

SYLLABUS FOR M.PHARM. PROGRAMME

2008 – 2010



**SIKSHA 'O' ANUSANDHAN UNIVERSITY
BHUBANESWAR
ORISSA, INDIA**

SIKSHA'O'ANUSANDHAN UNIVERSITY
POST GRADUATE PROGRAMME IN PHARMACEUTICAL SCIENCES
(M.PHARM)

SCHEME OF INSTRUCTIONS

M.PHARM - I SEMESTER

Course Code	Subject Title	L	T	P	Credits
M.PH. 1.1	Modern Analytical Techniques (common to all specializations)	3	0	0	3
M.PH. 1.2	Modern Analytical Techniques Practical (common to all specializations)	0	0	6	4
M.PH. 1.3	Biostatistics (common to all specializations)	3	0	0	3
M.PH. 1.4	Drug Regulatory Affairs and Intellectual Property Rights (common to all specializations)	3	0	0	3
M.PH. 1.5 (A to H)	Paper based on Specialization	3	0	0	3
M.PH. 1.6 (A to H)	Practical based on Specialization	0	0	6	4
M.PH. 1.7	Seminar / Assignment (common to all specializations)	0	0	3	2
M.PH. 1.8	Comprehensive Viva (common to all specializations)	0	0	0	3
T O T A L:		12	0	15	25

Total Credits for I Semester - 25

Contact hours - 27 Hrs / Week

Details of Specialization Paper and Practical against M.PH. 1.5A to G and M.PH.1.6A to G for different Specializations in M. Pharm - Ist Semester:

<u>Specialization</u>	<u>Paper Code and Title</u>	<u>Practical Code and Title</u>
PHARMACEUTICS	M.PH. 1.5A / M.PH. 1.5H Formulation Development	M.PH. 1.6A / M.PH. 1.6H Formulation Development Practical
PHARMACEUTICAL CHEMISTRY	M.PH. 1.5B Stereo Chemistry of drugs and Mechanism of Reactions	M.PH. 1.6B Stereo Chemistry of drugs and Mechanism of Reactions Practical
PHARM. ANALYSIS & QUALITY ASSURANCE	M.PH. 1.5C Stability of Drugs and Drug Products	M.PH. 1.6C Stability of Drugs and Drug Products Practical
PHARMACOLOGY	M.PH. 1.5D Pharmacological Screening Methods	M.PH. 1.6D Pharmacological Screening Methods Practical
PHARMACEUTICAL TECHNOLOGY	M.PH.1.5H/M.PH. 1.5A Formulation Development	M.PH. 1.6H/M.PH. 1.6A Formulation Development Practical
PHARMACOGNOSY	M.PH. 1.5F Advanced Pharmacognosy -I	M.PH. 1.6F Advanced Pharmacognosy - I Practical

**M.PHARM. - II SEMESTER
(PHARMACEUTICS)**

Course Code	Subject Title	L	T	P	Credits
M.PH2A.1	Advanced Physical Pharmaceutics	3	0	0	3
M.PH2A.2	Bio-Pharmaceutics and Pharmacokinetics	3	0	0	3
M.PH2A.3	Bio-Pharmaceutics and Pharmacokinetics Practical	0	0	6	4
M.PH2A.4	Novel Drug Delivery Systems	3	0	0	3
M.PH2A.5	Novel Drug Delivery Systems Pract.	0	0	6	4
M.PH2A.6	Advanced Pharmaceutical Technology	3	0	0	3
M.PH2A.7	Seminar / Assignment	0	0	3	2
M.PH2A.8	Comprehensive Viva	0	0	0	3
TOTAL:		12	0	15	25

Total Credits for II Semester - 25

Contact hours - 27 Hrs / Week

NOTE: M.PH2A.2, M.PH2A.4, M.PH2A.5 and M.PH2A.6 papers of M.Pharm Pharmaceutics specialization are the same as M.PH2H2.2, M.PH2H2.4, M.PH2H2.5 and M.PH2H2.6 papers respectively of M.Pharm Pharmaceutical Technology specialization.

**M.PHARM. - II SEMESTER
(PHARMACEUTICAL (CHEMISTRY))**

Course Code	Subject Title	L	T	P	Credits
M.PH2B.1	Advanced Medicinal Chemistry-I	3	0	0	3
M.PH2B.2	Advanced Medicinal Chemistry-II	3	0	0	3
M.PH2B.3	Advanced Medicinal Chemistry-III	3	0	0	3
M.PH2B.4	Advanced Medicinal Chemistry-III Practical	0	0	6	4
M.PH2B.5	Chemistry of Natural Products	3	0	0	3
M.PH2B.6	Chemistry of Natural Products Pract.	0	0	6	4
M.PH2B.7	Seminar / Assignment	0	0	3	2
M.PH2B.8	Comprehensive Viva	0	0	0	3
TOTAL:		12	0	15	25

Total Credits for II Semester - 25

Contact hours - 27 Hrs / Week

**M.PHARM. - II SEMESTER
(PHARM. ANALYSIS & QUALITY ASSURANCE)**

Course Code	Subject Title	L	T	P	Credits
M.PH2C.1	Quality Assurance of Pharmaceuticals	3	0	0	3
M.PH2C.2	Advanced Pharmaceutical Analysis -I	3	0	0	3
M.PH2C.3	Advanced Pharm. Analysis - I Practical	6	0	0	4
M.PH2C.4	Advanced Pharmaceutical Analysis -II	3	0	0	3
M.PH2C.5	Phyto-pharmaceutical Analysis	0	0	6	4
M.PH2C.6	Phyto-pharmaceutical Analysis Practical	3	0	0	3
M.PH2C.7	Seminar / Assignment	0	0	3	2
M.PH2C.8	Comprehensive Viva	0	0	0	3
TOTAL:		12	0	15	25

Total Credits for II Semester - 25

Contact hours - 27 Hrs / Week

**M.PHARM. - II SEMESTER
(PHARMACOLOGY)**

Course Code	Subject Title	L	T	P	Credits
M.PH2D.1	Pharmacokinetics & Drug metabolism	3	0	0	3
M.PH2D.2	Pharmacokinetics & Drug metabolism Practical	0	0	6	4
M.PH2D.3	General Pharmacology	3	0	0	3
M.PH2D.4	General Pharmacology practical	0	0	6	4
M.PH2D.5	Clinical Pharmacology and Toxicology.	3	0	0	
M.PH2D.6	Recent Advances in Pharmacology	3	0	0	3
M.PH2D.7	Seminar / Assignment	0	0	3	2
M.PH2D.8	Comprehensive Viva	0	0	0	3
T O T A L :		12	0	15	25

Total Credits for II Semester - 25
Contact hours - 27 Hrs / Week

**M.PHARM. - II SEMESTER
(PHARMACEUTICAL TECHNOLOGY)**

Course code	Subject Title	L	T	P	Credits
M.PH2H.1	Pharmaceutical Biotechnology	3	0	0	3
M.PH2H.2	Bio-Pharmaceutics & Pharmacokinetics	3	0	0	3
M.PH2H.3	Bio-Pharmaceutics & Biotechnology Practical	0	0	6	4
M.PH2H.4	Novel Drug Delivery Systems	3	0	0	3
M.PH2H.5	Novel Drug Delivery Systems Practical	0	0	6	4
M.PH2H.6	Advanced Pharmaceutical Technology	3	0	0	3
M.PH2H.7	Seminar/Assignment	0	0	3	2
M.PH2H.8	Comprehensive Viva	0	0	0	3
Total		12	0	15	25

Total Credits for II Semester-25
Contact hours-27hrs/week

**M.PHARM. - II SEMESTER
(PHARMACOGNOSY)**

Course code	Subject Title	L	T	P	Credits
M.PH2.1 F	Industrial Pharmacognosy - I	3	0	0	3
M.PH2.2 F	Industrial Pharmacognosy - I (Practical)	0	0	6	4
M.PH2.3 F	Herbal Drug Formulation & Standardization	3	0	0	3
M.PH2.4 F	Herbal Drug Formulation & Standardization practical	0	0	6	4
M.PH2.5 F	Chemistry of Natural Products	3	0	0	3
M.PH2.6 F	Advanced Pharmacognosy-II(Medicinal Plant Biotechnology)	3	0	0	3
M.PH2.7 F	Seminar/Assignment	0	0	3	2
M.PH2.8 F	Comprehensive Viva	0	0	0	3
Total		12	0	15	25

Total Credits for II Semester-25
Contact hours-27hrs/week

NOTE: M.PH2A.2, M.PH2A.4, M.PH2A.5 and M.PH2A.6 papers of M.Pharm Pharmaceutics specialization are the same as M.PH2H2.2, M.PH2H2.4, M.PH2H2.5 and M.PH2H2.6 papers respectively of M.Pharm Pharmaceutical Technology specialization.

**M.PHARM. - III SEMESTER
(COMMON FOR ALL SPECIALIZATIONS)**

Course Code	Subject Title	Credits
M.PH. 3.1	Seminar - I (Mid Semester / Literature Survey of the project)	2
M.PH. 3.2.	Seminar - II (End Semester / Progress of the project)	2

**M.PHARM. - IV SEMESTER
(COMMON FOR ALL SPECIALIZATIONS)**

Course Code	Subject Title	Credits
M.PH. 4.1	Project Dissertation	30
M.PH. 4.2.	Project Seminar and Viva-voce	6

Credit Distribution:

I Semester	25
II Semester	25
III Semester	04
IV Semester	36
Total -----	90

M.PH.1.1 MODERN ANALYTICAL TECHNIQUES
THEORY

(3-0-0)

MODULE - I

(10 Hours)

Good laboratory practices (GLP), Laboratory maintenance, Standard Operating Procedures (SOPs), Methods of validation.

