

**Pt. B. D. SHARMA UNIVERSITY OF HEALTH SCIENCES,  
ROHTAK**

**SCHEME OF EXAMINATION**

**for**

**MASTER OF PHARMACY COURSES**

| <b>S. NO.</b> | <b>SPECIALIZATION</b>            |
|---------------|----------------------------------|
| 1             | PHARMACEUTICS                    |
| 2             | PHARMACEUTICAL CHEMISTRY         |
| 3             | PHARMACOLOGY                     |
| 4             | PHARMACOGNOSY AND PHYTOCHEMISTRY |
| 5             | PHARMACEUTICAL BIOTECHNOLOGY     |

**Pt. B. D. SHARMA UNIVERSITY OF HEALTH SCIENCES, ROHTAK**  
**SCHEME OF EXAMINATION**

**M. Pharmacy (Pharmaceutics) - First Year**

| S. No. | Code MPH: | Subject (Theory Course)                      | Hrs/week | Marks |
|--------|-----------|--|----------|-------|
| 1.     | 101       | Modern Pharmaceutical Analytical Techniques  | 4        | 100   |
| 2.     | 102       | Advanced Physical Pharmacy                   | 3        | 100   |
| 3.     | 103       | Advanced Biopharmaceutics & Pharmacokinetics | 2        | 100   |
| 4.     | 104       | Modified Drug Delivery Systems               | 2        | 100   |
| 5.     | 105       | Advanced Pharmaceutical Technology           | 2        | 100   |

| S. No. | Code MPH: | Subject (Practical Course)                          | Hrs/week | Marks |
|--------|-----------|---|----------|-------|
| 6.     | 106       | Modern Pharmaceutical Analytical Techniques         | 6        | 100   |
| 7.     | 107       | Pharmaceutics-I (based on theory of MPH-102 & 103)  | 6        | 100   |
| 8.     | 108       | Pharmaceutics-II (based on theory of MPH-104 & 105) | 6        | 100   |

**Pt. B. D. SHARMA UNIVERSITY OF HEALTH SCIENCES, ROHTAK**  
**SCHEME OF EXAMINATION**

**M. Pharmacy (Pharmaceutical Chemistry) - First Year**

| S. No. | Code MPH: | Subject (Theory Course)                     | Hrs/week | Marks |
|--------|-----------|---|----------|-------|
| 1.     | 201       | Modern Pharmaceutical Analytical Techniques | 4        | 100   |
| 2.     | 202       | Advanced Organic Chemistry                  | 2        | 100   |
| 3.     | 203       | Advanced Medicinal Chemistry-I              | 2        | 100   |
| 4.     | 204       | Advanced Medicinal Chemistry-II             | 3        | 100   |
| 5.     | 205       | Advanced Medicinal Chemistry-III            | 2        | 100   |

| S. No. | Code MPH: | Subject (Practical Course)                                      | Hrs/week | Marks |
|--------|-----------|---|----------|-------|
| 6.     | 206       | Modern Pharmaceutical Analytical Techniques                     | 6        | 100   |
| 7.     | 207       | Advanced Organic chemistry (based on theory of MPH-202)         | 6        | 100   |
| 8.     | 208       | Advanced Medicinal chemistry (based on theory of MPH-203 & 204) | 6        | 100   |

**Pt. B. D. SHARMA UNIVERSITY OF HEALTH SCIENCES, ROHTAK**  
**SCHEME OF EXAMINATION**

**M. Pharmacy (Pharmacology) - First Year**

| S. No. | Code MPH: | Subject (Theory Course)  | Hrs/w<br>eek | Mark |
|--------|-----------|--|--------------|------|
| 1.     | 301       | Modern Pharmaceutical Analytical Techniques                    | 4            | 100  |
| 2.     | 302       | General Pharmacology & Toxicology                              | 3            | 100  |
| 3.     | 303       | Pathophysiology and Pharmacotherapeutics                       | 2            | 100  |
| 4.     | 304       | Screening methods, Clinical Research and Approval of New Drugs | 2            | 100  |
| 5.     | 305       | Animal Biotechnology and Immune Technology                     | 2            | 100  |

| S. No. | Code MPH: | Subject (Practical Course)                  | Hrs/w<br>eek | Mark |
|--------|-----------|---|--------------|------|
| 6.     | 306       | Modern Pharmaceutical Analytical Techniques | 6            | 100  |
| 7.     | 307       | Advanced Pharmacokinetics & Drug Metabolism | 6            | 100  |
| 8.     | 308       | General & Clinical Pharmacology             | 6            | 100  |

**Pt. B. D. SHARMA UNIVERSITY OF HEALTH SCIENCES, ROHTAK  
SCHEME OF EXAMINATION**

**M. Pharmacy (Pharmacognosy and Phytochemistry) - First Year**

| S. No. | Code MPH: | Subject (Theory Course)                                | Hrs/w<br>eek | Marks |
|--------|-----------|--|--------------|-------|
| 1.     | 401       | Modern Pharmaceutical Analytical Techniques            | 4            | 100   |
| 2.     | 402       | Advanced Pharmacognosy                                 | 2            | 100   |
| 3.     | 403       | Advanced Industrial Pharmacognosy                      | 2            | 100   |
| 4.     | 404       | Plant Drugs: Extraction, Formulation & Standardization | 3            | 100   |
| 5.     | 405       | Pharmaceutical Plant Biotechnology                     | 2            | 100   |

| S. No. | Code MPH: | Subject (Practical Course)                  | Hrs/w<br>eek | Marks |
|--------|-----------|---|--------------|-------|
| 6.     | 406       | Modern Pharmaceutical Analytical Techniques | 6            | 100   |
| 7.     | 407       | Plant Drug Formulation & Standardization    | 6            | 100   |
| 8.     | 408       | Pharmaceutical Plant Biotechnology          | 6            | 100   |

**Pt. B. D. SHARMA UNIVERSITY OF HEALTH SCIENCES, ROHTAK**  
**SCHEME OF EXAMINATION**

**M. Pharmacy (Pharmaceutical Biotechnology) - First Year**

| S. No. | Code MPH: | Subject (Theory Course)                                       | Hrs/w<br>eek | Marks |
|--------|-----------|---|--------------|-------|
| 1.     | 501       | Modern Pharmaceutical Analytical Techniques                   | 4            | 100   |
| 2.     | 502       | Fundamentals of Genetic Engineering                           | 2            | 100   |
| 3.     | 503       | Animal Biotechnology and Bioprocess<br>Technology             | 3            | 100   |
| 4.     | 504       | Pharmaceutical Plant Biotechnology                            | 2            | 100   |
| 5.     | 505       | Pharmaceutical Industrial Biotechnology and<br>Bioinformatics | 2            | 100   |

| S. No. | Code MPH: | Subject (Practical Course)   | Hrs/w<br>eek | Marks |
|--------|-----------|--|--------------|-------|
| 6.     | 506       | Modern Pharmaceutical Analytical Techniques                          | 6            | 100   |
| 7.     | 507       | Pharmaceutical Biotechnology-I (based on<br>theory of MPH-502 & 503) | 6            | 100   |
| 8.     | 508       | Pharmaceutical Biotechnology-I (based on<br>theory of MPH-504 & 505) | 6            | 100   |

