UNIVERSITY OF MYSORE

SYLLABUS FOR M. Sc. DEGREE COURSE
(CHOICE BASED CREDIT SEMESTER SCHEME)

ORGANIC CHEMISTRY

2011-2012

M. Sc Course in Organic Chemistry
Syllabus
2011-12

	Title of the paper	Credits	L	T	P	Exam duration (hours)	C_1	C_2	C_3
	B. Sc Honors First semester								
	Hard core papers								
OC1.1	Advanced separation techniques	3	3	0	0	2.5	25	25	50
OC1.2	Principles of Inorganic Chemistry	3	3	0	0	2.5	25	25	50
OC1.3	Stereochemistry and reaction mechanisms	3	3	0	0	2.5	25	25	50
OC1.4	Principles of physical chemistry	3	3	0	0	2.5	25	25	50
OC1.5	Analytical Chemistry Practical	3	0	0	6	6	25	25	50
OC1.6	Inorganic Chemistry Practical	3	0	0	6	6	25	25	50
	Soft core papers (any one)								
OC1.71	Peptides & Nucleic acids	2	2	0	0	2.5	25	25	50
OC1.72	Carbohydrates & Vitamins	2	2	0	0	2.5	25	25	50
OC1.73	Steroids and alkaloids	2	2	0	0	2.5	25	25	50
	Total credits	**20**							
	Second semester								
	Hard core papers								
OC2.1	Spectroscopy	3	3	0	0	2.5	25	25	50
OC2.2	Reagents and synthesis	3	3	0	0	2.5	25	25	50
OC2.3	Synthetic organic chemistry	3	3	0	0	2.5	25	25	50
OC2.4	Organometallics and non-metallics	3	3	0	0	2.5	25	25	50
OC2.5	Organic Chemistry Practical	3	0	0	6	6	25	25	50
OC2.6	Physical Chemistry Practical	3	0	0	6	6	25	25	50
	Soft core papers (any one)								
OC2.71	Bioanalytical chemistry	2	2	0	0	2.5	25	25	50
OC2.72	Bio-Inorganic chemistry	2	2	0	0	2.5	25	25	50
OC2.73	Bio-Organic chemistry	2	2	0	0	2.5	25	25	50
OC2.74	Bio-Physical chemistry	2	2	0	0	2.5	25	25	50
	Open electives								
OC2.81	Basic concepts in organic	2	2	0	0	2.5	25	25	50

	chemistry								
OC2.82	Life style chemicals	2	2	0	0	2.5	25	25	50
	Total credits	**20**							
	Third semester								
	Hard core papers								
OC3.1	Molecular rearrangements and Heterocyclic chemistry	3	3	0	0	2.5	25	25	50
OC3.2	Bonding, Photochemistry & Pericyclic reactions	3	3	0	0	2.5	25	25	50
OC3.3	Organic chemistry practical- Multistep synthesis	3	0	0	6	6	25	25	50
	Soft core papers (any two)								
OC3.41	Organic Chemistry Practical – Isolation of natural products	3	0	0	6	6	25	25	50
OC3.42	Lipids, Porphyrins, anthocyanins and flavonoids	3	2	1	0	2.5	25	25	50
OC3.43	Polymer chemistry	3	2	1	0	2.5	25	25	50
	Open electives								
OC3.51	Role of chemistry in animal health and growth	2	2	0	0	2.5	25	25	50
OC3.52	Chemistry of natural products	2	2	0	0	2.5	25	25	50
	Total credits	**19**							
	Fourth semester								
	Hard core papers								
OC4.1	Medicinal chemistry I	3	3	0	0	2.5	25	25	50
OC4.2	Dissertation	4	0	0	8		25	25	50
	Soft core papers (any two)								
OC4.31	Organic chemistry practical - Estimations	3	0	0	6	6	25	25	50
OC4.32	Medicinal chemistry –II	3	2	1	0	2.5	25	25	50
OC4.33	Dyes and insecticides	3	2	1	0	2.5	25	25	50
	Open electives								
OC4.41	Applications of synthetic products	2	2	0	0	2.5	25	25	50
OC4.42	Chemistry of soil and fertilizers	2	2	0	0	2.5	25	25	50
	Total credits	**17**							

GENERAL REQUIREMENTS

1. All hard core papers are compulsory.

2. The student has to take minimum 16 credits soft core subjects and 8 credit open elective subjects during the M. Sc course.

3. The students who have studied or opted as hard core/soft core subjects in any other or in the respective departments, are not eligible for opting these subjects.

4. Minimum of 10 students is eligible to study open electives in the department.

5. Open elective subjects are only for students of departments other than chemistry and organic chemistry.

6. Admission rules and regulations are laid down as per the University of Mysore.

7. Conduct of examinations and declaration of results are as per the rules and regulations of the University of Mysore.

8. **DISSERTATION:** Preparation of dissertation on the topic assigned. This include literature collection, identification of objectives, methodology followed, analytical instruments used, data collected, analysis of data, data synthesis and conclusions.

   The material collected has to be submitted in a bound volume from one month before the commencement of practical examination. A certificate has to be enclosed stating that the material collected and presented in the Dissertation has not been submitted for the award of any Diploma/Degree in this University or in any other University signed by the candidate and the guide.

Chairman
BOS in Organic chemistry

B. Sc., Honor's First Semester

OC1.1 Hard core: Advanced separation techniques

Unit I

Fundamentals of chromatography: General description, definition, terms and parameters used in chromatography, classification of chromatographic methods, criteria for selection of stationary and mobile phase-nature of adsorbents, factors influencing the adsorbents, nature and types of mobile phases and stationary phases.

Column chromatography: Theories – plate theory, rate theory, band broadening-eddy diffusion, longitudinal diffusion and resistance to mass transfer, column efficiency, Van Deemter's equation and its modern version, optimization column performance, interrelationships-capacity factor, selectivity factor, column resolution, distribution constant and applications of conventional column chromatography, advantages and limitations.

Thin layer chromatography (TLC): Definition, mechanism, efficiency of TLC plates, methodology –selection of stationary and mobile phases, preparation of micro and macro plates, development, spray reagents, identification and detection, reproducibility of Rf values, qualitative and quantitative analysis.

Paper chromatography (PC): Definitions, theory and principle, techniques; one, two-dimensional and circular PC, mechanism of separation, types of paper, methodology-preparation of sample, choice of solvents, location of spots and measurement of Rf value, factors affecting Rf values, advantages and applications

[16 HOURS]

Unit II

High performance liquid chromatography (HPLC)*:* Apparatus, pumps, column packing, characteristics of liquid chromatographic detectors-UV, IR, refractometer and fluorescence detectors, advantages and applications.

Gas chromatography (GC): Principle, instrumentations, columns, study of detectors –thermal conductivity, flame ionization, electron capture and mass spectrometry, factors affecting separation, retention volume, retention time, applications.

Ion exchange chromatography (IEC): Definitions, principle, requirements for ion-exchange resin and its synthesis, types of ion-exchange resins, basic features of ion-exchange reactions, resin properties-ion-exchange capacity, resin selectivity and factors affecting the selectivity, applications of IEC in preparative, purification and recovery processes.

Solvent extraction*:* definition, types, principle and efficiency of extraction, sequence of extraction process, factors affecting extraction-pH and oxidation state, masking and salting out agents, techniques-batch and continuous extraction, applications.

[16 HOURS]

Unit III

Paper chromatography: Definations, theory and principle, techniques, one, two dimensional and circular PC, preparation of sample, choice of solvents, location of spots, spray reagents. Applications - Separation of amino acids and carbohydrates.

Gel permiation chromatography: size exclusion chromatography (Gel filtration) with special reference to separation of protein, carbohydrates and nucleic acids. Preparation of medium, column, determination of void volume, sample application, detectors.

Affinity chromatography: Chromatographic matrix, ligand selection, linkage of ligands, absorbant derivatives.,

Electrophoresis: Introduction, two dimensional gel electrophoresis (ascending, descending), coomassie blue staining and silver staining, zone electrophoresis, capillary electrophoresis, isoelectric focusing.

Centrifugation: Introduction, high speeds centrifuges, ultracentrifuge, sedimentation coefficients, density gradient, sedimentation equlibrium, analytical centrifugation.

LC/MS, LC/MS-MS, GC/MS, GC/MS-MS for organic compound analysis.

(16 HOURS)

Reference books:

1. Analytical Chemistry, G.D. Christian, 5th ed., John Wiley & Sons, Inc, India, 2001.
2. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Pearson Education Pvt. Ltd., New Delhi, 2004.
3. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
4. Instrumental Methods of Analysis, Hobart H. Willard, Lynne L. Merritt, Jr., John A. Dean & Frank A. Settle, Jr., 6th edition, CBS Publishers & Distributors, Delhi, 1986.
5. Modern Analytical Chemistry, D. Harvey, McGraw-Hill International Edition, Singapore, 2000.
6. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West and F.J. Holler, 6th edition, Saunders College Publishing, New York, 1992

OCI.2 Principles of Inorganic chemistry

Unit I

Ionic Bond: Properties of ionic substances, structures of crystal lattices (NaCl, CsCl, and ZnS). Lattice energy, Born-Haber cycle, uses of Born-Haber type calculations, Born-Lande equation. Ionic radii, factors affecting the radii of ions, radius ratio effects, covalent character in ionic bonds, hydration energy and solubility of ionic compounds.

Covalent Bond: M.O. treatment for homonuclear and heteronuclear diatomic molecules. M.O. treatment involving delocalized Π-bonding (CO_3^{2-}, NO_3^-, NO_2^-, CO_2 and N_3^-). Weak interactions in covalent substances. VSEPR model for explaining structure of molecules including fluxional molecules, short comings of the VSEPR model.

[16 HOURS]

UNIT –II

Coordination Chemistry: Geometries of metal complexes of higher coordination numbers (2-12). Stepwise and overall stability constants of coordination compounds, factors influencing the stability of metal complexes with reference to the nature of metal ion and ligand, the Irving-William series, chelate effect.

Theoretical aspects of the determination of stability constants of the coordination compounds by spectrophotometric, pH metric, and polarographic methods.

Crystal Field Theory: Salient features of CFT, d-orbital splitting in octahedral, tetrahedral, square planar and tetragonal complexes, measurement of 10Dq. Spectrochemical series, short comings of CFT, evidences of M-L covalency.

[16 HOURS]

UNIT –III

MOLECULAR SYMMETRY AND GROUP THEORY: Symmetry elements and symmetry operations, rotation axis, rules for orientation of molecules, plane of symmetry, rotation-reflection axis, centre of symmetry and identity element of symmetry. Correlation of Schoenflies and Hermann-Maugin Symbols for symmetry elements. Multiplication of symmetry operations and elements. Multiplication tables for the symmetry operations of simple molecules. Symmetry and optical activity.

Groups, point groups, method of assigning a molecule to a point group, Schoenflies and Hermann-Maugin symbols for point groups. Properties and definitions of group theory, character tables for C_s, C_i, C_3 & C_{3v} and C_{2v} point groups.