MODULE - II

(12 Hours)

Theory, instrumentation and application with regard to drug analysis, decomposition product identification and estimation and metabolite analyses based on the following:

- (a) Ultraviolet - visible spectrophotometry (b) Infrared spectrophotometry
(c) H^1 N.M.R & C^{13} N.M.R (d) MASS spectroscopy

MODULE - III

(14 Hours)

Chromatographic methods- Gas Chromatography including GC-MS, High performance liquid chromatography; electrophoreses (gel and capillary) with an emphasis on specific examples in biological assay methods.

SPECIAL TECHNIQUES:

- (a) Immunological methods (RIA - ELISA) (b) H.P.C.P.C.
(c) H.P.T.L.C. (d) Super Critical Fluid
Chromatography

TEXT BOOK:

1. Organic Spectroscopy, William Kemp, Palgrave, 3rd Ed.
2. Instrumental Methods of Analysis, Scoog & West, Cengage Learning, 1st Ed.
3. Practical Pharmaceutical Chemistry Vol. I & II, Beckett & Stenlake, CBS, 4th Ed.
4. Vogel's Textbook of Quantitative Chemical Analysis, J.Mendham, R.C.Denney, Pearson Education, 6th Ed.
5. A Text book of Pharmaceutical Analysis, K.A.Conners, J.Willey, 3rd Ed.

REFERENCE BOOK:

1. Instrumental Methods of Analysis, Willard Denn & Merrit., CBS, 7th Ed.
2. I.P. + 2007 (Addendum) (Vol. - I, II, III)
3. B.P. - 2007 (Vol.- I, II, III & IV)
4. Remington's Pharmaceutical Sciences (Vol. I & II) Lippincot William & Wilkins, 21st Ed.
5. USP - 24, NF-19, Asian Edition 2000.

M.PH.1.2 MODERN ANALYTICAL TECHNIQUES
PRACTICAL

(0-0-6)

(A minimum of 20 experiments shall be conducted)

1. Use of spectrophotometer for analysis of pharmacopoeial compounds and their formulations.
2. Use of fluorimeter for analysis of pharmacopoeial compounds.
3. Use of Flame Photometer for analysis of Na, K^+ & Ca^{++} etc. in Biological fluids and formulations.
4. Use of Potentiometer and Conductometer for the analysis of Pharmacopoeial compounds.
5. Use of Nephelo -Turbidimetric analysis of dispersions and limit tests.
6. Experiments on electrophoresis.
7. Experiments on chromatography.
 - (a) Adsorption chromatography
 - (b) Thin layer chromatography
 - (c) Paper chromatography :
Ascending technique
Descending technique
Circular technique

MODULE - II (12 Hours)

6. ISO 9000 and 9002 documentation: Introduction and Support package: Guidance on the terminology used in ISO 9001:2000 and ISO 9004:2000.
7. General Principles of Intellectual Property: Copyright, Trademark
Patents: need of patents, major types of patents, patent offices in India, US and Europe, International registration of patents, how patents are obtained for drugs and their impact on industry and patients, patent term and extension The Patents Act, 1970 - Salient features.
8. New Drug Application: Steps involved in the development of new drug. New drug applications as per WHO guidelines and abbreviated NDA. Requirement and guidelines on clinical trials.

MODULE - III (10 Hours)

9. Industrial safety: Industrial hazards due to fire, chemicals, pharmaceuticals, radiation and accidents - mechanical and electrical equipments. Monitoring and prevention systems, Industrial effluent testing.
10. Stability Studies: ICH guidelines and WHO guidelines and stability protocols for dosage forms.

TEXT BOOK:

1. How to Practice GMPs, P.P.Sharma, Vandana Publication, New Delhi, 5th Ed. - 2008.

REFERENCE BOOK:

1. Law Relating to Drugs & Cosmetics, V.Mallick, Eastern Book Company, Lucknow, 19th Ed. - 2007.
2. Quality Assurance - Manual, D.H.Shah, Business Horizon, New Delhi, 1st Ed. - 2007.

M. PH. 1.5A/ M. PH.1.5H FORMULATION DEVELOPMENT (3-0-0)
THEORY

MODULE - I (9 Hours)

Preformulation Studies: pKa and solubility partition coefficient, crystal morphology, polymorphism, powder flow, structure characteristics, dissolution, compatibility studies, protocol for pre-formulation studies.

MODULE - II (14 Hours)

Drug Stability : Solution stability, solid state stability, parameters for physical stability, protocol for physical stability testing, accelerated stability studies and shelf assignment.

Formulation, stabilization and evaluation of tablets, capsules, parenteral dosage forms. Advances in pharmaceutical packaging.

MODULE - III (12 Hours)

Cosmetics :

Formulation and evaluation of :

Skin care products such as antiageing and sunscreen products.

Hair care products such as shampoos, hair dyes and hair tonics.

Safety testing of Cosmetic Products:

Microbiology in Cosmetics.

Knowledge of the various microbial contaminants in cosmetic products.

Knowledge of various preservative systems for cosmetic products.

Selection criteria for preservatives.

Efficacy and safety testing of preservatives in cosmetic products.

TEXT BOOK:

1. Theory & Practice of Industrial Pharmacy, Lachmann & Lieberman, Varghese Publishing House, Bombay, 3rd Ed. - 1991.
2. Cosmetics - FM & QA, P.P.Sharma, Vandana Publications, Delhi, 4th Ed. - 2008.

3. Physical Pharmacy, A.Martin, Lippincott Williams & Wilkins, London, 4th Ed. - 2001.

REFERENCE BOOK:

1. Pharmaceutical Dosage Form Tablets, Vol-I, II, III, Lieberman, Lachman & IB Schwartz, Marcel Dekker, New York, 2nd Ed. - 2008.

M.PH. 1.6A/M.PH. 1.6H FORMULATION DEVELOPMENT (0-0-6)

PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. Accelerated stability studies of various formulations or drugs with respect to
(a) Temperature
(b) Effect of buffers / pH dependent (2 - 4 Expts.)
2. Formulations and evaluation of some liquid orals such as Analgesic-antipyretics, Antihistamines, Co-trimoxazole, suspensions etc. (2 - 3 Expts.)
3. Formulation and evaluation of stability of reconstituted dry syrups of Amoxicillin, Ampicillin etc. (2 Expts.)
4. Preparation and evaluation of diclofenac sodium gels containing two different bases. (2 Expts.)
5. Formulation and evaluation of semisolid dosage forms using different - bases and drugs (cetrimide, salicylic acid) of current interest.
6. To study the effect of particle size, moisture content and lubricants on flowability and compressibility of powders.
7. Study of effect of various binding agents on the properties of tables (2 Expts.)
8. Preparation and evaluation of Skin care and Hair care products (4-5 Expts)

M. PH. 1.5B STEREOCHEMISTRY OF DRUGS AND REACTION MECHANISM (3-0-0)

THEORY

MODULE - I

(10 Hours)

I. Stereochemistry of Carbon & Nitrogen Compounds:

- (i) Optical Isomerism (due to Asymmetric carbon atoms)

Compounds with one asymmetric carbon atoms, compounds with two or more unequal asymmetric carbon atoms, compounds containing like asymmetric carbon atoms, compounds with asymmetric carbon atoms in branched chains.

- (ii) Stereo-chemistry of Biphenyls.

(iii) Racemic modification: Nature of modifications, formation of racemic modifications, (a) by mixing (b) by synthesis, (c) by racemization and by chemical transformation.

(iv) Configuration: Definition, rotation, absolute configuration and relative configuration.

(v) Synthesis of optically active compounds : Stereo selective synthesis.

(vi) Stereochemistry of Nitrogen compounds :

MODULE - II

(12 Hours)

II. Reaction with at least one application:

Free Radical Reaction: Kinetic characteristics of chain reaction, Structure reactivity relationship. Free radical substitution reaction, free radical addition reaction, Intramolecular free radical reaction, and Rearrangement and fragmentation reactions of free radical.

- Nucleophilic addition to carbonyl group
- Nucleophilic substitution at carbonyl group
- Nucleophilic substitution at carbonyl group with loss of C=O
- Nucleophilic substitution at saturated carbon
- Elimination reactions
- Electrophilic addition to Alkenes.

- Electrophilic Aromatic Substitution

Concerted Pericyclic Reaction: Electrocyclic reaction, Sigmatropic reaction, Cycloaddition reaction

MODULE - III (14 Hours)

III. Oxidation & Reduction Reactions: Alcohol to carbonyl using chromium (VI)

Oxidants, modified chromium (VI) Oxidants, dimethyl sulfoxide oxidation, Oxidation with other metal derivatives like TPAP, MnO₂, Oppenauer oxidation, oxidation with silver.

- Formation of Phenols & Quinone, Conversion of Alkenes to Epoxide, Conversion of Alkenes to Diols, Bayer-villegger Oxidation, Oxidative bond cleavage using KMnO₄, Osmium reagents, Ruthenium reagents and chromium reagents, LTA, Sodium per-iodate, Oxidation of alkyl or alkenyl fragments, Oxidation of sulphur, Selenium and nitrogen
- Reduction with complex metal hydrides, Alkoxy Aluminate reducing agents, Reduction with Boro hydrides, Alkoxy and alkyl Boro hydrides, Borane, aluminum hydride & derivatives, Catalytic hydrogenation, Dissolving metal reductions, Reduction with non-metallic reducing agents.