**MPH-101: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES  
THEORY**

**Max. Marks: 100**

**Total Hours: 100 (4hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **UV-VISIBLE SPECTROSCOPY:** Brief review of electromagnetic spectrum and absorption of radiations. The chromophore concept, absorption law and limitations. Theory of electronic spectroscopy, absorption by organic molecules, choice of solvent and solvent effects, modern instrumentation – design, working and principle. Interpretation of spectra. Applications of UV-Visible spectroscopy (qualitative and quantitative analysis), Woodward –Fischer rules for calculating absorption maximum, Photometric titrations and its applications. (10)
2. **FLAME EMISSION SPECTROSCOPY AND ATOMIC ABSORPTION SPECTROSCOPY:** Principle, instrumentation, interferences and applications in Pharmacy. (4)
3. **SPECTROFLUORIMETRY:** Theory, instrumentation, advantages, relationship of chemical structure to fluorescence spectra, solvent effect, effect of acids and bases on fluorescence spectra, concentration effects, factors affecting fluorescence intensity, comparison of fluorescence and UV-Visible absorption methods and applications in Pharmacy. (4)
4. **INFRARED SPECTROPHOTOMETRY:** Introduction, basic principles, vibrational frequency and factors influencing vibrational frequency, instrumentation and sampling techniques, interpretation of spectra, applications in Pharmacy. FT-IR-theory and applications. Attenuated Total Reflectance (ATR). (8)
5. **NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY:** Fundamental Principles and Theory. Instrumentation, solvents, chemical shift and factors affecting chemical shift, spin-spin coupling, coupling constant and factors influencing the value of coupling constant, spin-spin decoupling, proton exchange reactions, FT-NMR, 2D -NMR, NMDR, NOE, NOESY, COSY and applications in Pharmacy. Interpretation of spectra, <sup>13</sup>C NMR-Introduction, natural abundance, <sup>13</sup>C NMR spectra and its structural applications. (10)
6. **ELECTRON SPIN RESONANCE SPECTROSCOPY:** Theory and Principle, Limitations of ESR, choice of solvent, g-values, hyperfine splitting, instrumentation, difference between ESR & NMR and applications. (4)
7. **MASS SPECTROSCOPY:** Basic principles and instrumentation, ion formation and types, fragmentation processes and fragmentation pattern, Chemical ionization mass spectroscopy (CIMS), Field Ionization Mass Spectrometry (FIMS), Fast Atom Bombardment MS (FAB MS), Matrix Assisted laser desorption / Ionization MS (MALDI-MS), GC-MS, interpretation of spectra and applications in Pharmacy. (10)
8. **ELECTROPHORESIS:** Theory and principles, classifications, instrumentation, moving boundary electrophoresis, Zone Electrophoresis (ZE), Isoelectric focusing (IEF) and applications. (4)
9. **X-RAY DIFFRACTION METHODS:** Introduction, generation of X-rays, X-ray diffraction, Bragg's law, X-ray powder diffraction, interpretation of diffraction patterns and applications. (4)
10. **OPTICAL ROTARY DISPERSION:** Principle, Plain curves, curves with cotton effect, octane rule and its applications with examples, circular dichroism and its relation to ORD. (4)
11. **THERMAL METHODS OF ANALYSIS:** Theory, instrumentation and applications of Thermo Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) and Thermo Mechanical Analysis (TMA). (6)
12. **PARTICLE SIZE ANALYSIS:** Introduction. Particle size analyzers, theory, types and pharmaceutical applications. (4)
13. **CHROMATOGRAPHIC TECHNIQUES:** (8)
  - i. Gas Chromatography: Theory and principle, column operation, instrumentation, derivatisation methods and applications in Pharmacy.
  - ii. High Performance Liquid Chromatography: Principle, instrumentation, solvents used, elution techniques, RP-HPLC, LC-MS and applications in Pharmacy.
  - iii. HPTLC and Super Critical Fluid Chromatography (SFC): Theory and Principle, instrumentation, elution techniques and pharmaceutical applications.
14. **PHARMACOLOGICAL SCREENING** (4)
15. **PHARMACOGNOSTICAL SCREENING** (4)
16. **METHODS & TOOLS USE IN RESEARCH:** (8)
  - i. Qualitative studies, quantitative studies

- ii. Simple data organization, descriptive data analysis,
  - iii. Limitation & sources of Error
  - iv. Inquiries in form of Questionnaire, Opinionnaire or by Interview
  - v. Statistical analysis of data including variance, standard deviation, student "t" test, ANOVA, correlation data & its interpretation.
17. **DOCUMENTATION:** "How" of documentation, Techniques of documentation, Importance of documentation, Uses of Computer packages in documentation. (4)

**Books Recommended (Latest editions)**

1. M. Orchin and H.H. Jaffe – Theory and application of ultra- violet spectroscopy. (John Wiley and Sons. N.Y).
2. Silverstein, Basseler, Morrill- Spectroscopic identification of organic compounds (John Wiley and Sons. N.Y).
3. Willard, Merritt, Dean – Instrumental methods of analysis (CBS Publishers and Distributors, Delhi).
4. J.R. Dyer – Application of absorption Spectroscopy of Organic Compounds (Prentice Hall, London).
5. L.M. Jackmann and B.D. Sternhell – Application of NMR spectroscopy in organic chemistry (Pergamon Press, London.).
6. R.J. Hamilton- Introduction to High Performance Liquid Chromatography.(Chapman and Hall, London ).
7. J.W.Munson- Pharmaceutical Analysis- Modern methods –Part A and Part B (Marcel Dekker).
8. Introduction to Spectroscopy, 3<sup>rd</sup> edition, Pavia, Lampman, Kriz, Thomson Publisher.
9. Analytical chem., 2<sup>nd</sup> edition by Kellner, Mermet, Otto, Valcarcel Wiley ECH.
10. Ewing's Analytical Instrumentation Handbook, 3<sup>rd</sup> edition, edited by Jack Cazes, Marcel Dekker.
11. P.D. Sethi – Quantitative Analysis of Drugs in Pharmaceutical formulations (VBS Publishers, Delhi).
12. Pharmacopoeia of India.
13. United State Pharmacopoeia
14. British Pharmacopoeia
15. A.H. Beckett, J.B. Stenlake – Practical Pharmaceutical Chemistry, Part I and Part II (CBS Publishers Delhi).
16. D. Snell and C. T. Snell- Colorimetric Methods of analysis (Van Nostrand Reinhold Company, N.Y.).
17. Organic Spectroscopy by William Kemp.
18. Research In Education- John V. Best, John V. Kahn.



**MPH-102: ADVANCED PHYSICAL PHARMACY  
THEORY**

**Max. Marks: 100**

**Total Hours: 75 (3hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **Preformulation:** Introduction and concept, Need, Advantages, Organization. Techniques- Solubility & pKa, Spectroscopy, Chromatography, Thermal Analysis, X-ray diffraction, Techniques to generate & characterize amorphous & crystalline forms. Stability. Brief account of preformulation of:
  - i. Conventional tablet - Compaction of powders with particular reference to distribution and measurement of forces within the powder mass undergoing compression including- physics of tablet compression; Effect of particle size, moisture content, lubrication, lubricant sensitivity
  - ii. Oral liquids, Suspension.
  - iii. Semisolid.
  - iv. Aerosol products. (20)
2. **Solutions and Distribution:**
  - i) Solutions of Solids and Nonvolatile Liquids in Liquids-Ideal Solutions, Nonideal Solutions and the Solubility Parameter, Intermolecular and Intramolecular interactions between Molecules, Solubilization of Weak Acids or Weak Bases in Cosolvent Systems, Dissolution Kinetics of Solids in Liquids.
  - ii) Solutions of Volatile Liquids in Liquids-Two-Component & Three-component Liquid Systems.
  - iii) Distribution Law (Partition Coefficient)- Nondissociated and Nonassociated Systems, Association of a Solute in One Phase, Dissociation in Aqueous Phase and Association in Oil Phase, Distribution and Solubilization of Weak Acids or Weak Bases in Micelles and the Aqueous Phase, Distribution and Solubilization of Drug Chemicals by inclusion complex Formation, Distribution of Drugs in Proteins (Protein Binding). (15)
3. **Solubility:** Solubility of solid in liquids, Theory of solution formation. Solubilisation techniques using surfactants, cosolvents, complexation, inclusion compounds, drug derivatization and solid state manipulation. (15)
4. **Solid-state properties:** Crystal properties and polymorphism, techniques for study of crystal properties; solid-state stability, flow properties of powders. (5)
5. **Polymer Science:** Types of polymers, properties of polymers, thermodynamics of polymer solution and polymers in solid state. Applications of polymers in pharmaceutical formulations. (5)
6. **Diffusion:** Diffusion, steady state diffusion procedures and apparatus. Diffusion principles in biological systems, thermodynamics of diffusion. (03)
7. **Dissolution:** Theories of dissolution, dissolution models. Sink conditions in dissolution and its importance. *in-vitro*, *in-vivo* correlations. (06)
8. **Kinetics and Drug stability:** Rate equation, kinetics of decomposition, stability testing protocol, drug degradation and methods of stabilization, methods of accelerated stability testing in dosage forms, freeze-thaw methods, centrifugal methods. (06)

**Books Recommended (Latest editions)**

1. Physical Pharmacy by Martin, 4th Edition.
2. Bentley's Text Book of Pharmaceutics by E.A. Rawlin.
3. Pharmaceutical dosage forms: Tablets I, II, III.
4. Theory and Practice of Industrial Pharmacy by L. Lachman.
5. Physicochemical Principles of Pharmacy by A.T. Florence and D. Altwood.
6. Pharmaceutical preformulation by J.T. Cartensen.
7. Drug stability (Principles and Practices) by Jens. T. Carstensen and C. T. Rhodes. Drugs and Pharm. Sci. Series, Vol. 107, 3rd Ed., Marcel Dekker Inc., N.Y.
8. Stability of drug and dosage forms by Yoskioka.