[16 HOURS]

References:

1. Inorganic Chemistry (4th edition): J.E. Huheey, E.A. Keiter and R.L. Keiter (1993); Harper Collins.
2. Introduction to modern inorganic chemistry (4th edition): K.M. Mackay and R.A. Mackay (1989): Blackie.
3. Advanced Inorganic Chemistry (5th edition): F.A. Cotton and G. Wilkinson (1990): Wiley.
4. Concise Inorganic Chemistry (5th edition): J.D. Lee (2000); Blackwell Science.
5. Concepts and Models of Inorganic Chemistry (3rd edition): B.E. Douglas, D.H. Mc Daniel and Alexander. (2001): Wiley.
6. Chemistry of the Elements: Greenwood and Earnshaw. (1986): Pergamon Press.
7. Inorganic Chemistry (3rd edition): Shriver, Atkins and Langford (1999); Oxford Univ. Press.
8. Symmetry in Chemistry, - H. Jaffe and M. Orchin, John Wiles, New York, (1965).
9. Symmetry in Molecules, - J.M. Hollas, Chapman & Hall Ltd., London, (1972).
10. Chemical Applications of group theory, - F.A. Cotton, Wiley Eastern Ltd., 2nd Edition, New Delhi, (1971).
11. Group theory and Symmetry in Chemistry, -G. Raj, A. Bhagi and V. Jain, Krishna Prakashan Media (P) Ltd., Meerut, (1998).

HC OC1.3: Stereochemistry and reaction mechanisms

Unit I

Stereoisomerism: Projection formulae [fly, wedge, Fischer, Newman and saw horse].
Optical isomerism: Conditions for optical isomerism, optical isomerism due to chiral centers and molecular dissymmetry, allenes and biphenyls, criteria for optical purity. enantiomorphs, diastereoisomers, racemic mixtures and their resolution, configurational notations of simple molecules, DL and RS configurational notations.
Geometrical isomerism: Isomorphism due to C=C, C=N and N=N bonds, E,Z conventions, determination of configuration by physical and chemical methods.
Conformational analysis: Elementary account of conformational equilibria of ethane, butane and cyclohexane, Conformation of cyclic compounds such as cyclopentane, cyclohexane, cyclohexanone derivatives and decalins. Conformational analysis of 1,2-; 1,3-; 1,4- disubstituted cyclohexane derivatives, D-glucose. Effect of conformation on the course of rate of reactions.

Stereoselectivity: Stereoselective reactions, diastereoselective reactions, stereospecific reactions, regioselective & regiospecific reactions.

[16 HOURS]

Unit II

Structure and reactivity of organic compounds: Acids and Bases, functional group effects on acidity and basicity, hydrogen bonding, resonance, inductive and hyperconjugation effects.
Meaning and importance of reaction mechanism, Classification of reactions
Determination of reaction mechanism by kinetic and non-kinetic methods: ***Kinetic methods***: Mechanistic implications from rate laws, the transition state theory, ambiguities in interpreting kinetic data, solvent effect, ionic effect, isotopic effect, solvent isotopic effect, substituent effect, steric effect, linear free energy relationships–Hammett equation and Taft treatment.

Non-kinetic methods: Energy profile diagram, identification of products, testing possible intermediates, trapping of intermediates, cross over experiments, isotopic labeling, stereochemical studies, limitations of reactions.

[16 HOURS]

Unit III

Substitution reactions – Kinetics, mechanism and stereochemical factor affecting the rate of S_N1, S_N2, $S_{RN}i$, S_Ni, S_N1', S_N2', S_N1i, reactions, Neighbouring group participation.
Electrophilic substitution reactions – Kinetics, mechanism and stereochemical factor affecting the rate of S_E1 & S_E2
Aromatic electrophilic substitution reactions: Mechanism of nitration, halogenation, sulphonation, Friedel-Crafts alkylation and acylation, Mannich reaction, chloromethylation, Vilsmeier Haack reaction, Diazonium coupling, Gattermann–Koch reaction, Mercuration reaction.
Aromatic nucleophilic substitution reactions: S_N1, S_N2 and benzyne mechanism, Bucherer reaction, von Richter reaction.

[16 HOURS]

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. E. L. Elliel and S. H. Wilen, Stereochemistry of Organic Compounds, John Wiley and Sons, New York. 1994.
3. Introduction to stereochemistry – K. Mislow.
4. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993.
5. J. March, Advanced Organic Chemistry, Wiley Interscience, 1994.
6. E. S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 964.
7. A Guide book to mechanism in Organic Chemistry – Petersykes
8. Stereochemistry and mechanism through solved problems – P. S. Kalsi.
9. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
10. D. Nasipuri, Stereochemistry of Organic Compounds, 2nd edition, Wiley Eastern Limited, New Delhi, 1991.
11. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998.

OCO104 Principles of Physical chemistry

Unit I

Concepts of entropy and free energy: Entropy as a measure of unavailable energy. Entropy change during spontaneous process. Helmholtz and Gibbs free energies. Thermodynamic criteria of equilibrium and spontaneity. Variation of free energy with temperature and pressure. Maxwell's relations. Von't Hoff's reaction isotherm and isochore, Gibbs-Helmholtz equation. Determination of free energy changes. Nernst heat theorm and Third law of thermodynamics – calculation of absolute entropies.

Partial molar properties: Partial molar volumes and their determination by density measurements. Chemical potential and its significance. Variation of chemical potential with temperature and pressure. Principles of Gibbs-Duhem equation and deviation of Duhem-Margules equation.

Fugacity: Determination of fugacity of gases. Variation of fugacity with temperature and pressure. Activity and activity coefficients. Variation of activity with temperature and pressure. Determination of activity coefficients by vapour pressure, depression in freezing point, solubility measurements and by electrical methods.

[16 HOURS]

Unit II

Chemical Kinetics: Kinetics of complex reactions: Parallel, consecutive and reversible reactions. Arrehenius equation, energy of activation and its experimental determination. Simple colleision theory-mechanism of bimolecular reaction. Lindemann's theory for unimolecular reaction.

Activated complex theory of reaction rate, classical thermodynamic treatment, partition function, statistical thermodynamic treatment. Kinetics of reactions in solution:- Collision theory and the activated complex theory. Salt effect, effect of dielectric constant (single sphere and double sphere model), effect of pressure, volume and entropy change on reaction rates. Cage effect with an example. Kinetics of heterogeneous reactions: - Langmuir's theory, unimolecular and bimolecular surface reactions.

Fast reaction kinetics: Flow method, relaxation method (Flash photolysis, pulse radiolysis, Shock tube method).

[16 HOURS]

Unit III

Quantum Chemistry: Wave-particle duality of material particles, deBroglie equation, Heisenberg uncertainity principle, wave equation for stretched strings, concept of operators (operator-operand), Algebra of operators, commutative and non-commutative operators, linear operator, laplacian operator, Hamiltonian operator, eigen value, eigen function, class Q function, Hermitian operator, turn over rule, atomic units, schrodinger wave equation for particles, postulates of quatum mechanics.

Application od Schrodinger equation to a free particle and to a particle trapped in a potential field (one dimension and three dimensions), Degenracy. Wave equation for H- atom, separation and solution of R, ϕ and θ equations. Application of Schrodinger equation to regid rotator and harmonic oscillator.

[16 HOURS]

References

1. Thermodynamics for chemists by S. Glasstone, Affiliated East-West press, New Delhi (1965)
2. Chemical thermodynamics by I. M. Koltz, W. A. Benzamin Inc. New York, Amsterdam (1964)
3. Basic Physical Chemistry by W. J. Moore, Prentic Hall of India Pvt. Ltd., New Delhi (1986)
4. Text book of Physical Chemistry by S. Glasstone, McMillan Indian Ltd., (II edition), (1974)
5. Chemical klinetics by K. J. Laidler
6. Chemical klinetics by Frost and Pearson
7. Chemical klinetics by L. K. Jain
8. Chemical klinetics by Benson
9. Elements of Physical Chemistry by Lewis and Glasstone
10. Physical Chemistry by P.W. Atkins, ELBS, 4th Edition, Oxford University Press (1990).
11. Introduction to electrochemistry by S. Glasstone
12. Modern electrochemistry Vol. I and II, by J.O.M. Bockris and A.K.N. Reddy, Plenum Press, New York (1970).
13. Chemical and Electrochemical energy systems, by R. Narayan and B. Viswanathan, Universities Press (India) (1998).
14. Electrochemistry –Principles and applications by E.G. Potter.\
15. Electrochemistry by Reiger, Prentice Hall (1987).

OC1.5 Hard core: Analytical chemistry practicals

[48 hrs]

Material Safety Data Sheet (MSDS):Analysis of MSDS for all chemicals, noting the hazards and biological effects in the laboratory note book before doing the experiment.

1. Determination of carbonate and bicarbonate in a mixture by pH-metric titration and comparison with visual acid-base titration.
2. Determination of total acidity of vinegar and wines by acid-base titration.
3. Determination of total hardness of water by complexation titration using EDTA.
4. Determination of percentage of chloride in a sample by precipitation titration-Mohrs, Volhard and Fajans methods.
5. Potentiometric determination of the equivalent weight and Ka for a pure unknown weak acid.
6. Determination of chloride content of an industrial effluent by conductometric titration with silver nitrate.
7. Analysis of waste water for DO and BOD by titrimetry.

8. Determination of nitrate nitrogen in water by spectrophotometry using phenol disulphonic acid as chromogenic agent.
9. Spectrophotometric determination of creatinine in urine.
10. Analysis of urine for
    a. reducing sugars by titrimetry and spectrophotometry
    b. urea and uric acid by titrimetry and spectrophotometry.
    c. Inorganic phosphorus by spectrophotometry.
    d. Sulphate by precipitation titration after ion-exchange separation.
11. Analysis of blood for
    a. cholesterol by spectrophotometry
    b. urea and uric acid by spectrophotometry
    c. bicarbonate by acid-base titration.
12. Mercuricmetric determination of blood or urine chloride.
13. Determination of calcium in milk powder by EDTA titration.
14. Determination of iron in pharmaceuticals by visual and potentiometric titration using cerium(IV) sulphate.
15. Spectrophotometric determination of iron in natural water by thiocyante/orthophenanthroline method.
16. Determination of vitamin A in vanaspathi.
17. Assay of aspirin/caffeine/phenacetin by uv-spectrometry.
18. Determination of sulpha drugs by potentiometry using $NaNO_2$.

References

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch 8th edition, 2005, Saunders College Publishing, New York.
2. Analytical Chemistry, G.D. Christian, 5th ed., 2001 John Wiley & Sons, Inc, India.
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition,1993 prentice Hall, Inc. New Delhi.
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D. Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint.2003 Pearson Education Pvt. Ltd., New Delhi.
5. Analytical Chemistry Principles, John H. Kennedy, 2nd edition, Saunders College Publishing, California, 1990.
6. Practical Clinical biochemistry methods and interpretations, R.Chawla, J.P. Bothers Medical Publishers (P) ltd., 1995.
7. Laboratory manual in biochemistry, J. Jayaraman, New Age International Publishers, New Delhi, 1981.

8. Practical clinical Biochemistry-Harold Varley and Arnold.Hein Mann, 4th edn.
9. Environmental science: Laboratory Manual, Maurice A. Strabbe, The C.V.Mosbey Co. Saint Loucs, 1972.
10. Experiments in environmental chemistry, P.D.Vowler, and D.W.Counel, Pergamon press, Oxford 1980.

OC1.6 Hard core: Inorganic chemistry Practicals [48 hrs]

1. Analysis of Ores:

12. Hematite
    a. insoluble (gravimetrically)
    b. iron titrimetrically using cerium(IV) solution
13. Dolomite
    a. insoluble (gravimetrically)
    b. calcium and magnesium using EDTA
14. Pyrolusite
    a. insoluble (gravimetrically)
    b. Manganese dioxide titrimetrically using permanganate.

