SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

M.Sc. ORGANIC CHEMISTRY
(For students admitted from the academic year 2015-2016)
CURRICULUM AND SYLLABUS

UNDER CHOICE BASED CREDIT SYSTEM

FACULTY OF SCIENCE AND HUMANITIES
SRM UNIVERSITY
SRM NAGAR, KATTANKULATHUR – 603 203

M.Sc. ORGANIC CHEMISTRY
(For students admitted from the academic year 2015-2016)

CURRICULUM

SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	Total of L+T+P	C
SEMESTER I						
PCY15101	Inorganic Chemistry-I	3	3	-	6	4
PCY15102	Organic Chemistry-I	3	3	-	6	4
PCY15103	Physical Chemistry-I	3	3	-	6	4
PCY15E01/ PCY15E02	Major Elective-1 (Nanochemistry/Chemistry of Nanoscience and Technology)	3	3	-	6	3
PCY15104	Inorganic Chemistry Practical	-	-	6	6	3
Total		12	12	6	30	**18**
SEMESTER II						
PCY15201	Inorganic Chemistry-II	4	1	-	5	4
PCY15202	Organic Chemistry-II	4	1	-	5	4
PCY15203	Physical Chemistry-II	4	-	-	4	4
PCY15E51/ PCY15E52	Skill Based Elective-1 (Analytical Chemistry/ Advanced Analytical Methods)	2	2	-	4	4
	Open Elective-1	2	-	-	2	2
PCY15204	Organic Chemistry Practical	-	1	4	5	3
PCY15205	Physical Chemistry Practical	-	1	4	5	3
Total		16	6	8	30	**24**

SEMESTER III						
PCY15321	Natural Products	4	2	-	6	4
PCY15322	Spectroscopy of Organic Compounds	4	2	-	6	4
PCY15323	Heterocyclic Chemistry	4	2	-	6	4
PCY15E53	Skill based Elective-2 (Applications of Computer in Chemistry)	2	2	-	4	4
	Open Elective-2	2	-	-	2	2
PCY15324	Multistep Synthesis of Organic Compounds and Estimations	-	-	6	6	2
Total		18	8	6	30	**20**
SEMESTER IV						
Xxxxxxxx	Major Elective- 2	3	-	-	3	3
PCY15401	Seminar*	-	-	1	1	1
PCY15402	Project Work	-	-	28	28	14
Total		3	-	29	32	**18**
Total number of credits to be earned for the award of degree		**80**				

Mode for opting specialization: The number of seats in each specialization course would be upto a maximum of 30% of the total eligible candidates

Note:

* - Continuous Assessment (Full Internals)

L – Lecture Hours, T – Tutorial Hours, P – Practical Hours & C – Credits

MAJOR ELECTIVES

SEMESTER	SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	Total of L+T+P	C
I	PCY15E01	Nanochemistry	3	3	-	6	3
	PCY15E02	Chemistry of Nanoscience and Technology)	3	3	-	6	3
IV	PCY15E04	Advanced Experimental Techniques and Organic Synthesis	3	-	-	3	3
	PCY15E07	Bio-Organic Chemistry	3	-	-	3	3

SYLLABUS

SEMESTER I

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15101	Inorganic Chemistry-I	3	3	-	6	4
INSTRUCTIONAL OBJECTIVES						
(i)	To study in depth about atomic structure , periodic table , bonding and structure					
(ii)	To gain knowledge about the main group chemistry					
(iii)	To acquire knowledge about coordination chemistry					
(iv)	To study in detail about the reaction mechanism of complexes					

UNIT I Atomic Structure and PeriodicTable

Atom as nucleus with orbital electrons, concept of wave-functions, quantum numbers and spin, shape of s, p and d orbitals and their radial distribution functions, electronic configuration of atoms, Aufbau principle, Pauli Exclusion Principle and Hund's rule. Slater's rules for the determination of screening constants; arrangement of elements in Groups in the PeriodicTable- s-block, p-block, d-block and f- block elements; periodic properties, ionic radii, ionization potential, electron affinity, electronegativity (Pauling, Mulliken and Aflred-Rochnow scales) atomic states and term symbols.

UNIT II Bonding and Structure

Types of bonds, ionic, covalent, coordinate, double and triple bonds, orbital symmetry and overlaps. Concept o f M O andVB theory, concept of hybridization, the extent of d orbital participation in molecular bonding, bond energy and covalent radii. Concept of resonance, bond moment and molecular dipole moment;polarizing power and polarizability and Fajan's rules.