IV. Named Reactions : Acyloin condensation, Allylic rearrangement, Arndt-Eistert reaction, Bayer-villegger rearrangement, Beckmann rearrangement, Bischler Napieralski synthesis, Claisen condensation, Claisen-Schmidt reaction, Dakin reaction, Curtius reaction, Dieck-Mann reaction, Diels-Alder reaction, Fittig reaction, Fries rearrangement, Gabriel synthesis, Hell-Volhard Zelinsky reaction, Knoevenagel reaction, Leuckart reaction, Mannich reaction, Perkin reaction, Pechmann reaction, Pinacol-pinacolone Rearrangement, Reformatsky reaction, Schmidt reaction, Stobbe condensation, Wagner-Meerwein rearrangement. Willgerodt reaction, Wittig reaction, Wolff rearrangement, Suzuki coupling.

M. PH. 1.6B STEREOCHEMISTRY OF DRUGS AND REACTION MECHANISM (0-0-6)

PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. At least ten named reactions including reactions involving Grignard reagent and Reformatsky
2. At least five oxidation reactions involving different reagents
3. At least five reduction reactions involving different reagents

TEXT BOOK:

1. Organic Chemistry, Robert Thornton Morrison, Robert Neilson Boyd, Pearson Education, 6th Ed. - 2005.
2. Vogel's Text Book of Practical Organic Chemistry, Pearson Education, 5th Ed. - 2005.
3. Reaction & Reagents, O.P. Agarwal, Goel Publication, Meerut, 38th Ed. - 2004.
4. Stereochemistry of Organic Chemistry, E.L. ELIEL & S.H. WILEN, John Wiley & Sons - 1st Ed. - 2008.

REFERENCE BOOK:

1. Advanced Organic Chemistry, Michael B. Smith & Jerry March, Wiley Inter-Science A John Wiley & Sons, Inc., Publication, 6th Ed. - 2007.
2. Structure & mechanism in Organic Chemistry, C.K. Ingold, CBS Publishers, 2nd Ed. - 1994.
3. The Organic Chemistry of Drug Synthesis Vol-I to Vol-6, Lednicer & Mitscher, John Wiley & Sons, 1st ed. - 2005.

M.PH1.5C STABILITY OF DRUGS AND DRUG PRODUCTS (3-0-0)
THEORY

MODULE - I (14 Hours)

1. Overview of kinetic concepts – First, second and pseudo orders.
2. Complex order kinetics – concepts; equations and their application. Series, consecutive and reversible reaction, steady state approximation.
3. Stability prediction by pharmacist and calculation protocols.
4. Temperature as a stress : Arrhenius theory, activation energy calculations, Q10 value calculations.
5. Interpretation of kinetic data : Transition state theory, media effects, catalysis, pH effects. Some practical applications.

MODULE - II (10 Hours)

6. Drug decomposition mechanisms :
 - (a) Hydrolysis and acyltransfers : Nature of reaction, structure and utility, stabilization of pharmaceutical examples.
 - (b) Oxidation : Nature of oxidation, kinetics of oxidation, oxidation pathways of pharmaceutical, Interest Inhibition of oxidation
 - (c) Photolysis : Energetics of photolysis, kinetics photolysis, photolytic reactions of pharmaceutical interest, prevention of photolytic reactions.
7. Solid state chemical decomposition
Kinetic of solids state decomposition, Pharmaceutical examples of solid state decomposition,
Pure drugs, drug excipient and drug-drug interaction in solid state methods of stabilization.

MODULE - III (10 Hours)

8. Physical stability testing of dosage forms:
 - (1) Solids – tablets, capsules, powder and granules
 - (2) Disperse systems
 - (3) Microbial decomposition
 - (4) Over-view, physical stability of novel drug carriers, liposomes, niosomes, nano-particles.
9. Strategy and tactics of stability testing :
 - (1) Regulatory requirements
 - (2) Stability protocols
 - (3) Experimental Design
 - (4) Interpretation of data

TEXT BOOK:

1. Pharmaceutical Dosage Form Design -Tablets:Vol.-I, II & III, L.Lachmann, H.A.Lieberman, Marcel .Dekker, 2rd Ed.
2. Theory & Practice of Industrial Pharmacy, Lachmann, Varghese, 3rd Ed.
3. Physical Pharmacy, A.Martin, Lippincott Williams & Wilkins, London, 4thEd.- 2001.

REFERENCE BOOK:

1. Drug Stability: Principles & Practices, Cartensen & Rhodes, Marcel Dekker, New York, 3rd Ed. - 2008.

M.PH1.6 C STABILITY OF DRUGS AND DRUG PRODUCTS (0-0-6)
PRACTICAL

(A minimum of 20 experiments shall be conducted)

EXPERIMENTS BASED ON THEORY

M. PH.1.5D PHARMACOLOGICAL SCREENING METHODS (3-0-0)
THEORY

MODULE-I (9 Hours)

Drug discovery process: Principles, techniques and strategies used in new drug discovery. High throughput screening, human genomics. Regulations for laboratory animal care and ethical requirements.

MODULE-II

(14 Hours)

Preclinical and clinical models employed in the screening of new drugs belonging to following categories:

Antipsychotic agents, antianxiety agents; nootropic drugs; antidepressant drugs; antiparkinsonian agents; opioid analgesics; anti-inflammatory drugs. Infarction; antiatherosclerotic drugs; antimalarials; anthelmintics; antidiabetics; models for antiepileptics;

MODULE-III

(12 Hours)

Preclinical and clinical models employed in the screening of new drugs belonging to following categories.

local anesthetics; activity on the GI tract, transgenic animals and other genetically prone animal models.

Alternatives to animal screening procedures, cell-line, patch-clamp techniques, in-vitro models, molecular biology techniques.

Principles of toxicity evaluations, ED₅₀, LD₅₀ and TD values. International guidelines (ICH recommendations).

TEXT BOOK:

1. Screening Methods in Pharmacology – NS Parmar, S. Prakash, Norosa Publication, New Delhi, 1st Ed.

REFERENCE BOOK:

1. Drug Discovery & Evaluation – H.G. Vogel, S. Pringer, 3rd Ed.

M. PH. 1.6D PHARMACOLOGICAL SCREENING METHODS

(0-0-6)

PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. Administration of drugs by different routes in mice/rabbit
2. To study the effect of hepatic microsomal enzyme induction on the duration of action of pentobarbital sodium
3. To study the effect of pentobarbital on righting reflex (hypnosis) in mice
4. To study the effect of chlorpromazine on the locomotor activity of mice using actophotometer
5. To study the apomorphine induced compulsive behaviour (stereotype) in mice
6. To study the muscle relaxant property of diazepam in mice using rotarod apparatus
7. To study the analgesic effect of morphine in mice using the tail-flick method
8. To study the analgesic effect of morphine in mice using hot plate method
9. To study the analgesic effect of morphine against acetic acid-induced writhing in mice
10. To study the anti-inflammatory property of indomethacin against carrageenan-induced paw oedema
11. To study the anticonvulsant property of diazepam against pentylenetetrazol-induced convulsions in rats
12. To study the amnesic (loss of memory) effect of scopolamine using passive avoidance step-down task paradigm in mice
13. To study the antisecretory and ulcer-protective effect of cimetidine in pylorus-ligated rats
14. To study the local anaesthetic property of procaine hydrochloride using foot withdrawal reflex of frog
15. To determine the acute toxicity of the given drugs (To calculate LD₅₀ value) [4-5 experiments]

M. PH. 1.5H/ M. PH.1.5A FORMULATION DEVELOPMENT THEORY (3-0-0)

M.PH. 1.6H/ M.PH. 1.6A FORMULATION DEVELOPMENT PRACTICAL (0-0-6)

NOTE: M.PH1.5H, M.PH1.6H papers of M.Pharm Pharmaceutical Technology specialization are the same as M.PH1.5A, M.PH1.6A papers respectively of M.Pharm Pharmaceutics specialization.

M.PH. 1.7 SEMINAR TOPICS (0-0-3)

1. Intellectual property Rights.
 2. Drug Price Control Order
 3. ICH Guidelines.
 4. Total Quality Management
 5. W.H.O. Certification scheme for movement of drugs in international commerce.
 6. ISO - 9000 certification.
 7. GMP Certification.
 8. Food Adulteration and detection.
 9. Pharmaceutical Marketing
 10. Drug Information Centre / services
 11. Rational use of Drugs (RUD)
 12. Essential Drug Programme (EDP)
 13. Drugs and Therapeutics Committees.
 14. Biotechnology products
 15. Bio-assays
 16. Computer applications in pharmacy
 17. Computer Aided Drug Design
 18. Novel Drug Delivery Systems
 19. Patient Counseling
 20. Drug interactions
- Other related topics may also be selected by the teachers/students.

M.PH. 1.8 COMPREHENSIVE VIVA (0-0-0)

M.PHARM II SEMESTER **(PHARMACEUTICS)**

MPH2A.1: ADVANCED PHYSICAL PHARMACEUTICS THEORY (3-0-0)

MODULE - I (14 Hours)

Theory of solubilisation and solubilisation techniques: Solubility and solubilisation of non electrolytes, solubilisation by the use of surfactants, cosolvents, complexation, inclusion compounds, drug derivatization and solid state manipulation.

Solid state properties: crystal properties and polymorphism techniques for study of crystal properties; solid state stability, flow properties of powders, segregation and its importance.

MODULE - II (10 Hours)

- (a) Polymer Science: Properties of polymers thermodynamics of polymer solution, phase separation, polymers in solid state. Applications of polymers in pharmaceutical formulations.
- (b) Diffusion and dissolution: Diffusion, steady state diffusion procedures and apparatus. Diffusion principles in biological systems, thermodynamics of diffusion. Dissolution: Basic theories of dissolution, dissolution models. Sink conditions in dissolution and its importance. In-vitro - in-vivo correlations.