2. Micro-volumetric estimation of calcium using EDTA**.**

3. Analysis of alloys:

a) Solder – lead and tin using EDTA
b) Copper –nickel alloy
   (i) Copper volumetrically using KIO_3
   (ii) Nickel gravimetrically using DMG

4. Quantitative analysis of mixtures:

a) Chloride and iodide
   (i) iodide volumetrically using KIO_3
   (ii) total halide gravimetrically
b) Calcium and lead – using EDTA

5. Spectrophotometric determination of:

a) iron using thiocyanate/1,10-phenonthroline
b) chromium using diphenyl carbazide
c) nickel using dimethylglyoxime
d) titanium using hydrogen peroxide

6. Circular paper chromatography –separation of:

a) iron and nickel
b) copper and nickel

References

1. A Text Book of Quantitative Inorganic Analysis – A.I. Vogel. III edition
2. Vogel's Text Book of Quantitative Chemical Analysis – J. Basset, R.C. Denney, G.H. Jeffery and J. Mendhom.
3. Spectrophotometric determination of elements – Z. Marczenko.

4. Vogel's Qualitative Inorganic Analysis – Svelha.
5. Macro and Semimicro inorganic qualitative analysis – A.I. Vogel.
6. Semimicro Qualitative Analysis – F. J. Welcher and R.B. Halin.

OC1. 71 Soft core: peptides and nucleic acids

Unit I

Amino acids: General structure, essential amino acids physiological properties, isoelectric points, buffers {phosphate and acetate buffers) and two methods of synthesis (Gabriel phthalimide synthesis and Strecker synthesis).
Peptides: Peptide bond, structure determination: Amino acid residue analysis, C and N-terminal determination, selective cleavage of peptide bonds (two chemical and biochemical methods); Peptide synthesis: - Protection of amino group (Boc, Cbz, Fmoc-), carboxyl group as alkyl and aryl esters and activation of carboxylic groups, solution and solid phase techniques, use of DCC and Merrifield's resin, Racemization during peptide synthesis, synthesis of oxytocin, insulin, vasopressin and gramicidin, brief account of MSH, ACTH and HOBT.

(16 HOURS)

Unit II

Nucleic acids: Introduction, structure and synthesis of nucleosides and nucleotides, protecting groups for hydroxy group in sugar, amino group in the base and phosphate functions. Methods of formation of internucleotide bonds: DCC, phosphodiester approach, phosphite triester and phosphoramide methods. Solid phase synthesis of oligonucleotides.
Structure of RNA and DNA, Crick-Watson model, role of nucleic acids in the biosynthesis of proteins.
Genetic code, replication of DNA,

(16 HOURS)

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.
3. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.
4. Encyclopedia of Chemical technology – Kirck-Othmer series
5. Harper's review of biochemistry – P. W. Martin, P. A. Mayer & V. W. Rodfwell, 5th edition, Maurzen Asian Edition, California, 1981.

OC1. 72 Soft core: Carbohydrates and vitamins

Unit I

Monosaccharides: Introduction, general reactions, ring size determination of monosaccharides, configuration and conformations of monosacharides, anomeric effect, Hudson's rules, epimerization and mutarotation. Synthesis and biological importance of glycosides, amino sugars, anhydrosugars.
Dissaccharides: Structure, synthesis and biological aspects of sucrose, maltose and lactose. Industrial applications of sucrose.

Polysaccharides: General methods of structure elucidation.

(16 HOURS)

Unit IV

Vitamins: Introduction, constitution, synthesis and biological significance of thiamine, riboflavin, pyridoxine, biotin, ascorbic acid, vitamine A, E and K groups.

(16 HOURS)

References

1. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.
3. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.
4. Encyclopedia of Chemical technology – Kirck-Othmer series
5. Harper's review of biochemistry – P. W. Martin, P. A. Mayer & V. W. Rodfwell, 5th edition, Maurzen Asian Edition, California, 1981.

OC1.73 Soft core paper: **Steroids and Alkaloids**

Unit I

Steroids: Introduction, Structural elucidation of cholesterol, bile acids, Ergosterol and its irradiation products. Sex hormones and corticosteroids: Synthesis of estrone, progesterone, androsterone, testosterone. Barton reaction for the synthesis of aldosterone. Brief discussion of homosteroids, norsteroids and oral contraceptives. Biological significance of anabolic steroids

(16 HOURS)

Unit II

Alkaloids: Introduction, classification, isolation and general methods of structural elucidation. Biological importance of alkaloids. Structure and synthesis of nicotine, papavarine, quinine, morphine and reserpine.

(16 HOURS)

References

2. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
3. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.
4. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.
5. Encyclopedia of Chemical technology – Kirck-Othmer series
6. Introduction to alkaloids – G. A. Swan.
7. The alkaloids- K. W. Bently.
8. Steroids – L. Fischer & M. Fisher.
9. Steroids –Shoppe

Second Semester.
OC2.1 Hard Core: Spectroscopy

Unit I

UV-Visible spectroscopy: Modes of electronic excitations, simple chromophoric groups–systems of extended conjugation, aromatic systems. Types of auxochromes–functions of auxochromes, absorption and intensity shift. Types of transition probability, types of absorption bonds, solvent effects and choice of solvent. Effect of polarity on various type of bonds, Woodwards empherical rules for predicting the wavelength of maximum absorption: - Olefins, conjugated dienes, cyclic trienes and polyenes, α,β-unsaturated aldehydes and ketones, benzene and substituted benzene rings.

IR spectroscopy: Principles, Hook's law, characteristic group frequencies and skeletal frequencies. Finger print region. Identification of functional groups: Alkenes, alkynes, aromatics, carbonyl compounds (aldehydes and ketones, esters and lactones), halogen compounds, sulphur and phosphorous compounds, amides, lactams, amino acids, and imines. Factors affecting group frequencies and band shapes, conjugation, resonance and inductance, hydrogen bonding and ring strain, tautomerism, cis-trans isomerism. Applications of IR spectra to co-ordinatation compounds, organotransition metal complexes (N,N-dimethyl acetamides, urea, DMSO, NO_3^-, SO_4^{--}, NO_2^-) [**16 Hrs]**

Unit II

Nuclear magnetic resonance spectroscopy: General introduction and defination, magnetic properties of nuclei (magnetic moment, g factor) and theory of nuclear resonance. Larmor precession frequency, resonance condition and relaxation processes.

Chemical shift: Standards employed in NMR, factors affecting chemical shift, electronegativity, shielding and deshielding mechanism, Vander waals deshielding, H-bonding, diamagnetic and paramagnetic anisotropics. Spin-spin coupling, chemical shift values and correlation for protons bonded to carbon and other nuclei. Instrumentation and sample handling.

Equivalence and magnetic equivalence proton exchange reactions, effects of chiral center, complex spin-spin interaction, stereochemistry, hindered rotation, Karplus curve-variation of coupling constants with dihedral angles. Simplification of complex spectra: isotopic substitution, increasing magnetic field strength, double resonance, spin decoupling, constant shift reagents, solvent effect, Fourier-transfer technique, variable temperature profile, nuclear overhauser effect (NOE).

[16 HOURS]

Unit III

Mass spectrometry: Principles, instrumentation, different methods of ionization, EI, CI, FD and FAB, ion separators: single focusing separator with magnetic diffraction, focusing analyzer, time-of–flight separator and quadrupole analyzer. Mass spectra: molecular ion, base peak, meta-stable peak, nitrogen rule and McLafforty rearrangement. Mass spectral fragmentation of organic compounds and common functional groups: normal and branched alkanes, alkenes, cycloalkanes, benzene and its derivatives, alcohols, phenols, aldehydes and ketones, carboxylic acids, and their derivatives, amines, nitrocompounds. Determination of molecular formula by accurate molecular weight and isotopic abundance methods. Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

LC-MS, LC-MS/MS, GC-MS: Principles and applications

Composite problems
Problems involving the application of the above spectroscopic techniques for structural elucidation of organic molecules.

[16 HOURS]

References

1. Spectroscopy by B. P. Straughan and S. Walker, John Wiley & Sons Inc., New York, Vol. 2, 1976.
2. Organic spectroscopy by William Kemp, ELBS Society, MacMillan, 1987.
3. Application of absorption spectroscopy of organic compounds by John R. Dyer, Prentic-Hall of India Private Ltd., New Delhi, 1974.
4. Organic spectroscopy by V. R. Dhani, Tata McGrow-Hall publishing company Ltd., New Delhi, 1995.
5. Spectrometric identification of organic compounds, 4th edition, Robert M. Silverstein, G. Clayton Bassler and Terence C. Morrill, John Wiley & Sons Inc., New York, Vol. 1, 1981.
6. Interpretation of carbon-13 NMR spectra, F. W. Wehrli and T. Wirthlin, Heyden, London, 1976.

OC 2.2 Hard Core: Reagents & Synthesis

UNIT-I

Reductions: Catalytic hydrogenations (homogeneous and heterogeneous)-catalysts, solvents, equipment and reduction of functional groups, catalytic hydrogen transfer reactions, Wilkinson catalyst, Bakers yeast, $LiAlH_4$, $NaBH_4$, metal dissolving reactions (Birch reduction), Leukert reaction (reductive amination), diborane, Meerwein-Pondorf-Varley reduction, Wolf-Kishner reduction, Clemensen reduction.
Oxidations: Oxidation with chromium and manganese compounds (CrO_3, $K_2Cr_2O_7$, PCC, PDC, Sarret reagent, Jones reagent, MnO_2, $KMnO_4$), oxygen (singlet and triplet), ozone, peroxides and peracids, lead tetra acetate, periodic acid, OsO_4, SeO_2, NBS, chloramine-T, Sommelet oxidation, Oppenauer oxidation.

[16 HOURS]

UNIT-II

Protecting groups: protection of hydroxyl, carboxyl, carbonyl, thiol, amino groups,. Illustration of protection and deprotection in synthesis.
Functional group transformations
Reagents in organic synthesis: Use of following reagents in organic synthesis and functional group transformations: Gilmann reagent, dicyclohexyl carbodiimide, DDQ, trimethylsilyl halides, trimethylsilyl cyanides, dithianes, TBDMS-chloride, phase transfer catalyst, crown ethers, cyclodextrins, Fenton's reagent, triphenyl phosphine, Aluminium oxide, Ziegler-Natta catalyst, diazomethane, stannous chloride, Lawson reagent, thiourea, sharpless epoxidation, Woodward and Prevost hydroxylation, Peterson reaction, metal carbonyls. **[16 HOURS]**

UNIT III

Planning and Execution of Multistep Synthesis Basic principles and technologies used in disconnection approach, synthons and synthetic equivalents, Interconversion of functional groups,

one group C-X and two group C-X disconnections. Protecting groups-Principles of protection of hydroxyl, amino, carboxylic and carbonyl groups. Use of C-C one group and C-C two group disconnections in the synthesis of 1,2; 1,3; 1,4; 1,5 and 1,6-difunctionalised compounds. Retrosynthetic analysis of alcohols, carbonyl compounds, cyclic and acyclic alkanes, benzocaine, p-methoxyacetophenone, acetocyanohydrin, 2-methyl-6-methoxy-indole-3-acetic acid, 6-methylquinoline. Illustrative synthesis of Juvabione, Longifolene, Prelog-Djerassi lactone, Taxol and Epothilone A. Solid phase synthesis of polypeptides and oligonucleotides.

