

M. Sc. IN CHEMISTRY

Semester I

Code	Course Title	L	T	S	C
CY 1101	Physical Chemistry – 1	4	0	0	4
CY 1102	Inorganic Chemistry – 1	4	0	0	4
CY 1103	Organic Chemistry – 1	4	0	0	4
CY 1104	Nuclear, Analytical and Environmental Chemistry	4	0	0	4
CY 1151	Basic Physical Chemistry Laboratory	0	0	4	2
CY 1152	Water Analysis and Qualitative & Quantitative Analysis of Metal Ions	0	0	6	3
CY 1153	Organic Laboratory Processes and Qualitative Analysis	0	0	6	3
CY 1154	Comprehensive viva				1

Semester II

Code	Course Title	L	T	S	C
CY 2101	Physical Chemistry – 2	4	0	0	4
CY 2102	Inorganic Chemistry – 2	4	0	0	4
CY 2103	Organic Chemistry – 2	4	0	0	4
CY 2104	Biochemistry	4	0	0	4
CY 2151	Kinetic and Electrochemical Analysis	0	0	6	3
CY 2152	Quantitative Inorganic Analysis of Alloys	0	0	4	2
CY 2153	Organic Synthesis & Isolation of Natural Products	0	0	6	3
CY 2154	Comprehensive viva				1

Semester III

Code	Course Title	L	T	S	C
CY 3101	Physical Chemistry – 3	4	0	0	4
CY 3102	Inorganic Chemistry – 3	4	0	0	4
CY 3103	Organic Chemistry – 3	4	0	0	4
CY 3104	Instrumental Method of Analysis of chemical compounds & Computational chemistry	4	0	0	4
CY 3151	Spectrophotometric Analysis	0	0	6	3
CY 3152	Preparation, Separation & Characterization of Inorganic & Coordinate Compounds	0	0	6	3
CY 3153	Separation of Organic Compounds using Chromatographic Techniques	0	0	4	2
CY 3154	Comprehensive viva				1

Semester IV

Special Papers for Physical/Inorganic/Organic Chemistry

Code	Course Title	L	T	S	C
*****	Elective -I	4	0	0	4
*****	Elective -II	4	0	0	4
*****	Elective -III	4	0	0	4
*****	Elective-IV	4	0	0	4
CY 4151	Project Work	0	0	14	7
CY 4152	Seminar and Viva-voce				2

Electives

Sl. No.	Subject Code	Name of the Subject
For Physical Chemistry Specialization (Group A)		
01	CY 9111	Advanced Physical Chemistry -1
02	CY 9112	Advanced Physical Chemistry -2
03	CY 9113	Advanced Physical Chemistry -3
04	CY 9114	Advanced Physical Chemistry -4
For Inorganic Chemistry Specialization (Group B)		
05	CY 9121	Advanced Inorganic Chemistry -1
06	CY 9122	Advanced Inorganic Chemistry -2

07	CY 9123	Advanced Inorganic Chemistry -3
08	CY 9124	Advanced Inorganic Chemistry -4
For Organic Chemistry Specialization (Group C)		
09	CY 9131	Advanced Organic Chemistry -1
10	CY 9132	Advanced Organic Chemistry -2
11	CY 9133	Advanced Organic Chemistry -3
12	CY 9134	Advanced Organic Chemistry -4

Candidates have to choose any one group from the above list as their subject of specialization.

DETAILED SYLLABUS OF M. Sc. IN CHEMISTRY

SEMESTER I

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 1101	Physical Chemistry - 1	4-0-0	4	Dr. B.P. Mukhopadhyay Dr. D.Sukul Dr. S.S. Panja
Unit 1: Quantum Chemistry (15 L): Fundamentals of quantum mechanics: operators, functions, basic postulates, time-independent Schrödinger equation, particle in a box of various dimensions, rigid rotation in a plane, spherical harmonic functions, rotation of diatomic molecule, harmonic oscillator, electronic wave function of hydrogen and hydrogen like atom, magnetic effect on electron movement, many electron theory, raising and lowering operators, Pauli exclusion principle, time-dependent Schrödinger equation.				
Suggested books: 1. Quantum Chemistry by I. N. Levine (Pearson). 2. Molecular Quantum Mechanics by P. W. Atkins and R. S. Friedman (Oxford University Press).				
Unit 2: Group Theory (15 L): Symmetry and point groups, symmetry operation, irreducible representation and character table. GOT, SALC: Their applications: Representation of molecular orbitals and shape, chemical applications, selection rules in spectroscopy, crystal field theory, molecular orbital theory, spin-orbit coupling, stretching frequencies in IR and Raman spectroscopy. Application in pericyclic reactions: Woodward-Hoffman rules.				
Suggested books: 1. Chemical applications of group theory by F. A. Cotton (Wiley Interscience Publication).				
Unit 3: Chemical Thermodynamics (15 L): Second and third law of classical thermodynamics and their applications. Thermodynamics of ideal and non ideal binary solutions, free energy and entropy of mixing, partial molar quantities and their determination, fugacity and its determination, Gibbs-Duhem equation, Duhem- Margules equation, equilibrium constant, temperature dependent equilibrium constant, excess functions for non-ideal solutions and their determination. Experimental determination of activity coefficient of electrolytes and non electrolytes.				
Suggested books: 1. Physical Chemistry by P. W. Atkins (Oxford University Press). 2. Physical Chemistry by P. C. Rakshit (Sarat Book Distributors). 3. Physical Chemistry by T. Engel and P. Reid (Pearson).				

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 1102	Inorganic Chemistry - 1	4-0-0	4	Dr. M. Maji Dr. T. K. Saha

Unit 1: Valence Theories (20 L):

Atomic orbitals, molecular orbitals, valence bond theory, resonance, hybridization, molecular orbital theory, variation method, LCAO and Hückel approximation applied to H_2^+ and H_2 type systems, σ and π MO's (ethylene, allyl systems, butadiene etc.).

Comparative study of the application of VB and MO methods to diatomic species, MO of polyatomic molecules.

Perturbation: electronegativity, geometrical and intermolecular; Walsh diagram, configuration interaction, orbital construction for H_n type systems, isolobal analogy.

Suggested books:

1. Advanced Inorganic Chemistry by F. A. Cotton and G. Wilkinson (Wiley Interscience).
2. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi (Pearson Education India).
3. Inorganic Chemistry by C. Housecroft and A. G. Sharpe (Pearson Education India).
4. Concepts and Models of Inorganic Chemistry by B. E. Douglas, D. H. McDaniel, J. J. Alexander (John Wiley and Sons).
1. 5. Shriver and Atkins Inorganic Chemistry by P. W. Atkins, T. Overton, J. Rourke, F. Armstrong and M. Weller (Oxford University Press).

Unit 2: Coordination Chemistry: Bonding, Stereochemistry and Reactivity (20 L):

Bonding in coordination compounds: Crystal field theory, ligand field theory, molecular orbital theory.

Application of bonding theory: thermodynamic properties, variation of ionic radii, lattice energy and hydration energy; magnetic properties, spin-crossover phenomena, spectral properties, spectrochemical series, Nephelauxetic series.

Stereochemistry of complexes: Structural distortion and lowering of symmetry, electronic, steric and Jahn-Teller effects on energy levels, absolute configuration of complexes, stereoselectivity and conformation of chelate ring, structural equilibria.

Stability of complexes and determination of stability constants (slope ratio and mole ratio methods). Kinetic properties: lability of complexes, elementary idea on reaction mechanism

of coordination complexes in solution. Outer-sphere and inner-sphere reactions, cross-reaction and Marcus-Hush theory.

Suggested books:

1. Advanced Inorganic Chemistry by F. A. Cotton and G. Wilkinson (Wiley Interscience).
2. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi (Pearson Education India).
3. Inorganic Chemistry by C. Housecroft and A. G. Sharpe (Pearson Education India).
4. Concepts and Models of Inorganic Chemistry by B. E. Douglas, D. H. McDaniel, J. J. Alexander (John Wiley and Sons).
5. Shriver and Atkins Inorganic Chemistry by P. W. Atkins, T. Overton, J. Rourke, F. Armstrong and M. Weller (Oxford University Press).
2. 6. Concise Inorganic Chemistry by J. D. Lee (Wiley).

Unit 3: Cage and Cluster Compounds (10 L):

Bonding in Boranes, styx numbers, synthesis and reaction of boron hydrides, carborane, borazine and boron nitride complexes. Cluster and catalysis, molecular structure of cluster, stereochemical rigidity of clusters, electronic structure of clusters with pi-acid ligands, capping principle, halide cluster, synthesis of metal clusters.

Suggested books:

1. Advanced Inorganic Chemistry by F. A. Cotton and G. Wilkinson (Wiley Interscience).
2. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi (Pearson Education India).
3. Concepts and Models of Inorganic Chemistry by B. E. Douglas, D. H. McDaniel, J. J. Alexander (John Wiley and Sons).
3. 4. Shriver and Atkins Inorganic Chemistry by P. W. Atkins, T. Overton, J. Rourke, F. Armstrong and M. Weller (Oxford University Press).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 1103	Organic Chemistry - 1	4-0-0	4	Dr. S.C. Moi Dr. J. Chakraborty Dr. U. Adhikari

Unit 1: Reactive Intermediates with Allied Organic Reaction Mechanism (15 L):

Classical and non-classical carbocations and carbanions; radicals, radical cations, radical anions, carbenes, arenas and nitrenes. General methods of generation, detection, stability, reactivity and structure of intermediate. Nomenclature of carbocation and bridged ring system.