MODULE - III (10 Hours)

Kinetics and Drug stability: Stability calculations, rate equation, kinetics of decomposition, strategy of stability testing, methods of stabilization, methods of accelerated stability testing in dosage forms. Freeze thaw methods, centrifugal methods, temperature and humidity control.

TEXT BOOK:

1. Physical Pharmacy, Martin, Lippincott Williams & Wilkins, 4th Ed. – 2005.
2. Bentley's Text Book of Pharmaceutics, E.A. Rawlin, All India Traveller Bookseller, 8th Ed. – 2005.
3. Pharmaceutical Dosage Forms: Tablets I, II, III, Liberman & Lachman, Marcel Dekker, Ins, 2008.
4. Theory & Practice of Industrial Pharmacy, L. Lachman, Varghese Publishing House, Bombay, 3rd Ed.

MPH2A.2 BIO-PHARMACEUTICS & PHARMACOKINETICS (3-0-0)

THEORY

MODULE - I (10 Hours)

- I. Bioequivalence and its determination, study design for the assessment of bioavailability and bioequivalence, factors influencing bioavailability and bioequivalence.
Statistical concepts in estimation of bioavailability and bioequivalence.
Software used in biopharmaceutics and pharmacokinetics study and their significance.

MODULE - II (12 Hours)

- II Basic concepts of pharmacokinetics: Compartmental models: One and two compartmental approaches to Pharmacokinetics. Recent trends, merits and limitations of these approaches. Application of these models to determine various pharmacokinetic parameters pertaining to.
- i) Absorption: Mechanism and path ways of drug absorption, absorption rate constant, absorption half life, lag time and extent of absorption, AUC.
 - ii) Distribution: Physiological influence of drug distribution, protein binding of drug, determination of protein binding sites, clinical significance of drug protein binding. Apparent volume of distribution and its determination.
 - iii) Elimination: Over all apparent elimination rate constant, and half life. under the following conditions:
 - a) Intravenous bolus injection
 - b) Intravenous infusion
 - c) Single dose oral administration
 - d) Multiple dosage oral administration
 - iv) Concept of clearance: Organ clearance, total clearance, hepatic clearance, gut wall clearance and renal clearance.

MODULE - III (14 Hours)

- III Non-linear Pharmacokinetics: Concepts of linear and non linear pharmacokinetics, Michaelis – Menton kinetics characteristics, basic kinetic parameters, possible causes of non induction, non linear binding, non linearity of pharmacological responses.
- IV Time dependent pharmacokinetics: Introduction, classification, physiologically induced time dependency: Chronopharmacokinetics and Chronotherapeutics.
- V Non-compartmental pharmacokinetics:
 - i) Physiologic Pharmacokinetic Model: Concept, applications and limitations.

- ii) Statistical moments theory: Concept and applications, mean residence time, mean absorption time, mean dissolution time.

TEXT BOOK:

1. Biopharmaceutics & Pharmacokinetics, Robert E. Notari, Marcel Dekker, Inc. 4th Ed. 2008.

REFERENCE BOOK:

1. Biopharmaceutics and Clinical Pharmacokinetics, Milo Gibaldi, Marcel Dekker Inc., 2nd Ed. – 2006.
2. Remington's Pharmaceutical Sciences, Mack Publishing Company, Pennsylvania.
2. Pharmaceutical Codex.

MPH2A.3 BIOPHARMACEUTICS & PHARMACOKINETICS (0-0-6)

PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. To perform bioequivalence testing on marketed analgesic / sulphonamide tablets.
2. Comparison of dissolution of different marketed products of co-trimoxazole and other suspensions.
3. To determine K_a , biological half-life, AUC and other pharmacokinetic parameters of rifampicin / nitrofurantoin by urinary excretion method.
4. To determine protein-binding of drugs by equilibrium dialysis method (2 expts.)
5. Bioavailability studies of paracetamol or any other drug by salivary data (2 expts.)
6. To study the influence of urinary pH on salicylate excretion.
7. Calculation of K_a , K_e , $t_{1/2}$, C_{max} and T_{max} from the given data (2 expts.)
8. Calculation of AUC and bioequivalence from the given data (2 expts.)

MPH2A.4 NOVEL DRUG DELIVERY SYSTEMS (3-0-0)

THEORY

MODULE - I

(10 Hours)

Fundamentals of controlled drug delivery systems, theory of mass transfer, use of polymers in controlled drug delivery pharmacokinetic and pharmacodynamic basis of controlled drug delivery. Design, fabrication, evaluation and applications of the following controlled release systems:

1. Controlled release oral drug delivery systems.
2. Parenteral controlled release drug delivery systems.

MODULE - II

(10 Hours)

Fundamentals of controlled drug delivery systems, theory of mass transfer, use of polymers in controlled drug delivery pharmacokinetic and pharmacodynamic basis of controlled drug delivery. Design, fabrication, evaluation and applications of the following controlled release systems:

1. Implantable therapeutic systems.
2. Transdermal therapeutic systems and iontophoresis.
3. Ocular and intrauterine delivery systems.
4. Bioadhesive drug delivery systems.
5. Proteins and peptide drug delivery.

MODULE - III

(14 Hours)

Biochemical and molecular biology approaches to controlled drug delivery.

1. Micro particulate drug carriers: Liposomes, Neosomes, Microspheres, Nanoparticles and Resealed erythrocytes.
2. Monoclonal antibodies for drug delivery.
 - a. Drug targeting to particular organs:

1. Drug delivery to respiratory system.
2. Problems of drug delivery to the brain and targeting to brain.
3. Drug delivery to eye
4. Drug targeting in Neoplastic diseases.
 - b. Drug carrier systems targeted to widely dispersed cells.
 1. Delivery to Macrophages
 2. Delivery to lymphoid cells of immune network
 3. Delivery to lysosomal storage diseases.

TEXT BOOK:

1. Bentley's Text book of Pharmaceutics, Rawlins,.Publications All India Traveller Bookseller, 8th Ed. -2005.

REFERENCE BOOK:

1. Remington's Pharmaceutical Sciences, L.Wiliams & Wilkins, 21st Ed. (Vol. I & II)
2. Novel Drug Delivery Systems, Y.W.Chein, Marcel Dekker, Inc.
3. Controlled Drug Delivery Systems, Joseph R.Robinson & Vincent ILL.Lee.
5. Microencapsulation, Simon Benita, Pub. Marcel Dekker Inc.
6. Specialized Drug Delivery Systems, Praveen Tyle, Pub. Marcel Dekker Inc.

MPH2A.5 NOVEL DRUG DELIVERY SYSTEMS

(0-0-6)

PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. Study on diffusion of drugs through various polymer members (2 expts.)
2. Preparation and study on invitro dissolution of various sustained action products and comparison with marketed products (3 expts.)
3. Preparation of matrix tablets using various polymers like PVP etc and studying their release patterns (2 expts.)
4. Preparation and evaluation of microcapsules by different microencapsulation techniques like:
 - (a) Simple coacervation techniques: Gelatin-water-ethanol.
 - (b) Coacervation by temperature changes : Ethylcellulose in cyclohexane for phenobarbitone.
 - (c) Coacervation by non-solvent-addition: cellulose acetate butyrate in methyl ethyl ketone using isopropylether as non-solvent (1 expt. in each).
5. Preparation and evaluation of wax embedded micro-spheres of diclofenac sodium and theophylline (2 expts.)
6. Preparation of various polymer films containing different drugs and studying the film characteristics and release patters (3 expts.).
7. To perform sugar coating and nonenteric and enteric film coating on tablet and their evaluation (3 expts.)

MPH2A.6 ADVANCED PHARMACEUTICAL TECHNOLOGY

(3-0-0)

THEORY

MODULE - I

(12 Hours)

1. Formulation Development:

- (a) Solid dosage forms:

Improved production techniques for tablets: New materials, process, equipments improvements, high shear mixers, compression machines, coating machines, coating techniques in tablet technology for product development, physics of tablet compression and computerization for in process quality control of tablets.

- (b) Powder dosage forms:

Formulation development and manufacture of powder dosage form for internal and external use including inhalation dosage forms.

- (c) Liquid and semi-solid dosage forms:

Recent advances in formulation aspects and manufacturing of monophasic dosage forms, recent advances in formulation aspect and manufacturing of suspensions and semi-solid dosage forms.

(d) Aerosols:

Advances in propellants, metered dose inhaler designs, dry powder inhalers, selection of containers & formulation aspects in aerosol formulation, manufacture & quality control.

MODULE - II

(12 Hours)

2. Aseptic processing operation and parenteral dosage form development:

Introduction, Contamination control, Microbial environmental monitoring, Microbiological testing of water, Microbiological air testing, Characterization of aseptic process, Media and incubation conditions, Theoretical evaluation of aseptic operations. Advances in materials and production techniques for parenteral dosage forms.

3. Scale-up Techniques:

Effect of scale up on formulation, process parameters like mixing, granulation, drying, compression, coating, packaging, stability, selection and evaluation of suitable equipments.

MODULE - III

(12 Hours)

4. Process Validation:

Regulatory basis, Validation of solid dosage forms, Sterile products, Liquid dosage forms, Process validation of raw materials, Validation of analytical methods, Equipment and Process.

