and spin-lattice relaxation phenomenon. Free induction decay (FID) proton noise de-coupling signal, average time domain and frequency domain signals nuclear overhauser enhancement 13CNMR spectra, their presentation; characteristics, interpretation, examples and applications. Brief indication of application of magnetic resonance spectral data of other nuclei by modern NMR instruments. Introduction to 2-D NMR techniques.

4. MASS SPECTROSCOPY: Basic principles and brief outline of instrumentation. Ion formation and types; molecular ion, Meta stable ions, fragmentation processes. Fragmentation patterns and fragmentation characteristics in relation to parent structure and functional groups. Relative abundances of isotopes and their contribution to characteristic peaks. Mass spectrum, its characteristics, presentation and interpretation. Chemical ionization Mass Spectroscopy. GC-MS, other recent advances in MS. Fast atom bombardment mass spectrometry. LC-MS, LC MS-MS.

6. GAS CHROMATOGRAPHY: Instrumentation packed and open tubular column, Column efficiency parameters, the Vandemeter equation, Resolution, liquid stationary phase, derivatization methods of GC including acylation, perfloro acylation, alklylation and esterification. Detectors: FID, ECD, TCD, NPDA. Critical comparison of sensitivity, selectivity and field of applications of these detectors. Examples of GC applications in pharmaceutical analysis.

7. LIQUID CHROMATOGRAPHY: Comparison of GC and HPLC, instrumentation in HPLC, analytical, preparative and microbore columns, normal and reversed phase packing materials, reverse phase HPLC, Column selection, Mobile phase selection, Efficiency parameters, resolution, detectors in HPLC refractive index, photometric and electrochemical. Comparison of sensitivity, selectivity and field of applications of these detectors. HPTLC-instrumentation and applications.

8. ELECTROPHORESIS: Moving boundary electrophoresis, Zone electrophoresis, Iontophoresis, PAGE, Isotacophoresis and applications in pharmacy.

X-ray Diffraction methods: introduction, generation of X-rays, elementary crystallography, Miller Indices, X-rays diffraction, Bragg’s law, X-ray powder diffraction, X-ray powder diffractometer, obtaining and interpretation of X-ray powder diffraction data. Principle, instrumentation and application of the following: Differential Scanning Colorimetry (DSC), DTA &TGA in analysis of pharmaceuticals.

REFERENCES:
3. Instrumental methods of analysis by Willard, Merit, Dean, Settle.
5. Spectrometric identification of organic compounds by silverstein, Webster.
6. Spectroscopy by B.K.Sharma
7. Fundamentals of analytical chemistry by Skoog
8. Instrumental methods of analysis by Skoog.
10. Organic spectroscopy by William kemp
I. **BIO-STATISTICS**

1. **An introduction** to statistics and biostatistics-collection and organization of data, graphical, pictorial presentation of data, measures of central tendency and dispersion, sampling techniques, sample size, Coefficient of variation, mean error, relative error, precision and accuracy.


3. **Design of Experiments**: Principles of randomization, replication and local control; CRD, RBD, LSD – their applications and analysis of data; Factorial Experiments – Principles and applications; Probit analysis: Dose – effect relationships, calculation of LD$_{50}$, ED$_{50}$.


II. **INTELLECTUAL PROPERTY RIGHTS & REGULATORY AFFAIRS**


b). Documentation: Types related to pharmaceutical industry, protocols, harmonizing formulations, development for global filings, ANDA, NDA, CTD, dealing with post – approval changes – SUPAC, handling and maintenance including electronic documentation.