UNIT III Main Group Chemistry

Main Group Chemistry: Chemistry of boron – borane, higher boranes, carboranes, borazines and boron nitrides. Chemistry of silicon–silanes, higher silanes, multiple bonded systems, disilanes, silicon nitrides, siloxanes and silicates. P-N compounds, cyclophosphazenes and cyclophosphazanes. S-N compounds– S_4N_4,(SN)x.

Ionic Model-Lattice energy–Born-Lande equation –Kapustinski equation -High Tc

superconductors–Solid state reactions–Types and examples.

UNIT IV Coordination Chemistry

Theories of Metal-Ligand bond: VB theory and its limitations–Crystal field theory-splitting of d-orbitals under various geometries–Factors affecting splitting–CFSE and evidences for CFSE (Structural and thermodynamic effects)–Spectrochemical series–Jahn Teller distortion – Spectral and magnetic properties of complexes – Site preferences - Limitations of CFT – Ligand field theory – MO theory – sigma – and pi-bonding in complexes–Nephelauxetic effect–The angular overlap model.

UNIT V Reaction Mechanism of complexes

Coordination Chemistry–Reaction Mechanism: Kinetics and mechanism of reactions in solution–labile and inert complexes–Ligand displacement reactions in octahedral and square planar complexes–acid hydrolysis, base hydrolysis and anation reactions–trans effect– theory and applications. Electron transfer reactions–electron exchange reactions– complementary and non-complementary types–inner sphere and outer sphere processes–Application of Electron transfer reactions in inorganic complexes- isomerization and racemization reactions of complexes–Molecular rearrangement– reactions of four and six- coordinate complexes–Interconversion between stereo isomers. Reactions of coordinated ligands–Template effect and its application for the synthesis of Macrocyclic ligands–Unique properties.

Text Books

1. Day, M.C and Selbin,J (1985): Theoretical Inorganic Chemistry, 2nd Edition, Affiliated East West Press Pvt.Ltd.
2. Cotton, F. A and Wilkinson,G (2009): Advanced Inorganic Chemistry,4th Edition, A Wiley- Interscience Publication, John–Wiley &Sons, USA.
3. Huheey, J.E (1983): Inorganic Chemistry, 3rd Edition, Harper & Row publisher, Singapore.

References

1. Kettle, S.F.A. (1996): Physical Inorganic Chemistry – A Coordination Chemistry Approach, Spectrum, Academic Publishers, Oxford University Press.
2. Adamson, A.W (1975): Inorganic Photochemistry, John Wiley & Sons, New York.
3. Basolo, F. and Pearson, R.G (1967): Mechanism of Inorganic Reactions, JohnWiley, New York.

SEMESTER I

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15102	Organic Chemistry-I	3	3	-	6	4

INSTRUCTIONAL OBJECTIVES	
(i)	To gain knowledge on the importance of basic organic chemistry
(ii)	To acquire knowledge about aromaticity
(iii)	To understand the substitution reaction mechanisms
(iv)	To acquire knowledge in stereochemical aspects of organic molecules
(v)	To gain knowledge about the reagents and their application to organic chemistry

UNIT I Structure, Bonding and Reactive Intermediates

Structure and Bonding Localized Chemical Bonding: Electronic Structure of molecules; VB and MO - Inductive and Field Effects, Bond distances, Bond angles and Bond energies. Delocalized Chemical Bonding: Bond energies and Bond distances in compounds containing delocalized bonds - Cross conjugation- Resonance - Hyperconjugation and Keto – Enol tautomerism.

Reactive Intermediates: Generation, Structure, Stability and Reactivity of Carbocations and Carbanions, Free radicals, Carbenes, Nitrenes and Benzynes.

UNIT II Aromaticity

Huckel's theory of aromaticity, Concept of homoaromaticity and antiaromaticity.Electron occupancy in MO's. Systems with 2, 4, 8 and 10 electrons, systems of more than 10 electrons,alternant and non-alternant hydrocarbons (azulene type). Bonding properties of systems with $(4n + 2)\pi$ electrons and $4n\pi$ electrons, Aromaticity of benzenoid, heterocyclic and non-benzenoid compounds. Annulenes, Sydnones and Fullerenes. NMR concept of Aromaticity

UNIT III Substitution Reactions

Aliphatic Nucleophilic substitutions: The S_N2, S_N1, mixed S_N1 and S_N2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by σ and π- bonds, anchimeric assistance. Classical and nonclassical carbocations, phenonium ions and norbornyl system. The $S_Ni$mechanism.Nucleophilic substitution at an allylic, aliphatic trigonal and a vinylic carbon. Reactivity effects of substrate, attacking nucleophile, leaving group and reaction medium.

