

M. PHARM. – PHARMACOGNOSY
COURSE STRUCTURE (w. e. f. 2011-12)

I SEMESTER					
Course No.	Title	L(h)	T(h)	P(h)	C
THEORY					
MPS1101	Advanced Instrumental Analysis (AIA)	3	1	0	4
MPS1121	Advanced Pharmacognosy	3	0	0	3
MPS1123	Medicinal Plant Biotechnology	3	0	0	3
LAB					
MPS1122	Herbal Product Development & Formulation Lab	0	0	3	2
MPS1124	Herbal Raw Material Processing Lab	0	0	3	2
BREADTH					
MMA1101	Applied Science: Biostatistics	3	0	0	3
	Breadth Paper	3	0	0	3
Total		15	1	12	20
Total Hours		22			
II SEMESTER					
THEORY					
MPS2121	Industrial Pharmacognosy	3	0	0	3
MPS2123	Advanced Herbal Drug Delivery System	3	0	0	3
MPS2125	Herbal Drug Formulation & Standardization	3	0	0	3
ELECTIVE(ANY ONE)					
MPS2113	Natural Products Chemistry (NPC)	3	0	0	3
MPSE103	Advanced Drug Design				
MCSE107	Pharmaceutical Biotechnology				
LAB					
MPS2122	Advanced Pharmacognosy Lab I	0	0	6	4
MPS2124	Advanced Pharmacognosy Lab II	0	0	6	4
Total		12	0	12	20
Total Hours		24			
III SEMESTER					
MPS3121	THESIS	-	-	-	15
IV SEMESTER					
MPS4121	THESIS	-	-	-	20

Total Credit - 75

Note:

L: Lecture; T: Tutorial; P: Practical; C: Credit

MPS: M. Pharm. Pharmaceutical Sciences Core

MPSE: M. Pharm. Pharmaceutical Sciences ELECTIVE

MMA: Mathematics

MCR: M.S. Pharmaceutical Sciences Core

M. PHARM I SEMESTER

MPS1101: ADVANCED INSTRUMENTAL ANALYSIS (AIA) (4 CREDITS)

1. Analytical Application of Absorption Spectra: 3h
Absorptiometric assay of Organic Compounds, Structural Analysis.
2. Infrared Spectrophotometry: 6h
Qualitative uses; Interpretation of I.R. Spectra, Quantitative analysis.
3. NMR-Spectroscopy: 8h
The NMR-Signal, Instrumentation practical consideration, chemical shift, spin-spin coupling, Structure elucidation, investigation of dynamic properties of molecules, quantitative analysis.
4. Mass Spectrometry: 8h
Theory instrumentation, practical consideration, structure elucidation, detection of impurities, quantitative analysis, application to determination of structure, the gas chromatograph mass spectrometer combination.
5. Optical Rotatory Dispersion: 3h
Terminology Plain Curves, Rotatory dispersion of ketones, The Axial Haloketone Rule, Octant Rule.
6. Recent trends in chromatography with reference to analysis of drugs and related substances: HPLC, UPLC, HPTLC, GC and hyphenated techniques(LC-MS/ LC-MS/MS). 8h
7. Theory, Instrumentation and Applications of: 8h
Thermogravimetric Analysis (TGA), Differential thermal analysis (DTA), Differential Scanning Calorimeter (DSC), X ray Diffraction(XRD).

BOOKS RECOMMENDED:

1. Practical Pharmaceutical Chemistry (part II) by Beckett and Stenlake.
2. Optical Rotatory Dispersion by C. D. Jerassi (For ORD).
3. Indian Pharmaceutical (Biological & Microbiological Assay).
4. British Pharmaceutical (Biological & Microbiological Assay).
5. UV and Visible Spectroscopy, Chemical Application-C.N. R. Rao.
6. Spectrometric identification of organic compound- Silverstein.
7. Chemical application of IR spectroscopy – C.N.R. Rao.
8. Physical Methods of Organic Chemistry- Weissberger.
9. Interpretation of Mass Spectra of organic compounds-B. Kienicz, C. Djerassi.
10. Application of NMR Spectra to Organic Chemistry-Jackmann.
11. Instrumental Methods of Analysis- Willard.
12. Applications of Absorption spectroscopy of organic compounds – John R. Dyer.
13. Pharmaceutical Experiments on isolated preparations by the staff of the Department of Pharmacology, University of Edinburg.
14. Pharmacological Techniques in Drug evaluation, Vol. 1&2 by Peter E. Siegler, J.H. Meyer.
15. Lewis Pharmacology- James Crossland.
16. Fundamental of Experimental Pharmacology- M.N. Ghosh.
17. Indian Pharmacopoeia.
18. British Pharmacopoeia.
19. United States Pharmacopoeia .
20. Assay of Vitamins by Haskmi

