

M.Sc. CHEMISTRY (ORGANIC CHEMISTRY)

IV SEMESTER SYLLABUS

(For the batch admitted during the academic year 2017-2018)

Paper –I CH (OC) 401T: Drug design and Drug Discovery

OC-25: Principles of drug design and drug discovery

OC- 26: Lead modification and SAR studies

OC – 27: QSAR studies

OC -28: Molecular Modelling

OC – 25: Principles of drug design and drug discovery **15Hrs**

Introduction to drug discovery. Folklore drugs, stages involved in drug discovery – disease, drug targets, bioassay. Discovery of a lead – screening of natural products and synthetic compound libraries, Existing drugs as leads (me too drugs). Pharmacokinetics (ADME), Pharmacodynamics. Nature of drug – receptor interactions and their theories – occupancy theory, induced – fit theory, Macromolecular perturbation theory and Two-state model of receptor activation. Natural products as lead structures in drug discovery – pharmacophore – structure pruning technique e.g. morphine . Discovery of lead structure from natural hormones and neurotransmitters. Principles of design of agonists (e.g. Salbutamol), Antagonists e.g cimitidine) and enzyme inhibitors (e.g. Captopril). Drug discovery without lead – serendipity – penicillin and Librium as examples. Principles of prodrug design. Introduction to drug patents and clinical trials.

OC- 26: Lead modification and SAR studies **15 Hrs**

Lead modification strategies, Bioisosterism , variation of alkyl substituents , chain homologation and branching , Variation of aromatic substituents , Extension of structure , ring expansion and ring contraction , ring variation, variation and position of hetero atoms , ring fusion , simplification of the lead, rigidification of lead . Discovery of oxaminiquine, salbutamol, cimitidine and captoprill structure – activity relationship studies in sulfa drugs, benzodiazepines, and taxol analogs.

OC-27: Quantitive structure – activity relationship (QSAR) Studies **15 Hrs**

Introduction, physicochemical properties – pKa , electronic effects and hammett constants(σ), lipophilicity constant (π), Steric effects and Taft's constant , linear and nonlinear relationship between biological activity and hammett / lipophilicity substituent constants. Lipenski rule of five. Hansch analysis, Craig's plot, topliss scheme, free Wilson approach, cluster significant analysis. Three case studies.

OC-28: Molecular Modelling

15hrs

Introduction to molecular modelling; Coordinate systems – Cartesian coordinates, internal Coordinates, Z-matrix. Potential energy surfaces (definition only). Empirical force field models molecular mechanics, energy calculations. (bond stretch, bond angles, dihedral angle, non bonded interactions). Energy minimizations, modelling ligands for known and unknown receptors; molecular docking approaches and scoring techniques; Molecular docking applications.

Recommended books:

1. Burger's medicinal chemistry and drug discovery by Manfred E. Wolf.
2. Introduction to medicinal chemistry by Patrick.
3. Introduction to drug design by R Silverman
4. Comprehensive medicinal chemistry Vol 1-5 by Hanzsch.
5. Principles of medicinal chemistry. by William foye
6. Biochemical approach to medicinal chemistry. By Thomas nogrady .
7. Pharmaceutical chemistry and drug synthesis by Roth and kleeman
8. Drug design by E.J. Arienes
9. Principles of medicinal chemistry Vol I & II by kadam et al
10. Medicinal chemistry an introduction by Garreth Thomas
11. Organic and pharmaceutical chemistry by Delgrado
12. Organic pharmaceutical chemistry b Harikishan singh
13. Medicinal chemistry bty Ashtoshkar
14. Medicinal chemistry by chatwal
15. Organic drug synthesis by ledneicer vol 1-6
16. Strategies for organic drug synthesis and design by danie ledneicer.
17. Top Drugs : top synthetic routes by John saunders
18. Chirotechnoiogy by roger A. Sheldon
19. Burger's medicinal chemistry and drug discovery : Principles and practice , vol 1.
20. Molecular Modelling: Principles and Applications By Andrew Leach
21. Text book of drug design and discovery , edited by povl krogsgaard- Larsen tommy liljefors.