Aromatic Nucleophilic Substitution: The S_NAr, S_N1, benzyne and $S_{RN}1$mechanisms. Reactivity - effect of substrate, structure, leaving group and attacking nucleophile.

UNIT IV Stereochemistry

Fundamentals of Organic Stereochemistry: Principles of symmetry-Stereoisomerism-Optical isomerism-Definitions-Conventions used in Stereochemistry: Newmann, Sawhorse and Fischer notations and interconversions and representations. Nomenclature, correlation of configuration, Cahn-Ingold-Prelog rules for simple molecules, Optical activity and chirality-Types of molecules exhibiting optical activity-Fischer projection-absolute configuration. Molecules with more than one chiral center-molecular chirality-Atropisomerism-Biphenyl, allenes and spiranes. Methods of determining configuration. Prochiral centers-Asymmetric synthesis-racemisation and resolution.

Geometrical Isomerism: E&Z Nomenclature, Determination of configuration of geometrical isomers. Stereochemistry of addition and elimination reactions. Stereoselective and stereospecific synthesis(Elementary examples)Conformational Analysis. Basic concepts of conformation analysis-conformation of ethane, substituted ethane, n-butane and cyclohexane

UNIT V Reagents

Use of the following reagents in organic synthesis:, Diazomethane, Dicyclohexylcarbodiimide, DIBAL, Grignard, Lead tetraacetate, Lithium aluminium hydride, Lindlar's catalyst, N-Bromosuccinimide, Osmium tetraoxide, PCC, Raney Nickel, Selenium dioxide, Wittig reagent.

Text Books

1. March,J (2000): Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 5th edition, Wiley.
2. Morrison, R.Tand Boyd, R.N (1992): Organic Chemistry, 6th edition, Pearson.

References

1. Nasipuri, D (2002): Stereochemistry of organic compounds-Principles and applications,, 2nd edition, New Age International.
2. Bansal,R.K (1975): Organic Reaction Mechanisms, Tata McGraw Hill.

SEMESTER I

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15103	Physical Chemistry-I	3	3	-	6	4

INSTRUCTIONAL OBJECTIVES	
(i)	To understand the theories and concepts of electrochemistry.
(ii)	To suggest the applications of electrochemistry.
(iii)	To understand the thermodynamic properties and its determination.
(iv)	To make the students understand and appreciate the concepts of chemical kinetics.

UNIT I Ions in Solutions

Conductivity of solutions and their measurement - the Arrhenius ionisation theory - transport numbers and mobilities of ions - measurement of transport numbers - Hittorff method and moving boundary method - ionic activities and activity coefficients and their determination by various methods - Debye-Huckel-Onsager theory - ionic atmosphere - Debye-Huckel limiting law - dissociation constant of acids and bases.

UNIT II Electrochemical Cells

Electromotive force - measurement of EMF – the cell EMF and the cell reaction - reversible cells - types of half cells - classification of cells - the standard EMF of a cell - electrochemical potential - standard electrode potentials - calculation of the EMF of a cell - Nernst equation and its limitations - calculation of solubility products - standard free energies and entropies of aqueous ions - electrode concentration cells - electrolyte concentration cells - cells with liquid junctions - oxidation - reduction reactions, measurement of PH, concentration cells - decomposition voltages - concentration polarisation and over voltage - polarography.

UNIT III Chemical Kinetics - I

Simple collision theory, absolute reaction rate theory(ARRT),thermodynamic treatment, potential energy surfaces, application of ARRT to simple bimolecular process; chain reactions – general characteristics, study of kinetics of chain reaction like H_2-Br_2 reaction, decomposition of acetaldehyde and N_2O_5 ,study of H_2- O_2 explosive reactions. Theory of unimolecular reactions-Lindemann, Hinshelwood, RRKM and Slater treatment- steady state approximation, principle of microscopic reversibility and detailed balancing - kinetic isotope effect.

UNIT IV Chemical Thermodynamics

Second law of thermodynamics-concept of entropy-Gibbs function- Gibbs –Helmholtz equation- Maxwell relations- Thermodynamic equation of state- thermodynamics of systems of variable composition- partial molar quantities, partial molar volume-chemical potential, Gibbs-Duhem equation – Experimental determinations of fugacity of real gases. Third law of thermodynamics – absolute entropies-determination-exception to third law – Unattainability of absolute zero

UNIT V Surface Phenomenon and Catalysis

Introduction-adsorption of gases on solids- physisorption and chemisorptions, adsorption isotherms- Freundlich – Langmuir-BET-Temkin adsorption isotherm-Adsorption on liquid surface-surface tension-Gibbs's adsorption isotherm-surface area determination.

