

**PHARMACEUTICAL CHEMISTRY****SEMESTER – I**

| S. No. | Course codes | Course Name                                     | Hours per week |   |    | Credits |
|--------|--------------|---|----------------|---|----|---------|
|        |              |   | L              | T | P  |         |
| 1.     | 23S01101     | Modern Pharmaceutical Analytical Techniques     | 4              | - | -  | 4       |
| 2.     | 23S02101     | Advanced Organic Chemistry-I                    | 4              | - | -  | 4       |
| 3.     | 23S02102     | Advanced Medicinal Chemistry-I                  | 4              | - | -  | 4       |
| 4.     | 23S02103     | Chemistry of Natural Products                   | 4              | - | -  | 4       |
| 5.     | 23S01105     | Modern Pharmaceutical Analytical Techniques Lab | -              | - | 6  | 3       |
| 6.     | 23S02104     | Advanced Medicinal Chemistry-I Lab              | -              | - | 6  | 3       |
| 7.     |              | <b>Audit Course – I</b>                         | 2              | - | -  | 0       |
|        | 23DAC101a    | English for Research paper writing              |                |   |    |         |
|        | 23DAC101b    | Disaster Management                             |                |   |    |         |
|        | 23DAC101c    | Sanskrit for Technical Knowledge                |                |   |    |         |
|        | 23DAC101d    | Entrepreneurship Management                     |                |   |    |         |
| 8.     | 23S02105     | Seminar/Assignment                              | -              | 1 | 6  | 4       |
|        |              | <b>Total</b>                                    | 18             | 1 | 18 | 26      |

**SEMESTER – II**

| S.No. | Course codes | Course Name   | Hours per week |   |    | Credits |
|-------|--------------|---|----------------|---|----|---------|
|       |              |   | L              | T | P  |         |
| 1.    | 23S02201     | Advanced Organic Chemistry-II                             | 4              | - | -  | 4       |
| 2.    | 23S02202     | Advanced Medicinal Chemistry-II                           | 4              | - | -  | 4       |
| 3.    | 23S02203     | Computer Aided Drug Design                                | 4              | - | -  | 4       |
| 4.    | 23S02204     | Pharmaceutical Process Chemistry                          | 4              | - | -  | 4       |
| 5.    | 23S02205     | Advanced Organic Chemistry-II Lab                         | -              | - | 6  | 3       |
| 6.    | 23S02206     | Advanced Medicinal Chemistry-II Lab                       | -              | - | 6  | 3       |
| 7.    |              | <b>Audit Course – II</b>                                  | 2              | - | -  | 0       |
|       | 23DAC201a    | Pedagogy Studies  |                |   |    |         |
|       | 23DAC201b    | Stress Management for Yoga                                |                |   |    |         |
|       | 23DAC201c    | Personality Development through Life Enlightenment Skills |                |   |    |         |
| 8.    | 23S02207     | Seminar/Assignment  | -              | 1 | 6  | 4       |
|       |              | <b>Total</b>  | 18             | 1 | 18 | 26      |

**M PHARMACY III SEMESTER**

| S.No. | Course codes | Course Name  | Hours per week |   |    | Credits |
|-------|--------------|--|----------------|---|----|---------|
|       |              |  | L              | T | P  |         |
| 1.    | 23DRM101     | Research Methodology and Intellectual Property Right | 4              | - | -  | 4       |
| 2.    |              | <b>Open Elective</b>                                 | 3              | - | -  | 3       |
|       | 23SOE301a    | Stability of Drugs and Dosage forms                  |                |   |    |         |
|       | 23SOE301b    | Biostatistics  |                |   |    |         |
|       | 23SOE301c    | Pharmacoepidemiology and Pharmacoeconomics           |                |   |    |         |
|       | 23SOE301d    | Biological Screening methods                         |                |   |    |         |
| 3.    | 23S02301     | Teaching Practice/Assignment                         | -              | - | 4  | 2       |
| 4.    | 23S02302     | Comprehensive viva voce                              | -              | - | 4  | 2       |
| 5.    | 23S02303     | Research Work - I                                    | -              | - | 24 | 12      |
| 6.    | 23S02304     | Journal club   | 1              | - | -  | 0       |
|       |              | <b>Total</b>   | 8              | - | 32 | 23      |



| Course Code   | ADVANCED ORGANIC CHEMISTRY - I |  |  | L        | T | P | C |
|---|--------------------------------|--|--|----------|---|---|---|
| 23S02101  |                                |  |  | 4        | 0 | 0 | 4 |
| <b>Semester</b>   |                                |  |  | <b>I</b> |   |   |   |
| <b>Course Objectives:</b>   |                                |  |  |          |   |   |   |
| 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.  |                                |  |  |          |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to  |                                |  |  |          |   |   |   |
| <ul style="list-style-type: none"> <li>• Position to design a stereo selective synthesis of new chemical entities (NCE) for the treatment of different diseases in new drug discovery Program.</li> </ul>   |                                |  |  |          |   |   |   |
| <b>UNIT - I</b>   |                                |  |  |          |   |   |   |
| <b>Stereochemistry</b>  |                                |  |  |          |   |   |   |
| 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 exocyclic double bonds and spirans. 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.  |                                |  |  |          |   |   |   |
| <b>UNIT - II</b>  |                                |  |  |          |   |   |   |
| a. Reactive Intermediates: Definitions, generation, stability, structure and reactivity of free radicals carbocations, carbanions, carbenes, Nitrenes/Nitrenium ions.<br>b. Concepts of aromaticity and antiaromaticity, nonbenzenoid aromatic compounds.<br>c. Mechanisms of organic reactions: Free radical, Electrophilic, Nucleophilic reactions of aliphatic and aromatic compounds  |                                |  |  |          |   |   |   |
| <b>UNIT - III</b>   |                                |  |  |          |   |   |   |
| Detailed knowledge regarding the reactions, mechanisms and their relative reactivity and orientations.<br>a) Addition reactions<br>b) Nucleophilic uni- and bimolecular reactions (SN1 and SN2)<br>c) Elimination reactions (E1 & E2; Hoffman & Saytzeff's rule)  |                                |  |  |          |   |   |   |
| <b>UNIT - IV</b>  |                                |  |  |          |   |   |   |
| Electrocyclic, pericyclic and sigmatropic reactions: Introduction, terminology and mechanism, with suitable examples.   |                                |  |  |          |   |   |   |
| <b>UNIT - V</b>   |                                |  |  |          |   |   |   |
| <b>Study of mechanism and synthetic applications of following named Reactions:</b>  |                                |  |  |          |   |   |   |
| Ugi reaction, Brook rearrangement, Ullmann coupling reactions, Dieckmann Reaction, Doebner- Miller Reaction, Mitsunobu reaction, Sandmeyer Reaction, Mannich reaction, Vilsmeier-Haack Reaction, Ozonolysis and Michael addition reaction   |                                |  |  |          |   |   |   |
| <b>Textbooks:</b>   |                                |  |  |          |   |   |   |
| 1. Francis A. Carey & Richard J. Sunberg, Advanced Org. Chemistry, III rd Edition, Part B; Reactions and synthesis, Plenum Press, New York, London, Latest Edition.<br>2. Eliel I. Ernest and Samuel H., Stereochemistry of Org. Compounds, John Wiley and sons, New York, 2003 Edition.<br>3. Roland E. Lehr & Alan P Marchard, Orbital Symmetry: A Problem-Solving approach, Academic Press, New York Latest Edition.<br>4. J. March, Advanced Org. Chemistry, Reactions Mechanisms and Structure, 4 <sup>th</sup> Edition, John Wiley & Sons, New York Latest Edition<br>5. I. L. Finar, Organic Chemistry, ELBS<br>7. Herbert O. Modern Synthesis Reactions II <sup>nd</sup> Edition W.A. Beemans Inc. Menlo Park California W. Carruthers, Some Modern Methods of Org. Synthesis, III rd Edition, Cambridge University Press, Cambridge. |                                |  |  |          |   |   |   |