Paper-2 CH (OC) 402T: Reaction Mechanism, Non benzenoid Aromatics and Nanomaterials

OC-29 New Synthetic Reactions-II

OC-30 Reaction Mechanism-II

OC-31 Non benzenoid Aromatics

OC-32 Nanomaterials

OC-29 New synthetic reactions-II

15 Hrs

- 1. Ring Formation Reactions:** Pausan-Khand reaction, Bergman cyclisation, Nazarov cyclisation.
- 2. Click Chemistry:** Click reaction, Sharpless azide cycloadditions.
- 3. Metathesis:** Grubb's 1st and 2nd generation catalyst, Olefin cross coupling metathesis(OCM), ring closing metathesis(RCM), ring opening metathesis(ROM), applications.
- 4. Other important synthetic reactions:** Wacker oxidation, Mansanto oxidation, Hydroformylation reaction, Neber rearrangement, Nef reaction, Eschenmoser-Tanabe fragmentation, Mitsunobu reaction.

OC-30 Reaction Mechanisms –II

15 Hrs

Study of the following special mechanistic aspects in organic chemistry Principles of microscopic reversibility with reference to esterification – ester hydrolysis(with H₂SO₄) & hydration of alkenes – dehydration of alcohols (with H₂SO₄) – Super acids – Long living carbocations – Simultaneous and stereo specific 1,2 shifts – Cascade of ring expansions – Acylation of amines and acyl esters – Oxidative coupling through carbanions – Conversion of aryl iminoesters to diarylamides, Chapman rearrangement-Cyclodehydration of aldehydes and ketones – Von Richter rearrangement - Hoffman Loffler, Freytag reaction – Robinson's annulations –Knoevenagel condensation, The Darzens condensation.

OC-31 Non benzenoid Aromatics

15 Hrs

Concept of aromaticity, Robinson's sextet theory, ring current concept, to distinguish aromatic, non aromatic & antiaromatic molecules. Huckels rule applications & limitations of the Huckel's rule.

various nonbenzenoid aromatic molecules: synthesis & aromatic properties of cyclopropenium cation derivatives, cyclopentadienyl anion systems, cycloheptatrienylation(tropilium cation), cyclooctatetraenyl dianion, fulvenes, metallocenes, annulenes, hetero annulenes, azulenes, fullerenes(C₆₀), sydnones, antiaromatic compounds, alternate and non alternate hydrocarbons.

OC-32 Nanomaterials

15 Hrs

Introduction: The 'top-down' approach, the 'bottom-up' approach and Nanomanipulation.

Molecular Devices: Photochemical devices, Liquid crystals, Molecular wires, Rectifiers, Molecular switches and Molecular Muscles.

New Carbon family: Types of Fullerenes, Types of Carbon nanotubes (Zig-Zag, Armchair and

Chiral), Graphenes. Growth, Chemical Synthesis and optoelectronic properties of Fullerenes, CNTs (Zig Zag, Armchair and Chiral), singlewalled CNTs (SWCNTs) and multi walled MWCNTs)and Graphenes.

Structures of aromatics belts, nano car and molecular machines.

Optoelectronic molecules: OLEDs, Organic Solar Cells (Basic OLED mechanism and structures) Natural Benzheterazoles and their synthetic modifications as optoelectronic molecules.

Recommended Books:

1. Modern methods of organic synthesis by w Carruthers
2. Organic synthesis by Michael B Smith
3. Organic synthesis by O House
4. Reagents for organic synthesis by Fieser, vol 1-11(1984)
5. Organic synthesis by C Willis and M Willis
6. Reagents in organic synthesis by B.P Mundy and others
7. Name reactions by Jie Jack Li
8. Organic chemistry Claydon and others 2005
9. Advanced Organic Chemistry by Jerry March
10. Mechanism and Structure in Organic Chemistry S. Mukerjee
11. Guide Book to mechanism in Organic Chemistry, 6th Edition, Peter Sykes
12. Introduction to Nanotechnology. Charles P. Poole Jr & Frank J Owens. (Wiley India Pvt Ltd) – Student Edition 2007.
13. The Physics and Chemistry of Solids – Stephen Elliott. Wiley Student Edition – Wiley India Pvt. Ltd