MPS1121: ADVANCED PHARMACOGNOSY (3 CREDITS)

- A. Problem encountered in and prospects of discovering new drugs from plants. Natural substances as raw materials in drug synthesis. Biomedicinals of recent discovery. (3L)
- B. Introduction of Chemotaxonomy ,Role of secondary metabolites in Chemotaxonomy and, applications of Chemotaxonomy implants based drugs. (4L)
- C. Determination of various diagnostic features of identification of different herbs as per different herbal pharmacopoeias. Determination of Numerical values.(3L)
- D. Emerging plant drugs: A review of anti-hepatotoxic, anti-fertility, anti-malarial, anti-hypertensive and antibiotic plants.(5L)
- E. Current status of anti cancer and anti-diabetic plant drugs, immunomodulatory herbal drugs- a review.(4L)
- F. Saponins and Terpenoids with biological activity of pharmaceutical significance.(3L)
- G. Recent trend in utilization of vegetable laxatives and vegetable bitters. Natural coloring and sweetening agents.(3L)
- H. Hallucinogenic, allergic, teratogenic and other toxic plants. Endangered species of medicinal plants. .(4L)
- I. Drugs and pharmaceuticals from marine source (Marine Pharmacognosy), with special reference to cardiovascular, cytotoxic, antimicrobial and anti-inflammatory compounds. .(4L)
- J. A review covering current status of plants in alternative system of medicine .(2L)

BOOKS & JOURNALS RECOMMENDED

- 1) Text book of Pharmacognosy – Trease & Evans.
- 2) Medicinal Natural Products (2nd Edn.) A Biosynthetic Approach - Paul M. Dewier.
- 3) Pharmacognosy, Phytochemistry Medicinal Plants (2nd Edn.) – Jean Bructon.
- 4) Quality Control – Herbal Drugs – Pulok K. Mukherjee.
- 5) Pharmacognosy & Pharmabiotechnology – Ashutosh Kar.
- 6) Herbal Medicines – Manuchair Ebadi
- 7) Quality Control Methods for Medicinal Plants – WHO AITBS Publication
- 8) Chemistry of Natural Products – K.W. Bentley
- 9) Chemical Plant Taxonomy edited by T. Swain

JOURNALS

- 1) Chemical Abstract
- 2) Biological Abstract
- 3) Phytochemistry
- 4) Planta Medica
- 5) Phytotherapy Research
- 6) Fitotherapia
- 7) Indian Journal of Natural Products
- 8) Indian Journal of Pharmacology
- 9) Indian Journal of Pharmaceutical Sciences.

MPS1123 MEDICINAL PLANT BIOTECHNOLOGY (3 CREDITS)

1. Historical perspectives, prospects for development of plant biotechnology as source of medicinal agents. Applications in pharmacy and allied fields. .(4L)
2. Types, techniques, nutritional requirements and growth of plant tissue cultures. Organogenesis and embryogenesis. Protoplast fusion and cultures. Biotechnology of micropropagation of medicinal and aromatic plants. .(6L)
3. Secondary metabolism in tissue cultures with emphasis on production of medicinal agents. .(6L)
4. Biotransformation, bioreactors, for pilot and large scale cultures of plant cells and retention of biosynthetic potential in cell culture. .(8L)
5. Immobilization techniques and its application on secondary metabolites production. .(2L)
6. Hairy roots and multiple shoots culture and their application. Industrially potential cell systems of different types. .(3L)
7. Review on Biological Enzymes with reference to Trypsin, Papain etc.(2L)
8. Conservation of medicinal plants:Ex-situ and in-situ conservation of medicinal plants.(3L)

BOOKS RECOMMENDED:

- 1) 1.Plant tissue Culture – Bhojwani Vol 5. (Elsevier)
- 2) 2.Plant Cell and Tissue Culture (Lab. Manual) – J.R.M.M. Yeoman.
- 3) 3.Medicinal Natural Products IInd Edn. (A biosynthetic Approach) Paul M. Dewick.
- 4) 4.Pharmacognosy, Phytochemistry Medicinal Plants IInd Edn. Jean Bruneton.
- 5) 5.Elements of Biotechnology – P.K. Gupta. Kalyani Publication.
- 6) 6.Plant Tissue Culture an alternative for production of useful metabolites. Masanaru Misawa.
- 7) Tyler, V.E., Brady, R., Pharmacognosy, Lea & Febiger
- 8) Ashutosh Kar, Pharmacognosy and Biotechnology, New Age Publishers
- 9) Manitto P. The biosynthesis of natural products, Ellis Harwood, Chichester
- 10) Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne, U.K
- 11) Tyler, V.E., Brady, R., Pharmacognosy, Lea & Febiger
- 12) Wallis, T.E. Textbook Of Pharmacognosy, J.A. Churchill Limited, London

