Institute of Pharmaceutical Sciences
Kurukshetra University, Kurukshetra
Scheme of Examinations
M. Pharmacy
Annual scheme (2016-2017)
Specialization: Pharmaceutics

Paper Code	Subject	Hours/Week	Sessional Examination Marks	Final Examination Marks	Max. Marks	Exam Hours
M. Pharm –I						
MPH-1.1	Modern Analytical and Biostatistical Techniques	4	50	100	150	3
MPH-1.2	Modern Analytical and Biostatistical Techniques Practical	6	50	100	150	6
MPH-1.3	Pharmaceutics - I (Product Development and Quality Assurance)	4	50	100	150	3
MPH-1.5	Pharmaceutics -II (Advanced Pharmaceutics)	4	50	100	150	3
MPH-1.7	Pharmaceutics - III (Advances in Drug Delivery Systems)	4	50	100	150	3
MPH–1.4	Pharmaceutics Practical –I	6	50	100	150	6
MPH-1.6	Pharmaceutics Practical – II	6	50	100	150	6
	Total	**34**	**350**	**700**	**: 1050**	
M. Pharm - II						
Progressive Seminar / Presentation			**100**	**----**	**100**	
Dissertation Evaluation			**----**	**100**		
Seminar- cum-Viva-Voce			----	150	**250**	
					Grand Total: 1400	

Institute of Pharmaceutical Sciences
Kurukshetra University, Kurukshetra
Scheme of Examinations
M. Pharmacy
Annual scheme (2016-2017)
Specialization: Pharmaceutical Chemistry

Paper Code	Subject	Hours/Week	Sessional Examination Marks	Final Examination Marks	Max. Marks	Exam Hours
M. Pharm –I						
MPH-1.1	Modern Analytical and Biostatistical Techniques	4	50	100	150	3
MPH-1.2	Modern Analytical and Biostatistical Techniques Practical	6	50	100	150	6
MPH-2.3	Pharmaceutical Chemistry –I **(Advanced Organic Chemistry And Analytical Techniques)**	4	50	100	150	3
MPH-2.5	Pharmaceutical Chemistry II **(Advanced Natural Products Chemistry)**	4	50	100	150	3
MPH-2.7	Pharmaceutical Chemistry – III **(Advanced Medicinal Chemistry And Drug Design)**	4	50	100	150	3
MPH–2.4	Pharmaceutical Chemistry Practical –I	6	50	100	150	6
MPH-2.6	Pharmaceutical Chemistry Practical – II	6	50	100	150	6
	Total	**34**	**350**	**700**	**: 1050**	
M. Pharm - II						
Progressive Seminar / Presentation			**100**	**----**	**100**	
Dissertation Evaluation			**----**	**100**		
Seminar- cum-Viva-Voce			----	150	**250**	
					Grand Total: 1400	

Institute of Pharmaceutical Sciences
Kurukshetra University, Kurukshetra
Scheme of Examinations
M. Pharmacy
Annual scheme (2016-2017)
Specialization: Pharmacology

Paper Code	Subject	Hours/Week	Sessional Examination Marks		Final Examination Marks	Max. Marks	Exam Hours
M. Pharm –I							
MPH-1.1	Modern Analytical and Biostatistical Technique	4	50		100	150	3
MPH-1.2	Modern Analytical and Biostatistical Technique Practical	6	50		100	150	6
MPH-3.3	Pharmacology-I (Drug Discovery & Recent Advances In Pharmacology)	4	50		100	150	3
MPH-3.5	Pharmacology-I I (Clinical Pharmacology & Pharmacotherapeutics)	4	50		100	150	3
MPH-3.7	Pharmacology-I II (Drug Evaluation Techniques & Molecular Pharmacology)	4	50		100	150	3
MPH–3.4	Pharmacology Practical –I	6	50		100	150	6
MPH-3.6	Pharmacology Practical – II	6	50		100	150	6
	Total	**34**	**350**		**700**	**: 1050**	
M. Pharm - II							
Progressive Seminar / Presentation			**100**		**----**	**100**	
Dissertation Evaluation				**----**	**100**		
Seminar- cum-Viva-Voce				----	150	**250**	
						Grand Total: 1400	

Institute of Pharmaceutical Sciences, Kurukshetra University, Kurukshetra

Scheme of Examinations

M. Pharmacy

Annual scheme (2016-2017)

Specialization: Pharmacognosy

Paper Code	Subject	Hours/Week	Sessional Examination Marks	Final Examination Marks	Max. Marks	Exam Hours
M. Pharm –I						
MPH-1.1	Modern Analytical and Biostatistical Techniques	4	50	100	150	3
MPH-1.2	Modern Analytical and Biostatistical Techniques Practical	6	50	100	150	6
MPH-4.3	Pharmacognosy-I (Advanced Pharmacognosy)	4	50	100	150	3
MPH-4.5	Pharmacognosy-II (Extraction, Isolation And Standarization Of Herbal Drugs)	4	50	100	150	3
MPH-4.7	Pharmacognosy -III (Characterization And Formulation Of Herbal Drugs)	4	50	100	150	3
MPH–4.4	Pharmacognosy Practical –I	6	50	100	150	6
MPH-4.6	Pharmacognosy Practical – II	6	50	100	150	6
	Total	**34**	**350**	**700**	**: 1050**	
M. Pharm - II						
Progressive Seminar / Presentation			**100**	**----**	**100**	
Dissertation Evaluation			**----**	**100**		
Seminar- cum-Viva-Voce			----	150	**250**	
					Grand Total: 1400	

INSTITUTE OF PHARMACEUTICAL SCIENCES, KURUKSHETRA UNIVERSITY, KURUKSHETRA

Syllabus: M. Pharm. Part-I

MPH – 1.1 MODERN ANALYTICAL AND BIOSTATISTICAL TECHNIQUES

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. **Infrared Spectroscopy** (8h)

   Introduction, the infrared absorption process, the modes of vibrations, bond properties and absorption trends, instrumentation techniques, radiation source, detectors, sample handling, quantitative and qualitative applications. The Hook's law, stretching frequencies and their bond strengths, coupled interactions, hydrogen bonding, examination of infrared spectrum, functional groups with examples, with reference to stereochemical aspects and hydrogen bonding. Near-IR spectroscopy, reflectance spectrophotometry, Far Infrared spectroscopy, FTIR and its applications.

2. **Ultraviolet Spectroscopy** (8h)

   Introduction, the nature of electronic excitation, the origin of uv band structure, principle of absorption spectroscopy, chromophore - $\sigma \rightarrow \sigma^*$, $\eta \rightarrow \sigma^*$, $\pi \rightarrow \pi^*$ transitions, basics of instrumentation techniques, pharmaceutical applications. Energy level and selection rules, effect of substituents, effect of conjugation, conformation and geometry, the Woodward-Fisher rules, the Fisher-Kuhn rules. Derivative spectroscopy and its applications.

3. **Nuclear Magnetic Resonance Spectroscopy** (8h)

   Introduction, nuclear spin states, nuclear magnetic moments, absorption of energy, the mechanism of resonance, chemical equivalence, spin-spin coupling, basics of instrumentation techniques, pharmaceutical applications.

4. **X-Ray Spectroscopy** (8h)

   Introduction, production and properties of the X-ray, X-ray emission, X-ray absorption, principles of X-ray diffraction, powder diffraction, X-ray diffraction methods, application of X-ray diffraction technique in pharmaceutical sciences.

5. **Thermal Analysis** (8h)

   Introduction to various thermal methods of analysis, basic principles and theory, instrumentation and pharmaceutical applications of thermo gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) and microcalorimetry.

6. **Biological evaluation methods** (8h)

   Models for screening of anti-inflammatory, analgesic, anti-convulsant, antioxidant, antimalarial, antioxidant, antimicrobial and anti-diabetic activity.

7. **Preformulation studies** (8h)

   Significance and parameters, chemical stability studies and concept of prodrug.

8. **Medicinal plants Extraction techniques** (10h)

Introduction to novel methods of extraction such as solid phase micro-extraction,supercritical fluid extraction, Microwave-assisted extraction, Ultrasonic-assisted extraction and comparison with Conventional extraction methods.

9. **Research methodology** (8h)

Introduction, Roles and responsibilities, Choosing a subject, Making a good plan, Selecting and studying literature, Extracting information from the selected literature, Terminology, Writing: outline, summary, draft, final thesis.

10. **Biostatistics** (6h)

General concepts, two-tail student t-test and paired sample t-test, two samples t-test, Wilcoxon rank-sum test, Mann-Whitney test, one-way analysis of variance, Kruskal-Wallis test, two-way analysis of variance, multiple comparison procedures in ANOVA: Fischer's LSD test, Tukey's studentized range test and Dunnett's test. Non-linear regression: Introduction, iterative method. Correlation, linear regression, PCA and PLS.

11. **Intellectual property rights (IPR)** (10h)

Economic importance, mechanism for protection of intellectual property - patents, copyright, trademarks; role of IP in pharmaceutical industry; global ramifications and financial implications.

Intellectual property and international trade, concept behind WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIPs (Trade Related Intellectual Property Rights),TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services), status in India and other developing countries, case studies and examples, TRIPS issues on herbal drugs.

12. **Patenting** (10h)

Copyright and trade mark protection, criteria for patentability, Indian patent act. 1970: WTO and modifications under TRIPS, filing of a patent application, precautions -disclosures/non-disclosures, publication-article/ thesis, prior art search – published patents search, internet search patent sites, specialized service search requests, costs, patent application forms and guidelines, fee structure, time frames, jurisdiction aspects, types of patent application - provisional, nonprovisional, PCT and convention patent applications, international patenting requirement procedures and costs. Patent infringement: Trademarks legislation and registration system in India.

MPH 1.2: MODERN ANALYTICAL AND BIOSTATISTICAL TECHNIQUES PRACTICAL

6 Hours/week **Max. Marks: 100**

Modern experiments having relevance to the topics covered under theory including:

1. Simultaneous estimation of Paracetamol and Ibuprofen: Aspirin and Caffeine ; Rifampicin and Isoniazid or other combination formulation (4 expts).
2. UV-Visible spectrum scanning of certain organic cornpounds – absorption and correlation of structures and comparison e.g., Chloramphenicol, Analgin, Sulphadiazine, Ibuprofen
3. Exercises on interpretation of at least 5-different known compounds of Natural origin by using spectroscopic data (UV, IR, NMR & MASS)
4. Workshop on spectroscopy structural elucidation of at least a unknown compound.

5. Effect of pH and solvent on U.V. Spectrum of certain drugs.

Reading Material Recommended

1. Indian Pharmacopoeia, Central Indian Pharmacopoeia Laboratory, Govt. of India, Ministry of Health & Family Welfare, Ghaziabad, Latest Edition.
2. U. S. Pharmacopoeia – NF, The United States Pharmacopoeial Convention, Rockville, USA, Latest Edition.
3. European Pharmacopoeia, Directorate for the Quality of Medicines of the Council of Europe (EDQM), Strasbourg, Europe, Latest Edition.
4. British Pharmacopoeia, The Stationary Office on behalf of the Medicine Health Care Product Regulatory Agency (MHRA), London, Latest Edition.
5. Mendham J, Denney RC, Barnes JD and Thomas M. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Education Limited, Singapore. Latest Edition.
6. Treece DJ. Managing Intellectual Capital: Organizational, Strategic and Policy Dimension. Oxford University Press, England. Latest Edition.
7. Wadedhra BL. Law Relating to Patents, Trademarks, Copyright Design and Geographical Indications. Universal Law Publishing, New Delhi. Latest Edition.
8. Bansal P. IPR Handbook for Pharma Students and Researchers, Pharma Book Syndicate, Hyderabad. Latest Edition.
9. Trivedi PR. Encylcopedia of Intellectual Property Rights. Jnanada Prakashan, New Delhi. Latest Edition.
10. Arya P. P. and Yashpal, Research Methodology in Management, Deep and Deep publications Private Limited, New Delhi.
11 Green and Tull : A research for marketing research decisions, PHI (P) Ltd. New Delhi.
12. Karishna Swami, Shiva Kumar & Mathirajan, Management Research Methodology, Pearson Education.
13 Hooda, R P, Statistics for Business and Economics, MacMillan India Limited, New Delhi.
14 Heinz, Kohler: Statistics for business and Economics, Harper Collins.
15. Lawrence B Morse: Statistics for business and economics, Harper Collins.
16. Silverstein RM and Webster FX. Spectrometric Identification of Organic Compounds. John Wiley and Sons, New York. Latest Edition.
17. Pavia DL, Lampman GM and Kriz GS. Introduction to Spectroscopy. Harcourt College Publishers, Orlando. Latest Edition.
18. Vogel HG and Vogel WH. Drug Discovery and Evaluation. Springer-Verlag, Berlin. Latest Edition.
19. Kulkarni SK. Handbook of Experimental Pharmacology. Vallabh Prakashan, New Delhi. Latest Edition.
20. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata. Latest Edition.