Paper-3 CH (0C) 403T: Drug synthesis and mechanism of action

OC-33: Drugs acting on metabolic process, cell wall and specific enzymes

OC-34: Drugs acting on genetic material and immune system

OC-35: Drugs acting on receptors and ion channels

OC-36: Chiral drugs

OC-33: Drugs acting on metabolic process, cell wall and specific enzymes **15 Hrs**

Basic concepts of mechanism of drug action: Introduction to macromolecular targets, carbohydrates, proteins, lipids and nucleic acids as possible drug targets. Classification of drugs. Enzyme inhibition and its types.

a) Drugs acting on metabolic process: Antifolates --Discovery and mechanism of action of sulphonamides, Synthesis of sulfamethoxazole, sulfadoxine, sulfaguanidine and dapsone. Diaminopyrimidines -trimethoprim, bacterial resistance to sulfonamides and drug synergism.

b) Drugs acting on cell wall: Structure of bacterial cell wall, *β -lactam antibiotics*- mechanism of action of penicillins and cephalosporins. Synthesis of penicillin-G and cephalosporin-C, cefalexin and cycloserine. Resistance to penicillins, *Broad spectrum penicillins*- cloxacillin, methicillin, ampicillin, amoxicillin and carbenicillin. *β -Lactamase inhibitors*- Structural formulae and mode of action of clavulanic acid and sulbactam

c) Drugs acting on specific enzymes: *H^+ / K^+ -ATPase inhibitors*- synthesis of Omeprazole and Carbonic anhydrase inhibitors- synthesis of Acetazolamide.

OC-34: Drugs acting on genetic material and immune system **15 Hrs**

Drugs acting on genetic material: Introduction, classification and mechanism of action.

a) DNA-intercalating agents: Anticancer and antimalarial agents. Structural formulae of Daunomycin. Adriamycin and Amsacrine. Synthesis of Amsacrine, Nitracrine, Quinacrine and Chloroquine.

b) DNA-Binding and nicking agents: Antiprotozoal drugs, Synthesis of Metronidazole, Dimetridazole and Tinidazole.

c) DNA-Alkylators: Synthesis of Cyclophosphamide and Busulphan.

d) DNA-Polymerase inhibitors: Antiviral agents- Synthesis of Acyclovir and AZT.

e) DNA-Topoisomerase inhibitors: Anti bacterial agents. Synthesis of Ciprofloxacin and Norfloxacin. Structural formulae of ofloxacin and Lomefloxacin.

f) Inhibitors of transcribing enzymes: Anti-TB and antileprosy agents-structural formulae of Rifamycins and partial synthesis of Rifampicin.

g) Drugs interfering with translation process: Antibacterial drugs- Structural formulae of Erythromycin, 5-Oxytetracycline and Streptomycin. Synthesis of Chloromycetin

Drugs acting on immune system: Introduction to immune system. immunosuppressing agent- structural formula of Cyclosporin. Immunoenhancers-use of vaccines and structural formula of levamisole.

OC-35: Drugs acting on receptors and ion channels

15 Hrs

Introduction to nervous system: structure of neuron, nerve transmission. Definition and examples of agonist, antagonist, neurotransmitters and receptors.

Drugs acting on receptors:

a) Adrenergic receptors: Introduction and classification. α -Adrenergic-receptor agonists and antagonists- Synthesis and biological activity of Nor-adrenaline, Methyl L dopa and Tetrahydrozoline. β -Adrenergic-receptor - agonists and antagonists — Synthesis and pharmacological activity of Salbutamol, Terbutaline, Propranolol and Atenolol.

b) Cholinergic-receptors: Introduction and classification. Cholinergic-receptor agonists and antagonists- Structural formulae of Nicotine, Atropine and Tubocurarine. Synthesis of Acetylcholine and Succinylcholine

c) Dopamine receptors: Introduction and classification. Dopamine- receptor agonists and antagonists- Biosynthesis of Dopamine. Synthesis of L-Dopa and Chlorpromazine.

d) Serotonin receptors: Introduction and classification. Serotonin receptor agonists and antagonists-synthesis and pharmacological activity of Serotonin and Metoprolol.

e) Histamine receptors: Introduction and classification. Histamine receptor agonists and antagonists-synthesis and biological action of Histamine, Chlorpheniramine, and Ranitidine.

f) Hormone receptors: Introduction to estrogen receptors, Structural formula of Tamoxifen.

