JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

M. Pharmacy (PHARMACEUTICAL CHEMISTRY)

COURSE STRUCTURE AND SYLLABUS
Effective from Academic Year 2017-18 Admitted Batch

I Year – I Semester

Category	Course Title	Int. marks	Ext. marks	L	P	C
Core Course I	Advanced Organic Chemistry-I	25	75	4	--	4
Core Course II	Advanced Medicinal Chemistry-I	25	75	4	--	4
Core Course III	Chemistry of Natural Products	25	75	4	--	4
Core Elective I	1. Modern Pharmaceutical Analytical Techniques 2. Intellectual Property Rights	25	75	4	--	4
Open Elective I	1. Drug Regulatory Affairs 2. Pharmacoepidemiology and Pharmacoeconomics 3. Pharmaceutical management 4. Drug Discovery & Design 5. Phytochemistry	25	75	4	--	4
Laboratory I	Advanced Organic Chemistry Lab-I	25	75	-	6	3
Laboratory II	Chemistry Of Natural Products Lab	25	75	--	6	3
Seminar I	Seminar	100	--	--	4	2
Total Credits		**275**	**525**	**20**	**16**	**28**

I Year – II Semester

Category	Course Title	Int. marks	Ext. marks	L	P	C
Core Course IV	Advanced Organic Chemistry -II	25	75	4	--	4
Core Course V	Pharmaceutical Process Chemistry	25	75	4	--	4
Core Course VI	Advanced Medicinal Chemistry II	25	75	4	--	4
Core Elective II	1. Biostatistics And Research Methodology 2. Stability of Drugs and Dosage forms	25	75	4	--	4
Open Elective II	1. Screening Methods in Pharmacology 2. Spectral analysis 3. Entrepreneurship management 4. Nano Based Drug Delivery Systems 5. Herbal & Cosmetics analysis	25	75	4	--	4
Laboratory III	Advanced Organic Chemistry-II Lab	25	75	--	6	3
Laboratory IV	Advanced Medicinal Chemistry – II Lab	25	75	--	6	3
Seminar II	Seminar	100	--	--	4	2
Total Credits		**275**	**525**	**20**	**16**	**28**

II Year - I Semester

Course Title	Int. marks	Ext. marks	L	P	C
Comprehensive Viva-Voce	--	100	--	--	4
Project work Review II	100	--	--	24	12
Total Credits	**100**	**100**	--	24	**16**

II Year - II Semester

Course Title	Int. marks	Ext. marks	L	P	C
Project work Review III	100	--	--	8	4
Project Evaluation (Viva-Voce)	--	100	--	16	12
Total Credits	**100**	**100**	**--**	**24**	**16**

$ For Project review I, please refer 7.9 in R17 Academic Regulations

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I Sem M. Pharm (Pharmaceutical Chemistry)

ADVANCED ORGANIC CHEMISTRY – I (Core course I)

Course Objectives: The course structure is designed to give the knowledge of organic chemistry at an advanced level and mainly aimed at the stereochemistry and different organic named reactions including preparations of reactive intermediates.

Course Outcome: The student would be in position to design a stereoselective synthesis of new chemical entities (NCE) for the treatment of different diseases in new drug discovery programme.

UNIT - I

a. Stereochemistry: **a.** Elements of symmetry, simple axis of symmetry. Notation, relative configuration, and absolute configuration .Compounds with a chiral carbon atom, compounds with other quadrivalent chiral atoms. Optical isomerism in compounds containing no chiral atom, biphenyl, allenes, compounds with exocylic double bonds and spirans.
b. Chirality due to helical shape.cis / trans, E – Z isomerism resulting from double bonds, monocyclic compounds, fused ring system. Racemic modifications and methods for resolution of racemic mixtures. Asymmetric synthesis and stereo – selective synthesis.

UNIT - II

a. Reactive Intermediates**:** Definitions, generation, stability, structure and reactivity of free radicals carbocations, carbanions, carbenes, Nitrenes/Nitrenium ions.
b. Concepts of aromaticity and antiaromaticity, nonbenzenoid aromatic compounds.

UNIT - III

Mechanisms of organic reactions: Free radical, Electrophilic, Nucleophilic reactions of aliphatic and aromatic compounds

UNIT - IV

Elimination Reactions: E_1, E_2, E_{1CB} and E_{2CB} mechanisms, Mechanisms and orientation in pyrolytic eliminations, effect of substrate structure, attacking base, leaving group and reaction bond, medium and reactivity addition to carbon – carbon multiple bond reactions. Mechanisms, Orientation and reactivity.

UNIT - V

Electrocyclic, pericyclic and sigmotropic reactions: Introduction, terminology and mechanism, with suitable examples.