MPH -1.3: PHARMACEUTICS-I
(PRODUCT DEVELOPMENT & QUALITY ASSURANCE)
4 Hours/week **Max. Marks: 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. **Preformulation** (08 h)

Objectives, methodology, physicochemical parameters *viz.* pKa and solubility, partition coefficient, effect of various variants like temperature, pH etc. on partition coefficient, log P values estimation, polymorphism, surface characteristics, compatibility tests, applications of solubility parameters in the development of solid, oral liquid and parenteral dosage forms.

2. **Pilot plant scale up techniques** (08 h)

Significance, scale-up techniques for tablets, capsules and liquid orals involving specific considerations e.g. formula, equipment, product uniformity, stability, processing, physical layouts, personnel required, legal and regulatory aspects.

3. **Production management and documentation** (12h)

GMP considerations, quality control, quality assurance, process control, total quality management and productivity, process and equipment validation for solid formulations and parenterals, validation of sterilization methods, basic principles of materials management and cost control, ISO- 9000 series, intellectual property rights, national and international patent procedures. ,,

4. **Optimization procedures in formulation & processing** (12 h)

Optimization parameters, advanced modern techniques, statistical design, Design of Experiments (DoE) using experimental designs, response surface methodology, basics of factorial, composite and mixture designs with merits and limitations, strategy for DoE optimization, applications of systematic optimization techniques. .

5. **Drug stability** (10 h)

Shelf-life determination, overages, accelerated stability testing, ICH guidelines, packaging influence on stability, factors affecting stability of pharmaceutical products.

6. **Solid Dosage forms** (16 h)

Theoretical and practical aspects in the manufacture and evaluation of following dosage forms:

a) Tablets: Type of tablets, formulation of tablets, granulation techniques, recent advances in granulation technology, equipments and processes involved in granulation, tabletting machinery employed for production of single-layer, multi layer, compression coated, inlay tablets and lozenges and tablet tooling. Coating of tablet: Coating processes, advances in coating technology and evaluation of coatings.Quality control of tablets.

b) Capsules: Advantages and applications, recent advances in capsule technology, formulation and large scale production of hard and soft gelatin capsules, Quality control of capsules.

7. Disperse systems (08 h)
General consideration and recent advances in disperse system technology with main emphasis on pharmaceutical suspensions and emulsions, formulation, stabilization and large scale production of pharmaceutical suspensions and emulsions. Quality control of disperse systems.

8. Semisolid dosage forms (08 h)
General considerations, recent developments, formulation and large scale production of various types of semi solid dosage forms, factors affecting release of drugs from semisolid dosage forms. Quality control of semisolid dosage forms.

9. Parenterals: (18h)
Detailed study of the following sterile product, technological aspects, including recent advancements:

(a) History of parenteral medication, development and packaging of parenterals, types of preparations. Vehicles and added substances for parenterals, sterile suspensions and ophthalmic solutions.

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(b) Environmental control, personnel, packaging components, product preparation, control and labeling.

(c) Parenteral admixtures and incompatibilities. Fundamentals of fluid and electrolyte therapy. Radiopharmaceuticals used in parenterals. Parenteral devices such as syringes, cannula, catheters, hazards associated with parenteral therapy.

RECOMMENDED READINGS:

1. Theory and Practice of Industrial Pharmacy - Lachman, L. and Liberman, H.A. 3rd ed., Varghese Publishing House, Bombay.
2. Pharmaceutical Dosage Forms - Tablets, Vols. - I, II and III - Lachman, L. and Liberman, H.A. 2nd ed., Revised and Expanded, Marcel Dekker, Inc.
3. Modern Pharmaceutics - Banker, G.S. and Rhodes 4th ed.,Marcel Dekker, Inc.
4. Physical Pharmacy - Martin, A., 4th ed.; Lippincott Williams and Wilkins.
5. Bentley's Textbook of Pharmaceutics -:- Rawlins, E.A., All India Traveller Book seller, New Delhi.
6. Pharmaceutical Dosage Forms and Drug Delivery Systems – Ansel, 8th ed., Lippincott Williams and Wilkins.
7. The Science and Practice of Pharmacy. Remington, 20th ed., Lippincott Williams and Wilkins.
8. Encyclopedia of Pharmaceutical Technology- Swarbrick and Boylan 2nd ed. Marcel Dekker, Inc.
9. Pharmaceutical Dosage Forms-Parenteral Medications-Vol. - I, II and III Avis K.E., Lachman L. and Lieberman H.A, 2nd ed. , Revised and Expanded, Marcel Dekker, Inc.
10. Wells J.I. Pharmaceutical Prefomulation: The Physicochemical Properties of Drug Substances Ellis Horwood, Chiechester, U. K. Latest Edition.
11. Carstensen J.T. Drug Stability: Principles and Practices. Marcel Dekker, New York. Latest

Edition.

MPH – 1.5: PHARMACEUTICS-II (ADVANCED PHARMACEUTICS)

4 Hours/week **Max. Marks: 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

(A) A detailed study of the cosmetic preparations/regulatory standards/safety testing of cosmetics,

including recent advancements:

1. **Raw materials used for cosmetic preparation**: (06 h)

   Detailed knowledge of various raw materials used in cosmetic industry like surfactants, humectants, cream bases, perfumes, colours etc.

2. **Cosmeceuticals:** (04 h)

   Cosmeceutical actives, application of cosmeceuticals.

3. **Hair care products (08h)** Introduction, hair structure, shampoos, conditioners, styling aids, setting lotion, hair creams, bleaches and hair dyes.

4. **Skin care products**: (08 h)

   Introduction, anatomy and physiology of skin, formulation of skin cleaners, moisturizers, sunscreen products and acne products.

5. **Colour cosmetics:** (06 h)

   Introduction, lip colour, nail polish, face make up and eye make-up.

6. **Dental products**: (05 h)

   Dentrifices, oral rinses, tooth powder and tooth paste.

7. **Herbal cosmetics**: (06 h)

   Formulation development and evaluation.

8. **Regulatory requirements**: (07 h)

   Legal/ Regulatory standards/systems governing cosmetic products- Indian: BIS standards and International - U.S.A

9. **Safety testing of cosmetic products**: (08 h)

   Various microbial contaminants in cosmetic products, selection criteria for preservatives, Efficacy and safety testing of preservatives in cosmetic products, stability evaluation of cosmetic products.

(B) A detailed study of the following pharmaceutical packaging materials/containers/machines, including recent advancements:

1. Glass and plastic containers for pharmaceuticals: types, their manufacture, basic steps in container design and development, chemical performance, testing and biological toxicity. Flexible packaging and type of films.(08h)

2. Paper and paper board: Types of paper, folding cartons, quality control testing of paper and paper board; Corrugated boxes. (05 h)
3. Metal container: Aluminium and tin-plated drums, collapsible tubes and aerosol containers. (lacquering, coating and lining). (05 h)
4. Caps and closures: Various types of closures, child-resistant caps, emphasis on elastometric closure for parenterals, methods of evaluation of closures. (06h)

5. Labels and labeling: Types of labels, adhesives, bar-coding, legal requirements of labeling, new developments in labeling technologies. (04h)

6. Pharmaceutical packaging machinery including strip packaging, blister packaging, and pouch packaging machinery. (06 h)

7. Pharmaceutical product-package compatibility, packaging selection, Tamper evident packaging. (04 h)

8. Environmental considerations of packaging materials along with national and international regulations. (04 h)

RECOMMENDED READINGS

1. Handbook of cosmetic science and technology-Knowlton, J. and Rearce, S.
2. Harry's Cosmetology- Wilkinson, J.B. and Moore, R.J.
3. Modern cosmetics-Thomssen, E.G.
4. Cosmetic Technology- Nanda, A. and Khar, R.K.
5. Cosmetic Ingedients, their safety assessment- Elder,R.L.
6. Cosmetic Product Testing- Moskowitz , H.R.

7. The Theory & Practice of Industrial Pharmacy, 3rd edition, Leon Lachman, Herbert A. Lieberman, Joseph. L. Karig, Varghese Publishing House, Bombay.
8. Introduction to Pharmaceutical Dosage Forms, Hourared C. Ansel, 4th edition, Varghese Publishing, Bombay.
9. Quality control of Packaging Materials in the Pharmaceutical Industry, Kenneth Herburn, Marcel Dekker, Inc., New York.
10. E.A.Rawlins, Bentley's Textbook of Pharmaceutics, University Printing House, Oxford, 1998.
11. AI Brody & K S Marsh, "The Wiley Encyclopedia of Packaging Technology", John Wiley & Sons, New York.
12. T C KacChesney, "Packaging of Cosmetics and Toiletries", Newness- Butterworth, London.
13. "Remington' Pharmaceutical Sciences", Mack Publishing Co., P.A.

MPH-1.7: PHARMACEUTICS-III
(ADVANCES IN DRUG DELIVERY SYSTEMS)

4 Hours/week **Max. Marks: 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. **Fundamentals of Novel Drug Delivery:** (08h)

   Rationale of sustained/controlled release (CR), physicochemical and biological factors influencing design and performance of CR products. Theory of mass transfer: Fick's laws and their applications in drug release, Pharmacokinetic and Pharmacodynamic basis of novel drug delivery system.

2. **Oral Controlled Drug Delivery Systems** (07h)
   Oral systems based on dissolution, diffusion and other mechanism. pH control, ion exchange resins, gel diffusion, osmotic pumps.

3. **Mucosal Drug Delivery System:** (08 h)
   Mechanism of trasmucosal permeation, mucous membrane model, buccal, nasal, pulmonary drug delivery system.

4. **Ocular Drug Delivery Systems:** Classification, fabrication and applications of ocuserts. (05h)

5. **Parenteral Drug Delivery Systems:** (06 h)

   Biopharmaceutical considerations. Solutions, suspensions and emulsions. Implantable therapeutic systems.

6. **Transdermal Drug Delivery Systems:** (10 h)

   Drug absorption through skin, basic components of TDDS, types and techniques for development and evaluation. Iontophoresis and Sonophoresis, Drug permeation enhancers.

7. **Biochemical and Molecular Biology Approaches to CDDS:** (08 h)

   a) Microparticulate drug carriers- structural aspects, preparation, characterization and applications of microspheres.

   b) Monoclonal antibodies- preparation and applications.

8. **Colloidal and Supramolecular Delivery Systems** (20 h)

(a) Closed bilayered system: Historical background, structural aspects, preparation, characterization, evaluation and applications, specialized liposomes in drug targeting; Niosomes, pharmacosomes, aquasomes and solid lipid nanoparticles (SLNs).

(b) Multiple w/o/w emulsions as drug vehicles: Introduction, composition of the multiple emulsion and stability, influence of the nature of oil phase, methods for stabilizing w/o/w multiple emulsions.

(c) Microemulsions: Introduction, structure of microemulsions, solubilization and formulation of microemulsions, pharmaceutical applications of microemulsions.

9. **Protein and Peptide Drug Delivery** (10 h)

Considerations in the physiological delivery of therapeutic proteins: Carrier mediated transport of peptides and peptide analogues, problems associated with the delivery of protein and peptides, membrane barriers, delivery systems for protein and peptide drugs, enzyme and enzyme immobilization, recent trends in vaccine and vaccine delivery systems.

10. **Targeted Drug Delivery** (12 h)

Basic principles of drug targeting, Introduction to approaches for drug delivery with special reference to organ targeting (e.g. brain, tumor and lung).

11. **Herbal Product Development** (06 h)

Background and present scenario, formulation considerations, major hurdles and challenges, future prospects.

RECOMMENDED READINGS

1. Novel Drug Delivery Systems – Chien, Y.W.
2. Controlled Drug Delivery Systems – Robinson, J.R. and Vincent, H.L.
3. Treatise on Controlled Drug Delivery – Kydoneus, A. (Ed.)
4. Targetted Therapeutic Systems – Tyle, P and Ram, B.P.
5. Microencapsulation – Deasy, P.B.
6. Transdermal Drug Delivery – Kydoneus, A.
7. Opthalmic Drug Delivery Systems – Mitra, A.K.
8. Controlled Drug Delivery. Vol. I (Basic Concepts) - Bruck S.D.
9. Controlled Drug Delivery. Vol. II (Clinical Applications) - Bruck S.D.
10. Targeted Therapeutic Systems, - Tyle P. and Ram B.