Suggested books:

1. Reactive intermediate Chemistry by R. A. Moss, M. S. Platz and M. Jones (Wiley Interscience).
2. Advanced Organic Chemistry (A&B) by F.A. Carey and R. J. Sundberg (Springer).
3. Advanced Organic Chemistry by J. March (Wiley).
4. Organic Chemistry (Vol. 1&2) by I. L. Finar (Pearson India).
5. Advanced Organic Chemistry: Reaction Mechanism by R. Bruckner (Elsevier).

Unit 2: Stereochemistry (20L):

Molecular symmetry and chirality; stereoisomerism, definitions, classifications, configurational nomenclature, configuration and conformation.

Relative and absolute configuration; determination of relative configuration: (i) chemical correlation not affecting the chiral atom, (ii) chemical correlation affecting bonds to the chiral atom in a 'known way' (iii) correlation by asymmetric synthesis: Horeaus rule, Prelog's rule, Cram's rule (Felkin modification), and Sharpless rule, (iv) Physical methods: NMR, MS, IR, dipole moment, ORD, CD.

Conformation of acyclic and cyclic system (3-8 membered rings), decalin, octalene, and bridged bicyclo systems; stability, reactivity and mechanism, Cortin Hammett principle and Winstein-Elieil equation (special emphasis on 5 and 6 membered rings with and without heteroatoms like O, S and N).

Suggested books:

1. Stereochemistry of Organic Compounds by E. L. Eliel and S. H. Wilen (Wiley).
2. Organic Chemistry by Clayden, Warren, Wothers and Greeves (Oxford University Press).
3. Advanced Organic Chemistry (A&B) by F.A. Carey and R. J. Sundberg (Springer).
4. Advanced Organic Chemistry by J. March (Wiley).

Unit 3: Amino Acids and Protein Chemistry (15L):

Introduction, classification according to their composition. Different methods of peptide synthesis. Different methods to determine the composition of peptides and proteins (amino acid analysis). Primary and secondary structure of proteins. Denaturation of proteins. Different methods of molecular weight determination.

Suggested books:

1. Organic Chemistry (Vol. 1&2) by I. L. Finar (Pearson India).
2. Lehninger: Principles of Biochemistry by D. Nelson and M. Cox (Macmillan).
3. Fundamentals of Biochemistry by D. Voet and J. G. Voet (Wiley).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 1104	Nuclear, Analytical and Environmental Chemistry	4-0-0	4	Dr. A. K. Patra Dr. R.N. Saha

Unit 1: Nuclear Chemistry (15L):

Mass-energy relation of atomic nuclei, concept of nuclear angular momentum, magnetic dipole moment, nuclear binding energy and stability of atomic nucleus. Liquid drop model, binding energy equation and its application. Separation of radioisotopes. Radioactive decay and equilibrium, Q value, cross section, types of reactions, nuclear reactor and its design, chemical effects of nuclear transformations, fission and fusion, fission products and fission yields. Calculation of fission probability by liquid drop model. Shell model, nuclear magic number, prediction of nuclear spin from shell model, nuclear isomerism

Radioactive techniques: tracer technique, neutron activation analysis, counting techniques such as G.M. ionization and proportional counter. NQR-principle, Mossbauer-introduction, Doppler effect, isomer shift, typical spectra of iron and tin compounds.

Suggested books:

1. Concise Inorganic Chemistry by J. D. Lee (Wiley).
2. General and Inorganic Chemistry by R. Sarkar (Part I) (New Central Book Pvt. Ltd.).
3. Elemental Inorganic Chemistry by R. L. Dutta (Part I) (New Book Stall)

Unit 2: Analytical Chemistry (20L):

Liquid-Liquid extraction: Principle, operation technique, successive extraction, different inorganic extraction systems, various factors, counter-counter distribution.

Chromatography: general principles, methods and applications of column (adsorption and partition), paper chromatography, paper electrophoresis, thin layer chromatography, gas chromatography, high performance liquid chromatography, supercritical fluid chromatography, size-exclusion chromatography and ion chromatography.

Thermal methods: introduction, thermogravimetry, differential thermogravimetry, differential thermal analysis, differential scanning calorimetry and thermometric titration and their applications in numerous chemical systems. Electrochemical methods: introduction, membrane electrodes, diffusion controlled process; polarography, Ilkovic

equation, current-voltage diagram and voltametry (CV & DPV).

Suggested books:

1. Fundamentals of Analytical Chemistry by D. A. Skoog and D. M. West (Cengage Learning).

Unit 3: Chemistry of the Environment (15L):

Chemical aspects of air, water and soil pollution, chemistry of photochemical and sulphurous smog, stratosphere-chemistry and pollution, chemical speciation and organometallic compounds in the environment, priority and water pollutants-their effects, chemical analysis and control. Solid wastes from Industries. Radioactive solid waste disposal. Recovery and recycling. Ecological balance and planning of Industrial complexes. Reactions in living systems. Bioreactors. Biochemical process in industries. Biotechnology as low-energy, ecologically safe alternatives. Green chemistry, some recent environment disasters: Bhopal gas tragedy, Chernobyl, Three mile island etc.

Suggested books:

1. Chemistry for Environmental Engineering by C. N. Sawyer, P. L. McCarty and G. F. Parkin (McGraw-Hill).

2. Fundamentals of Environmental Chemistry by S. E. Manahan (Lewis Publishers).

3. Atmospheric Chemistry and Physics: from Air Pollution to Climate Change by J. H. Seinfeld and S. N. Pandis (Wiley).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 1151	Basic Physical Chemistry Laboratory	0-0-4	2	Dr. D.Sukul Dr. S.S. Panja
<ol style="list-style-type: none"> 1. Determination of indicator constant by spectrophotometric method. 2. Determination of rate constant of alkaline hydrolysis of ethyl acetate, determination of activation parameters, effect of ionic strength. 3. Determination of critical solution temperature of phenol-water system. 4. Determination of amount of acetic acid adsorbed by charcoal at different concentrations of the acid and to draw the adsorption isotherm. 				
TEXT BOOKS:				
REFERENCE BOOKS:				

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 1152	Water Analysis and Qualitative & Quantitative Analysis of Metal Ions	0-0-6	3	Dr. R.N. Saha Dr. T.K.Saha
<ol style="list-style-type: none"> 1. Determination of DO, BOD, and COD of water, 2. Estimation of metals ions in mixture. Paper chromatography and Ion-exchange chromatography. 3. Qualitative and quantitative analysis of less common metal ions: Tl, Mo, Ti, Zr, Th, V, U (two metal ions in cationic and anionic forms); Insoluble oxides, sulphates and halides. 				

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 1153	Organic Laboratory Processes and Qualitative Analysis	0-0-6	3	Dr. S.C. Moi Dr. J. Chakraborty

Mixed Melting Point Determination:

Urea – Cinnamic acid mixture of various composition (1:4, 1:1, 4:1)

Distillation: Simple distillation of ethanol-water mixture using water condenser

Distillation of nitrobenzene and aniline using air condenser

Crystallization: Concept of induced crystallization, Phthalic acid from hot water (using fluted filter paper and stem less funnel), Acetanilide from boiling water, Naphthalene from ethanol, Benzoic acid from water.

Decolourization and Crystallization: Decolourization of brown sugar (sucrose) with animal charcoal using gravity filtration. Crystallization and decolourization of impure naphthalene (100 g of naphthalene mixed with 0.3 g of congo red using 1 g decolourizing carbon) from ethanol.

Sublimation (Simple and Vacuum): Camphor, Naphthalene, phthalic acid and Succinic acid.

Qualitative Analysis:

Identification of an organic compound through the functional group analysis, determination of melting point and preparation of suitable derivatives.

Separation and analysis of an organic mixture and preparation of suitable derivatives.

TEXT BOOKS:

REFERENCE BOOKS:

SEMESTER II

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 2101	Physical Chemistry - 2	4-0-0	4	Dr. B.P. Mukhopadhyay Dr. D.Sukul Dr. S.S. Panja

Unit 1: Statistical Thermodynamics (15 L):

Introduction to statistical thermodynamics, probability, ensembles and distribution laws, partition function. Comparison among Maxwell-Boltzmann, Fermi-Dirac and Bose-Einstein Statistics.

Statistical mechanics of mono, diatomic and polyatomic ideal gas-contribution of rotation, vibration and transition to partition function, electronic contribution to the specific heat of diatomic gases, solids-vibrational contribution to the specific heat of solids, Einstein-Born-Debye model. Dynamics of chemical reaction in solution-transition state theory using partition functions.

Suggested books:

1. Physical Chemistry by T. Engel and P. Reid (Pearson).
2. Statistical Mechanics: Theory and Molecular Simulation by M. E. Tuckerman (Oxford).

Unit 2: Atomic and Molecular Spectroscopy (20 L):

Quantum numbers, orbital and spin momentum of electron, Stern-Gerlach experiment, vector model of atom, atomic term symbol, atomic spectra, pure rotational and vibrational spectra of diatomic and polyatomic molecules, vibrational-rotational coupling, Raman spectroscopy of molecules, electronic spectra of molecules, spectroscopic selection rules for vibrational, electronic and Raman spectra, Introduction to resonance spectroscopy-NMR, ESR, EPR, hyperfine interaction, photoelectron spectroscopy, Auger spectroscopy, Mössbauer spectroscopy.