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| Course Code   | ADVANCED MEDICINAL CHEMISTRY – I |          | L | T | P | C |
|---|----------------------------------|----------|---|---|---|---|
| 23S02102  |                                  |          | 4 | 0 | 0 | 4 |
| Pre-requisite   |                                  | Semester | I |   |   |   |
| <b>Course Objectives:</b>   |                                  |          |   |   |   |   |
| 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.  |                                  |          |   |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to  |                                  |          |   |   |   |   |
| <ul style="list-style-type: none"> <li>• The application of basic knowledge of pharmaceutical-chemical aspects of drugs that are in clinical use in defining, analyzing and proposing actions related to the research and implementation of new laboratory methods for detecting and monitoring diseases and effects and/or efficacy of the therapy.</li> <li>• Interpretation of the results of laboratory analysis by the clinical aspects by knowing the pharmacotherapeutic groups of drugs, their classification, and the most important representatives.</li> <li>• The assurance of positive interactions with patients, colleagues, health professionals and the public.</li> </ul> |                                  |          |   |   |   |   |
| <b>UNIT – I</b>   |                                  |          |   |   |   |   |
| a) Physicochemical properties in relation to biological action<br>b) 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.   |                                  |          |   |   |   |   |
| <b>UNIT – II</b>  |                                  |          |   |   |   |   |
| <b>Prodrug Design and Analog design</b>   |                                  |          |   |   |   |   |
| a) Prodrug design: Basic concept, Carrier linked prodrugs/Bioprecursors, Prodrugs of functional group, Prodrugs to improve patient acceptability, Drug solubility, Drug absorption and distribution, site specific drug delivery and sustained drug action. Rationale of prodrug design and practical consideration of prodrug design.  |                                  |          |   |   |   |   |
| b) Combating drug resistance: Causes for drug resistance, strategies to combat drug resistance in antibiotics and anticancer therapy, Genetic principles of drug resistance.  |                                  |          |   |   |   |   |
| c) Analog Design: Introduction, Classical & Non classical, Bioisosteric replacement strategies, rigid analogs, alteration of chain branching, changes in ring size, ring position isomers, design of stereo isomers and geometric isomers, fragments of a lead molecule, variation in inter atomic distance.  |                                  |          |   |   |   |   |
| <b>UNIT – III</b>   |                                  |          |   |   |   |   |
| Medicinal chemistry aspects of the following class of drugs Systematic study, SAR, Mechanism of action and synthesis of new generation molecules of following class of drugs: Anti-hypertensive drugs, Anti convulsant drugs, COX1 & COX2 inhibitors, H1 & H2 receptor antagonist, Antineoplastic and Antiviral agents.   |                                  |          |   |   |   |   |
| <b>UNIT – IV</b>  |                                  |          |   |   |   |   |
| Stereochemistry and Drug action: Realization that stereo selectivity is a pre-requisite for evolution. Role of chirality in selective and specific therapeutic agents. Case studies, Enantio selectivity in drug adsorption, metabolism, distribution and elimination.  |                                  |          |   |   |   |   |
| <b>UNIT – V</b>   |                                  |          |   |   |   |   |
| <b>Structure based drug design</b>  |                                  |          |   |   |   |   |
| 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-binding Inhibitors.   |                                  |          |   |   |   |   |
| <b>Textbooks:</b>   |                                  |          |   |   |   |   |
| <ol style="list-style-type: none"> <li>1. Berger's Medicinal Chemistry and Drug Design. 6th Edition.</li> <li>2. Korolkovas Essentials of Medicinal Chemistry</li> <li>3. Purcell Strategies of Drug Design</li> <li>4. Corwin, Hansen Comprehensive Medicinal Chemistry</li> <li>5. William O Foye Medicinal Chemistry</li> <li>6. Structure based Drug Design by Pandi Veerapandion.</li> <li>7. Stenlake, Foundation of Molecular Pharmacology- Pharma Med Press, volume I&amp;II</li> </ol>   |                                  |          |   |   |   |   |

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| Course Code  | CHEMISTRY OF NATURAL PRODUCTS |  |                 | L        | T | P | C |
|--|-------------------------------|--|-----------------|----------|---|---|---|
| 23S02103   |                               |  |                 | 4        | 0 | 0 | 4 |
|  |                               |  | <b>Semester</b> | <b>I</b> |   |   |   |
| <b>Course Objectives:</b>  |                               |  |                 |          |   |   |   |
| 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.   |                               |  |                 |          |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |                               |  |                 |          |   |   |   |
| <ul style="list-style-type: none"> <li>Position to explore the natural lead compounds for the treatment of different diseases like cancer, malaria, diabetes etc</li> </ul>  |                               |  |                 |          |   |   |   |
| <b>UNIT – I</b>  |                               |  |                 |          |   |   |   |
| <p><b>Extraction:</b> Introduction, definition, factors influencing the choice of extraction, principles of extraction methods, types of extraction (extraction of plant drugs by microwave assisted techniques wherever applicable) and their merits and demerits. Selection and purification of solvents for extraction</p> <p><b>Carbohydrates:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Glucose.</p> <p><b>Glycosides:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of cardiac glycosides-Digoxin.</p> <p><b>Vitamins:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Ascorbic Acid.</p>   |                               |  |                 |          |   |   |   |
| <b>UNIT – II</b>   |                               |  |                 |          |   |   |   |
| <p><b>Steroids:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Cholesterol.</p> <p><b>Terpenoids:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Citral, Menthol and Zingiberene. Isoprene and Special Isoprene rule.</p> <p><b>Anti-biotics:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Penicillin.</p>  |                               |  |                 |          |   |   |   |
| <b>UNIT – III</b>  |                               |  |                 |          |   |   |   |
| <p><b>Amino acids:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance. General Preparation and Properties of Amino acids.</p> <p><b>Peptides:</b> Introduction, Definition, Classification, Synthesis, determination of structure of Peptides. <b>Proteins:</b> Introduction, Definition, Classification, Properties, Structure of protein, Chemistry of Insulin.</p> <p><b>Alkaloids:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Quinine.</p> <p><b>Purines:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Caffeine.</p>   |                               |  |                 |          |   |   |   |
| <b>UNIT – IV</b>   |                               |  |                 |          |   |   |   |
| <p><b>Natural Pigments:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Carotene.</p> <p><b>Plant Hormones:</b> Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Structural elucidation of Auxins.</p> <p>Fats and Oils: Introduction, Definition, Classification, Nomenclature, Source, Importance, Structure, Chemistry, Properties and analysis of fixed oils, fats and waxes.</p>   |                               |  |                 |          |   |   |   |
| <b>UNIT – V</b>  |                               |  |                 |          |   |   |   |
| <p><b>Natural products as markers for new drug discovery:</b></p> <ul style="list-style-type: none"> <li>The role of natural products as potential new drug discovery.</li> <li>The role of natural products chemistry in drug discovery.</li> <li>Selection and optimization of lead compounds for further development with suitable examples.</li> </ul> <p><b>Chromatography:</b> Introduction, Definition, Classification, general principles of different chromatographic techniques, and applications of TLC, HPTLC, Column, Paper, HPLC, GC in the isolation, separation and purification of natural products.</p> <p><b>Spectroscopy:</b> General principles and applications of UV, IR, HNMR, C<sup>13</sup> NMR, Mass Spectroscopy in the structural elucidation of natural products.</p> <p><b>Stereoisomerism:</b> Introduction, Definition, Types, Concept of stereoisomerism taking examples of natural products.</p>                    |                               |  |                 |          |   |   |   |
| <b>Textbooks:</b>  |                               |  |                 |          |   |   |   |
| <ol style="list-style-type: none"> <li>Finar IL. Organic Chemistry-stereochemistry and the chemistry of natural products. 5th ed. vol2. Delhi: Dorling Kindersley (India) Pvt. Ltd.,2006.</li> <li>Morrison RT, Boyd RN. Organic Chemistry. 6th ed. Delhi: Pearson education Pvt. Ltd.,2003.</li> <li>Pelletier SW. Alkaloids-chemical &amp; biological perspectives. vol 1-15. London: Pergamon;2001.</li> <li>Steroids by Fischer &amp; Fischer</li> <li>Evans WC. Trease and Evans pharmacognosy. 15th d. Edinburgh: Saunders.2004.</li> <li>Ataur Rahman. Chemistry of natural products</li> <li>Bhat SV, Nagasampagi BA, Sivakumar M. Chemistry of natural products. New Delhi: Narosa Publishing House;2005.</li> <li>Agrawal OP. Organic chemistry-natural products. 30th ed. vol 1-2. Meerut: Goel Publishing House;2006.</li> <li>Wallis TE. Textbook of pharmacognosy. 5th ed. New Delhi: CBS Publishers &amp; Distributors;2002.</li> </ol> |                               |  |                 |          |   |   |   |

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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. the 6 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, Lippincott Willams&Wilkins, NewDelhi,2005.

|                      |  |                   |          |          |          |
|----------------------|--|-------------------|----------|----------|----------|
| <b>Course Code</b>   | <b>MODERN PHARMACEUTICAL ANALYTICAL<br/>TECHNIQUES LAB</b> | <b>L</b>          | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>23S01105</b>      |  | <b>0</b>          | <b>0</b> | <b>6</b> | <b>3</b> |
| <b>Pre-requisite</b> |  | <b>Semester I</b> |          |          |          |

List of Experiments

1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis Spectrophotometer.
2. Simultaneous estimation of multi component containing formulations by UV Spectrophotometry
3. Effect of pH and solvent on UV -Spectrum
4. Determination of Molar absorption coefficient
5. Estimation of riboflavin/ quinine sulphate by fluorimetry
6. Study of quenching effect by fluorimetry
7. Estimation of sodium or potassium by flame photometry
8. Colorimetric determination of drugs by using different reagents
9. Quantitative determination of functional groups
10. Experiments based on Column chromatography
11. Experiments based on HPLC
12. Experiments based on Gas Chromatography

|                      |   |                   |          |          |          |
|----------------------|---|-------------------|----------|----------|----------|
| <b>Course Code</b>   | <b>ADVANCED MEDICINAL CHEMISTRY – I LAB</b> | <b>L</b>          | <b>T</b> | <b>P</b> | <b>C</b> |
| <b>23S02104</b>      |   | <b>0</b>          | <b>0</b> | <b>6</b> | <b>3</b> |
| <b>Pre-requisite</b> |   | <b>Semester I</b> |          |          |          |

List of Experiments

1. Synthesis of any two drugs from the following classes of drugs (Minimum two from each class)
  - a. Analgesics, NSAIDS and antipyretic
  - b. CNS and CVS drugs
2. Isolation and characterization of
  - a. Eugenol from Clove
  - b. Curcumin fromTurmeric
  - c. Sennosides from senna
  - d. Hesperidine from Orange Peel
  - e. Embelin from EmbelliaRibes
  - f. Glycyrrhizin from Glycyrrhiza Glabra
  - g. Plumbagin from Plumbago Rosea
  - h. Solanine from potatoes
  - i. Naringen from Grape Fruit Peel
  - j. Trimyristin and Myristin from Nutmeg
  - k. Azylic acid from Castor Oil
  - l. Pectin from Orange Peel
  - m. Lycopene from Tomato Peel
  - n. Epicatechin from Cashew Kernel outer covering
  - o. Piperine from Black pepper Degradation reaction of following natural products and the identification of the degraded intermediates by micro TLC and qualitative test. Atropine, caffeine, Ephedrine, aponification of Trimyristin.