RECOMMENDED BOOKS:

1. Francis A. Carey & Richard J. Sunberg, Advanced Org. Chemistry , III rd Edition, Par B; Reactions and synthesis , Plenum Press, new York , London , Latest Edition.
2. Eliel I. Ernest and Samuel h, Stereochemistry of Org. Compounds, John Wiley and sons, New York, 2003 Edition.
3. Roland E. Lehr & Alan P Marchard, Orbital Symmetry: A Problem solving approach, Academic Press, New York Latest Edition.
4. J. March , Advanced Org. Chemistry , Reactions Mechanisms and Structure, 4th
5. Edition, John Wiley & Sons , New York Latest Edition
6. I. L. Finar , Organic Chemistry , ELBS

7. Herbert O. Modern Synthesis Reactions IInd Edition W.A. Beenamis Inc. Menco Park California
8. W. Carruthers, Some Modern Methods of Org. Synthesis, III rd Edition, Cambridge University Press, Cambridge.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I Sem M. Pharm. (Pharmaceutical Chemistry)

ADVANCED MEDICINAL CHEMISTRY – I (Core course II)

Course Objectives: The course contents are mainly aimed to have advanced knowledge of rational drug design including QSAR and molecular modeling and also aimed at the identification of lead molecule from natural sources for the development of new drugs.

Course Outcome: The student would be in a position to have detailed knowledge of computer aided drug design which is useful to involve in new drug discovery programme by the utilization of natural leads and also with the help of structure based drug design.

UNIT - I

Modern methods of Drug Discovery target validation: Introduction to discovery of lead molecule, methods, rational drug discovery models. Target structure, active site identification and methods of validation.

UNIT - II

Rational Drug Design: QSAR: Parameters involved in QSAR, lipophilicity (Polarisabiltiy, electronic and steric parameters). Quantitative models. Hansch Analysis, Free Wilson Analysis and their relationships, linear relationships and applications of Hansch and Free Wilson Analysis.

UNIT - III

a. Computer aided drug design (CADD):

Virtual screening: concept, drug likeness screening, focused screening libraries for lead identification, pharmacophore screening, structure based virtual screening and applications.

Molecular modeling: Molecular mechanics, quantam mechanics, modeling ligands for known receptors and unknown receptors.

b. Drug Design: Introduction, Pharmacophase – based drug design, Known receptors, structure – based drug design, homology modeling, unknown receptors.

UNIT - IV

Natural Products as Leads for New Drugs: Introduction/History, approaches to discovery and development of natural products as potential new drugs, selection and optimization of lead compounds for further developments from CNS, anticancer antibiotics and cardiovascular drugs.

UNIT - V

Structure based drug design: Inhibitors of HIV-I Prokinase, Structural studies of HIV-I Reverse transcriptase and implications for drug design, Bradykinin receptor antagonists, Design of purine nucleoside and Phosphorylase inhibitors, Aldose Reductase Inhibitors, Thrombin inhibitors. Rhinoviral-Capsid-biding Inhibitors.

RECOMMENDED BOOKS:

1. Berger's Medicinal Chemistry and Drug Design. 6th Edition.
2. Korolkovas Essentials of Medicinal Chemistry
3. Purcell Strategies of Drug Design
4. Corwin , Hansen Comprehensive Medicinal Chemistry
5. William O Foye Medicinal Chemistry
6. Structure based Drug Design by Pandi Veerapandian.
7. Stenlake , Foundation of Molecular Pharmacology- Pharma Med Press, volume I &II

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – ISem M. Pharm. (Pharmaceutical Chemistry)

CHEMISTRY OF NATURAL PRODUCTS (Core course III)

Course Objective: The contents of Unit I mainly aimed to identify lead molecules from the natural sources. The contents of Unit II &III are mainly designed to have the knowledge of alkaloids and steroids especially structural elucidation of few important compounds. The contents of Unit IV and V are to offer an understanding of utilization of natural products for the preparation of new molecules for the treatment of different diseases like cancer, malaria etc.

Course Outcome: the student would be in a position to explore the natural lead compounds for the treatment of different diseases like cancer, malaria, diabetes etc.

UNIT - I

Natural products as leads for new drugs: Introduction/history, approaches to discovery and development of natural products as potential new drugs selection and optimization of lead compounds for further development with suitable examples from antibiotics, CNS, and cardiovascular agents.

UNIT - II

Alkaloids: Introduction and general methods of structure elucidation.

From opium: morphine-structure elucidation, development of morphine analogues and morphine antagonists.

From Rauwolfia: Reserpine-structure eludication, structural modifications and uses.

From vincarosea: vincristine and vinblastine - structural modification, semisynthetic derivatives and uses.

UNIT - III

Steroids: Introduction, nomenclature, stereochemistry of steroids. Source and structure elucidation of cholesterol and diosgenin.

Structures, structure modifications and therapeutic uses of steroidal anti-inflammatory agents and antifertility agents.