Suggested books:

1. Fundamentals of Molecular Spectroscopy by C. N. Banwell (Tata McGraw Hill).

2. Physical Chemistry by P. W. Atkins (Oxford University Press).

Unit 3: Electrochemistry and Electrode Kinetics (15 L):

Debye-Huckel-Onsagar theory of inter-ionic interaction, Thermodynamic of electrified interface, polarisable and non-polarisable interface, over voltage, exchange current density, derivation of Butler-Volmer equation, Tafel plot, low and high field approximation, mass transfer, charge transfer and Ohmic polarization, some redox reactions, transport property through membrane.

Suggested books:

1. Modern Electrochemistry 1, 2A & 2B by J. O. Bockris and A. K. N. Reddy (Springer).

2. Physical Chemistry by P. W. Atkins (Oxford University Press).

3. Physical Chemistry by P. C. Rakshit (Sarat Book Distributors).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 2102	Inorganic Chemistry - 2	4-0-0	4	Dr. A. K. Patra Dr. M. Maji Dr. R.N. Saha Dr. T.K.Saha

Unit 1: Chemistry of Elements and Comparative Accounts (20 L):

Periodicity and aperiodicity. Synthesis, stereochemistry, bonding and reactivity studies of various coordination compounds of transition and non-transition metals with halides, pseudohalides, aquo, hydroxo, oxo, carboxylate, amine, amide, polypyridine, azoimine, phosphine, carbonyl, nitrosyl, dioxolene, azophenols, Schiff-bases etc. and their mixed mono-, bi-, and polynuclear complexes.

A closer look at the applications of coordination molecules in different fields of chemistry and related disciplines.

Suggested books:

1. Shriver and Atkins Inorganic Chemistry by P. W. Atkins, T. Overton, J. Rourke, F. Armstrong and M. Weller (Oxford University Press).
2. General and Inorganic Chemistry by R. Sarkar (Part II) (New Central Book Pvt. Ltd.).
3. Concepts and Models of Inorganic Chemistry by B. E. Douglas, D. H. McDaniel, J. J. Alexander (John Wiley and Sons).
4. Concise Inorganic Chemistry by J. D. Lee (Wiley).
5. Advanced Inorganic Chemistry by F. A. Cotton and G. Wilkinson (Wiley Interscience).
6. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi (Pearson Education India).
7. Elemental Inorganic Chemistry by R. L. Dutta (Part II) (New Book Stall)

Unit 2: Organometallic Chemistry (15 L, 30 Marks):

Historical development, classification, nomenclature, valence electron count, oxidation number, and formal ligand charge. Main group and d-block organometallics, structure and bonding of the carbonyls, nitrosyls, and related π -acids, alkyl, alkene, alkyne, π -allyl, polyene and cyclopolyene compounds.

Metal-ion catalyzed reactions with special reference to oxidative addition, reductive elimination, insertion, hydrogenation, carbonylation, hydroformylation and polymerization.

Suggested books:

1. Shriver and Atkins Inorganic Chemistry by P. W. Atkins, T. Overton, J. Rourke, F. Armstrong and M. Weller (Oxford University Press).
2. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi (Pearson Education India).
3. Advanced Inorganic Chemistry by F. A. Cotton and G. Wilkinson (Wiley Interscience).
4. Concepts and Models of Inorganic Chemistry by B. E. Douglas, D. H. McDaniel, J. J. Alexander (John Wiley and Sons).

Unit 3: Bioinorganic Chemistry (15 L):

Bioinorganic Chemistry: Biochemistry of iron and copper: Dioxygen binding, transport and storage through Hemoglobin, Myoglobin, Hemerythrin, and Hemocyanin. Blue copper proteins: Type 1, Type 2, and Type 3 copper centers in O_2 activating proteins. Metal-sulfide proteins: Ferredoxin and Nitrogenase. Metalloporphyrins and respiration: Cytochromes. Metals at the center of photosynthesis: Magnesium and Manganese. Metalloenzymes: Carbonic anhydrase, carboxypeptidases, alcohol dehydrogenase and vitamin B_{12} . Ion transport across membrane. Nitrogen fixation.

Suggested books:

1. Bioinorganic Chemistry: Inorganic Elements in the Chemistry of life by W. Kaim and B. Schwederski (John Wiley and Sons).
2. Principles of Bioinorganic Chemistry by S. J. Lippard and J. M. Berg (University Science Books).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 2103	Organic Chemistry - 2	4-0-0	4	Dr. S.C. Moi Dr. J. Chakraborty Dr. U. Adhikari

Unit 1: Organic Synthesis (20L):

Retrosynthesis, protective groups. Ring formation, Robinson annulation, Ring contraction, Ring expansion reactions. Steric aspect of synthesis. Method of C-N bond formation. Organo-Transition metal reagents: Complex metal hydrides, Gilman's reagents, Lithium dimethylcuprate, Lithium-diisopropylamide (LDA), dicyclohexyl-carboamide, 1,3-dithianes (umpolung reactivity), trimethylsilyl iodide, tri-n-butyltin hydride, Woodward and Prevost hydroxylation, OsO₄, DDQ, SeO₂, phase transfer catalysts, crown ether and Merrifield reagents. Peterson's synthesis, Wilkinson's catalyst, Baker yeast.

Suggested books:

1. Principles of Organic Synthesis by N. Coxon (CRC Press).
2. Organic Chemistry by Clayden, Warren, Wothers and Greeves (Oxford University Press).
3. Modern Methods of Standard Synthesis by W. Caruthers and I. Coldham (Cambridge).
4. Advanced organic Chemistry (A&B) by F.A. Carey and R. J. Sundberg (Springer).
5. Advanced Organic Chemistry: Reaction Mechanism by R. Bruckner (Elsevier).

Unit 2: Heterocyclic Chemistry (15 L, 30 Marks):

Nomenclature of heterocycles, aromatic and nonaromatic heterocycles, small ring heterocycles, benzofused 5 membered heterocycles. Generalized approach to the synthesis

of heterocycles possessing 5, 6 and 7 membered rings with one or two heteroatoms per ring. Reactions of heterocycles: Oxidation and reduction, reactions with electrophiles and nucleophiles. Heterocyclic systems containing P, As, Sb and B.

Suggested books:

1. Heterocyclic Chemistry by Gilchrist (Pearson).
2. Organic Chemistry (Vol. 1&2) by I. L. Finar (Pearson India).
3. Heterocyclic Chemistry at a glance by J. A. Joule and K. Mills (Wiley).
4. Heterocyclic Chemistry by R. K. Bansal (New Age International Publishers).

Unit 3: Structure and Function of Biomolecules (15L):

Conformation analysis of Monosaccharides (pentoses and hexoses), anomeric effect and reverse anomeric effect and their origin, Mutarotation and abnormal mutarotation. Uses of complexing agents borates, phosphates and copper compounds. Synthesis of glycosides; General treatment of polysaccharide chemistry: isolation, purification, hydrolysis, methylation and periodic oxidation, Smith degradation, Barry degradation. Sugar that contains nitrogen, glycolipids, glycoproteins, nucleic acid and proteins, enzyme and coenzyme.

Suggested books:

1. Monosaccharides: Their chemistry and their role in natural product by P. C. Collins and R. J. Ferrier (Wiley Interscience).
2. Lehninger: Principles of Biochemistry by D. Nelson and M. Cox (Macmillan).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 2104	Biochemistry	4-0-0	4	Dr.B.P.Mukherjee Dr. J. Chakraborty Dr. U. Adhikari

Unit 1: Cell Structure and Functions (5L):

Structure of prokaryotic and eukaryotic cells, intracellular organelles and their functions, Overview of metabolic process catabolism and anabolism. ATP – the biological energy currency. Origin of life – chemical evolution and rise of living systems. Introduction to biomolecules, building blocks of biomolecules.

Suggested books:

1. Lehninger: Principles of Biochemistry by D. Nelson and M. Cox (Macmillan).
2. Principles of Physical Biochemistry by K. E. van Holde, C. Johnson and P. S. Ho (Pearson).
3. Fundamentals of Biochemistry by D. Voet and J. G. Voet (Wiley).

Unit 2: Carbohydrates (8L):

Conformation of monosaccharides, structure and functions of important monosaccharides like glycosides, deoxy sugars, myoinositol amino sugars. N-acetylmuramic acid, sialic acid, disaccharides and polysaccharides. Structural polysaccharides – cellulose and chitin. Storage polysaccharides - starch and glycogen.

Structure and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition.

Blood group substances. Ascorbic acid.

Carbohydrate metabolism: Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenesis, pentose phosphate pathway.

Suggested books:

1. Fundamentals of Biochemistry by D. Voet and J. G. Voet (Wiley).
2. Organic Chemistry (Vol. 2) by I. L. Finar (Pearson India).

Unit 3: Lipids: (6 L):

Fatty acids, essential fatty acids, structure and function of triacyl glycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Lipoproteins-composition and function, role in atherosclerosis.

Properties of lipid aggregates – micelles, bilayers, liposomes and their possible biological functions. Biological membrane. Fluid mosaic model of membrane structure.

Lipid metabolism – β oxidation of fatty acids.

Suggested books:

1. Fundamentals of Biochemistry by D. Voet and J. G. Voet (Wiley).
2. Lehninger: Principles of Biochemistry by D. Nelson and M. Cox (Macmillan).
3. Principles of Physical Biochemistry by K. E. van Holde, C. Johnson and P. S. Ho (Pearson).

Unit 4: Amino Acids, Peptides and Proteins (6L):

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, forces responsible for holding of secondary structures. α -helix, β -sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein – folding and domain structure. Quaternary structure.

