DEPARTMENT: PHARMACEUTICAL CHEMISTRY

M.PHARM SCHEME

FIRST YEAR

Subject Code	Subject	Teaching Scheme			Marking System			
		Theory (Hrs)	Practical (Hrs)	Total Hours	Theory		Practical	
					External	Internal	External	Internal
08200101	Modern Analytical Techniques (Common)	3	4	7	100	50	100	50
08202101	Research Methodology and Global Regulations	4	-	4	100	50	-	-
08202102	Logic in Organic Chemistry	3	6	9	100	50	100	50
08202103	Advance Medicinal Chemistry	3	6	9	100	50	100	50
		Total Hour		29				

SECOND YEAR

Subject Code	Subject	Marking System	
		External	Internal
	Introduction to Dissertation	30	20
	Dissertation – Thesis	20	50
	Dissertation – Open defense	60	20
Total Marks		110	90

SUJECT NAME: MODERN PHARMACEUTICAL ANALYTICAL TECHNIQUES

Objective of the course:

To make students familiar with the principles of modern analytical techniques and application of analytical instruments in pharmacy

Students learning outcomes/objectives:

A] Knowledge:

1. Students will able to analysis of various drugs in single and combination dosage forms

2. The student will be able to understand the fundamental concept of modern analytical techniques, which is important for qualitative as well as quantitative analysis of drug substances and drug product

3. Illuminate relevance & significance of Advance analytical techniques to Pharmaceutical Sciences.

4. Understand the basic principles of chromatographic, spectroscopic and scattering methods.

5. Apply spectroscopic methods for analysis of Raw materials and Formulation.

6. Develop an in-depth knowledge and critical awareness of the application of modern analytical methods.

7. Understand and apply different spectroscopic and separation on raw materials

8. Explain types, instrumentation and applications of spectroscopic, chromatographic and separation techniques

9. Define and compare the terms used in spectroscopic methods like UV-VIS Spectroscopy, IR Spectroscopy, NMR and Mass Spectroscopy.

10.Understand & apply the theory and operational principles of UV-VIS Spectroscopy, IR Spectroscopy etc .

11.Understand the basic concepts and applications of Mass Spectroscopy.

12.Elucidate structure of organic compounds by various spectroscopic methods.

B. Skills:

Clarify and understand the correct use of laboratory instruments like UV-Visbile spectrophotometer, High Performance Liquid Chromatography , Flame Photometer with calibration of various instruments used in pharmaceutical analysis laboratory together with safety measures to be followed.

Develop practical hand in analytical methods by estimation of analyte concentration in pure form and in formulation with thorough understanding of principle and procedures used in different analytical techniques.

Develop UV and HPLC method for simultaneous estimation of Drugs

Various advanced analytical instrumental techniques for identification, characterization and quantification of drugs using IR, HPLC and TLC

THEORY (4 HOURS/WEEK)

Chapter No.	Topics	Hours Allotted
1	**UV-VISIBLE SPECTROSCOPY** Theory of UV-Spectroscopy, absorption law and limitations, choice of solvent and solvent effects. Applications of UV-Visible spectroscopy, Woodward–Fischer rules for calculating absorption maximum, interpretation of spectra, multi-component assay, difference spectra and derivative spectra.	06
2	**INFRARED SPECTROPHOTOMETRY:** Introduction, basic principles, and sampling techniques, interpretation of spectra, applications in Pharmacy. FT-IR, Attenuated Total Reflectance (ATR), near infrared Spectroscopy (NIR) -theory and applications,.	06
3	**NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY:** Fundamental Principle 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, simplification of complex spectra, FT-NMR, 2D -NMR and applications in Pharmacy, interpretation of spectra. C13 NMR-Introduction, Natural abundance, C13 NMR Spectra and its structural applications.	08
4	**MASS SPECTROMETRY** Principle, Theory, Instrumentation of Mass Spectroscopy, Different types of ionization like electron impact, chemical, field, FAB and MALDI, Analyzers of Quadrupole and Time of Flight, Mass fragmentation and its rules, Fragmentation of important functional groups like alcohols, amines, carbonyl groups and alkanes, Meta stable ions, Mc Lafferty rearrangement, Ring rule,	08