Specific and general acid-base catalysis. Bronsted catalysis law. Acidity functions. Enzyme catalysis (single substrate reactions only).Michaelis-Menton kinetics. Influence of pH and temperature on enzyme catalysis. Kinetics of heterogeneous catalysis (Langmuir Hinshelwood mechanism and Eley-Rideal mechanism)

Text Books

1. Gurudeep Raj (2006): Advanced Physical chemistry, 32nd edition, Goel Publishing House, Krishna Prakashan Media (P) Ltd.
2. Bockris J.O.M and Reddy,A.K.N (2008): Electrochemistry, volumes 1 and 2, Springer.
3. Laidler,J (1987): Chemical Kinetics, 3rd edition, Harper & Row.

References

1. Glasstone,S (2004) : An Introduction to Electrochemistry, Affiliated East West press, New Delhi.
2. Arthur W. Adamson, Alice P. Gast (1997): Physical chemistry of surfaces, 6thEdition,Wiley Eastern Ltd.
3. Glasstone, S (2012): Thermodynamics for chemists, East West press.

SEMESTER I

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15E01	Major Elective-1a (Nanochemistry)	3	3	-	6	3

INSTRUCTIONAL OBJECTIVES	
(i)	To educate students on the basics of nanochemistry
(ii)	To make students understand the various techniques involved in the characterisation of nanomaterials
(iii)	To acquire knowledge on the synthesis of nanomaterials
(iv)	To envision the importance of nanomaterials

UNIT I Nanochemistry – An Introduction

Definition of nanodimensional materials - Some historical milestones in the saga of nano forms - Size effects - Importance of nanomaterials - Classification of nanomaterials - Simple examples of unique properties of nanosized materials - Elementary aspects of bio nanotechnology - Some important recent discoveries in nanoscience and technology.

UNIT II Techniques in Nanochemistry

Techniques for characterisation of nanoscale materials (Basic aspects): Atomicforce microscopy (AFM)-Transmission electron microscopy (TEM)-Resolutionand scanning transmission electron microscopy (STEM) Scanning Tunneling Microscopy (STM) Scanning near field optical microscopy (SNOM) and surface plasmon spectroscopy.

UNIT III Synthesis of Nanomaterials

Chemical methods in preparation of nanomaterials: Sol – gel technique – co-precipitation hydrolysis –sonochemical method – combustion technique – colloidal precipitation – template process.

Inorganic Nanoparticles and Nanoporous Materials: Oxide nano particles – Oxomolybdates – Nano catalysis – Porous silicon –Transition and Non transition metal phosphates.

UNIT IV Carbon Clusters and Nanostructures

Nature of carbon bond − New carbon structures − Carbon clusters: Discoveryof C60 − Alkali doped C60 − Superconductivity in C60 − Larger and smallerfullerenes. Carbon nanotubes: Synthesis − Single walled carbon nanotubes −Structure and characterization − Mechanism of formation – Chemically modified carbon nanotubes − Doping − Functionalizing nanotubes − Application of carbonnanotubes. Nanowires − Synthetic strategies − Gas phase and solution phasegrowth − Growth control − Properties.

UNIT V Organic Films and Supramolecular Assembly

Organic films - insulating and passivating layers – electron transfer – Organic nanostructures – Optical properties – Organic semiconductors – Active organicdevices. Polymerization – Sizes of polymers – Nanocrystals – Conductive polymers – Block co-polymers. Supramolecular structures – Transition-metal mediated types - Dendritic molecules – Supramolecular dendrimers – Micelles – Biological nanostructures – Examples of proteins

Applications of nanomaterials: Applications of Nanoparticle in various fundamental research, industries, medical fieldand environmental issue; toxicity, biosafety and ethical issue in application of Nanoparticles.

Text Books

1. Rao, C. N. R, Muller,A and Cheetam, A.K. (Eds) (2004): The Chemistry of Nanomaterials, Vol.1, and 2, Wiley – VCH, Weinheim.
2. Poole, C. P and Owens,Jr: F. J (2003): Introduction to Nanotechnology Wiley Interscience, New Jersey.
3. Kenneth J. Klabunde (Ed) (2001), Nanoscale materials in Chemistry, Wiley-Interscience, New York.

References

1. Pradeep,T (2007): Nano: The Essentials in understanding nanoscience and nanotechnology, Tata McGraw Hill, New Delhi.
2. Gleiter,H (2000): Nanostructured Materials: Basic Concepts, Microstructure and Properties.
3. Tang, T and Sheng, P. (2004): Nano Science and Technology – Novel Structures and Phenomena, Taylor & Francis, New York, 2004.

