JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

(Established by an Act No.30 of 2008 of A.P. State Legislature)

Kukatpally, Hyderabad – 500 085, Andhra Pradesh (India)

M. Pharm. (PHARMACEUTICAL CHEMISTRY)
COURSE STRUCTURE AND SYLLABUS

I Year I Semester

Code	Group	Subject	L	P	Credits
		Modern Pharmaceutical Analytical Techniques	3	0	3
		Advanced biostatistics and research methods	3	0	3
		Advanced Pharmaceutical Organic Chemistry – 1	3	0	3
		Advanced Medicinal Chemistry – I	3	0	3
		Advanced Medicinal Chemistry-II	3	0	3
	Lab	Modern Pharmaceutical Analytical Techniques Practical	0	3	2
	Lab	Advanced Pharmaceutical Organic Chemistry Practical	0	3	2
		Seminar	-	-	2
		Total Credits	15	6	21

I Year II Semester

Code	Group	Subject	L	P	Credits
		Intellectual Property Rights & Regulatory Affairs	3	0	3
		Pharmacological Screening methods and clinical research	3	0	3
		Advanced Medical Chemistry-III	3	0	3
		Advanced Chemistry of natural Products	3	0	3
		Advanced Pharmaceutical Organic Chemistry-II	3	0	3
	Lab	Advanced Medical Chemistry-III Practical	0	3	2
	Lab	Advanced Chemistry of Natural Products Practical	0	3	2
		Seminar	-	-	2
		Total Credits	15	6	21

II Year - I Semester

Code	Group	Subject	L	P	Credits
		Comprehensive Viva	-	-	2
		Project Seminar	0	3	2
		Project work	-	-	18
		Total Credits	-	3	22

II Year - II Semester

Code	Group	Subject	L	P	Credits
		Project work and Seminar	-	-	22
		Total Credits	-	-	22

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – I Sem M.Pharm (Pharm. Chemistry)

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

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, Mass, 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.

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}C NMR spectra and its applications, 2D-NMR, COSY and applications in pharmacy

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.

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

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – I Sem M.Pharm (Pharm. Chemistry)

ADVANCED BIOSTATISTICS AND RESEARCH METHODS

Objective: The student shall know the introduction, scope of biostatistics and Research work, calculation and present of all data. It also informs the students, how the present research work writing and correlating.

UNIT I

Introduction and scope of biostatistics: Use of statistics in Pharmacy. Population and Sample collection. Stages of research, types of data and methods of data collections. Data arrangement and presentation, formation of table and charts.

UNIT II

Measures of central tendency: computation of means, median and mode from grouped and ungrouped data.
Measure of dispersion: computation of variance, standard deviation, standard error and their coefficients.

UNIT III

Measures of Correlation and Regression: Experimental designing, planning of an experiment, replication and randomization. Probit analysis.
Probability rules: Binomial, Poison and Normal distribution.
Hypothesis testing: Student't' test, Chi square test, Analysis of Variance (ANOVA): 1-way, 2-way, 3-ways

UNIT IV

Developing a research question, Resources for research question,
Literature Review: Traditional Qualitative Review,
Meta-Analysis—A Quantitative Review
Preparation of Research Proposal
Variables—Definition of Variable, Types of variables (Dependent and Independent variables, Confounded variables), Measurement of variables, Types of measurement scales and their comparison. Reliability and Validity of Measurements.

UNIT V

The research report paper writing/ thesis writing
Different parts of the research paper

1. Title-Title of project with authors' name
2. Abstract – Statement of the problem, Background list in brief and purpose and scope
3. Key words
4. Methodology- subject, apparatus, instrumentation and procedure
5. Results – tables, graphs figure and statistical presentation
6. Discussion support or non-support of hypothesis, practical and theoretical implications
7. Conclusion
8. Acknowledgements
9. References
10. Errata
11. Importance of Spell check for entire projects
12. Uses of footnotes

Outcome: The student will be known the Biostatistics arrangement, presentation and formation of tables and charts. They also know the correlation and regression & application of different methods, analysis of data and also learn how to write dissertation, thesis and Research paper.