	Isotopic peaks, Tandem Mass Instruments, Interpretation and Applications of Mass spectroscopy	
5	**ATOMIC ABSORPTION AND PLASMA EMISSION SPECTROSCOPY:** Principle, instrumentation, interferences and applications in Pharmacy.	**04**
6	**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	**04**
7	**OPTICAL ROTARY DISPERSION:** Principle, Plain curves, curves with cotton effect, octant rule and its applications with example, circular dichroism and its relation to ORD.	**03**
8	**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).	**04**
9	**CHROMATOGRAPHIC TECHNIQUES:** a) Classification of chromatographic methods based on mechanism of separation. Theories of chromatographic separation. b) Principles, elution techniques, instrumentation, derivatization and applications of gas chromatography, HPLC and HPTLC. c)Principles, elution techniques, applications of ion exchange and ion pair chromatography, affinity chromatography, size exclusion chromatography, and chiral chromatography, super fluid chromatography (SFC), GC-MS, UPLC and LC-MS-stability studies and its applications.	**15**
10	**ELECTROPHORESIS:** Principle, Instrumentation, Working conditions, factors affecting separation and applications of the following: a) Paper electrophoresis b) Gel electrophoresis c) Capillary electrophoresis d) Zone electrophoresis e) Moving boundary	**03**

	electrophoresis f) Iso electric focusing	
11	**RADIO IMMUNO ASSAY:** Introduction, Principle, Theory and Methods in Radio Immuno Assay, Related Immuno Assay procedures and applications of RIA Techniques. Enzyme immuno assay- ELISA and EMIT	**03**
12	**REFERENCE STANDARDS** Source, preparation, characterization, usage, storage , records and Concept of Working standard.	**02**
13	**ELECTRON MICROSCOPY:** Introduction to Scanning Electron Microscopy and Travelling Electron Microscopy.	**02**
14	**PREFORMULATION**	**07**

SUJECT NAME: RESEARCH METHODOLOGY AND GLOBAL REGULATION

Objective of the course:

Regulatory Affairs courses are conceptualized with vision to create effective Regulatory Affairs for Pharma Market.

Students learning outcomes/objectives:

A] Knowledge:

1. To impart clear understanding on various essential elements of Drug Regulatory Affairs
2. To provide theoretical knowledge on various essential topics: Regulatory Introduction and Authorities, Regulatory Requirements, ICH Guidelines etc.
3. The learner will have knowledge of fundamentals & history of drug regulatory requirements in India and other countries.
4. The learner is able to understand the need of the documents & process required to file a new product in various countries.
5. Analyze how emerging developments and trends are reshaping medical device regulations
6. Regulatory approval process and registration procedures for drug products in US, EU, Japan, Australia, UK and Canada.

THEORY (4 HOURS/WEEK) **CREDITS: 4**

RESEARCH METHODOLOGY

S. No.	Topics	Hours Allotted
1.	**INTRODUCTION TO RESEARCH** Introduction to research and research methodology: Meaning of research, Objectives of research, Motivations in research, different types of research, research approaches, steps involved in research process, Significance of research.	2
2.	**LITERATURE SURVEY & RESEARCH PROBLEM FORMULATION** Purpose, Methods and Use of literature survey, locating relevant information, use of library & electronic databases, patent data base, preparation & presentation of literature review, research article reviews, identification of gaps in research, selecting the problem, formulation of research problem, definition of research objectives, preparing research proposals	8
3.	**SCIENTIFIC WRITING & PRESENTATION** Research report and thesis writing (Title, abstract, key words, introduction, methodology, results, discussion, conclusion, acknowledgement, references), types of research paper (research articles, review article, short communications), instructions to Authors, steps involved in the process of publications (registration, new article submission, submitting articles electronically, review process, tracking the process, submitting revised articles), importance of publishing a research paper, Citations, Citation index, Quality indices, Impact factor, etc. Importance, types, content, posters, oral presentation, importance of body language -posture, gestures, eye contact, facial expressions, stage, fright, volume, pitch, speed, pause & language, visual aids & seating, questionnaire.	9