UNIT - IV

Polypeptides and proteins: introduction and general methods of separation, general methods of degradation and end group analysis, general methods of synthesis of peptides. Primary, secondary, tertiary and quaternary structure of proteins; chemistry of insulin.

UNIT - V

Compounds of medicinal Interest: Structure, structural modifications, mechanism of action and therapeutic uses of a) taxanes b) camptothecin c) artemisinin e) ginkgolides and f) gymnemic acids.

Recommended Books:

1. Finar IL. Organic Chemistry-stereochemistry and the chemistry of natural products. 5th ed. vol 2. Delhi: Dorling Kindersley (India) Pvt. Ltd., 2006.
2. Morrison RT, Boyd RN. Organic Chemistry. 6th ed. Delhi: Pearson education Pvt. Ltd., 2003.
3. Pelletier SW. Alkaloids-chemical & biological perspectives. vol 1-15. London: Pergamon; 2001.
4. Steroids by Fischer & Fischer.
5. Evans WC. Trease and evans pharmacognosy. 15th ed. Edinburgh: Saunders. 2004.
6. Ataur Rahman. Chemistry of natural products

7. Bhat SV, Nagasampagi BA, Sivakumar M. Chemistry of natural products. New Delhi: Narosa Publishing House; 2005.
8. Agrawal OP. Organic chemistry-natural products. 30th ed. vol 1-2. Meerut: Goel Publishing House; 2006.
9. Wallis TE. Textbook of pharmacognosy. 5th ed. New Delhi: CBS Publishers & Distributors; 2002.
10. Abraham DJ, editor. Burger's medicinal chemistry and drug discovery. 6th ed. vol 1-6, Singapore: John Wiley & Sons, 2007.
11. Lemke TL, Williams DA, Roche VF, Zito SW. Foye's principles of medicinal chemistry. 6th ed. New Delhi: Wolters Kluwer/ Lippincott Williams & Wilkins. 2008.
12. Block JH, Beale JM, editor. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry. 11th ed. Baltimore: Lippincott Williams & Wilkins; 2004.
13. Jerry M. Advanced organic chemistry-reactions, mechanisms, and structure. 4th ed. Kundli: Replika Press Pvt. Ltd; 2003.
14. Murray RK, Granner DK, Mayes PA, Rodwell VW. Harper's Illustrated biochemistry. 26th ed. New Delhi: McGraw Hill, 2003.
15. Rama Rao AVSS. A text book of biochemistry. 9th ed. Delhi: Rajkamal electric press, 2004.
16. Remington: The science and practice of pharmacy. 21st ed., vol. I & II, Lippincatt Willams & Wilkings, New Delhi, 2005.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I Sem M. Pharm (Pharmaceutical Chemistry)

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES (Core Elective - I)

Course Objective: The course is designed to impart the knowledge in the field of Pharmaceutical Analysis. The various modern analytical techniques like UV-Visible, IR, NMR, MS, GC, HPLC, different chromatographic methods and other important topics are taught to enable the students to understand and apply the principles involved in the determination of different bulk drugs and their formulation. In addition to the theoretical aspects, the basic practical knowledge relevant to the analysis is also imparted.

Course Outcome: The appreciable knowledge will be gained by the students in the Modern Analytical Techniques and can apply the theories in the Analysis of various bulk drugs and their formulations. The students will also be in a position to apply their knowledge in developing the new methods for the determination and validate the procedures

UNIT - I

Introduction to chromatography and classification of chromatographic methods based on the mechanism of separation

a. Column Chromatography: Adsorption and partition, theory, preparation, procedure and methods of detection
b. Thin Layer Chromatography: Theory, preparation, procedures, detection of compounds
c. Paper Chromatography: Theory, different techniques employed, filter papers used, qualitative and quantitative detection
d. Counter – current extraction, solid phase extraction techniques, gel filtration

UNIT - II

a. Gas chromatography: Introduction, fundamentals, instrumentation, columns: preparation and operation, detection, dramatization.
b. **HPLC**: Principles and instrumentation, solvents and columns used, detection and applications
c. **HPTLC**: Theory and principle, instrumentation, elution techniques and pharmaceutical applications

UNIT - III

a. UV-Visible spectroscopy: Introduction, electromagnetic spectrum, absorbance laws and limitations, instrumentation-design and working principle, chromophore concept, auxochromes, Wood-Fisher rules for calculating absorption maximum, applications of UV-Visible spectroscopy
b. IR spectroscopy: Basic principles-Molecular vibrations, vibrational frequency, factors influencing vibrational frequencies, sampling techniques, instrumentation, interpretation of spectra, FT-IR, theory and applications

UNIT - IV

Mass spectroscopy: Theory, ionization techniques: electron impact ionization, chemical ionization, field ionization, fast atom bombardment, plasma desorption, fragmentation process: types of fission, resolution, GC/MS, interpretation of spectra and applications for identification and structure determination