**MPH 103: ADVANCED BIO-PHARMACEUTICS & PHARMACOKINETICS  
THEORY**

**Max. Marks: 100**

**Total Hours: 50 (2hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **Bioequivalence:** Bioequivalence and its determination, study design for the assessment of bioavailability and bioequivalence, factors influencing bioavailability and bioequivalence. Bioequivalence studies of various controlled release dosage forms. Statistical concepts in estimation of bioavailability and bioequivalence. Software used in biopharmaceutics and pharmacokinetics study and their significance. (20)
2. **Basic concepts of pharmacokinetics:** Compartmental models, One and two compartmental approaches to Pharmacokinetics. Recent trends, merits and limitations of these approaches. Application of these models to determine various pharmacokinetic parameters pertaining to:
  - i. Absorption: Mechanism and pathways of drug absorption, absorption rate constant, absorption half-life, lag time and extent of absorption, AUC. (04)
  - ii. Distribution: Physiological influence of drug distribution, protein binding of drug, determination of protein binding sites, clinical significance of drug protein binding. Apparent volume of distribution and its determination. (06)
  - iii. Elimination: Over all apparent elimination rate constant, and half life under the following conditions: (07)
    - a) Intravenous bolus injection
    - b) Intravenous infusion
    - c) Single dose oral administration
    - d) Multiple dosage oral administration
  - iv. Concept of clearance: Organ clearance, total clearance, hepatic clearance, gut wall clearance and renal clearance. (03)
3. **Non-linear Pharmacokinetics:** Concepts of linear and non linear pharmacokinetics, Michaelis – Menton kinetics, characteristics, basic kinetic parameters, possible causes of non induction, non linear binding, non linearity of pharmacological responses. Time dependent pharmacokinetics: Introduction, classification, physiologically induced time dependency: Chronopharmacokinetics and Chronotherapeutics. (05)
4. **Non-compartmental pharmacokinetics:** (05)
  - i. Physiologic Pharmacokinetic Model: Concept, applications and limitations.
  - ii. Statistical moments theory: Concept and applications, mean residence time, mean absorption time, mean dissolution time.

**Books Recommended (Latest editions)**

1. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi.
2. Remington's Pharmaceutical Sciences by Mack publishing company, Pennsylvania.
3. Biopharmaceutics and Pharmacokinetics by Robert E. Notari.
4. Pharmaceutical Codex.
5. Applied Biopharmaceutics and Pharmacokinetics by Leon. Shargel, Andrew B.C. Yes.
6. Biopharmaceutics & Pharmacokinetics by Robert E. Notari, Marcel Dekker, Inc.
7. Biopharmaceutics and Clinical Pharmacokinetics by Milo Gibaldi, Marcel Dekker Inc.,
8. Pharmacokinetic by Welling and Tse.

**MPH 104: MODIFIED DRUG DELIVERY SYSTEMS  
THEORY**

**Max. Marks: 100**

**Total Hours: 50 (2hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **Controlled drug delivery systems:** Fundamentals of controlled drug delivery systems, terminology, potential advantages, drug properties relevant to formulation, pharmacokinetic and pharmacodynamic basis of controlled drug delivery. Design, fabrication, evaluation and applications of the following controlled release systems:
  - i. Controlled release oral drug delivery systems. (07)
  - ii. Modulated GI retentive drug delivery systems. (03)
  - iii. Parenteral controlled drug delivery systems (05)
  - iv. Implantable therapeutic systems. (03)
  - v. Transdermal therapeutic systems. (03)
  - vi. Ocular and intrauterine delivery systems. (03)
  - vii. Bioadhesive drug delivery systems. (03)
  - viii. Proteins and peptide drug delivery (05)
  - ix. Resealed erythrocytes (02)
  - x. Colloidal drug delivery systems: Liposomes, microspheres, nanoparticles and polymeric micelles (06)
2. **Drug targeting:** Concepts and drug carrier systems. Approaches to active drug targeting: Monoclonal antibodies, Targeting to particular organs such as brain, lungs, liver and targeting to neoplastic diseases. (10)

**Books Recommended (Latest editions)**

1. Remington's Pharmaceutical Sciences.
2. Novel Drug Delivery Systems by Y.W.Chein, Marcel Dekker, Inc.
3. Controlled Drug Delivery Systems by Joseph R.Robinson and Vincent ILL.Lee.
4. Bentley's Text book of Pharmaceutics by Rawlins, EL. Publications.
5. Microencapsulation by Simon Benita, Pub. By Marcel Dekker Inc.
6. Drug Targeting and Delivery edited by H.E.Junginger
7. Specialized Drug Delivery Systems edited by Praveen Tyle, Pub. By Marcel Dekker Inc.
8. Colloidal Drug Delivery System by Jorg Kreuter.

**MPH 105: ADVANCED PHARMACEUTICAL TECHNOLOGY  
THEORY**

**Max. Marks: 100**

**Total Hours: 50 (2hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

**1. Formulation Development:**

- i. Solid dosage forms: (09)
    - a) Tablets: Improved production techniques for tablets, new materials, process, equipment improvements, high shear mixers, compression machines, coating machines, coating techniques in tablet technology for product development, physics of tablet compression and computerization for in process quality control of tablets.
    - b) Capsules: Improved techniques (semi and fully automatic) for hard and soft gelatin capsule production, new alternate materials, process development, equipment improvements, computerization for in process quality control of capsules.
  - ii. Powder dosage forms: Formulation development and manufacture of powder dosage form for internal and external use including inhalation dosage forms. (03)
  - iii. Liquid and semi-solid dosage forms: Recent advances in formulation aspects and manufacturing of monophasic dosage forms, recent advances in formulation aspects and manufacturing of suspensions and semi-solid dosage forms. (06)
  - iv. Aerosols: Advances in propellants, metered dose inhaler designs, dry powder inhalers, selection of containers & formulation aspects in aerosol formulation, manufacture & quality control. (04)
  - v. Aseptic processing operation and parenteral dosage form development: Introduction, Contamination control, Microbial environmental monitoring, Microbiological testing of water, Microbiological air testing, Characterization of aseptic process, Media and incubation conditions, Theoretical evaluation of aseptic operations. Advances in materials and production techniques for parenteral dosage forms. (08)
- 2. Scale-up Techniques:** Effect of scale up on formulation, process parameters like mixing, granulation, drying, compression, coating, packaging, stability, selection and evaluation of suitable equipments. Process Validation: Regulatory basis, Validation of solid dosage forms, Sterile products, Liquid dosage forms, Process validation of raw materials, Validation of analytical methods, Equipment and Process. (10)
- 3. Optimization:** Optimization techniques in pharmaceutical and processing: Optimization parameters, statistical design and other applications, design, development and optimization of *in-vitro* test systems to evaluate and monitor the performance of different types of dosage forms, the relevance and importance of *in-vitro/in-vivo* associations at every stage of product development and manufacture, the regulatory evolution and current thinking on this aspect, application of statistical techniques in product development and evaluation including quality control. (10)

**Books Recommended (Latest editions)**

1. Theory & Practice of Industrial Pharmacy, Lachmann & Lieberman, Varghese Publishing House, Bombay, 3rd Ed. – 1991.
2. Pharmaceutical dosage forms, Vol.1, 2, 3, H. A. Liberman, L. Lachman, Marcel Dekker, INC, 2nd Edition.
3. Pharmaceutical process validation, R. A. Nash & A. H. Wachter, Marcel Dekker, 3<sup>rd</sup> Edition, Vol.-129, 2003.
4. Pharmaceutical statistics, S. Botton, C. Bon, Marcel Dekker, 4th Edition.
5. Encyclopedia of Pharmaceutical technology-Volume: 1 to 19.
6. Pilot plants model and scale-up methods, by Johnstone and Thring.  
GMP practices for pharmaceutical-James Swarbrick.

**MPH-106: Modern Pharma. Analyt. Techniques (based on theory of MPH-101)  
PRACTICALS**

**Max. Marks: 100**

**Total Hours: 150 (6hrs/week)**

1. The practicals to be conducted should be illustrative of basic principles of theory subjects as mentioned in the scheme.
2. Experiments should be designed to show latest developments in profession of Pharmacy.
3. All laboratory exercises should be performed in a manner so that students learn applications of fundamental principles.
4. At least 20 experiments should be conducted.
5. The duration of annual practical examination shall not be less than 6 hours.

**MPH-107: Pharmaceutics-I (based on theory of MPH-102 & 103)  
PRACTICALS**

**Max. Marks: 100**

**Total Hours: 150 (6hrs/week)**

1. The practicals to be conducted should be illustrative of basic principles of theory subjects as mentioned in the scheme.
2. Experiments should be designed to show latest developments in profession of Pharmacy.
3. All laboratory exercises should be performed in a manner so that students learn applications of fundamental principles.
4. At least 20 experiments should be conducted.
5. The duration of annual practical examination shall not be less than 6 hours.

**MPH-108: Pharmaceutics-II (based on theory of MPH-104 & 105)  
PRACTICALS**

**Max. Marks: 100**

**Total Hours: 150 (6hrs/week)**

1. The practicals to be conducted should be illustrative of basic principles of theory subjects as mentioned in the scheme.
2. Experiments should be designed to show latest developments in profession of Pharmacy.
3. All laboratory exercises should be performed in a manner so that students learn applications of fundamental principles.
4. At least 20 experiments should be conducted.
5. The duration of annual practical examination shall not be less than 6 hours.