MPH-1.4: PHARMACEUTICS PRACTICAL-I

06 Hours/week **Max. Marks: 100**

Experiments having relevance to the topics covered under theory, MPH-1.3, MPH-1.5.

MPH-1.6: PHARMACEUTICS PRACTICAL-II

06 Hours/week **Max. Marks: 100**

Experiments having relevance to the topics covered under theory, MPH-1.7.

INSTITUTE OF PHARMACEUTICAL SCIENCES, KURUKSHETRA UNIVERSITY, KURUKSHETRA

Syllabus: M. Pharm. Part-I

MPH – 1.1 MODERN ANALYTICAL AND BIOSTATISTICAL TECHNIQUES

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. **Infrared Spectroscopy** (8h)

   Introduction, the infrared absorption process, the modes of vibrations, bond properties and absorption trends, instrumentation techniques, radiation source, detectors, sample handling, quantitative and qualitative applications. The Hook's law, stretching frequencies and their bond strengths, coupled interactions, hydrogen bonding, examination of infrared spectrum, functional groups with examples, with reference to stereochemical aspects and hydrogen bonding. Near-IR spectroscopy, reflectance spectrophotometry, Far Infrared spectroscopy, FTIR and its applications.

2. **Ultraviolet Spectroscopy** (8h)

   Introduction, the nature of electronic excitation, the origin of uv band structure, principle of absorption spectroscopy, chromophore - $\sigma \rightarrow \sigma^*$, $\eta \rightarrow \sigma^*$, $\pi \rightarrow \pi^*$ transitions, basics of instrumentation techniques, pharmaceutical applications. Energy level and selection rules, effect of substituents, effect of conjugation, conformation and geometry, the Woodward-Fisher rules, the Fisher-Kuhn rules. Derivative spectroscopy and its applications.

3. **Nuclear Magnetic Resonance Spectroscopy** (8h)

   Introduction, nuclear spin states, nuclear magnetic moments, absorption of energy, the mechanism of resonance, chemical equivalence, spin-spin coupling, basics of instrumentation techniques, pharmaceutical applications.

4. **X-Ray Spectroscopy** (8h)

   Introduction, production and properties of the X-ray, X-ray emission, X-ray absorption, principles of X-ray diffraction, powder diffraction, X-ray diffraction methods, application of X-ray diffraction technique in pharmaceutical sciences.

5. **Thermal Analysis** (8h)

   Introduction to various thermal methods of analysis, basic principles and theory, instrumentation and pharmaceutical applications of thermo gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) and microcalorimetry.

6. **Biological evaluation methods** (8h)

   Models for screening of anti-inflammatory, analgesic, anti-convulsant, antioxidant, antimalarial, antioxidant, antimicrobial and anti-diabetic activity.

7. **Preformulation studies** (8h)

Significance and parameters, chemical stability studies and concept of prodrug.

8. **Medicinal plants Extraction techniques** (10h)
   Introduction to novel methods of extraction such as solid phase micro-extraction,supercritical fluid extraction, Microwave-assisted extraction, Ultrasonic-assisted extraction and comparison with Conventional extraction methods.

9. **Research methodology** (8h)
   Introduction, Roles and responsibilities, Choosing a subject, Making a good plan, Selecting and studying literature, Extracting information from the selected literature, Terminology, Writing: outline, summary, draft, final thesis.
10. **Biostatistics** (6h)
    General concepts, two-tail student t-test and paired sample t-test, two samples t-test, Wilcoxon rank-sum test, Mann-Whitney test, one-way analysis of variance, Kruskal-Wallis test, two-way analysis of variance, multiple comparison procedures in ANOVA: Fischer's LSD test, Tukey's studentized range test and Dunnett's test. Non-linear regression: Introduction, iterative method. Correlation, linear regression, PCA and PLS.

11. **Intellectual property rights (IPR)** (10h)
    Economic importance, mechanism for protection of intellectual property - patents, copyright, trademarks; role of IP in pharmaceutical industry; global ramifications and financial implications.
    Intellectual property and international trade, concept behind WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIPs (Trade Related Intellectual Property Rights),TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services), status in India and other developing countries, case studies and examples, TRIPS issues on herbal drugs.
12. **Patenting** (10h)
    Copyright and trade mark protection, criteria for patentability, Indian patent act. 1970: WTO and modifications under TRIPS, filing of a patent application, precautions -disclosures/non-disclosures, publication-article/ thesis, prior art search – published patents search, internet search patent sites, specialized service search requests, costs, patent application forms and guidelines, fee structure, time frames, jurisdiction aspects, types of patent application - provisional, nonprovisional, PCT and convention patent applications, international patenting requirement procedures and costs. Patent infringement: Trademarks legislation and registration system in India.

MPH 1.2: MODERN ANALYTICAL AND BIOSTATISTICAL TECHNIQUES PRACTICAL

6 Hours/week **Max. Marks: 100**

Modern experiments having relevance to the topics covered under theory including:

1. Simultaneous estimation of Paracetamol and Ibuprofen: Aspirin and Caffeine ; Rifampicin and Isoniazid or other combination formulation (4 expts).
2. UV-Visible spectrum scanning of certain organic cornpounds – absorption and correlation of structures and comparison e.g., Chloramphenicol, Analgin, Sulphadiazine, Ibuprofen

3. Exercises on interpretation of at least 5-different known compounds of Natural origin by using spectroscopic data (UV, IR, NMR & MASS)
4. Workshop on spectroscopy structural elucidation of at least a unknown compound.
5. Effect of pH and solvent on U.V. Spectrum of certain drugs.

Reading Material Recommended

1. Indian Pharmacopoeia, Central Indian Pharmacopoeia Laboratory, Govt. of India, Ministry of Health & Family Welfare, Ghaziabad, Latest Edition.
2. U. S. Pharmacopoeia – NF, The United States Pharmacopoeial Convention, Rockville, USA, Latest Edition.
3. European Pharmacopoeia, Directorate for the Quality of Medicines of the Council of Europe (EDQM), Strasbourg, Europe, Latest Edition.
4. British Pharmacopoeia, The Stationary Office on behalf of the Medicine Health Care Product Regulatory Agency (MHRA), London, Latest Edition.
5. Mendham J, Denney RC, Barnes JD and Thomas M. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Education Limited, Singapore. Latest Edition.
6. Treece DJ. Managing Intellectual Capital: Organizational, Strategic and Policy Dimension. Oxford University Press, England. Latest Edition.
7. Wadedhra BL. Law Relating to Patents, Trademarks, Copyright Design and Geographical Indications. Universal Law Publishing, New Delhi. Latest Edition.
8. Bansal P. IPR Handbook for Pharma Students and Researchers, Pharma Book Syndicate, Hyderabad. Latest Edition.
9. Trivedi PR. Encylcopedia of Intellectual Property Rights. Jnanada Prakashan, New Delhi. Latest Edition.
10. Arya P. P. and Yashpal, Research Methodology in Management, Deep and Deep publications Private Limited, New Delhi.
11 Green and Tull : A research for marketing research decisions, PHI (P) Ltd. New Delhi.
12. Karishna Swami, Shiva Kumar & Mathirajan, Management Research Methodology, Pearson Education.
13 Hooda, R P, Statistics for Business and Economics, MacMillan India Limited, New Delhi.
14 Heinz, Kohler: Statistics for business and Economics, Harper Collins.
15. Lawrence B Morse: Statistics for business and economics, Harper Collins.
16. Silverstein RM and Webster FX. Spectrometric Identification of Organic Compounds. John Wiley and Sons, New York. Latest Edition.
17. Pavia DL, Lampman GM and Kriz GS. Introduction to Spectroscopy. Harcourt College Publishers, Orlando. Latest Edition.
18. Vogel HG and Vogel WH. Drug Discovery and Evaluation. Springer-Verlag, Berlin. Latest Edition.
19. Kulkarni SK. Handbook of Experimental Pharmacology. Vallabh Prakashan, New Delhi. Latest Edition.
20. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata. Latest Edition.

MPH – 2.3: PHARMACEUTICAL CHEMISTRY – I
(ADVANCED ORGANIC CHEMISTRY AND ANALYTICAL TECHNIQUES)
4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. Reactive intermediates in organic synthesis. (20h)

a) **Carbocations**: Formation, structure, stability and reactions of carbocations. Rearrangement reactions like, Wagner-Meerwein, Beckmann rearrangement and pinacol-pinacolone.

b) **Carbanions:** Formation, structure, stability and reactions of carbanions. Perkin, Claisen, Benzoin Aldol condensations, Cannizaro reaction, Neber rearrangement and Favorskii rearrangement.

c) **Free radicals**: Formation, structure, stability, detection, reactions involving free radicals, addition to carbon-carbon multiple bonds.

d) **Carbenes:** Formation, structure, stability and reactions of carbenes. Reimer-Tiemen reaction, Wolff rearrangement. Ring expansion reactions - conversion of pyrrole to pyridine.

2. Stereochemistry : (10h)

General concept of Stereoisomerism, axially dissymmetric molecules such as biphenyls and allenes. Stereochemistry of some elements other than carbon: elementary stereochemistry of Nitrogen Sulfur and Phosphorous compounds. Conformational analysis of cyclohexane, mono and disubstituted cyclohexanes, heterocycles such as tetrahydro-pyrans with special emphasis on monosaccharides, and piperidines.

3. Heterocyclic compounds: [15]

Nomenclature, molecular orbital picture and aromatic character, method of synthesis and important chemical reactions of Furan, Thiophene, Pyrrole, Pyridine. Introduction to condensed five and six-membered heterocycles. Preparation and chemical reactions including electrophilic substitution reaction of Indole, Quinoline and Isoquinoline

4. Organic Photochemistry: (09h)

Light absorption. Electronic transitions, Jablonski diagram. Intersystem crossing. Photosensitization. Excited states of ketones. α Cleavage, γ - hydrogen abstraction, di-pie methane rearrangement, Paterno-Buchii reaction and Photoreduction. Photochemistry of conjugated dienes and enones.

5. Name reactions; their mechanism and applications in drug synthesis (06h)

i) Witting
ii) Knorr Pyrazole synthesis
iii) Mannich
iv) Wolf Kishner reduction
v) Meerwein Ponndorf- verley
vi) Oppenauer oxidation

6. Design of synthesis: (12h)

An introduction of synthons and synthetic equivalents, general principles of the disconnection approach, functional group interconversions, the importance of order of events in organic synthesis, one group C-X and two group C-X, chemoselectivity, reversal of

polarity, use of nitro compounds in organic synthesis and concept of protection and deprotection of functional groups.

7. NMR: Nuclear Magnetic Resonance Spectroscopy (16h)

Introduction, nuclear spin states, nuclear magnetic moments, absorption of energy, the mechanism of resonance, basics of instrumentation techniques, Magnetic equivalence, failure of the N+1 rule, chemical shifts, local diamagnetic shielding, hybridization effects, magnetic anisotropy, mechanism of spin-spin coupling, the origin of spin-spin splitting, Pascal's triangle, the coupling constant, protons on oxygen, nitrogen and sulphur, diastereomeric protons, chemical shift reagents, long range coupling, spin decoupling methods, nuclear over Hauser effect. Correlation NMR spectrometry: introduction to ^{1}H -^{1}H cosy and ^{1}H - ^{13}C cosy and its applications. Introduction and applications of 2D NMR; solid state NMR. ^{13}C-NMR spectroscopy: Introduction, peak assignments, off resonance decoupling, selective proton decoupling; chemical shift equivalence; chemical shifts; spin coupling. Spectrometry of other important nuclei - Introduction to ^{15}N, ^{19}F, ^{31}P, basic concepts.