5. Optimization techniques in pharmaceutical and processing:

Optimization parameters, statistical design and other applications, design, development and optimization of in-vitro test systems to evaluate and monitor the performance of different types dosage forms, the relevance and importance of in-vitro/in-vivo associations at every stage of product development and manufacture, the regulatory evolution and current thinking on this aspect, application of statistical techniques in product development and evaluation including quality control.

TEXT BOOK:

1. Theory & practices of Industrial Pharmacy, Lachman & Liberman, Varghese Publication, 3rd Ed.
2. Pharmaceutical Dosage forms & Drug Delivery Systems, Howard C. Ansel, 8th Edition.
3. Pharmaceutics, M.E. Aulton, Churchill Livingstone, 3rd Edition, 2007.
4. Physical Pharmacy, A. Martin, Lippincott Williams, 4th Edition, 2005.
5. Modern Pharmaceutics, G.S. Banker, C.T. Rhodes, 4th Edition, Marcel Dekker.

REFERENCE BOOK:

1. Pharmaceutical dosage forms, Vol.1,2,3, H.A. Liberman, L. Lachman, Marcel Dekker, INC, 2nd Edition.
2. Pharmaceutical process validation, R.A. Nash & A.H. Wachter, Marcel Dekker, 3rd Edition, Vol.-129, 2003.
3. Pharmaceutical statistics, S. Botton, C. Bon, Marcel Dekker, 4th Edition.

MPH2A.7: SEMINAR / ASSIGNMENT

(0-0-3)

MPH2A.8. COMPREHENSIVE VIVA

(0-0-0)

- b) Antidepressants:** MAO inhibitors and tricyclic antidepressants and Miscellaneous. Mechanism of action, clinical and biological uses, side effects and their SAR studies. Synthesis of clinically useful drugs of each of the above classes.

MODULE - II

(11 Hours)

II. Chemotherapy of Cancer: Molecular Biology of Carcinogenesis. A detailed classification of antineoplastic agents, mechanisms of action of different classes; Alkylating agents and radiomimetic agents, antimetabolites their SAR studies, sex hormones and analogs, antibiotics. A mention of natural products used in cancer treatment; vinca alkaloids (Vincristine and Vinblastine) podophyllum and Taxol.

MODULE - III

(14 Hours)

III. Drugs Related to Hormones & other Autocoids: A study of the following hormones autocoids with a special reference to their agonists and antagonists;

- a) Peptide Hormones: Insulin, Vasopressin and oxytocin,
- b) Histamine (H¹ and H²) and 5-HT.
- c) Thyroid Hormones (T₃ and T₄)
- d) Prostaglandins
- e) Angiotensins

IV. Study of the following with emphasis on recent advances:

- a) Antilipemic agents
- b) Biomarkers
- c) Diagnostic agents
- d) Antiparkinsonian agents
- e) Antialzheimer agents
- f) Antirheumatics and antigout agents
- g) Orphan drugs

TEXT BOOK:

1. Principles of Medicinal Chemistry, William Foye, Lippincott Williams & Wilkins, 5th Ed.
2. A Text Book of Medicinal & Pharmaceutical Chemistry, Wilson & Gisvold, Lippincott Williams & Wilkins Publication, 10th Ed.
3. Organic Chemistry of Drug Design & Drug Action, R.B.Silverman, Elsevier Publication, 2nd Ed.-2004.

REFERENCE BOOK:

1. Medicinal Chemistry & Drug Discovery, Alfred Burger, A.John, Wiley & Sons Inc. Publication, 6th Ed.
2. Introduction to Medicinal Chemistry, Alex Gringavz, Wiley Publication, 1st Ed.-1997.

MPH-2B.4 ADVANCED MEDICINAL CHEMISTRY-III

(0-0-6)

PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. Synthesis of various Barbiturates and determination of pKa value of Barbiturates in relation to their biological activity.
2. Synthesis of local anesthetics and evaluation of their biological activity.
3. Synthesis of some Anticonvulsants (other than Barbiturates) and their evaluation.
4. Synthesis and evaluation of non-narcotic analgesics.
5. Suitable synthesis and the evaluation of drugs based on theory topics.

MPH-2B.5 CHEMISTRY OF NATURAL PRODUCTS
THEORY

(3-0-0)

MODULE - I

(10 Hours)

1. General methods of isolation and separation of plant constituents. Qualitative reactions employed for the detection of plant constituents. Application of G.L.C., HPLC and counter current distribution to separation and analysis of plant constituents Determination of Organic structures through Interpretation of - **Infrared spectroscopy, H¹ N.M.R & C¹³ N.M.R, MASS spectroscopy.**

2. Study of biogenesis: The acetate hypothesis, Isoprene rule Biogenetic hypotheses relation to alkaloids.

MODULE - II (10 Hours)

3. Alkaloids: Isolation and study of the constitution of ergot alkaloids, opium alkaloids, atropine and reserpine.

4. Steroids: Chemistry and stereo-chemistry of cholesterol. Preparation and chemistry of corticosteroids.

5. Glycosides: A general study of glycosides with detailed treatment of cardiac glycosides, Digoxin, Sciliarin-A and ovabain.

MODULE - III (14 Hours)

6. Antibiotics: A general study of the chemistry of antibacterial antibiotics, antifungal antibiotics and anti viral antibiotics with detailed treatment of newer semi synthetic penicillins and cephalosporins.

7. Vitamins: Detailed study including commercial preparations of vitamin-A, vitamin - C, cyanacobalamin, Nicotinamide, folic acid, thiamine, riboflavine and pyridoxine.

TEXT BOOK:

1. Organic Chemistry Vol.-II - Stereochemistry & the Chemistry of Natural Products, I.L.Finar, Low Price Ed., Person Education, 5th Ed.-2003.
2. Pharmacognosy Trease & Evans, Elsevier Publication, 15th Ed.-2008.
3. Organic Chemistry of Natural Products Vol.-I, Gurudeep & Chatwal, Himalaya Publishing House, 7th Ed. -2008.
4. Organic Chemistry Natural Product Vol.-I, O.P.Agarwal, Goel Publication Meerut, 36th Ed.-2008.

REFERENCE BOOK:

1. Recent Progress in Medicinal Plants Vol.-I, Singh, Govil, Singh, Sci. Tech Publication LLC, USA, 1st Ed.-2002.

MPH-2B.6 CHEMISTRY OF NATURAL PRODUCTS (0-0-6)
PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. Exercise involving the extraction, isolation and separation characterization by modern methods

and quantitative estimation of therapeutically important phytoconstituents.

2. Screening of natural products for biological activities mentioned as below:

- a) Anti-inflammatory activity
- b) Hypoglycemic activity
- c) Diuretic activity
- d) Cardiac activity
- e) Antimicrobial activity
- f) Anti-neoplastic activity
- g) Psychopharmacological activity
- h) Anti-fertility activity.

MPH-2B.7 SEMINAR / ASSIGNMENT (0-0-3)

MPH-2B.8 COMPREHENSIVE VIVA (0-0-0)

M.PHARM (PHARM. ANALYSIS & QUALITY ASSURANCE)

MPH2C.1 QUALITY ASSURANCE OF PHARMACEUTICALS (3-0-0) THEORY

MODULE-I (12 Hours)

1. Concept of total quality management, philosophy of GMP, CGMP and GLP.
2. Organization and personnel, responsibilities, training hygiene.
3. Premises: Location, design, plan layout, construction, maintenance and sanitations, environmental control, sterile areas, control of contamination.
4. Equipments: Selection, purchase specifications, maintenance, clean in place, sterilize in place.

MODULE-II (12 Hours)

5. Raw materials: Purchase specifications, maintenance of stores, selection of vendors, controls and raw materials.
6. Manufacture of and controls on dosage forms: Manufacturing documents master formula, batch formula records, standard operating procedures, quality audits of manufacturing processes and facilities.
7. In process quality control on various dosage forms sterile, biological products and non-sterile, standard operating procedures for various operations like cleaning, filling, drying, compression, coating, disinfection, sterilization, membrane filtration etc. Guidelines for Quality assurance of Human Blood products and Large volume parenterals.
8. Packaging and labeling controls, line clearance and other packaging materials.

MODULE-III (12 Hours)

9. Quality control laboratory: Responsibilities, good laboratory practices, routine controls, instruments, protocols, non-clinical testing, controls on animal house, data generation and storage, quality control documents, retention samples, records, audits of quality control facilities.
10. Finished products release: Quality review, quality audits, batch release document.
11. Distribution and distribution-records: Handling of returned goods recovered materials and reprocessing.
12. Complaints and recalls, evaluation of complaints recall procedures, related records and documents.

TEXT BOOK:

1. How to Practice GMPs , P.P.Sharma, Vandana Publication, 5th Ed.
2. The Drugs & Cosmetic Act 1940, Vijay Malik, Eastern Book Company, 19th Ed.
3. Q.A. Manual, D.H.Shah, Business Horizon, 1st Ed.
4. SOP Guidelines, D.H.Shah, Business Horizon, 2nd Ed.