**MPH-201: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES  
THEORY**

**Max. Marks: 100**

**Total Hours: 100 (4hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **UV-VISIBLE SPECTROSCOPY:** Brief review of electromagnetic spectrum and absorption of radiations. The chromophore concept, absorption law and limitations. Theory of electronic spectroscopy, absorption by organic molecules, choice of solvent and solvent effects, modern instrumentation – design, working and principle. Interpretation of spectra. Applications of UV-Visible spectroscopy (qualitative and quantitative analysis), Woodward –Fischer rules for calculating absorption maximum, Photometric titrations and its applications. (10)
2. **FLAME EMISSION SPECTROSCOPY AND ATOMIC ABSORPTION SPECTROSCOPY:** Principle, instrumentation, interferences and applications in Pharmacy. (4)
3. **SPECTROFLUORIMETRY:** Theory, instrumentation, advantages, relationship of chemical structure to fluorescence spectra, solvent effect, effect of acids and bases on fluorescence spectra, concentration effects, factors affecting fluorescence intensity, comparison of fluorescence and UV-Visible absorption methods and applications in Pharmacy. (4)
4. **INFRARED SPECTROPHOTOMETRY:** Introduction, basic principles, vibrational frequency and factors influencing vibrational frequency, instrumentation and sampling techniques, interpretation of spectra, applications in Pharmacy. FT-IR-theory and applications. Attenuated Total Reflectance (ATR). (8)
5. **NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY:** Fundamental Principles and Theory. Instrumentation, solvents, chemical shift and factors affecting chemical shift, spin-spin coupling, coupling constant and factors influencing the value of coupling constant, spin-spin decoupling, proton exchange reactions, FT-NMR, 2D -NMR, NMDR, NOE, NOESY, COSY and applications in Pharmacy. Interpretation of spectra, <sup>13</sup>C NMR-Introduction, natural abundance, <sup>13</sup>C NMR spectra and its structural applications. (10)
6. **ELECTRON SPIN RESONANCE SPECTROSCOPY:** Theory and Principle, Limitations of ESR, choice of solvent, g-values, hyperfine splitting, instrumentation, difference between ESR & NMR and applications. (4)
7. **MASS SPECTROSCOPY:** Basic principles and instrumentation, ion formation and types, fragmentation processes and fragmentation pattern, Chemical ionization mass spectroscopy (CIMS), Field Ionization Mass Spectrometry (FIMS), Fast Atom Bombardment MS (FAB MS), Matrix Assisted laser desorption / Ionization MS (MALDI-MS), GC-MS, interpretation of spectra and applications in Pharmacy. (10)
8. **ELECTROPHORESIS:** Theory and principles, classifications, instrumentation, moving boundary electrophoresis, Zone Electrophoresis (ZE), Isoelectric focusing (IEF) and applications. (4)
9. **X-RAY DIFFRACTION METHODS:** Introduction, generation of X-rays, X-ray diffraction, Bragg's law, X-ray powder diffraction, interpretation of diffraction patterns and applications. (4)
10. **OPTICAL ROTARY DISPERSION:** Principle, Plain curves, curves with cotton effect, octane rule and its applications with examples, circular dichroism and its relation to ORD. (4)
11. **THERMAL METHODS OF ANALYSIS:** Theory, instrumentation and applications of Thermo Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) and Thermo Mechanical Analysis (TMA). (6)
12. **PARTICLE SIZE ANALYSIS:** Introduction. Particle size analyzers, theory, types and pharmaceutical applications. (4)
13. **CHROMATOGRAPHIC TECHNIQUES:** (8)
  - i. Gas Chromatography: Theory and principle, column operation, instrumentation, derivatisation methods and applications in Pharmacy.
  - ii. High Performance Liquid Chromatography: Principle, instrumentation, solvents used, elution techniques, RP-HPLC, LC-MS and applications in Pharmacy.
  - iii. HPTLC and Super Critical Fluid Chromatography (SFC): Theory and Principle, instrumentation, elution techniques and pharmaceutical applications.
14. **PHARMACOLOGICAL SCREENING** (4)
15. **PHARMACOGNOSTICAL SCREENING** (4)
16. **METHODS & TOOLS USE IN RESEARCH:** (8)
  - i. Qualitative studies, quantitative studies

- ii. Simple data organization, descriptive data analysis,
  - iii. Limitation & sources of Error
  - iv. Inquiries in form of Questionnaire, Opinionnaire or by Interview
  - v. Statistical analysis of data including variance, standard deviation, student "t" test, ANOVA, correlation data & its interpretation.
17. **DOCUMENTATION:** "How" of documentation, Techniques of documentation, Importance of documentation, Uses of Computer packages in documentation. (4)

**Books Recommended (Latest editions)**

1. M. Orchin and H.H. Jaffe – Theory and application of ultra- violet spectroscopy. (John Wiley and Sons. N.Y).
2. Silverstein, Basseler, Morrill- Spectroscopic identification of organic compounds (John Wiley and Sons. N.Y).
3. Willard, Merritt, Dean – Instrumental methods of analysis (CBS Publishers and Distributors, Delhi).
4. J.R. Dyer – Application of absorption Spectroscopy of Organic Compounds (Prentice Hall, London).
5. L.M. Jackmann and B.D. Sternhell – Application of NMR spectroscopy in organic chemistry (Pergamon Press, London.).
6. R.J. Hamilton- Introduction to High Performance Liquid Chromatography.(Chapman and Hall, London ).
7. J.W.Munson- Pharmaceutical Analysis- Modern methods –Part A and Part B (Marcel Dekker).
8. Introduction to Spectroscopy, 3<sup>rd</sup> edition, Pavia, Lampman, Kriz, Thomson Publisher.
9. Analytical chem., 2<sup>nd</sup> edition by Kellner, Mermet, Otto, Valcarcel Wiley ECH.
10. Ewing's Analytical Instrumentation Handbook, 3<sup>rd</sup> edition, edited by Jack Cazes, Marcel Dekker.
11. P.D. Sethi – Quantitative Analysis of Drugs in Pharmaceutical formulations (VBS Publishers, Delhi).
12. Pharmacopoeia of India.
13. United State Pharmacopoeia
14. British Pharmacopoeia
15. A.H. Beckett, J.B. Stenlake – Practical Pharmaceutical Chemistry, Part I and Part II (CBS Publishers Delhi).
16. D. Snell and C. T. Snell- Colorimetric Methods of analysis (Van Nostrand Reinhold Company, N.Y.).
17. Organic Spectroscopy by William Kemp.
18. Research In Education- John V. Best, John V. Kahn.

**MPH-202: ADVANCED ORGANIC CHEMISTRY  
THEORY**

**Max. Marks: 100**

**Total Hours: 50 (2hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **Chemical Kinetics & Thermodynamics:** Kinetic and thermodynamic requirements for reaction, kinetic versus thermodynamic control. Non-kinetic and kinetic methods for determining mechanisms. (4)
2. **Free radical reactions:** Formation – Detection – Reactions, Homolysis and free radical displacements – additions and rearrangements of free radicals. (2)
3. Reactions of carboxylic acids and esters, BAC2, AAC2, BAL2, BAL1, AAL1. Claisen condensation, decarboxylation, carbanions, enolisation, keto-enol equilibria. (4)
4. Stereochemistry, Molecular asymmetry, compounds with one, two or more unequal asymmetric carbon atoms, racemic modifications, Configurations-absolute, relative, synthesis of optically active compounds-cyclohexane, six membered heterocyclic rings-stereoisomerism of compounds with asymmetric plane – allenes and related compounds – stereoselective synthesis. (6)
5. **Study of individual reactions:** Allylic rearrangement, Arndt-Eistert reaction, Bayer-villegier rearrangement, Beckmann rearrangement, Bischler Napieralski synthesis, Claisen condensation, Claisen-Schmidt reaction, Dakin reaction, Curtius reaction, Dieck-Mann reaction, Diels–Alder reaction, Fittig reaction, Fries rearrangement, Gabriel synthesis, Hell-Volhard Zelinsky reaction, Knoevenagel reaction, Leuckart reaction, Mannich reaction, Perkin reaction, Pechmann reaction, Pinacol-pinacolone rearrangement. Willgerodt reaction, Wittig reaction, Wolf rearrangement, Suzuki coupling. (21)
6. Use of diazonium salt-diazomethane and peracids in synthesis. (2)
7. **Photochemistry:** Theory, energy transfer-characteristics of photoreactions- typical photo reactions. (3)
8. Concerted pericyclic reactions, electrocyclic reactions, sigmatropic rearrangements, cycloaddition reaction. (2)
9. **Green Chemistry:** Water as solvent, ionic liquids, supercritical liquids, Supported reagents and catalysts, Solvent free reactions, activation by Microwave, Ultrasound. (3)
10. Importance of functional groups in determining drug action, toxicity and stability of drugs. (3)

