THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY
CHENNAI-600 032

SYLLABUS – M.PHARMACY 2006-2007
BRANCH I - PHARMACEUTICS

M. PHARMACY

I YEAR

SYLLABUS FOR PHARMACEUTICS – BRANCH I

COMMON TO ALL BRANCHES - PAPER – I

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

THEORY **75 Hours(3 hrs./week)**

1. UV-VISIBLE SPECTROSCOPY : 6 Hours.

Brief review of electromagnetic spectrum and absorption of radiations. The chromophore concept, absorption law and limitations. Theory of electronic spectroscopy, absorption by organic molecules, choice of solvent and solvent effects, modern instrumentation – design and working principle. Applications of UV-Visible spectroscopy (qualitative and quantitative analysis), Woodward – Fischer rules for calculating absorption maximum, Photometric titrations and its applications.

2. FLAME EMISSION SPECTROSCOPY AND ATOMIC ABSORPTION SPECTROSCOPY : 3 Hours.

Principle, instrumentation, interferences and applications in Pharmacy.

3. SPECTROFLUORIMETRY : 3 Hours.

Theory, instrumentation, advantages, relationship of chemical structure to fluorescence spectra, solvent effect, effect of acids and bases on fluorescence spectra, concentration effects, factors affecting fluorescence intensity, comparison of fluorescence and UV-Visible absorption methods and applications in Pharmacy.

4. INFRARED SPECTROPHOTOMETRY : 6 Hours.

Introduction, basic principles, vibrational frequency and factors influencing vibrational frequency, instrumentation and sampling techniques, interpretation of spectra, applications in Pharmacy. FT-IR-theory and applications, Attenuated Total Reflectance (ATR).

5. NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY : 8 Hours.

Fundamental Principles and Theory, Instrumentation, solvents, chemical shift, and factors affecting chemical shift, spin-spin coupling, coupling constant, and factors influencing the value of coupling constant, spin-spin decoupling, proton exchange reactions, FT-NMR, 2D -NMR, NMDR, NOE, NOESY, COSY and applications in Pharmacy, interpretation of spectra, C13 NMR-Introduction, Natural abundance, C13 NMR Spectra and its structural applications.

6. ELECTRON SPIN RESONANCE SPECTROSCOPY : 2 Hours.

Theory and Principle, Limitations of ESR, choice of solvent, g-values, hyperfine splitting, instrumentation, difference between ESR & NMR and applications.

7. MASS SPECTROSCOPY : 8 Hours.

Basic principles and instrumentation, ion formation and types, fragmentation processes and fragmentation pattern, Chemical ionization mass spectroscopy (CIMS), Field Ionization Mass Spectrometry (FIMS), Fast Atom Bombardment MS (FAB MS), Matrix Assisted laser desorption / ionization MS (MALDI-MS), GC-MS, interpretation of spectra and applications in Pharmacy.

8. X-RAY DIFFRACTION METHODS : 4 Hours.

Introduction, generation of X-rays, X-ray diffraction, Bragg's law, X-ray powder diffraction, interpretation of diffraction patterns and applications.

9. OPTICAL ROTARY DISPERSION : 4 Hours.

Principle, Plain curves, curves with cotton effect, octant rule and its applications with example, circular dichroism and its relation to ORD.

10. THERMAL METHODS OF ANALYSIS : 5 Hours.

Theory, instrumentation and applications of Thermo Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) and Thermo Mechanical Analysis (TMA).

11. CHROMATOGRAPHIC TECHNIQUES : 15 Hours.

a) Classification of chromatographic methods based on mechanism of separation: paper chromatography, thin layer chromatography, ion exchange chromatography, column chromatography and affinity chromatography – techniques and applications.

b) Gas Chromatography : Theory and principle, column operation, instrumentation, derivatisation methods and applications in Pharmacy.

c) High Performance Liquid Chromatography : Principle, instrumentation, solvents used, elution techniques, RP-HPLC, LC-MS and applications in Pharmacy.

d) HPTLC and Super Critical Fluid Chromatography (SFC) : Theory and Principle, instrumentation, elution techniques and pharmaceutical applications.

12. ELECTROPHORESIS : 3 Hours.

Theory and principles, classifications, instrumentation, moving boundary electrophoresis, Zone Electrophoresis (ZE), Isoelectric focusing (IEF) and applications.

13. RADIO IMMUNO ASSAY: 3 Hours.

Introduction, Principle, Theory and Methods in Radio Immuno Assay, Related Immuno Assay procedures and Applications of RIA Techniques.