**Recommended Books:**

I  
  a) KS Negi ‘Biostatistics’ AITB Publishers, Delhi.  
  b) Irfan Alikhan ‘Fundamentals of Biostatistics’ Ukaaz Publications  
  c) Khan and Khanum ‘Biostatistics for Pharmacy’ Ukaaz Publications  
  d) J.E. Demuth ‘Basic statistics and Pharmaceutical applications’ Mercel & Dekker.  
  e) Applied statistics by S.C.Gupta & V.K.Kapoor  

II  
2. Protection of Industrial Property rights, P. Das & Gokul Das  
3. Law and Drugs, Law Publications. S.N. Katju  
4. Original Laws Published By Govt. of India  
5. Laws of drugs in India, Hussain  
7. fda.org, wipo.int, patentlawlinks.com, hc-sc.gc.ca, ich.org, cder.org
ADVANCED PHARMACOLOGY


2. Structural activity relationships, Pharmacodynamic and pharmacokinetic aspects of chiral drugs, allo-steric binding, thermodynamics of drug interactions with the receptors.

3. Neurotransmitter receptor mechanism, ion channel and G-protein linked receptors, secondary messenger systems: receptor expression and regulation with specific emphasis and adrenergic, dopaminergic, cholinergic, serotonergic, histaminergic, GABA/BZ and excitatory aminoacid receptors, opioid receptors, purinoceptors and their sub types with agonists and antagonists. Isolation and their characterization of receptors.

4. Mediators of inflammation and allergy: Autacoids (histamine, bradykinins, PAF, eicosanoide, prostaglandins, thrombaxanes, leukotrienes and related compounds), nitric oxide/EDRF and vascular substances, oxygen free radicals, their scavengers. Cytokinins and their actions Cox-I, Cox-II inhibitors and their load in inflammatory process, anti-inflammatory agents, asthma and COPD.

5. Immuno-modulators (immunosuppressant and immunostimulants), AIDS and Rheumatoid arthritis.

6. Theoretical aspects of drug action

7. Microbial conversions as tools in the preparation of drugs: introduction, practical aspects of microbial transformation, some theoretical aspects of microbial transformation, conversion by microorganisms.

8. Prodrug design: various aspects governing prodrug design.

REFERENCE:
5. Pharmacology by Sathoshkar
1. Drugs acting on central nervous system

   General Anaesthetics, anxiolytics and hypnotics, anti-psychotics, anti-depressants anti-epileptics, analgesics, anti-migraine agents and anti-parkinsonism agents.

2. Drugs acting on autonomic nervous system

   Sympathomimetics, sympatholytics, parasympathomimetics, parasympatholytics and neuro muscular junction blockers.

3. Drugs acting on cardiovascular system:

   Anti-hypertensive, cardiotonics, anti-arrhythmics, anti-anginal, hypolipidemics and anti-atherosclerotic agents.

4. Drugs acting on hormones

   Pitutary, thyroid, parathyroid, pancreatic, adrenal. male and female sex hormones. Diabetes Mellitus.

5. Drugs acting on GIT, respiratory and kidney

   GIT-GERD and Anti-ulcer agents, emetics and anti-emetics, laxatives and purgatives, anti-tussives, expectorants, Inflammatory bowel disease, anti-asthmatics, cough and pneumonia, diuretics and anti-diuretics.

6. Recent developments in chemotherapeutic agents, mechanism of multi drug resistance (MDR), anti-bacterial, anti-viral, anti Protozoal and anti-helmenthic, cancer chemotherapy.

7. Toxicology: Definition, scope and general principles of toxicology, dose-response relationship, factors influencing toxicity, evaluation safety, biotransformation and toxico-kinetics, target organ toxicity, neuronal and behavioral toxicity, kidney, pulmonary, hepatic, cutaneous, oto-toxicity. Haemato-toxicity, mutagenecity, carcinogenicity, reproductive toxicity, environmental and industrial toxicology, management of toxicity reactions in humans.

REFERENCE:
5. Pharmacology by Sathoshkar
MODERN PHARMACEUTICAL ANALYSIS - PRACTICAL

2. UV-Visible spectrum scanning of certain organic compounds- absorption and co-relation of structures, comparisons. Ex: a. Chloramphenicol  
   b. Sulphadiazine  
   c. Analgin
3. Effect of pH and solvent on UV spectrum of certain drugs.
4. Two dimensional paper chromatography and TLC.
5. Gradient elution and other techniques in column chromatography.
6. Separation by electrophoresis.(PAGE and agarose Gel electrophoresis)
7. Experiments based on HPLC and GC.
8. IR, NMR and Mass spectroscopy of compound each.
9. DSC/XRD curves of a sample and mixture to understand polymorphism.
10. Determination of insulin / any other hormones by ELISA method.
1. Common laboratory animals: breeding, maintenance, handling and CPCSEA regulations.