8. Mass Spectrometry (12h)

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

Reading Material Recommended

1. Jerry March's Advanced Organic Chemistry, Reactions, Mechanisms and Structure, 5th edition, M.B. Smith and Jerry March, John Wiley and Sons New York, U.S.A., 2001.
2. Stereochemistry of Carbon Compounds, reprint 14th edition, Ernest L. Eliel McGraw- hill Book Company Inc., New York, U.S.A., 1990.
3. Organic Photochemistry by William Horsepool. Reactive Intermediates by C.W. Rees.
4. S.P. Singh and S.M. Mukherji, Reaction Mechanism in Organic chemistry, The macmillian Company of India Limited, New Delhi, India.
5. Organic Chemistry Vol-II, by I.L. Finar Chapter II and IV. Some Modern Methods of Organic Synthesis, IIIrd edition, by W. Carruthers, 1993.
6. Chapter-1, 3 and 6. Organic Synthesis by M.B. Smith, McGraw International edition, 1994
7. Chapter 1,3,4 & 5. The Logic of Organic Synthesis by E.J. Corey and X.M. Cheng, John Wiley and Sons, 1989, Chapter 1 & 2. Principles of Organic Synthesis, R.O.C. Norman and J.M. Coxon, Chapmann and Hall, 1998.
8. Cycloadditions in Organic Synthesis by W.R Carruthers, Pergamon Press, London, 1990.
9. Classics in Total Synthesis by K.C. Nicolau and E.J. Sorensen, John Wiley, 1996.
10. Silverstein RM and Webster FX. Spectrometric Identification of Organic Compounds. John Wiley and Sons, New York. Latest Edition.
11. Chatten LG. Pharmaceutical Chemistry, Vol I & II. Marcel Dekker, New York. Latest Edition.
12. James WD and Kenneth HT. Analytical Chemistry by Open Learning: Thermal Methods. John wiley and Sons, New York. Latest Edition.

13. Abraham RJ, Fisher J and Bftus P. Introduction to NMR Spectroscopy. John Wiley and Sons, New York. Latest Edition.
14. Pavia DL, Lampman GM and Kriz GS. Introduction to Spectroscopy. Harcourt College Publishers, Orlando. Latest Edition.
15. UV and Visible Spectroscopy, Chemical Application-C.N. R. Rao.
16. Spectrometric identification of organic compound- Silverstein.
17. Spectrometric identification of organic compound- William Kemp
18. Chemical application of IR spectroscopy - C.N.R. Rao.
19. Interpretation of Mass Spectra of organic compounds-B. Kienicz, C. Djerassi.
20. Application of NMR Spectra to Organic Chemistry-Jackmann.
21. Instrumental Methods of Analysis- Willard.
22. Applications of Absorption spectroscopy of organic compounds - John R. Dyer.
23. Kasture, A.V. Mahadik, K.R. Wadodkar , S.G. and More, H.N. (2004). Pharmaceutical analysis Vol-II Instrumental methods. Nirali Prakashan.

MPH – 2.5: PHARMACEUTICAL CHEMISTRY – II

(ADVANCED NATURAL PRODUCTS CHEMISTRY)

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. General introduction and classification, isolation and purification methods of alkaloids, structure elucidation of atroipine, reserpine, morphine. (12 h)
2. Study of chemistry, stereochemical aspects and pharmaceutical importance of plant derived steroids -cardiac glycosides (cholesterol, diosgenin). (10 h)
3. Recent advances in the chemistry of naturally occurring anti-neoplastic agents (catharanthus alkaloids, camptothecin); antimalarials (cinchona alkaloids, artemisinin derivatives). (10 h)
4. General introduction and classification terpenoids; Essential Oils; Production of Essential Oils ; Chemistry and Analysis of Essential Oils ; Biological Activities of Essential Oils ; Aromatherapy with Essential Oils ; Industrial Uses of Essential Oils, Essential Oils Used in Veterinary Medicine. (12 h)
5. Amino acids and peptides, nucleic acids: General introduction, synthesis, degradative and synthetic approaches supported by spectral data of peptides and amino acids. End group analysis, structural features of Insulin, vasopressin and oxytocin, structural features of DNA & RNA. (12 hrs)
6. Vitamins - Introduction and Chemistry and biological utility of Vitamine A, E and K. Synthesis of Riboflavin, Pyridoxine, vitamin C, Niacin. (10 h)
7. Classification, method of isolation, chemistry, degradation, synthetic methods, spectral techniques for structural elucidation and biological activity of flavonoids rutin and quercetin. (10 h)
8. Marine products with therapeutic potential in drug discovery. (06 h)
9. Role of natural products in “Neglected Diseases” (dengue, protozoal diseases including leishmaniasis, trypanosomiasis, schistosomiasis, tuberculosis, leprosy). (07h)
10. Chromatography **(**11h)
    a. Gas Chromatography: Gas liquid chromatography, gas solid chromatography, instrumentation and applications (GC-MS and GC-FTIR). Derivatization as a means of sampling of thermosensitive compounds.

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

Reading Material Recommended

1. Cordell GA. Introduction to Alkaloids. John Wiley and Sons, New York. Latest Edition.
2. Fieser LF and Fieser M. Steroids. Reinhold Publishing Co., New York. Latest Edition.
3. Wickery ML and Wickery B. Secondary Plant Metabolism. Mcmillan Press Ltd. London. Latest Edition.
4. Torseel KBG. Natural Product Chemistry. John Wiley and Sons, New York. Latest Edition.
5. Harborne JB. Phytochemical Methods. Chapman and Hall, London. Latest Edition.
6. Finar IL. Organic Chemistry. The English Language Book Society, London. Latest Edition.
7. Wolff ME. Burger's Medicinal Chemistry and Drug Discovery, Principle and Practice. John Wiley and Sons, New York. Latest Edition.
8. Mitscher LA and Baker WR. A Search for Novel Chemotherapy Against Tuberculosis Amongst Natural Products. Pure and Applied Chemistry (1998) , Vol. 70, No.2, pp 365-371.
9. Wermuth CG. The Practice of Medicinal Chemistry. Academic Press, Jordon Hill, Oxford. Latest Edition.
10. Boldi AM. Combinatorial Synthesis of Natural Product Based Libraries. Taylor and Francis, London. Latest Edition.
11. Monographs and relevant review articles appearing in various periodicals and journ

MPH – 2.7: PHARMACEUTICAL CHEMISTRY – III
(ADVANCED MEDICINAL CHEMISTRY AND DRUG DESIGN)

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. **Drugs affecting Adrenergic neurotransmission**(14Hrs)
   a. Introduction, history and neurotransmission at sympathetic nervous system; biosynthesis and metabolism of NE; characterization of adrenergic receptor subtypes and mechanism. Structure activity relationship of adrenergic agonists and antagonists.
   b. Serotonin receptor and drugs affecting serotonergic neurotransmission.
2. **Chemotherapeutic agents** (14hrs)
   a. Introduction, history and development of resistance to known antibacterials such as penicillins. Bacterial DNA-gyrase inhibitors - mode of action of fluoro-quinolones and development of newer analogues: Trovafloxacin, Levofloxacin, Gratifloxacin including Ciprofloxacin and Norfloxacin, Oxazolidinones: Inhibitors of DNA Synthesis.
   b. Cancer and chemptherapy - Newer targets for anticancer therapy, Topoisomerase inihibitors etc: Tumor necrosis factor converting enzyme (TACE) inhibitors. Anti cancer drugs for crossing BBB.
3. **Drugs affecting the Cardiovascular system (**18Hrs)
   a. Anti-hypertensives: Designing of ACE & AT1 inhibitors – Captopril, Enalapril, Enalprilat, Lisinpril, Losartan.
   b. β-blockers, α-blockers and α,β-blockers – Atenolol, Metprolol and analogues, Carvedilol, Prazocin, Trazocin, Labetelol

c. Calcium Channel blockers: 1,4-dihydropyridines (Nifedipine, Nimodipine, Nicardipine), Verapamil, Diltiazem.
d. Lipid lowering and anti-thrombotics, thrombolytics, antiplatelets and coagulants – Statins eg., Atorvastatin, Rosuvastatin; Aspirin, Lipitor, Gemfibriogel, abciximab, Probucol, Celcade, clopidgrel.
e. Selective human β3 adrenergic agonists used as antiobesity agents.
f. Anti – arrhythmic agents: Amidorane, Digoxin, Flecainide, Mexiletine, Tocainide, Lidocaine.

4. **Antiviral Agents (**8Hrs)
DNA and RNA viruses, retroviruses, strategies to design anti-HIV drugs, viral replication, anti-viral agents for RNA-virus infections, development of new drugs and drug discovery Diadanosine, Nevirapine.

5. **Psychopharmacological Agents (**10 Hrs)
Psychopharmacological agents : Antipsychotic Agents : Biochemical basis of mental disorders, Development of antipsychotic agents, tricyclic antidepressants, Monoamine oxidase inhibitors; Selective serotonin-reuptake inhibitors; Atypical antidepressants, Antianxiety Agents : Chemistry of benzodiazepines; SAR of benzodiazepine derivatives, medicinal chemistry of non-benzodiazepines; serotonin-reuptake inhibitors, development of meprobamate and analogues; atypical anxiolytic agents; including studies of various receptors - GABA, Dopamine, NMDA, Metabotropic glutamate, excitatory amino acid neurotransmitters

6. **Quantitative structure activity relationships** (9 Hrs)
Fundamentals of QSAR, Quantitative description of physico-chemical properties: hydrophobicity, partition coefficient, electronic effects, steric effects. Statistical methods in QSAR, Correlation of physicochemical parameters with biological activity: Hansch approach, Free Wilson analysis, Topliss decision tree. 3D QSAR approach, Limitations of QSAR.
7. **Molecular Modeling:** (9 Hrs)
Drawing chemical structures, conversion of 2D structures in 3D form, visualization of 3D structures, viewing proteins, geometry optimization, energy minimization procedures, molecular mechanics methods, quantum mechanics methods, molecular properties, conformational analysis, Pharmacophore concept, Pharmacophoric approach, Pharmacophore elements and representation, Pharmacophore identification, docking, homology modeling, currently used softwares for molecular modeling.
8. **Prodrug Design** (8 Hrs)
Concept, definition and characteristics of the prodrug, Prodrugs of various functional groups, design strategies for modification of drug properties, modification of the physicochemical, pharmacokinetic and pharmacodynamic properties of a drug through chemical transformation. Applications of the prodrug approach: increased absorption, aqueous solubility, prolongation of activity, site specific chemical delivery systems, mutual prodrugs. Hard and soft drugs.
9. **Rational Design of Enzymes Inhibitors** (10 Hrs)
Introduction, enzyme inhibitors in medicine and basic research: *Design of non-covalently binding enzymes inhibitors* and *covalently binding enzyme inhibitors*: Mechanism based

inhibitors, affinity labels and pseudo-irreversible inhibitors viz acetylcholinesterase, angiotensin converting enzyme, HMG CoA reductase.

Reading Material Recommended

1. Wolff ME. Burger's Medicinal Chemistry and Drug Discovery, Principle and Practice. John Wiley and Sons, New York. Latest Edition.
2. Alnley W and James EF. Martindale, The Extra Pharmacopoeia. Pharmaceutical Press,London. Latest Edition.
3. Nogrady T. Medicinal Chemistry, A Biochemical Approach. Oxford University Press,New York. Latest Edition.
4. Monographs and relevant review articles appearing in various periodicals and journals.
5. Franke R. Theoretical Drug Design Methods, Vol.VII. Elsevier, New York. LatestEdition.
6. C. H. Wermuth, "The Practice of Medicinal Chemistry", Academic Press, London, 1969, 264.
7. The Quinolones, 2nd edition, edited by V.T. Andriole. Academic Press, 1998
8. Cancer Chemotherapeutic Agents. Edited by W.O. Foye, American Chemical Society, 1995.
9. Introduction to the Principles of Drug Design and Drug Action, Edited by H.J. Smith, Taylor and Francis, 2006.
10. Manfred E Wolff, (ed), Burger's Medicinal Chemistry and Drug Discovery, Vol – I Principles and Practice, 5th Ed., Join Wiley and Sons, 1995.
11. J. G Vinter and Mark Gardner, (Eds.) Molecular Modelling and Drug Design, The Macmillan Press Ltd., London, U.K., 1994.
12. C. Hansch, A. Leo and D. Heokman, Exploring QSAR: Applications in Chemistry and Biology, ACS Professional Reference Book, American Chemical Society, Washington U.S.A., 1995.
13. Comprehensive Medicinal Chemistry, Pcrgamon press, 1990, Vol. 4. · Medicinal Chemistry for the 21st Century, Edited by C.G. Wermuth, Blackwell Scientific Publications, Oxford, 1992.
14. Pseudopeptides in Drug Discovery, Edited by P.E. Nielson, Wiley-VCH, 2004
15. Introduction to the Principles of Drug Design and Drug Action, Edited by H.J. Smith, Taylor and Francis, 2006.
16. The Organic Chemistry of Drug Design and Drug Action, 2nd edition, R.B.Silverman, Academic Press, 2006.
17. Molecular Modeling in Drug Design, Edited by N.C. Cohen, Elsevier, 2006

MPH 2.4: PHARMACEUTICAL CHEMISTRY PRACTICAL – I

06 Hours/week **Max. Marks: 100**

Modern experiments having relevance to the topics covered under theory of papers MPH –2.3, 2.5. Synthesis of some biologically active heterocyclic nuclei such as hydantoin, thiazolidinone, imidazolidinone, indole, phenyl urea, diphenyl urea, thio-hydantoin, benzofuran, benzimidazole, thiazolidindione, etc. and their characterization. Including identification of a binary mixture (including derivative formation).