REFERENCE BOOK:

1. The International Pharmacopoeia Vol 1,2,3,4, General Methods of Analysis & Quality Specifications for Pharmaceutical Substances, Excipients, Dosage forms., CBS (WHO), 3rd Ed.
2. Quality Assurance of Pharmaceuticals – A compendium of guidelines and related materials Vol.1 & Vol.2, WHO, 1999
3. Basic Tests for Pharmaceutical Substances, WHO, 1988.
3. Basic Tests for Pharmaceutical Dosage Forms, WHO (1991)
5. Pharmaceutical Process Validation, Vol.129, Wachter & Mash, M.Dekker, 3rd Ed.

containing the following groups of drugs included in I.P. (Biological and microbiological methods excluded)

- | | |
|---------------------------------|----------------------------------|
| (a) Analgesics and Antipyretics | (b) Sedatives & Tranquillizers |
| (c) Antihypertensives | (d) Antibiotics & Antibacterials |
| (e) Cardiovascular drugs | (f) Vitamins |
| (g) Antihistaminics | (h) Antidiabetics |

MODULE-III

(12 Hours)

4. A detailed study of the principles and procedures involved in the qualitative and quantitative analysis of pharmaceutical preparations and dosage form using the following reagents and reactions.
 - (i) Oxidative coupling reactions using MBTH (3-methyl-2-benzothiazolinone hydrazone hydrochloride)
 - (ii) Diazotization followed by coupling
 - (iii) Oxidation followed by complexation.
 - (iv) Oxidation followed by charge transfer reaction.
 - (v) Condensation reactions using the reagents Para Dimethyl Amino Benzaldehyde (PDAB), Para Dimethyl Amino Cinnamaldehyde (PDAC), Folin's reagent and Gibb's reagent.
 - (vi) Folinicalteu reagent (FC reagent)

TEXT BOOK:

1. A text book of Pharmaceutical Analysis, K.A.Conners, John Wiley, 3rd Ed.
2. Pharmaceutical Analysis, Higuchi & Brochmann, CBS Publishers, 1st Ed.

REFERENCE BOOK:

3. Instrumental Methods of Analysis, Scoog & West, Thomson, 6th Ed.
4. Chemical Analysis-Modern Instrumentation Methods & Techniques, F.Rouessac, J. Wiley, 4th Ed.
5. Instrumental Methods of Analysis, Willard Dean & Merrit, CBS Publishers, 7th Ed.
6. Hand book of Instrumental Techniques for Analytical Chemistry, Frank Settle Pub., Prentice Hall Inc.
7. Spectrophotometric Identification of Organic Compounds, Silverstein, Willey, 6th Ed.
8. Organic Spectroscopy, William Kemp, Palgrave, 3rd Ed.

M.PH 2C.5 PHYTOPHARMACEUTICAL ANALYSIS

(0-0-6)

THEORY

MODULE - I

(12 Hours)

Methods of systematic phytochemical analysis including extraction and identification of plant constituents using chromatographic techniques.

Quality control of crude drugs : proximate analysis including ash and extractive values, crude fibre content, U.V. and fluorescence analysis of powdered drugs.

MODULE - II

(10 Hours)

Qualitative & quantitative microscopy and microchemical tests.

Detection of common adulterants and insects infestation in whole and powdered drugs.

MODULE - III

(12 Hours)

Analysis of official formulations derived from crude drugs including some Ayurvedic preparations.

Brief study of quality control of plant-products and their high-throughput screening.

Microbiological screening methods for antimicrobial activity.

WHO guidelines for the quality control of raw materials used in herbal formulations.

M.PH 2C.6 PHYTOPHARMACEUTICAL ANALYSIS (3-0-0)
PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. Spectrophotometric determination of caffeine from tea powder.
2. The Estimation of curcumin from curcuma longa by spectrophotometric methods.
3. Determination of sugars by descending paper chromatography.
4. Determination of bitterness value of crude drugs.
5. Determination of extractive values of crude drugs.
6. Fluorimetric analysis of iso-quinoline alkaloids.
7. Determination of Rf values of different amino acids and alkaloids.
8. Antimicrobial activity of some plant extracts using different pathogenic and non-pathogenic organisms.
9. Colorimetric analysis of some plant drugs.

TEXT BOOK:

1. The Quantitative Analysis of Drugs, D.C.Garrat, CBS Publishers, 3rd Ed.

REFERENCE BOOK:

1. Textbook of Pharmacognosy, Trease & Evans, Saunden Elsevier, 15th Ed..
2. Instrumental Methods of Analysis, Willard, Merrit, Dean, CBS Publishers, 7th Ed.
3. Pharmacopoeial Standards for Ayurvedic Formulation (Council of Research in Indian Medicine & Homoeopathy)

MPH2C.7: SEMINAR/ ASSIGNMENT (0-0-3)

MPH2C.8: COMPREHENSIVE VIVA (0-0-0)

M.PHARM (PHARMACOLOGY)

MPH2D.1 PHARMACOKINETICS & DRUG METABOLISM (3-0-0)

THEORY

MODULE-I (14 Hours)

Drug absorption: Gastrointestinal, Percutaneous and rectal kinetics and factors affecting drug absorption and bioavailability

Drug distribution: Plasma protein binding - Factors affecting plasma protein binding, Tissue binding, transfer of drugs through biological barriers and their therapeutic implication in drug action.

Elimination of drugs: Concept of renal clearance and excretion of drugs, biological half-life.

MODULE-II (10 Hours)

Reaction of body to foreign substances: Biotransformation of drugs, phase I and phase II metabolic reactions. Microsomal and non microsomal reactions.

Drug metabolism in liver, kidney, intestine and placenta. Drug metabolism in fetus and new born. In-vitro and In-vivo studies in drug metabolism

MODULE-III (10 Hours)

Factors influencing drug metabolism: 1. Stereo chemical, and physico chemical factors, 2. Physiological factors: species difference, strain difference, sex, age and environmental factors. 3. Pathological states, 4. Genetic factors: Pharmacogenetics, heritable factors recognized in man by use of drugs.

**MPH2D.2 PHARMACOKINETICS AND DRUG METABOLISM
PRACTICAL**

(0-0-6)

(A minimum of 20 experiments shall be conducted)

1. Pharmacokinetic study of sulphonamides after oral administration in humans from urine samples.
2. Pharmacokinetic study of sulphonamides after oral administration in rabbits from blood data.
3. Pharmacokinetic study of sulphonamides after I.V. administration in rabbits from blood data
4. Calculation of bioavailability of sulphonamide from the above blood data in rabbits
5. To determine Protein binding studies of any three drugs by using equilibrium dialysis method.
6. Bioavailability studies of sulphonamide/paracetamol or any other drug from salivary data of humans.
7. To study the influence of urinary pH on salicylate excretion.
8. Calculation of different Pharmacokinetic parameters like K_a , K_e , $t_{1/2}$, C_{max} , T_{max} and AUC from the given blood data.

TEXT BOOK:

1. Pharmacokinetics – Gibaldi, M. & Donald Perrier, Pharma Med. Press, 4th Ed.
2. Clinical Pharmaceutics – Rowland, M. & Tozer, T.N., Lea & Fibiger, USA, 3rd Ed.

REFERENCE BOOK:

1. Principles of Medicinal Chemistry - William O. Foye, Thomas L, David A. Williams, B.I.Publication Pvt. Ltd. 5th Ed.
2. Text Book of Organic Medicinal & Pharmaceutical Chemistry, Joume N. Delgado & William A. Remers, Lippincott Williams, 11th Ed.

MPH2D.3 GENERAL PHARMACOLOGY

(3-0-0)

THEORY

MODULE- I

(12 Hours)

Drugs acting on ANS:

- Cholinergic drugs and Cholinergic blocking drugs
- Ganaglionic stimulants, ganglionic blockers
- Neuromuscular blockers
- Adrenergic (or) Sympathomimetic drugs
- Antiadrenergic (or) sympathetic blockers

Drugs acting on peripheral nervous system: Local anesthetics

MODULE-II

(14 Hours)

Drugs acting on CNS:

General anesthetics, Anxiolytics & hypnotic drugs, Antiepileptics, Analgesics, CNS stimulants,

NSAID's, Antigout drugs, Antipsychotic drugs, Antidepressants and Anti Parkinsonian drugs

Drugs acting on CVS: Cardiotonics, Antiarrhythmic drugs, Antianginal drugs, Antihypertensives

Diuretics

MODULE-III

(12 Hours)

Drugs acting on Digestive system: Drugs used in gastric ulcer, purgatives, antiemetics, antidiarrhoeals

Drugs acting on Respiratory System: Bronchodilators, Expectorants & Anti-tussive agents

Chemotherapy: Basic principles of chemotherapy; chemotherapy of bacterial infections (antibacterial and antibiotics); chemotherapy of tuberculosis and leprosy; chemotherapy of viral and fungal infections, malaria, amoebiasis, cancer & AIDS.

TEXT BOOK:

1. Essentials of Medical Pharmacology, K.D.Tripathy, JAYPEE, 6th Ed.
2. Pharmacology & Parmacotherapeutics, Satoshkar & Bhandarkar, Popular Publication, 2nd Ed.
3. Pharmacology, Prasun Kumar Das, S.K.Bhattacharya, Elsevier, 2nd Ed.
4. Text book of Pharmacology, S.D. Sethi, Elsevier, 2nd Ed..
6. Pharmacology, Rang, Dale and Ritter, Churchill Living Stone, 6th Ed.
7. Basic & Clinical Pharmacology, B.G.Katzung, Lange, 10th Ed.
8. Pharmacology, Mary J, Mycer, Richard A, Lippincott William & Willans, 3rd Ed.