**MPS1122: HERBAL PRODUCT DEVELOPMENT AND FORMULATION LAB
(2 CREDITS)**

1. Method of preparation of different herbal formulation.
2. Methods of preparations of these products used as cosmetics using different excipients
3. Evaluation of stability and compatibility studies of prepared formulations.

BOOKS RECOMMENDED:

- 1) Harry's Text book of Cosmeticology.
- 2) Cosmeceuticals, Marcel Dekker Inc., NY.
- 3) Sahu: "The Technology of Preparation & Distribution of Drugs & Cosmetics," 1st ed., Kislav Book House, 1990.
- 4) Carter, Ed.: "Cooper & Gunn's Dispensing for Pharmaceutical Students," 12th ed., CBS Publishers, 1987.
- 5) Hoover, Ed. : "Dispensing of Medication," Mac Publishing Co., 1976.
- 6) A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors
- 7) Ayurvedic Formulary of India, Govt. of India, New Delhi
- 8) Ayurvedic Pharmacopoeia of India, All Volumes
- 9) British Herbal Pharmacopoeia
- 10) Herbal Pharmacopoeia, IDMA, Mumbai

MPS1124 HERBAL RAW MATERIAL PROCESSING LAB (2 CREDITS)

- I. Isolation and characterization herbal excipients like Carbohydrates, Pectin, Gums etc from different plant sources .
- II. Study of herbal excipients in various pharmaceutical dosage forms.
- III. To study effect of chemical modification of excipients on their properties.
- IV. (i) Isolation and characterization of phyto pharmaceuticals like Ricinolic acid and Azelaic acid from Castor oil, (ii) Lycopene from Tomato , (iii) Hesperidin from Orange peel, (iv) Menthol from Mentha oil (v) Carvenone from Caraway oil (vi) Piperine form Black pepper etc.

M.PHARM II SEMESTER

MPS2121: INDUSTRIAL PHARMACOGNOSY (3 CREDITS)

1. Exogenous and endogenous factors influencing production of drugs. Plant growth regulators and their application in pharmacy. Disease management of medicinal and aromatic plants. .(3L)
2. Profiles for commercial cultivation technology / and post harvest care of following medicinal plants – Aswagandha, Periwinkle, medicinal Yams, Ergot, Senna, Neem, Opium poppy, Ipecac, Aloe, Digitalis, Lemon grass, Geranium, Basil, Palmarosa, Vetiver, Patchouli, Japanese Mint, .(9L)
3. Techniques employed in elucidation of pathways for Biogenesis of Tropane, Quinoline, Imidazole, Isoquinoline, and Indole alkaloids; Sterols, Anthraquinone and saponin glycosides; Flavanoids; and isoprenoid compounds of Pharmaceutical significance. .(5L)
4. Nutraceuticals – concept of nutritional requirements at different age, sex and in different conditions like normal, diseases, pregnancy etc.. Different types of additives used. Analysis of these nutritional and other ingredients in ethical and non-ethical foods. .(6L)
5. Cosmeceuticals- study of various raw materials used in various herbal cosmetics. .(4L)
6. Pharmaceutical aids: Profile for manufacture and commerce of Papain, Pectin, Pharmaceutical gums, Starch, absorbent cotton and gelatin. .(3L)
7. Isolation and analysis of Volatile oils clove oils, Palmarosa, citronella oil and Sandal wood oil. .(3L)

BOOK RECOMMENDED:

- 1) A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors
- 2) Herbal drugs industry by R.D. Chaudari.
- 3) Herbal Medicine – Manuchair Ebadi
- 4) Horborne J. B. Phytochemical methods, Chapman and Hall, International Edition, London
- 5) Jean Bruneton: Pharmacognosy and Phytochemistry, Medicinal Plants. Springer Verlag
- 6) Medicinal Natural Products 2nd Edn. (A Biosynthetic Approach) – Paul M Dewier.
- 7) Natural Products, A Laboratory Guide – Raphael Ikan – Academic Press
- 8) Pharmacognosy, Phytochemistry, Medicinal Plants 2nd Edn. – Jean Bruneton.
- 9) Pulk Mukherjee, Quality control of Herbal drugs, Business Horizons Pharmaceutical Publishers
- 10) Quality Control Methods for Medicinal Plants – WHO, AITBS Publication.
- 11) Raphael Ikan, Natural products a laboratory Guide, Academic Press.
- 12) Raphael Ikon, Natural products a laboratory Guide, Academic Press.
- 13) Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York
- 14) Stahl, E., Thin Layer Chromatography- A Laboratory handbook, Springer-Verlag, Berlin
- 15) Text book of Pharmacognosy – Trease and Evans.
- 16) Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne, U.K
- 17) V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II
- 18) Wagner, S.B., Zgainsky, Plant drug Analysis
- 19) Wallis, T.E. Textbook Of Pharmacognosy, J.A. Churchill Limited, London
- 20) Original laws published by Govt. of India
- 21) Quantitative Thin Layer Chromatography and its Industrial applications by Trieber LR

MPS2123 ADVANCED HERBAL DRUG DELIVERY SYSTEM (3 CREDITS)

Development of advanced drug delivery system for Herbal formulations.

- Conventional dosage forms
- Rationale for Phyto formulations
- Prerequisite for Novel carriers
- Pharmacokinetic approaches for design and formulation of herbal drugs with reference to following formulations
 - Liposome
 - Nanoparticles
 - Phytosomes
 - Emulsions
 - Novel vesicular herbal formulations
 - Microsphere
 - Buccal/Mucoadhesives etc. and other related drug delivery systems.

BOOKS RECOMMENDED

1. Weiss R, Fintel mann V. Herbal medicine. 2nd ed. Stuggart, New York: Thieme; 2000.
2. Blumenthal M, Goldberg A, Brinkmann J. Herbal medicine. Integrative Medicine communications. Newton;2000
3. Pharmacognosy, Phytochemistry, Medicinal Plants 2nd Edn. – Jean Bruneton.
4. Banker and Rhodes, Eds.: “Modern Pharmaceutics,” 3rd ed.(Revised & Expanded), Marcel Dekker {series in Drugs and Pharmaceutical Sciences –Vol. 72), 1996.
5. Ansel et al.: “Pharmaceutical Dosage Forms and Drug Delivery System”, 7th ed. (International Student Edition, Indian Reprint), Lippincott Williams & Wilkins, 2000.
6. Gebelein & Carraher, Jr., Eds.: “Polymeric Materials in Medication,” Plenum Press (Polymer Sci. & Biotechnology- Vol. 32), 1985.
7. Chien : “Novel Drug Delivery System (Fundamentals, Developmental Concepts & Biomedical Assessments),” Marcel Dekker (series in Drugs and Pharmaceutical Sciences -Vol. 14), 1982.
8. Robinson and Lee, Eds., “Controlled Drug Delivery: Fundamentals & Applications,” 2nd ed. (Revised & Expanded), Marcel Dekker (series in Drugs and Pharmaceutical Sciences –Vol. 29), 1987.
9. Jain, Ed.: “Advances in Controlled & Novel Drug Delivery,” CBS Publishers & Distributors, 2000.
10. Potts and Guy, Eds.: “Mechanisms of Transdermal Drug Delivery,” Marcel Dekker (series in Drugs and Pharmaceutical Sciences -Vol. 83), 1997.
11. Wise, Ed.: *Biopolymeric Controlled Release Systems, Vol. 1, CRC Presss, 1984.*
12. Betagiri, Jenkins & Parsons : Liposomes Drug Delivery Systems, Technomatic, 1993.
13. McCulloch & Shalaby, Eds: Tailored Polymeric Materials for Controlled Delivery Systems, ACS Symposium Series 709 (American Chemical Society), 1998.

MPS2125: HERBAL DRUG FORMULATION & STANDARDIZATION (3 CREDITS)