Amino acid metabolism – degradation and biosynthesis of amino acids, sequence determination: chemical/ enzymatic/ mass spectral, racemization/ detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH).

Suggested books:

1. Organic Chemistry (Vol. 1&2) by I. L. Finar (Pearson India).

2. Fundamentals of Biochemistry by D. Voet and J. G. Voet (Wiley).
3. Lehninger: Principles of Biochemistry by D. Nelson and M. Cox (Macmillan).
4. Principles of Physical Biochemistry by K. E. van Holde, C. Johnson and P. S. Ho (Pearson).

Unit 5: Nucleic Acids (5 L):

Purine and pyrimidine bases of nucleic acids, base pairing via H-bonding. Structure of RNA and DNA, double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis of heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

Suggested books:

1. Fundamentals of Biochemistry by D. Voet and J. G. Voet (Wiley).
2. Lehninger: Principles of Biochemistry by D. Nelson and M. Cox (Macmillan).
3. Principles of Physical Biochemistry by K. E. van Holde, C. Johnson and P. S. Ho (Pearson).

Unit 6: Biophysical Chemistry (5L):

Application of 2nd law of thermodynamics and thermochemistry towards biological systems; **molecular mechanics:** molecular potentials, bonding potentials, non-bonding potentials, electrostatic interactions, dipole-dipole interactions, van der Waal's interaction, hydration and hydrophobic effect. Hydrogen bonds and their effect on stabilizing interactions in macromolecules.

Suggested books:

1. Principles of Physical Biochemistry by K. E. van Holde, C. Johnson and P. S. Ho (Pearson).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 2151	Kinetic and Electrochemical Analysis	0-0-6	3	Dr. B.P. Mukhopadhyay Dr. D.Sukul Dr. S.S. Panja
<p>Solvent effect and salt effect on the kinetics of alkaline hydrolysis of crystal violet; Determination of standard electrode potential of AgCl-Ag electrode and evaluation of mean activity coefficient of HCl; Cyclic voltammetry for ferricyanide-ferrocyanide system.</p> <p>Conductometric Measurements.</p> <p>Determination of catalytic constant for mutarotation of glucose in presence of perchloric acid.</p>				
TEXT BOOKS:				
REFERENCE BOOKS:				

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 2152	Quantitative Inorganic Analysis of Alloys	0-0-4	2	Dr. A.K.Patra Dr. M.Maji Dr. R.N.Saha Dr. T.K.Saha
<p>Analysis of Brass and Aluminium in Bronze, Spectroscopic determination of Iron in Bauxite, Dolomite and Steel, Analysis of silicates, Spectroscopic determination of Mn and Cr. Determination of Ni in steel (Gravimetrically).</p>				
TEXT BOOKS:				
REFERENCE BOOKS:				

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 2153	Organic Synthesis & Isolation of Natural Products	0-0-6	3	Dr. S.C.Moi Dr. J.Chkraborty Dr. U.Adhikari
<p>Acetylation of salicylic acid, aniline, glucose and hydroquinone. Benzoylation of aniline and phenol.</p> <p>Preparation of iodoform from ethanol and acetone.</p> <p>Nitration: Preparation of m-dinitobenzene and p-nitroacetanilide</p> <p>Halogenation: Preparation of p-bromoacetanilide, 2,4,6- tribromophenol</p> <p>Diazotization: Preparation of methyl orange and methyl red</p> <p>Oxidation: Preparation of benzoic acid from toluene</p> <p>Reduction: Preparation of aniline from nitrobenzene, Preparation of m-nitroaniline m-dinitobenzene.</p> <p>Isolation of caffeine from tea leaves, Isolation of Nicotin-dipicrate from tobacco.</p>				
TEXT BOOKS:				
REFERENCE BOOKS:				

SEMESTER III

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 3101	Physical Chemistry - 3	4-0-0	4	Dr. B. P. Mukhopadhyay Dr. D. Sukul Dr. S. S. Panja

Unit 1: Photochemistry (15 L):

Interaction of electromagnetic radiation and matter, electric and magnetic dipole moment, transition probabilities, selection rules, violation of selection rules, oscillator strength, Jablonski diagram, fluorescence and phosphorescence, excited state lifetime and quantum yields, fluorescence anisotropy, instrumentation for fluorescence spectroscopy, fluorescence polarization, effects of solvents on fluorescence emission spectra, mechanism and dynamics of solvent relaxation, quenching of fluorescence, Stern-Volmer equation, energy transfer, protein fluorescence, fluorescence lifetime of proteins, dynamics of protein revealed by fluorescence methods. Determination of excited state dipole moment and pK value.

Suggested books:

1. Principles of Fluorescence Spectroscopy by I. R. Lakowicz (Springer).
2. Physical Chemistry by P. W. Atkins (Oxford University Press).
3. Physical Chemistry by P. C. Rakshit (Sarat Book Distributors).

Unit 2: Reaction Dynamics (15 L):

Molecular basis of chemical reaction, potential energy surfaces and reaction dynamics. Kinetics of different complex reactions. Statistical approach to reaction dynamics, Transition state theory. General features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and NMR method. Dynamics of electron transfer and proton transfer processes, photoisomerization. Effect of movement of solvent on reaction dynamics. Diffusion controlled reactions. Kinetic isotope effect.

Suggested books:

1. Physical Chemistry by P. W. Atkins (Oxford University Press).
2. Physical Chemistry by P. C. Rakshit (Sarat Book Distributors).

Unit 3: Properties of Surfaces and Self-Organized Assemblies (15 L):

Adsorption on surface: BET equation, Hysteresis, Harkins & Jura equation. Phase diagram of micellar system. Mass action model and pseudophase model for non-ionic and ionic micelles. Relationship between thermodynamic properties for micellization with CMC. Estimation of fraction of counter ion, aggregation number and solvation for micelles. Concept of reverse micelle and microemulsion. Conductance through micellar system. Applications of micellar systems. Donnan effect.

Suggested books:

1. Surfactant Science and Technology by D. Myers (Wiley).
2. Surface Chemistry Essentials by K. S. Birdi (CRC Press).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 3102	Inorganic Chemistry-3	4-0-0	4	Dr. A.K.Patra Dr. M.Maji Dr. R.N.Saha Dr. T.K.Saha

Unit 1: Solid State Chemistry (20 L):

Introduction to single-crystal, unit cell, Bravais lattice, crystal system and symmetry, crystal planes, Miller indices, reciprocal lattice, Lau-equation, Bragg's law, scattering of X-ray and X-ray diffraction, Fourier series, electron density and structure factor. Various X-ray diffraction method. determination of space group, methods of solving the phase problem, Patterson and direct methods for determination of crystal structure.

Voids, radiostic, structures of AX, AX₂, AX₃ types and their derived species, sphalite, wurzite, fluorite, perovskite, ilmentite, rutile, silicate and layered structure.

Band theory, structure maps; electronic properties of solids, conductors, semiconductors, insulators, superconductors.

Optical properties: Refraction, refraction index, birefringence, absorption, luminescence, laser.

Suggested books:

1. Solid State Chemistry and Its Application by A. R. West (Wiley).
2. Physical Chemistry by P. W. Atkins (Oxford University Press).
3. Physical Chemistry by P. C. Rakshit (Sarat Book Distributors).

Unit 2: Molecular Magnetism (20 L):

Basic concepts of molecular magnetism including types of magnetic behavior, Pascal's constant, the van Vleck equation and its applications to specific situations. Curie law and Curie-Weiss law, Zero-field splitting, spin-orbit coupling, quenching of orbital contribution, high-spin/low-spin equilibrium, magnetic interactions in polynuclear systems, mechanisms of exchange interactions, Bleaney-Bowers equation, types of exchange interactions, deliberate synthetic approach of ferromagnetically coupled systems, accidental orthogonality, spin-canting, spin-frustration, calculation of ground state and spin manifold, magnetization versus field studies, inorganic, organic and organometallic magnetic

materials.

Suggested books:

1. Elements of Magnetochemistry by R. L. Dutta and A. Syamal (Affiliated East West Press Pvt. Ltd.).

Unit 3: Inorganic Photochemistry (10 L):

Fluorescence, phosphorescence, photosensitization, quenching, charge- and energy-transfer, substitution, decomposition, fragmentation, isomerisation and redox reactions; photochromism; selective photochemistry using laser beams; chemical actinometry, inorganic photochemistry in biological processes and their model studies; application of photochemical reactions of coordination compounds-synthesis and catalysis.

Suggested books:

1. Elements of Inorganic Photochemistry by G. J. Ferraudi (Wileyinterscience).

2. Introduction to Inorganic Photochemistry by A. S. Negi (Cyber Tech Publications).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 3103	Organic Chemistry-3	4-0-0	4	Dr. S.C. Moi Dr. J. Chakraborty Dr. U. Adhikari
<p>Unit 1: Use of Organic Reagents (15L):</p> <p>Reduction: Hydride transfer reagent: DIBAL, Na(CN)BH, trialkyl borohydrides, trialkyl tin hydride; low valent titanium species, Bakers yeast, diimide, Merrifield resins.</p> <p>Oxidation: CrO₃, pyridine complexes, Mn(IV) oxide, OsO₄, RuO₄, sharpless epoxidation, SrO₂, Moffat oxidation</p>				
<p>Suggested books:</p> <ol style="list-style-type: none"> 1. Advanced organic Chemistry (A&B) by F.A. Carey and R. J. Sundberg (Springer). 2. Modern Methods of Standard Synthesis by W. Caruthers and I. Coldham (Cambridge). 3. Advanced Organic Chemistry by J. March (Wiley). 				
<p>Unit 2: Organic Photochemistry (10L):</p> <p>Photo-chemical energy, Jablonski-diagram, photo-sensitisation and quenching, Norrish type-I, type-II processes, Paterno-Buchi reaction, photochemistry of unsaturated compounds.</p>				
<p>Suggested books:</p> <ol style="list-style-type: none"> 1. Modern molecular photochemistry of organic molecules by N. J. Turro, V. Ramamurthy and J. C. Scaiano (University Science Book) 				
<p>Unit 3: Pericyclic Reaction (15L):</p> <p>Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach.</p>				

Electrocyclic reaction – conrotatory and disrotatory motions, $4n$, $4n+2$ and allyl systems.