Text Books

1. Deepak Chawla Neena Sondhi, Research Methodology Concepts and Cases, Vikas books publishers
2. Donald H. McBurney -Theresa L. White "Research Methods" (Cengage learning India Pvt. Ltd)

Reference Books

1. Remington"s Pharmaceutical Sciences
2. Theory & Practice of Industrial Pharmacy by Lachman
3. Statistics for business and economics 3rd edition by Vikas books publications
4. Biostatistics & Computer applications by GN Rao and NK Tiwari
5. Sokal, R.R. and Rohlf, F.J. 1987. An Introduction to Biostatistics. W.H. Freeman and Company.
6. Bailey, N.T.J. 1981. Statistical Methods in Biology. English University Press.
7. Mitchell, K. and Glover, T. 2001. Introduction to Biostatistics. McGraw Hill, Publishing Co.
8. Biostatistics and Computer Applications by G.N. Rao and N.K. Tiwari
9. Fundamentals of Biostatistics by Khan and Khanum
10. Research Methodology by RK Khanna bis and Suvasis Saha
11. Research methods and Quantity methods by G.N.Rao
12. A practical approach to PG dissertation.

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – I Sem M.Pharm (Pharm. Chemistry)

ADVANCED PHARMACEUTICAL ORGANIC CHEMISTRY – I

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.

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 mechanis, with suitable examples.

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.

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 Edition, John Wiley & Sons , New York Latest Edition
5. I. L. Finar , Organic Chemistry , ELBS
6. Herbert O. Modern Synthesis Reactions II nd Edition W.A. Beenamis Inc. Menco Park California
7. W. Carruthers, Some Modern Methods of Org. Synthesis, III rd Edition, Cambridge University Press, Cambridge.

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – I Sem M.Pharm (Pharm. Chemistry)

ADVANCED MEDICINAL CHEMISTRY – I

Objectives: The content of this syllabus is designed to give the knowledge of different theories of drug actions at molecular level and also to identify different targets for the development of new drugs for the treatment of infectious and GIT, CNS diseases. Also aimed at different Phase I and Phase II reactions of drug metabolism.

UNIT I

a. **Genesis of New Drugs**: Serendipity, Random Screening, Extraction of active principles from Natural Sources, Molecular Modification of known drugs, Selection or Synthesis of Soft drugs, Drug latentiation and rational drug design.

b. **Theoretical Aspects of Drug Action**

Types of drug action, Physiochemical parameters and pharmacological activity, Nonempirical Electronic parameters, steric parameters and Stereochemical aspects of Drugs. Drug Receptors, Receptor types and isolation, Drug Receptor Interaction, theories of drug action, mechanism of drug action.

UNIT II

Targets for the development of following chemotherapeutic agents: Antitubercular, Antimalarial , Antifungal, Immunomodulators, Antiamoebic drugs.

UNIT III

Targets for the development of following pharmacodynamic agents: Antiulcer, Analgesic, Antiinflammatory, Antiatherosclerotic, Anti- angiogenesis, antihypertensives.

UNIT IV

Biotransformation of drugs: Prodrug approach, Soft Drug approach, enzymes responsible for biotransformation, microsomal and non microsomal mechanisms. Factors influencing enzyme induction and inhibition.

UNIT V

Design of Local anesthetics, diuretics, Anti- HIV, anticancer, Introduction, general considerations on the development of new drugs, classical and rational procedures for the development of local anesthetics

Outcome: The student would be equipped with the advanced knowledge of identification of different targets in different diseases. The student will be able to involve in drug discovery programmers' including lead identification, design of pro drug and their metabolic pathways.

Recommended Books

1. Richard B. Silvermann, Org. Chemistry of Drug Design and drug Action.
2. Berger's Medicinal Chemistry and Drug Design. 6th Edition.
3. Korolkovas Essentials of Medicinal Chemistry
4. Purcell Strategies of Drug Design
5. Alfred Berger Biochemical Basis of Drug Design
6. Corwin , Hansch Comprehensive Medicinal Chemistry, 1-6 volume
7. William O Foye Medicinal Chemistry
8. Testa B and Jenner P. Drug Metabolism Chemical & Biochemical Aspects, Marcel Dekker
9. Ariens. Drug design medicinal chemistry a series of monograph-volume 11- III, academic press, an imprint of Elsevier pub.
10. Durai Raj, Compendiem of Organic Medicinal compounds, Pharma Med Pres, Hyderbad – 2013, 1-6 volumes.