- A. i. Traditional Formulations: General consideration of Ayurvedic formulations and their preparation like Churna, Kwath, Avaleha, Satwa, Asava, Arishta etc. & pure Phytopharmaceuticals. .(6L)
- ii. Herbal Formulations: Introduction Preparation of Single, composite drug formulation and formulation containing pure phytopharmaceuticals. .(5L)
- B. Manufacture of Herbal Formulations: .(6L)
 - i. Introduction to good manufacturing practice for (GMP) herbal formulation.
 - ii. Raw Material Testing.
 - iii. Development of suitable dosage forms.
 - iv. Quality Control Parameters for Manufacturing of Formulation containing Plant Drugs.
- C. Standardization of Herbal Formulations: .(3L+ 5L+ 2L)
 - i. WHO guideline for herbal drugs including standard for pesticide residue / aflatoxins. Current status of regulatory affairs for herbal formulations.
 - ii. Development of analytical methods for quality control of the formulation with special reference to Pharmaceutical / Pharmacological markers by using-
 - a. Chromatographic methods of analysis (PC, TLC, HPTLC, HPLC & GLC, GPC etc.)
 - b. Colorimetric and Fluorimetric methods.
 - c. Spectral methods (UV, Visible, IR, c-NMR, H-NMR, and Mass spectroscopy)
 - iii. Testing for heavy metal and microbial contamination.
- D. Preparation of standardized extracts for incorporation in various dosage forms. .(4L)
- E. Occurrence, Methodology for extraction and chemistry of Sennosides, digoxin, ginsengosides, solasodine, berberine, quinine, scopolamine, hyoscyamine, Reserpine, Cascosides, Atropine, Emetine, Ergot, alkaloids, Caffeine, taxol, withanolids, podophyllotoxin.(3L)
- F. Herbal based Industry: Scope, study of infrastructure, staff requirement, project profiles, plant and equipment, processing, research and development, regulatory requirement. Pilot scale up techniques. .(3L)
- G. Patents and Intellectual Property Rights (IPR) : Definition, scope, objectives, sources of patent information, patent processing & application, Patents, copyrights, trademarks, salient features, trade related aspects (TRIPS), international & regional agreements. .(3L)

BOOKS RECOMMENDED:

- 1) Ayurvedic Pharmacopoeia
- 2) Herbal Pharmacopoeia
- 3) Quality Control Methods for Medicinal Plants – WHO AITBS Publication.
- 4) Herbal Drug Industry – R.D. Choudhary
- 5) Quality Control – Herbal Drugs – Pulok K. Mukherjee
- 6) Plant Drug Analysis – H.Wagner, S. Bladt, E.M. Zgainski; Springer – Verlag
- 7) Harry’s Text book of Cosmeticology.
- 8) Cosmeceuticals, Marcel Dekker Inc., NY.
- 9) Sahu: “The Technology of Preparation & Distribution of Drugs & Cosmetics,” 1st ed., Kislly Book House, 1990.
- 10) Carter, Ed.: “Cooper & Gunn’s Dispensing for Pharmaceutical Students,” 12th ed., CBS Publishers, 1987.
- 11) Hoover, Ed. : “Dispensing of Medication,” Mac Publishing Co., 1976.
- 12) A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors
- 13) Ayurvedic Formulary of India, Govt. of India, New Delhi
- 14) Ayurvedic Pharmacopoeia of India, All Volumes
- 15) British Herbal Pharmacopoeia
- 16) Herbal Pharmacopoeia, IDMA, Mumbai

MPS2113 NATURAL PRODUCT CHEMISTRY (3 CREDITS)

1. Phytochemical Methods: Extraction, Isolation, purification and characterization of phytoconstituents using modern analytical tools (UV, IR, HPLC, HPTLC, NMR, Mass etc.)
2. Natural Pigments: Isolation, Classification and Identification. Chemistry and application of Flavanoids (Anthocyanins, Flavonols and flavones) and Quinone pigments.
3. Terpenoids: Introduction, General and Instrumental methods of Structure elucidation using UV, Mass etc. Biosynthesis of Terpenoids. Diterpenoids: Acyclic - Phytol and Tetracyclic - Gibberellins. Triterpenoids: Acyclic (Squalene), Tetracyclic - Lanosterol, & Pentacyclic - α & β -amyrin, Ursolic acid & Oleanolic acid.
4. Sterols: Introduction & Biosynthesis of Steroids. Phytosterols, Saponins & Sapogenins, Cardiotonic glucosides, Plant Bufadienolides and steroidal alkaloids including Solanum and Kurchi alkaloids.
5. Nitrogenous Compounds: Alkaloids and their natural occurrence, chemistry and SAR of Opium, Ergot, Rauwolfia and Vinca alkaloids. Cyanogenic glycosides, Indoles and Chlorophylls.
6. An introduction to Natural leads in Drug Discovery: Docking studies on Caffeine and its derivatives, Piperine and its derivatives, Morphine and its derivatives, Certain Antidiabetics and Anti-inflammatory drugs.
7. Chemistry of therapeutically important phytoconstituents: Antidiabetic (Diabecon), Liver tonic (Liv52), Taxol, Curcumin, Podophyllotoxin, Ginsenosides & Artemisinin.