Cycloaddition – antarafacial and suprafacial additions, $4n$ and $4n+2$ systems, $2+2$ addition of ketenes, $1,3$ –dipolar cycloadditions and chelotropic reactions.

Sigmatropic rearrangements - suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, $3,3$ - and $5,5$ - sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangements, Fluxional tautomerism. Ene reaction. regioselectivity, periselectivity.

Suggested books:

1. Pericyclic Reactions: A Mechanistic and Problem Solving Approach by S. Kumar, V. Kumar and S. P. Singh (Academic Press).

2. Pericyclic Reactions by I. Fleming (Oxford Science).

Unit 4: Paints, Agrochemicals and Food Chemicals (10L):

Preparation of organic pigments and their applications. Synthesis of pesticides/herbicides/fungicides. Food chemicals: Flavour, coloring and preservatives. Pheromones: Acyclic and cyclic, chiral and achiral sex attractants, their synthesis.

Suggested books:

1. Food Chemistry by H. K. Chopra and Panesar (Narosa).

2. Handbook of Analysis and quality Control of Fruit and Vegetable Product by S. Ranganna (Tata McGrawHill).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 3104	Instrumental Method of Analysis of Chemical Compounds & Computational Chemistry	4-0-0	4	Dr. A. K. Patra Dr. S. S. Panja Dr. U. Adhikari

PART A: Instrumental Method of Analysis of Chemical Compounds

Unit 1 (10 L):

Applications of UV-VIS, IR and Raman spectroscopy to elucidate the structure of different organic and inorganic molecules.

Suggested books:

1. Spectrometric Identification of Organic Compounds by R. M. Silverstein and F. X. Webster (Wiley).
2. Classics in spectroscopy by S. Berger and D. Sicker (Wiley-VCH).
3. Organic Spectroscopy by W. Kemp (Macmillan).

Unit 2: ESR Spectroscopy (10 L):

Hyperfine coupling, Spin polarization for atoms and transition metal ions, Spin-orbit coupling and significance of g-tensors, application to transition metal complexes including free radicals.

Suggested books:

1. Electron Spin Resonance Spectroscopy of Organic Radicals by F. Gerson and W. Huber (Wiley-VCH).
2. Principles and Applications of ESR Spectroscopy by A. Lund, M. Shiotani, and S. Shimada (Springer).

Unit 3: Mössbauer Spectroscopy (10 L):

Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of i) bonding and structures of Fe^{II}, Fe^{III} compounds including those of intermediate- spin, ii) Sn^{II} and Sn^{IV} compounds, nature of M-L bond, coordination number and structure and iii) detection of oxidation states.

Suggested books:

1. Mossbauer Spectroscopy: Applications in Chemistry, Biology and Nanotechnology by V. K. Sharma, G. Klingelhofer and T. Nishida (Wiley).
2. Mössbauer Spectroscopy Tutorial Book by Y. Yoshida, and G. Langouche (Springer)

Unit 4: NMR Spectroscopy (15L):

Long-range spin-spin interaction. Interpretation of non-first order NMR; double resonance, Lanthanide shift reagent, spin-tickling, INDOR, NOE, effect of solvents (aliphatic and aromatic), preliminary idea on ¹⁹F, ³¹P, ¹⁴N, ¹⁵N, ¹⁷O. NMR of solids, NMR imaging.

¹³C NMR Spectroscopy: Introduction, theory, instrumentation, chemical shift, coupling constants, application in organic molecules.

Suggested books:

1. Spectrometric Identification of Organic Compounds by R. M. Silverstein and F. X. Webster (Wiley).
2. Classics in spectroscopy by S. Berger and D. Sicker (Wiley-VCH).
3. Organic Spectroscopy by W. Kemp (Macmillan).
4. Organic Spectroscopy by Lampman and D. L. Pavia (Wiley).

Unit 5: Mass Spectroscopy (5L):

Generation of ions and detection; EI, CI, FD, FAB, plasma desorption etc; fragmentation pattern in EI, GC-MS, MS-MS, LC-MS. Application of UV, IR, NMR and MS in structure elucidation.

Suggested books:

1. Spectrometric Identification of Organic Compounds by R. M. Silverstein and F. X. Webster (Wiley).
2. Classics in spectroscopy by S. Berger and D. Sicker (Wiley-VCH).
3. Organic Spectroscopy by W. Kemp (Macmillan).

4. Organic Spectroscopy by Lampman and D. L. Pavia (Wiley).

PART B: Computational Chemistry (20 L):

Basic computer architecture and data representation, binary arithmetic. Algorithm development and program design. Introduction to Fortran language: data types, integer, complex, character, logical constants and variables. Arithmetic statements, expressions, library function, relational operators, Input and output statements, I/O format statements, different types of control statements, loop structures, subscribed variables and arrays. Writing, executing and running of simple FORTRAN programmes. Simple application to chemical problems.

Matrix diagonalisation, numerical differentiation, integration, solution of second order linear differential equations with constant and variable coefficients.

Concept on macromolecule modeling software.

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 3151	Spectrophotometric Analysis	0-0-6	3	Dr. B. P. Mukhopadhyay Dr. D. Sukul Dr. S. S. Panja

1. Solvent and micellar effect on the fluorescence of 1-naphthol and determination of CMC of a surfactant.
2. Calibration of mercury vapour lamp with chemical actinometer and determination of quantum yield of unknown substances.
3. Spectral studies of charge-transfer complexes.
4. Any other experiments set by the Instructor.

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 3152	Preparation, Separation & Characterization of Inorganic & Coordinate Compounds	0-0-6	3	Dr. A.K. Patra Dr. M. Maji
<p>Preparation of inorganic and coordination compounds and their characterization: (a) Bi-, tri- and polydentate ligands, (b) Complexation and purification, (c) spectral studies (IR, UV-VIS), (d) Solution conductivity and electrochemical measurements, (e) Magnetic studies.</p> <p>Kinetics and mechanistic studies of some selected reactions (substitution and redox).</p> <p>Experiments on separation techniques by ion-exchange, chromatography and solvent extraction processes.</p>				
TEXT BOOKS:				
REFERENCE BOOKS:				

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 3153	Separation of Organic Compounds using Chromatographic Techniques	0-0-4	2	Dr. J. Chrakraborty Dr. U. Adhikari

Thin Layer Chromatography

Determination of R_f values and identification of organic compounds.

Separation of green leaf pigments (spinach leaves may be used).

Preparation and separation of 2,4-dinitrophenylhydrazones of acetone, 2-butanone, hexan-2- and 3- one using toluene and light petroleum(40:60).

Separation of a mixture of dyes using cyclohexane and ethyl acetate (8.5:1.5).

Paper Chromatography: Ascending and Circular

Determination of R_f values and identification of organic compounds.

Separation of a mixture of phenylalanine and glycine. Alanine and aspartic acid. Leucine and glutamic acid. Spray reagent - ninhydrin.

Separation of a mixture of D, L – alanine, glycine and L – Leucine using n-butanol: acetic acid: water (4:1:5). Spray reagent - ninhydrin.

Separation of monosaccharides – a mixture of D-galactose and D-fructose using n-butanol: acetone: water (4: 5: 1). Spray reagent - aniline hydrogen phthalate.

Column Chromatography:

Separation of Fluorescein and methylene blue

Separation of leaf pigments from spinach leaves

Resolution of racemic mixture of (\pm) mandelic acid.

TEXT BOOKS:

REFERENCE BOOKS:

SEMESTER IV

ELECTIVE PAPERS:

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9111	Advanced Physical Chemistry -1	4-0-0	4	Dr. B. P. Mukhopadhyay Dr. D. Sukul
Unit 1: Advanced Quantum Chemistry (20 L): Variation method and time independent perturbation theory: Application to He atom. Antisymmetric and exclusion principle, Slater determinantal wave function, spin-orbital interaction: LS and JJ coupling, Term symbol and spectroscopic states, molecules and chemical bonding, Born-Oppenheimer approximation: MO and VB treatment of diatomic molecules. Directed valence and hybridization in simple polyatomic molecules. Idea of self-consistent field. Time dependent perturbation theory: Transition dipole moment. Hückel theory of conjugated systems. Bond order and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical, cyclobutadiene.				
Suggested books: 1. Quantum Chemistry by I. N. Levine (Pearson). 2. Molecular Quantum Mechanics by P. W. Atkins and R. S. Friedman (Oxford University Press).				
Unit 2: Advanced Biophysical Chemistry (15 L): Different types of bio-molecules. Complexities in macromolecules, general principles for macromolecular separation: ion exchange, gel filtration chromatography, sedimentation, electrophoresis and isoelectric focusing, solvent effect, structure activity relation, kinetic of enzyme and enzyme-inhibiting complex, cooperative allosteric effect.				
Suggested books: 1. Principles of Physical Biochemistry by K. E. van Holde, C. Johnson and P. S. Ho (Pearson). 2. Biochemistry by J. M. Berg and J. L. Tymoczko (Freeman). 3. Lehninger: Principles of Biochemistry by D. Nelson and M. Cox (Macmillan).				