UNIT - V

NMR: Theory, instrumentation, chemical shift, shielding and deshielding effects, splitting of

signals, spin-spin coupling, proton exchange reactions, coupling constant(J), nuclear overhauser effect(NOE), ^{13}CNMR spectra and its applications, 2D-NMR, COSY and applications in pharmacy

REFERENCES:

1. Instrumental Methods of Chemical Analysis by B. K Sharma
2. Organic spectroscopy by Y.R Sharma
3. A Text book of Pharmaceutical Analysis by Kerrenth A. Connors
4. Vogel's Text book of Quantitative Chemical Analysis by A.I. Vogel
5. Practical Pharmaceutical Chemistry by A.H. Beckett and J.B. Stenlake
6. Organic Chemistry by I. L. Finar
7. Organic spectroscopy by William Kemp
8. Quantitative Analysis of Drugs by D. C. Garrett
9. Quantitative Analysis of Drugs in Pharmaceutical Formulations by P. D. Sethi
10. Spectrophotometric identification of Organic Compounds by Silverstein
11. HPTLC by P.D. Seth
12. Indian Pharmacopoeia 2007
13. High Performance thin layer chromatography for the analysis of medicinal plants by Eike Reich, Anne Schibli
14. Introduction to instrumental analysis by Robert. D. Braun

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I SemM.Pharm (Pharmaceutical Chemistry)

INTELLECTUAL PROPERTY RIGHTS (Core Elective - I)

Course Objective: Various types of Intellectual Property Rights Patentable Subject History of Indian Patent Protection, Patent filing procedure in India, Opposition- pre-grant opposition and post-grant opposition, Patent filing procedure under PCT, advantages, patent search and literature and Salient features of Indian Patents are discussed in detail.

Course Outcome: The clear information about the patent laws, intellectual property rights and drug regulation in India and abroad is gained by the students.

UNIT - I

Introduction, Types of Intellectual Property Rights (Patents, Trademarks, Copyrights, Geographical Indications Industrial Designs and Trade secrets), Patentable Subject Matter (Novelty, Non-Obviousness, Utility, enablement and Best mode),

UNIT - II

a. History of Indian Patent Protection, Rationale behind Patent System, Objectives and Advantages of Patent System, and future challenges. Indian Patents Act 1970, Definitions and Key Terminology, Types of Patent applications, Inventions not patentable (section 3 and 4).
b. Patent filing procedure in India (Patent Prosecution), Specifications (Provisional and Complete), Claims- types of claims and legal importance of claims, Grant of patent, Rights of Patentee and co-owners
c. Opposition- pre-grant opposition and post-grant opposition, Anticipation, Infringement, Compulsory Licensing, revocation of patents, and power of Controller.
d. Patent filing procedure under PCT, advantages, patent search and literature

UNIT - III

a. Salient features of Indian Patents (Amendments) Act 1999, 2002 and 2005. US and European Patent System,

b. Background, Salient Features and Impact of International Treaties / Conventions like

1. Paris Convention, Berne convention
2. World Trade Organization (WTO)
3. World Intellectual Property Organization (WIPO)
4. Trade Related Aspects of Intellectual Property Rights (TRIPS)
5. Patent Co-operation Treaty (PCT), Madrid Protocol

UNIT - IV

a. PCT Application procedure and review procedure
b. National phase application procedure for US& EU
c. Patent prosecution procedure in US and EU
d. WIPO and its role in IPR
e. Hatch- Waxman provision for IPR

UNIT - V

a. Patent in validation process in India, US and Europe
b. IPR related to copyright, trade mark, trade secret and geographical indication.
c. Patent application writing
d. Claim construction and claims.

RECOMMENDED BOOKS:

1. Research Methodology concepts and cases by Depak Chawla, Neena Sondhi
2. Draft manual of Patent Practice and Procedure -2008 , The Patent Office, India
3. Manual of Patent Office Practice and Procedure -2010
4. Original Laws Published by Govt. of India
5. Protection of Industrial Property rights by P.Das and Gokul Das
6. Law and Drugs, Law Publications by S.N. Katju
7. Laws of drugs in India, Hussain
8. New drug approval process, 5th edition, by Guarino
9. Commercial Manual on Drugs and Cosmetics 2004, 2nd edition
10. Drugs and Cosmetics act by Vijay Malik
11. Good Manufacturing Practices for Pharmaceuticals, S.H. Wiling, Vol. 78, Marcel Decker.
12. fda.org,wipo.int,patentlawlinks.com, hc-sc.gc.ca,ich.org,cder.org
13. Current good manufacturing practices for pharmaceuticals by Manohar A. Potdar

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I SemM.Pharm (Pharmaceutical Chemistry)

DRUG REGULATORY AFFAIRS (Open Elective – I)

Course Objective: The topics which are present in the Drug regulatory affairs are very much useful which increases the knowledge regarding the regulatory aspects in the pharmaceutical industries.