Drugs acting on ion channels: Introduction to ion channels, drugs acting on Ca^{2+} , Na^+ and Cl^- channels and their mode of action. Structural formulae of Tetracaine and synthesis of Nifedipine, Diltiazem, Tetracaine and 4-Aminopyridine.

OC-36: Chiral drugs

15 Hrs

Introduction to chiral drugs Three-point contact model, Eutomer, Distomer and eudesmic ratio. Pfeiffer's rule. Role of chirality on biological activity: Distomers — a) with no side effects b)with undesirable side effects c) both isomers having independent therapeutic value d)combination products having therapeutic advantages e) metabolic chirality inversion.

Synthesis and pharmacological activity of S-Ibuprofen, S- Metoprolol, Indinavir sulfate, Levocetirizine, 2S-Verapamil, S,S-Ethambutol, (+)Lomefloxacin, Fluvastatin, Dextropropoxyphen, (+)Ephedrine, (+)Griseofulvin, Dexormaplatin, R-Indacrinone, Nateglinide, Oxybutynin hydrochloride, S,S.- Captopril and S,S,S- Enalaprilate

Recommended Books:

1. Introduction to Medicinal chemistry. By Graham Patrick.
2. Burger's medicinal chemistry and drug discovery. By Manfred B. Wolf.
3. Introduction to drug design. By R.B.Silverman
4. Comprehensive medicinal chemistry. Vol 1-5 by Hanzsch.
5. Principles of medicinal chemistry. By William O. Foye etal.
6. Biochemical approach to medicinal chemistry. By Thomas Nogrady.
7. Pharmaceutical Chemistry and Drug synthesis By Roth and Klecman
8. Drug design By El Arienes
9. Principles of Medicinal Chemistry. Vols.1 & 2 By Kadam etal
10. Medicinal chemistry an introduction By Gareth Thomas
11. Wilson and Gisvold,s text book of Organic, Medicinal and Pharmaceutical chemistry By J.N.Delgado and W.A.Remers.
12. Organic Pharmaceutical chemistry By Harikishan singh.
13. Medicinal Chemistry By Ashutoshkar
14. Medicinal Chemistry By G.Chatwal
15. Organic Drug synthesis By Ledneiser Vol 1-6
16. Strategies for organic drug synthesis and design By Daniel Ledneiscr
17. Top Drugs: Top synthetic routes By John Saunders
18. Chirotecnology by Roger A. Sheldon

Elective-3A

Paper-III CH (OC) 403(CB1)T: Biopharmaceutics and Pharmacodynamics

OC(CB1)-29 : Pharmacokinetics

OC(CB1)-30 : Pharmacodynamics

OC(CB1)-31 : Principles of Therapeutics

OC(CB1)-32: Drug Interactions

OC(CB4)-29: Pharmacokinetics

15Hrs

Introduction and importance of ADME studies of drugs. Routes of administration .

i)Absorption: Definition, absorption of drugs across the membranes. Physico chemical factors affecting the drug absorption (emphasis on pH partition hypothesis and Drug Dissolution).

Methods of determination of drug absorption. Bioavailability. ii)Distribution: Apparent volume of drug distribution. Factors affecting distribution, plasma protein binding. iii)

Metabolism: Sites of drug metabolism, metabolic rate constant, bioactivation and

biotransformation of drugs (phase I and phase II reactions) iv)Elimination: Types of

elimination and overall apparent elimination rate constant and half-life, concept of clearance.

OC(CB4)-29: Pharmacodynamics

15Hrs

Introduction, targets for drug action, receptor concept. Pharmacological binding terms.

Twostatereceptor

model, receptor families- structure and signal transduction mechanisms- channel

linked proteins, gating mechanism, G-protein coupled receptors, G-protein and their role,

Targets for G-proteins, Kinase linked receptors, receptors that regulate gene transcription.

Theories of concentration -response relationship, dose-response curves.

OC(CB4)-30: Principles of Therapeutics

15Hrs

Plasma Drug concentration vs Time profile, Definition and explanation of various terms:

MEC, MSC, MTC, AUC(graph). Peak plasma concentration, time of peak concentration.