[16 hrs]

References:

a. Organic Synthesis-Special Techniques, V.K.Ahluwalia and R. Aggarwal, Narosa, New Delhi, 2001.
b. Organic Synthesis, R.E.Ireland, Prentice Hall India, 1969.
c. Advanced Organic Chemistry, IV Ed., Part A &B, F.J.Carrey & R.J.Sundberg, Kluwer, 2001.
d. Organic Synthesis- A Disconnection Approach, Stuart
e. Art in Organic Synthesis, Anand, Bindra & Ranganath, Wiley, New Delhi, 1970.
f. Modern Methods of Organic Synthesis, N. Carruthers, Cambridge University, 1996.
g. Organic Reaction Mechanisms, V.K.Ahluwalia & R.K.Parashar, Narosa, 2006
h. Stereochemistry- Conformation and Mechanism, P.S.Kalsi, Wiley Eastern, New Delhi, 1993.
i. Stereochemistry of Carbon Compounds, E. L. Elliel, Tata McGraw Hill, New Delhi, 1994.

OC2.3: Synthetic organic chemistry
Unit I

Addition reactions: Addition to C-C multiple bonds involving electrophiles, nucleophiles and free radicals. Markownikoff's rule and antiMarkownikoff's rule, Hydroboration.
Typical additions to carbonyl compounds: Addition of hydride, water, alcohol, thioalcohol, bisulphite, HCN, Grignard reagents and amino compounds to carbonyl compounds.
Aldol and related reactions: Keto-enol tautomerism, mechanism and synthetic applications of aldol condensations, Claisen reaction, Schmidt reaction, Perkin reaction, Knoevenogel, benzoin, Stobbe and Darzen's glysidic ester condensation, Cannizaro reaction, Tishchenko reaction, Michael addition, Robinson's annulation reactions.
Mechanism of ester formation and their hydrolysis, formation and hydrolysis of amides, decarboxylation mechanisms.
Elimination reactions: Mechanism and stereochemistry of eliminations–E1, E2, E1cb mechanism, *cis*-elimination, Hofmann and Saytzeff eliminations, competition between elimination and substitution, Chugaev reaction.

[16 HOURS]

UNIT II:

Asymmetric synthesis:

Definition, importance, mechanism, energy consideration, advantages and limitations, methods of determination of enantiomeric excess.

i. **Topocity - Prochirality**- Substrate selectivity - Diastereoselectivity and enantio-selectivity- Substrate controlled methods-use of chiral substrates - examples

ii. **Auxiliary controlled methods**- Use of chiral auxiliaries-Chiral enolates-alkylation of chiral imines - Asymmetric Diels - Alder reaction

Reagent controlled methods- Use of chiral reagents - Asymmetric oxidation –Sharpless epoxidation - Asymmetric reduction - Use of lithium aluminium hydride and borate reagents.

Synthesis and applications of oxazaborolidines, IPC-BBN, IPC_2BH, (S)-BINAP-DIAMINE and (R)-BINAL-H. Use of (R,R)-DIPAMP, (S,S)-CHIRAPHOS, (R,R)-DIOP, SAMP, RAMP, S-Proline, S-PBMgCl, (-)-$BOAlCl_2$, (+) and (-)-DET.

UNIT III:

Green Chemistry

Definition and principles, planning a green synthesis in a chemical laboratory, Green preparation-Aqueous phase reactions, solid state (solvent less) reactions, photochemical reactions, Phase transfer catalyst catalyzed reactions, enzymatic transformations & reactions in ionic liquids.

Microwave induced organic synthesis: Introduction, reaction vessel and reaction medium, concept, specific effect, atom efficiency, % atom utilization, advantages and limitations, N-alkylation and alkylation of active methylene compounds with aldehydes, synthesis of Ibuprofen by BHC and BOOTS approaches, Diels-Alder reaction, Leuckardt reductive amination of ketones, oxidation of alcohols and sulfides. Organic process research, process development, process optimization. Basics of environmental health safety, basics of intellectual property rights.

(16 HOURS)

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984
2. J. March, Advanced Organic Chemistry, Wiley Interscience, 1994.
3. E. S. Gould, Mechanism and Structure in Organic Chemistry, Halt, Rinhart & Winston, New York, 1964.
4. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
5. Comprehensive Organic Synthesis – B. M. Trost and I. Fleming series, Pergamon Press, New York, 1991.
6. A Guide book to mechanism in organic chemistry – Petersykes.
7. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998
8. R. K. Bansal, Organic Reaction Mechanism, Wiley Eastern Limited, New Delhi, 1993
9. Green Chemistry-Environment friendly alternatives, R.Sanghi & M.M.Srivatsava, Narosa, 2003.
10. 10. Green Chemistry-Environment benign reactions, V.K.Ahluwalia, Ane Books India, 2006.

OC2.4 Hard core: Organometallics and organononmetallics

Unit I

Organometallic Chemistry: Introduction, 16 and 18 electrons rule, classification of organometallic compounds by bond type, nomenclature.

Metal Carbonyl Complexes: Preparation, structure, chemical bonding in metal carbonyls, physical evidence related to M-CO bonding. Important reaction of M-CO/ and preparation of anionic metal carbonyl complexes.

Substituted Metal Carbonyl Complexes and Related Compounds: Methods of preparation of substituted metal carbonyl complexes, structures, and M-L bonding in substituted metal carbonyl complexes.

Biological applications and environmental aspects of organometallic compounds: Introduction, organometallics in medicine, agriculture and in horticulture, and environmental aspects of organometallic compounds.

[16 HOURS]

Unit II

Chemistry of organometallic compounds: Synthesis and reactions of organolithium (n-BuLi, PhLi}, organocadmium, organomagnesium (Grignard reagent), organomanganese, organoselenium and organotellurium.

Organoaluminium reagents: Preparation, site selective and stereoselctive additions of nucleophiles mediated by organoaluminum reagents, reaction with acid chlorides, allyl vinyl ethers, 1,2-addition to imines and application in the synthesis of natural products.

Organocopper reagents: Gilman reagent, preparation, reactions with aldehydes, ketones and imines. Application in the synthesis of brevicomin,

Organopalladium compounds: Suzuki coupling, Heck reaction.

Organozinc reagents: Preparation - oxidative addition and transmetallation, addition reactions of alkyl, aryl, allylic and propargylic zinc reagents, diastereoselective and enantioselective addition reaction with aldehydes, Reformatsky reaction.

Organosamarium reagents: Reactions promoted by samarium diiodide and dicyclopentadienyl samarium – Barbier type reaction, Reformatsky type reactions, ketyl-alkene coupling reactions, pinacolic coupling reactions, acyl anion reactions.

Organotin reagents: tributyltin hydride, Barton decarboxylation reaction, Barton deoxygenation reaction, Stille coupling, Stille-Kelley coupling reactions, Barton McCombie reaction, Keck stereoselective allylation and other applications.

(16 HOURS)

Unit III

Organoboron compounds: Introduction and preparations. Hydroboration and its applications. *Reactions of organoboranes*: isomerization reactions, oxidation, protonolysis, carbonylation, cyanidation. *Reaction of nonallylic boron stabilized carbanions*: Alkylation reactions, Acylation reaction, Reactions with aldehydes or ketones (E and Z-alkenes).

Organosulphur compounds: Introduction. Preparations, reactions, mechanism and synthetic applications of important sulphur containing reagents like dithiane, sulphur ylides etc.

Organosilicon compounds: Introduction, preparations and reactions, Peterson reaction.

Organophosphorous compounds: Nomenclature, synthesis and reactions of trialkyl phosphine, triarylphosphine, trialkyl phosphite, triaryl phosphite, trialkyl phosphate, triaryl phosphates. Wittig reaction and Wittig-Horner reactions: - mechanisms and synthetic uses. Arbasov reaction, transesterification.
Organofluorine compounds

(16 HOURS)

References:

1. J. March, Advanced Organic Chemistry, Willey Interscience, 1994.
2. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
3. Comprehensive Organic Chemistry, Pergamon Press, New York, Vol 1, 1996,
4. Comprehensive Organic Synthesis – B. M. Trost and I. Fleming series, Pergamon Press, New York, 1991.
5. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998

OC2.5 Hard Core: Organic Chemistry Practical – Qualitative analysis [48 hrs]

Qualitative analysis: Separation of binary mixtures, identification of functional groups and preparation of suitable solid derivatives.

Reference:

1. A Text book of practical organic chemistry – A. I. Vogel Vol. I.
2. Semimicro qualitative organic analysis by Cheronis, Entrikin and Hodnet.
3. J. N. Guthru & R. Kapoor, Advance experimental chemistry, S. Chand Company, New Delhi, 1991.
4. R. K. Bansal, Laboratory Manual of Organic Chemistry, New PGE International (P) Ltd. London, 3rd edition, 1996.

OC2.6 Hard Core: Physical Chemistry Practical [48 hrs]

Kinetics

2. Study of kinetics of hydrolysis of an ester using HCl/H_2SO_4 at two different temperatures, determination of rate constants and energy of activation.
3. Study of kinetics of reaction between $K_2S_2O_8$ and KI, first order, determination of rate constants at two different temperatures and Ea.
4. Study of kinetics of reaction between $K_2S_2O_8$ and KI, second order, determination of rate constant and Ea.
5. Study of kinetics of reaction between CAT and indigocarmine spectrophotometrically and determination of rate constant.
6. Determination of energy of activation for the bromide-bromate reaction.

Conductometry

7. Conductometric titration of a mixture of HCl and CH_3COOH against NaOH.
8. Determination of equivalent conductance at infinite dilution of a strong electrolyte and verification of Onsager equation.
9. Determination of dissociation constant of a weak electrolyte by conductivity method.
10. Conductometric titration of formic acid/oxalic acid against NaOH and NH_4OH.
11. Potentiometric titration of KI vs $KMnO_4$ solution.
12. Determination of dissociation constant of a weak acid by potentiometric method.

13. Potentiometric titration of $AgNO_3$ vs KCl.
14. Determination of redox potential and estimation of Fe^{2+} ions by potentiometric method.
15. To obtain the absorption spectra of coloured complexes, verification of Beer's law and estimation of metal ions in solution using a spectrophotometer.
16. Spectrophotometric titration of $FeSO_4$ against $KMnO_4$.
17. Determination of heat of solution of benzoic acid/salicylic acid by variable temperature method (graphical method).
18. Thermometric titration of an acid with a base.
19. Determination of molecular weight of a compound using Beckmann's cryoscopic method using benzene or/and water as solvent.
20. Determination of partial molar volume of (a) NaCl-H_2O and (b) C_2H_5OH-H_2O systems.
21. Determination of degree of association of benzoic acid in benzene by distribution method.

References

1. Practical Physical Chemistry – A.J. Findlay.
2. Experimental Physical Chemistry –F. Daniels et al.
3. Selected Experiments in Physical Chemistry – Latham.
4. Experiments in Physical Chemistry – James and Prichard.
5. Experiments in Physical Chemistry – Shoemaker.
6. Advanced Physico-Chemical Experiments –J. Rose.
7. Practical Physical Chemistry –S.R. Palit.
8. Experiments in Physical Chemistry – Yadav, Geol Publishing House.
9. Experiments in Physical Chemistry – Palmer.

OC2.71; Soft Core: **BIOANALYTICAL CHEMISTRY**

UNIT-I

Body fluids: Composition and detection of abnormal level of certain constituents leading to diagnosis, sample collection and preservation of physiological fluids, analytical methods for the constituents of physiological fluids (blood, urine).
Blood: Estimation of glucose, cholesterol, urea, haemeglobin and bilirubin.
Urine: Urea, uric acid, creatinine, calciumphosphate, sodium, potassium and chloride.
Enzymes: Biological significance, analysis and assay of enzymes (pepsin, tyrasinase), vitamins (thiamine ascorbic acid, vitamin A) and harmones (progesterone, oxytocin, insulin), chemical, instrumental and biological assays to be discussed wherever necessary.
Forensic analysis: General discussion of poisons with special reference to mode of action of cyanide organophosphates and snake venom, estimation of poisonous materials such as lead, mercury, and arsenic in biological materials.