4.	**PROJECT PROPOSALS** a) **COST MANAGEMENT:** Different types of cost, Cost analysis of the project- cost incurred on raw materials, procedure, instrumentations & clinical trials. b) **RESEARCH GRANTS**: Introduction to various research funding organization and their funding schemes (AICTE, UGC, CSIR, ICMR, DST, DBT, GUJCOST, etc.) c) **INDUSTRY- INSTITUTION COLLABORATION:** Industrial-institution interaction, Industrial projects, significance, feasibility reports. d) **MORALS:** Issues related to plagiarism, collaborative models and ethics, acknowledgements.	**8**
5.	**Introduction to Experimental Design** Basic Biostatistics used in experimental design: Study of F Test, t test, Chi Square Test, ANOVA and Normal Distribution in Pharmacy. Numerical Problems related to above. Introduction to Design of Experiments, Terminologies used in Experimental Design such as factors, levels, confounding, Response, Screening, Optimization, etc. Application of Experimental Design in various pharmaceutical fields. Methods of selection of different designs. Screening studies using Placket and Burman Design and Taguchi Design.	**7**
6.	**Factorial Design, Response Surface Methodology & Applications** Full and fractional factorial designs, Design layout, How to implement the Design in Pharmaceutical Research. Evolution of full and reduced mathematical models in experimental design. Application of Factorial Designs. Introduction to Central Composite Design, axial points prediction, Contour Plots, 3D Plots, Box Behnken Design and Validation of optimized model. Application of Response Surface Methodology. Parallel, Crossover Designs and clusters designs used in clinical trials and their applications. Pharmacoinformatics, Methodology, Tools and Application in Pharmacy field.	**8**

7.	**Introduction to Patents, Patent Claims & Patent Websites** Patents Definition, Need for patenting, Types of Patents, Condition to be satisfied by an invention to be patentable, Introduction to patent search, The essential elements of patents, Guidelines for preparations of laboratory notebook, non-obviousness in patents, Introduction to Patent Claims, Drafting of patent claims, important patent related websites. How to search Patents in different websites.	**5**
8.	**Trademark protection and WO patents** Brief introduction to trademark protection and WO patents, Introduction to "The Patents Act 1970" and "The Patents Rule 2003", with special emphasis on the forms to be submitted along with a patent application.	**3**

GLOBAL REGULATION

Chapter No.	Topics	Hours Alloted
1	Legislation to regulate, import, manufactures distribution and sales of drugs, cosmetics- The Drugs & Cosmetic Act 1940 & rules 1945 with amendments.	**05**
2	Regulatory aspects of pharmaceutical and bulk drug manufacture and biotechnology derived product.	**04**
3	Quality safety and legislation for cosmetic and herbal products	**04**
4	Standard institutes & certification agencies like ISI(BIS), ASTM, ISO, WHO, US-FDA, UK-MHRA, TGA	**05**
5	Drug Master File	**03**
6	Material Safety Data Sheet (MSDS) preparation	**03**
7	Industrial Safety & Health Guide lines for filing in countries like US & EU	**03**

8	Indian pharmacopoeia, Indian Pharmacopoeia commission, IP review process, Guideline for formation of monograph, IP reference substances	**02**
9	Study of compendia – Evolution, Study of parts of compendia like: Policies, General notices, Monographs, Comparative picture of IP, USP, BP	**04**
10	Overview of ICH guidelines with special emphasis on Quality guidelines; Study of ICH common technical documents.	**05**
11	A) New Drug Application & Approval in India from CDSCO as per schedule Y & related provisions. B) Approval of new drugs: Investigational New Drug (IND) submission, format & content of AND, content of Investigator Brochure, general consideration of New Drug Approval (NDA) specific requirements, content & format of NDA, manufacturing control requirement of NDA.	**12**

SUGGESTED BOOKS OF Global Regulation

Text Books:

1. Drugs and Cosmetics Laws by Krishnan Arora, Professional Book Publishers, New Delhi
2. Mittal B.M., A Textbook of Forensic Pharmacy.
3. Deshpande S.W., Drugs and Cosmetic Act.1940. th Ed., Vallabh Prakashan

References Books:

1. Gnarino Richard A, New Drug Approval Process, 3 rd Ed., Marcel Dekker Inc.
2. P. Warayan, Intellectual Property Laws, Eastern Law House.
3. Drug and Cosmetic Act 1940, Eastern Book company by Vijay Malic, 11th Ed. Patents for Medicine, by N. B. Zareri, Indian Drug Manufacturers Association (IDMA)
4. Ira R. Bery, “Introduction to the Pharmaceutical Regulatory Process”, Drugs and Pharm Sci. Series, Vol. 144, Marcel Dekker Inc., N.Y.