SEMESTER I

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15E02	Major Elective -1b (Chemistry of Nanoscience and Technology)	3	3	-	6	3

INSTRUCTIONAL OBJECTIVES	
(i)	To understand the basic concept of nano science and technology.
(ii)	To acquire knowledge about synthesis, preparation and characterization of nanomaterials
(iii)	To gain knowledge on application of nanomaterials.

UNIT I Basic Aspects of Nanotechnology

Introduction and classification - What is nanotechnology - Classification of nanostructures - Nanoscale architecture - How nanoscale dimensions affect properties - Carbon and inorganic nanostructure - self assembled materials - Making thin organic films –nano patterning surfaces by self-assembly - Templated nanostructures.

UNIT II Characterization Methods

X-ray diffraction - XPS Working Principle, Instrumentation and Applications. Impedance Analysis - Micro hardness – nano indentation– Nuclear Magnetic Resonance (NMR). Differential scanning calorimeter (DSC)-Thermogravimetric/Diffferential Thermal Analyzer (TG/DTA)-UV-Visible Spectrophotometer - FTIR – Principle and Applications – Photoluminescence (PL) Spectroscopy.

UNIT III Lithographic Methods

Introduction – Lithography – Photolithography - Phase-shifting photolithography - Electron beam lithography - X-ray lithography - Focused ion beam (FIB) lithography - Neutral atomic beam lithography - Nanomanipulation and Nanolithography - Soft Lithography - Assembly of Nanoparticles and Nanowires Other Methods for Microfabrication.

UNIT IV Sensors

Static and Dynamic Characteristics - Inorganic Nanotechnology Enabled Sensors - Gas Sensing with Nanostructured Thin Films - Nanotechnology Enabled Mechanical Sensors - Nanotechnology Enabled Optical Sensors - Magnetically Engineered Spintronic Sensors - Organic Nanotechnology Enabled Sensors - Surface Materials and Surface Modification.

UNIT V Energy Devices

Nanoscale Electronic and Ionic Transport – Energy Conversion and Storage in Electrochemistry - Overview of the Principles of Operation of Energy Conversion and Storage Devices - Solar Cells -Nanomaterials and Nanostructured Films as Electro active Electrodes - Nanomaterials as Electrolytes - Lithium Ion Batteries - Fuel Cells. Quantum Dot Sensitizers.

Text Books

1. Robert W. Kelsall, Ian W. Hamley and Mark Geoghegan (2005): Nanoscale Science and Technology John Wiley & Sons, Ltd., UK.
2. Pradeep,T (2008): Nano:The Essentials: Understanding Nanoscience and Nanotecnology, Tata McGraw-Hill Publishing Company Limited, New Delhi.

References

1. Rao,C. N. R, Thomas,P. J. and Kulkarni,G. U (2007): Nanocrystals: Synthesis, Properties and Applications, Springer .
2. Kourosh Kalantar-zadeh and Benjamin Fry (2008): Nanotechnology - Enabled Sensors,Springer.
3. Guozhong Gao (2004): Nanostructures & Nanomaterials: Synthesis, Properties & Applications, ImperialCollegePress .

SEMESTER I

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15104	Inorganic Chemistry Practical	-	-	6	6	3
INSTRUCTIONAL OBJECTIVES						
(i)	To enable the students, to apply the principle in the semi-micro analysis of an inorganic salt mixture.					

Semi – micro qualitative analysis:

Analysis of mixtures containing two familiar and two less familiar cations from the following W, Pb, Se, Te, Mo, Cu, Cd, As, Sb, Ce, Be, Th, Zr, Ti, V, Cr, Mn, U, Ni, Co, Zn, Ca, Ba, Sr, Li, Mr (insoluble and interfering anion may be avoided).

Any eight combinations of different salts.

General scheme for distribution of marks in practical examination

Time: 6 h (One day Examination) Marks: 50 (External) + 50 (Internal)
Identification of ions: 20 Marks
Procedure : 10 Marks
Record : 10 Marks
Viva-Voce : 10 Marks
Internal : 50 Marks
Total : 100

Text Books

1. Vogel's (1987): Qualitative Inorganic Analysis, Revised by G Svehla, 6th Edition, Longman.
2. Ramanujam, V.V (1974):Inorganic Semi-micro Qualitative Analysis", The National Publishing Co, Chennai.