Therapeutic range. Steady state concentration, onset of action, onset of time, duration of

action, intensity of action. LD50, ED50. Therapeutic objective. Dosage regimen, Design of

dosage regimes: Dose size, dosing frequency, drug accumulation during multiple dosing, time

to reach steady-state during multiple dosing, average concentration and body content on

multiple dosing to steady state, loading dose, maintenance dose, maintenance of drug within

the therapeutic range, design of dosage regimen from plasma concentration. Kinetics of fixed

dose, fixed time interval regimes. Modification to dosage regime: Dosing of drugs in obese

patients, dosing of drugs in Neonates, infants & children, dosing of drugs in geriatrics

(elderly), dosing of drugs in Hepatic disease, dosing of drugs in renal disease.

OC(CB4)-31: Drug Interactions.**15Hrs**

Introduction, classification, Mechanisms of drug interactions.– pharmacokinetic interactions(alteration of gastrointestinal absorption, compexation and adsorption, alteration of distribution, alteration of metabolism and alteration of excretion) & pharmacodynamic interactions (antagonistic effects, synergistic effects, alteration of electrolyte levels, interactions involving adrenergic system, alteration of receptor site interaction and antibiotic combinations). Influence of alcohol(Anti biotics, Anti coagulants, Anti histamines, Anti psychotic drugs, sedatives and Hypnotics), smoking(Theophylline, Diazepam, a Tri cyclic antidepressants), food (Bronchodaliators, Diuretics, ACE Inhibitors, Anti coagulants,Tetracyclines) on drug action.

Reference books:

1. Pharacokinetics. By Shobha Rani
2. Elements of Pharmacology. By Gandhi,Desani& Goyal.
3. Goodmann&Gilmann's " The pharmacological basis of therapeutics. By Gilman &Rali.
4. Pharmacology. By Rang.
5. Biopharmaceutics and pharmacokinetics By Brahmanikar
6. Pharmacology By Lippincot
7. Modern Pharmacology with Clinical Applications. By R.Craig.
8. Compehensive pharmacy review by Leon Shargel
9. Hospital and clinical pharmacy
10. Burger's medicinal chemistry and drug discovery. By Manfred E. Wolf.
11. Introduction to Medicinal chemistry. By Patrick.
12. Comprehensive medicinal chemistry. Vol 1-5 By Hanzsch.
13. Principles of medicinal chemistry. By William Foye
14. Biochemical approach to medicinal chemistry. By Thomas Nogrady.

Paper-4 (ID Paper) CH (0C) 404T : Advanced Natural Products

OC-1: Biosynthesis of natural products

OC-2: Structure determination and stereochemistry of natural products by chemical methods.

OC-3: Structure determination and stereochemistry of natural products by spectral methods.

OC -4: Total stereo selective synthesis of natural products.

OC -1: Biosynthesis of natural products

15 Hrs

Biosynthesis of secondary metabolites: Introduction, Difference between Laboratory synthesis and biosynthesis. Methods for determination of biosynthetic mechanism. Isolation and identification of Biosynthetic precursors, Feeding experiments — use of radioisotopes Measurement of incorporation — absolute incorporation, specific incorporation. Identification of the position of labels in labelled natural products by chemical degradation and spectral methods.

Major biosynthetic pathways: 1) Acetate-Malonate pathway: Biosynthesis of aromatic compounds, 2) Shikimic acid pathway; Biosynthesis of essential amino acids — phenylalanine, tyrosine and tryptophan, carboxylic acid derivatives, flavonoids and morphine alkaloids. 3) Mevalonic acid pathway: Biosynthesis of terpenes — mono, sesqui, di, tri (β -amyrin) and carotenoids, steroids — cholesterol.

OC-2: Structure determination and stereochemistry of natural products by chemical methods

15 Hrs

Determination of structure and stereochemistry of morphine, reserpine, abietic acid, quinine, atropine.

OC-3: Structure determination and stereochemistry of natural products by spectral methods

15 Hrs

Spectroscopic techniques IR, UV, $^1\text{H-NMR}$, $^{13}\text{C-NMR}$, COSY, HETEROCOSY, NOESY, 2D-INADEQUATE and MS in the structure elucidations of natural products, Examples, flavones, biflavones, flavanones, isoflavones, coumarins, quinolines, isoquinolines.