5. The Drugs and Cosmetic Act 1940 – Vijay Malik 9. Indian Pharmacopoeia, Vol. 1-3, 2007.
6. The Indian Pharmacopoeia commission, Gahaziabad, Govt. of India.
7. The International Pharmacopoeia Vol 1, 2,3,4,5 3rd Editions
8. Pollution Control Act, 1974
9. Prevention of Food Adulteration Act 1954
10. Industrial Development & Regulation Act 1951
11. Consumer Protection Act 1986
12. "WHO Expert Committee on specification on Pharmaceutical Preparation"34th report, Geneva, World Health Organisation, 1996 (WHO Technical Report Series, No. 863.
13. Quality Assurance of Pharmaceuticals – A compendium of guidelines and related materials Vol.1 and Vol.2, WHO, (1999)
14. A.C. Cartwright and Brian Mathews,"International Pharmaceutical Registration" Taylor and Francis Ltd. UK, 2002
15. United State Pharmacopoeia (USP) 32,NF27, 2009
16. Industrial Health and Safety, Dr. A.M. Sarma, Himalaya Publication

SUBJECT NAME: LOGIC IN ORGANIC CHEMISTRY

Objective of the course:

The course is designed to make students familiar with the principles of organic chemistry as applied to pharmaceuticals and to study organic agents and understand basic organic chemistry.

Students learning outcomes/objectives:

A. Knowledge:

1. Understand basic of organic chemistry & its significance in Pharmaceutical Sciences.

2. Explain the reactivity and various stability aspects of the organic compounds.

4. Clarify mechanism and applications of rearrangement of electron deficient & electron rich systems.

B. Skills:

1. Understand relevance of organic compounds & its significance in Pharmaceutical Sciences.

2. Explain the synthesis and reaction of Hetrocyclic Compounds.

Instructional methods and pedagogy:

The faculty shall explain the lectures using black board, Over Head Projector or Multimedia projector.

THEORY (3 HOURS/WEEK)

Chapter No.	Topics	Hours Alloted
1	**Localized and Delocalized Chemical Bonding:** Atomic structure, molecular structure, atomic orbitals, wave equation, molecular orbital theory ,bonding and antibonding orbitals, electronegativity of atoms, introduction to ionic bond and covalent bond, bond dissociation energy, hybridization and hybrid orbitals, intermolecular and intramolecular forces, polarity of bonds, polarity of molecules, resonance, hyperconjugation, steric and its effect on reactivity	7
2	**Basics of Organic Chemistry**: Various acid base theory concepts, inductive field steric resonance, electronic effect and other factor affecting on acid base character,	4

	pka and its significance. soft and hard acid theories.	
3	**Stereochemistry and Chiral Techniques** **a)**. Stereochemistry of compounds with asymmetric plane. **b).** Concept of chiral drugs, resolution of racemic mixtures, cram's rule, racemic switches, asymmetric synthesis of following drugs: Vit.C, Nifedipine, Atenolol, Ethambutol, Omeprazole, Ampicillin and Thalidomide.	**7**
4	**Organic reaction mechanism:** **a) Nucleophilic Aliphatic substitution reactions:** Mechanism, kinetics and reactivity of SN_1 and SN2 reactions. Participation of neighbouring group reaction and mechanism as anchimeric assistance, non classical carbocation **b) Nucleophilic Aromatic substitution reactions:** Mechanism, kinetics and reactivity of Bimolecular displacement reaction **c) Electrophilic substitution reactions:** Orientation and Reactivity of Electrophilic aromatic substitution recation **d)Addition reaction:** Mechanism and Stereochemistry of Nucleophilic,Electrophilic and Free radical addition reaction ,Markonikov rule,Anti-Markonikov rule, Michael addition and peroxide effect **e) Elimination reactions:** Mecahnism, reactivity and stereochemistry of E1, E2 and E1cb elimination reaction **f) Oxidation – reduction reactions**: Various reagents used for such reactions. **g) Protection and deprotection of various groups.**	**20**
5	**Detailed study of individual Name reactions -** allylic rearrangement, Amdt ester synthesis-Bayer-Villiger rearrangement, benzillic acid rearrangement – Curtius rearrangement-Dimorth rearrangement, Heck reaction, Lossen –Schmidt rearrangement, Pinner reaction, Reformatsky reaction, Sharpless oxidation, Suzuki reaction, Sonogashira reaction, Swern oxidation, Vilsmeir Haack reaction, Aldol and Cross aldol condensation, Clasein condensation, Pinacol rearrangements, Beckman rearrangement, Hofmann rearrangement, Birch	**14**