Unit 3: Biomolecular Structure (15 L):

General principle of X-ray diffraction, crystallization of bio-molecules, different methods of crystallization of proteins: vapor diffusion, micro dialysis. Reciprocal space and diffraction pattern, structure factor and phase problem, solving the structure by different X-ray methods, nucleic acid structure, protein structure: folding, motif, fibre and collagen structure.

Suggested books:

1. Introduction to Macromolecular Crytallography by A. Mcpherson (Wiley).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9112	Advanced Physical Chemistry -2	4-0-0	4	Dr. B. P. Mukhopadhyay Dr. D. Sukul

Unit 1: Non-Equilibrium Thermodynamics (15 L):

Non-equilibrium thermodynamics, postulates and methodologies, forces and fluxes, linear laws, Gibbs equation, Onsagar reciprocal theory. Curie-Prigogine principle, diffusion, effusion, sedimentation, thermoelectric effect, membrane properties. Stationary states: time variation of entropy production, minimum entropy production, stability of stationary state, fluctuation.

Suggested books:

1. Non-Equilibrium Thermodynamics: Principles and Applications by C. Kalidas and M. V. Sanganarayana (Macmilan India).

Unit 2: Transport Phenomena (15 L):

Mass transport: diffusion, Fick's first and second law, statistical view of diffusion, time evaluation of concentration gradient, thermal conduction, viscosity, diffusion and viscosity of liquids, sedimentation and centrifugation, ion conductance: strong and weak electrolytes, Ostwald dilution law, relaxation effect, effect of solvent, Stokes-Einstein equation.

Suggested books:

1. Physical Chemistry by P. W. Atkins (Oxford University Press).
2. Physical Chemistry by P. C. Rakshit (Sarat Book Distributors).
3. Modern Electrochemistry 1, 2A & 2B by J. O. Bockris and A. K. N. Reddy (Springer).

Unit 3: Fundamental of Corrosion and its Inhibition (15L):

Fundamentals of corrosion science: electrochemical aspects, electrochemical kinetics and phenomena of polarization, E-pH diagram. Different forms of corrosion: mechanism and control. Dry oxidation. Corrosion under various industrial condition and their control. Cathodic and anodic protection. Corrosion inhibitors and passivation, surface coating, corrosion rate expression. Electrochemical methods of corrosion inspection and monitoring.

Suggested books:

1. Green Corrosion inhibitors-Theory and Practice By V. S. Sastri (Wiley)
2. Principles and Prevention of Corrosion By D. A. Jones
3. Corrosion inhibitors By I. L. Rozenfeld (McGraw Hill)

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9113	Advanced Physical Chemistry- 3	4-0-0	4	Dr. S. S. Panja

Unit 1: Solid State Chemistry (30L):

Crystal lattices, space groups, Miller indices, crystal morphology and unit cell dimension, crystallization, X-ray data collection: system and procedure, standard deviation (error), phase determination, scattering, isotropic and anisotropic temperature factors, modeling, refinements, disorder, structural parameters determinations, 3-D structure solution.

Bonding of atoms in metals, Band theory. Properties of metal: free electron theory, zone theory. Electrical, magnetic and thermal properties of metals.

Properties of semiconductors: Band theory, conductivity, optical properties, junction properties, transistors.

Properties of insulators: electrical properties, optical properties, magnetic properties.

Suggested books:

1. Physical Chemistry by P. W. Atkins (Oxford University Press).
2. Physical Chemistry by P. C. Rakshit (Sarat Book Distributors).
3. Solid State Chemistry and Its Application by A. R. West (Wiley).
4. Introduction to Solid State Physics by C. Kittel (Wiley).

Unit 2: Fundamental of Polymer Chemistry (15L):

Introductory concept, definition, common system chemistry and classification of polymers, resin, rubber, plastics. Characterization: number average, molecular weight average and viscosity average molecular weight. Concept of segment and segment length. Effect of solvents. Thermodynamic of dilute polymer solution. Light scattering method to determine molecular weight and structure of polymers in solution. Kinetics of polymerization. Mechanistic aspect: Addition, ionic, emulsion, aqueous, coordination, condensation polymerization processes. Dendrimers.

Crystal structure of polymers: crystalline melting point T_m , glass transition temperature (T_g). Effect of different parameters on T_m and T_g .

Suggested books:

1. Principles of Polymer Chemistry by P. J. Flory (Cornell University Press).
2. Principles of Polymer Chemistry by A. Ravve (Springer).
3. Introduction to Polymers by R. J. Young and P. A. Lovell (CRC Press).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9114	Advanced Physical Chemistry- 4	4-0-0	4	Dr. B. P. Mukhopadhyay Dr. D. Sukul Dr. S.S. Panja

Unit 1: Advanced Spectroscopy (15 L):

Fundamentals of 2D-NMR and FT-NMR, Auger spectroscopy, X-ray photoelectron spectroscopy, analytical techniques based on Auger spectroscopy, SEM, TEM, surface enhanced Raman spectroscopy, UV-photoelectron spectroscopy. Single molecule spectroscopy, 3-photon echo spectroscopy.

Suggested books:

1. Modern Spectroscopy by J. M. Hollar (Wiley).

Unit 2: Physical Chemistry of Electron-Transfer in Macromolecules (10 L):

Metalloprotein interactions, kinetic aspect of different metalloproteins : haemoglobin, hemocyanin, cytochromes. Electron transfer process by different cytochromes, enzyme kinetics.

Suggested books:

1. Metal ions in Biochemistry by P. K. Bhattacharya (Alpha Science Int. Ltd.)

Unit 3: Non-Ideal Systems (15 L):

Van der waals equation of state, virial coefficient, fugacity and standard state; gas mixture. Non ideal solution, activity and activity coefficient, different scales. Duhem-Margules equation and it's application. Regular solution and excess thermodynamic function.

Suggested books:

1. Physical Chemistry by P. W. Atkins (Oxford University Press).

2. Physical Chemistry by P. C. Rakshit (Sarat Book Distributors).

Unit 4: Advanced Photochemistry and Application of Laser (10 L):

Application of fluorescence spectroscopy to determine the properties of self-organized assemblies.

Laser: fundamentals of laser, Q-switched and mode locked laser. Application of ultra fast lasers to determine excited state lifetime and dynamics.

Suggested books:

1. Modern Spectroscopy by I. M. Holler (Wiley).
2. Principles of Fluorescence Spectroscopy by I. R. Lakowicz (Springer).

Unit 5: Some Advanced Topics:

Super conductors, ionic liquids, super critical fluids. Nanoparticles, semiconductor, fuelcell, liquid crystals.

1. Modern Spectroscopy by I. M. Holler (Wiley).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9121	Advanced Inorganic Chemistry- 1	4-0-0	4	Dr. M. Maji

Unit 1: Chemical Application of Group Theory (20 L):

Point group, the great orthogonality theorem, character table, representation, projection operator, SALC, direct product; symmetry aspects of MO theory, carbocyclic systems (benzene etc.), electron deficient molecules. Cyclization reactions: thermal and photochemical, symmetry consideration of pericyclic reactions, hybrid and molecular orbitals, sigma- and pi-bonding schemes for AB_n type molecules (n = 6). Treatment of ligand field theory, term splitting, energy level diagram, electronic transitions, vibronic coupling, Tanabe-Sugano diagram, selection rules, polarization.

Molecular vibrations, symmetry of normal vibrations and symmetry types of the normal modes, internal coordinates, selection rules for fundamental vibrations, illustrations.

Suggested books:

1. Chemical applications of group theory by F. A. Cotton (Wiley Interscience Publication).
2. Molecular Symmetry and Group Theory by R. L. Carter (Wiley)

Unit 2: Electrochemical Studies (20 L):

Preamble, electrochemical cell, electrode, mass transfer, electron transfer, three electrode configuration, supporting electrolyte, solvent, switching and action potentials, electrode potential and factors affecting.

Techniques: polarography, cyclic voltammetry, differential pulse voltammetry and coulometry.

Pathways: reversible, quasireversible and irreversible, E, EE, ECE, EC, ECEC, protic-electroprotic equilibria.

Electroinduced reactions: electrosynthesis, electrocatalysis, electropolymerization, electrocrystallization, electrochemiluminescence.

Conjunctive study: cell design, OTTLE, surface-modified electrode, photoelectrochemistry, spectroelectrochemistry, excimer and its structure, excited state potential, redox orbital, redox series, redox isomer.

Applications: electrochemical reactor, corrosion, fuel cell, electro dialysis, bilayer-liquid membrane and bioelectrochemistry, nerve pulse and cardiovascular electrochemistry, electrochemical sensor.

Suggested books:

1. Inorganic Electrochemistry: theory practice and application by P. Zanello (RS.C)
2. Electrochemical Methods: Fundamentals and Applications by A. J. Bord and L. R. Faulkner (Wiley).

Unit 3: Stereochemistry of Coordination Compounds (10 L):

Basic concept about stereochemistry, structure, geometry and symmetry. Theoretical bases for coordination geometries of metal ion. Classification of ligand, isomerism, stereochemical nomenclature. Stereochemistry of mononuclear coordination compounds, polynuclear complexes and stereochemistry of metal complexes.