**Books Recommended (Latest editions)**

1. J. March, Advanced Organic Chemistry, Reaction Mechanisms and Structure, (John Wiley and Sons, N.Y).
2. E.S.Gould, Hold Rinchart and Winston, Mechanisms and structure in Organic Chemistry, New York.
3. Thomas N. Serrell, Organic Chemistry, 1st edition, (Viva Books Pvt. Ltd.)
4. Carey, Organic Chemistry, 5th edition, (Tata Mcgraw - Hill Pub. Comp. Ltd.)
5. R.A. Sheldon, Chirotechnology, (Marcell Dekker Inc., New York, 1993).
6. R.A. Aitken and S.M. Kilengi, Asymmetric Synthesis, Ed., (Blackie Academic and Professional, London, 1992).
7. Finar Vol-1 & 2, Organic Chemistry.
8. Bernard Miller, Advanced Organic Chemistry, Reaction Mechanisms, 2nd edition, (Pearson education Ptc. Ltd. Singapore).
9. Microwaves in organic and medicinal Chemistry, C.O. Kappe, A. Stadler, (Wiley-Vch).
10. Organic Chemistry, Robert Thornton Morrison, Robert Neilson Boyd, Pearson Education
11. Structure & mechanism in Organic Chemistry, C.K. Ingold, CBS Publishers.



**MPH-203: ADVANCED MEDICINAL CHEMISTRY-I  
THEORY**

**Max. Marks: 100**

**Total Hours: 50 (2hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. Physicochemical properties in relation to drug action, metabolic transformation of drugs and its role in development of new drug molecules, Metabolic antagonism. (4)
2. **Molecular concept of drug receptor interactions:** Advances in following classes of receptors and their drug ligands: Opioid, Dopamine, Adrenergic, Cholinergic, Histamine, 5-HT<sub>1A</sub>, GABA. (6)
3. Stereochemical aspects of drug receptor interactions and mechanism of drug interaction. Isosterism and bioisosterism as guides to structural variations, Concepts of conformational analysis and its role in design and development of new drug molecules. (4)
4. **Metabolism of drugs:** Role of cytochrome P-450 monooxygenase in oxidative biotransformation, oxidation of aromatic moieties, olefins, benzylic carbon, allylic carbon, carbon nitrogen systems, carbon oxygen systems, carbon sulphur systems with examples of drugs, reductive reactions involving aldehydes, ketones, nitro and azo compounds, hydrolytic reactions with examples, conjugation pathway with glucuronic acid, glycine, glutamine with specific example, acetylation and methylation of drugs. (5)
5. **Enzyme Inhibition:** Enzyme structure: primary, secondary, tertiary and quaternary. Enzyme Kinetics. Enzyme Inhibitors – Reversible, Irreversible, Keats inhibitors, Transition state analogs. Enzyme Inhibitors as drugs – ACE, leukotrienes, Lipoxygenase, Aromatase, Xanthine oxidase, DNA Polymerase Inhibitors, HIV – Protease/Reverse Transcriptase, Integrase and Cytochrome P-450 Inhibitors. (8)
6. **Synthon approach:** Definition, terms and abbreviation, rules and guidelines used in synthesis of following drugs: Rosiglitazone, Trimethoprim, Terfenadine, Ibuprofen, Fentanyl, Midazolam, Ciprofloxacin, Captopril, Diclofenac, Losartan. (10)
7. **Large-Scale Synthesis.** (3)
8. **Chemotherapy of Cancer:** Molecular Biology of Carcinogenesis. A detailed classification of antineoplastic agents, mechanisms of action of different classes; Alkylating agents and radiomimetic agents, antimetabolites their SAR studies, sex hormones and analogs, antibiotics. A mention of natural products used in cancer treatment; vinca alkaloids (Vincristine and Vinblastine), podophyllum and Taxol. (8)
9. **Nanochemistry:** Introduction and pharmaceutical relevance. (2)

**Books Recommended (Latest editions)**

1. M. Burger: Medicinal Chemistry (John Wiley & Sons N.Y.)
2. Foye: Principles of Medicinal Chemistry (Varghese & Co.)
3. Lednicer: Organic Drug synthesis Vol. 1,2,3,4 (John Wiley & Sons N.Y.)
4. Ariens: Medicinal Chemistry Series.
5. Ellis and West: Progress in Medicinal Chemistry Series.
6. Butterworth: Progress in Medicinal Chemistry Series.
7. Wilson and Gisvold: Text book of Medicinal Chemistry (J.B. Lippincott cam).
8. Comprehensive Medicinal Chemistry - Series -I-VI (Academic Press)
9. Nanochemistry: A chemical approach to nanomaterials, G Ozin, A. Arsenault, (RSCPublishing).

**MPH-204: ADVANCED MEDICINAL CHEMISTRY-II  
THEORY**

**Max. Marks: 100**

**Total Hours: 75 (3hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **Strategies for synthesis of Candidate Drug:** Target selection, Retro- synthesis (The disconnection approach, Consecutive versus convergent synthesis), Various strategic approaches including LHASA, Strategic bond approach, Strategic bond in ring approach, Degradation techniques as a tool for Retro-synthesis. (8)
2. **Microorganism in drug development:** Microbial conversions of drugs like steroids, prostaglandins and antibiotics. These should include some biotechnology-oriented topics like enzymes immobilization techniques. (10)
3. Design and applications of prodrugs. (8)
4. **Proteins and Peptide drugs:** Chemistry, structure and stability. Reactivity of proteins and peptides. Different ways to synthesize these drugs. Study of Insulin, Relaxin, Somatostatin, DNAse Interferon. (10)
5. **Recombinant DNA as a new source of drugs:** Principles of Recombinant DNA, The Process of Recombinant DNA, Drugs Produced by Recombinant DNA. (8)
6. **Designer Drugs:** What Are Designer Drugs, Illegal Designer Drugs. (3)
7. Carbohydrate based therapeutics. (8)
8. **Analogue-Based Drug Discovery:** General Aspects, Selected Examples of Analogue-Based Drug Discoveries: Esomeprazole in the Framework of Proton-Pump Inhibitor, Case Study of Lacidipine in the Research of New Calcium Antagonists, Development of Organic Nitrates for Coronary Heart Disease, Quinolone Antibiotics: The Development of Moxifloxacin, Cisplatin and its Analogues for Cancer Chemotherapy, Corticosteroids: From Natural Products to Useful Analogues. (15)
9. Medicinal Chemistry and Pharmacological Potential of Fullerenes and Carbon Nanotubes. (5)

**Books Recommended (Latest editions)**

1. M. Burger: Medicinal Chemistry (John Wiley & Sons N.Y.)
2. Foye: Principles of Medicinal Chemistry (Varghese & Co.)
3. Ariens: Medicinal Chemistry Series.
4. Ellis and West: Progress in Medicinal Chemistry Series.
5. Butterworth: Progress in Medicinal Chemistry Series.
6. Wilson and Gisvold: Text book of Medicinal Chemistry (J.B. Lippincott cam).
7. Comprehensive Medicinal Chemistry - Series -I-VI (Academic Press)
8. Computer Aided Drug Design, T.J.Perun & C.L.Propst, Marcel Dekker, Publisher.
9. Medicinal Chemistry & Drug Discovery, Alfred Burger, A.John Wiley & Sons, Inc. Publication.
10. An Introduction to Medicinal Chemistry, Graham L.Patrick Oxford University Press.
11. Fundamentals of Medical Chemistry – G.Thomas, Wiley Publication, 1stEd.–2006.
12. Carbohydrate-based Drug Discovery, Wong, C.-H., Wiley Publication.

## MPH-205: ADVANCED MEDICINAL CHEMISTRY-III

### THEORY

Max. Marks: 100

Total Hours: 50 (2hrs/week)

Note: Examiner to set seven questions and the candidates are required to attempt any five.