| Course Code  | ADVANCED ORGANIC CHEMISTRY - II |           |   |   | L | T | P | C |
|--|---------------------------------|-----------|---|---|---|---|---|---|
| 23S02201   |                                 | 4         | 0 | 0 |   |   |   | 4 |
|  | <b>Semester</b>                 | <b>II</b> |   |   |   |   |   |   |
| <b>Course Objectives:</b>  |                                 |           |   |   |   |   |   |   |
| 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 |                                 |           |   |   |   |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |                                 |           |   |   |   |   |   |   |
| <ul style="list-style-type: none"> <li>• Position to have advanced knowledge of different synthetic reagents and reaction processes, synthetic routes by involving green chemistry principles.</li> <li>• Techniques to utilize the chemical library of combinatorial chemistry.</li> </ul>  |                                 |           |   |   |   |   |   |   |
| <b>UNIT – I</b>  |                                 |           |   |   |   |   |   |   |
| <b>Synthetic Reagents &amp; Application</b>  |                                 |           |   |   |   |   |   |   |
| Lead Tetra Acetate (LTA), N- Bromosuccinimide (NBS), Osmium Tetroxide, Lithium Aluminum Hydride (LAH) and Sodium Borohydride, Dicyclohexylcarbodiimide (DCC) and 2,3-dichloro-5,6-dicyano-1,4-benzoquinone(DDQ).   |                                 |           |   |   |   |   |   |   |
| <b>UNIT – II</b>   |                                 |           |   |   |   |   |   |   |
| <b>Catalysis</b>   |                                 |           |   |   |   |   |   |   |
| a. Types of catalysis, heterogeneous and homogeneous catalysis, advantages and disadvantages   |                                 |           |   |   |   |   |   |   |
| b. Heterogeneous catalysis – preparation, characterization, kinetics, supported catalysts, catalyst deactivation and regeneration, some examples of heterogeneous catalysis used in synthesis of drugs.  |                                 |           |   |   |   |   |   |   |
| c. Homogeneous catalysis, hydrogenation, hydroformylation, hydrocyanation, Wilkinson catalysts, chiral ligands and chiral induction, Ziegler-Natta catalysts, some examples of homogeneous catalysis used in synthesis of drugs  |                                 |           |   |   |   |   |   |   |
| d. Transition-metal and Organo-catalysis in organic synthesis: Metal-catalyzed reactions   |                                 |           |   |   |   |   |   |   |
| e. Phase transfer catalysis -theory and applications   |                                 |           |   |   |   |   |   |   |
| <b>UNIT – III</b>  |                                 |           |   |   |   |   |   |   |
| <b>Molecular Rearrangements &amp; their applications</b>   |                                 |           |   |   |   |   |   |   |
| 1. Carbon to Carbon Migration: Wagner – Meerwin rearrangement, Claisen rearrangement and benzil– benzilic acid rearrangement.  |                                 |           |   |   |   |   |   |   |
| 2. Carbon to Nitrogen Migration: Hoffmann rearrangement, Curtius rearrangement and Lossen rearrangement, Beckman rearrangement.  |                                 |           |   |   |   |   |   |   |
| 3. Carbon to Oxygen Migration: Baeyer – Villiger rearrangement, Rearrangement of hydro peroxides and Wittig rearrangement  |                                 |           |   |   |   |   |   |   |
| <b>UNIT – IV</b>   |                                 |           |   |   |   |   |   |   |
| <b>Chemistry of peptides</b>   |                                 |           |   |   |   |   |   |   |
| a. Coupling reactions in peptide synthesis   |                                 |           |   |   |   |   |   |   |
| b. Principles of solid phase peptide synthesis, t-BOC and Fmoc protocols, various solid supports and linkers: Activation procedures, peptide bond formation, deprotection and  |                                 |           |   |   |   |   |   |   |
| c. cleavage from resin, low and high HF cleavage protocols, formation of free peptides and peptide amides, purification and case studies, site-specific chemical modifications of peptides   |                                 |           |   |   |   |   |   |   |
| d. Segment and sequential strategies for solution phase peptide synthesis with any two case studies Side reactions in peptide synthesis: Deletion peptides, side reactions initiated by proton abstraction, protonation, over activation and side reactions of individual aminoacids.  |                                 |           |   |   |   |   |   |   |
| <b>UNIT – V</b>  |                                 |           |   |   |   |   |   |   |
| <b>Green Chemistry</b>   |                                 |           |   |   |   |   |   |   |
| a. Introduction, principles of green chemistry   |                                 |           |   |   |   |   |   |   |
| b. Microwave assisted reactions: Merit and demerits of its use, increased reaction rates, mechanism, superheating effects of microwave, effects of solvents in microwave assisted synthesis, microwave technology in process optimization, its applications in various organic reactions and heterocycles synthesis  |                                 |           |   |   |   |   |   |   |
| c. Ultrasound assisted reactions: Types of sono chemical reactions, homogeneous, heterogeneous liquid- liquid and liquid-solid reactions, synthetic applications   |                                 |           |   |   |   |   |   |   |
| <b>Textbooks:</b>  |                                 |           |   |   |   |   |   |   |
| 1. W. Carruthers, Some Modern Methods of Org. Synthesis, III rd Edition, Cambridge University Press, Cambridge(1988)   |                                 |           |   |   |   |   |   |   |
| 2. Gorgy Keri and Istarian Toth, Molecular Patho-mechanisms and New Trends in Drug Research – Taylor and Francis Group, London2003   |                                 |           |   |   |   |   |   |   |
| 3. R. K. Mackie, A Guidebook to Organic Thesis – PrenticeHall  |                                 |           |   |   |   |   |   |   |
| 4. T.W. Greene and PGM Warts, Protecting Groups – JohnWilley   |                                 |           |   |   |   |   |   |   |
| 5. Michael B. Smith, Organic Synthesis   |                                 |           |   |   |   |   |   |   |
| 6. Organic synthesis- Special techniques VK Ahluwaliaand R Aggarwal, NarosaPublishers.   |                                 |           |   |   |   |   |   |   |
| 7. “Organic Chemistry” VolI and II. I.L. Finar. ELBS, Sixth ed.,1995.  |                                 |           |   |   |   |   |   |   |
| 8. “Advanced Organic chemistry, Reaction, mechanisms and structure”, J March, John Wiley and sons, NewYork.  |                                 |           |   |   |   |   |   |   |
| 9. Principles of organic synthesis, ROC Norman and JM Coxan, Nelsonthorns  |                                 |           |   |   |   |   |   |   |
| 10. Carey, Organic chemistry, 5th edition (Viva Books Pvt.Ltd.)  |                                 |           |   |   |   |   |   |   |

| Course Code  | ADVANCED MEDICINAL CHEMISTRY – II | L         | T | P | C |
|--|-----------------------------------|-----------|---|---|---|
| 23S02202   |                                   | 4         | 0 | 0 | 4 |
| <b>Semester</b>  |                                   | <b>II</b> |   |   |   |
| <b>Course Objectives:</b>  |                                   |           |   |   |   |
| 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.  |                                   |           |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |                                   |           |   |   |   |
| <ul style="list-style-type: none"> <li>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.</li> </ul>  |                                   |           |   |   |   |
| <b>UNIT – I</b>  |                                   |           |   |   |   |
| <b>Enzyme Inhibitors I</b>   |                                   |           |   |   |   |
| A detailed study of the following types of enzyme inhibitors, related drugs and their pharmaceutical significance:   |                                   |           |   |   |   |
| <ol style="list-style-type: none"> <li>Prostaglandin Synthetase (Cyclooxygenase &amp; Lipoxygenase Inhibitors)</li> <li>Phosphodiesterase (PDE) Inhibitors</li> <li>Carbonic Anhydrase Inhibitors.</li> <li>Beta-Secretase.</li> </ol>   |                                   |           |   |   |   |
| <b>UNIT – II</b>   |                                   |           |   |   |   |
| <b>Enzyme Inhibitors II</b>  |                                   |           |   |   |   |
| <ol style="list-style-type: none"> <li>Angiotensin Converting Enzyme (ACE) Inhibitors</li> <li>Acetyl Cholinesterase (Ach E) Inhibitors.</li> <li>HMG-CoA inhibitors</li> <li>Protease inhibitors</li> </ol>   |                                   |           |   |   |   |
| <b>UNIT – III</b>  |                                   |           |   |   |   |
| <b>Antipsychotic Agents</b>  |                                   |           |   |   |   |
| Role of Dopamine, Serotonin, Glutamate and their receptors. SAR and Pharmacokinetics of Ticyclic Neuroleptics, Butyrophenones and Benzamides. A brief account of non – benzodiazepine agonist.   |                                   |           |   |   |   |
| <b>UNIT – IV</b>   |                                   |           |   |   |   |
| Peptidomimetics Therapeutic values of Peptidomimetics, design of peptidomimetics by manipulation of the amino acids, modification of the peptide backbone, incorporating conformational constraints locally or globally. Chemistry of prostaglandins, leukotrienes and thromboxones.   |                                   |           |   |   |   |
| <b>UNIT – V</b>  |                                   |           |   |   |   |
| <p><b>Biotechnologically produced drugs:</b> Biotechnology of Recombinant DNA, Process of Recombinant proteins, Immunogenicity of biotechnologically produced drugs.</p> <p><b>Recombinant drug products:</b> Hormones, cytokinins, interferons, Interleukins, enzymes, vaccines and monoclonal antibody drugs.</p>  |                                   |           |   |   |   |
| <ol style="list-style-type: none"> <li>Berger's Medicinal Chemistry and Drug Design. 6<sup>th</sup> Edition</li> <li>Korolkovas Essentials of Medicinal Chemistry</li> <li>William O Foye Medicinal Chemistry</li> <li>Lednicer, Organic Chemistry of Drug Synthesis</li> <li>Ariens, Drug Design, Academic Press</li> <li>Purcell Strategies of Drug Design</li> <li>Corwin, Hansen Comprehensive Medicinal Chemistry</li> <li>Richard B. Silvermann, Org. Chemistry of Drug Design and drug Action</li> <li>Smith and Williams, Introduction to principles of Drug Design – Harwood Academy Press</li> <li>Gyorgy Keri &amp; Istvan Toth Molecular Pathomechanism and New Trends in Drug Research, Taylor &amp; Francis Pub</li> <li>Thomas Nogrady, Medicinal Chemistry. A biochemical Approach, Oxford Univ. Press.</li> </ol> |                                   |           |   |   |   |