Study of the following solved problems:

Mass, IR, ^1H , $^{13}\text{C-NMR}$, HOMOCOSY, HECTOR, DEPT, 2D-INADEQUATE and NOE of Geraniol, INEPT of **menthol**, APT of **apparicine**, NOESY of **buxaquamarine**, HETEROCOSY of **strictanol**, 2D-INADEQUATE of α -picoline and **β -methyl tetrahydran furan**.

OC-4: Total stereoselective synthesis of natural products.**15 Hrs**

Woodward's synthesis of reserpine Corey's synthesis of prostaglandins (E_2 , $F_{2\alpha}$) and Sharpless synthesis of L-hexoses, Nicolaou's synthesis of taxol, Danishefsky's synthesis of indolizomycin, Takasago's synthesis of menthol, Hoffmann-LaRoche's synthesis of Biotin.

Recommended books:

1. Textbook of organic chemistry, Vol II by I L Finar
2. Chemistry of natural products, Vol 12, by Atta-Ur-Rahman
3. An introduction to the chemistry of terpenoids and steroids, by William Templeton
4. Systematic identification of flavonoid compounds by Mabry & Markham
5. Steroids by Fieser and Fieser
6. Alkaloids by Manske
7. Alkaloids by Bentley
8. The chemistry of terpenes by A Pinder
9. The terpenes by Simenson
10. Terpenoids by Mayo
11. Alkaloids by Pelletier
12. Total synthesis of Natural Products by Apsimon Vol 1-5
13. Biosynthesis by Geismann
14. Principles of organic synthesis 3rd Ed. R O C Norman and J M Coxen
15. One and two dimensional nmr spectroscopy by Atta Ur Rahman
16. Classics in total synthesis K C Nicolaou and E J Sorenson
17. Spectrometric: identification of organic compounds by Silverstein and Webster

Elective-4A(ID Paper) Paper-IV CH (OC)303T (CB2): Bioorganic Chemistry

OC(CB2)-1: Carbohydrates

OC(CB2)-2: Nucleic acids and Lipids

OC(CB2)-3: Proteins and Enzymes

OC(CB2)-4: Coenzymes and Vitamins

OC(CB2)-1: Carbohydrates

15 Hrs

Introduction to the importance of Carbohydrates. Types of naturally occurring sugars. Deoxy sugars, aminosugars, branched chain sugars methyl ethers and acid derivatives of sugars. Determination of configuration and determination of ring size of D-glucose and D-Fructose. Conformational analysis of monosaccharides. 4C_1 and 1C_4 conformations of D-glucose. Reactions of six carbon sugars: Ferrier, Hanesian reaction and Ferrier rearrangement. Synthesis of amino, halo and thio sugars. Structure, ring size determination of sucrose and maltose. Conformational structures of sucrose, lactose, maltose, cellobiose and gentobiose. Structure and biological functions of starch, cellulose, glycogen and chitin. Role of sugars in cell to cell recognition, blood groups.

OC(CB2)-2: Nucleic acids & lipids

15 Hrs

Nucleic acids: Retro synthetic analysis of nucleic acids - Nucleotides, Nucleosides, Nucleotide bases and Sugars. Structure and synthesis of nucleosides and nucleotides. Primary, secondary and tertiary structure of DNA. Types of mRNA, tRNA and rRNA. Replication, transcription and translation. Genetic code. Protein biosynthesis. DNA finger printing.

Lipids: Introduction and classification of lipids. Stereochemical notation in lipids. Chemical synthesis and biosynthesis of phospholipids and glycolipids. Properties of lipid aggregates, micelles, bilayers, liposomes and biological membranes.

OC(CB2)-3: Proteins and Enzymes

15 Hrs

Proteins: Introduction. Peptide bond, classification and nomenclature of peptides. Amino acid sequence of polypeptides and proteins: terminal residue analysis and partial hydrolysis. Peptide synthesis by solution phase and solid phase synthesis methods. Proteins - Biological importance and classification - Primary, secondary and tertiary structure of proteins.