2. **History of Quantitative Structure-Activity Relationships (QSAR):** with detail coverage of Free- Wilson Model, Fugita- Ban Model, Hansch analysis, Electronic factors, steric factors, & hydrophobic factors. Comparison between Free- Wilson model and Hansch analysis. Molecular Connectivity Index (MCI). Recent techniques and applications in Pharmacophore Mapping. (9)
3. **3-D QSAR Analysis:** Receptor independent 3-D QSAR Analysis, Receptor dependent 3-D QSAR Analysis. Receptor pre-organization for activity and its role in identifying Ligand-binding sites on Docking molecules into protein binding sites. (8)
4. An overall treatment of various approaches to drug design including the method of variation, e.g. – Fibonacci search, Topliss tree, Craigs plot, Simplex methods, and Cluster analysis. (6)
5. Molecular modeling in drug design. (3)
6. **Drug target binding forces:** Advances in force field approaches. (2)
7. Virtual screening. (3)
8. Chemical information computing systems in drug discovery. (3)
9. **High-Throughput Screening:** Introduction and application in lead discovery. (4)
10. **Combinatorial chemistry:** High throughput organic synthesis, Solid phase organic synthesis, Solution phase synthesis, Library construction strategy, Parallel synthesis, pooled synthesis, Compound design within combinatorial library, Library diversity, controlling Molecular properties. Looking for leads, Discovery Library, Synthesis of oligomers, efficient constructions, branching strategy, leveraging knowledge, targeted libraries. The fundamentals of Pharmacophore under lying in combinatorial chemistry. (7)
11. The FDA and regulatory issues. (3)
12. Intellectual property in drug discovery. (2)

#### Books Recommended (Latest editions)

1. Textbook of Medicinal & Pharmaceutical Chemistry, Wilson & Gisvold, L. Williams & Wilkins.
2. Principles of Medicinal Chemistry, L. William.
3. Medicinal Chemistry, Alfred Burger, A John Wiley & Sons, Inc. Publication, 6<sup>th</sup> Ed.
4. Analogue-based Drug Discovery, János Fischer and C. Robin Ganellin, Wiley-VCH.
5. ADVANCED DRUG DESIGN AND DEVELOPMENT, P.N. Kourounakis and E.Rekka, ELLIS HORWOOD, NEW YORK.
6. INTRODUCTION TO THE PRINCIPLES OF DRUG DESIGN AND ACTION, H. John Smith, Taylor & Francis Group, London.

**MPH-206: Modern Pharma. Analyt. Techniques (based on theory of MPH-201)**  
**PRACTICALS**

**Max. Marks: 100**

**Total Hours: 150 (6hrs/week)**

1. The practicals to be conducted should be illustrative of basic principles of theory subjects as mentioned in the scheme.
2. Experiments should be designed to show latest developments in profession of Pharmacy.
3. All laboratory exercises should be performed in a manner so that students learn applications of fundamental principles.
4. At least 20 experiments should be conducted.
5. The duration of annual practical examination shall not be less than 6 hours.

**MPH-207: Advanced Organic chemistry (based on theory of MPH-202)**  
**PRACTICALS**

**Max. Marks: 100**

**Total Hours: 150 (6hrs/week)**

1. The practicals to be conducted should be illustrative of basic principles of theory subjects as mentioned in the scheme.
2. Experiments should be designed to show latest developments in profession of Pharmacy.
3. All laboratory exercises should be performed in a manner so that students learn applications of fundamental principles.
4. At least 20 experiments should be conducted.
5. The duration of annual practical examination shall not be less than 6 hours.

**MPH-208: Advanced Medicinal chemistry (based on theory of MPH-203 & 204)**  
**PRACTICALS**

**Max. Marks: 100**

**Total Hours: 150 (6hrs/week)**

1. The practicals to be conducted should be illustrative of basic principles of theory subjects as mentioned in the scheme.
2. Experiments should be designed to show latest developments in profession of Pharmacy.
3. All laboratory exercises should be performed in a manner so that students learn applications of fundamental principles.
4. At least 20 experiments should be conducted.
5. The duration of annual practical examination shall not be less than 6 hours.

**MPH-401: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES  
THEORY**

**Max. Marks: 100**

**Total Hours: 100 (4hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **UV-VISIBLE SPECTROSCOPY:** Brief review of electromagnetic spectrum and absorption of radiations. The chromophore concept, absorption law and limitations. Theory of electronic spectroscopy, absorption by organic molecules, choice of solvent and solvent effects, modern instrumentation – design, working and principle. Interpretation of spectra. Applications of UV-Visible spectroscopy (qualitative and quantitative analysis), Woodward –Fischer rules for calculating absorption maximum, Photometric titrations and its applications. (10)
2. **FLAME EMISSION SPECTROSCOPY AND ATOMIC ABSORPTION SPECTROSCOPY:** Principle, instrumentation, interferences and applications in Pharmacy. (4)
3. **SPECTROFLUORIMETRY:** Theory, instrumentation, advantages, relationship of chemical structure to fluorescence spectra, solvent effect, effect of acids and bases on fluorescence spectra, concentration effects, factors affecting fluorescence intensity, comparison of fluorescence and UV-Visible absorption methods and applications in Pharmacy. (4)
4. **INFRARED SPECTROPHOTOMETRY:** Introduction, basic principles, vibrational frequency and factors influencing vibrational frequency, instrumentation and sampling techniques, interpretation of spectra, applications in Pharmacy. FT-IR-theory and applications. Attenuated Total Reflectance (ATR). (8)
5. **NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY:** Fundamental Principles and Theory. Instrumentation, solvents, chemical shift and factors affecting chemical shift, spin-spin coupling, coupling constant and factors influencing the value of coupling constant, spin-spin decoupling, proton exchange reactions, FT-NMR, 2D -NMR, NMDR, NOE, NOESY, COSY and applications in Pharmacy. Interpretation of spectra, <sup>13</sup>C NMR-Introduction, natural abundance, <sup>13</sup>C NMR spectra and its structural applications. (10)
6. **ELECTRON SPIN RESONANCE SPECTROSCOPY:** Theory and Principle, Limitations of ESR, choice of solvent, g-values, hyperfine splitting, instrumentation, difference between ESR & NMR and applications. (4)
7. **MASS SPECTROSCOPY:** Basic principles and instrumentation, ion formation and types, fragmentation processes and fragmentation pattern, Chemical ionization mass spectroscopy (CIMS), Field Ionization Mass Spectrometry (FIMS), Fast Atom Bombardment MS (FAB MS), Matrix Assisted laser desorption / Ionization MS (MALDI-MS), GC-MS, interpretation of spectra and applications in Pharmacy. (10)
8. **ELECTROPHORESIS:** Theory and principles, classifications, instrumentation, moving boundary electrophoresis, Zone Electrophoresis (ZE), Isoelectric focusing (IEF) and applications. (4)
9. **X-RAY DIFFRACTION METHODS:** Introduction, generation of X-rays, X-ray diffraction, Bragg's law, X-ray powder diffraction, interpretation of diffraction patterns and applications. (4)
10. **OPTICAL ROTARY DISPERSION:** Principle, Plain curves, curves with cotton effect, octane rule and its applications with examples, circular dichroism and its relation to ORD. (4)
11. **THERMAL METHODS OF ANALYSIS:** Theory, instrumentation and applications of Thermo Gravimetric Analysis (TGA), Differential Thermal Analysis (DTA), Differential Scanning Calorimetry (DSC) and Thermo Mechanical Analysis (TMA). (6)
12. **PARTICLE SIZE ANALYSIS:** Introduction. Particle size analyzers, theory, types and pharmaceutical applications. (4)
13. **CHROMATOGRAPHIC TECHNIQUES:** (8)
  - i. Gas Chromatography: Theory and principle, column operation, instrumentation, derivatisation methods and applications in Pharmacy.
  - ii. High Performance Liquid Chromatography: Principle, instrumentation, solvents used, elution techniques, RP-HPLC, LC-MS and applications in Pharmacy.
  - iii. HPTLC and Super Critical Fluid Chromatography (SFC): Theory and Principle, instrumentation, elution techniques and pharmaceutical applications.
14. **PHARMACOLOGICAL SCREENING** (4)
15. **PHARMACOGNOSTICAL SCREENING** (4)
16. **METHODS & TOOLS USE IN RESEARCH:** (8)
  - i. Qualitative studies, quantitative studies

- ii. Simple data organization, descriptive data analysis,
  - iii. Limitation & sources of Error
  - iv. Inquiries in form of Questionnaire, Opinionnaire or by Interview
  - v. Statistical analysis of data including variance, standard deviation, student "t" test, ANOVA, correlation data & its interpretation.
17. **DOCUMENTATION:** "How" of documentation, Techniques of documentation, Importance of documentation, Uses of Computer packages in documentation. (4)

**Books Recommended (Latest editions)**

1. M. Orchin and H.H. Jaffe – Theory and application of ultra- violet spectroscopy. (John Wiley and Sons. N.Y).
2. Silverstein, Basseler, Morrill- Spectroscopic identification of organic compounds (John Wiley and Sons. N.Y).
3. Willard, Merritt, Dean – Instrumental methods of analysis (CBS Publishers and Distributors, Delhi).
4. J.R. Dyer – Application of absorption Spectroscopy of Organic Compounds (Prentice Hall, London).
5. L.M. Jackmann and B.D. Sternhell – Application of NMR spectroscopy in organic chemistry (Pergamon Press, London.).
6. R.J. Hamilton- Introduction to High Performance Liquid Chromatography.(Chapman and Hall, London ).
7. J.W.Munson- Pharmaceutical Analysis- Modern methods –Part A and Part B (Marcel Dekker).
8. Introduction to Spectroscopy, 3<sup>rd</sup> edition, Pavia, Lampman, Kriz, Thomson Publisher.
9. Analytical chem., 2<sup>nd</sup> edition by Kellner, Mermet, Otto, Valcarcel Wiley ECH.
10. Ewing's Analytical Instrumentation Handbook, 3<sup>rd</sup> edition, edited by Jack Cazes, Marcel Dekker.
11. P.D. Sethi – Quantitative Analysis of Drugs in Pharmaceutical formulations (VBS Publishers, Delhi).
12. Pharmacopoeia of India.
13. United State Pharmacopoeia
14. British Pharmacopoeia
15. A.H. Beckett, J.B. Stenlake – Practical Pharmaceutical Chemistry, Part I and Part II (CBS Publishers Delhi).
16. D. Snell and C. T. Snell- Colorimetric Methods of analysis (Van Nostrand Reinhold Company, N.Y.).
17. Organic Spectroscopy by William Kemp.
18. Research In Education- John V. Best, John V. Kahn.