| Course Code  | COMPUTER AIDED DRUG DESIGN |  |          | L  | T | P | C |
|--|----------------------------|--|----------|----|---|---|---|
| 23S02203   |                            |  |          | 4  | 0 | 0 | 4 |
|  |                            |  | Semester | II |   |   |   |
| <b>Course Objectives:</b>  |                            |  |          |    |   |   |   |
| The subject is designed to impart knowledge on the current state of the art techniques involved in computer assisted drug design.  |                            |  |          |    |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |                            |  |          |    |   |   |   |
| <ul style="list-style-type: none"> <li>• Role of CADD in drug discovery</li> <li>• Different CADD techniques and their applications</li> <li>• Various strategies to design and develop new drug like molecules.</li> <li>• Working with molecular modeling softwares to design new drug molecules</li> <li>• The in silico virtual screening protocols</li> </ul>   |                            |  |          |    |   |   |   |
| <b>UNIT – I</b>  |                            |  |          |    |   |   |   |
| Introduction to Computer Aided Drug Design (CADD) History, different techniques and applications. Quantitative Structure Activity Relationships: Basics History and development of QSAR: Physicochemical parameters and methods to calculate physicochemical parameters: Hammett equation and electronic parameters (sigma), lipophilicity effects and parameters (log P, pi-substituent constant), steric effects (Taft steric and MR parameters) Experimental and theoretical approaches for the determination of these physicochemical parameters.  |                            |  |          |    |   |   |   |
| <b>UNIT – II</b>   |                            |  |          |    |   |   |   |
| Quantitative Structure Activity Relationships: Applications Hansch analysis, Free Wilson analysis and relationship between them, Advantages and disadvantages; Deriving 2D- QSAR equations. 3D-QSAR approaches and contour map analysis. Statistical methods used in QSAR analysis and importance of statistical parameters  |                            |  |          |    |   |   |   |
| <b>UNIT – III</b>  |                            |  |          |    |   |   |   |
| <b>Molecular Modeling and Docking</b>  |                            |  |          |    |   |   |   |
| a) Molecular and Quantum Mechanics in drug design.<br>b) Energy Minimization Methods: comparison between global minimum conformation and bioactive conformation<br>c) Molecular docking and drug receptor interactions: Rigid docking, flexible docking and extra- precision docking. Agents acting on enzymes such as DHFR, HMG-CoA reductase and HIV protease, choline esterase (AChE & BchE)  |                            |  |          |    |   |   |   |
| <b>UNIT – IV</b>   |                            |  |          |    |   |   |   |
| <b>Molecular Properties and Drug Design</b>  |                            |  |          |    |   |   |   |
| a) Prediction and analysis of ADMET properties of new molecules and its importance in drug design.<br>b) De novo drug design: Receptor/enzyme-interaction and its analysis, Receptor/enzyme cavity size prediction, predicting the functional components of cavities, Fragment based drug design.<br>c) Homology modeling and generation of 3D-structure of protein.   |                            |  |          |    |   |   |   |
| <b>UNIT – V</b>  |                            |  |          |    |   |   |   |
| Pharmacophore Mapping and Virtual Screening Concept of pharmacophore, pharmacophore mapping, identification of Pharmacophore features and Pharmacophore modeling; Conformational search used in pharmacophore mapping. In Silico Drug Design and Virtual Screening Techniques Similarity based methods and Pharmacophore based screening, structure based In-silico virtual screening protocols.   |                            |  |          |    |   |   |   |
| <b>Reference Books:</b>  |                            |  |          |    |   |   |   |
| 1. Computational and structural approaches to drug discovery, Robert M Stroud and Janet. F Moore, RCS Publishers.<br>2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor & Francis group..<br>3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers.<br>4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor & Francis.<br>5. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.<br>6. Medicinal Chemistry by Burger, Wiley Publishing Co.<br>7. An Introduction to Medicinal Chemistry – Graham L. Patrick, Oxford University Press.<br>8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ippincott Williams & Wilkins.<br>9. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers.<br>10. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore |                            |  |          |    |   |   |   |

**Academic Regulations (R23) & Syllabus for M. Pharm.**

| Course Code  | PHARMACEUTICAL PROCESS CHEMISTRY | L         | T | P | C |
|--|----------------------------------|-----------|---|---|---|
| 23S02204   |                                  | 4         | 0 | 0 | 4 |
| <b>Semester</b>  |                                  | <b>II</b> |   |   |   |
| <b>Course Objectives:</b>  |                                  |           |   |   |   |
| The goal of a process chemist is to develop synthetic routes that are safe, cost-effective, environmentally friendly, and efficient. The subject is designed to impart knowledge on the development and optimization of a synthetic route/s and the pilot plant procedure for the manufacture of Active Pharmaceutical Ingredients (APIs) and new chemical entities (NCEs) for the drug development phase.   |                                  |           |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |                                  |           |   |   |   |
| <ul style="list-style-type: none"> <li>• The strategies of scale up process of APIs and intermediates</li> <li>• The various unit operations and various reactions in process chemistry</li> </ul>   |                                  |           |   |   |   |
| <b>UNIT – I</b>  |                                  |           |   |   |   |
| Process chemistry Introduction, Synthetic strategy Stages of scale up process: Bench, pilot and large-scale process. In-process control and validation of large-scale process. Case studies of some scale up process of APIs. Impurities in API, types and their sources including genotoxic impurities  |                                  |           |   |   |   |
| <b>UNIT – II</b>   |                                  |           |   |   |   |
| <b>Unit operations</b>   |                                  |           |   |   |   |
| a) Extraction: Liquid equilibria, extraction with reflux, extraction with agitation, counter current extraction.<br>b) Filtration: Theory of filtration, pressure and vacuum filtration, centrifugal filtration,<br>c) Distillation: azeotropic and steam distillation<br>d) Evaporation: Types of evaporators, factors affecting evaporation.<br>e) Crystallization: Crystallization from aqueous, nonaqueous solutions factors affecting crystallization, nucleation. Principle and general methods of Preparation of polymorphs, hydrates, solvates and amorphous APIs.   |                                  |           |   |   |   |
| <b>UNIT – III</b>  |                                  |           |   |   |   |
| <b>Unit Processes - I</b>  |                                  |           |   |   |   |
| a) Nitration: Nitrating agents, Aromatic nitration, kinetics and mechanism of aromatic nitration, process equipment for technical nitration, mixed acid for nitration,<br>b) Halogenation: Kinetics of halogenations, types of halogenations, catalytic halogenations. Case study on industrial halogenations process.<br>c) Oxidation: Introduction, types of oxidative reactions, Liquid phase oxidation with oxidizing agents. Nonmetallic Oxidizing agents such as H <sub>2</sub> O <sub>2</sub> , sodium hypochlorite, Oxygen gas, ozonolysis.  |                                  |           |   |   |   |
| <b>UNIT – IV</b>   |                                  |           |   |   |   |
| <b>Unit Processes - II</b>   |                                  |           |   |   |   |
| a) Reduction: Catalytic hydrogenation, Heterogeneous and homogeneous catalyst; Hydrogen transfer reactions, Metal hydrides. Case study on industrial reduction process.<br>b) Fermentation: Aerobic and anaerobic fermentation. <ol style="list-style-type: none"> <li>i. Production of Antibiotics; Penicillin and Streptomycin,</li> <li>ii. Vitamins: B<sub>2</sub> and B<sub>12</sub></li> <li>iii. Statins: Lovastatin, Simvastatin</li> </ol> c) Reaction progress kinetic analysis <ol style="list-style-type: none"> <li>i. Streamlining reaction steps, route selection,</li> </ol> Characteristics of expedient routes, characteristics of cost-effective routes, reagent selection, families of reagents useful for scale-up.   |                                  |           |   |   |   |
| <b>UNIT – V</b>  |                                  |           |   |   |   |
| <b>Industrial Safety</b>   |                                  |           |   |   |   |
| a) MSDS (Material Safety Data Sheet), hazard labels of chemicals and Personal Protection Equipment (PPE)<br>b) Fire hazards, types of fire & fire extinguishers<br>c) Occupational Health & Safety Assessment Series 1800 (OHSAS-1800) and ISO- 14001 (Environmental Management System), Effluents and its management.   |                                  |           |   |   |   |
| <b>Reference Books:</b>  |                                  |           |   |   |   |
| <ol style="list-style-type: none"> <li>1. Computational and structural approaches to drug discovery, Robert M Stroud and Janet. F Moore, RCS Publishers.</li> <li>2. Introduction to Quantitative Drug Design by Y.C. Martin, CRC Press, Taylor &amp; Francis group.</li> <li>3. Drug Design by Ariens Volume 1 to 10, Academic Press, 1975, Elsevier Publishers.</li> <li>4. Principles of Drug Design by Smith and Williams, CRC Press, Taylor &amp; Francis.</li> <li>5. The Organic Chemistry of the Drug Design and Drug action by Richard B. Silverman, Elsevier Publishers.</li> <li>6. Medicinal Chemistry by Burger, Wiley Publishing Co.</li> <li>7. An Introduction to Medicinal Chemistry – Graham L. Patrick, Oxford University Press.</li> <li>8. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, Ippincott Williams &amp; Wilkins.</li> <li>9. Comprehensive Medicinal Chemistry – Corwin and Hansch, Pergamon Publishers. Computational and structural approaches to drug design edited by Robert M Stroud and Janet. F Moore</li> </ol> |                                  |           |   |   |   |