Course Outcomes:

- Students will come to know the different competent regulatory authorities globally.
- Students be aware of technical aspects pertaining to the marketing authoritization application (MAA)
- The regulatory guidelines and directions framed by the regulatory authorities will be helpful to place the drug products in market for marketing approvals.

UNIT - I

A study of regulatory aspects that affect drug product design, manufacture and distribution in India with special emphasis on the detailed study of the following Acts (with latest amendments)

UNIT - II

The Drugs and Cosmetics Act, 1940 and Rules there under. Recent amendments to Drugs and Cosmetic Act and other relevant rules.

Drugs (Price Control) Order in force. Loan license (contract manufacture). Certification and licensing procedures.

UNIT - III

A detailed study of regulatory aspects that affect drug product design, manufacture and distribution in a developed country such as USA and in a developing country such as Brazil, Hatch Waxmann Act;

Bolar Provisions and other FDA Regulations. Regulatory aspects of pharmaceutical and bulk drug manufacture, regulatory drug analysis.

UNIT - IV

Documentation related to manufacturing, cleaning methods, retention samples and records, quality control, batch release documents, distribution records, complaints and recalls.

Quality, safety and legislation for cosmetic products and herbal products.

UNIT - V

Governing Regulatory Bodies across the globe.

Country Authority Submission

a. U.S Food & Drug Administration USDMF
b. Canada Therapeutic Product Directorate DMF
c. Europe

1) European Medicines Agency (EMEA/ National Authorities) EDMF
2) European Directorate for Quality of Medicines CEP/COS & Health Care Products

d. Product Filing
e. Responding Regulatory Deficiencies
f. Final Approval Procedure

Preparation, review, and submission of Drug Master Files to Regulatory Authorities as per their specific requirements.

TEXT AND REFERENCE BOOKS:

1. Original laws published by Govt. of India.
2. Text Book of Forensic Pharmacy by Mithal B. M.; Vallabh Prakashan, New Delhi.
3. Laws of Drugs in India by Hussain.
4. Text Book of Forensic Pharmacy by Jain N. K.; Vallabh Prakashan, New Delhi.
5. Pharmaceutical Regulatory Affairs - Selected Topics, CVS Subramanyam and J Thimmasetty, Vallabha Prakashan Delhi - 2013

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I Sem M. Pharm. (Pharmaceutical Chemistry)

PHARMACOEPIDEMIOLOGY & PHARMACOECONOMICS (Open Elective – I)

Course Objective:
This course enables students to understand various pharmacoepidemiological methods and their clinical applications. Also, it aims to impart knowledge on basic concepts, assumptions, terminology, and methods associated with Pharmacoeconomics and health related outcomes, and when should be appropriate Pharmacoeconomic model should be applied for a health care regimen.

Course Outcome: Upon completion of this course it is expected that students shall be able to:

- Understand the various epidemiological methods and their applications
- Understand the fundamental principles of Pharmacoeconomics.
- Identify and determine relevant cost and consequences associated with pharmacy products and services.
- Perform the key Pharmacoeconomics analysis methods
- Understand the Pharmacoeconomic decision analysis methods and its applications.
- Describe current Pharmacoeconomic methods and issues.
- Understand the applications of Pharmacoeconomics to various pharmacy settings.

UNIT- I
Introduction to Pharmacoepidemiology:
Definition, Scope, Need, Aims & Applications; Outcome measurement: Outcome measures, Drug use measures: Monetary units, Number of prescriptions, units of drug dispensed, defined daily doses, prescribed daily doses, Diagnosis and Therapy surveys, Prevalence, Incidence rate, Monetary units, number of prescriptions, unit of drugs dispensed, defined daily doses and prescribed daily doses, medications adherence measurements. Concept of risk: Measurement of risk, Attributable risk and relative risk, Time- risk relationship and odds ratio

UNIT- II
Pharmacoepidemiological Methods:
Qualitative models: Drug Utilization Review; Quantitative models: case reports, case series, Cross sectional studies, Cohort and case control studies, Calculation of Odds' ratio, Meta analysis models, Drug effects study in populations: Spontaneous reporting, Prescription event monitoring, Post marketing surveillance, Record linkage systems, Applications of Pharmacoepidemiology

UNIT- III
Introduction to Pharmacoeconomics:
Definition, history of Pharmacoeconomics, Need of Pharmacoeconomic studies in Indian healthcare system. Cost categorization and resources for cost estimation: Direct costs. Indirect costs. Intangible costs. Outcomes and Measurements of Pharmacoeconomics: Types of outcomes: Clinical outcome, Economic outcomes, Humanistic outcomes; Quality Adjusted Life Years, Disability Adjusted Life Years Incremental Cost Effective Ratio, Average Cost Effective Ratio. Person Time, Willingness To Pay, Time Trade Off and Discounting.