**MPH-402: ADVANCED PHARMACOGNOSY  
THEORY**

**Max. Marks: 100**

**Total Hours: 50 (2hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **Chemotaxonomy of medicinal plants:** Introduction, principle of Chemotaxonomy, Role of secondary metabolites in chemotaxonomy, applications of chemotaxonomy in medical botany. (5)
2. General techniques of biosynthetic studies and application of tracer techniques in evaluation of biogenetic pathways of secondary metabolites. Factors affecting production of secondary metabolites in medicinal plants. (6)
3. **Recent advances in Pharmacognosy:** High through put screening. Role of biomarkers in crude drug analysis. Drug discovery from plant sources. (6)
4. Insecticides & pesticides of herbal origin and their suitable utilization. (2)
5. Distribution of chemical groups and its confirmation. (3)
6. Distribution of unorganized drugs in nature and its importance. (3)
7. Immunity, Immunomodulatory drugs of plant origin. (2)
8. **Marine Pharmacognosy:** 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. Potential of Indian oceans as a source of drugs. (5)
9. Antibacterial, antiviral, hypolipidemic, anti-inflammatory, anti-malarial, hepatoprotective, antidiabetics and anticancer drugs from natural origin. Their recent advances as reported in literature. Biological allergens and hallucinogens. (16)
10. **Comparative Phytochemistry:** History, concepts, applications and methods, DNA finger printing. (5)

**Books Recommended (Latest editions)**

1. Trease and Evans, Pharmacognosy, Saunders Company, London.
2. Wallis T. E., Text Book of Pharmacognosy, CBS Publishers & Distribution, Delhi.
3. Pharmacognosy, C.K. Kokate, A.P.Purohit & S.B. Gokhale, Nirali Prakashan, Pune.
4. Pharmacognosy & Phytochemistry, V.D.Rangari, Career Publication.
5. E. Ramstad, Modern Pharmacognosy, Mc-graw hill Book Company.
6. Chopra, Indigenous drug of India.
7. Wealth of India.
8. Nadkarni, Material Medica.
9. Indian Pharmacopoeia.
10. British Pharmacopoeia.
11. Martindale Extra Pharmacopoeia
12. Gunnar Samuelsson, Drugs of Natural Origin: A Textbook of Pharmacognosy.
13. Swain, T., Chemical Plant Taxonomy Academic Press, London.

**MPH-403: ADVANCED INDUSTRIAL PHARMACOGNOSY  
THEORY**

**Max. Marks: 100**

**Total Hours: 50 (2hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **Technology for production of crude drugs:** Factors involved in cultivation, collection, preservation and storage of plant drugs. Medicinal plant growth regulators. Disease management of medicinal and aromatic plants. Mutation, polyploidy, hybridization with special reference to natural drugs. (8)
2. Profiles for commercial cultivation technology and post harvest care of following medicinal and aromatic plants - Aswagandha, Senna, Ergot, Opium poppy, Aloe, Digitalis, Periwinkle, Safed musli, Ginseng, Squill, Strophanthus, Jethropha, Lemon grass, Geranium, Patchouli, Clove, Sandalwood. (8)
3. Profile for manufacture and commerce of Papain, Pectin, Starch and Gelatin. (2)
4. **Role of Medicinal Plants in National Economy:** Economic growth potential in natural health and cosmetic products. Future economic growth. Development of herbal medicine industry. (4)
5. **Worldwide trade in medicinal plants and derived products:** Demand for medicinal plants and herbal medicine. Trends in worldwide trade of Medicinal plants. International trade. Major importing-exporting regions and countries. (4)
6. **Indian trade in medicinal and aromatic plants:** Export potential of Indian medicinal herbs. Indian medicinal plants used in cosmetics and aromatherapy. Spices and their exports. (4)
7. **Plant based industry and institutions involved in work on medicinal and aromatic plants in India:** Classification of medicinal plant based industry. Production and utilization of medicinal plants and their products in India. List of medicinal plants cultivated in India. Technology sources of some Indian medicinal plants. (4)
8. **Study of infrastructure:** For different types of industries involved in making standardized extracts and various dosage forms including traditional ayurvedic dosage forms and modern dosage forms. (7)
9. **Patents:** Indian and international patent laws, Recent amendments as applicable to herbal/natural products and processes Plant breeders right. (4)
10. **Import – export of Natural Products:** Legal requirement & processing / techniques for marketing of raw material & value-added products (Medicine, food supplements, herbal cosmetics). (5)

**Books Recommended (Latest editions)**

1. Trease and Evans, Pharmacognosy, Saunders Company, London.
2. Wallis T. E., Text Book of Pharmacognosy, CBS publishers & distribution, Delhi.
3. E. Ramstad, Modern Pharmacognosy, Mc-graw hill Book Company.
4. Pridham J B, Swain T, Biosynthetic pathway in higher plants, Academic Press, New York.
5. Chopra, Indigenous drug of India.
6. Wealth of India.
7. Nadkarni, Material Medica.
8. Indian Pharmacopoeia.
9. British Pharmacopoeia.
10. Martindale Extra Pharmacopoeia.
11. Textbook of Industrial Pharmacognosy, by A. N. Kalia, CBS Publishers and Distributors. New Delhi.
12. Chaudhari R D, Herbal Drug Industry, Eastern publication.
13. PDR for Herbal Medicines, Second Ed., Medicinal Economic Company, New Jersey.
14. Gunnar Samuelsson, Drugs of Natural Origin: A Textbook of Pharmacognosy.
15. Atal, C.K., Kapur, B.M., Cultivation and Utilization of Medicinal and Aromatic Plants, R.R.L., Jammu.



**MPH-404: PLANT DRUGS: EXTRACTION, FORMULATION & STANDARDIZATION  
THEORY**

**Max. Marks: 100**

**Total Hours: 75 (3hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. **Methods of Preparation of Extracts:** Principles of extraction and selection of suitable extraction method. Different methods of extraction including maceration, percolation, hot continuous extraction, pilot scale extraction, microwave method and supercritical fluid extraction with their merits and demerits. Purification and Recovery of Solvents. (5)
2. **Standardization of Herbal Raw materials and Extracts:** Standardization of herbal raw materials including Pharmacognostical, physical, chemical and biological methods with examples. Standardization of herbal extracts, physical, chemical and spectral analysis. Qualitative and Quantitative estimation of active principles from standardized extracts by HPTLC. Biological standardization -Pharmacological screening of herbal extracts and Microbiological evaluation of herbal extracts. Toxicology studies of herbal extracts. (8)
3. **Chromatographic separation techniques:** Chromatographic techniques used in qualitative and quantitative study of phytochemicals. TLC, column chromatography, Flash chromatography, HPLC, and solid phase extraction. Their principles, operation, and application to the plant derived products. (4)
4. **Non-chromatographic separation techniques:** Chemical derivatisation-based separation methods, fractional crystallization, centrifugation, Froth-floatation technique. (2)
5. **Extraction, isolation, purification and characterization of following phytopharmaceuticals:** Alkaloids- atropine, ergometrine, morphine. Glycosides- digoxin, sennosides. Flavonoids- rutin, quercetin. Terpenoids- taxol, pyrethrin. Saponins- glycyrrhizinic acid, diosgenin. (6)
6. **Brief introduction to Pharmacological Screening Methods (*in vivo* and *in vitro* models) with example of following category of medicinal herbs:** Hepatoprotectives, Antidaibetics, Antiepileptics, Hypolipidaemics, Antioxidants, Anti-inflammatory, Analgesics. (5)
7. **Evaluation of Drugs:** Concept, considerations, parameters and methods of quality control for medicinal plant materials as per various pharmacopoeia and other guidelines. Preparation of monograph of crude drug. Comparative study of IP, European Pharmacopoeia, BP / Ayurvedic Pharmacopoeia of India / Ayurvedic formulary of India and WHO guidelines in relation to above. (6)
8. **Herbal drug standardization:** Fundamentals and comparative account of multi-component, multi-target phytotherapy and single-molecule, single-target concept of modern medicine. Conventional methods used in herbal drug standardization and their limitations. Sources of variation in chemical make-up of plant derived drugs: genotypic, ecotypic and biotypic variations and variations resulting during processing and storage. System biology approach for quality control of herbal drugs, DNA micro-array technique. (6)
9. **Analysis of Ayurvedic Formulations and crude drugs with references to:** Identity, purity and quality of crude drugs. Determination of pesticide residues, determination of arsenic and heavy metals, determination of microorganisms, determination of microbial load in crude drugs. Identification of aflatoxins in crude drugs. Quality assurance in herbal drug industry, concept of GMP and ISO-9000. (5)
10. **Formulation development and quality assurance of herbal drugs:** Difficulties in development of herbal formulations and possible remedies to overcome these problems. Formulation of dried extracts, solid and liquid dosage forms and their quality control using physical parameters. Stabilization and stability of herbal formulations, preservation of liquid formulations. Applications of Novel drug delivery systems for phytochemicals. Quality assurance in breeding, cultivation, harvesting, post harvesting, processing and storing of medicinal plants. (8)
11. **Preparation of herbal formulation:** for Diabetes, Liver disorders, Inflammation, Fever using indigenous medicinal plants. (3)
12. **Cosmetics:** Information on ingredients used in various products such as creams, powders, lotions, hair products, nail polishes, lipsticks, depilatories, toiletries etc. and their analysis. The sources and description of raw materials of herbal origin used like fixed oils, waxes, gums, hydrophilic colloids, colours, perfumes, protective agents, bleaching agents, preservatives, antioxidants and other ancillary agents. (4)