SEMESTER II

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15201	Inorganic Chemistry-II	4	1	-	5	4

INSTRUCTIONAL OBJECTIVES	
(i)	To understand the various concepts of acids and bases
(ii)	To understand the basic principles of Ionic bond
(iii)	To gain knowledge in nuclear chemistry
(iv)	To educate students on the various spectroscopic techniques and its applications to some selected molecules

UNIT I Acids and Bases

Acids and Bases: Bronsted and Lewis acids and bases, pH, pKa, acid–base concept in non-aqueous media, buffer solution, Protonic acids–Proton Affinities–Differentiation and Leveling solvents–Hammet Ho scale–Acidic behavior of the binary hydrides–Cosolvating agents – Oxyacids–Organic acids–Acetic acid and the Inductive Effect, Aromatic Acids and Resonance Effects – Hydrolysis and Aquo acids– Basic precipitations–Amphoteric oxides–Non protonic concepts of Acid–Base reactions–Lux Concept–Solvent Ion theory of Acids and Bases–Liquid Ammonia, Acetic acid as a solvent, Bromine trifloride, Dinitrogen tetra oxide, Liquid hydrogen chloride–Hard and Soft Acids and Bases – Classification – Acid – Base strength and Hardness and Softness – Symbiosis– Theoretical basis of Hardness and Softness–Electronegativity and Hardness and Softness.

UNIT II Ionic Bond and Crystal Structure

Radius Ratio rules–Calculation of some limiting radius ratio values for C . N . 3 (planar triangle), C.N. 4 (tetrahedral), C.N. 6(octahedral). Classification of Ionic structures – AX (ZnS, NaCl, CsCl),AX_2(fluorite, rutile, beta-cristobalite) and AX_3types(Structures only), Layer structure – CdI_2, Nickel arsenide structures–Lattice energy–Born-Lande equation derivation–Important points arising from Born –Lande equation–Schottky defect and Frenkel defect–explanation and calculation of number of defects formed percm^3–Metal excess defect–F centers and interstitial ions–Metal deficiency defect–positive ions absent–extra interstitial negative ions–Semiconductors and transistors–Rectifiers –Photovoltaic cell–Transistors–steps in the manufacture of memory chips for computers.

UNIT III Nuclear Chemistry

Radioactive decay – Theories of decay processes – Laws of radioactivity – Detection and measurement of radiations – Nuclear structure – Composition of nuclei – properties of nuclei – nuclear radii, nuclear spin etc – nuclear forces – its characteristics–Meson field theory – nuclear stability – characteristics – nuclear models–liquid drop, shell and collective models. Artificial radioactivity – Nuclear reactions transmutations, stripping and pickup, fission, fusion, spallation and fragmentation reactions– scattering reactions–nuclear cross section. Nuclear reactors–charged particle accelerators– neutron sources – gamma ray and X-ray sources. Applications of nuclear science in agriculture and biology–neutron activation and isotopic dilution analysis.

UNIT IV Spectroscopic Techniques

Infrared and Raman Spectroscopy: Structural elucidation of coordination compounds containing the following molecules/ions as ligands - $NH_3, H_2O, CO, NO, OH^-, SO_4^{2-} CN^-, SCN^-, NO^{2-}$ and X^- (X=halogen).

Electron Paramagnetic Resonance Spectroscopy:

EPR of d^1 and d^9 transition metal ions in cubic and tetragonal ligand fields, evaluation of g values and metal hyperfine coupling constants.

UNIT V Studies and Applications of Lanthanides and Actinides

Spectral and magnetic properties, use of lanthanide compounds as shift reagents, Modern methods of separation of lanthanides and actinides, Organometallic chemistry applications of lanthanide and actinide compounds in Industries

Text books

1. Bodie, E.Douglas and DarlH.McDaniel(1970): Concepts and Models in Inorganic Chemistry, Indian Edition, Oxford & IBH Publishing Co, NewDelhi.
2. Friedlander,J.W, Kennady and Miller,J.M(1981): Nuclear and Radiochemistry,3rd Edition.
3. Cotton and Wilkinson (1988): Advanced Inorganic Chemistry,5thed.,John Wiley & Sons,NewYork.

References

1. Kaim ,W and Schwederski, B (1994): Bioinorganic Chemistry, Inorganic elements in the Chemistry of Life, John Wiley & Sons, New York.
2. James E.Huheey, Ellen A Keiter and Richard L.Keiter (2006):Inorganic Chemistry, Principles of Structures and Reactivity, 4thed, Addison-Wesley, New York.