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – I Sem M.Pharm (Pharm. Chemistry)

ADVANCED MEDICINAL CHEMISTRY – II (Drug Design)

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.

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. Molecular Modeling: Introduction, molecular methods, Known receptors, 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.

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.

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 Veerapandion.
7. Stenlake , Foundation of Molecular Pharmacology- Pharma Med Press, volume I &II

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – I Sem M.Pharm (Pharm. Chemistry)

MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES LAB

List of experiments

1. Colorimetry/ UV/ Visible, Spectroscopy, scanning of few compounds for UV-absorption, calculation of Assay/ content uniformity / % of drug release (2-3 experiments.)
2. Estimation of multi components formulation by UV of two different methods
3. Experiment base on HPLC (Isocratic and gradient) Techniques (2 experiments)
4. Incompatibility studies, identification and functional groups. Determination by FTIR (2 experiments)
5. Separation and calculation of Rf values by using paper chromatography, TLC, HPTLC Technique (2-3 experiments)
6. Interpretation of spectra and structure determination of Mass Spectroscopy
7. Separation of protein drug substances by electrophoresis.
8. Workshop on IR and NMR interpretation
9. Development and evaluation of drugs by derivative spectroscopy.

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – I Sem M.Pharm (Pharm. Chemistry)

ADVANCED PHARMACEUTICAL ORGANIC CHEMISTRY PRACTICAL 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-Ddimethylamino propiophenone 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.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.

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – II Sem M.Pharm (Pharm. Chemistry)

INTELLECTUAL PROPERTY RIGHTS AND REGULATORY AFFAIRS

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.

Intellectual Property Rights:

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
i. Paris Convention, Berne convention
ii. World Trade Organization (WTO)
iii. World Intellectual Property Organization (WIPO)
iv. Trade Related Aspects of Intellectual Property Rights (TRIPS)
v. Patent Co-operation Treaty (PCT), Mandrid Protocol

Regulatory Affairs

UNIT IV
a. National Drug Regulatory requirements, National Drug Policy, Drugs and Cosmetics Act and its amendments, overview of schedules, detail study of schedule M and Schedule Y.
b. USFDA, FDA guidelines on IND, NDA and ANDA approvals, and SUPAC changes and understanding on 505 (b) (2) applications

UNIT V
a. Requirement of GLP Guidance and recommendation on Dissolution and Bio-equivalence requirement. Types of ANDA filing (Para I, II, III, IV filing). Exclusivities (NCE, NS, NP, NDF, PED, ODE, PC)
b. ICH objectives and Guidelines- stability testing, WHO guidelines, ISOs- Production design, certification. ICH 8(QbD), ICH Q9 and ICHQ10

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

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

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – II Sem M.Pharm (Pharm. Chemistry)

PHARMACOLOGICAL SCREENING METHODS AND CLINICAL RESEARCH

Objective: The students is going to study about various techniques for screening of drugs for various pharmacological activities and guide lines for handling animals and human and animal ethics for screening of drugs.

UNIT I
Care Handling and breeding techniques of laboratory animals, Regulations for laboratory animals, CPCSEA guidelines, alternatives to animal studies, Good laboratory Practices.

UNIT II
Bioassays: Basic principles of Biological standardization: Methods used in the bio-assay of Rabbis Vaccine, Oxytocin, Tetanus Antitoxin and Diphtheria Vaccine. Test for pyrogens.

UNIT III
Toxicity tests: OECD guidelines, determination of LD50, acute, sub-acute and chronic toxicity studies.

UNIT IV
Organization of screening for the Pharmacological activity of new substances with emphasis on the evaluation cardiac, psychopharmacological, anti-inflammatory, analgesic and anti-diabetic.

UNIT V
Clinical evaluation of new drugs, Phases of clinical trial, protocol design, Ethics in human research.

Outcome: The expected outcomes are student will know how to handle animals and know about various techniques for screening drugs for different pharmacological activities and guidelines and regulations for screening new drug molecules on animals and human volunteers.