MPH – 2.6: PHARMACEUTICAL CHEMISTRY PRACTICAL – II
06 Hours/week **Max. Marks – 100**

Multi-step Synthesis of Organic Medicinal Compounds their intermediates covered in theory MPH-2.7 with chromatographic purification and spectroscopic characterization viz sulfanilamide, para-aminobenzoic acid, anti-pyrine, benzocaine, methaqualone, phenytoin, uramil, saccharine, chloramine-T, dichloramine-T, PABA etc.

1. Determination of Ascorbic acid (Vitamin C) by UV. Spectroscopic method in crude drugs.
2. Determination of Hyoscymine/Hyoscine in Datura species by UV. Spectroscopic method.
3. Quantitative estimation of Reserpine in Rauwolfia serpentina by HPLC method.
4. Quantitative estimation of Quinine in Cinchona bark by HPLC method.
5. Exercises on Identification of simple molecules by UV, IR and NMR spectroscopy.
6. Extraction and isolation of pectin, starch, caffeine, piperine, solanine, aromatic oils, calcium citrate, solanine, casein, etc.
7. Practicals based on extraction and isolation of natural products using Hot continous soxhalation, preparative TLC, HPTLC.
8. Paper reading/seminar with respect to the latest developments in pharmaceutical chemistry, writing of papers, projects and reports. Skills in oral presentation/presenting research papers.

Reading Material Recommended

1. F.C. Mann and B.C. Saunders, Practical Organic Chemistry, orient Longman, 4th edition, New Delhi, India 1960
2. A.I. Vogal, A Text Book of Practical Organic Chemistry, 5th edition, The English Language Book Society and Longman Group Limited London, U.K. 1991.
3. R.M. Silverstein, G.C. Bassler and T.C. Morrill, Spectrometric Identificaion of Organic Compounds, 5th edition, John Wiley and sons, Inc., New York, U.S.A., 1991
4. E.L. Eliel, Sterochemistry of Carbon Compunds, Reprint 14th edition, Mc GrawHill Book Company, Inc., New York, U.S.A. 1990.

INSTITUTE OF PHARMACEUTICAL SCIENCES, KURUKSHETRA UNIVERSITY, KURUKSHETRA

Syllabus: M. Pharm. Part-I

MPH – 1.1 MODERN ANALYTICAL AND BIOSTATISTICAL TECHNIQUES

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. **Infrared Spectroscopy** (8h)

   Introduction, the infrared absorption process, the modes of vibrations, bond properties and absorption trends, instrumentation techniques, radiation source, detectors, sample handling, quantitative and qualitative applications. The Hook's law, stretching frequencies and their bond strengths, coupled interactions, hydrogen bonding, examination of infrared spectrum, functional groups with examples, with reference to stereochemical aspects and hydrogen bonding. Near-IR spectroscopy, reflectance spectrophotometry, Far Infrared spectroscopy, FTIR and its applications.

2. **Ultraviolet Spectroscopy** (8h)

   Introduction, the nature of electronic excitation, the origin of uv band structure, principle of absorption spectroscopy, chromophore - $\sigma \rightarrow \sigma^*$, $\eta \rightarrow \sigma^*$, $\pi \rightarrow \pi^*$ transitions, basics of instrumentation techniques, pharmaceutical applications. Energy level and selection rules, effect of substituents, effect of conjugation, conformation and geometry, the Woodward-Fisher rules, the Fisher-Kuhn rules. Derivative spectroscopy and its applications.

3. **Nuclear Magnetic Resonance Spectroscopy** (8h)

   Introduction, nuclear spin states, nuclear magnetic moments, absorption of energy, the mechanism of resonance, chemical equivalence, spin-spin coupling, basics of instrumentation techniques, pharmaceutical applications.

4. **X-Ray Spectroscopy** (8h)

   Introduction, production and properties of the X-ray, X-ray emission, X-ray absorption, principles of X-ray diffraction, powder diffraction, X-ray diffraction methods, application of X-ray diffraction technique in pharmaceutical sciences.

5. **Thermal Analysis** (8h)

   Introduction to various thermal methods of analysis, basic principles and theory, instrumentation and pharmaceutical applications of thermo gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) and microcalorimetry.

6. **Biological evaluation methods** (8h)

   Models for screening of anti-inflammatory, analgesic, anti-convulsant, antioxidant, antimalarial, antioxidant, antimicrobial and anti-diabetic activity.

7. **Preformulation studies** (8h)

   Significance and parameters, chemical stability studies and concept of prodrug.

8. **Medicinal plants Extraction techniques** (10h)

Introduction to novel methods of extraction such as solid phase micro-extraction,supercritical fluid extraction, Microwave-assisted extraction, Ultrasonic-assisted extraction and comparison with Conventional extraction methods.

9. **Research methodology** (8h)

Introduction, Roles and responsibilities, Choosing a subject, Making a good plan, Selecting and studying literature, Extracting information from the selected literature, Terminology, Writing: outline, summary, draft, final thesis.

10. **Biostatistics** (6h)

General concepts, two-tail student t-test and paired sample t-test, two samples t-test, Wilcoxon rank-sum test, Mann-Whitney test, one-way analysis of variance, Kruskal-Wallis test, two-way analysis of variance, multiple comparison procedures in ANOVA: Fischer's LSD test, Tukey's studentized range test and Dunnett's test. Non-linear regression: Introduction, iterative method. Correlation, linear regression, PCA and PLS.

11. **Intellectual property rights (IPR)** (10h)

Economic importance, mechanism for protection of intellectual property - patents, copyright, trademarks; role of IP in pharmaceutical industry; global ramifications and financial implications.

Intellectual property and international trade, concept behind WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIPs (Trade Related Intellectual Property Rights),TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services), status in India and other developing countries, case studies and examples, TRIPS issues on herbal drugs.

12. **Patenting** (10h)

Copyright and trade mark protection, criteria for patentability, Indian patent act. 1970: WTO and modifications under TRIPS, filing of a patent application, precautions -disclosures/non-disclosures, publication-article/ thesis, prior art search – published patents search, internet search patent sites, specialized service search requests, costs, patent application forms and guidelines, fee structure, time frames, jurisdiction aspects, types of patent application - provisional, nonprovisional, PCT and convention patent applications, international patenting requirement procedures and costs. Patent infringement: Trademarks legislation and registration system in India.

MPH 1.2: MODERN ANALYTICAL AND BIOSTATISTICAL TECHNIQUES PRACTICAL

6 Hours/week **Max. Marks: 100**

Modern experiments having relevance to the topics covered under theory including:

1. Simultaneous estimation of Paracetamol and Ibuprofen: Aspirin and Caffeine ; Rifampicin and Isoniazid or other combination formulation (4 expts).
2. UV-Visible spectrum scanning of certain organic cornpounds – absorption and correlation of structures and comparison e.g., Chloramphenicol, Analgin, Sulphadiazine, Ibuprofen
3. Exercises on interpretation of at least 5-different known compounds of Natural origin by using spectroscopic data (UV, IR, NMR & MASS)
4. Workshop on spectroscopy structural elucidation of at least a unknown compound.

5. Effect of pH and solvent on U.V. Spectrum of certain drugs.

Reading Material Recommended

1. Indian Pharmacopoeia, Central Indian Pharmacopoeia Laboratory, Govt. of India, Ministry of Health & Family Welfare, Ghaziabad, Latest Edition.
2. U. S. Pharmacopoeia – NF, The United States Pharmacopoeial Convention, Rockville, USA, Latest Edition.
3. European Pharmacopoeia, Directorate for the Quality of Medicines of the Council of Europe (EDQM), Strasbourg, Europe, Latest Edition.
4. British Pharmacopoeia, The Stationary Office on behalf of the Medicine Health Care Product Regulatory Agency (MHRA), London, Latest Edition.
5. Mendham J, Denney RC, Barnes JD and Thomas M. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Education Limited, Singapore. Latest Edition.
6. Treece DJ. Managing Intellectual Capital: Organizational, Strategic and Policy Dimension. Oxford University Press, England. Latest Edition.
7. Wadedhra BL. Law Relating to Patents, Trademarks, Copyright Design and Geographical Indications. Universal Law Publishing, New Delhi. Latest Edition.
8. Bansal P. IPR Handbook for Pharma Students and Researchers, Pharma Book Syndicate, Hyderabad. Latest Edition.
9. Trivedi PR. Encylcopedia of Intellectual Property Rights. Jnanada Prakashan, New Delhi. Latest Edition.
10. Arya P. P. and Yashpal, Research Methodology in Management, Deep and Deep publications Private Limited, New Delhi.
11 Green and Tull : A research for marketing research decisions, PHI (P) Ltd. New Delhi.
12. Karishna Swami, Shiva Kumar & Mathirajan, Management Research Methodology, Pearson Education.
13 Hooda, R P, Statistics for Business and Economics, MacMillan India Limited, New Delhi.
14 Heinz, Kohler: Statistics for business and Economics, Harper Collins.
15. Lawrence B Morse: Statistics for business and economics, Harper Collins.
16. Silverstein RM and Webster FX. Spectrometric Identification of Organic Compounds. John Wiley and Sons, New York. Latest Edition.
17. Pavia DL, Lampman GM and Kriz GS. Introduction to Spectroscopy. Harcourt College Publishers, Orlando. Latest Edition.
18. Vogel HG and Vogel WH. Drug Discovery and Evaluation. Springer-Verlag, Berlin. Latest Edition.
19. Kulkarni SK. Handbook of Experimental Pharmacology. Vallabh Prakashan, New Delhi. Latest Edition.
20. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata. Latest Edition.

MPH – 3.3: PHARMACOLOGY-I

(DRUG DISCOVERY & RECENT ADVANCES IN PHARMACOLOGY)

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. Introduction to Drug Discovery (4h)

Sources of drugs (plants, animals, microorganisms, drugs from organic synthesis), existing drugs as a source of new drug, lead identification and optimization.

2. Preclinical Studies and Drug Development (10h)

Stages of drug discovery, pre-clinical and safety evaluation, acute, sub-acute, chronic studies, in-vivo and in-vitro studies (behavioral, biochemical, neurochemical models) and special studies including carcinogenicity, mutagenicity, teratogenicity.

3. Novel Drug Targets for Drug Discovery (12h)

Exploration and investigation of therapeutic drug targets as enzymes, receptors, genes, platelets and matrix metalloproteases for drug design.

4. Toxicology (14h)

Concept, development and scope of toxicology, behavioural and neurotoxicity, teratology, endotoxin, pesticides, cardiac, hepatic, renal and pulmonary toxicity. Industrial, environmental and forensic toxicology, clinical toxicology, principles and management of different types of poisoning.

5. Immunotherapy (16h)

Introduction to immune system, cellular and humoral immunity, complement, antigen- antibody interactions, immunity to bacteria, virus, protozoa, and fungi, immunomodulators and immunosuppressants and their use in autoimmune disorders, principles and development of vaccines against different diseases.

6. Pharmacological and clinical implications of Endogenous bioactive molecules (16h)

Such as cytokinines, neuropeptide and their modulators, neurosteroids, nitric oxide, phosphodiesterase enzymes and protein kinase C, arachidonic acid metabolites, Platelet Activating Factor, Cyclo-oxygenase 1 and 2 regulators and their role in inflammation, reactive oxygen intermediates, antioxidants and their therapeutic applications.

7. Pharmacology of Receptors: (15h)

Classification, cellular signaling systems, pharmacology of agonists and antagonists of the following receptor types:

i) Adrenoceptors
ii) Cholinergic
iii) Serotonin receptors
iv) Dopamine receptors
v) GABA and benzodiazepine receptors
vi) Histamine receptors
vii) Excitatory amino acid receptors

viii) Angiotensin receptors
ix) Cannabinoid receptors
x) Opoid receptor
xiii) Glutamate Receptor

8. **Ion Channels and their modulators:** (13h)

Classification and biology of ionic channels, pharmacology of substances which modulate the following cannels:

i) Calcium channels
ii) Potassium channels
iii) Sodium channels

RECOMMENDED READINGS:

1) Annual reviews of Pharmacology and Toxicology
2) Annual reviews of Medicine
3) Trends in Pharmacological Sciences
4) Trends in Biochemical Sciences
5) Advances in Pharmacology
6) Advances in Drug Therapy
7) Drug Discovery Today
8) Receptor-based drug design, Paul Left, Marcel Dekker, Inc.
9) Drug Receptors & their Effectors
Edited by Nigel, J.M. Birdsall, MC Millan Publishers Ltd.
10) Receptor Classification :
The Integration of Operational, structural and Transductional Information.
D.G.Trist, P.P.A. Humphery, P.Left; N.P.Shankley- New York Academy of Sciences
11) Text Book of Receptor Pharmacology John C. Foreman,Torben Johansen

MPH – 3.5: PHARMACOLOGY-II

(CLINICAL PHARMACOLOGY & PHARMACOTHERAPEUTICS)

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. Introduction to Clinical Pharmacology (12 **h)**

Definition, scope and development of clinical pharmacology, role of pharmacist in healthcare system, prescription monitoring and rational use of drugs, essential drugs and national drug policy, pharmacoepidemiology, pharmacovigilance, patient counselling, medication errors and drug information systems.Clinical pharmacokinetics, racial and ethnic differences in response to drugs**.**

2. Drugs affecting nervous system (12 h)

A) **ANS:** Parasympathomimetics, Parasympatholytics, sympathomimetics, sympatholytics, ganglion and neuromuscular blockers.