| Course Code   | ADVANCED ORGANIC CHEMISTRY – II LAB | L        | T | P  | C |
|---|-------------------------------------|----------|---|----|---|
| 23S02205  |                                     | 0        | 0 | 6  | 3 |
|   |                                     | Semester |   | II |   |
| List of Experiments   |                                     |          |   |    |   |
| <ol style="list-style-type: none"> <li>1. Analysis of Pharmacopoeial compounds and their formulations by UV Vis spectrophotometer, RNA &amp; DNA estimation</li> <li>2. Simultaneous estimation of multi component containing formulations by UV spectrophotometry</li> <li>3. Experiments based on Column chromatography</li> <li>4. Experiments based on HPLC</li> <li>5. Experiments based on Gas Chromatography</li> <li>6. Estimation of riboflavin/quinine sulphate by fluorimetry</li> <li>7. Estimation of sodium/potassium by flame photometry</li> <li>8. To perform the following reactions of synthetic importance Purification of organic solvents, column chromatography               <ol style="list-style-type: none"> <li>a. Claisen-schimidt reaction.</li> <li>b. Benzyllic acid rearrangement.</li> <li>c. Beckmann rearrangement.</li> <li>d. Hoffmann rearrangement</li> <li>e. Mannich reaction</li> </ol> </li> <li>9. Synthesis of medicinally important compounds involving more than one step along with purification and Characterization using TLC, melting point and IR spectroscopy (4experiments)</li> <li>10. Estimation of elements and functional groups in organic natural compounds Isolation, characterization like melting point, mixed melting point, molecular weight determination, functional group analysis, co-chromatographic technique for identification of isolated compounds and interpretation of UV and IR data.</li> <li>11. Some typical degradation reactions to be carried on selected plant constituents</li> </ol> |                                     |          |   |    |   |

| Course Code   | ADVANCED MEDICINAL CHEMISTRY – II LAB | L        | T | P  | C |
|---|---------------------------------------|----------|---|----|---|
| 23S02206  |                                       | 0        | 0 | 6  | 3 |
| Pre-requisite   |                                       | Semester |   | II |   |
| List of Experiments   |                                       |          |   |    |   |
| <ol style="list-style-type: none"> <li>1. Synthesis of 4-chlorobenzhydrylpiperazine. (an intermediate for cetirizine HCl).</li> <li>2. Synthesis of 4-iodotoluene from p-toluidine.</li> <li>3. NaBH<sub>4</sub> reduction of vanillin to vanillyl alcohol</li> <li>4. Synthesis of umbelliferone by Pechhman reaction</li> <li>5. Synthesis of triphenyl imidazole</li> <li>6. To perform the Microwave irradiated reactions of synthetic importance(Any two)</li> <li>7. Determination of log P, MR, hydrogen bond donors and acceptors of selected drugs using softwares</li> <li>8. Calculation of ADMET properties of drug molecules and its analysis using softwares Pharmacophore modeling</li> <li>9. 2D-QSAR based experiments</li> <li>10. 3D-QSAR based experiments</li> <li>11. Docking study based experiment</li> <li>12. Virtual screening based experiment</li> <li>13. Synthesis purification and identification of the following compounds employing some medicinal compounds.</li> </ol> |                                       |          |   |    |   |

| Course Code  | RESEARCH METHODOLOGY AND INTELLECTUAL PROPERTY RIGHTS | L   | T | P | C |
|--|---|-----|---|---|---|
| 23DRM101   |   | 4   | 0 | 0 | 4 |
| Semester   |   | III |   |   |   |
| <b>Course Objectives:</b>  |   |     |   |   |   |
| To understand the research problem, know the literature studies, plagiarism and ethics. To get the knowledge about technical writing. To analyze the nature of intellectual property rights and new developments and patent rights.  |   |     |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |   |     |   |   |   |
| <ul style="list-style-type: none"> <li>• Understand research problem formulation.</li> <li>• Analyze research related information</li> <li>• Follow research ethics</li> <li>• Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.</li> <li>• Understanding that when IPR would take such important place in growth of individuals &amp; nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general &amp; engineering in particular.</li> <li>• Understand that IPR protection provides an incentive to inventors for further research work and investment in R &amp; D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.</li> </ul> |   |     |   |   |   |
| <b>UNIT – I</b>  |   |     |   |   |   |
| Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations  |   |     |   |   |   |
| <b>UNIT – II</b>   |   |     |   |   |   |
| Effective literature studies approaches, analysis, Plagiarism, Research ethics   |   |     |   |   |   |
| <b>UNIT – III</b>  |   |     |   |   |   |
| Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee   |   |     |   |   |   |
| <b>UNIT – IV</b>   |   |     |   |   |   |
| Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.  |   |     |   |   |   |
| <b>UNIT – V</b>  |   |     |   |   |   |
| Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs.  |   |     |   |   |   |
| <b>Textbooks:</b>  |   |     |   |   |   |
| <b>Reference Books:</b>  |   |     |   |   |   |
| <ol style="list-style-type: none"> <li>1. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"</li> <li>2. Halbert, "Resisting Intellectual Property", Taylor &amp; Francis Ltd ,2007.</li> <li>3. Mayall, "Industrial Design", McGraw Hill, 1992.</li> <li>4. Niebel, "Product Design", McGraw Hill, 1974.</li> <li>5. Asimov, "Introduction to Design", Prentice Hall, 1962.</li> <li>6. Robert P. Merges, Peter S. Menell, Mark A. Lemley, "Intellectual Property in New Technological Age", 2016.</li> <li>7. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008</li> </ol>   |   |     |   |   |   |

# AUDIT COURSE-I

| Course Code   | ENGLISH FOR RESEARCH PAPER WRITING | L              | T | P | C |
|---|------------------------------------|----------------|---|---|---|
| 23DAC101a   |                                    | 2              | 0 | 0 | 0 |
| <b>Semester</b>   |                                    | <b>I</b>       |   |   |   |
| <b>Course Objectives:</b> This course will enable students:   |                                    |                |   |   |   |
| <ul style="list-style-type: none"> <li>• Understand the essentials of writing skills and their level of readability</li> <li>• Learn about what to write in each section</li> <li>• Ensure qualitative presentation with linguistic accuracy</li> </ul>   |                                    |                |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to  |                                    |                |   |   |   |
| <ul style="list-style-type: none"> <li>• Understand the significance of writing skills and the level of readability</li> <li>• Analyze and write title, abstract, different sections in research paper</li> <li>• Develop the skills needed while writing a research paper</li> </ul>   |                                    |                |   |   |   |
| <b>UNIT - I</b>   |                                    | Lecture Hrs:10 |   |   |   |
| 1 Overview of a Research Paper- Planning and Preparation- Word Order- Useful Phrases - Breaking up Long Sentences-Structuring Paragraphs and Sentences-Being Concise and Removing Redundancy<br>-Avoiding Ambiguity   |                                    |                |   |   |   |
| <b>UNIT - II</b>  |                                    | Lecture Hrs:10 |   |   |   |
| Essential Components of a Research Paper- Abstracts- Building Hypothesis-Research Problem - Highlight Findings- Hedging and Criticizing, Paraphrasing and Plagiarism, Caution   |                                    |                |   |   |   |
| <b>UNIT - III</b>   |                                    | Lecture Hrs:10 |   |   |   |
| Introducing Review of the Literature – Methodology - Analysis of the Data-Findings - Discussion- Conclusions- Recommendations.  |                                    |                |   |   |   |
| <b>UNIT - IV</b>  |                                    | Lecture Hrs:9  |   |   |   |
| Key skills needed for writing a Title, Abstract, and Introduction   |                                    |                |   |   |   |
| <b>UNIT - V</b>   |                                    | Lecture Hrs:9  |   |   |   |
| Appropriate language to formulate Methodology, incorporate Results, put forth Arguments and draw Conclusions  |                                    |                |   |   |   |
| <b>Suggested Reading</b>  |                                    |                |   |   |   |
| <ol style="list-style-type: none"> <li>1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering &amp; Technology PG Courses [Volume-I]</li> <li>2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press</li> <li>3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.<br/>Highman'sbook</li> <li>4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011</li> </ol> |                                    |                |   |   |   |

| Course Code   | DISASTER MANAGEMENT | L        | T | P | C |
|---|---------------------|----------|---|---|---|
| 23DAC101b   |                     |          | 2 | 0 | 0 |
| <b>Semester</b>   |                     | <b>I</b> |   |   |   |
| <b>Course Objectives:</b> This course will enable students:   |                     |          |   |   |   |
| <ul style="list-style-type: none"> <li>Learn to demonstrate critical understanding of key concepts in disaster risk reduction and humanitarian response.</li> <li>Critically evaluate disaster risk reduction and humanitarian response policy and practice from Multiple perspectives.</li> <li>Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations</li> <li>Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in</li> </ul> |                     |          |   |   |   |
| <b>UNIT - I</b>   |                     |          |   |   |   |
| <p><b>Introduction:</b><br/>Disaster: Definition, Factors and Significance; Difference Between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.</p> <p><b>Disaster Prone Areas in India:</b><br/>Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post- Disaster Diseases and Epidemics</p>  |                     |          |   |   |   |
| <b>UNIT - II</b>  |                     |          |   |   |   |
| <p><b>Repercussions of Disasters and Hazards:</b><br/>Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.</p>   |                     |          |   |   |   |
| <b>UNIT - III</b>   |                     |          |   |   |   |
| <p><b>Disaster Preparedness and Management:</b><br/>Preparedness: Monitoring of Phenomena Triggering A Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.</p>  |                     |          |   |   |   |
| <b>UNIT - IV</b>  |                     |          |   |   |   |
| <p><b>Risk Assessment Disaster Risk:</b><br/>Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival.</p>   |                     |          |   |   |   |
| <b>UNIT - V</b>   |                     |          |   |   |   |
| <p><b>Disaster Mitigation:</b><br/>Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.</p>  |                     |          |   |   |   |
| <p><b>Suggested Reading</b></p> <ol style="list-style-type: none"> <li>R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies</li> <li>"New Royal book Company.. Sahni, Pardeep Et. Al. (Eds.), "Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi.</li> <li>Goel S.L., "Disaster Administration And Management Text And Case Studies", Deep &amp; Deep Publication Pvt. Ltd., New Delhi</li> </ol>   |                     |          |   |   |   |