[16 HOURS]

UNIT-II

Food Analysis: Historical perspectives, objectives of food analysis. Sampling procedures. Detection and determination of sugars and starch. Methods for protein determination. Oils and fats and their analysis-iodine value, saponification value and acid value. Rancidity-detection and determination (peroxide number). Tests for common edible oils. Analysis of foods for minerals-phosphorus,sodium, potassium and calcium. General methods for the determination of moisture, crude fibre and ash contents of foods. Analysis of milk for fat and added water. Non-alcoholic

beverages. Determination of chicory and caffeine in coffee;caffeine and tannin in tea. Alcoholic beverages-methanol in alcoholic drinks and chloral hydrate in toddy. Food additives. Chemical preservatives-inorganic preservatives-sulphur dioxide and sulphites, their detection and determination. Organic preservatives-benzoic acid and benzoates, their detection and determination. Artificial sweetenes-saccharin, cyclamate and dulcin-detection and determination. Flavouring agents-dection and determination of vanilla and vanillin. Coloring matters in foods-classification, certified colours, detection of water soluble dyes, colour in citrus fruits, beet dye in tomato products, mineral colour. Pesticide residues in foods. Determination of chlorinated organic pesticides. **[16 HOURS]**

REFERENCES

1. Pharmaceutical Analysis, T. Higuchi and E.B. Hanssen, John Wiley and Sons, New York.
2. Quantitative Analysis of drugs, P.D. Sethi, 3rd edition, CBS Publishers, New Delhi, 1997.
3. Practical Clinical biochemistry methods and interpretations, R.Chawla, J.P. Bothers Medical Publishers (P) ltd., 1995.
4. Laboratory manual in biochemistry, J. Jayaraman, New Age International Publishers, New Delhi, 1981.
5. Pharmaceutical Analysis, Modern methods-Part A and B, Edited by James W. Munson.
6. Hawk's physiological chemistry-edited by B.L. Oser, 14th edn, Tata Mc Graw Hill. (1976).
7. The Essentials of Forensic Medicine and Toxicology-Dr.K.S. Narayana Reddy.
8. Practical clinical Biochemistry-Harold Varley and Arnold.Hein mann, 4th edn.
9. Analysis of Foods-H.E.Cox.
10. Chemical Analysis of Foods-H.E.Cox and pearson.

OC2.72; Soft Core: Bioinorganic Chemistry

UNIT –I

Biochemistry of Calcium: Binding, transport and accumulation of Ca^{2+}, calcium and muscle contraction, calcium in blood cloting mechanisms.

Biochemistry of Cobalt: Vitamin B_{12} and B_{12} coenzymes, Coenzyme A, enzyme co-factor, NAD, FMN and FAD.

Bioenergetics: Energy in biology, energy transfer, the energy of ATP, Kinetic stability of ATP, standard free energy change entropy. High energy compounds, mitochondrial flow of electrons from NADH to O_2.

Bioinorganic Chemistry of Phosphorous: Phosphates, oxidative phosphorylation-substrate level phosphorylation, respiratory chair phosphorylation, mechanism of oxidative phosphorylation.

Transport and Storage of Iron: Ferretin, transferrin, phosvitin and gastroferrin.

Iron Transport in Microbes: Siderophores, *in vivo* microbial transport of iron.

[16 HOURS]

UNIT –II

Dioxygen metal complexes in biological system: Reactions of molecular oxygen, activation of dioxygen molecule in transition metal complexes.

Oxygen Carrying Proteins: Introduction to porphyrin system, substituent effects on porphyrin rings, hemoglobin and myoglobin, model compounds for oxygen carriers (cobalt, iridium, iron and nickel). Hemerythrin and hemocyanin.
Electron Transport Proteins: Iron-sulphur proteins (rubredoxins and ferredoxins) and cytochromes including cytochrome P450.
Iron and Copper Containing redox enzymes: Catalase and peroxidase. Superoxide dismutase.
Zinc containing enzymes: Alcohol dehydrogenase, carboxypeptidase A.
Molybdenum containing enzymes: Aspects of molybdenum chemistry, xanthine oxidase, aldehyde oxidase, sulphite oxidase, nitrogenase and nitrate reductase.

[16 HOURS]

References:

1. Biochemistry – A.L. Lehninger
2. Biochemistry – L. Stryer
3. Bioinorganic Chemistry - R.W. Hay
4. The Inorganic Chemistry of Biological Processes – 2nd edition, M.N. Hughes
5. Bioinorganic Chemistry –M. Satake and Y. Mido.
6. Bioinorganic Chemistry – G.R. Chatwal and Ajaykumar Bhagi.
7. Biological aspects of Inorganic Chemistry – A.W. Addison, W.R. Cullen, D. Dolphin and B.R. James.
8. Principles of drug action: The basis of pharmacology, 2nd edition – A. Goldstein, L. Aronow and S. M. Kalman.
9. Advanced Inorganic Chemistry-II – Gurdeep Raj.
10. Bioinorganic Chemistry.
11. General Biochemistry – J.H. Weil.
12. Organometallic Chemistry – R.C. Mehrothra and A. Singh.
13. Fundamental Transition metal Organometallic Chemistry – Charles M. Lukehart.
14. Modern Aspects of Inorganic Chemistry –Emeleus and Sharpe.
15. Inorganic Chemistry – Purcell and Kotz.
16. Inorganic chemistry- J.E.Huheey.
17. Organometallic chemistry by Nayori.

OC2.73: SoftCore: Bioorganic chemistry

Unit I

Biopolymers:
Biological importance of cellulose, starch, glycogen, dextran, hemicellulose, pectin, agar-agar.
Photosynthesis and biosynthesis of other sugars.
Industrial importance of cellulose.
Proteins: Isolation, purification and classification, primary, secondary and tertiary structure, denaturation and renaturation, biological and industrial importance of silk, casein, gelatin, seed protein, single cell protein.
Lignin: Different process of isolation, structure, importance of delignification in paper industry, biodegradation of lignins.

(16 HOURS)

Unit II

Enzymes: Introduction, nomenclature, classification with examples and their functions.
The mechanistic role of the following co-enzymes in the living systems:- i. Thiamine pyrophosphate (TPP) in oxidative and non-oxidative decarboxylation of α-keto acids and formation of ketols; ii. Pyridoxal phosphate:- transamination, decarboxylation, dealdolization and elimination reactions of amino acids; iii. Lipoic acid in the transfer of acyl group and oxidation reactions; iv. Co-enzyme A: generation and ternsfer of acyl groups; v. biotin – in the addition of carboxyl groups to saturated carbon atoms and in transcarboxylation reactions; tetrahydrofolic acid – in one carbon transfer reactions at all oxidation levels except that of CO_2; Nicotenamide and flavin coenzymes – in biological oxidation-reduction reactions.
Biogenesis of fatty acids, terpenoids (mono and sesquiterpenoids), steroids, aminoacids, alkaloids.

(16 HOURS)

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
1. Essentials of physiological chemistry – Anderson, John Wiley & Sons, New York, 1953.
2. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, ist edition, New Delhi, 1993.
3. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.
4. Encyclopedia of Chemical technology – Kirck-Othmer series
5. Harper's review of biochemistry – P. W. Martin, P. A. Mayer & V. W. Rodfwell, 15th edition, Maurzen Asian Edition, California, 1981

OC2.74; Soft Core: Biophysical Chemistry

UNIT-I

ENZYME KINETICS: Effect of substrate concentration, Effect of pH, effect of catalysts and inhibitors (substrate, zeoliter, Cr^{3+}, Fe^{2+} ZnO, U.V light) and effect of temperature. A brief kinetic and mechanistic applications of glucose oxidase and L-amino oxidase in the oxidation of glucose and L-amino acids.
Biological significance of Donnan membrane phenomenon. Micelles and involvement during digestion and absorption of dietary lipids. Diffusion of solutes across bio-membranes and its application in the mechanism of respiratory Exchange. "Salting In" and "Salting out" of proteins. Osmotic behaviour of cells and osmo-regulation and its application in the evolution of excretory systems of organisms. Significance of visulity in biological systems-mechanism of muscle contraction, detection of in trastrand disulfide bonds in proteins, polymerization of DNA and nature of blood flow tarongu different vessels. Effect of temperature solute concentration (amino acids) in surface tension. Biological significance of surface tension, stability of Alveoli in lungs, interfacial tension in living cells (Danielle and Davson model).
In metabolism studies; Radioimmuno and assay (cabeling of antigens) Immune radiometry.

(16 Hours)

UNIT-II

PHARMOCOKINETICS: Plasma concentration time curve, drug dissolution rate, phyiso-chemical factors effecting bioavailability. Pharmocokinetics applied to one component open model. Calculation of elimination rate constant and metabolism constant apparent volume of drug

distribution and kinetics of drug clearance. Protein binding of drugs, Bioavailability and bio equivalence. Factors affecting bioavailability route of drug administration and kinetics of protein binding.

Chemical biology: What is life? Its chemical definition in the perspective of modern scientific progress. **Origin of life**: spontaneous generation of life and its failure; abiotic origin of life: Urey-Miller's experiment, Oparin-Haldane concept of origin of life, panaspermic origin of life and genetic code (life material has come from extra- terrestrial source through meteorites. What is the first important polymer in the evolution of life? RNA based origin of life.

Water – the major constituent of life, its physical and chemical nature that makes it versatile as a solvent. Is life possible without water?

(16 HOURS)

References

1. Thermodynamics for chemists by S. Glasstone, Affiliated East-west press, New Delhi, (1965).
2. Chemical Thrmodynamics by I.M. Klotz, W.A. Benzamin Inc. New York, Amsterdam, (1964).
3. Basic Physical Chemistry by W.J. Moore, Prentice Hall of India Pvt. Ltd., New Delhi, (1986).
4. Text book of Physical Chemistry by Samuel Glasstone, MacMillan Indian Ltd., (II edition), (1974).
5. Theoretical chemistry by S. Glasstone.
6. Statistical themodynamics by B.C. Meclelland, Chapman and Hall, London (1973).
7. Elementary statistical thermodynamics by N.D. Smith Plenum Press, NY (1982).
8. Elements of classical and statistical thermodynamics by L.K. Nash, Addison-Wesley (1970).
9. Statistical thermodynamics by I.M. Klotz.
10. Introduction to Statistical Thermodynamics by M. Dole, Prantice-Hall, (1962).

Cross Border Paper

OC2.81 Basic concepts in Organic Chemistry:

Unit I

Acids and bases, electrophiles and nucleophiles, hybridization in carbon compounds, inductive effect, resonance effect, hydrogen bonding {types of hydrogen bonding, hydrogen bonding in HF, water, alcohols, acids, nitrophenols) bond angle and bond length.

Purification:- Crystallization, sublimation, fractional crystallization, distillation techniques (simple distillation, steam distillation, distillation under reduced pressure, fractional distillation).

Separation techniques:-Solvent extraction, continuous extraction, chromatography (principles of TLC, PC, column, GC, ion exchange chromatography) and electrophoresis

Characterization: Detection of elements, estimation of carbon, hydrogen, halogens, sulphur, nitrogen and phosphourous. Detection of functional groups (hydroxyl, carboxyl, keto, ester, amino, nitro, amide, thiol, ether etc) in the unknown samples. Basic principles for the determination of hydroxyl, carboxyl, keto, ester, amino, nitro groups. Estimation of sugars, aminoacids and proteins. **(16 HOURS)**

Unit II

Basics of organic reactions:- Meaning and importance of reaction mechanism, classification and examples for each classes.