A) CNS: Pathophysiology and drug therapy of epilepsy, anxiety, depression, schizophrenia and Parkinson's disease.

3. Drug Therapy of following Disorders (19h)

A) CVS: Hypertension, congestive heart failure, angina, cardiac arrhythmias and hyperlipidemia.

B) GIT: Peptic ulcers, emesis, diarrhoea and constipation**.**

C) ENDOCRINE: diabetes mellitus, oral contraceptives, drugs affecting uterine motility**.**

D) **RESPIRATORY:** Asthma.

E) **INFLAMMATORY:** Rheumatoid arthritis and gout

4. Antineoplastic agents: Pharmacology of anticancer agents.(4**h)**

5. Chemotherapy: (17h)

General principles of chemotherapy, penicillins, cephalosporins, aminoglycosides, tetracyclines, macrolides, sulfonamides and fluorquinolones.

Drug therapy of tuberculosis, leprosy, urinary tract infections, sexually transmitted diseases, viral diseases, fungal diseases, malaria, amoebiasis and helminthiasis.

5. Drug Therapy in Specialized Patient Populations (14h)

- **Neonates:** Special childhood diseases and their management, national immunization programmes, relevant paediatric management issues as dosages adjustment, pharmacokinetics of development stage and compliance.
- **Geriatrics:** Pharmaceutical care plan based on age related physiological and pharmacokinetic / pharmacodynamic changes, compliance related issues.
- **Pregnancy and Lactation:** Guidelines and principles of drug therapy during pregnancy and lactation. Management of hypertension, diabetes, epilepsy during pregnancy.

6. Clinical Trials (18h)

- Requirements of clinical trials, Helsinki declaration, ethical and legal issues in clinical trials.
- Design (placebo, multicentre clinical trials, randomization, blinding) and different phases of clinical trials (Phase 1 to 4), principles of controlled clinical trials.
- Protocol designing, CRF, patient informed consent, patient enrolment, inclusion and exclusion criteria, withdrawals and drop out, run-in period.
- Clinical trial team, monitoring of clinical trial, report preparation, deviations in clinical trials.

7. Adverse Drug Reactions (4h)

Incidence, importance, surveillance and their monitoring, WHO ADR reporting programmes in India and drug interactions. Drug food interaction, Drug food-herb interaction.

Reading Material Recommended

1. Bennett PN and Brown MJ. Clinical Pharmacology. Churchill Livingstone, Edinburgh. Latest Edition.
2. Walker R and Edwards C. Clinical Pharmacy and Therapeutics. Churchill Livingstone, London. Latest Edition.
3. Shargel L, Mutnick AH, Souney PF and Swanson LN. Comprehensive Pharmacy Review. Wolters Kluwer Health / Lippincott William & Wilkins, New Delhi. Latest Edition.
4. Dipiro JT, Talbert RL, Yee GC, Matzke GR, Wells BG and Posey LM, Eds. Pharmacotherapy: A Pathophysiologic Approach. McGraw-Hill, New York. Latest Edition.
5. Laurence DR. Clinical Pharmacology. Churchill Livingstone, London. Latest Edition.

6. Goodman and Gilman's The Pharmacological Basis of Therapeutics, - McGraw- Hill Companies, Inc.
7. B.G. Katzung, Basic and Clinical Pharmacology, Prentice Hall, International.
8. D.R. Lawrence and P.N. Bennett, Clinical Pharmacology, Churchill Livingstone, U.K.
9. H.P. Rang and M.M. Dale, Pharmacology, ELBS/Churchill Livingstone.
10. J. T. Dipiro, R.L. Talbert, P.E. Hayers, G.C. Yee and L.M. Possy (eds), Pharmacotherapy: A Pathophysiological Approach, Appleton Lange, USA.

MPH – 3.7: PHARMACOLOGY-III
(DRUG EVALUATION TECHNIQUES & MOLECULAR PHARMACOLOGY)
4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. Principles of Experimental Pharmacology (10h)
Common laboratory animals in pharmacological research, limitations of animal tests, alternatives to animal use, anesthetics used in laboratory animals, euthanasia of experimental animals. CPCSEA guidelines for regulations for the care and use of laboratory animals.

2. Drug Discovery (13h)
Strategies and approaches employed in drug discovery. OECD guidelines for toxicological evaluation of new drug entities. High throughput screening, cell lines, and their application in drug discovery. Transgenic animal models in the development of new drugs.

3. Pharmacological Techniques to evaluate the following Class of Drugs (40h)
1. Antihypertensive agents
2. Antiepileptics
3. Antiparkinsonian agents
4. Antianxiety agents and drugs used in mood and sleep disorders
5. Antipsychotics
6. Drugs affecting memory
7. Drugs used in Alzheimer's disease
8. Local anesthetics
9. Skeletal muscle relaxants and neuromuscular blockers
10. Antidiabetic agents
11. Antifertility agents
12. Analgesics and drugs used in arthritis and neuropathic pain
13. Anti-inflammatory agents
14. Antiasthmatic agents
15. Antiulcer agents
16. Antiemetics
17. Drugs used in inflammatory bowel disease
18. Hepatoprotective agents
19. Antiobesity agents
20. Drugs used in erectile dysfunction
21. Antiviral agents
22. Antimalarial agents

23. Dermatological agents and experiment models in skin pharmacology

4. Introduction to Molecular Biology and molecular genetics (15 h)

1. Gene structure: Organization and elucidation of genetic code.
2. Gene expression: Expression systems (pro and eukaryotic), genetic elements that control gene expression
3. Protein synthesis: Mechanisms of protein synthesis, initiation in eukaryotes, translation control and post-translation events
4. Oncogenes and tumor suppressor genes.
5. **Cellular signaling system (**15 h)

   Receptor occupancy, communication between cells and their environment, role of G-proteins, cyclic nucleotides, calcium and phosphatidyl inositol in cell signaling system.

6. Apoptosis:

1. Pharmacological and clinical implication (7 h)

Recommended Readings:

1 Molecular Biology of the Cell by Alberts B., Bray, D., Lewis, J., Raff M., Roberts, K and Watson, JD, 3rd edition.
2 Molecular Cell Biology By Lodish, H., Baltimore, D., Berk, A et al., 5th edition
3 Molecular Biology by Turner, PC., McLennan, AG., Bates, AD and White MRH 2nd edition.
4 Genes VIII by Lewin, B., (2004)
5 Pharmaceutical Biotechnology, by Crommelin, DJA and Sindelar RD (1997)
6 Recombinant DNA by Watson, JD., Gilman, M., et al., (1996)
7 Biopharmaceutical: Biochemistry and Biotechnology by Walsh, G., (1998)
8 H.G. Vogel (ed), Drug Discovery and Evaluation-Pharmacological Assays, 2nd edition, Springer Verlag, Berlin, Germany, 2002.
9 M.N. Ghosh, Fundamentals of Experimental Pharmacology, 2nd edition, Scientific Book Agency, Calcutta, India, 1984.
10 D.R. Laurence and A.L. Bacharach (eds), Evaluation of Drug Activities: Pharmacometerics, Vol. 1 and 2, Academic Press, London, U.K., 1964.
11 David R. Gross, Animal Models in Cardiovascular Research, 2nd edition, Kluwer Academic Publishers, London, U.K., 1994.

MPH 3.4: PHARMACOLOGY PRACTICAL-I

06 Hours/week **Max. Marks – 100**

Practical Based on Pharmacology and Pharmacotherapeutics

a) Bioassay of histamine using guinea pig / rat ileum.
b) Bioassay of serotonin using rat fundus.
c) Bioassay of oxytocin using rat uterus.
d) Bioassay of acetylcholine using rat ileum preparation.
e) Determination of pA2 value of atropine using acetylcholine as agonist employing rat ileum preparation.
f) To record CRC of noradrenaline using isolated rat anococcygeus muscle preparation.
g) To study the effect of noradrenaline and acetylcholine on the coronary blood flow and heart rate of rat isolated heart using Langendorff's heart preparation.

Practical based on MPH-3.7

a) Antihypertensive agents
b) Antiepileptics
c) Antianxiety agents and drugs used in mood and sleep disorders
d) Antipsychotics
e) Drugs affecting memory
f) Local anesthetics
g) Skeletal muscle relaxants and neuromuscular blockers
h) Antidiabetic agents
i) Analgesics and drugs used in arthritis and neuropathic pain
j) Anti-inflammatory agents
k) Antiasthmatic agents
l) Antiulcer agents
m) Hepatoprotective agents

Practicals realted to Toxicology

Behavioural and neurotoxicity, teratology, endotoxin, pesticides, cardiac, hepatic, renal and pulmonary toxicity, environmental, forensic toxicology, and clinical toxicology.

RECOMMENDED READINGS:

1. Practical Pharmacology and Clinical Pharmacy by Professor S.K. Kulkarni, Vallabh Prakashan, Delhi.
2. Practical Pharmacology by Professor R. K. Goyal, B. S. Shah Prakashan, Ahemdabad.
3. 1. H.G. Vogel (ed), Drug Discovery and Evaluation-Pharmacological Assays, 2nd edition, Springer Verlag, Berlin, Germany, 2002.
4. 2. M.N. Ghosh, Fundamentals of Experimental Pharmacology, 2nd edition, Scientific Book Agency, Calcutta, India, 1984.
5. 3. D.R. Laurence and A.L. Bacharach (eds), Evaluation of Drug Activities: Pharmacometerics, Vol. 1 and 2, Academic Press, London, U.K., 1964.

MPH 3.6: PHARMACOLOGY PRACTICAL -II

06 Hours/week **Max. Marks – 100**

1. **Practical based on clinical and regulatory pharmacology**
2. **Practical based on cellular and molecular pharmacology**

a. Plasmid DNA Extraction
b. Restriction Enzyme Digestion.
c. Ligation of Digested DNA
d. Transformation of Bacterial Cells
e. Genomic DNA Extraction
f. PCR amplification
g. Polyacrylamide Gel Electrophoresis
h. Western Blotting.
i. Southern Blotting

3. Practical based on receptor pharmacology

INSTITUTE OF PHARMACEUTICAL SCIENCES, KURUKSHETRA UNIVERSITY, KURUKSHETRA

Syllabus: M. Pharm. Part-I

MPH – 1.1 MODERN ANALYTICAL AND BIOSTATISTICAL TECHNIQUES

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. **Infrared Spectroscopy** (8h)

   Introduction, the infrared absorption process, the modes of vibrations, bond properties and absorption trends, instrumentation techniques, radiation source, detectors, sample handling, quantitative and qualitative applications. The Hook's law, stretching frequencies and their bond strengths, coupled interactions, hydrogen bonding, examination of infrared spectrum, functional groups with examples, with reference to stereochemical aspects and hydrogen bonding. Near-IR spectroscopy, reflectance spectrophotometry, Far Infrared spectroscopy, FTIR and its applications.

2. **Ultraviolet Spectroscopy** (8h)

   Introduction, the nature of electronic excitation, the origin of uv band structure, principle of absorption spectroscopy, chromophore - $\sigma \rightarrow \sigma^*$, $\eta \rightarrow \sigma^*$, $\pi \rightarrow \pi^*$ transitions, basics of instrumentation techniques, pharmaceutical applications. Energy level and selection rules, effect of substituents, effect of conjugation, conformation and geometry, the Woodward-Fisher rules, the Fisher-Kuhn rules. Derivative spectroscopy and its applications.

3. **Nuclear Magnetic Resonance Spectroscopy** (8h)

   Introduction, nuclear spin states, nuclear magnetic moments, absorption of energy, the mechanism of resonance, chemical equivalence, spin-spin coupling, basics of instrumentation techniques, pharmaceutical applications.