	reduction, Oppeneaur oxidation	
6	**Photochemistry:** Theory, energy transfer, characteristics of photoreactions, typical photochemical reactions like photo reduction, photodimerization, photolysis, photo rearrangement, photo oxidation, photoisomerization, photoenolization.	**3**
7	**Ylides and its property:** **Phosphorous Ylides**: Structure and reactivity, stabilized and Non-stabilized ylides, Wittig reaction, Schlosser modification **Sulphur Ylides:** Stabilized and non-stabilized ylides; thermodynamically and kinetically controlled reactions with carbonyl compounds, regio- and stereo-selective reactions.	**4**
8	**Retrosynthetic Analysis:** Definition, terms and abbreviation, rules and guidelines used in retrosynthesis of following drugs:captopril,cetrizine,ibuprofen,diclofenac,pyrimethamine	**5**
9	**Heterocyclic Chemistry:** Synthetic approaches for attaching heterocyclic ring systems in drug molecules having a) five membered ring -Thiophene,Furan,Pyrole,Imidazole b) six membered ring- Pyridine,Pyrimidine,Pyridazine c)fused ring systems-Indole,Quinoline,Isoquinoline,Acridine	**8**
10	**Click chemistry:** Click reaction-criteria, water as solvent, various classes of reactions, thermodynamics; Huisgen cycloaddition and its modification, and nucleophilic ring opening of epoxide and aziridine.	**3**

PRACTICAL (6 HOURS/WEEK)

1) Demonstration of Various Laboratory Technique-

a) Various types of Distillation

b) Column Chromatography

c) Reaction set up

d) Thin layer chromatography

e) Heating and cooling techniques.

f) Various techniques of Work up

g) Drying of solids and liquids.

2) Use of MSDS use in synthesis of organic compound.

3) Synthesis of the following heterocyclic compounds by Green chemistry and/or by Conventional method and characterization by TLC, M.P and I.R method.

a) Benzimidazole.

b) Benzotriazole.

c) Quinoxaline.

d) Imidazolidine-2-4-dione

e) Thiadiazole.

f) Pthalimide

4) Perform the following reactions of synthetic importance with characterization by TLC, M.P and I.R

1) Clasein-Schmidt Condensation

2) Biginelli reaction

3) Nitration

4) Bromination

5) Scotten Baumann reaction

6) Freidel Craft Acetylation

7) Oxidation

8) Reduction

9) Hydrolysis

10) Diazotization

11) Esterification

12) Benzillic acid rearrangement

13) Beckmann rearrangement

14) Hofmann Rearrangement

Recommended Books:

1. Advanced Organic Chemistry – Reaction, Mechanism and Structure – J. March, John Wiley & Sons, New York

2. Designing Organic Syntheses by Stuart Warren \

3. Organic Synthesis: the Disconnection Approach by Stuart Warren

4. Advanced Organic Chemistry: Reactions and Synthesis, Part A: Structure & Mechanism by Francis A. Carey; Richard J. Sundberg

5. Advanced Organic Chemistry: Reactions and Synthesis, Part B: Reaction & Mechanism by Francis A. Carey; Richard J. Sundberg

6. Modern Synthetic Reactions by Herbert O. House

7. Modern Methods of Organic Synthesis by Carruthers, William Coldham, Iain

8. Mechanism and Structure in Organic Chemistry by Gould

9. Advanced Inorganic Chemistry by Cotton , Wilkinson, Murillo and Bochmann

10. Fundamentals of Medicinal Chemistry by Thomas ISBN047084307

SUBJECT NAME: ADVANCE MEDICINAL CHEMISTRY

Objective of the course:

The course is designed to make students familiar with the principles of organic chemistry as applied to pharmaceuticals and to study organic agents and understand basic organic chemistry.