Structural determination of organic compounds by: **UV spectroscopy** –absorption maxima for simple organic molecules; **IR spectroscopy** –absorption frequencies for functional groups in simple organic molecules; **NMR-spectroscopy** – Chemical shift (δ-scale), spin-spin coupling, coupling constants, applications to simple molecules. [For all spectroscopic methods, simple molecules like ethyl alcohol, methyl cyanide, ethane, propane, ethylene, benzene, methyl amine, aniline, acetone, acetophenone and other simple molecules are considered]. **(16 HOURS)**

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998

OC 2.82 Life Style Chemicals

UNIT I

Perfumery: Introduction, Compounds used in perfumery and their classification, methods of preparation and importance of phenyl ethanol, Yara yara, Ionone musk ketone, musk ambrette, musk xylene, phenyl acetic acid and its esters, benzyl acetate, synthetic musks and jasmine.

Flavours: Introduction, classification, Chemical basis for flavour, flavours in diary products, flavours formed by heating or cooking-caramelisation & Maillard reaction, flavour degradation by oxidation-rancidity, molecular structure & odour/taste, sweetness, acidity & sourness, saltness, bitterness, synthetic chemicals, Natural flavouring materials & classification. Flavouring materials-Acidulants, sweeteners, potentiators, enhancers & sodium-restricted food flavourings. Organic chemicals used in flavorings & food colorants.

Essential oils: Source, constituents, isolation & uses.

Cosmetics: Detailed study of formulations and manufacturing of cream and lotions, lipstick and nail polish, shampoos, hair dyes and tooth pastes. A formulary of cosmetic preparation-Godwin.

[16 hrs]

UNIT II

Oils, soaps and Detergents: Refining of edible oils, manufacturing of soaps, detergents-classification-anionic, cationic, non-ionic and amphoteric detergents, comparison of soaps and detergents, detergent builders and additives, liquid soaps. Manufacturing of fatty acids and glycerol, greases from fatty acids, turkey red oil. Paints, varnishes and inks-constitutions, examples of preparation and applications.

Food Analysis: Moisture, ash, crude protein, crude fiber, fat, carbohydrate, calcium, potassium, sodium and phosphates, food adultration-common adulteration in food, contamination of food stuffs, microscopic examination of food for adulterants, pesticide analysis in food products.

[16 hrs]

References

1. Synthetic organic chemistry, G R Chatwal, Himalaya publishing house.
2. A formulary of paints and other coatings, M Ash & I Ash
3. Encyclopedia of Chemical Technology, Kiik & others.
4. Perfumary Technology,B. Billot and F. V. Wells

5. Lehninger principles of Biochemistry, David .L Nelson and Michael M Cox
6. Dairy chemistry and animal nutrition, V.K. Chhozllani
7. Principles of Animal nutrition and Feed technology Part I and II, D.V Reddy
8. Feeds and Principles of animal nutrition, G.C.Banerjee.
9. Source book of flavors, Heath.

Third Semester

OC3.1 Hard core: Molecular rearrangement and heterocyclic chemistry

Unit I

Molecular rearrangements: Introduction,
Carbon to carbon migrations: Pinacol-pinacolone, Wagner-Meerwein, Benzidine, Demyanov, Benzylic acid, Favorskii, Arndt-Eistert synthesis, Fries rearrangement, Stevens rearrangement.
Carbon-to nitrogen migrations: Hofmann, Curtius, Lossen, Schmidt and Beckmann rearrangement.
Miscellaneous rearrangement: Sommelet-Hauser, Wittig, Smiles, Neber, Rupe, Jap-Klingermann rearrangement, Meisenheimer rearrangements, Bayer-Villeger rearrangement. Allylic rearrangements.

[16 hrs]

Unit II

[16 hrs]

Nomenclature of heterocyclic systems; Structure, reactivity, synthesis and reactions of furan, pyrrole, thiophene, indole, pyridine, quinoline, isoquinoline, pyrazole, imidazole, pyrone, coumarin, chromones, pyrimidines and purines.

(16 HOURS)

Unit III

Chemistry of heterocyclic compounds II: Synthesis and synthetic applications of azirines & aziridines, azetidines, oxazolines, isoxazolines, isoxazole, triazole and azepines and benzodiazepines.

(16 HOURS)

References:

1. J. March, Advanced Organic Chemistry, Willey Interscience, 1994.
2. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
3. Comprehensive Organic Chemistry, Pergamon Press, New York, Vol 1, 1996,
4. H. Pine, Hendrickson, Cram and Hammond, Organic Chemistry, Mac Grow Hill, New York, 1987.
5. I. I. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984
6. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990
7. Comprehensive Organic Synthesis – B. M. Trost and I. Fleming series, Pergamon Press, New York, 1991.
8. S. K. Ghosh, Advanced General Organic Chemistry, Book and Alleied (P) Ltd, 1998

9. Heterocyclic Chemistry –Joule & Smith
10. Heterocyclic chemistry – Achaeson
11. Basic Principles of heterocyclic chemistry – L. A. Pacquette
12. Comprehensive heterocyclic chemistry –Kartritzky series, Pergamon Press, New York, 1984.

OC3.2 Hard Core: Bonding, Photochemistry and Pericyclic reactions

Unit I

Bonding in organic systems: Theories of bonding- Valence and molecular orbital approaches. Huckel molecular orbital theory and its application to simple π-systems: ethylene, allyl, cyclopropyl, butadienyl, cyclopentadienyl, pentadienyl, hexatrienyl, cyclohexatrienyl, heptatrienyl, cycloheptatrienyl systems. Calculation of the total π-energy, delocalization energy, bond order and M.O. coefficients of the systems.

Aromaticity: Concept of aromaticity, Huckel's rule, Polygon rule, annulenes, heteroannulenes and polycyclic systems. Aromaticity and bonding in fullerenes.

[16 HOURS]

Unit II

Photochemistry: General consideration: Activation in thermal and photochemical reactions. Light absorption and excitation. Singlet and triplet states. Morse curve, Franck-Condon principle.

Deexcitation: Physical process, Jablonski diagram. Photosensitization (donor acceptor concept, resonance and collision transfer). Chemical process, quantum efficiency, quantum and chemical yields.

Photochemistry of functional groups:

i) *Olefins*: *Cis-trans* isomerism, [2+2] cycloaddition, rearrangements. Reaction of conjugated olefins; di-π-methane rearrangement.

ii) *Ketones*: Excited state of C=O. Norrish type-I and type-II cleavages. Paterno-Buchi reaction. α,β-unsaturated ketones. [2+2] addition, *cis-trans* isomerisation. Rearrangements of cyclohexadienones.

iii) *Aromatic compounds*: Photorearrangement of benzene and its derivatives, cycloaddition of benzene.

iv) *Photochemical oxidations and reductions*: Cycloaddition of singlet molecular oxygen. Oxidative coupling of aromatic compounds, photoreduction by hydrogen absorptions.

Photodegradation: Photocatalyst –ZnO, TiO2, principle, application of ZnO/TiO2 in the phodegradation of dyes (IC), pesticides (DDT, HCCH0 and in industrial affluents. Effect of photodegradation on COD values.

(16 HOURS)

Unit III

Pericyclic reactions: Classification of pericyclic reactions. Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system.

Electrocyclic reactions: Woodward-Hofmann rules for electrocyclic reactions, FMO theory of electrocyclic reactions, correlation diagram for cyclobutadiene and cyclohexadiene systems.

Cycloaddition reactions: [2+2], [3+2] and [4+2] cycloadditions, analysis by FMO and correlation diagram method. Cycloadditions - antarafacial and suprafacial additions, [2+2] additions of ketenes.

1,3-dipolar cycloadditions: involving nitrile oxide, nitrile imine, nitrile ylide cycloaddition. Intra and intermolecular 3+2 cycloaddition and their application in organic synthesis.

[4+2] cycloaddition reactions: Deil's-Alder reaction, hetero Diel's-Alder reaction and their applications.

Sigmatropic rearrangements - Classification, stereochemistry and mechanisms. suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties. [3,3]- and [5,5]-sigmatropic rearrangement, Claisen, Cope and aza-Cope rearrangements.

Chelotropic reactions:

(16 HOURS)

Reference books

1. F. A. Carey and Sundberg, Advanced Organic Chemistry – Part A & B, 3rd edition, Plenum Press, New York, 1990.
2. Dupey and Chapmann, Molecular reactions and Photochemistry, Prentic Hall- International, Tokyo, 1972.
3. Introduction to physical organic chemistry – Kosower
4 Molecular orbital calculations – J. D. Roberts
5. N. J. Turro, Modern molecular photochemistry, The Benzamin Cummings Publishing Co. Ltd, Menlo Park, 1978.
6 K. Yates, Huckel's Molecular Orbital Theory, Academic Press, New York, 1978.
7. T. L. Gilchrist & R. C. Storr, Organic reaction and orbital symmetry, Cambridge Univ. Press, London, 1979.
8. D. C. Neckers, Mechanistic Organic Photochemistry, Reinhold, New York, 1967.

OC3.3 Hard Core: Multi step synthesis [48 hrs]

Oxidation of alcohols: Oxidation of cyclohexanol to adipic acid via cyclohexanone

1. Esterification: Preparation of benzoccaine from p-nitrotoluene
2. Diazotization (Sandmeyer's reaction): Preparation of p-chlorobenzoic acid from p-toluidine
3. Molecular rearrangement:
    i. Preparation of o-chlorobenzoic acid from phthalic anhydride
    ii. Preparation benzilic acid from benzaldehyde
    iii. Preparation of o-hydroxy benzophenone via Fries rearrangment
    iv. Prepartion of benzanilide from benzophenone oxime.
4. Grignard reaction: Prepearation of triphenyl carbinol
5. Preparation of luminol from phthalic anhydride
6. Preparation of paracetomol.
7. Synthesis of isoxazolines and pyrazolines via 1,3-dipolar cycloadditions.
8. Synthesis of malemides and pthalimides using microwave techniques

9. Synthesis of benzophenone derivatives via Fries rearrangement.
10. Solvothermal synthesis
11. Synthesis of tetralones starting from aryl aldehydes.
12. Synthesis of metachloroiodobenzene from dinitrobenzene

OC3.41 Soft Core: Organic Chemistry Practical – Isolation of natural products

[48 hrs]

1. Fractional crystallization: separation of mixture of naphthalene and biphenyl
2. Fractional distillation: Separation of mixture of hexane and toluene.
3. Azeotropic distillation and removal of water.
4. Thin layer chromatography: Separation of plant pigments
5. Column chromatography: Separation of mixture of o & p-nitro anilines
6. Paper chromatography: Separation of amino acids
7. Isolation of piperine from pepper
8. Isolation of caffeine from tea
9. Isolation of cysteine from hair
10. Isolation of hesperidiene from orange peal
11. Isolation of azeleic acid from castor oil
12. Isolation and spectroscopic characterization of Lycopene
13. Isolation of lipids from egg yolks
14. Extraction of nicotine from Tobacco Leaves

References

1. Manual of Organic Chemistry – Dey and Seetharaman
2. Natural Products Chemistry by Raphel Ikhan
3. Modern experimental organic chemistry by John H. Miller and E. F. Neugil, p 289.

OC3.42 Soft Core: Lipids, Porphyrins, anthocyanins and flavonoids

Unit I

Lipids: Nomenclature, classification, purification, structure and synthesis of fatty acids, phospholipids, sphingolipids. Biological importance of lipids (Lecithin, sphingolipids, oils and fats).

Prostaglandins: Introduction, classification and biological importance of PG's. Constitution of PGE_1. Synthesis of PGE & F series.