4. **X-Ray Spectroscopy** (8h)

   Introduction, production and properties of the X-ray, X-ray emission, X-ray absorption, principles of X-ray diffraction, powder diffraction, X-ray diffraction methods, application of X-ray diffraction technique in pharmaceutical sciences.

5. **Thermal Analysis** (8h)

   Introduction to various thermal methods of analysis, basic principles and theory, instrumentation and pharmaceutical applications of thermo gravimetric analysis (TGA), differential thermal analysis (DTA), differential scanning calorimetry (DSC) and microcalorimetry.

6. **Biological evaluation methods** (8h)

   Models for screening of anti-inflammatory, analgesic, anti-convulsant, antioxidant, antimalarial, antioxidant, antimicrobial and anti-diabetic activity.

7. **Preformulation studies** (8h)

   Significance and parameters, chemical stability studies and concept of prodrug.

8. **Medicinal plants Extraction techniques** (10h)

Introduction to novel methods of extraction such as solid phase micro-extraction,supercritical fluid extraction, Microwave-assisted extraction, Ultrasonic-assisted extraction and comparison with Conventional extraction methods.

9. **Research methodology** (8h)

Introduction, Roles and responsibilities, Choosing a subject, Making a good plan, Selecting and studying literature, Extracting information from the selected literature, Terminology, Writing: outline, summary, draft, final thesis.

10. **Biostatistics** (6h)

General concepts, two-tail student t-test and paired sample t-test, two samples t-test, Wilcoxon rank-sum test, Mann-Whitney test, one-way analysis of variance, Kruskal-Wallis test, two-way analysis of variance, multiple comparison procedures in ANOVA: Fischer's LSD test, Tukey's studentized range test and Dunnett's test. Non-linear regression: Introduction, iterative method. Correlation, linear regression, PCA and PLS.

11. **Intellectual property rights (IPR)** (10h)

Economic importance, mechanism for protection of intellectual property - patents, copyright, trademarks; role of IP in pharmaceutical industry; global ramifications and financial implications.

Intellectual property and international trade, concept behind WTO (World Trade Organization), WIPO (World Intellectual Property Organization), GATT (General Agreement on Tariff and Trade), TRIPs (Trade Related Intellectual Property Rights),TRIMS (Trade Related Investment Measures) and GATS (General Agreement on Trades in Services), status in India and other developing countries, case studies and examples, TRIPS issues on herbal drugs.

12. **Patenting** (10h)

Copyright and trade mark protection, criteria for patentability, Indian patent act. 1970: WTO and modifications under TRIPS, filing of a patent application, precautions -disclosures/non-disclosures, publication-article/ thesis, prior art search – published patents search, internet search patent sites, specialized service search requests, costs, patent application forms and guidelines, fee structure, time frames, jurisdiction aspects, types of patent application - provisional, nonprovisional, PCT and convention patent applications, international patenting requirement procedures and costs. Patent infringement: Trademarks legislation and registration system in India.

MPH 1.2: MODERN ANALYTICAL AND BIOSTATISTICAL TECHNIQUES PRACTICAL

6 Hours/week **Max. Marks: 100**

Modern experiments having relevance to the topics covered under theory including:

1. Simultaneous estimation of Paracetamol and Ibuprofen: Aspirin and Caffeine ; Rifampicin and Isoniazid or other combination formulation (4 expts).
2. UV-Visible spectrum scanning of certain organic cornpounds – absorption and correlation of structures and comparison e.g., Chloramphenicol, Analgin, Sulphadiazine, Ibuprofen
3. Exercises on interpretation of at least 5-different known compounds of Natural origin by using spectroscopic data (UV, IR, NMR & MASS)
4. Workshop on spectroscopy structural elucidation of at least a unknown compound.

5. Effect of pH and solvent on U.V. Spectrum of certain drugs.

Reading Material Recommended

1. Indian Pharmacopoeia, Central Indian Pharmacopoeia Laboratory, Govt. of India, Ministry of Health & Family Welfare, Ghaziabad, Latest Edition.
2. U. S. Pharmacopoeia – NF, The United States Pharmacopoeial Convention, Rockville, USA, Latest Edition.
3. European Pharmacopoeia, Directorate for the Quality of Medicines of the Council of Europe (EDQM), Strasbourg, Europe, Latest Edition.
4. British Pharmacopoeia, The Stationary Office on behalf of the Medicine Health Care Product Regulatory Agency (MHRA), London, Latest Edition.
5. Mendham J, Denney RC, Barnes JD and Thomas M. Vogel's Textbook of Quantitative Chemical Analysis. Pearson Education Limited, Singapore. Latest Edition.
6. Treece DJ. Managing Intellectual Capital: Organizational, Strategic and Policy Dimension. Oxford University Press, England. Latest Edition.
7. Wadedhra BL. Law Relating to Patents, Trademarks, Copyright Design and Geographical Indications. Universal Law Publishing, New Delhi. Latest Edition.
8. Bansal P. IPR Handbook for Pharma Students and Researchers, Pharma Book Syndicate, Hyderabad. Latest Edition.
9. Trivedi PR. Encylcopedia of Intellectual Property Rights. Jnanada Prakashan, New Delhi. Latest Edition.
10. Arya P. P. and Yashpal, Research Methodology in Management, Deep and Deep publications Private Limited, New Delhi.
11 Green and Tull : A research for marketing research decisions, PHI (P) Ltd. New Delhi.
12. Karishna Swami, Shiva Kumar & Mathirajan, Management Research Methodology, Pearson Education.
13 Hooda, R P, Statistics for Business and Economics, MacMillan India Limited, New Delhi.
14 Heinz, Kohler: Statistics for business and Economics, Harper Collins.
15. Lawrence B Morse: Statistics for business and economics, Harper Collins.
16. Silverstein RM and Webster FX. Spectrometric Identification of Organic Compounds. John Wiley and Sons, New York. Latest Edition.
17. Pavia DL, Lampman GM and Kriz GS. Introduction to Spectroscopy. Harcourt College Publishers, Orlando. Latest Edition.
18. Vogel HG and Vogel WH. Drug Discovery and Evaluation. Springer-Verlag, Berlin. Latest Edition.
19. Kulkarni SK. Handbook of Experimental Pharmacology. Vallabh Prakashan, New Delhi. Latest Edition.
20. Ghosh MN. Fundamentals of Experimental Pharmacology. Hilton & Company, Kolkata. Latest Edition.

MPH – 4.3: PHARMACOGNOSY-I
(ADVANCED PHARMACOGNOSY)

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. Ethnopharmacognosy / Ethnomedicine, its concept, scope and importance. (5)
2. Drug Discovery From Natural Sources like Terrestrial Plants, Microorganisms, vertebrates/invertebrates. (10h)
3. Marine Drugs/Products: Definition, present status, classification of important bioactive agents, their general methods of isolation and purification (where reported), study of important bioactive agents including their chemistry and uses. (10 h)
4. Introduction, Classification and uses of the followings (25 h)
    i) Natural Pigments and colorants/dye yielding plants.
    ii) Natural Bitters and Sweeteners
    iii) Natural Pesticides and Insecticides
    iv) Plant hormones
    v) Natural Polymers

5 Pharmacognostic characterstics, chemical constituents and pharmacological basis of therapeutic uses of the following plants (25 h)
   i) Hepatoprotective plants: *Andrographis paniculata, Glycyrrhiza glabra, Picrorrhiza, Silybum marianum* and *Swertia chirata*.
   ii) Anti inflammatory plants: *Boswellia serrata,Commiphora mukul* and *Curcuma longa.*
   iii) Antidiabitic plants: *Allium cepa, Azadirachta indica, Gymnema sylvestris, Momordica charantia,*
   and *Trigonella foenum graecum.*
   iv) Plants used in cardiovascular disorders: *Digitalis, Terminalia arjuna, Thevetia nerrifolia* and *Viscum album*
   v) Antiviral plants: *Echinaceae purpurea, Sambucus nigra, Saponaria officinalis, Rhizophora species* and *Thuja occidentalis.*
   vi) Plants used as adaptogens and immunomodulators: *Allium sativum, Asparagus racemosus,*
   Ocimum sanctum, Panax ginseng, Phyllanthus emblica, Tinospora cordifolia and *Withania somnifera.*
   vii) Anticancer drugs: *Camptotheca acuminata, Catharanthus roseus, Podophyllum species* and *Taxus species*

6. Role of natural products in "Neglected Diseases" (Dengue, protozoal diseases including leishmaniasis, trypanosomiasis, schistosomiasis, tuberculosis, leprosy).(15 h)
7. Pharmaceutical aids: Profile for manufacture of papain, pectin, Pharmaceutical gums, starch, absorbent cotton and gelatin (10h)

Recommended Readings:

1. Vogel H.G. and Vogel W.H. Drug Discovery and Evaluation, Springer Verlag, Berlin Herideleberg.

2. Ghosh M.N. Fundamentals of Experimental Pharmacology, Scientific Book Agency, Calcutta
3. Turner R.A Screening Methods in Pharmacology, Vol. I & II, Academic Press, New York & London.
4. Lawrence D.R. and Bacharach, AL. Evaluation of drug activities: Pharmacometrics, Academic press, 'London.
5. Malafaya, P.B.; Silva, G.A.; Reis, R.L. Natural-origin polymers as carriers and scaffolds for biomolecules and cell delivery in tissue engineering applications. *Adv. Drug Deliv. Rev.* **2007**, *59*,207-233.
6. Shirwaikar, A.; Shirwaikar, A.; Prabu, S.L.; Kumar, G.A. Herbal excipients in novel drug delivery systems. *Indian J. Pharm. Sci.* **2008**, *70*, 415-422
7. Polymeric Plant-derived Excipients in Drug Delivery *Molecules* 2009, *14*, 2602-2620; doi:10.3390/molecules14072602
8. Clinically Important Plants of Ayurveda by FRLHT, Business Horizon
9. Colour Atlas of Medicinal Plants by Narayan Das Prajapati and Dr. S. S. Purohit, Business Horizon
10. Database on Medicinal plants used in Ayurveda Vol 1 to Vol. 6. By Central council for researchin ayurveda Bioactive Natural Products: Detection, Isolation, and Structural Determination; CRC Press.
11. Natural Product Chemistry at a Glance, Stephen P. Stanforth; Blackwell.
12. Medicinal Plants, Moshrafuddin Ahmed; Oxford & IBH publishing co. Pvt Ltd,
13. Herbal Drugs: Ethnomedicine to Modern Medicine; Springer
14. Herbal Combinations, Woodland Publishing, Rita Elkins Mh; Woodland Publishing.
15. Herbal Medicine: Trends and Traditions (A Comprehensive Sourcebook on the Preparation and Use of Medicinal Plants), Charles W. Kane ; Publisher: Lincoln Town Press
16. Herbal Medicine: Biomolecular and Clinical Aspects; CRC Press.
17. Herbal Products: Toxicology and Clinical Pharmacology, Humana Press
18. Herbal Technology: Concepts & Approaches; M. Danial; Publisher: Satish Serial
19. Pharmacognosy, A. Roseline; MJP Publishers
20. Textbook of Pharmacognosy and Phytochemistry, Biren Shah, Elsevier.
21. Text Book of Pharmacognosy and Phytochemistry, Jarald, CBS.
22. Textbook Of Phytochemistry, Syed Aftab Iqbal; Discovery Publishing House Pvt Ltd.