Text Books:
1. Screening methods in Pharmacology, Vol.-1&2 by Robert .A. Turner and Peter Hebborn.
2. Drug discovery and evaluation by H.G.Vogel and W.H.Vogel, Springerverlag, Berlin Heideleberg.
3. Handbook of experimental pharmacology by S.K. Kulkarni, Vallabh Prakashan, Delhi.
4. Textbook of clinical trials edited by David Machin, Simon Day and Sylvan green.
5. Principles of clinical research edited by Giovanna di ignazio, Di Giovanna and Haynes

Reference Books:
1. ICH of technical requirements for registration of pharmaceuticals for human use, ICH harmonized tripartite guidelines - Guidelines for good clinical practice, E6, May 1996.
2. Good clinical practice - Guidelines for Clinical trials on pharmaceutical products in India, Central drug standard control organization, New Delhi, Minister of Health- 2001.

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – II Sem M.Pharm (Pharm. Chemistry)

ADVANCED MEDICINAL CHEMISTRY – III

Objective: The course contents of Unit I and Unit II are mainly aimed at enzyme inhibitors for the treatment of different CNS and CVS diseases. Unit III contents are aimed to have advanced knowledge of the developments of antipsychotic agents. The remaining contents are aimed to design prodrugs, peptidomimetic agents and recombinant DNA products.

UNIT I
Enzyme Inhibitors I: A detailed study of the following types of enzyme inhibitors, related drugs and their pharmaceutical significance:
a. Prostaglandin Synthetase (Cycloxygenase & Lipoxygenase Inhibitors)
b. Phosphodiesterase (PDE) Inhibitors
c. Carbonic Anhydrase Inhibitors.

UNIT II
Enzyme Inhibitors II:
a. Angiotensin Converting Enzyme (ACE) Inhibitors
b. Acetyl Cholinesterase (Ach E) Inhibitors.
c. HMG-CoA inhibitors

UNIT III
Antipsychotic Agents: Role of Dopamine, Serotonin, Glutamate and their receptors. SAR and Pharmacokinetics of Ticyclic Neuroleptics, Butyrophenones and Benzamides. A brief account of non – benzodiazepine agonist.

UNIT IV
Peptidmimetic agents & Prodrugs
a.Physiological role of peptids, Endogenous peptide transmitters & function, cyclosporin and oxytocin
b. Prodrugs belong to esters, Lactones, amides, hydrazides and azo compounds. Targetted prodrug, bioprecurror of prodrugs

UNIT V
Biotechnologically produced drugs : Biotechnology of Recombinant DNA, Process of Recombinant proteins, Immunogencity of biotechnologically produced drugs.
Recombinant drug products: Hormones, cytokinins, interferons, Interleukins, enzymes, vaccines and monoclonal antibody drugs.

Outcome: The student would be in a position to involve in the development of different enzyme inhibitors, prodrugs and also equipped with different biotechnological techniques of recombinant DNA products.

Recommended Books
1. Berger's Medicinal Chemistry and Drug Design. 6th Edition
2. Korolkovas Essentials of Medicinal Chemistry
3. William O Foye Medicinal Chemistry
4. Lednicer, Organic Chemistry of Drug Synthesis
5. Ariens ,Drug Design , Academic Press
6. Purcell Strategies of Drug Design
7. Corwin , Hansen Comprehensive Medicinal Chemistry
8. Richard B. Silvermann, Org. Chemistry of Drug Design and drug Action
9. Smith and Williams , Introduction to principles of Drug Design – Harwood Academy Press
10. Gyorgy Keri & Istdan Toth Molecular Pathomechanism and New Trends in Drug Research, Taylor & Francis Pub
11. Thomas Nogrady, Medicinal Chemistry. A biochemical Approach, Oxford Univ. Press.

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – II Sem M.Pharm (Pharm. Chemistry)

ADVANCED CHEMISTRY OF NATURAL PRODUCTS

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.

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 vinca rosea: 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.

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.

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: Mc Graw 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.