| Course Code  | SANSKRITFOR TECHNICAL KNOWLEDGE | L        | T | P | C |
|--|---------------------------------|----------|---|---|---|
| 23DAC101c  |                                 | 2        | 0 | 0 | 0 |
| <b>Semester</b>  |                                 | <b>I</b> |   |   |   |
| <b>Course Objectives:</b> This course will enable students:  |                                 |          |   |   |   |
| <ul style="list-style-type: none"> <li>• To get a working knowledge in illustrious Sanskrit, the scientific language in the world</li> <li>• Learning of Sanskrit to improve brain functioning</li> <li>• LearningofSanskrittodevelopthelogicinmathematics,science&amp;othersubjects enhancing the memory power</li> <li>• The engineering scholars equipped with Sanskrit will be able to explore the huge</li> <li>• Knowledge from ancientliterature</li> </ul> |                                 |          |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |                                 |          |   |   |   |
| <ul style="list-style-type: none"> <li>• Understanding basic Sanskrit language</li> <li>• Ancient Sanskrit literature about science &amp;technology can be understood</li> <li>• Being a logical language will help to develop logic in students</li> </ul>  |                                 |          |   |   |   |
| <b>UNIT - I</b>  |                                 |          |   |   |   |
| Alphabets in Sanskrit,   |                                 |          |   |   |   |
| <b>UNIT - II</b>   |                                 |          |   |   |   |
| Past/Present/Future Tense, Simple Sentences  |                                 |          |   |   |   |
| <b>UNIT - III</b>  |                                 |          |   |   |   |
| Order, Introduction of roots   |                                 |          |   |   |   |
| <b>UNIT - IV</b>   |                                 |          |   |   |   |
| Technical information about Sanskrit Literature  |                                 |          |   |   |   |
| <b>UNIT - V</b>  |                                 |          |   |   |   |
| Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics  |                                 |          |   |   |   |
| <b>Suggested Reading</b>   |                                 |          |   |   |   |
| <ol style="list-style-type: none"> <li>1. "Abhyaspustakam" –Dr. Vishwas, Sanskrit-Bharti Publication, New Delhi</li> <li>2. "Teach Yourself Sanskrit" Prathama Deeksha- VempatiKutumbshastri, RashtriyaSanskrit Sansthanam, New Delhi Publication</li> <li>3. "India's Glorious ScientificTradition" Suresh Soni, Ocean books (P) Ltd.,New Delhi</li> </ol>  |                                 |          |   |   |   |



| Course Code   | ENTREPRENEURSHIP MANAGEMENT |   | L | T | P | C |
|---|-----------------------------|---|---|---|---|---|
| 23DAC101d   |                             |   | 2 | 0 | 0 | 0 |
|   | Semester                    | I |   |   |   |   |
| <b>Course Objectives:</b>   |                             |   |   |   |   |   |
| This course is designed to impart knowledge and skills necessary to train the students on entrepreneurship management.  |                             |   |   |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to  |                             |   |   |   |   |   |
| On completion of this course it is expected that students will be able to:  |                             |   |   |   |   |   |
| <ul style="list-style-type: none"> <li>• The Role of enterprise in national and global economy</li> <li>• Dynamics of motivation and concepts of entrepreneurship</li> <li>• Demands and challenges of Growth Strategies and Networking</li> </ul>  |                             |   |   |   |   |   |
| <b>UNIT - I</b>   |                             |   |   |   |   |   |
| Conceptual Frame Work: Concept need and process in entrepreneurship development. Role of enterprise in national and global economy. Types of enterprise – Merits and Demerits. Government policies and schemes for enterprise development. Institutional support in enterprise development and management.  |                             |   |   |   |   |   |
| <b>UNIT - II</b>  |                             |   |   |   |   |   |
| Entrepreneur: Entrepreneurial motivation – dynamics of motivation. Entrepreneurial competency – Concepts. Developing Entrepreneurial competencies - requirements and understanding the process of entrepreneurship development, self-awareness, interpersonal skills, creativity, assertiveness, achievement, factors affecting entrepreneur role.  |                             |   |   |   |   |   |
| <b>UNIT - III</b>   |                             |   |   |   |   |   |
| Launching and Organizing an Enterprise: Environment scanning – Information, sources, schemes of assistance, problems. Enterprise selection, market assessment, enterprise feasibility study, SWOT Analysis. Resource mobilization -finance, technology, raw material, site and manpower. Costing and marketing management and quality control. Feedback, monitoring and evaluation.   |                             |   |   |   |   |   |
| <b>UNIT - IV</b>  |                             |   |   |   |   |   |
| Growth Strategies and Networking: Performance appraisal and assessment. Profitability and control measures, demands and challenges. Need for diversification. Future Growth – Techniques of expansion and diversification, vision strategies. Concept and dynamics. Methods, Joint venture, coordination and feasibility study.   |                             |   |   |   |   |   |
| <b>UNIT - V</b>   |                             |   |   |   |   |   |
| Preparing Project Proposal to Start on New Enterprise Project work – Feasibility report; Planning, resource mobilization and implementation.  |                             |   |   |   |   |   |
| <b>Reference Books:</b>   |                             |   |   |   |   |   |
| <ol style="list-style-type: none"> <li>1. Akhauri, M. M. P.(1990): Entrepreneurship for Women in India, NIESBUD, New Delhi.</li> <li>2. Hisrich, R. D &amp; Brush, C.G. (1996) The Women Entrepreneurs, D.C. Health&amp; Co., Toronto.</li> <li>3. Hisrich, R.D. and Peters, M.P. (1995): Entrepreneurship – Starting Developing and Managing a New Enterprise, Richard D., Inwin, INC, USA.</li> <li>4. Meredith, G.G. etal (1982): Practice of Entrepreneurship, ILO, Geneva.</li> <li>5. Patel, V.C. (1987): Women Entrepreneurship – Developing New Entrepreneurs, Ahmedabad EDII</li> <li>6. Arya kumar.(2012): Entrepreneurship- Creating and Leading an Entrepreneurial Organization, Pearson</li> </ol> |                             |   |   |   |   |   |

# AUDIT COURSE-II

| Course Code   | PEDAGOGY STUDIES | L         | T | P | C |
|---|------------------|-----------|---|---|---|
| 23DAC201a   |                  |           | 2 | 0 | 0 |
| <b>Semester</b>   |                  | <b>II</b> |   |   |   |
| <b>Course Objectives:</b> This course will enable students:   |                  |           |   |   |   |
| <ul style="list-style-type: none"> <li>Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.</li> <li>Identify critical evidence gaps to guide the development.</li> </ul>  |                  |           |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to  |                  |           |   |   |   |
| Students will be able to understand:  |                  |           |   |   |   |
| <ul style="list-style-type: none"> <li>What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries?</li> <li>What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?</li> <li>How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?</li> </ul>   |                  |           |   |   |   |
| <b>UNIT - I</b>   |                  |           |   |   |   |
| <b>Introduction and Methodology:</b> Aims and rationale, Policy back ground, Conceptual frame work and terminology Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.  |                  |           |   |   |   |
| <b>UNIT - II</b>  |                  |           |   |   |   |
| <b>Thematic overview:</b> Pedagogical practices are being used by teachers in formal and informal classrooms in developing countries. Curriculum, Teacher education.  |                  |           |   |   |   |
| <b>UNIT - III</b>   |                  |           |   |   |   |
| Evidence on the effectiveness of pedagogical practices, Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.  |                  |           |   |   |   |
| <b>UNIT - IV</b>  |                  |           |   |   |   |
| <b>Professional development:</b> alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barrier to learning: limited resources and large class sizes   |                  |           |   |   |   |
| <b>UNIT - V</b>   |                  |           |   |   |   |
| <b>Research gaps and future directions:</b> Research design, Contexts, Pedagogy, Teacher education, Curriculum and assessment, Dissemination and research impact.   |                  |           |   |   |   |
| <b>Suggested Reading</b>  |                  |           |   |   |   |
| <ol style="list-style-type: none"> <li>Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.</li> <li>Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.</li> <li>Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.</li> <li>Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272-282.</li> <li>Alexander RJ (2001) Culture and pedagogy: International comparisons in primary education. Oxford and Boston: Blackwell.</li> <li>Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.</li> <li><a href="http://www.pratham.org/images/resource%20working%20paper%202.pdf">www.pratham.org/images/resource%20working%20paper%202.pdf</a>.</li> </ol> |                  |           |   |   |   |