Reference Books & Journals:

1. Chemistry of Alkaloids by S. W. Pelletier
2. Alkaloids by Manske.
3. Plant Physiology by Dieter Hess.
4. Steroids by Fieser and Fieser.
5. Organic Chemistry by I. L. Finar Vol. II.
6. Chemistry of Natural Products by K. W. Bentley.
7. Biosynthesis of Aromatic Compounds by Ulrich Weiss & J. Michael Edwards.

Journals:

1. Phytochemistry, Planta Medica, Phytotherapy Research, Fitoterapia etc.

MPSE103 ADVANCED DRUG DESIGN (3 CREDITS) (Elective)

1. Introduction to basic concepts in Molecular modelling:

- Basic concepts of direct drug design and indirect drug design
- Introduction to Computer Graphics for display of Molecular structures, structural analysis of small molecules and macromolecular structures
- Energy minimization methods and Conformational analysis methods
- Introduction to various molecular modeling software – Sybl, Glide, Autodock Scigress, Flexidock, Comfa

2. Computational chemistry approaches:

- Molecular mechanics methods including study of empirical force field models
- Quantum mechanical models including semi empirical and *ab initio* methods
- Molecular dynamics and Monte Carlo Simulation Techniques
- Applications of above methods in drug design

3. Computer Assisted Design approaches:

- Pharmacophore search and modeling methods,
- Receptor mapping methods,
- Three dimensional database search approaches,
- Structure Based Drug Design: Molecular Docking and Scoring Methods,
- Basic Concepts of Homology Modelling.

4. Computerized QSAR approaches:

- 3D QSAR Methods – Principles steps to be followed and applications,
- 4D QSAR, 5D QSAR, 6D QSAR and HQSAR methods – Principles, steps to be followed and applications,
- Statistical analytical methods – Partial Least Square analysis, SIMCA methods, Principal Components analysis, Back propagation neural networks, Pattern recognition techniques with applications of these methods.

5. Peptidomimetic and Nucleotide drug design:

- Use of peptidomimetics in drug design, cyclisation of peptides, constrained amino acids, amide bond isosteres, and oligonucleotide therapeutics.

6. Recombinant DNA technology and drug design:

- Protein engineering
- Site directed mutagenesis
- Genetically engineered drugs
- Structural biology studies

7. ADMET Approaches in Drug Design:

- Principles of ADMET and ADME/TOX model building requirements
- *In silico* ADME tools and QSPR approaches
- High Througput ADME
- Introduction related to software of Schrodinger and Scigress & TOPKAT, Explore for ADME

BOOKS RECOMMENDED:

1. Comprehensive Medicinal Chemistry by C. Hansch, P.G. Sammes and G.B. Taylor, Vol. II-IV.
2. Guidebook on Molecular Modelling in Drug Design by N.C. Cohen.
3. Molecular Modelling, Principles and Applications by Andrew R. Leach.
4. Manfred E. Wolff and Burger's, Medicinal Chemistry and Drug Discovery- Vol.1, Principles and Practice, Vth Ed, John Wiley & Sons.
5. E.J. Ariens; Drug Design, Academic Press, New York.
6. Progress in Medicinal Chemistry, Series by Ellis & Wert.
7. Wilson & Gisvolds – Text book of organic medicinal and pharmaceutical chemistry, 10th Edition, 1998.
8. Receptor based drug design, by P. Leff, Marcel Dekker, New York, 1998.
9. Paul's charifron – Practical application of computer Aided drug design – Marcel Dekker – 1997.
10. The Organic Chemistry of Drug design and Drug Action - R.B.Silverman – Academic Press –1992.
11. Exploring QSAR – Fundamental and applications in Chemistry and Biology by Carowari Hansch and Albert Leo, ACS, Washington DC – 1995.
12. Alan L. Harney - Advanced in drug discovery techniques

MCSE107 PHARMACEUTICAL BIOTECHNOLOGY
(3 CREDITS)

1. Central dogma of molecular biology, DNA as genetic material, structure of DNA, DNA replication, Transcription, RNA processing and RNA editing translation, Post translational modifications. [5]
2. General properties and types of mutation, DNA damage and repair, site directed mutagenesis. Discovery and salient features of genetic code, Regulation of gene activity, *lac* operon, regulation of bacteriophage λ life cycle. Vectors and cloning of DNA, Transformations. [6]
3. Restriction and modifying enzymes, Polymerase Chain Reaction (PCR) and Thermostable DNA polymerases, RACE PCR, Real Time PCR, Genomic and cDNA libraries, screening of libraries with DNA probes and antisera. Large inset genomic libraries, strategies and approaches to genome sequencing. [6]
4. Pharmacogenomics of hereditary disorders, Single Nucleotide polymorphism and development of personal and molecular medicines. [5]
5. Concepts and methods of production of r-Therapeutics such as Insulin, Interferons, Hematopoietic growth factors, Hormones etc. [7]
6. Gene Therapy – Principles, Methods and its applications in therapy of cancer, Inborn errors and Hematopoietic disorders. [7]
7. Diagnostic Biotechnology – Design and development of ELISA kit for diagnostic purpose, Application of Nucleic Acid amplification by PCR in Clinical Microbiology, Particularly in detection of microbes including viruses and cancer cells. [7]