Terpenoids: Introduction, classification and general methods of structural elucidation. Biological importance of terpenoids. Chemistry of pinene, camphor, caryophyllene, santonin, abietic acid and vetivone.

(16 HOURS)

Unit II

Porphyrins: Introduction, structure and biological functions of haemin. Vitamin B_{12} : structure and as coenzyme in molecular rearrangement reactions; Chlorophyll: structure and biological importance.

Flavonoids and Isoflavonoids: Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Kaempferol, Quercetin, wedelolactone, Butein, Daidzein.

Biosynthesis of flavonoids and isoflavonoids: Acetate Pathway and Shikimic acid Pathway. Biological importance of flavonoids and isoflavonoids

Carotenoids: Methods of isolation. Structure elucidation and synthesis of β-carotene. Structural relationship of α-, β- and γ-carotenes.

(16 HOURS)

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2. K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.
3. Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.
4. Encyclopedia of Chemical technology – Kirck-Othmer series
5. Harper's review of biochemistry – P. W. Martin, P. A. Mayer & V. W. Rodfwell, 5th edition, Maurzen Asian Edition, California, 1981.

OC3.43 Soft Core: Polymer chemistry

Polymers

Importance of polymers. Basic concepts: Monomers, repeat units, degree of polymerization, linear, branched and network polymers. Classification and nomenclature of polymers. Properties of polymers (brief explanation of molecular weight, glass transition temperature - T_g , solubility and visco-elasticity).

Methods of polymerization-addition and condensation polymerization, ionic and free-radical polymerization processes, polymerization with complex catalysts (Ziegler-Natta catalysis), co-polymerization and their mechanisms. Techniques of polymerization - bulk, emulsion etc.,

Stereospecific Polymers - Preparation and significance- classification of polymers based on physical properties - Thermoplastics - Thermosetting plastics - Fibers and elastomers -.General applications.

Preparation of Polymers - Preparation of Polymers based on different types of monomers -Industrial applications-olefin polymers - Diene polymers- nylons - Glyptal resins - Urea-formaldehyde, phenol - formaldehyde and melamine resins - Epoxy resins - Ion exchange resins, polycarbonates and its applications.

Rubber: Natural and synthetic rubbers, structure elucidation of natural rubber.

Polymer degradation reactions: Thermal, oxidative and radiative processes.

Synthesis and properties of Buna-S and butyl rubbers.

Conducting Polymers: Polyanilines

Polymer Characterizations: Isolation and purification of polymers-Fractional precipitation, partial dissolution, gradient elution and Gel permeation chromatography. Principles of determination of molecular weights-End group analysis, viscosity, light scattering, osmometry, cryoscopy, ebulliometry and ultracentrifugation method. Thermal characterization- Isothermal gravimetric analysis, Thermogravimetry , Differential Thermal Analysis and Differential Scanning Calorimetry. Mechanical properties-Tensile, Impact and Flexural strengths. Flammability and Limiting Oxygen Index.

Characterization and structural analysis of polymers - IR, NMR, ESR, X-Ray Diffraction and Scanning Electron Microscopic Methods.

[32 hrs]

REFERENCES

1. Text book of polymer Science. F.W. Billmeyer, Jr., John Wiley. London (1994).
2. Polymer Science. V. R. Gowrikar, N. V. Vishwanathan and J. Srreedhar, Wiley Eastern, New Delhi (1990).
3. Fundamentals of Polymer Science and Engineering. A. Kumar and S.K. Gupta. Tata –McGraw Hill New Delhi (1978).
4. Polymer Characterization, D. Campbell and J. R. White, Chapman and Hall, New York.
5. Fundamental Principles of Polymer materials, R. L. Rosen, John Wiley and Sons, New York.
6. Infrared spectroscopy by R. T. Conley, Allyn and Bacon, Inc.
7. Functional monomers and polymers by K. Takemoto, Y. Inaki and P. M. Ottenbrite, Marcel dekker, Inc., New York, 1987.
8. Progress in Inorganic Chemistry, by Stephen J. Lippard, John Wiley and Sons, Inc.,New York, vol. **20**, 1976.

Open elective:OC 3.51 Role of Chemistry in Animal Health and Growth

UNIT I

Citric acid cycle-Krebs cycle, Uric acid formation; Antinutritional factors present in feed components and degradation methods, Antioxidants- Role of antioxidants in animals, Mechanism of actions; Proteins-Metabolism of proteins in animals-Sources of proteins for animals, Protein deterioration due to stress, Role of amino acids for growth and development; Toxins- Toxins found in feed ingredients, Origin of toxins, Effects of toxins on animal productivity, Adsorption techniques for irreversible toxin binding. Lipids-Storage of lipids in animals, Structural lipids in membranes, Oxidation of fatty acids, Metabolism of lipid in animals. **16 hrs**

UNIT II

Dairy Chemistry-Rumen metabolism, role of ruminants in global warming; Antibiotics-Role of antibiotics in animal growth, commonly used antibiotics, structure & activity relationship, Implications of use of antibiotics in the food chain; Enzymes-Role of enzymes in animal growth & development, enzymes kinetics, regulatory enzymes; Probiotics-Role of probiotics in animal growth & development; Vitamins & minerals-Role of vitamins in animals, Importance trace minerals & their role in animal nutrition **16 hrs**

References

Dairy chemistry and animal nutrition, V.K. Chhozllani

1. Principles of Animal nutrition and Feed technology Part I and II, D.V Reddy
2. Feeds and Principles of animal nutrition, G.C.Banerjee.
3. Source book of flavors, Heath.

Open elective: OC3.52 Chemistry of natural products

Fats and oils: Isolation, purification, structure and biological importance.

Essential oils: Source, constituents, isolation & uses.
Phospholipids: Isolation, structure and biological significance of lecithin and cephalin
Sphingolipids: Examples with structure and biological importance.
Prostaglandins: Classification, source, structure, nomenclature and its significance.
Terpenoids: Introduction, classification, source, structure of biologically important terpenoids (antihelmentic, anticancer terpenoids, etc)
Steroids: Structure and biological significance of cholesterol, bile acids, androgen, estrone, progesterone and anabolic steroids.
Flavonoids and Isoflavonoids: Occurrence, nomenclature, structure and their biological importance.
Porphyrins: Introduction, structure and biological functions of haemin. Vitamin B_{12} : structure and as coenzyme in molecular rearrangement reactions; Chlorophyll: structure and biological importance.
Carotenoids: Methods of isolation, structure and their biological importance..
Alkaloids: Introduction, source, structure and biological significance of vinca alkaloids, chincona alkaloids, LSD, reserpine, morphine, codeine, strychnine, brucine, nicotine, yohimbine,
Vitamins: structure and biological functions of vitamin A, C, D, E, K, biotin, pyridoxine, thiamine. [32 hrs]

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2 Essentials of physiological chemistry – Anderson, John Wiley & Sons, New York, 1953.
3 K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.
4 Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.
5 Encyclopedia of Chemical technology – Kirck-Othmer series
6 Harper's review of biochemistry – P. W. Martin, P. A. Mayer & V. W. Rodfwell, 15th edition, Maurzen Asian Edition, California, 1981.

OC4.1 Hard Core: Medicinal chemistry –I

Synthetic drugs: Introduction, chemotherapy, pharmacodynamies, metabolites and antimetabolities, agonists and antagonists. Pharmaco kinetics theories of drug action.

Anti pyretics: Aspirin, parcetamol, phenacetin, novalgin

Stimulants: Caffeine

Antineoplastic Agents: Introduction, cancer chemotherapy, role of alkylating agents and antimetabolites in treatment of cancer. Mention of carcinolytic antibiotics and mitotic inhibitors. Synthesis of mechlorethamine, cyclophosphamide, melphalan, mustards and mercaptopurine. Recent development in cancer chemothery – podophyllotoxin and its derivatives, taxol.
Cardiovascular drugs: Introduction, cardiovascular diseases, drug inhibitors of peripheral symphatetic function, central intervention of cardiovascular output direct acting arteriolar dilators,

synthesis of dithiazem, verapamil, methyldopa, atenolol, oxprenolol, antihypertensive drugs, lipid lowering agents (atorvastatin, statin derivatives).
Local antiinfective drugs: Introduction and general mode of action, structure of sulphonamides, forazalidione, nalidixic acid, ciprofloxacin, norfloxicin, dapsone, aminosalicylic acid, isoniazid, ethionamide, ethambutal, fluconazole, griseofulvin, chloroquine and primoquine.

Psychoactive drugs: Introduction, neurotransmitters, CNS depressants, general anesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazapines, buspirone, neurochemistry of mental diseases, antipsychotic drugs, the neuroleptics, antidepressants, butyrophenones, serendipity and drugs development, stereochemical aspects of psychotropic drugs, structure of benzodiazepine drugs (diazepam, oxazepam, chlorazepam), Recent development in CNS drugs -.theroxetine, carbanozapine, sertalins, cetalopram.

(48 HOURS)

References;

1. Introduction to medicinal chemistry, A Gringuage, Wiley-VCH.
2. Wilson and Gisvold's Text Book of organic medicinal and pharmaceutical chemistry, Ed Robert F. Dorge.
3. An introduction to drug design, S.S. Pandey and J.R. Dimmock, New Age International.
4. Burger's medicinal chemistry and drug discovery, Vol-1 (Chapter-9 and Ch-14), Ed. M.E. Wolff, John Wiley.
5. Goodman and Gilman's pharmacological basis of therapeutics, McGraw-Hill.
6. The organic chemistry of drug design and drug action, R. B. Silverman, Academic Press.
7. Strategies for organic drug synthesis and design, D. Lednicer, John Wiley.
8. Medicinal Chemistry, A Kar, Wiley, 2000.
9. Synthetic drugs, G. R. Chatwal, Himalaya, New Delhi, 1995.
10. Comprehensive organic chemistry, Vol. 5 (Antibiotics), D.H.R. Barton, W. D. Ollis, Pergamon Press, NY, 1979.
11. Instant Notes Medicinal Chemistry, P Graham, Viva, New Delhi, 2002.

OC4.2 Hard Core:Dissertation

OC4.31 Soft core: Estimations [48 hrs]

1. Equivalent weight of acids by silver salt method
2. Iodine value of n oil and fats by chloramine-T
3. Saponification value of an oil or fats
4. Estimation of sugars by Fehlings method
5. Determination of enol content by Meyer’s method
6. Determination hydroxyl groups
7. Determination of vicinal hydroxyl groups
8. Estimation of ketones by haloform reaction
9. Estimation of sugars by Bertrand’s method
10. Estimation of nitro groups
11. Estimation of amino acids
12. Estimation of ketones by oxime method

Reference Books:

1. A Text book of practical organic chemistry – A. I. Vogel Vol. I
2. Practical Organic Chemistry – Mann & Saunders
3. Manual of Organic Chemistry – Dey and Seetharaman
4. An introduction to practical organic chemistry – Robert, Vingrove etc.
5. Semimicro qualitative organic analysis by Cheronis, Entrikin and Hodnet
6. R. K. Bansal, Laboratory Manual of Organic Chemistry, New AGE International (P) Ltd. London, 3rd edition, 1996
7. N. K. Visno, Practical Organic Chemistry, New AGE International (P) Ltd. London, 3rd edition, 1996

4.32: Soft core: Medicinal chemistry-II

Unit I

Antibiotics: Introduction, cell wall biosynthesis, inhibitors, β-lactum group of antibiotics - Penicillin, Ampicillin and Amoxycillin, amoxicillin, chloramphenicol, cephalosporin analogs, tetracycline, streptomycin, Erythromycin analogs and Ciprofloxacin.