Students learning outcomes/objectives:

A. Knowledge:

1. Understand drugs used in treatment of various diseases.

B. Skills:

1. Make aware about recent analogues of drugs which are used in treatment of various diseases.

Instructional methods and pedagogy:

The faculty shall explain the lectures using black board, Over Head Projector or Multimedia projector.

THEORY (3 HOURS/WEEK)

Chapter No.	Topics	Hours Alloted
1	**QSAR:** Electronic effects: Hammett equation, lipophilicity effects. Hansch equation, steric effects. Taft equation. Experimental and theoretical approaches for the determination of physico-chemical parameters, parameter inter-dependence; case studies. Descriptor calculation.	5
2	**Informatics methods in drug design:** Brief introduction to bioinformatics, chemoinformatics. Their relation to drug design.	3
3	**Pharmacophore concept:** Pharmacophore mapping, methods of conformational search used in pharmacophore mapping. Comparison between the popular pharmacophore methods like Catalyst/HipHop, DiscoTech with practical examples, Virtual screening.	4
4	**Electronic Structure methods:** Quantum chemical methods semi-empirical and ab initio methods. Conformational analysis, energy minimization, comparison between global minimum conformation and bioactive conformation. Predicting the mechanism of organic	4

	reactions using electronic structure methods.	
5	**Molecular modeling:** 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. Computer methodologies behind molecular modeling including artificial intelligence methods.	**5**
6	**De Novo drug design techniques:** Receptor/enzyme cavity size prediction. Predicting the functional components of cavities, designing drugs fitting into cavity.	**3**
7	**Molecular docking:** Rigid docking, flexible docking, manual docking. Advantages and disadvantages of Flex-X, Flex-S, Autodock and Dock softwares, with successful examples.	**3**
8	**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.	**3**
9	**Structure Activity Relationships in drug design:** Qualitative versus quantitative approaches- advantages and disadvantages. Random screening, Non-random screening, drug metabolism studies, clinical observations, rational approaches to lead discovery. Homologation, chain branching, ring-chain transformations, bio-isosterism. Insights into molecular recognition phenomenon. Structure based drug design, ligand based drug design. The importance of biological data in the correct form; 2D QSAR; 3D-QSAR examples of CoMFA and CoMSIA.	**5**
10	**Quantum chemical methods of analyzing drugs:** Metformin, its comparison to carbones, rapid racemization in glitazones, metabolism and toxicity of troglitazone, conversion of proguanil to cycloguanil.	**3**
11	Introduction, combinatorial approaches, applications, methodology, combinatorial organic synthesis, Peptide and small molecule libraries, assays and screening of combinatorial libraries, introduction to High Throughputs Screening (HTS).	**10**
12	Recent advances in therapy of following a. Neurodegenerative diseases: Alzheimer's and Parkinsonism	**17**

	b. CVS disorders: Hypertension, Arrhythmia, Atherosclerosis. c. Hormonal disorder: steroidal agents d. Disorders of immune system: NSAID's, antihistamines e. Chemotherapeutic agents: anti-tubercular, anti-malarial, antiviral, anti-cancer.	
13	Green Chemistry and Microwave reaction	**4**
14	Ultrasound reactions	**3**
15	Nanochemistry	**3**

PRACTICALS (6 HOURS/WEEK)

Practical exercises based on the relevant topics. Synthesis of some drug and drug intermediate falls under therapeutic class mentioned in theory syllabus.

Reference Books:

1. Corwin Hansch, Peter G. Sammes, John B. Taylor; Comprehensive Medicinal Chemistry Vol. 4, Pergamon.

2. John H. Block, John M. Beale; Wilson & Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, 11th edition, Lippincott Williams and Wilkins.

3. Davis A. Williams, Thomas L. Lemke; Foye: Principles of Medicinal Chemistry, 5th edition,

Lippincott Williams Wilkins.

4. Bernard Testa, Walter Fuhrer – Perspectives in Medicinal Chemistry.

5. Donald J. Abraham; Berger's Medicinal Chemistry and Drug Discovery, 6th edition, John Wiley and Sons.

6. Daniel Lednicer; the Organic Chemistry of Drug Synthesis, Vol. 1-6, Wiley Interscience.