| Course Code  | STRESSMANAGEMENT BY YOGA | L         | T | P | C |
|--|--------------------------|-----------|---|---|---|
| 23DAC201b  |                          |           | 2 | 0 | 0 |
| <b>Semester</b>  |                          | <b>II</b> |   |   |   |
| <b>Course Objectives:</b> This course will enable students:  |                          |           |   |   |   |
| <ul style="list-style-type: none"> <li>• To achieve overall health of body and mind</li> <li>• To overcome stress</li> </ul>   |                          |           |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |                          |           |   |   |   |
| <ul style="list-style-type: none"> <li>• Develop healthy mind in a healthy body thus improving social health also</li> <li>• Improve efficiency</li> </ul>   |                          |           |   |   |   |
| <b>UNIT - I</b>  |                          |           |   |   |   |
| Definitions of Eight parts of yog.(Ashtanga)   |                          |           |   |   |   |
| <b>UNIT - II</b>   |                          |           |   |   |   |
| Yam and Niyam.   |                          |           |   |   |   |
| <b>UNIT - III</b>  |                          |           |   |   |   |
| Do's and Don't's in life.  |                          |           |   |   |   |
| i) Ahimsa, satya, asthaya, bramhacharya and aparigraha ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan   |                          |           |   |   |   |
| <b>UNIT - IV</b>   |                          |           |   |   |   |
| Asan and Pranayam  |                          |           |   |   |   |
| <b>UNIT - V</b>  |                          |           |   |   |   |
| i) Various yog poses and their benefits for mind & body<br>ii) Regularization of breathing techniques and its effects-Types of pranayam  |                          |           |   |   |   |
| <b>Suggested Reading</b>   |                          |           |   |   |   |
| 1. 'Yogic Asanas for Group Training-Part-I': Janardan Swami Yogabhyasi Mandal, Nagpur<br>2. 'Rajayoga or conquering the Internal Nature' by Swami Vivekananda, Advaita Ashrama (Publication Department), Kolkata |                          |           |   |   |   |

| Course Code  | PERSONALITY DEVELOPMENT THROUGH LIFE<br>ENLIGHTENMENT SKILLS | L         | T | P | C |
|--|--|-----------|---|---|---|
| 23DAC201c  |  |           | 2 | 0 | 0 |
| <b>Semester</b>  |  | <b>II</b> |   |   |   |
| <b>Course Objectives:</b> This course will enable students:  |  |           |   |   |   |
| <ul style="list-style-type: none"> <li>• To learn to achieve the highest goal happily</li> <li>• To become a person with stable mind, pleasing personality and determination</li> <li>• To awaken wisdom in students</li> </ul>  |  |           |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |  |           |   |   |   |
| <ul style="list-style-type: none"> <li>• Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life</li> <li>• The person who has studied Geeta will lead the nation and mankind to peace and prosperity</li> <li>• Study of Neetishatakam will help in developing versatile personality of students</li> </ul> |  |           |   |   |   |
| <b>UNIT - I</b>  |  |           |   |   |   |
| Neetishatakam- Holistic development of personality<br>Verses-19,20,21,22(wisdom)<br>Verses-29,31,32(pride & heroism)<br>Verses-26,28,63,65(virtue)   |  |           |   |   |   |
| <b>UNIT - II</b>   |  |           |   |   |   |
| Neetishatakam- Holistic development of personality<br>Verses-52,53,59(dont's)<br>Verses-71,73,75,78(do's)  |  |           |   |   |   |
| <b>UNIT - III</b>  |  |           |   |   |   |
| Approach to day to day work and duties.<br>Shrimad Bhagwad Geeta: Chapter 2-Verses 41,47,48, Chapter 3-<br>Verses 13,21,27,35, Chapter 6-Verses 5,13,17,23,35,<br>Chapter 18-Verses 45,46,48.  |  |           |   |   |   |
| <b>UNIT - IV</b>   |  |           |   |   |   |
| Statements of basic knowledge.<br>Shrimad Bhagwad Geeta: Chapter 2-Verses 56,62,68<br>Chapter 12 -Verses 13,14,15,16,17,18<br>Personality of Role model. Shrimad Bhagwad Geeta:  |  |           |   |   |   |
| <b>UNIT - V</b>  |  |           |   |   |   |
| Chapter 2-Verses 17, Chapter 3-Verses 36,37,42,<br>Chapter 4-Verses 18,38,39<br>Chapter 18- Verses 37,38,63  |  |           |   |   |   |
| <b>Suggested Reading</b>   |  |           |   |   |   |
| 1. "Srimad Bhagavad Gita" by Swami Swarupananda Advaita Ashram (Publication Department),<br>Kolkata<br>2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P. Gopinath, Rashtriya Sanskrit<br>Sansthanam, New Delhi.   |  |           |   |   |   |

# OPEN ELECTIVE

| Course Code   | STABILITY OF DRUGS AND DOSAGE FORMS<br>( Elective) |          | L   | T | P | C |
|---|--|----------|-----|---|---|---|
| 23SOE301a   |  |          | 3   | 0 | 0 | 3 |
| Pre-requisite   |  | Semester | III |   |   |   |
| <b>Course Objectives:</b>   |  |          |     |   |   |   |
| These topics are designed impart a specialized knowledge to preserve the properties of drugs and dosage forms during manufacture storage and shelf life. The understanding of properties and evaluation of stability during storage, by solution and solid state against several factors of degradation.  |  |          |     |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to  |  |          |     |   |   |   |
| <ul style="list-style-type: none"> <li>Evaluation of stability of solutions, solids and formulations against adverse conditions.</li> <li>Suggest the measures to retain stability and storage conditions for retaining the efficacy of the products.</li> </ul>  |  |          |     |   |   |   |
| <b>UNIT – I</b>   |  |          |     |   |   |   |
| <b>Drug decomposition mechanisms</b>  |  |          |     |   |   |   |
| 1. Hydrolysis and acyl transfers: Nature of reaction, structure and utility, stabilization of Pharmaceutical examples.<br>2. Oxidation: Nature of oxidation, kinetics of oxidation, oxidation pathways of pharmaceutical, Interest Inhibition of oxidation<br>3. Photolysis: Energetics of photolysis, kinetics photolysis, photolytic reactions of pharmaceutical interest, prevention of photolytic reactions.  |  |          |     |   |   |   |
| <b>UNIT – II</b>  |  |          |     |   |   |   |
| <b>Solid state chemical decomposition</b>   |  |          |     |   |   |   |
| Kinetic of solids state decomposition, Pharmaceutical examples of solid-state decomposition, Pure drugs, drug excipient and drug-drug interaction in solid state, methods of stabilization.   |  |          |     |   |   |   |
| Physical stability testing of dosage forms:   |  |          |     |   |   |   |
| 1. Solids – tablets, capsules, powder and granules<br>2. Disperse systems<br>3. Microbial decomposition<br>4. Over-view, physical stability of novel drug carriers, liposomes, niosomes, nano-particles.  |  |          |     |   |   |   |
| <b>UNIT – III</b>   |  |          |     |   |   |   |
| Identification and quantitative determination of preservatives, Antioxidants, colouring materials, emulsifiers and stabilizers in Pharmaceutical formulation.   |  |          |     |   |   |   |
| Analysis of drugs from biological samples including, selection of biological sample, extraction of drugs by various methods as LLE, SPE and Membrane filtration. Factors affecting extraction of drugs.   |  |          |     |   |   |   |
| <b>UNIT – IV</b>  |  |          |     |   |   |   |
| General method of analysis to determine the quality of raw materials used in cosmetic industry.   |  |          |     |   |   |   |
| Indian Standard Specifications (ISI) laid down for sampling and testing of various cosmetics in finished form by the Bureau of Indian Standards   |  |          |     |   |   |   |
| <b>UNIT – V</b>   |  |          |     |   |   |   |
| Methods of analysis to determine the quality of cosmetics in the finished forms such as Hair care products, Skin care products, Baby care products, Dental products, Personal hygiene products, Colour cosmetics, Ethnic products, Colour makeup preparation, Lipsticks, Hair setting lotions and Eye shadows. Toxicity testing in cosmetics and Safety and Legislation of Cosmetic products.   |  |          |     |   |   |   |
| a) Stability studies: Concept of stability studies. cGMP& ICH guidelines for Accelerated stability Testing.<br>b) Interaction of containers & closure Compatibility Testing.  |  |          |     |   |   |   |
| <b>Reference Books:</b>   |  |          |     |   |   |   |
| 1. Comprehensive Pharmacy Review 5th Edition by Leon Shargel, Alan H. Mutnick, Paul F. Souney, Larry N. Sawnsen – 2004.<br>2. A.H. Beckett and J. B. Stenlake Practical Pharmaceutical Chemistry, Part I and Part II, 4thEdition.<br>3. G. H. Jeffery, J. Basset, J. Mendham, R. C. Denny (Rev. by) Vogels Text Book of Quantitative Chemical Analysis, 5th Edition 1989, ELBS.<br>4. The Controller of Publications; New Delhi, Govt. of India, Indian Pharmacopoeia, Vol. I and Vol. II - 2010.<br>5. J. B. Wilkinson and R. J. Moore, Herry's Cosmeticology; Longman Scientific and Technical Publishers, Singapore.<br>6. P.D. Sethi; Quantitative Analysis of Drugs in Pharmaceutical Formulations, 3rd Edition - 1997,<br>7. Classification of cosmetics raw materials and adjuncts IS 3958 of Indian Standards Institution (BIS).<br>8. Cosmetic and toilet goods – methods of sampling IS 3958 of Indian Standards Institution (BIS).<br>9. Methods of sampling and test for various cosmetics as laid down by Bureau of Indian Standards.<br>10. Drug stability: Principles and practices by Jens T. Carstensen<br>11. Stability Testing of Drug Products by W. Grimm. 12. Stability of Drugs and Dosage Forms by Yoshioka and Stella. |  |          |     |   |   |   |