14. STATISTICAL ANALYSIS: 5 Hours.

Introduction, significance of statistical methods, normal distribution, probability, degree of freedom, standard deviation, correlation, variance, accuracy, precision, classification of errors, reliability of results, confidence interval, Test for statistical significance – students T-test, F-test, Chi-square test, correlation and regression.

PRACTICALS

1. Use of colorimeter for analysis of Pharmacopoeial compounds and their formulations.
2. Use of Spectro photometer for analysis for Pharmacopoeial compounds and their formulations.
3. Simultaneous estimation of combination formulations (minimum of 4 experiments).
4. Effect of pH and solvent on UV Spectrum of certain drugs.
5. Use of fluorimeter for analysis of Pharmacopoieal compounds.
6. Experiments on Electrophoresis.
7. Experiments of Chromatography.
    (a) Thin Layer Chromatography.
    (b) Paper Chromatography.
        1) Ascending Technique.

2) Descending Technique.
3) Circular Technique.
4) Two dimensional Paper Chromatography and TLC.

8. Experiments based on HPLC & GC.
9. IR, NMR and Mass Spectroscopy – Interpretation of spectra & Structural elucidation (atleast for 4 compounds each).
10. Any other relevant exercises based on theory.

REFERENCES

1. Spectrometric identification of Organic Compounds, Robert. M. Silverstein et al, 7th Edition, 1981.
2. Fundamentals of Mathematical Statistics, S.C. Gupta and V.K. Kapoor.
3. Principles of Instrumental Analysis by Donglas A. Skoog, James, J. Leary, 4th Edition.
4. Pharmaceutical Analysis – Modern Methods – Part A, Part B, James W. Munson – 2001.
5. Vogel's Text Book of Quantitative Chemical Analysis, 6th Edition, 2004.
6. Chromatographic Analysis of Pharmaceuticals, John A. Adamovics, 2nd Edition.
7. Practical Pharmaceutical Chemistry, Part two, A. H. Beckett & J. B. Stenlake – 4th Edition.
8. Instrumental Methods of Chemical Analysis – B. K. Sharma - 9th Edition.
9. Instrumental Methods of Analysis – Hobert H. Willard, 7th Edition.
10. Organic Spectroscopy – William Kemp, 3rd Edition.
11. Techniques and Practice of Chromatography – Raymond P. W. Scott, Vol. 70.
12. Identification of Drugs and Pharmaceutical Formulations by Thin Layer Chromatography – P. D. Sethi, Dilip Charegaonkar, 2nd Edition.
13. HPTLC – Quantitative Analysis of Pharmaceutical Formulations – P. D. Sethi.
14. Liquid Chromatography – Mass Spectrometry, W. M. A. Niessen, J. Van Der Greef, Vol. 58.
15. Stereo Chemistry – Conformation and Mechanism by P. S. Kalsi, 2nd Edition.
16. Spectroscopy of Organic Compounds by P. S. Kalsi.
17. Organic Chemistry by I. L. Finar Vol. II – 5th Edition.

SYLLABUS FOR PHARMACEUTICS

BRANCH – I

PAPER – II

INDUSTRIAL PHARMACY

THEORY **75 Hours(3 hrs./week)**

1. PREFORMULATION: 8 Hours

Introduction, organoleptic properties, purity, particle size, shape, and surface area. Solubilisation, surfactants and its importance, temperature, pH, co-solvency; Techniques for the study of crystal properties and polymorphism. Physico-chemical characteristics of new drug molecules with respect to different dosage forms.

2. COMPACTION AND COMPRESSION : 8 Hours.

Compaction of powders with particular reference to distribution and measurement of forces within the powder mass undergoing compression including- physics of tablet compression; Effect of particle size, moisture content, lubrication etc on strength of tablets.

3. PRODUCTION MANAGEMENT AND GMP CONSIDERATIONS: 8 Hours.

An Industrial account of production management, legal control, lay out of building, finance management, inventory management, material management, production planning and control, sales forecasting; ISO 9000 series, GMP considerations, Quality assurance, process control and process validation.

4. PATENT,INTELLECTUALPROPERTYRIGHTSANDREGULATORY AFFAIRS: 5 Hours.

Definitions, Pharmaceutical aspects related to GATT,TRIPS, TRIMS & WTO.

5. OPTIMIZATION TECHNIQUES IN PHARMACEUTICAL FORMULATION AND PROCESSING: 5 Hours.

Concept of optimization, Optimization parameters, Classical optimization, Statistical design, and Optimization methods.