2. Effect of various drugs on isolated mammalian heart preparation using Langendorff’s setup.

3. Effect of various drugs on rat / rabbit thoracic aorta (with and without endothelium).

4. Effect of various drugs on rat phrenic nerve diaphragm preparation.

5. Anti-arrhythmic activity in rats using ECG.

6. Effect of various autonomic drugs on rabbit blood pressure.

7. Effect of various drugs on rabbit jejunum preparation.

8. Determination of LD_{50} and ED_{50} of some drugs (mice).

9. Estimation of insulin by ELISA.

10. Serum estimation of SGOT, SGPT, AST, glucose, bilirubin, cholesterol, HDL, LDL, VLDL, catalase, SOD, lipid peroxidation.
BIO PHARMAECUTICS AND PHARMACOKINETICS

1. **Bioavailability and Bioequivalence studies:** Designing of bioavailability and bioequivalence studies and interpretation of results. Tests of significance test ANOVA.

2. Physicochemical properties affecting bioavailability, pH-partition theory, dissolution, surface area adsorption, complexation, polymorphism and techniques of enhancing dissolution rate.

3. Formulation factors affecting bioavailability of drugs in dosage forms of tablets, capsules, parenterals, liquid orals and topical dosage forms.

4. **Basic concepts of pharmacokinetics:** compartment models: One, two and non-compartmental approaches to pharmacokinetics. Recent trends, merits and limitations of these approaches. Application of these models to determine the various pharmacokinetic parameters pertaining to
   a. Absorption: (wherever applicable) absorption rate constant, absorption half-life, lag time and extent of absorption, AUC.
   c. Metabolism: Metabolic rate constant
   d. Elimination: Over all apparent elimination rate constant, and half life.
      All the above under the following conditions:
      1. Intravenous bolus injection
      2. Intravenous infusion
      3. Single dose oral administration
      4. Multiple dose injections
      5. Multiple dosage oral administration
   e. Noninvasive methods of estimating pharmacokinetics parameters with emphasis on salivary and urinary compartments
   f. Concept of clearance: organ, total clearance, hepatic clearance, lung clearance and renal clearance.
   g. Concept of loading dose, maintenance dose, accumulation index, dosage adjustment in renal and hepatic impairment, individualization of therapeutic drug monitoring.

5. **Non-linear pharmacokinetics:** Concepts of linear and non-liner pharmacokinetics, Michaelis-Menten Kinetics characteristics. Basic Kinetic parameters, possible causes of non-induction, non-linear binding, and non-linearity of pharmacological responses.


REFERENCE:

2. Bio Pharmaceutics And Pharmacokinetics by Madan
1. The cell, cell cycle, cellular aging and death, transformation of cell-metastasis, tumour gland part animal cell culture.


5. r-DNA Biotechnological aspects, cloning of DNA, Expression of cloned DNA, manipulation of DNA sequence information, now biological targets of drugs development, novel drug screening strategies, novel biological agents, antibodies, antisense oligonucleotide therapy, gene therapy.


REFERENCE:

1. The Cell by Cooper.
3. Cell and Molecular Biology by De Robertis and De Robertis.
4. The Cell by Albert.
5. The World of the Cell by W.M. Becker.
CLINICAL PHARMACOLOGY & PHARMACOTHERAPEUTICS

1. Principles of Pharmacokinetics
   a. Revision of basic concepts.
   b. Clinical Pharmacokinetics.
      i. Dose – response in man.
      ii. Influence of renal and hepatic disease on Pharmacokinetics.
      iii. Therapeutic drug concentration monitoring.