ANTIPROTOZOAL DRUGS – Metronidazole

ANTIHELMENTHICS – Mebendazole/albendazole

ANTIVIRALS - Azothymidine(AZT), Acyclovir

ANTITUBERCULAR DRUGS - Ethambutol

ANTIFUNGALS - Griseofulvin

AUTACOIDS: **Definition, Occurrence, Isolation, Classification, Stereochemical Studies, Synthesis, Biological and Therapeutic functions**

Histamines :Histamine antagonists, -H1 blockers - Chlorpheneramine, -H2 blockers - Ranitidine

5-HT Seratonin, 5-HT receptor antagonist – Metaclopramide

Computational chemistry and combinatorial chemistry.

(16 HOURS**)**

Unit II

NATURAL PRODUCTS AS LEADS FOR NEW DRUGS

Occurrence, Structure and therapeutic uses (Synthesis Not Expected) of

A) Drugs acting on Central Nervous System - i) alkaloids (Heroin, pethidine)
i). Cannabinoids [Δ9 cannabinol (THC)

B) Neuromuscular Blocking Agents – Curare, Decamethonium

C) Anticancer Drugs - Vinca Alkaloids (Vincristin and vinblastine), Taxol and Taxotere, Podophyllotoxin, Etoposide, Teniposide.

D) Cardiovascular Drugs-Lovastatin, Simvastatin, Pravastatin, Dicoumarol, Warfarin and Khellin

References;

1. Introduction to medicinal chemistry, A Gringuage, Wiley-VCH.

2. Wilson and Gisvold's Text Book of organic medicinal and pharmaceutical chemistry, Ed Robert F. Dorge.
3. An introduction to drug design, S.S. Pandey and J.R. Dimmock, New Age International.
4. Burger's medicinal chemistry and drug discovery, Vol-1 (Chapter-9 and Ch-14), Ed.M.E. Wolff, John Wiley.
5. Goodman and Gilman's pharmacological basis of therapeutics, McGraw-Hill.
6. The organic chemistry of drug design and drug action, R. B. Silverman, Academic Press.
7. Strategies for organic drug synthesis and design, D. Lednicer, John Wiley.
8. Medicinal Chemistry, A Kar, Wiley, 2000.
9. Synthetic drugs, G. R. Chatwal, Himalaya, New Delhi, 1995.
10. Comprehensive organic chemistry, Vol. 5 (Antibiotics), D.H.R. Barton, W. D. Ollis, Pergamon Press, NY, 1979.
11. Instant Notes Medicinal Chemistry, P Graham, Viva, New Delhi, 2002.

OC4.33 Soft Core: Dyes & Insecticides

Unit I

Dyes: Introduction, modern theories of colour and chemical constitution. A general study of the following: Direct azo dyes (congored, rosanthrene O, procion dyes), acid azo dyes (ponceau2R, Naphthol blue black 6B), basic azo dyes (chrysoidin G, bismark brown), developed dyes, mordent dyes, vat dyes, disperse dyes, fibre reactive dyes, sulphur dyes and solvent dyes. Fluoroscent brightening agents (tinopal B.V), cyanine dyes (classification, application in photography, quinoline blue and sensitol), chemistry of colour developer, and instant colour processes.
Synthesis and applications of malachite green, rhodamine-B, phenolphthalein and methyl orange.
Triphenylmethane dyes: crystal violet, pararosaniline, aurin, chromeviolet.
Application of dyes: i. photography, ii. Biological studies.

(16 HOURS)

Insecticides: Introduction, classification, mode of action and synthesis of chlorinated insecticides (DDT, chlordane, heptachlor and hexachlorocyclohexane), Naturally occurring insecticides-pyrethroids-natural pyrethrins-isolation and structures, synthetic pyrethroids, allethrin, cypermethrin, phenvalerate.
Organophosphorous insecticides: Malathion, parathion, DDVP, diazenon.
Carbamate insecticides: Sevin, carbofluron, aldicab, beygon.
Insect Pheromones: Introduction, classification, use in insect pest control. Synthesis of disparlure, faranol, grandisol, brevicomin and bomykol.
Fungicides: Introduction, Inorganic & organic fungicides, Systemic fungicides-types & examples.
Herbicides: Introduction, study of sulfonyl ureas, heterocyclic sulfonamides, heterocyclic amines, dihydropyrano[2,3-*b*]pyridylimidazolinones,pyrrolopyridylimidazolinones,1,2,4-triazine-3,5-diones, hydroxyoxazolidinones & hydroxypyrrolidinones, pyridine herbicides & 1,3,4-oxadiazoles. Mechanism of action and toxicities of insecticides, fungicides and herbicides.

[16 hrs]

References

1. A Text Book of Fertilizers, Ranjan Kumar Basak.
2. Agronomy - Theory & Digest, Bidhan Chandra, Krishi Vishwavidyalaya, Mohanpur.
3. Fundamentals of Agronomy, S.S.Cheema, K.Dhaliwal, T.S. Shota, Punjab Agricultural University.
4. Principles and Practices of Agronomy, Shri.S.S.Singh, Allahabad Agricultural Institute.

5. Principles of Agronomy, T.Yellamanda Reddy, Agricultural Research Station, Anantapur.
6. Fertilizers, Organic Manures & Biofertilizers–A Product Quality Guide for Major & Micronutrients, HLS Tandon, Fertilizer Development and Consultation Organisation, New Delhi.
7. Handbook on Fertilizer Technology, Bham Swaminathan & Manish Goswami, The Fertilizer Association of India, New Delhi.
8. Outlines of Chemical Technology, Charles E. Dryden, Affiliated East-West Press, New Delhi.
9. Synthetic Organic Chemistry, G. R. Chatwal, Himalaya Publishing House.
10. Synthesis and Chemistry of Agrochemicals, Vol I & II, ACS, Wahington.
11. Chemistry of Pesticides, K H Buchel.
12. Advances in Pesticide Formulation Technology, ACS.
13. Chemicals for Crop Protection and Pest Managements, M B Green, G.S. Hartley West, Pergamon.
15. Chemistry of Insecticides and Fungicides, Sree Ramulu, Oxford & IBH, 1985.

Open elective: OC4.41 Applications of synthetic products:

Unit I

Dyes: Colour and constitution, classification, method dyeing and their industrial importance.
Drugs: Basic concepts, classification, structures of well known drugs and their medicinal properties.
Polymers: Introduction, biodegradable and non-biodegradable polymers and their industrial importance, plastics (uses and effects on enviornment), natural and synthetic rubbers, polyamides and poly esters like nylon, decron, terelyne.Thermoplastics- poly carbonates, poly acrylates in lens applications, polyurethanes and conducting polymers.
Soaps and detergents: Production and their cleansing action.
Liquid crystals and their applications.

(16 **HOURS**)

Unit II

Surfactants:
Cosmetics: Detailed study of formulations and manufacturing of cream and lotions, lipstick and nail polish, shampoos, hair dyes and tooth pastes.
Flavours: Natural flavouring materials & classification
Sweetners: Natural and synthetic sweetners.
Insecticides: Introduction, classification, applications and their effect on environment.
Pheromones: Introduction, Sources, biological importance.
Explosives: Introduction, RDX, Gun powder.

(16 **HOURS**)

References

1. I. L. Finar, Organic Chemistry, ELBS Longmann, Vol. I & II, 1984.
2 K. Albert, L. Lehninger, D. L. Nelson, M. M. Cox, Principles of Biochemistry, CBZ publishers, 1st edition, New Delhi, 1993.
3 Harper's Biochemistry, Ed. R.Harper, 22nd edition, Prentice Hall Press, New York, 1990.
4 Encyclopedia of Chemical technology – Kirck-Othmer series
5 Harper's review of biochemistry – P. W. Martin, P. A. Mayer & V. W. Rodfwell, 15th edition, Maurzen Asian Edition, California, 1981.

Open elective: OC 4.42 CHEMISTRY OF SOIL & FERTILIZERS

UNIT I

Soil Chemistry: Essential elements for plants, Function of essential elements- Nitrogen, Phosphorus, Potassium, Calcium, Magnesium, Sulphur, Iron, Zinc, Molybdenum, Manganese, Copper, Boron, Chlorine, Sodium, Cobalt, **Forms of nutrients used by plants-**Ion Exchange in soils-Cation exchange, Cation exchange capacity (CEC), Anion exchange. **Nitrogen in Soils-** Forms of Nitrogen in soils, Forms of Nitrogen absorbed by plants, Nitrogen content of soils, Mineralization of organic nitrogen compounds, Gains of nitrogen in soils, Losses of nitrogen from soils, **Phosphorus in soils-**Forms of phosphorus in soils, Forms of phosphorus absorbed by plants, Gains of phosphorus in soils, Losses of phosphorus from soils, Reactions of phosphorus in soils, **Potassium in soils-**Forms of potassium in soils, Form of potassium absorbed by plants, Gains of potassium in soils, Losses of potassium from soil solution, Potassium availability to plants. Analysis of soil-moisture, pH, total nitrogen, phosphorous, silica, lime, magnesia, manganese, sulphur, alkali salts and micronutrients. **[16 hrs]**

UNIT II

Fertilisers: Introduction, Essential plant Nutrients, Classification of Essential Nutrients, Primary Nutrients, Secondary Nutrients, Micronutrients, Macronutrients, **Classification of Fertilizers-** Straight Fertilizers, Compound/Complex Fertilizers, Fertilizer Mixtures, **Feed Stock/ Raw materials-** Nitrogenous Fertilizers, Phosphatic Fertilizers, Potassic Fertilizers, **Manufacture and general properties of Fertilizer products-** Intermediates- Ammonia, Nitric Acid, Sulphuric Acid, Phosphoric Acid, Nitrogenous Fertilizers- Ammonium Sulphate, Ammonium Nitrate, Calcium Ammonium Nitrate, Calcium Nitrate, Ammonium Chloride, Urea, Phosphatic Fertilizers, Ground Rock Phosphate, Single Superphosphate, Triple Superphosphate, Potassic Fertilizers- Potassium Chloride (Muriate of Potash), Potassium Sulphate (Sulphate of Potash), Potassium Nitrate, Complex Fertilizers- Ammonium Phosphate Sulphate, Ammonium Phosphates, Mono Ammonium Phosphate (MAP), Di-Ammonium Phosphate (DAP), Nitrophosphates, Urea Ammonium Phosphates, NPK Complex Fertilizers, Fertilizer mixtures- Physical Mixtures, Granulated Mixtures. **[16 hrs]**

References

1. A Text Book of Fertilizers, Ranjan Kumar Basak.
2. Agronomy - Theory & Digest, Bidhan Chandra, Krishi Vishwavidyalaya, Mohanpur.
3. Fundamentals of Agronomy, S.S.Cheema, K.Dhaliwal, T.S. Shota, Punjab Agricultural University.
4. Principles and Practices of Agronomy, Shri.S.S.Singh, Allahabad Agricultural Institute.
5. Principles of Agronomy, T.Yellamanda Reddy, Agricultural Research Station, Anantapur.
6. Fertilizers, Organic Manures & Biofertilizers–A Product Quality Guide for Major & Micronutrients, HLS Tandon, Fertilizer Development and Consultation Organisation, New Delhi.
7. Handbook on Fertilizer Technology, Bham Swaminathan & Manish Goswami, The Fertilizer Association of India, New Delhi.
8. Outlines of Chemical Technology, Charles E. Dryden, Affiliated East-West Press, New Delhi.
9. Synthetic Organic Chemistry, G. R. Chatwal, Himalaya Publishing House.