Enzymes: Definition. Classification based on mode of action. Mechanism of enzyme catalysis - Lock and Key, Induced-Fit and three point contact models. Enzyme selectivity - chemo, regio, diastereo and enantio selectivity - illustration with suitable examples. Factors affecting enzyme catalysis. Enzyme inhibition- reversible and irreversible inhibition. Enzymes in organic synthesis. Immobilised enzymes.

OC(CB2)-4: Coenzymes and Vitamins

15 Hrs

Coenzymes: Introduction. Co-factors - cosubstrates - prosthetic groups. Classification - Vitamin derived coenzymes and metabolite coenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate (TPP), pyridoxal phosphate (PLP), oxidized and reduced forms of i) nicotinamide adenosine dinucleotide / their phosphates (NAD), NADH, NADP⁺ NADPH) ii) Flavin adenine nucleotide FAD, FADH₂

and iii) Flavin mononucleotide (FMN, FMNH₂) lipoic acid, biotin, tetrahydrofolate and ubiquinone. Adenosine triphosphate (ATP) and adenosine diphosphate (ADP), S-adenosyl methionine (SAM) and uridine diphosphosugars (UDP-sugars) Mechanism of reactions catalyzed by the above coenzymes.

Vitamins: Introduction, classification and biological importance of vitamins. Structure determination and synthesis of vitamins A, B₁, and B₂. Synthesis of vitamins - B₆, C, E and K. Structure of vitamin B₁₂.

Reference Books:

1. Organic Chemistry Vol.I and Vol.II by I.L.Finar
2. Carbohydrate Chemistry by Barton Volumes
3. Carbohydrate chemistry by G.J.Boons
4. The chemistry of natural products:vol.V - carbohydrates by S.F.Dyke
5. Organic Chemistry by McMurry
6. Nucleic acids in Chemistry and Biology by G M Blackburn MI Gait
7. Lehninger Principles of Biochemistry by D L Nelson and M MCoxon
8. Outlines of Biochemistry by Conn and Stumpf
9. Enzyme structure and mechanism by Fersht and Freeman
10. Enzymes for green organic synthesis by V.K.Ahluwalia
11. Biotransformations in Organic Chemistry by K Faber.
12. Principles of biochemistry by Horton & others.
13. Bioorganic chemistry - A chemical approach to enzyme action by Herman Dugas and Christopher Penney.
14. Concepts in Biotechnology by D.Balasubramanian & others
15. Chemistry and physiology of the vitamins by H.R.Rosenberg.

ORGANIC PRACTICALS: 6Hrs/Week

Paper CH (OC)451: Spectroscopic identification of organic compounds and Green syntheses

A) Spectroscopic identification of organic compounds: Identification of unknown organic compounds by interpretation of IR, UV, ^1H NMR, ^{13}C NMR and mass spectral data. A minimum of 30 representative examples should be studied.

B) Green syntheses

- i) Clay catalyzed solid state synthesis of 7-hydroxy-4-methyl coumarine
- ii) Nitration of phenol using calcium nitrate and acetic acid
- iii) Bromination of acetanilide using ceric ammonium nitrate (CAN) and Potassium bromide
- iv) Preparation of 1,1-bis-2-naphthol
- v) Synthesis of dihydropyrimidinone(Three component coupling)
- vi) Synthesis of 2-cyano-3-(4-methoxyphenyl)-prpnoate (Microwave-assisted ammonium formate-mediated Knoevengel reaction)
- vii) **Solid state synthesis:** Ring opening reactions: Aniline react with anhydrides (Maleic, Succinic & Pthalic)

Paper CH (OC) 452: Synthesis and analysis of drugs

(A) Laboratory Synthesis of the following drugs:

Paracetamol, Phenytoin, Benzocaine, 6-Methyluracil. Chloritone, 4-Aminobenzene sulfonamide, Fluorescein and antipyrine.

(B) Estimation of the following drugs:

Aspirin (titrimetry), Ibuprofen (titrimetry), Analgin (titrimetry), Chloride in Ringer's lactate (argentometry), ascorbic acid {titrimetry(Iodometry and Cerimetry), colorimetry}, Isoniazid(Iodometry), Riboflavin(colorimetry),