UNIT- IV
Pharmacoeconomic evaluations:
Definition, Steps involved, Applications, Advantages and disadvantages of the following Pharmacoeconomic models: Cost Minimization Analysis (CMA), Cost Benefit Analysis (CBA), Cost

Effective Analysis (CEA), Cost Utility Analysis (CUA), Cost of Illness (COI), Cost Consequences Analysis (COA).

UNIT - V

Definition, Steps involved, Applications, Advantages and disadvantages of the following:

Health related quality of life (HRQOL): Definition, Need for measurement of HRQOL, Common HRQOL measures. Definition, Steps involved, Applications of the following: Decision Analysis and Decision tree, Sensitivity analysis, Markov Modeling, Software used in pharmacoeconomic analysis, Applications of pharmacoeconomics.

REFERENCES:

1. Rascati K L. Essentials of Pharmacoeconomics, Woulters Kluwer Lippincott Williams & Wilkins, Philadelphia.
2. Thomas E Getzen. Health economics. Fundamentals and Flow of Funds. John Wiley & Sons, USA.
3. Andrew Briggs, Karl Claxton, Mark Sculpher. Decision Modelling for Health Economic Evaluation, Oxford University Press, London.
4. K G Revikumar, Pharmacoepidemiology and Pharmacoeconomics Concepts and Practices.
5. Michael Drummond, Mark Sculpher, George Torrence, Bernie O'Brien and Greg Stoddart. Methods for the Economic Evaluation of Health Care Programmes Oxford University Press, London.
6. George E Mackinnon III. Understanding health outcomes and pharmacoeconomics.
7. Graker, Dennis. Pharmacoeconomics and outcomes.
8. Walley, Pharmacoeconomics.
9. Pharmacoeconomic – ed. by Nowakowska – University of Medical Sciences, Poznan.
10. Relevant review articles from recent medical and pharmaceutical literature
11. Guru Prasad Mohanta and P K Manna, Textbook of Pharmacovigilance Concepts and Practice

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I SemM.Pharm (Pharmaceutical Chemistry)

PHARMACEUTICAL MANAGEMENT (Open Elective – I)

Course Objective: The topics which are present in the pharmaceutical management are very much useful to the students in personality development become a perfect pharma professional.

Course Outcomes:

- These topics are useful for the students to know how to manage a pharma industry and its various departments viz QA, QC, RA, Production etc.
- Along with this it aids the students to develop leadership qualities, communication &interpersonal skills, decisions making, motivation, organization &various managerial functions &professional skills required for a dynamic professional.
- Management helps to understand the concept of managerial control, its levels &role, importance in pharma industry

UNIT - I

Pharmaceutical Management: Meaning, Evolution-scientific, administrative and human relation approach. Process of management: Planning, organizing, staffing, directing, coordinating and controlling–a preliminary idea of concepts, processes and techniques.

UNIT - II

Fundamental concepts of production, financial, personal, legal and marketing functions with special reference to Pharmaceutical Management. Introduction to budgeting, costing, accounting, auditing, and budgetary control. Entrepreneurship development.

UNIT - III

Understanding organizations: Meaning, process, types of organization structures and departmentation, line/staff authority, promoting organizational culture. Organizations, pharmaceutical services and functioning of hospital pharmacy, bulk drug unit, formulation unit, Ayurvedic and Unani manufacturing units and testing labs etc.

UNIT - IV

Professional Mangers; Tasks, responsibilities and skills needed. Leadership; Styles and managing change. Decision Making; Types, procedures, evaluation and selection of alternatives, decision making under various situations. Management information and decision support systems and time management.

Personnel Management: Job Analysis, recruitment, selection, orientation and training, performance appraisal and compensation. Retrenchment, lay off and discharge.

UNIT - V

Management of Industrial Relations: Industrial disputes, settlement of disputes through various routes such as bargaining, etc.

Motivational aspects, theories of motivation, group dynamics, rewards and incentives, interpersonal skills, significance of communication, its processes, measures for effective communication, conflict management. Stress management.

TEXT AND REFERENCE BOOKS:

1. Marketing Management by Philip Kotlar; Prentice-Hall of India Ltd., New Delhi.
2. Management and Organization by Louis A. Allen; McGraw Hill, Tokyo.

3. Corporate Strategy by Ansoff, H.T.; McGraw Hill, New York.
4. Modern Management by Hempran David R.; McGraw Hill, New York.
5. Management by Stoner and Freeman; Prentice Hall, New Delhi.
6. Motivation and Personality by Maslow, Abraham, Harper & Row, New York.
7. Management of Organizational Behavior, Utilizing the Human Resources by Harcey, Paul and Blanchard Kenneth; Prentice Hall of India, New Delhi
8. Organization Structure, Process and out comes V thEdition Richard. H. Hall
9. Principles and Methods of Pharmacy Management III rd Edition Harry A. Smith.
10. Management “Global Perspective Heinz Weihrich, Harold Koontz by Tata Mcgraw Hill”.
11. Personnel Management and Industrial Relations by P. C. Tripathi.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I Sem M. Pharm. (Pharmaceutical Chemistry)

DRUG DISCOVERY AND DESIGN (Optional Elective – I)

Course Objective: The topics are framed to enhance the student's knowledge in the various areas of molecular modelling, molecular docking, pharmacophore concepts, drug design techniques with detail concepts of all the mentioned areas.