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – II Sem M.Pharm (Pharm. Chemistry)

ADVANCED PHARMACEUTICAL ORGANIC CHEMISTRY – II

Objective: The content of Unit I and II are mainly aimed at utilization of different synthetic reagents used in the preparation of intermediates and final compounds and also aimed at the principles of green chemistry. Unit III and IV contents are mainly aimed at scale of processes for the preparation of new pharmaceutical agents and also to design different synthetic strategies. Unit V is mainly aimed to utilize the knowledge of chemical library for drug design.

UNIT I
Synthetic Reagents & Applications: Lead Tetra Acetate (LTA), N- Bromosuccinimide (NBS), Osmium Tetroxide, Lithium Aluminum Hydride (LAH) and Sodium Borohydride, Dicyclohexyl carbodimide (DCC) and 2,3-dichlro-5,6-dicyano-1,4-benzoquinone (DDQ).

UNIT II
a. Unit Process in Organic Synthesis: Catalytic hydrogenation, Nitration, Sulphonation, Halogenation, Amination, Acetylation, Esterification and Hydrolysis.
b. A brief account on Green Chemistry: Principles and applications

UNIT III
a. Scale Up Techniques for process optimization, Maximization of productivity, in – process control techniques with examples.
b. Molecular Rearrangements & their applications:
Carbon to Carbon Migration: Wagner – Meerwin rearrangement, Claisen rearrangement and benzil – benzilic acid rearrangement.
Carbon to Nitrogen Migration: Hoffmann rearrangement, Curtius rearrangement and Lossen rearrangement, Beckman rearrangement.
Carbon to Oxygen Migration: Bayor – Villiger rearrangement, Rearrangement of hydro peroxides and Wittig rearrangement.

UNIT IV
Synthetic Strategies: Introduction to disconnection approach, consecutive vs convergent synthesis, various strategic approaches in retro synthesis, strategic bond approach preliminary scan, criteria in disconnection of strategic bonds, identifying strategic bonds in rings.

UNIT V
Combinatorial Chemistry: Introduction, sokid phase techniques, parallel synthesis, mixed combinatorial chemistry, diconvulution techniques, tagging, photolithography, limitations of combinatorial chemistry, planning and designing of combinatorial synthesis.

Outcome: The student would be in a position to have advanced knowledge of different synthetic reagents and reaction processes, synthetic routes by involving green chemistry principles. The student would also have techniques to utilize the chemical library of combinatorial chemistry.

Recommended Books
1. W. Carruthers , Some Modern Methods of Org. Synthesis , III rd Edition , Cambridge University Press, Cambridge(1988)
2. Groggins, Unit process in Org. Synthesis, McGraw Hill Book Crop.
3. S. Warren, Org. Synthesis. The Disconnection Approach, J. Wiley & Sons. NY
4. Gorgy Keri and Istarian Toth , Molecular Patho-mechanisms and New Trends in Drug Research – Taylor and Francis Group ,London 2003
5. R.K. Mackie , A Guidebook to Organic Thesis – Prentice Hall
6. T.W. Greene and PGM Warts ,Protecting Groups – John Willey
7. Michael B. Smith , Organic Synthesis

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations
JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
I Year – II Sem M.Pharm (Pharm. Chemistry)

ADVANCED MEDICINAL CHEMISTRY PRACTICALS – III

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

1. Synthesis and characterization of the following drugs:
   a. Phenacetin
   b. Antipyrin
   c. Benzocaine
   d. Uramil
   e. Tolbutamide
   f. Phenothiazine
   g. Isoniazid
   h. Sulphasalazine
   i. aspirin from salicylic acid
   j. paracetamol from p-aminophenol

2. Determination of partition coefficient of any medicinal compound by shake flask method.

3. Any other relevant experiments based on theory.

References:

1. Lednicer D, Mitscher LA, The organic chemistry of drug synthesis, Volume-1-6. New York: A wiley-interscience publication; 2005.
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.
7. Indian Pharmacopoeia. Controller of Publication. Delhi, 1996.
8. British Pharmacopoeia. British Pharmacopoeia Commission Office, London, 2008.
9. United States Pharmacopoeia. United States Pharmacoepial Convention, Inc, USA, 2003.

M. Pharm. (PHARMACEUTICAL CHEMISTRY)-R13 Regulations

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

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

ADVANCED CHEMISTRY OF NATURAL PRODUCTS PRACTICALS

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.