| Course Code  | BIOSTATISTICS<br>(Elective) |  |  | L   | T | P | C |
|--|-----------------------------|--|--|-----|---|---|---|
| 23SOE301b  |                             |  |  | 3   | 0 | 0 | 3 |
| Semester   |                             |  |  | III |   |   |   |
| <b>Course Objectives:</b>  |                             |  |  |     |   |   |   |
| The student shall know the introduction, scope of biostatistics and Research work, calculation and present of the data   |                             |  |  |     |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to   |                             |  |  |     |   |   |   |
| 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   |                             |  |  |     |   |   |   |
| <b>UNIT - I</b>  |                             |  |  |     |   |   |   |
| An introduction to statistics and biostatistics-collection and organization of data, graphical, pictorial presentation of data, measures of central tendency and dispersion, sampling techniques, sample size, Coefficient of variation, mean error, relative error, precision and accuracy  |                             |  |  |     |   |   |   |
| <b>UNIT - II</b>   |                             |  |  |     |   |   |   |
| Tests of significance: Testing hypotheses – Principles and applications of Z, t, F-ratio and chi-square tests in pharmaceutical and medical research. Non-parametric tests: sign test, Wilcoxon signed rank test, Wilcoxon rank sum test, Kruskal Wallis test, run test and median tests.  |                             |  |  |     |   |   |   |
| <b>UNIT - III</b>  |                             |  |  |     |   |   |   |
| Design of Experiments: Principles of randomization, replication and local control; CRD, RBD, LSD – their applications and analysis of data;  |                             |  |  |     |   |   |   |
| <b>UNIT - IV</b>   |                             |  |  |     |   |   |   |
| Factorial Experiments – Principles and applications; Probit analysis: Dose – effect relationships, calculation of LD50, ED50   |                             |  |  |     |   |   |   |
| <b>UNIT - V</b>  |                             |  |  |     |   |   |   |
| Statistical quality control: Meaning and uses, Construction of X, R, P, np and charts.   |                             |  |  |     |   |   |   |
| <b>Textbooks:</b>  |                             |  |  |     |   |   |   |
| <ol style="list-style-type: none"> <li>1. Statistics for business and economics 3rd edition by Vikas books publications</li> <li>2. Biostatistics &amp; Computer applications by GN Rao and NK Tiwari</li> <li>3. Sokal, R.R. and Rohlf, F.J. 1987. An Introduction to Biostatistics. W.H. Freeman and Company.</li> <li>4. Bailey, N.T.J. 1981. Statistical Methods in Biology. English University Press.</li> <li>5. Mitchell, K. and Glover, T. 2001. Introduction to Biostatistics. McGraw Hill, Publishing Co.</li> </ol>   |                             |  |  |     |   |   |   |
| <b>Reference Books:</b>  |                             |  |  |     |   |   |   |
| <ol style="list-style-type: none"> <li>1. Remington's Pharmaceutical Sciences</li> <li>2. Theory &amp; Practice of Industrial Pharmacy by Lachman</li> <li>3. Statistics for business and economics 3rd edition by Vikas books publications</li> <li>4. Biostatistics &amp; Computer applications by GN Rao and NK Tiwari</li> <li>5. Sokal, R.R. and Rohlf, F.J. 1987. An Introduction to Biostatistics. W.H. Freeman and Company.</li> <li>6. Bailey, N.T.J. 1981. Statistical Methods in Biology. English University Press.</li> <li>7. Mitchell, K. and Glover, T. 2001. Introduction to Biostatistics. McGraw Hill, Publishing Co.</li> </ol> |                             |  |  |     |   |   |   |



| Course Code   | PHARMACOEPIDEMIOLOGY &<br>PHARMACOECONOMICS (Elective) |  | L   | T | P | C |
|---|--|--|-----|---|---|---|
| 23SOE301c   |  |  | 3   | 0 | 0 | 3 |
| Pre-requisite   | Semester   |  | III |   |   |   |
| <b>Course Objectives:</b>   |  |  |     |   |   |   |
| 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.  |  |  |     |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to  |  |  |     |   |   |   |
| <ul style="list-style-type: none"> <li>Understand the various epidemiological methods and their applications</li> <li>Understand the fundamental principles of Pharmacoeconomics.</li> <li>Identify and determine relevant cost and consequences associated with pharmacy products and services.</li> <li>Perform the key Pharmacoeconomics analysis methods</li> <li>Understand the Pharmacoeconomic decision analysis methods and its applications.</li> <li>Describe current Pharmacoeconomic methods and issues.</li> <li>Understand the applications of Pharmacoeconomics to various pharmacy settings.</li> </ul>   |  |  |     |   |   |   |
| <b>UNIT – I</b>   |  |  |     |   |   |   |
| <b>Introduction to Pharmacoepidemiology</b>   |  |  |     |   |   |   |
| 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:<br>Measurement of risk, Attributable risk and relative risk, Time- risk relationship and odds ratio  |  |  |     |   |   |   |
| <b>UNIT – II</b>  |  |  |     |   |   |   |
| <b>Pharmacoepidemiological Methods</b>  |  |  |     |   |   |   |
| 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   |  |  |     |   |   |   |
| <b>UNIT – III</b>   |  |  |     |   |   |   |
| <b>Introduction to Pharmacoeconomics</b>  |  |  |     |   |   |   |
| 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.  |  |  |     |   |   |   |
| <b>UNIT – IV</b>  |  |  |     |   |   |   |
| <b>Pharmacoeconomic evaluations</b>   |  |  |     |   |   |   |
| 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).  |  |  |     |   |   |   |
| <b>UNIT – V</b>   |  |  |     |   |   |   |
| <b>Health related quality of life (HRQOL)</b>   |  |  |     |   |   |   |
| 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  |  |  |     |   |   |   |
| <b>Reference Books:</b>   |  |  |     |   |   |   |
| <ol style="list-style-type: none"> <li>Rascati K L. Essentials of Pharmacoeconomics, Woulters Kluwe rLippincott Williams &amp; Wilkins, Philadelphia.</li> <li>Thomas E Getzen. Health economics. Fundamentals and Flow of Funds. John Wiley &amp; Sons, USA.</li> <li>Andrew Briggs, Karl Claxton, Mark Sculpher. Decision Modeling for Health Economic Evaluation, Oxford University Press, London.</li> <li>K G Revikumar, Pharmacoepidemiology and Pharmacoeconomics Concepts and Practices.</li> <li>Michael Drummond, Mark Sculpher, George Torrence, Bernie O'Brien and Greg Stoddart. Methods for the Economic Evaluation of Health Care Programs Oxford University Press, London.</li> <li>George E Mackinnon III. Understanding health outcomes and Pharmacoeconomics.</li> <li>Graker, Dennis. Pharmacoeconomics and outcomes.</li> <li>Walley, Pharmacoeconomics.</li> <li>Pharmacoeconomic – ed. by Nowakowska – University of Medical Sciences, Poznan.</li> <li>Relevant review articles from recent medical and pharmaceutical literature Guru Prasad Mohanta and P K Manna, Textbook of Pharmacovigilance Concepts and Practice</li> </ol> |  |  |     |   |   |   |

| Course Code  | BIOLOGICAL SCREENING METHODS |  | L   | T | P | C |
|--|------------------------------|--|-----|---|---|---|
| 23SOE301d  | ( Elective)                  |  | 3   | 0 | 0 | 3 |
| Semester   |                              |  | III |   |   |   |
| <b>Course Objectives:</b>  |                              |  |     |   |   |   |
| The students are 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.  |                              |  |     |   |   |   |
| <b>Course Outcomes (CO):</b> Student will be able to know  |                              |  |     |   |   |   |
| <ul style="list-style-type: none"> <li>• How to handle animals</li> <li>• About various techniques for screening of drugs for different pharmacological activities</li> <li>• Guidelines and regulations for screening new drug molecules on animals.</li> </ul>   |                              |  |     |   |   |   |
| <b>UNIT – I</b>  |                              |  |     |   |   |   |
| <b>Drug discovery process:</b><br>Principles, techniques and strategies used in new drug discovery. High throughput screening, human genomics, robotics and economics of drug discovery, Regulations. Alternatives to animal screening procedures, cell-line, patch –clamp technique, In-vitro models, molecular biology techniques.   |                              |  |     |   |   |   |
| <b>UNIT – II</b>   |                              |  |     |   |   |   |
| <b>Bioassays:</b><br>Basic principles of bioassays, official bioassays, experimental models and statistical designs employed in biological standardization.  |                              |  |     |   |   |   |
| <b>UNIT – III</b>  |                              |  |     |   |   |   |
| <b>Toxicity Evaluations</b><br>Principles of toxicity evaluations, ED50, LD50 and TD values, International guidelines (ICH recommendations). Preclinical studies: General principles and procedures involved in acute, sub-acute, chronic, teratogenicity, mutagenicity and carcinogenicity.   |                              |  |     |   |   |   |
| <b>UNIT – IV</b>   |                              |  |     |   |   |   |
| <b>Screening of drugs</b><br>Screening of different classes of drugs using micro-organisms. Vitamin and antibiotic assays. Screening methods involved in toxins and pathogens.   |                              |  |     |   |   |   |
| <b>UNIT – V</b>  |                              |  |     |   |   |   |
| <b>Enzymatic screening methods</b><br>$\alpha$ -glucosidase, $\alpha$ - amylase, DNA polymerase, nucleases, Lasparginase, lipases and peptidases.  |                              |  |     |   |   |   |
| <b>Reference Books:</b>  |                              |  |     |   |   |   |
| <ol style="list-style-type: none"> <li>1. Basic and clinical pharmacology by Bertram G. Katzung (International edition) lange medical book / Mc Graw Hill, USA 2001 8th edition</li> <li>2. Pharmacology by Rang H.P, Dale MM and Ritter JM., Churchill Livingston, London, 4/e</li> <li>3. Goodman and Gilman’s The pharmacological basis of therapeutics (International edition) Mc Graw Hill, USA 2001 10th edition.</li> <li>4. General and applid toxicology by B.Ballantyne, T.Marrs, P.Turner (Eds) TheMc Millan press Ltd, London.</li> <li>5. Drug Discovery by Vogel’s</li> <li>6. Drug Discovery and evaluation – Pharmacological assays by H.Gerhard.Vogel, 2nd edition, Springer verlag, Berlin, Heidelberg.</li> <li>7. Tutorial Pharmacy (Vol I and II) by Cooper and Gunns.</li> </ol> |                              |  |     |   |   |   |