6. PILOT PLANT SCALE UP TECHNIQUES AND MANUFACTURING PROCESS: 15 Hours.

Significance of pilot plant scale up study and large scale manufacturing

techniques (formula, equipment, process, stability and quality control) of some important dosage forms such as tablets, capsules, injections, liquid orals, semisolids, ophthalmic products, dry syrups, emulsions including multiple emulsions, multivitamin products.

7. STERILIZATION PROCESS: 10 Hours.

Principle, Advantages, Disadvantages, Applications of different sterilization methods, equipments. Sterility testing: Principle, general procedure, control tests, sterility testing of some preparations like parenterals and ophthalmic preparation, surgical sutures and ligatures, surgical dressings, ampoules, vials, transfusion bottles, vaccine bottles, syringes and needles.

8. STABILITY TESTING: 6 Hours.

Physicochemical and biological factors affecting stability of drugs, Methods to find out degradation pathways, Determination of shelf life by accelerated stability testing, Overages and ICH guidelines.

9. PACKAGING OF PHARMACEUTICALS: 6 Hours.

Desirable features and a detailed study of different types of Pharmaceutical containers and closures (Glass, Plastics and Rubber), including their merits and demerits; selection and evaluation of Pharmaceutical packaging materials.

10. INDUSTRIAL SAFETY: 4 Hours.

Industrial hazards due to fire accidents, mechanical and electrical equipments, Chemicals and pharmaceuticals; Monitoring and preventive systems (Safety measures).

PRACTICALS

1. Preformulation study of tablets.
2. Preparation and comparative evaluation with marketed products for antacid efficiency of neutralizing property of suspensions.
3. Formulation and evaluation of stability of reconstituted dry syrup of amoxycillin, ampicillin etc.
4. Accelerated stability studies on various formulations, with reference to:
    a. Temperature dependence.
    b. Effect of buffers.
5. Determination of the order of decomposition for drugs like Aspirin, Benzocaine, Acetanilide or any other three drugs.
6. Effect of hardness of the tablets on disintegration time.
7. Studying the stability of suspensions using the data on sedimentation volume and degree of flocculation.
8. Determination of the critical micellar concentration of various surfactants by drop weight method or any other suitable method.

9. Determination of the optimum concentration of the surfactant for solubilisation (eg.,) peppermint oil with tween 20.
10. Study on the effect of various excipients on the dissolution rate of tablets.
11. Determination of particle size and size distribution of selected drugs by microscopy, sieving, sedimentation (using Andreasen pipette) etc.
12. Determinations of flow properties of powders by Angle of repose and flow through an orifice with, and without glidants.
13. Sterility testing of commercially available injections like water for injection, Dextrose injection, Analgin injection.
14. Determination of stability of emulsions by studying the globule size.
15. Estimation of optimum concentration of the various glidants for the flow of granules using angle of repose.
16. Other formulations based on the theory topics.

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 – Rawbins.
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.

SYLLABUS FOR PHARMACEUTICS

BRANCH – I

PAPER – III

BIOPHARMACEUTICS AND PHARMACOKINETICS

THEORY **75 Hours(3 hrs./week)**

1. ABSORPTION OF DRUGS : **11 Hours.**

Definition, Structure of cell membrane and composition, Gastrointestinal absorption – Mechanism, Factors affecting drug absorption: Biological, Physiological, Physico-Chemical and Pharmaceutical dosage form factors; Methods of determining absorption: Invitro and Invivo methods; Absorption of drugs from non-oral route.

2. DISTRIBUTION OF DRUGS: **11 Hours.**

Definition, Distribution in blood and other fluids: cellular distribution, drug penetration to CNS, placental transfer of drugs and blood flow; Volume of distribution, Plasma protein binding: Drug distribution and drug effects, Drug binding in tissues.

3. BIOTRANSFORMATION OF DRUGS: **7 Hours.**

Definition, Phase I and Phase II reactions and Factors affecting biotransformation.

4. EXCRETION OF DRUGS: **7 Hours.**

Definition, Renal and non- renal excretion.

5. PHARMACOKINETICS: **15 Hours.**

a) Definitions, Basic considerations - zero order and first order kinetics.
b) A detailed study of open one compartment model and open Two-compartment model.
c) Non-compartmental methods-Area under first movement curve (AUMC), drug clearance, apparent volume of distribution, mean residence time (MRT) and its significance.
d) Concept of clearance- Organ clearance, Total clearance, Hepatic clearance and Renal clearance.

e) Non- linear Pharmacokinetics: Cause of non-linearity, Michaelis-menten equation, Estimation of Km and Vmax.