3. Pathophysiology and drug therapy of the following disorders.
   a. Schizophrenia, anxiety, depression, epilepsy, Parkinson’s, Alzheimer’s diseases, migraine, hypertension, angina pectoris, arrhythmias, atherosclerosis, myocardial infraction,

4. TB, leprosy, leukemia, solid tumours, lymphomas, psoriasis, respiratory, urinary, GI tract infections, endocarditis, fungal and HIV infection, rheumatoid arthritis, glaucoma, menstrual disorders, menopause.

5. Drug therapy in Geriatrics.


7. Pharmacogenetics: Inter-racial and individual variability in drugs metabolism.

8. Orphan diseases and its management.
REFERENCE:
5. Pharmacology by Sathoshkar
7. Clinical Pharmacy by Dr.Laurence , PN Bennet and MJ.Brown, 8 th edition, Churchil Livingston.
SCREENING METHODS IN PHARMACOLOGY AND CLINICAL RESEARCH


2. Bioassays: Basic principles of bioassays, official bioassays, experimental models and statistical designs employed in biological standardization. Biological standardization of vaccines and sera, vasopressin, oxytocin, acetylcholine, adrenaline, insulin, d-tubocurarine, HCG, hyaluronidase, corticotrophin, pertussis, rabies and plague.

3. Preclinical models employed in the screening of new drugs belonging to following categories-I
   Anti-fertility agents, sympathomimetics, parasympathomimetics, muscle relaxants (both central and peripheral), sedatives, hypnotics, anti-arrhythmic agents, anti hypertensive, cardiac stimulants, cardiotonic agents, bronchodilators, anti-histaminics, eicosanoids.

4. Preclinical models employed in the screening of new drugs belonging to following categories-II
   Anti-psychotic agents, anti-anxiety agents, nootropic drugs, antidepressant drugs; anti-parkinsonian agents, anti-epileptics; analgesics and anti-inflammatory agents; antiulcer agents; myocardial infarction; anti-atherosclerotic drug, hepatoprotective;

5. Preclinical models employed in the screening of new drugs belonging to following categories-III
   antimalarials; anti-helmintics anti-diabetics; models for status epilepticus drugs/ cerebroventricular and other newer techniques of drug administration and development; transgenic animals and other genetically prone animal models.


8. Drug development process, clinical trials, safety evaluation, preparation IND/NDAs, statistical design in clinical trials, data analysis technique and presentation skills.
CLINICAL PHARMACOLOGY AND MOLECULAR BIOLOGY

1. Monitoring of concentration of drugs in saliva/urine.

2. Determination of concentration of drugs in blood of children, adults, following oral administration of a safe drug.

3. Drug mutagenicity studies using mice bone-marrow chromosomal aberration tests.

4. Drug mutagenicity studies using mice bone-marrow micro nucleus tests.

5. Transformation of bacteria.

6. Isolation of plasmid DNA containing resistant gene ($p^{BR322}$).

7. Establishing of Breast cancer cell line and testing the anti cancer activity of a drug.

8. Preparation of antibody (polyclonal) from rabbit.

9. Study of possible drug interactions from prescription of local doctors (10-20 prescriptions are to be collected).
4. PA-2 values of various antagonists using suitable isolated tissue preparations.
5. Screening of anxiolytic drugs.
6. Screening of anti-depressant drugs.
7. Screening of anti-ulcer drugs.
8. Screening of anti-inflammatory, analgesic and antipyretic activity.
MINIMUM EQUIPMENTS FOR PHARMOCOLOGY

List of equipment:

1. Student physiograph -----3No.s
2. Auto analyzer ------1 No
3. Langendorf’s heart perfusion apparatus ----3No.s
4. Students organ bath (Temperature controlled) ----10 No.s
5. Elevated plus Maze ------1No
6. Condon’s manometer (for rat B.P) ----3No.s
7. Bio Pac----01 No
Mini Projects:

The mini projects can be taken up as industrial visit/training and report submission. Or
A suitable project shall be carried out in the college.

The Project Work:

Separate guidelines will be issued