Course Outcome: This enables the students to get a broad idea on the drug discovery mechanisms, its related terms and concepts of designing of drugs.

UNIT - I

Molecular modelling: Molecuelar Mechanics, Quantum Mechanics, Energy minimization, geometry optimization, conformational analysis, global conformational minima determination; approaches and problems. Bioactive vs. Global minimum conformations. Automated methods of conformational search. Advantages and limitations of available software. Molecular graphics. Molecular properties, reactivity, Homo, Lumo, Electrostatic potential, Solvent accessible surface.

UNIT - II

Pharmacophore concept: Pharmacophore mapping, methods of conformational search used in pharmacophore mapping. Comparison between the popular pharmacophore methods like Catalyst/HipHop, DiscoTech, GASP with practical examples, 3D QSAR Techniques.

UNIT - III

Design of drugs for the following biological targets Agent acting on enzymes: DHFR, HIV-protease HMG-CoA Reductase, Phosphodiesterase, ACE, Transpeptidase, β-lactamase. Agents acting on receptors: PPAR, protein kinases. Agents acting on Nucleic acids: Topoisomerase, DNA and RNA polymerase, HIV-Reverse transcriptase

UNIT - IV

Molecular docking: Rigid docking, flexible docking, manual docking. Advantages and disadvantages of Flex-X, Flex-S, Autodock and Dock softwares, with successful examples. Molecular dynamics: Dynamics of drugs, biomolecules, drug-receptor complexes, Monte Carlo simulations and Molecular dynamics in performing conformational search and docking. Estimation of free energy from dynamical methods.

UNIT - V

De Novo drug design techniques: Receptor/enzyme cavity size prediction. Predicting the functional components of cavities, designing drugs fitting into cavity. Active site analysis structure – based drug design. Informatics methods in drug design: Informatics methods in drug design: Brief introduction to bioinformatics, chemoinformatics.

REFERENCES:

1. Robert GCK, ed., "Drug Action at the Molecular Level" University Prak Press Baltimore.
2. Martin YC. "Quantitative Drug Design" Dekker, New York.
3. Lien EJ. SAR "Side effects and Drug Design" Dekker, New York.
4. William H, Malick JB "Drug Discovery and Development" Humana Press Clifton.
5. Molecular Modelling, by A. R. Leach
6. Organic Chemistry of Drug Design and Drug Action, by R.B. Silverman
7. Practical Applications of computer aided drug design, by P.S. Charifson

8. Molecular modeling in Drug Design, by C. Cohen
9. Chemical Applications of Molecular modeling, by J. Goodman
10. Pharmacophore perception, by O.F. Guner

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I Sem M. Pharm. (Pharmaceutical Chemistry)

PHYTOCHEMISTRY (Open elective - I)

Course Objective: Helps the students to get exposed to natural product drug discovery and to perform quantitative and qualitative evaluation of herbal extracts. To understand the chemistry of important phytoconsitituents of different categories.

Course Outcome: On the basis of chemistry data of phytoconsitituents students will acquire knowledge on various types of phytoconstituents present in the plants.

UNIT - I

Extraction and Phytochemical studies: Recent advances in extractions with emphasis on selection of method and choice of solvent for extraction, successive and exhaustive extraction and Methods of fractionation. Separation of phytoconstituents by latest CCCET, SCFE techniques including prep and Flash column chromatography.

UNIT - II

Sources, Chemical structure, Identification tests, mechanism of action, SAR and uses of following Alkaloids

a) Caffeine

b) Quinine, Reserpine, Atropine, Vinca alkaloids

c) Morphine and brief account on its derivatives and analogues

UNIT - III

Sources, Chemical structure, Identification tests, mechanism of action SAR , uses and semi-synthetic derivatives of the following phytopharmaceuticals:

Camptothecin, Podophyllotoxin, Taxol, Digoxinand Artemisinine

UNIT - IV

Structure elucidation of the following compounds by spectroscopic techniques like UV, IR, NMR (1H, 13C)

a. Carvone, Citral, Menthol

b. Luteolin, Kaempferol

c. Nicotine, Caffeine

UNIT - V

Drug discovery and development: History of herbs as source of drugs and drug discovery. Sourcing and archiving Natural products for discovery. Evaluating natural products for therapeutic properties, Identifying the biologically active Natural products, the lead structure selection process and structure development with suitable examples from the following source: artemesin, and rographolides.