6. BIOAVAILABILITY: 5 Hours.

Definition, Estimating absorption rate of drugs; Preabsorptive hydrolysis and metabolism; Presystemic metabolism:Hepatic metabolism and Gut wall metabolism; Bioavailability of some specific drugs namely Acetazolamide, Ampicillin, Carbamazepine, Diazepam, Furosemide, Nitrofurantoin, Tolbutamide; Measurement of bioavailability- Pharmacokinetic methods and Pharmacodynamic methods. Methods of Enhancing Bioavailability of Drugs : Solubilisation, Prodrugs, Enhancement of dissolution characteristics, Inclusion of bioavailability enhancers.

7. DOSAGE REGIMEN : 9 Hours.

Multiple dosing with respect to IV and oral route, concept of loading dose, maintenance dose and accumulation index.

8. BIOEQUIVALENCE STUDIES: 5 Hours.

Definitions: Bio equivalence, Chemical equivalence, Therapeutic equivalence, Pharmaceutical equivalence; Testing of bioequivalence of dosage forms.

9. PHARMACOKINETIC VARIABILITY: 5 Hours.

Body weight, Age, Sex, Genetic factors, Pharmacokinetic variabilities in disease, states of Renal, Liver, Cardiovascular, Thyroid and Dosage adjustment in the above conditions.

PRACTICALS

1. Improvement of dissolution characteristics of slightly soluble drugs by some methods.
2. Comparison of dissolution studies of two different marketed products.
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.
6. Bioavailability studies of some commonly used drugs.
7. Calculation ka, ke, t1/2, Cmax.
8. Calculation of bioavailability from the urinary excretion data for two drugs.
9. Calculation of AUC and bioequivalence from the given data for two drugs.
10. Invitro absorption studies.

REFERENCES

1. Biopharmaceutics and clinical Pharmacokinetics By Milo Gibaldi.
2. Remington's Pharmaceutical Sciences; By Mack publishing company, Pennsylvania.
3. Pharmacokinetics; By Milo Gibaldi, Donald Perrier; Marcel Dekker, Inc.
4. Handbook of clinical Pharmacokinetics; By Milo Gibaldi and Laurie Prescott by ADIS Health Science Press.
5. Biopharmaceutics and Pharmacokinetics; By Robert E. Notari.
6. Biopharmaceutics; By Swarbrick.
7. Biopharmaceuties and Pharmacokinetics- A Treatise; By D.M.Brahmankar and Sunil B.Jaiswal., Vallabh Prakashan Pitampura, Delhi.
8. Clinical Pharmacokinetics, Concepts and Applications; By Malcolm Rowland and Thomas N.Tozer. Lea and Febiger, Philadelphia, 1995.
9. Dissolution, Bioavailability and Bioequivalence; By Abdou.H.M., Mack Publishing Company, Pennsylvania, 1989.
10. Biopharmaceutics and Clinical Pharmacokinetics- An introduction; 4th edition, Revised and expanded By Robert. E. Notari, Marcel Dekker Inc, New York and Basel, 1987.
11. Encyclopedia of Pharmaceutical Technology, Vol 13, James Swarbrick, James. C.Boylan. Marcel Dekker Inc, New York, 1996.

SYLLABUS FOR PHARMACEUTICS

BRANCH – I

PAPER – IV

ADVANCES IN DRUG DELIVERY SYSTEM

THEORY **75 Hours(3 hrs./week)**

1. SUSTAINED RELEASE DRUG DELIVERY SYSTEMS. (SRDDS): 10 Hours.

Introduction ; Rationale of SRDDS; Advantages and Disadvantages of SRDDS; Factors influencing the design and performances of SRDDS; Physicochemical properties of a drug influencing design and performance: a)Aqueous solubility, b)Partition coefficient and Molecular size, c)Drug Stability, d)Protein binding; Biological factors influencing design and performance of SRDDS: a)Absorption, b)Distribution, c)Metabolism, d)Duration of Action, e)Side effects, f)Margin of safety, g)Role of disease state; Selected routes of drug administration of SRDDS: a) Parenteral, b)Oral, c) Buccal/Sublingual, d)Rectal, e)Nasal, f)Pulmonary, g)Vaginal, h)Intrauterine, i)Transdermal, j)Ocular ; MICRO ENCAPSULATION TECHNIQUES - Different Micro- encapsulation processes, Advantages, Disadvantages and Applications.

2. POLYMERS USED IN CONTROLLED DRUG DELIVERY SYSTEMS: 7 Hours.

Introduction, Polymer-classification, Applications for Polymers in formulation of controlled drug delivery systems, Biodegradable and Natural polymers.