SEMESTER II

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15202	Organic Chemistry– II	4	1	-	5	4
INSTRUCTIONAL OBJECTIVES						
(i)	To gain knowledge in the addition reactions and its applications					
(ii)	To acquire knowledge about Elimination reactions					
(iii)	To understand the rearrangements and its mechanisms					
(iv)	To acquire knowledge in photochemistry of organic molecules					
(v)	To gain knowledge in pericyclic concerted reactions					

UNIT I Addition Reactions

Addition to Carbon - Carbon Multiple Bonds: Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals - regio and chemo selectivity, orientation and reactivity. Addition to cyclopropane ring. Hydrogenation of double and triple bonds - Hydrogenation of aromatic rings and Hydroboration. Sharpless asymmetric epoxidation.

Addition to Carbon - Hetero Multiple Bonds: Steric course of addition reactions to C=O and C=N, Cram's rule, Aldol condensation, Cannizzaro, Perkin, Knoevenagel condensations, Claisen - Schmidt, Claisen, Dieckman, Benzoin and Stobbe condensations, Wittig, Grignard, Mannich, Michael reaction. Hydrolysis of Carbon-Nitrogen bond, Isocyanates and isothiocyanates.

UNIT II Elimination Reactions, Esterification and Hydrolysis

Elimination Reactions: Types of elimination reactions, Mechanisms, Stereochemistry and Orientation. Hofmann and Saytzeff rules. Syn elimination versus anti- elimination, competition between elimination and substitution, factors influencing elimination and substitution reaction, dehydration, dehydrogenation, dehalogenations, decarboxylative eliminations, pyrolytic eliminations, molecular rearrangement during elimination and Fragmentation reactions.

Esterification and hydrolysis: Mechanism of hydrolysis of Esters, amides and acyl halides, Esterification of acids and trans esterification.

UNIT III Rearrangements

Rearrangement involving migration to electron-deficient carbon

Wagner-Meerwein, Pinacol-Pinacalone, Benzil-Benzilic, Wolf rearrangements.

Rearrangement involving migration to electron-deficient nitrogen

Beckmann, Hofmann, Curtius, Lossen, Schmidt rearrangements

Rearrangement involving migration to electron-deficient oxygen

Baeyer-Villiger oxidation, Hydroperoxide rearrangement.

Rearrangement involving migration to electron-rich carbon

Favorskii, Stevens, Neber rearrangements

UNIT IV Photochemistry

Organic Photochemistry – Fundamental concepts – Jablonski diagram – Energy transfer, characteristics of photoreactions, photoreduction and photoxidation, photoreactions of ketones and enones, Norrish Type I and II reactions. Photochemistry of alkenes, dienes and aromatic compounds, reactions of unactivated centres – Photolytic cycloadditions and photolytic rearrangements – Photosenstitisation –Photoadditions – Barton reaction – PaternoBuchi reaction.

UNIT V Pericyclic Reactions

Concerted reactions – stereochemistry-orbital symmetry and concerted symmetry and correlation diagram –Frontier molecular orbital approach – Woodward and Hoffmann rules – Electrocyclic reactions – cycloaddition reactions – sigmatropic rearrangements – selection rules and examples with simple molecules – 1,3 and 1,5 hydrogen shifts – Cope and Claisen rearrangements.

Text Books

1. March, J (2000): Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 5th edition, Wiley.
2. Morrison, R.T. and Boyd, R.N (1992): Organic Chemistry, 6th edition, Pearson.

References

1. Finar, I.L (1975): Organic Chemistry, Vol.II, 5th edition, ELBS.
2. Bansal,R.K (1975): Organic Reaction Mechanisms, Tata McGraw Hill.
3. CareyF.A and Sundberg, R.J (2002): Advanced Organic Chemistry, Parts A & B, Plenum, 2002

SEMESTER II

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15203	Physical Chemistry - II	4	-	-	4	4

INSTRUCTIONAL OBJECTIVES	
(i)	To have a good foundation in understanding the physical and mathematical aspects of quantum mechanics.
(ii)	To become familiar with the aspects of group theory.
(iii)	To understand and appreciate the concepts of statistical thermodynamics.
(iv)	To know about electrochemical phenomena.

UNIT I Electrochemical Phenomena

Evidences for electrical double layer. Electrocapillary phenomena-Electro capillary curves, Electro-osmosis, electrophoreses. Streaming and Sedimentation potentials. Zeta potentials and its determination by electrophoresis, influence of ions on Zeta potential. Helmholtz-Perrin, Guoy-Chapmann and Stern models of electrical double layer-Applications and limitations.Kinetics of electrode process. Energy barrier at electrode surface- electrolyte interface, overpotential, Butler – Volmer equation, Tafel equation

UNIT II Chemical Kinetics II

Comparison between gas phase and solution reactions, Cage effect.The influence of the solvent on the reactions between ions and reaction between ions and neutral molecules. Influence of ionic strength on rates of reactions in solution. ARRT to reaction in solution, Significance of volume and entropy of activation.Primary and secondary salt effect.