Suggested books:

1. Coordination Chemistry by John. Ribas Gispert (Wiley-VCH).
2. Electron Structure and Properties of Transition Metal Complexes by I. B. Bersuker (Wiley).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9122	Advanced Inorganic Chemistry - 2	4-0-0	4	Dr. T. K. Saha

Unit 1: Synthetic Methodology for Metal Compounds (20 L):

Ligand design and ligand synthesis: polypyridine, Schiff-base, oxime, macrocycle, electron reservoir, tripod, podand, coronand, cryptand, octopus, tailoring, and appending of pendant arm, ligand topology and molecular mechanics. Coordination compound design and synthesis: self-assembly, structured-directed synthesis, building block, metalloligand, polymeric ensemble (chain, sheet, network), supramolecular framework, molecular machine, biomodelling, molecular/crystal engineering.

Suggested books:

1. Advanced Inorganic Chemistry by F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann (Wiley).
2. Inorganic Chemistry: Principles of Structure and Reactivity by J. E. Huheey, E. A. Keiter, R. L. Keiter and O. K. Medhi (Pearson Education India).
3. Concepts and Models of Inorganic Chemistry by B. E. Douglas, D. H. McDaniel, J. J. Alexander (John Wiley and Sons).

Unit 2: Applications of Molecular Luminescence, Photoacoustic, Raman and Flame Atomic Spectrometry (10 L):

Molecular luminescence spectrometry: theory, instrumentation and applications, photoacoustic spectrometry light scattering techniques including nephelometry and Raman spectroscopy. Flame spectrometric techniques: atomic absorption, atomic emission and atomic fluorescence. Theory, instrumentation and applications of these techniques.

Suggested books:

1. Principles of physical chemistry by B. R. Puri, L. R. Sharma, M. S. Pathania (Vishal Publishing).
2. Photoacoustic Effect Principles and Applications, Edited by E. Lüscher, P. Korpiun, H-J. Coufal, R. Tilgner (Springer).

Unit 3: Supramolecular Chemistry (20 L):

Definition, supramolecular building block and spacer, molecular recognition and host-guest

interactions, spherical recognition, receptors, co-receptor molecules and multiple recognition, organometallic/macrocyclic receptors, catenane, rotaxane, catenand, catenate, coronand, ferrocene, cobaltocenium and other metallocene receptors, molecular and supramolecular devices, self organization and self assembly of inorganic architectures, study of inorganic polymers containing B-N, B-O, P-N, P-O, S-N, V-O, Mo-O, Fe-S, and Mo-S etc.

Suggested books:

1. Supramolecular Chemistry: Fundamental and Applications by K. Ariga and T. Kunitake (Springer).
2. Supramolecular Chemistry: Concepts and Perspectives by J. Lehn (Wiley-VCH).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9123	Advanced Inorganic Chemistry - 3	4-0-0	4	Dr. A. K. Patra Dr. R. Saha

Unit 1: Inorganic Material (20 L)

Solid state reaction: ceramic method, carbothermal reduction, combustion synthesis. Formation of solid from gas phase: chemical vapor transport, chemical vapor deposition, aerosol process. Formation of solid from solution and melt: precipitation method, solvothermal process, sol-gel process, micelle and reverse micelle method. Preparation and modification of inorganic polymer, porous material, nano-structured material, glasses and ceramic, composites, electronic and magnetic material.

Suggested books:

1. Synthesis of Inorganic Materials by U. Schwurt and N. Hüsing (Wiley-VCH).

Unit 2: Nitric Oxide and Metal Nitrosyls Related to Biology (15 L):

Introduction, History of Nitric oxide (NO) gas, Nitric oxide (NO) synthases, inhibitors of NO synthase, diverse roles of NO on different organs, NO donors (organic and inorganic), metal nitrosyls with photolabile NO, Ligand design for the synthesis of photolabile metal nitrosyls, NO inactivated enzyme Nitrile Hydratase, NO detection, Enemark-Feltham {MNO}ⁿ notation, spectroscopy of NO ligated metal complexes, determination of oxidation state of the iron center in iron nitrosyl with the help of Mössbauer and magnetic Mössbauer spectroscopy, different oxidation states of NO and its characteristic IR spectra, finally X-ray structural proof of the oxidation states of NO.

Suggested books:

1. Methods in Nitric Oxide Research by M. Feelisch and J. S. Stamler (Wiley).
2. Activation of Small Molecules Edited by W. B. Tolman (Wiley-VCH).

Unit 3: Analysis of Air and Water Pollution (15 L):

Objectives of chemical analysis of air and water. Analysis of water: colour, turbidity, total solid, conductivity, acidity, alkalinity, hardness, chloride, sulfate, fluoride, phosphates, and different forms of nitrogen. Heavy metal analysis with respect to health significance.

Measurement of DO, BOD and COD. Pesticides as water pollutants analysis.

Monitoring and analysis of air: Monitoring technique through high volume sampler, SPM and RPM sampler. Measurement and analysis of SPM, RPM, SOX and NOX.

Air and water pollution laws and standards.

Suggested books:

1. Chemistry for Environmental Engineering by C. N. Sawyer, P. L. McCarty and G. F. Parkin (McGraw-Hill).

2. Fundamentals of Environmental Chemistry by S. E. Manahan (Lewis Publishers).

3. Atmospheric Chemistry and Physics: from Air Pollution to Climate Change by J. H. Seinfeld and S. N. Pandis (Wiley).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9124	Advanced Inorganic Chemistry- 4	4-0-0	4	

				Dr. A.K. patra Dr. R. N. Saha
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Unit 1: Introduction to Green Chemistry (20 L):

Definition and strategic of green chemistry. Why Green Chemistry? Prevention, Atom Economy, Less Hazardous Chemical Syntheses, Designing Safer Chemicals, Safer Solvents and Auxiliaries, Design for Energy Efficiency, Use of Renewable, Feedstocks, Reduce Derivatives, Catalysis, Design for Degradation, Real-time analysis for Pollution Prevention, Inherently Safer Chemistry for Accident Prevention, Laboratory pollution prevention.

Suggested books:

1. Innovations in Green Chemistry and Green Engineering by Paul T. Anastas, J. Beth Zimmerman (Springer).
2. Alternative Solvents for Green Chemistry by F. M Kerton and R. Marriott (RSC).
3. Introduction to Green Chemistry by A. Matlack (CRC Press).

Unit 2: Application of Green Chemistry (15 L):

Applications and benefits of green chemistry: Production of new chemicals, materials, and products. Examples of successful green technologies; Alternative synthetic routes, new separation processes, new methods for delivery or product application (Alternative solvents, Energy vs. material activity). Importance of pollution and wastefulness in modern cultures by reflecting on the green chemistry.

Suggested books:

1. Innovations in Green Chemistry and Green Engineering by Paul T. Anastas, J. Beth Zimmerman (Springer).
2. Alternative Solvents for Green Chemistry by F. M Kerton and R. Marriott (RSC).
3. Introduction to Green Chemistry by A. Matlack (CRC Press).

Unit 3: Medicinal and Toxic Effect of Metals (15 L):

The elements of life and bioinorganic chemistry, biological functions of the bio-elements, disturbing factors in the metabolic processes and causes of diseases, principles of bioinorganic chemistry in medicine, different classes of drugs.

Evaluation methods for environmental and human health impact, metal deficiency and disease, toxic effects of metals, metals used for diagnosis and chemotherapy with particular reference to anticancer drugs; Metal ions and metal complex interactions with nucleic acid and DNA.

Suggested books:

1. *Chemical Reviews*, 1999, 99, 2201-2842.

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9131	Advanced Organic Chemistry -1	4-0-0	4	Dr. S.C.Moi Dr. J.Chakraborty Dr. U.Adhikari

Unit 1: Quantitative Relationship between Structure and Reactivity (5L):

Linear free energy relations: Hammett equation; equilibria and rates in organic reactions. The separation of polar, steric and resonance effects: Taft equation; Grunwald-Winstein equation.

Suggested books:

1. Reactive intermediate Chemistry by R. A. Moss, M. S. Platz and M. Jones (Wiley Interscience).
2. Advanced Organic Chemistry: Reaction Mechanism by R. Bruckner (Elsevier).
3. Advanced Organic Chemistry by J. March (Wiley).
4. Organic Chemistry (Vol. 1&2) by I. L. Finar (Pearson India).

Unit 2: Pericyclic Reactions (20L):

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3 butadiene, 1,3,5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO & PMO approach. Electrocyclic reactions-conrotatory and disrotatory motions. $4n$, $4n+2$ system, $2+2$ addition of ketenes, 1,3 dipolar cycloadditions and cheletropic reactions. Sigmatropic rearrangements-suprafacial and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties, 3,3- and 5,5 sigmatropic rearrangements. Claisen, cope and aza-cope carbon rearrangements. Fluxional tautomerism, Ene reactions. Recent advances from current literature.

Suggested books:

1. Pericyclic Reactions: A Mechanistic and Problem Solving Approach by S. Kumar, V. Kumar and S. P. Singh (Academic Press).
2. Pericyclic Reactions by I. Fleming (Oxford Science).

Unit 3: Organic Photochemistry (25L):

General information, effect of light intensity on the rate of photochemical reactions. Types

of photochemical reactions: Photo-dissociation, gas phase photolysis. Photochemistry of alkenes: Intramolecular reactions of the olefinic bond-geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1,5-dienes.

Photochemistry of Carbonyl compounds: Intramolecular reactions of carbonyl compounds saturated, cyclic and acyclic, β,γ -unsaturated and α,β -unsaturated compounds. Cyclohexadienones, Intermolecular cycloaddition reactions, dimerisation and oxetane formation.