REFERENCE BOOK:

1. The Pharmacological Basis of Therapeutics, Goodman & Gilman, Mc Graw Hill, 11th Ed.

MPH2D.4 GENERAL PHARMACOLOGY (0-0-6)

PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. Dose response curve of acetylcholine by using the rectus abdominis muscle of frog
2. 1.1 bio-assay of acetylcholine on the rectus abdominis muscle of frog
3. 2.1 bioassay of acetylcholine on the rectus abdominis muscle of frog
4. Effect of an agonist on acetylcholine using rectus abdominis muscle of frog
5. Effect of an antagonist on acetylcholine using rectus abdominis muscle of frog
6. 2.1 bioassay of histamine in the guinea pig ileum
7. To calculate pA₂ value for atropine using acetylcholine as an agonist employing guinea pig ileum preparation
8. To estimate the strength of an unknown sample of acetylcholine by four point bioassay using rectus abdominis muscle of frog
9. To estimate the strength of an unknown sample of histamine by four point bioassay using guinea pig ileum
10. To record the CRC of 5-hydroxytryptamine using rat fundus strip preparation
11. To record the CRC of oxytocin using rat uterus preparation

Demonstration:

- Effect of autonomic drugs on rabbit intestine
- Bronchodilation on guinea pig tracheal chain
- To study the effect of drugs on the coronary blood flow and heart rte of isolated rat heart (Langendorff's heart preparation)
- To demonstrate the effect of various drugs on the blood pressure of anaesthetized dog

MPH2D.5 CLINICAL PHARMACOLOGY & TOXICOLOGY (3-0-0)

THEORY

MODULE-I

(10 Hours)

Drugs interactions: Mechanism, Pharmacokinetic & Pharmacodynamic drug-drug interaction, Food-drug and drink interaction

Adverse drug reactions: Definition and classification, epidemiology, predisposing factors, pharmacovigilance & pharmacoepidemiology, mechanism of ADR & different types of ADR, Therapeutic Drug Monitoring

MODULE-II

(10 Hours)

Various disorders and their therapeutic monitoring

- **CVS disorders :** Hypertension, Ischaemic heart disease, CHF, Cardiac arrythmias

- **CNS disorders** : Epilepsy, Parkinsonism, Psychotropic disorders(Schizophrenia depression and mania)
- **Infectious disorders** : Gastrointestinal, respiratory and urinary infections, Endocarditis and Meningitis
- **Endocrine disorders** : Diabetes mellitus, Hypo / Hyperthyroidism, Cushing's syndrome, Addison's disease, Sexually transmitted diseases

MODULE-III

(14 Hours)

Drug therapy in

- Geriatrics
- Pediatrics
- Pregnancy & lactation

Drug Induced Diseases, (Letrogenic Diseases), Teratogenicity & Carcinogenicity

Clinical Evaluation of Drugs: Clinical Trials

Testing of Acute, Subacute & Chronic Toxicity

Determination of LD₅₀ & ED₅₀

TEXT BOOK:

1. Clinical Pharmacy, Tipnis Bajaj, Career, 1st Ed.
3. Clinical Pharmacy & Therapeutics, Roger Walker, Edwards, Churchill Living Stone, 4th Ed.
5. Clinical Pharmacy & Therapeutics, Herfindal, Gourley & Lioyd Hardt, Williams & Wilkans, 4th Ed.

REFERENCE BOOK:

1. The Science & Practice of Pharmacy, Remington, Lipincott Williams & Wilkans, 21st Ed.
2. Clinical Pharmacology & Drug Therapy, Grahame Smith DG, Aronson J.K, Oxford, 3rd Ed.

MPH2D.6 RECENT ADVANCES IN PHARMACOLOGY

(3-0-0)

THEORY

MODULE-I

(10 Hours)

Neurohumoral transmission in Central and Autonomic Nervous system:

Mechanism of Neurohumoral transmission in CNS and ANS, Adrenergic cholinergic, dopaminergic, Serotonergic, Histaminergic, GABA ergic, Glutamate and Purinergic systems.

MODULE-II

(14 Hours)

Autacoid Pharmacology : A study of the mechanism involved in the formation, release Pharmacological actions and possible physiological role of histamine, serotonin, kinins, prostaglandins, Opioid autacoids, cyclic 3.5 AMP, leukotrienes, polypeptides & nitric oxide in central and peripheral tissues.

Renin-angiotensin system: Its physiological role, essential hypertension, Interrelationship between rennin angiotensin system and sympathetic nervous system - Pharmacology of Drugs acting on Renin-angiotensin system

MODULE-III

(10 Hours)

Theories of Drug action: Principles of drug action, ion channels, enzymes, Drug receptor theory : Types of receptors : G-Proteins, Second messengers and genterapy, Principle of drug design, structure activity relationship of selected groups like opioid drugs, catecholamines, penicillins, barbiturates, benzodiazepines.

TEXT BOOK:

1. The Pharmacological basis of therapeutics, Joel G. Hardman, Lee E. Limbird and Alfred Goodman Gilman, Mc. Graw Hill, 11th Ed.
2. Principles of Medicinal Chemistry, William O. Foye, Tomas L. Lemke & David A. Williams, Lippincott Williams & Wilkins, 6th Ed.
3. Pharmacology, H.P. Rang, M.M. Dale, J.M. Ritter & P.K. Moore, Churchill Livingstone, 5th Ed.

REFERENCE BOOK:

1. Indian Journal of Pharmacology
2. Journal of Indian Medical Association
3. Journal of Pharmacy & Pharmacology
4. Journal of Pharmacology & Experimental Therapeutics
5. Indian Drugs

MPH2D.7: SEMINAR / ASSIGNMENT (0-0-3)

MPH2D.8: COMPREHENSIVE VIVA (0-0-0)

M.PHARM (PHARMACEUTICAL TECHNOLOGY)

M.PH.2H.1 PHARMACEUTICAL BIOTECHNOLOGY (3-0-0)

THEORY

MODULE-I (10 Hours)

1. Nanotechnology: Introduction and History of Nanotechnology and Nanobiology
General and Medical /Therapeutic applications of nanobiology and nanotechnology – Techniques used in nanotechnology.

MODULE-II (12 Hours)

2. Genetic Engineering: Techniques of gene manipulation, cloning strategies, procedures, cloning vectors, expression vectors, recombination selection and screening. Application of R-DNA technology for the production of Insulin, erythropoietin, Hepatitis B Vaccine, and Tissue plasminogen activator.

MODULE-III (14 Hours)

3. Enzyme technology: Sources of enzymes, production, isolation and purification of enzymes. Applications of enzymes in pharmaceutical industry, therapeutics and clinical analysis.
Bioprocess technology: Fermentor design, surface and submerged liquid substrate fermentation, solid substrate fermentation, down stream processing.
4. Immuno technology: Hybridoma techniques, fusion methods for myeloma cells and blymphocytes. Selection and screening techniques, production and purification and monoclonal antibodies and their applications.

TEXT BOOK:

1. Modern Pharmaceutics, G.S.Banker, M.Dekker, Inc., 4th Ed.

REFERENCE BOOK:

1. Gene transfer & expression protocols – methods in molecular Biology, Vol-VII, Edit b E.T. Murry.
2. Controlled and Novel Drug delivery, N.K.Jain,CBS Publisher & Distributor, 1st Ed.
3. Novel Drug Delivery, Y.W.Chein, M.Dekker, Inc., 2nd Ed.

MPH2H.3 BIOPHARMACEUTICS & BIOTECHNOLOGY (0-0-6)

PRACTICAL

(A minimum of 20 experiments shall be conducted)

1. Comparison of dissolution of different marketed products of co-trimoxazole and other suspensions.
4. To determine K_a , biological half-life, AUC and other pharmacokinetic parameters of rifampicin / nitrofurantoin by urinary excretion method.
5. To determine protein-binding of drugs by equilibrium dialysis method (2 expts.)
6. Bioavailability studies of paracetamol or any other drug by salivary data (2 expts.)
7. To study the influence of urinary pH on salicylate excretion.
8. Calculation of AUC and bioequivalence from the given data (2 expts.)

9. Isolation and Analysis of Genomic DNA/RNA by gel electrophoresis and spectroscopy
10. ELISA technique
11. Production of Alcohol using bioreactor.
12. Blotting techniques (Southern, Northern, Western)

NOTE: *M.PH2H.2, M.PH2H.4, M.PH2H.5 and M.PH2H.6 papers of M.Pharm Pharmaceutical Technology specialization are the same as: M.PH2A.2, M.PH2A.4, M.PH2A.5 and M.PH2A.6 papers of M.Pharm Pharmaceutics specialization respectively.*

MPH2H.7: SEMINAR / ASSIGNMENT (0-0-3)

MPH2H.8: COMPREHENSIVE VIVA (0-0-0)

M.PHARM (PHARMACOGNOSY)

M. PH. 1.5F ADVANCED PHARMACOGNOSY-I (3-0-0)

THEORY

MODULE-I (10 Hours)

Prospects and Problems encountered in discovering new drugs from plants. Anticancer, Antidiabetic, Antifertility and Antihepatotoxic drugs of natural origin and their current status.

Drugs obtained from marine resources with special reference to Cardiovascular, Cytotoxic, Antimicrobial and Anti-inflammatory compounds.

MODULE-II (10 Hours)

Hallucinogenic, Allergic, Teratogenic and Toxic plants.

Saponins and Terpenoids with biological activity of Pharmaceutical significance.

Chemotaxonomy of natural drugs.

MODULE-III (14 Hours)

Biological screening of natural products: Description, handling and applications of common lab animals, CPCSEA guidelines for conducting animal experiments. Transgenic animals – Production, maintenance and applications, Toxicity studies- Acute toxicity and repeated dose toxicity studies.

Review and biological screening (In-vivo & In-vitro) of phytopharmaceuticals of the following therapeutic classes: Antinflammation, Antiallergic, Hepatoprotective, Anticancer, Antidiabetic, Antiviral, Immunomodulatory, Antioxidant and Antimicrobial agents.

Application of various chromatographic techniques like TLC, CC, GLC, HPLC, HPTLC.