MPH – 4.5: PHARMACOGNOSY-II
(EXTRACTION, ISOLATION AND STANDARIZATION OF HERBAL DRUGS)

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

1. Conventional extraction methods such as maceration, infusion, digestion, decoction, percolation, Soxhlet's extraction etc., Various Steps involved in extraction of medicinal plants (5h)

2. General methods of extraction, isolation and analysis of phytoconstituents: Carbohydrates, alkaloids, glycosides, and volatile oils (10h)
3. Introduction and applications of various separation techniques in plant drug analysis: bioassay-guided fractionation, TLC, preparative TLC, column chromatography, Flash Chromatography HPTLC, HPLC, GC, counter current chromatography, Vacuum liquid chromatography. (20h)

4. Standardization of herbal drugs/extracts as per WHO guidelines (20h)
   i) Physical, chemical, spectral and toxicological standardization
   ii) Qualitative and quantitative estimations exemplifying the methods of preparation of at least two standardized extracts
   iii) Standardization of single drug and compound formulation
   iv) Importance of standardization and problems involved in the standardization of herbs

5. Plant tissue culture: Conventional breeding v/s tissue culture, Applications of Plant tissue culture technique,Tissue culture media (composition & preparation), Preparation of explant, Sterilization techniques, Type of cultures, Protoplast technology and its applications, Immobilization techniques and their applications, Tissue culture as a technique to produce novel plants and hybrids, Factors affecting the production of secondary metabolites from tissue- culture. (15)

5. Standardization and extraction methods of herbal drugs: *Aloe barbadensis*, *Andrographis paniculata*, *Boswellia serrata*, *Centella asiatica*, *Terminalia arjuna*, *Tinospora cordifolia*, *Withania somnifera*.
   (15h)

7. Quality assurance and Stability testing of Herbal Drugs: (10h)
   i) Indicative substances for quality assurance
   ii) GMP/GLP in herbal medicines.
   iii) Physical Quality Assurance
   iv) Stabilization methods
   ii) Validation of Analytical Procedures

8. Regulatory requirements for herbal medicines in India and USA. (05 h)

Reading Material Recommended

1. Industrial Scale Natural Product Extraction by Hans-Jörg Bart, Stephan Pilz; Wiley
2. Solvent Extraction Principles and Practice, Rydberg Rydberg, Michael Cox; CRC Press.
3. Laboratory Handbook for the Fractionation of Natural Extracts, Peter Houghton, Peter J. Houghton, Amala Raman; Springer
4. Quality Control of Herbal drugs: an approach to evaluation of botanicals, Pulock K. Mukherjee, Horizons Publishers.
5. Legal regulations of complementary and alternative medicines in different countries, Pharmacogn Rev. 2012 Jul-Dec; 6(12): 154-160.
6. Standardization of Botanicals: Testing and Extraction Methods of Medicinal Herbs, Volume 1 and Volume 2.

7. GMP for Botanicals By: Prof. Dr. Robert Verpoorte and Dr. Pulok K. Mukherjee, Business Horizon.
8. Herbal Drug Industry by V.Rajpal and DPS Kohli, Business Horizon.
9. Indian Herbal Pharmacopoeia by: Indian Drug Manufacturers Association
10. Regulatory Roadmap for Herbal Medicines By: G. Sudesh Kumar, Business Horizon
11. Monographs and relevant review articles appearing in various Periodicals and Journals.

MPH – 4.7: PHARMACOGNOSY-III
(CHARACTERIZATION AND FORMULATION OF HERBAL DRUGS)

4 hours/week **Max. Marks 100**

Note: The paper setter will set 7 questions (First question shall be compulsory and consists of sub-parts of 1 or 2 marks each from the whole syllabus); out of which the candidate will be required to attempt 5 questions in all. All questions will carry equal marks.

2. General methods of investigation of biogenetic pathways. (5 h)
3. Extraction, Isolation and characterization by Chromatographic and spectral means of following active principles: (10 h)
    i) Atropine
    ii) Caffeine
    iii) Piperine
    iv) Ephedrine
    v) Ergotamine
    vi) Quinine
4. Chemistry and structure elucidation of the following categories: (15 h)
    i) Alkaloids: Morphine, Reserpine.
    ii) Steroids: Cholesterol, Digitoxin
    iii) Flavonoids: Quercitin
    iv) Terpenoids: Citral, menthol
5. Stereochemistry of natural products: Introduction, types of stereoisomerism with suitable examples and special emphasis on tropines, monosacchrides, camphor, menthol and neomenthol. (15 h)
6. Review of various phytoconstituents used as prototypes for therapeutically active Constituents. (5h)
7. Natural pigments: occurrence, general methods of isolation and characterization of anthocyanins and carotenoids with special emphasis on cyanin and beta carotene. (5 h)

8. Herbal product development: (20 h)

    i) Liquid orals, tablets, capsules and dermatologic.
    ii) Methods involved in monoherbal and polyherbal formulations with their merits and demerits.
    iii) Excipients used in herbal formulations.
    iv) Compatibility studies
    v) Stability studies
    vi) Phytoequivalence & pharmaceutical equivalence
    vii) Quality control of finished herbal medicinal products
    viii) Packaging and Labelling of finished products

9. Herbal cosmetics: (15 h)

Identification, collection and chemical nature of the natural products used in:
Hair care, dandruff, dyeing, Skin care, anti-wrinkles & anti-aging, Teeth care

10. Herbs as health food: (10 h)
    i) Antioxidants
    ii) Prebiotics & Probiotics
    iii) Polyunsaturated fatty acids
    iv)Dietary supplements

Reading Material Recommended

1. Trivedi PR. Encylcopedia of Intellectual Property Rights. Jnanada Prakashan, New Delhi. Latest Edition. Organic Chemistry: Stereochemistry and the chemistry of natural products,Vol.-II, I.L. Finar.
2. Analytical profiles of drug substances, K. Florey, Academic press.
3. Recent progress in medicinal plants: Phytochemistry & Pharmacology, V.K. Singh etal, Studium press, USA
4. Structure Elucidation of Natural Products by Mass Spectroscopy- Vol I & II, H. Budzikiewiez, C.Djerassic and D.H. Williams
5. Tables of Spectral Data for Structural Determination of Organic Compounds, E. Pretsch, T,Clerc, J. Seibl and W. Simon
6. Heterocyclic Chemistry, Albert
7. Biogenesis of natural Compounds, Bernfeld
8. An Introduction to the Chemistry of Terpenoids and Steroids, Templeton
9. Chemistry of the Alkaloids, Pelletier
10. The Chemistry of the Natural Products, Butterworths.
11. Pharmacogonosy and Pharmacobiotechnology : J.E. Robbers, M.K. Speedie and V.E. Tyler.
12. Modern Methods of Plant analysis, Peach and Tracey, All Volumes, Springer-Verlag
13. Practical evaluation of phytopharmaceuticals, Brain and Turner, Wright-Scientechnica.
14. Phytochemical methods, Harborne, J.B., Champman Hall.
15. Screening Methods in Pharmacology Turner, Academic Press
16. Different relevant pharmacopoeias, Current editions
17. Isolation and Identification of Drugs, Clark E.C.G, The Pharmaceutical Press, London.
18. Vogel's Text Book of Practical Organic Chemistry.
19. Applications of Absorption Spectroscopy, John R.Dyer
20. Organic Chemistry, Morrison & Boyd
21. Natural Product Chemistry, Vol. I & II, O.P. Aggarwal
22. Experimental Methods in Organic Chemistry, Moore and Dalrymple
23. Stereochemistry- R.S. Kalsi.
24. G.A. Cordell, Introduction to Alkaloids, John Wiley and Sons, New York.
25. L.F. Fieser and M. Fieser, Steroids, Reinhold Publishing Co. New York.
26. K.B.G. Torsell, Natural Products Chemistry, John Wiley and Sons, NewYork.
27. J.B. Harborne, Phytochemical Methods, Chapman and Hall, London
28. Burger's Medicinal Chemistry and Drug Discovery, Vol. I.
29. Natural Products for Plants by Kaufmann, CRC Press New York.

30. Nakanishi K (1977). Chemistry of Natural Products, Kodansha Book Publishing Company, Osaka (Japan).
31. Chemistry of Natural Products, S. V. Bhat, B.A.Nagasampagi, M. Sivakumar, Narosa Publishing House.
32. The Phytochemistry of Herbs By: Lisa Ganora, Business Horizon
33. Herbal Drugs Industry- R.D. Choudhry
34. Text Book of Pharmacognosy Wallis, CBS Publishers
35. Text Book of Pharmacognosy – Trease & Evans
36. Pharmacopoeial Standards for Ayurvedic drugs, C.C.A.R.I., New Delhi
37. Remington -The Science and Practice of Pharmacy - Vol. I & II, A.R. Gennard
38. Ayurvedic Formulary of India
39. All Pharmacopoeias relevant, current editions.
40. Herbal Medicines by Jonne Bernes, Pharmaceutical Press, London.
41. Medicinal Plants in Skincare by Sushil Kumar, CIMAP, Lucknow.
42. Tyler's Herbs of Choice: The Therapeutic uses of Phytomedicine, James E. Robbers, Varoo E. Tyler, CBS Publishers & Distributors
43. Formulating, Packaging and Marketing of Natural Cosmetic Products, Lambros Kromidas, Nava Dayan; Wiley

MPH 4.4: PHARMACOGNOSY PRACTICAL – I

06 Hours/week **Max. Marks: 100**

Modern experiments having relevance to the topics covered under theory of papers MPH – 4.3, 4.5 & 4.7 including the following:

1. Preparation of herbarium.
2. Isolation of papain.
3. Isolation of pectin.
4. Isolation of natural dye anthocyanin.
5. Isolation of glycyrrhizin from Liquorice.
6. Isolation of total oleogum resins from Ginger.
7. Isolation of nicotine as nicotine picrate from Tobacco leaves.
8. Isolation of hesperidine from Orange peels.
9. Isolation of bererine from Berberis aristata.
10. Isolation of Rhein from rhizome of Rheum species.
11. Isolation of Piperine from Piper nigrum.
12. Isolation of Quinine from Cinchona bark.
13. Isolation of Menthol from Mentha species.
14. Isolation of Caffeine from Tea leaves
15. Isolation of Carvone content of Umbelliferous fruits.
16. Isolation of Starch and successive isolation of amylase and amylopectin from potato.
17. Determination of Anthracene derivatives in Senna by spectrophotometric method.
18. Thin Layer Chromatography/ Paper Chromatography identification of phytoconstituents.
19. WHO methods of standardization of Herbal drugs:
    i) Determination of Swelling index.
    ii) Determination of Foaming index.
    iii) Determination of Ash value.
    iv) Determination of Extractable matter.
    v) Determination of Volatile oil.

vi) Determination of Moisture Content.
vii) Determination of Haemolytic activity.
viii) Determination of Tannins.
ix) Determination of Bitterness value.
x) Determination of Leaf constants.
xi) Determination of Foreign organic matter.

20. Phytochemical screening of active constituents obtained from plants.

Recommended Readings:

1. Practical Evaluation of Phytopharmaceuticals – Brain and Turner, Wright Scientechnica
2. Modern Methods of Plant Analysis-Peach and Tracy, Springer Verlag
3. Different relevant Pharmacopoeias Like IP, BP, USP, IHP, etc. current editions.
4. Practical Pharmacognosy, C.K. Kokate, Vallabh Prakashan
5. Practical Pharmacognosy – K.R. Khandlwal, Nirali Prakashan, Pune.
6. Herbal Drug Technology, S.S. Agrawal, M. Paridhavi, Universities Press
7. Quality Control of Herbal drugs: an approach to evaluation of botanicals, Pulock K. Mukherjee, Horizons Publishers

MPH – 4.6: PHARMACOGNOSY PRACTICAL – II

06 Hours/week **Max. Marks – 100**

1. Study of UV-Visible and IR spectral data of Sennoside, rutin, vasicine, curcumin, atropine, ephedrine, aloe-emodin, brucine, ellegic acid, diosgenin, caffeine, cholesterol, reserpine, ursolic acid, quinine.
2. Solubility, melting point, optical rotation of the above mentioned compounds.
3. Estimation of phenolic contents.
4. Estimation of aldehyde contents.
5. Estimation of Total triterpenic acids in *Boswellia serrata.*
6. Estimation of Andrographolides from *Andrographis paniculata*.
7. Determination of Ascorbic acid (Vitamin C) by UV. Spectroscopic method in crude drugs.
8. Determination of Hyoscymine/Hyoscine in Datura species by UV. Spectroscopic method.
9. Quantitative estimation of Reserpine in *Rauwolfia serpentina* by HPLC method.
10. Quantitative estimation of Quinine in Cinchona bark by HPLC method.
11. HPTLC analysis of herbal extracts.
12. Evaluation of herbal preparations.
13. Preparation of explants, Surface sterilization, development of callus for the production of phytoconstituents in Plant tissue culture technique.
14. Exercises on interpretation of a known compounds of Natural origin by using spectroscopic data (IR, NMR & MASS).

Recommended Readings:

1. Practical Evaluation of Phytopharmaceuticals – Brain and Turner, Wright Scientechnica
2. Modern Methods of Plant Analysis-Peach and Tracy, Springer Verlag
3. Different relevant Pharmacopoeias Like IP, BP, USP, IHP, etc. current editions.
4. Practical Pharmacognosy, C.K. Kokate, Vallabh Prakashan
5. Practical Pharmacognosy – K.R. Khandlwal, Nirali Prakashan, Pune.
6. Herbal Drug Technology, S.S. Agrawal, M. Paridhavi, Universities Press
7. Quality Control of Herbal drugs: an approach to evaluation of botanicals, Pulock K. Mukherjee, Horizons Publishers