Books:

1. Pharmaceutical Biotechnology by Daan J.A.Crommilin & Robert D. Sindelar (eds), Routledge, Taylor & Francis group, London (2002).
2. Biotechnology and Biopharmaceuticals by Rodney J.Y. Ho and Milo Gibaldi, Wiley Liss Sons, Inc. Publication, New Jersey.
3. Techniques in clinical immunology, R.A. Thompson (ed), Blackwell Scientific Publications, Oxford, London.
4. PCR in Bioanalysis by Stephen J. Meltzer (Ed), Humana Press (1998) (Methods in Molecular Biology Vol. 92).
5. Gene Therapy: Therapeutic mechanism and strategies, Nancy Smyth Tenpleton & Danilo D. Lasic, Marcel Dekker Inc. (2000).
6. Cell and molecular biology, P.K. Gupta, Kalyani Publisher, Merut.
7. Pharmaceutical Biotechnology by Vyas & Dixit.

MPS2122: ADVANCED PHARMACOGNOSY LAB. – 1 (4 CREDITS)

1. Raw material Testing.
2. Isolation of pure phytopharmaceuticals.
3. Estimation of total Phenolic compounds from plant drugs.
4. Determination of Anti-oxidant potential of some plant drugs by DPPH methods.
5. Determination of total bitters from the following plant drugs:
 - a. Kalmegh
 - b. Picrorhiza
 - c. Tinospora
 - d. Chirata
6. Development of suitable dosage forms for of plant drugs.
7. Estimation of total saponins from
 - a. Liquorice
 - b. Tribulus terrestris
8. Quality control parameters for good manufacturing of formulation of plant drug.
9. Development and validations of analytical method for the formulations containing plant drugs.
10. HPTLC estimation of Reserpine in Rauwolfia species.
11. Estimation of flavonoids in Liquorice
12. Estimation of Withanolids from Withania Somnifera.

BOOK RECOMMENDED:

- 1) A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors
- 2) Herbal drugs industry by R.D. Chaudari.
- 3) Herbal Medicine – Manuchair Ebadi
- 4) Horborne J. B. Phytochemical methods, Chapman and Hall, International Edition, London
- 5) Jean Bruneton: Pharmacognosy and Phytochemistry, Medicinal Plants. Springer Verlag
- 6) Medicinal Natural Products 2nd Edn. (A Biosynthetic Approach) – Paul M Dewier.
- 7) Natural Products, A Laboratory Guide – Raphael Ikan – Academic Press
- 8) Pharmacognosy, Phytochemistry, Medicinal Plants 2nd Edn. – Jean Bruneton.
- 9) Pulok Mukherjee, Quality control of Herbal drugs, Business Horizons Pharmaceutical Publishers
- 10) Quality Control Methods for Medicinal Plants – WHO, AITBS Publication.
- 11) Raphael Ikan, Natural products a laboratory Guide, Academic Press.
- 12) Raphael Ikon, Natural products a laboratory Guide, Academic Press.
- 13) Robinson, T., The biochemistry of alkaloids, Springer- Verlag, New York
- 14) Stahl, E., Thin Layer Chromatography- A Laboratory handbook, Springer-Verlag, Berlin
- 15) Text book of Pharmacognosy – Trease and Evans.
- 16) Trease, G.E. and Evans, W.C. Pharmacognosy, 12th Edition, Bailliere Tindall, Eastbourne, U.K
- 17) V.D.Rangari, Pharmacognosy and Phytochemistry Volume I & II
- 18) Wagner, S.B., Zgainsky, Plant drug Analysis
- 19) Wallis, T.E. Textbook Of Pharmacognosy, J.A. Churchill Limited, London
- 20) Kokate, C.K., Practical Pharmacognosy, Nirali Publications.

MPS2124: ADVANCED PHARMACOGNOSY LAB. – II (4 CREDITS)

- A. Experiment on plant tissue culture for production of secondary metabolites
 - i. Preparation of Media
 - ii. Formation of Callus
 - iii. Isolation of secondary metabolites.
- B. Visit to Medicinal Plants Garden for cultivation technique, collection and Identification of Medicinal Plants.
- C. Preparation of herbarium.