3. CONCEPTS AND SYSTEM DESIGN FOR THE RATE - CONTROLLED DRUG DELIVERY: 8 Hours.

Introduction, Classification, Rate - programmed drug delivery systems, Activation - moduled drug delivery systems, Feed back - regulated drug delivery systems, In-vitro and in - vivo evaluation of controlled released drug delivery.

4. PARENTERAL CONTROLLED RELEASE DRUG DELIVERY SYSTEMS: 8 Hours.

Approaches for injectable controlled release formulations, Development of Injectable controlled - Release formulations: Long acting Penicillin preparations, Long acting Insulin preparations, Long acting Steroid preparations and Long acting Contraceptive preparations; Approaches and applications of Implantable Drug Delivery Systems.

5. TRANSDERMAL DRUG DELIVERY SYSTEMS (TDDS): 7 Hours.

Permeation through skin, Factors affecting permeation, Basic components of TDDS, Formulation approaches used in development of TDDS and their evaluation, Permeation enhancers.

6. CONTROLLED RELEASE ORAL DRUG DELIVERY SYSTEMS: 9 Hours.

Introduction, Design and Development of oral controlled release drug administration : Dissolution controlled, Diffusion controlled (Reservoir devices, Matrix devices), Membrane permeation controlled, Osmotic pressure controlled, Gel diffusion controlled, pH controlled, Ion - exchange controlled delivery systems; Prolongation of GI retention of oral drug delivery system.

7. MUCOADHESIVE DRUG DELIVERY SYSTEMS: 8 Hours.

Introduction, Buccal drug delivery system: Concepts, Advantages and Disadvantages, Structure of oral mucosa, Trans-mucosal permeability, Mucosal membrane modules, Permeability enhancers, invitro and invivo methods for buccal absorption; Buccal strips; Nasal Drug Delivery Systems: Introduction, Physiology of nose, Fundamentals of nasal absorption, Distribution of drug in the nasal cavity, Enhancement in absorption, invitro and invivo methods for determination of nasal absorption, Applications of Nasal Drug Delivery system; Pulmonary Drug Delivery System and its applications.

8. OCCULAR DRUG DELIVERY SYSTEM: 8 Hours.

Formulation and evaluation of occular controlled drug delivery systems, Ophthalmic inserts and insitu gels.

9. TARGETED DRUG DELIVERY SYSTEM: 10 Hours.

Concepts, Advantages and Disadvantages, Targeting of drugs through nanoparticles, liposomes, resealed erythrocytes, microspheres, magnetic microspheres and monoclonal antibodies. Brief study on colon targeting.

PRACTICALS

1. Preparation of albumin microspheres by heat stabilization technique and their practical size determination.
2. Preparation and evaluation of microcapsules by different microencapsulation techniques.
3. Study on diffusion of drugs through various polymer membranes.
4. Preparation of resealed erythrocytes, loading of various drugs and the study on the release pattern.

5. Study on In-vitro dissolution of various sustained release formulations of marketted products.
6. Preparation of various drug formulations by solid dispersion technique and their evaluation.
7. Preparation of matrix tablets using various polymers, like polyvinyl alcohol, polyvinyl pyrrolidone etc., and studying their release patterns.
8. Preparation of various polymer films, loading of drugs and studying the release pattern.
9. Film coating of drug pellets for granules with sodium CMC and the study on In-vitro dissolution.

REFERENCES

1. Encyclopedia of controlled delivery; By Edith Mathiowitz, Published by Wiley Interscience Publication, John Wiley and sons, Inc, New York / Chichester / Weinheim.
2. Controlled and Novel Drug Delivery; By N.K.Jain, CBS Publishers and Distributors, New Delhi, First edition, 1997 (reprint in 2001).
3. Controlled Drug Delivery - Concepts and Advances; By S.P.Vyas and R.K.Khar, Vallabh Prakashan, New Delhi, First edition, 2002.
4. Remington's Pharmaceutical Sciences.
5. Novel drug delivery system; By Y.M.Chien, Marcel Dekker, Inc.
6. Controlled Drug Delivery - Fundamentals and Applications, 2nd edition; By Joseph R.Robinson and Vincent H.L.Lee.
7. Pharmaceutical Dosage forms, disperse system: Volume 1, By Herbert A.Libermann et.al, Marcel Dekker, Inc.
8. Pharmaceutical Dosage forms: Tablets Volume II, Herbert A.Libermann et.al, Marcer Dekker, Inc.
9. Bentley's Textbook of Pharmaceutics; By E.A.Rawline, ELBS Publications.
10. Microencapsulation and Related Drug Process; By Patric B.Deasy.