13. **Nutraceuticals:** Concept of nutritional requirements at different age, sex and in different conditions like normal, diseases, pregnancy etc.. Different types of additives used. Analysis of these nutritional and other ingredients in ethical and non-ethical foods. (3)
14. Ethno medicinal documentation of medicinal plants to be useful for preparation of herbal formulation to cure the ailments in human beings. (2)
15. Traditional approach of herbal formulation and its scientific exploration. (2)
16. Recent trends in poly-herbal medicines. (2)
17. Global regulatory status of herbal drugs. (2)
18. Clinical study of plant derived medicines. (2)

#### **Books Recommended (Latest editions)**

1. Herbal drug industry by R.D. Choudhary, 1st edition, Eastern Publisher, New Delhi: 1996.
2. GMP for Botanicals - Regulatory and Quality issues on Phytomedicine Business horizons, New Delhi, First edition, 2003. Robert Verpoorte, Pulok K Mukharjee.
3. Herbal Cosmetics - H.Pande, Asia Pacific Business press, New Delhi.
4. H.Pande, "The complete technology book on herbal perfumes and cosmetics", National Institute of Industrial Research, Delhi.
5. Quality control of herbal drugs by Pulok K Mukarjee, 1st edition, Business horizons Pharmaceutical publisher, New Delhi, 2002.
6. PDR for herbal medicines, 2nd edition, medicinal economic company, New Jersey, 2000.
7. Indian Herbal Pharmacopoeia, Vol.1&2, RRL, 1DMA, 1998, 2000.
8. Text book of Pharmacognosy by C.K. Kokate, Purohit, Gokhlae, 4th edition, Nirali Prakashan.
9. Text book of Pharmacognosy and Phytochemistry by Rangare.
10. Plant drug analysis, 2nd edition by Wagner, Bladt.
11. Biological standardization by J.N.Barn, D.J.Finley and L.G. Good win
12. Cosmetic analysis- Selective methods and Techniques by P. Borc
13. Henry,s cosmeticology- Martin M. Rieger.
14. Cosmaceuticals Drug vs Cosmetics
15. Herbal cosmetics. Beuty through Herbs- Dr. Urjita jain.
16. Morris B. Jacobs. The chemical analysis of foods and food products.
17. S. Suzanne Neilson. "Introduction to chemical analysis of foods.'
18. Jemns T Cartenson. Drug stability- Principles and Practices. 2nd edition, Marsel Deckker.
19. WHO Guide line for the quality control of herbal plant material.
20. The practical evaluation of phytopharmaceutical by Brain & Turner.
21. Wallis T. E., Text Book of Pharmacognosy, CBS publishers & distribution, Delhi
22. Ayurvedic formulary of India Govt of India.
23. Pharmacopocial standards for Ayurvedic drugs C.C.A.R.A., New delhi.
24. Clare M. Hasler, Regulation of Functional Foods and Nutraceuticals: A Global Perspective. Blackwell Publishing.
25. Iqbal Ahmad, Farrukh Aqil, Mohammad Owais, Modern Phytomedicine: Turning Medicinal Plants Into Drugs. Wiley-VCH, 2006.
26. Norman Grainger Bisset, Max Wichtl. Herbal Drugs and Phytopharmaceuticals: A Handbook for Practice on a Scientific Basis. Medpharm Scientific Publishers, 1994.

**MPH-405: PHARMACEUTICAL PLANT BIOTECHNOLOGY  
THEORY**

**Max. Marks: 100**

**Total Hours: 50 (2hrs/week)**

**Note: Examiner to set seven questions and the candidates are required to attempt any five.**

1. Historical perspectives, prospects for development of plant biotechnology as source of medical agents. Applications in pharmacy and allied fields. (3)
2. Types, techniques, nutritional requirements and growth of plant tissue cultures, Organogenesis and embryogenesis. Protoplast fusion and cultures, artificial seeds, micropropagation of medicinal and aromatic plants. Genetic stability of tissue cultures. (15)
3. Secondary metabolism in tissue cultures with emphasis on production of medicinal agents and its impact in pharmacy. Screening and selection of high yielding cell lines. Effect of cultural practices, precursors and elicitors on production of biomedicinals. (8)
4. Biotransformation, bioreactors, industrially potential tissue culture systems for pilot and large scale cultures of plant cells, cellular totipotency, cryopreservation and retention of biosynthetic potential in cell cultures. (10)
5. Immobilised plant cells culture systems, immobilization techniques, effect of immobilization on secondary metabolism and realization of chemosynthetic potential in immobilized cells. (4)
6. Techniques employed in elucidation of biosynthetic pathway, biogenesis of tropane, quinoline, imidazole, isoquinoline and indole alkaloids, sterols, anthraquinone and saponin glycosides, flavanoids and isoprenoid compounds of pharmaceutical significance. (10)

**Books Recommended (Latest editions)**

1. Industrial Microbiology, Prescott and Dunn.
2. Biochemical Engineering and Biotechnology Handbook, Atkinson, B and Marituna, F., The Nature Press, Macmillan Publ. Ltd.
3. Biochemical Engineering Fundamentals, Bailey & Olis. MGH.
4. Chemical Process Principles (Part one and two), Hougen, Watson & Ragatz, Asian Student Edition, Asia Publishing House
5. Chemical Reaction Engineering, Wiley Eastern Ltd., Levenspiel, O.
6. Fermentation and Biochemical Engineering Handbook, Vogel, H. C.

**MPH-406: Modern Pharma. Analyt. Techniques (based on theory of MPH-401)**

**PRACTICALS**

**Max. Marks: 100**

**Total Hours: 150 (6hrs/week)**

1. The practicals to be conducted should be illustrative of basic principles of theory subjects as mentioned in the scheme.
2. Experiments should be designed to show latest developments in profession of Pharmacy.
3. All laboratory exercises should be performed in a manner so that students learn applications of fundamental principles.
4. At least 20 experiments should be conducted.
5. The duration of annual practical examination shall not be less than 6 hours.

**MPH-407: Plant Drug Formulation & Standardization**

**PRACTICALS**

**Max. Marks: 100**

**Total Hours: 150 (6hrs/week)**

1. The practicals to be conducted should be illustrative of basic principles of theory subjects as mentioned in the scheme.
2. Experiments should be designed to show latest developments in profession of Pharmacy.
3. All laboratory exercises should be performed in a manner so that students learn applications of fundamental principles.
4. At least 20 experiments should be conducted.
5. The duration of annual practical examination shall not be less than 6 hours.

**MPH-408: Pharmaceutical Plant Biotechnology**

**PRACTICALS**

**Max. Marks: 100**

**Total Hours: 150 (6hrs/week)**

1. The practicals to be conducted should be illustrative of basic principles of theory subjects as mentioned in the scheme.
2. Experiments should be designed to show latest developments in profession of Pharmacy.
3. All laboratory exercises should be performed in a manner so that students learn applications of fundamental principles.
4. At least 20 experiments should be conducted.
5. The duration of annual practical examination shall not be less than 6 hours.