Aromatic compounds: Isomerisations, additions and substitutions. Miscellaneous photochemical reactions: Photo-fries reactions of anilides, photo-fries rearrangement, Barton reaction, Singlet molecular oxygen reactions. Photochemical formation of smog. Photodegradation of polymers, photosubstitution, photoreduction of ketones, photooxidation, di- π methane rearrangement, photochemistry of areanes. Organometallic photochemistry, photochemistry of vision.

Suggested books:

1. Modern molecular photochemistry of organic molecules by N. J. Turro, V. Ramamurthy and J. C. Scaiano (University Science Book)

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9132	Advanced Organic Chemistry-2	4-0-0	4	Dr. S.C.Moi Dr. J.Chakraborty Dr. U.Adhikari

Unit 1: Asymmetric Synthesis (10L, 20 Marks):

Diastereoselective and enantioselective reactions, homogenous asymmetric hydrogenation, asymmetric catalysis via chiral metal complexes and with purely organic compounds; chiral oxazolines, Sharpless' asymmetric epoxidation in organic synthesis.

Suggested books:

1. Advanced Organic Chemistry by J. March (Wiley).
2. Principles of Organic Synthesis by N. Coxon (CRC Press).
3. Organic Chemistry by Clayden, Warren, Wothers and Greeves (Oxford University Press).
4. Organic Chemistry (Vol. 1&2) by I. L. Finar (Pearson India).
5. Modern Methods of Standard Synthesis by W. Caruthers and I. Coldham (Cambridge).
6. Advanced organic Chemistry (A&B) by F.A. Carey and R. J. Sundberg (Springer).

Unit 2: Application of Important Organic Reactions in Organic Synthesis (10L, 20 Marks):

Hydroboration, Wittig reaction, Birch reduction and few important reactions in organic synthesis.

Suggested books:

1. Advanced Organic Chemistry by J. March (Wiley).
2. Principles of Organic Synthesis by N. Coxon (CRC Press).
3. Organic Chemistry by Clayden, Warren, Wothers and Greeves (Oxford University Press).
4. Organic Chemistry (Vol. 1&2) by I. L. Finar (Pearson India).
5. Modern Methods of Standard Synthesis by W. Caruthers and I. Coldham (Cambridge).

Unit 2: Application of Important Organic Reactions in Organic Synthesis (10L, 20 Marks):

Hydroboration, Witting reaction, Birch reduction and few important reactions in organic synthesis.

Suggested books:

1. Advanced Organic Chemistry by J. March (Wiley).
2. Principles of Organic Synthesis by N. Coxon (CRC Press).
3. Organic Chemistry by Clayden, Warren, Wothers and Greeves (Oxford University Press).
4. Organic Chemistry (Vol. 1&2) by I. L. Finar (Pearson India).
5. Modern Methods of Standard Synthesis by W. Caruthers and I. Coldham (Cambridge).

Unit 3: Organic Synthetic Chemistry (15L, 30 Marks):

Organic synthetic process and uses of Phosphorus, Silicon and Sulphur compounds in synthetic organic chemistry Planning a synthetic pathway; molecular characteristics: Retrosynthesis; method of formation of carbon skeleton: carbon to carbon bond formations, logistic and stereochemistry. Phospho ylide and sulphur ylide.

Suggested books:

1. Advanced Organic Chemistry by J. March (Wiley).
2. Principles of Organic Synthesis by N. Coxon (CRC Press).
3. Organic Chemistry by Clayden, Warren, Wothers and Greeves (Oxford University Press).
4. Organic Chemistry (Vol. 1&2) by I. L. Finar (Pearson India).
5. Modern Methods of Standard Synthesis by W. Caruthers and I. Coldham (Cambridge).

Unit 4: Organometallic Chemistry (15 L, 30 Marks):

Bonding in transition metal. Organo-metallic complexes. Some common properties of organo-metallic complexes. Fluxionality, epolarizatio of reactive or unstable molecules. Catalytic hydrogenation, insertion reactions. Organo-Cu, -Zn, -Cd, -Hg and -Pd compounds. Metallocenes (Fe, Ru, Os). Carbene and epolar complexes.

Suggested books:

1. Advanced organic Chemistry (A&B) by F.A. Carey and R. J. Sundberg (Springer).
2. Modern Methods of Standard Synthesis by W. Caruthers and I. Coldham (Cambridge).
3. Organic Chemistry by Clayden, Warren, Wothers and Greeves (Oxford University Press).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9133	Advanced Organic Chemistry -3	4-0-0	4	Dr. J.Chakraborty Dr. U.Adhikari

Unit 1: Alkaloids (5L):

Classification, general reactions of alkaloids, typical reaction conversions and rearrangement of morphine, papaverine, cinchona alkaloids.

Suggested books:

1. Organic Chemistry (Vol. 2) by I. L. Finar (Pearson India).
2. Organic Chemistry of Natural Products (Vol. 1 & 2) by G. R. Chatwal (Himalaya Publication).

Unit 2: Terpenes (10L):

Structural studies on sesquiterpenes, diterpenes, triterpenes and carotenoids; chemistry of carryophyllene, abietic acid, beta-amyrin, alpha and beta-carotenoids.

Suggested books:

1. Organic Chemistry of Natural Products (Vol. 2) by G. R. Chatwal (Himalaya Publication).
2. Natural Products: The secondary Metabolites by J. R. Hanson (RS.C).

Unit 3: Steroids and Prostanoids (10L):

Reaction and synthesis of steroids, sources of steroid hormones; diosgenin, hecogenin, etc., structure and synthesis of prostanoids.

Suggested books:

1. Organic Chemistry of Natural Products (Vol. 2) by G. R. Chatwal (Himalaya Publication).
2. Natural Products: The secondary Metabolites by J. R. Hanson (RS.C).

Unit 4: Natural Pigments (10L, 20 Marks):

General methods of isolation, structure elucidation and synthesis of anthocyanins, flavones, flavones, isoflavones, aurone, chalcone, xanthone and their chemical interconversions.

Suggested books:

1. Organic Chemistry of Natural Products (Vol. 1 & 2) by G. R. Chatwal (Himalaya Publication).
2. Natural Products: The secondary Metabolites by J. R. Hanson (RS.C).

Unit 5: Drug Design (10L):

Introduction to rational approach to drug design, physical and chemical factors associated with biological activities, structure-activity relationship, mechanism of drug action. Classification of drugs: Based on structure or pharmacological basis with examples. Antineoplastic agents, cardiovascular drugs, local anti-infective drugs, psychoactive drugs, antibiotics. Synthesis: Synthesis of important drugs. Modelling: Molecular modeling, conformational analysis, qualitative and quantitative structure-activity relationship.

Suggested books:

1. The Organic Chemistry of Drug Design and Drug Action by R. Silvermann (Academic Press).

SUBJECT CODE	SUBJECT	L-T-P	CREDIT	DEVELOPER
CY 9134	Advanced Organic Chemistry-4	4-0-0	4	Dr. S.C.Moi Dr. J.Chakraborty

12. Advanced Organic Chemistry-4 (CY 9134)**Unit 1: Nucleic Acids (20 L):**

Introduction, classification, occurrence, nucleosides: Isolation, properties and synthesis of ribosyl and deoxyribosyl nucleosides; biosynthesis of alpha-D- ribose phosphate; nucleotides: Isolation and functions, structure of ribosyl and deoxyribosyl nucleotides, biosynthesis of isosinic acid, adenylic acid, guanylic acids, cystodylic acid and uridylic acid; translation and transcription (general idea), RNA & DNA (structural composition) codon, anticodon, genetic code, protein synthesis.

Suggested books:

1. Lehninger: Principles of Biochemistry by D. Nelson and M. Cox (Macmillan).
2. Fundamentals of Biochemistry by D. Voet and J. G. Voet (Wiley).
3. Harper's Illustrated Biochemistry (McGrawHill).

Unit 2: Enzyme Chemistry (15 L):

Enzymes: Chemical and biological catalysts. Nomenclature and classification, concept and identification of active sites by use of inhibitors, catalytic power, specificity and regulation. Examples of some typical enzyme mechanisms for chymotrypsin, ribonuclease, lysozyme and carboxypeptidase-A.

Different types of enzyme catalyzed reactions, Co-enzyme chemistry. Enzyme models: Host-guest chemistry, chiral recognition, molecular asymmetry and prochirality, biomimetic chemistry, crown ether, cryptates, cyclodextrins, calixarin.

Suggested books:

1. Fundamentals of Biochemistry by D. Voet and J. G. Voet (Wiley).
2. Harper's Illustrated Biochemistry (McGrawHill).
3. Protein, Structure and Function by D. Whitford (Wiley).

Unit 3: Bioorganic Chemistry (20L):

Enzyme kinetics: Michaelis Menten and Lineweaver-Burk plots, reversible and irreversible inhibition.

Mechanism of enzyme action: Typical enzyme mechanism for ribonuclease, lysozyme. Chemical models and mimics for enzymes, receptors, peptides, carbohydrates and other bioactive molecules, catalytic antibodies- Design, synthesis and evaluation of enzyme inhibitors.

Enzyme catalyzed reactions: Carboxylation and decarboxylation. Isomerization and rearrangement.

Suggested books:

1. Lehninger: Principles of Biochemistry by D. Nelson and M. Cox (Macmillan).
2. Fundamentals of Biochemistry by D. Voet and J. G. Voet (Wiley).
3. Harper's Illustrated Biochemistry (McGrawHill).