RECOMMENDED/ REFERENCE BOOKS:

1. Phytochemical methods of chemical analysis by Harbone
2. Modern methods of plant analysis- peach & M.V. Tracey Vol. 1 to VII
3. Pharmacognosy & Phytochemistry of medical plants by Jean Brunton
4. Thin layer chromatography by Stahl
5. Chemistry of natural products by AturRahman
6. Comprehensive Medicinal Chemistry, Vol 1-6, Elsevier Publication

7. Medicinal Chemistry Drug Discovery by Donald J, Abrahm,
8. Plant drug analysis by Wagner
9. Clarke's isolation & identification of drugs by AC Mottal
10. Chromatography of Alkaloids by Varpoorte Swendson
11. Jenkins Quantitative pharmaceutical chemistry by AN Kenwell
12. Standardization of botanicals by V. Rajpal Vol 1 & 2
13. Medicinal chemistry and drug discovery by Burger's
14. Chemistry of Natural Products by S. V. Bhat, B. A. Nagasampagi, M. Sivakumar
15. Herbal Drugs: Quality and Chemistry by D. D. Joshi

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – I Sem M. Pharm. (Pharmaceutical Chemistry)

ADVANCED ORGANIC CHEMISTRY LAB I

List of Experiments: (Minimum of 10 experiments shall be conducted)

1. Synthesis and characterization of the following drugs:

a. Benzanilide by Beckmann rearrangement
b. 4-Benzylidene-2-methyloxazol-5-one (or) azalactone
c. N-(m-Nitrobenzyl) aniline from m-nitrobenzaldehyde
d. 2, 3-Diphenyl quinoxaline
e. 1H-Indole-3-carboxaldehyde
f. 3, 4-Dihydropyrimidin-2(1H)-one from benzaldehyde, ethyl acetoacetate and urea in presnce of $CaCl_2$ (catalyst).
g. Schiff base by microwave irradiation
h. Cinnamic acid by Perkin reaction
i. β-Ddimethylaminopropiophenone hydrochloride (Mannich base)
j. 2-Phenyl indole
k. Dimedone (5,5-dimethyl cyclohexane-1,3-dione)
l. 3-Bromo cyclohexene from cyclohexene using NBS.
m. p-Amino benzyl alcohol from p-amino benzaldehyde using sodium borohydride.
n. Cyclohexane-2,5-dicarboxylic acid from benzoic acid (hydrogenation).

2. Any other relevant experiments based on theory.

REFERENCES:

1. 1. Roth HJ, Kleemann A. Pharmaceutical Chemistry. Vol-I. Drug synthesis. New York: Ellis Horwood Limited; 1988.
2. Mann FG, Saunders BC. Practical organic chemistry. 4th ed. New Delhi: Orient Longman; 2005.
3. Furniss BS, Hanaford AJ, Smith PWG, Tatchell AR. Vogel's textbook of practical organic chemistry. 5th ed. Singapore: Longman Singapore Publishers P Ltd; 1989.
4. Vogel A. Elementary practical organic chemistry. Part 1: Small scale preparations. 2nd ed. New Delhi: CBS publishers and distributors; 2004.
5. Bansal RK. Laboratory manual of organic chemistry. 4th ed. New Delhi: New Age International (P) limited; 2005.
6. Kar A. Advanced Practical Medicinal Chemistry. New Delhi: New Age International (P) limited; 2006.

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

I Year – II Sem M. Pharm. (Pharmaceutical Chemistry)

CHEMISTRY OF NATURAL PRODUCTS - LAB

List of Experiments: (Minimum of 8 experiments shall be conducted)

1. Isolation and characterization of the following natural products:
a. Piperine from black pepper
b. Hesperidin from orange peel.
c. Strychnine from Nux vomica seeds.
d. Curcumin from turmeric powder.
e. Lycopene from tomatoes.
f. Myristicin and trimyristicin from nutmeg.
g. Tannic acid from myrobalan.
h. Isolation of casein from milk.
i. Lysozyme from albumen.

2. Extraction and estimation of carvone from caraway seeds.

3. Separation of natural products through column chromatography.

4. Degradation and characterization of degradation products of
a) Piperine b) Atropine and c) Caffeine.

5. Any other relevant experiments based on theory.

REFERENCES:

1. Raphel I. Natural products: a laboratory guide. 2nd ed. New Delhi: Elsevier, 2005.
2. Kokate CK. Practical pharmacognosy. New Delhi: Vallabh Prakashan.
3. Khandelwal KR. Practical pharmacognosy. Pune: Nirali Prakashan.
4. Rangari VD. Pharmacognosy & phytochemistry. Part II. Nashik: Career Publications; 2004.
5. Qadry JS. Shah and Qadry's pharmacognosy. 12th ed. Ahmedabad: B. S. Shah Prakashan; 2005.