BOOK RECOMMENDED:

- 1) Kokate, C.K., Practical Pharmacognosy, Nirali Publications.
- 2) Harry's Text book of Cosmeticology.
- 3) Cosmeceuticals, Marcel Dekker Inc., NY.
- 4) Sahu: "The Technology of Preparation & Distribution of Drugs & Cosmetics," 1st ed., Kislal Book House, 1990.
- 5) Carter, Ed.: "Cooper & Gunn's Dispensing for Pharmaceutical Students," 12th ed., CBS Publishers, 1987.
- 6) Hoover, Ed. : "Dispensing of Medication," Mac Publishing Co., 1976.
- 7) A.N. Kalia, A textbook of Industrial Pharmacognosy, CBS Publishers and Distributors
- 8) Ayurvedic Formulary of India, Govt. of India, New Delhi
- 9) Ayurvedic Pharmacopoeia of India, All Volumes
- 10) British Herbal Pharmacopoeia
- 11) Herbal Pharmacopoeia, IDMA, Mumbai

M. PHARM III SEMESTER (15 CREDITS)

MPS3121: Thesis :

- **Thesis Seminar**

M. PHARM IV SEMESTER (20 CREDITS)

MPS4121: Thesis :

- **Presentation, Submission and Viva-Voce**

BREADTH PAPERS

MMA1101: BIOSTATISTICS (3 Credits)

1. **Introduction:** 1h
Relevance and the scope of Statistics.
Difference between 'Descriptive' and 'Inferential' Statistics; Relationship between them

2. **Sampling Methods** 4h
Introduction of sampling, probability and non probability sampling, sampling procedures – simple random, stratified, systematic, cluster and multistage sampling, concept of sampling distribution.

3. **Statistical Inference** 6h
Statistical estimation – point and confidence interval estimations, Introduction of statistical hypothesis and testing, comparison of population mean with sample means, comparing two sample means, comparison of population proportion with sample proportions, comparing two sample proportions, comparison of more than two samples, introduction of non parametric statistical tests.

4. **Correlation and linear regression** 6h
Introduction of correlation & regression concepts, estimation of correlation coefficient, regression coefficients, assumption of tests of hypothesis in linear regression, variance of sample estimates of the parameters, confidence intervals in regression analysis, non linear regressions, weighted and transformations in regression analysis, application of linear regressions - standard curves in drug analysis and drug stability studies, analysis of covariance.

5. **Concepts of Inferential Statistics** 4h
Basics of Statistical Inference
Sampling distribution
Estimation – Point estimation, Interval estimation
Parameter, Statistic, Concept of a hypothesis, Research Hypothesis, Null Hypothesis, Level of Significance, Comparison of means of two samples, Comparison of sample proportion with population proportion, Comparison of two sample proportions, Degrees of Freedom, Critical Value, Table value, Type I and Type II errors, Rules for rejection & acceptance of Null Hypothesis, Standard Error

6. **Inferential Statistics - Parametric Test:** 4h
't' test – Comparison of sample mean with the population mean, Comparison of means of two independent samples, Comparison of two correlated samples
'Z' test – different applications
Annova – one way annova: 'F' test

7. **Quality control:**
Introduction, control charts, acceptance sampling and operating characteristic curves, statistical procedures in Assay.Department, establishing in-house limits, some statistical aspects of quality and the "Barr Decision".

8. **Inferential Statistics - Non-parametric test:** 2h
Chi square test- Testing of goodness of fit, testing of independence, Test of homogeneity;
Wilcoxon signed rank test; McNemar test
9. **Computer Applications & Practicals:** 2h
Introduction of statistical software – SPSS with practical exercises

BOOKS RECOMMENDED:

1. Statistical issues in Drug Development by Stephen Senn, 1997, published by John Wiley and Sons Inc.
2. Practical and Clinical Applications 3rd Edn. Sandord Bolton, 1997 Marcel Dekkar Inc, Newyork.
3. Non parametric statistics for Behavioral Sciences by Sidney Siegel; 1956, McGraw Hills, New Delhi.
4. Design and Analysis of Bioavailability and Bioequivalence Studies – 2nd Edn. By Shein-Chung Chow and Jen-Pei Liu, 2000, Marcel Dekkar Inc, Newyork.
5. Computer Applications and Practicals: Introduction of softwares – SPSS/SAS and practical exercises.

Text Books

1. Pharmaceutical Statistics