Text Book:

1. Pharmacognosy, G.E. Trease & W.C Evans, Saunders Elsevier.
2. Text Book of Pharmacognosy, C.K.Kokate, A.P.Purohit, S.B.Gokhale, Nirali Prakashan, Pune.
3. Quality Control Methods for Medicinal Plant, W.H.O., Geneva
4. Text Book of Pharmacognosy, V.E. Tyler, L.R. Brody, J.E. Robbors, Len & Febiger, Philadelphia
5. Screening Methods in Pharmacology, Robert A.Turner, Raven Press, New York

2. Isolation of Pharmaceutically important phytochemicals from crude drugs.
3. TLC characterization of medicinal plant extracts and isolation of phytochemicals.
4. Column Chromatography characterization of medicinal plant extracts and isolation of phytochemicals.
5. Identification of chemical groups distributed in the plant.
6. Characterization of plant drugs by histologic study and establish its correlation with adulterant and substitute variety available in nature.
7. Microscopic measurement of cell and cell contents and other parameters to be useful for standardization of plant drug.

Text Books:

1. Pharmacognosy, G.E. Trease & W.C Evans, Sounders Elsevier.
2. Drug Discovery & Evaluation, Pharmacological Assays, H.Gernard Vogel, Springer -verlag, Berlin Herdelberg, New York.
3. Herbal Drug Industry, R.D. Choudhury, Eastern Publications, New Delhi
4. Pharmaceutical Biotechnology, S.P. Vyan & V.K.Dixit,CBS Publishers, New Delhi.

Reference Books:

1. Text Book of Industrial Pharmacognosy, A.N.Kalia, CBS Publishers, New Delhi.
2. Organic Chemistry of Natural Products, O.P. Agarwal, K.P.Maedia Publishers, New Delhi.
3. Medicinal Natural Products (a biosynthetic approach), Paulm. Dewick, John Wiley & Sons Ltd, England.
4. Natural Products from Plants, Petor B. Koufman, CRC Press, New York.
5. Recent Progress in Medicinal Plants, V.K.Singh,J.N.Govil,S.Hasmi,G.Singh,Stadium Press,LLC, USA.

M.PH2.3 F: HERBAL DRUG FORMULATION AND STANDARDIZATION (3-0-0)

THEORY

MODULE-I (10 Hours)

Preparation of herbal formulation for Diabetes, Liver disorders, Inflammation, Fever using indigenous medicinal plants.
Preparation of herbal cosmetics using Indian traditional medicines.

MODULE-II (10 Hours)

Traditional Formulations: General consideration of Ayurvedic formulations and their preparation like Churna, Kwath Avaleha, Satwa, Asara, Arista, Ghutika, etc. and pure phytopharmaceuticals manufacture of herbal formulations, Introduction to good manufacturing practice (GMP) and WHO guidelines for formulations, Raw material testing, Quality control parameters for manufacturing of formulations containing plant drugs. Types and methodology of polyherbal and monoherbal formulations.

MODULE-III (12 Hours)

Standardization of herbal raw material or extract as per WHO/CCMP guidelines, Macroscopical, Microscopical, Physical, Chemical, Spectral and biological standardization.
Quality Assurance in herbal drug industry as per GAP, GMP, and GLP in traditional system of medicine.

M.PH2.4 F: HERBAL DRUG FORMULATION AND STANDARDIZATION (0-0-6)

PRACTICAL

(A minimum of 20 experiments shall be conducted from the following)

1. Preparation of herbal formulation and its biological evaluation.
2. Standardization of some herbal formulations.
3. Biological Screening of plant extracts – Anti-inflammatory, Antidiabetic, Diuretics, Antimicrobial, Antipyretic, Antiulcer, Analgesic
4. Preparation of extractive values of plant materials using various solvents.
5. Extraction of volatile oil from plant and its characterization.

Text Books:

1. Pharmacognosy, G.E. Trease & W.C Evans, Saunders Elsevier.
2. Drug Discovery & Evaluation, Pharmacological Assays, H.Gernard Vogel, Springer -verlag, Berlin Herdelberg, New York.
3. Herbal Drug Industry, R.D.Choudhury, Eastern Publishers, New Delhi.
4. Quality Control of Herbal Drugs, P.K. Mukharjee, Business Horizons Pharmaceutical Publishers, New Delhi.

Reference Books:

1. Plant Drug Analysis, H.Wagner & S.Bladt, Springer, Berlin.
2. The Complete Technology Book on Herbal Perfumes and Cosmetics, H.Pande, National Institute of Industrial Research, New Delhi
3. Indian Herbal Pharmacopoeia, IDMA, Mumbai
4. Herbal Medicines, J.Bownes, L.A. Anderson & J.D Phillipson, Pharmaceutical Press, U.K.
5. Quality Assurance of Pharmaceuticals, W.H.O, Geneva.

M.PH2.5 F: CHEMISTRY OF NATURAL PRODUCTS (3-0-0)

THEORY

MODULE-I (10 Hours)

1. General methods of Extraction isolation and separation of plant constituents.
2. General techniques of biosynthetic studies and brief introduction to biogenesis of secondary metabolites.
3. Factors affecting production of secondary metabolites in medicinal plant.

MODULE-II (11 Hours)

4. Alkaloids- Isolation and Chemistry of Atropine, Quinine, Morphine and Ephedrine.
5. Steroid- Chemistry and Stereochemistry of Cholesterol.
6. Preparation and Chemistry of Corticosteroids.
7. Glycosides- A general study of glycosides with detail treatment of Digoxin, Scillarin A, Ouabain.

MODULE-III (14 Hours)

8. Antibiotics- Chemistry and therapeutic activity of Penicillin, Streptomycin, Tetracycline and Cephalosporin.
9. Terpenes- Chemistry of Citral, Menthol, Camphor
10. Vitamins- Detailed study including commercial production and chemistry of Vitamin-A, Cyanocobalamine, Nicotinamide, Folic acid, Riboflavine .
11. Chemical and Spectral approaches to simple molecules of natural origin. Application of various spectrometric Techniques like UV, IR, NMR, MS, Fluorimetry, etc. for standardization of plant drugs.

Text Books:

- a. Pharmacognosy, G.E. Trease & W.C Evans, Saunders Elsevier.
- b. Drug Discovery & Evaluation, Pharmacological Assays, H.Gernard Vogel, Springer -verlag, Berlin Herdelberg, New York.
3. Phytochemical Methods, J.B.Honborne, John Wiley & Sons Ltd., England
4. Organic Chemistry of Natural Products, O.P. Agarwal, K.P. Media Publishers, New Delhi.
5. Organic Chemistry of Natural Products, G.Chatwal, Himalaya Publishers, New Delhi.

Reference Books:

1. Chemistry of Natural Products, R.H.Thimuin, Springer International Edn, Berlin
2. Recent Progress in Medicinal Plants, D.K. Majumdar, J.N.Govil, V.K. Singh, R.K. Sharma, Stadium Press, LLC, USA
3. Indian Pharmacopoeia
4. United States Pharmacopoeia
5. Techniques in Organic Chemistry, Weins Greger, CRC Press, New York
6. Spectrometric Identification of Organic Compounds, Robert M Silverstein, Sixth Edn., John Wiley & Sons, England

M.PH2.6 F: ADVANCED PHARMACOGNOSY-II (MEDICINAL PLANT BIOTECHNOLOGY) (3-0-0)**THEORY****MODULE-I****(10 Hours)**

1. Historical perspectives, prospects for development of plant biotechnology as source of medical agents. Applications in pharmacy and allied fields.
2. Types, techniques, nutritional requirements and growth of plant tissue cultures, Organogenesis and embryogenesis. Protoplast fusion and cultures, artificial seeds, micropropagation of medicinal and aromatic plants, Genetic stability of tissue cultures.

MODULE-II**(11 Hours)**

3. Secondary metabolism in tissue cultures with emphasis on production of medicinal agents and its impact in pharmacy. Screening and selection of high yielding cell lines. Effect of cultural practices, precursors and elicitors on production of biomedicinals.
4. Biotransformation, bioreactors, industrially potential tissue culture systems for pilot and large scale cultures of plant cells, cellular totipotency, crypreservation and retention of biosynthetic potential in cell cultures.

MODULE-III**(14 Hours)**

5. Immobilised plant cells culture systems, immobilization techniques, effect of immobilization on secondary metabolism and realization of chemosynthetic potential in immobilized cells.
6. Techniques employed in elucidation of biosynthetic pathway, biogenesis of tropane, quinine, imidazole, isoquinoline and indole alkaloids, sterols, anthraquinone and saponin glycosides, flavanoids and isoprenoid compounds of pharmaceutical significance.

Text Books:

1. Pharmacognosy, G.E. Trease & W.C Evans, Saunders Elsevier.
2. Drug Discovery & Evaluation, Pharmacological Assays, H.Gernard Vogel, Springer -verlag, Berlin Herdelberg, New York.

3. Plant Tissue Culture, Bhagwani, Vol.5, Elsevier
4. Element in Biotechnology, P.K.Gupta, Eastern Publisher, New Delhi

Reference Books:

1. Advanced Method in Plant Breeding and Biotechnology, David R. Murnnay, CRC Press, New York.
2. Plant Tissue Culture, Dixon, Oxford, Washington DC,
3. Introduction to Biotechnology, Bullock John, WB Sahenders Edinburgh, New York.
4. Secondary Plant Metabolism, Margaret L., Vikery and Brian Vikery, Oxford Washington DC.
5. Plant Cell Culture Technology, M.M. Yeoman, John Wiley & Sons, New York

MPH2.7 F: SEMINAR / ASSIGNMENT (0-0-3)

MPH2.8 F. COMPREHENSIVE VIVA (0-0-0)