UNIT III Statistical Thermodynamics

Aims of statistical thermodynamics, definition of state of a system, ensembles (microcanonical and canonical) Boltzmann distribution law and its derivation. Boltzmann-Planck equation: partition functions, thermodynamic properties from partition functions, partition function and equilibrium constant; Quantum statistics-Fermi Dirac and Bose-Einstein statistics, photon gas, electron gas according to such statistics: population inversion, negative Kelvin temperature, Einstein's and Debye's theories of heat capacities of solids. Nuclear spin statistics-statistical basis of entropy of H_2 gas- ortho and para nuclear states- Calculation of entropy in terms of ortho-para ratio – residual entropy of H_2 at 0 K.

UNIT IV Basics of Group Theory

Symmetry elements and symmetry operations, group and its properties, Multiplication table, point symmetry groups. Schoenflies symbol, representations of groups by matrices, Irreducible representation of groups, the Great Orthogonality theorem, construction of character table (C_{2v}, C_{3v} only). Applications of group theory to normal modes analysis, Selection rules for fundamental vibrational transition – IR and Raman activity of fundamentals in H_2O,BF_3,– The rule of mutual exclusion.

UNIT V Basics of Quantum Mechanics

de-Broglie's concept, experimental verification- Compton effect - Heisenberg's uncertainty principle – derivation of Schrodinger wave equation - requirements of the acceptable wave function. Operators, linear operators, method of getting the following quantum mechanical operators: Position, Momentum, kinetic energy, potential energy, total energy, angular momentum. Hermicity and proving the quantum mechanical operators are Hermitian operation- commutator algebra-evaluation of commutators - eigen functions and eigen values - postulates of quantum mechanics.

Text Books

1. Prasad,R. K (2010): Quantum chemistry, 4th edition, New Age International.
2. Cotton F. A (2004): Chemical applications of group theory, 3rd edition, John Wiley& Sons.
3. Rajaram J (2013): Chemical Thermodynamics: Classical, Statistical and Irreversible, Dorling Kindersley (India)Pvt Ltd.

References

1. Bockris J.O.M and Reddy, A.K.N (2008): Electrochemistry, volumes 1 and 2, Springer.
2. Banwell, C.N (2013): Fundamentals of molecular Spectroscopy,5thedition., TMH, New Delhi.
3. Gilbert W. Castellan (2004): Physical Chemistry, 4th edition, Narosa Publishing House.

SEMESTER II

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15E51	Skill Based Elective-2a (Analytical Chemistry)	2	2	-	4	4

INSTRUCTIONAL OBJECTIVES	
(i)	To learn the fundamental principles of analytical chemistry.
(ii)	To understand the difference between accuracy and precision, significance of figures, and be able to apply statistical analysis to rely on or reject results.
(iii)	To understand the different types of titrations and their applications.
(iv)	To understand the different chromatographic methods and their applications.

UNIT I Errors and Evaluations

Systematic and random errors, Effects of errors on analytical results, Accuracy, precision, Absolute and Relative errors, Significant figures, mean, mean deviation and median, standard deviation, variance, confidence limits, application of statistics, Reliability and rejection of results, Q test, Analysis of variance.

UNIT II Types of Titrations

Redox titration: Redox potentials, theory and feasibility of redox titration, calculation of potentials at different stages of titrations, redox indicators, their choice and applications.

Precipitation titrations: Theory and types, Mohr, Volhard and Fajan's methods. Adsorption indicators: theory, choice and applications.

Complexometric titrations: Theory, Stepwise and overall formation constants, Titrations involving chelates (EDTA). Metallochromic indicators: Theory and Choice, Masking and demasking methods and applications.

UNIT III Chromatography

Solvent extraction, principles, types and applications of paper, column, thin layer, gas and ion exchange Chromatographic techniques. Adsorbents, columns, detection methods, estimations, preparative column, GC, MS techniques: methods, principles and uses.

UNIT IV Thermal Methods of Analysis

Thermogravimetric analysis: Principle, Thermal analysis of silver nitrate, methods of obtaining thermograms, TGA, factors influencing the thermogram, Instrumentation, precautions in the use of thermo balance and applications.

Differential Thermo Analysis: Theory, principle, instrumentation and applications, DTA of calcium oxalate monohydrate, thermal analysis of calcium monohydrate.

Thermometric titrations: Theory, instrumentation, technique of thermometric titrations applications of thermometric titrations in complexometric and redox titrations.

UNIT V Electro analytical Techniques

Polarography: Introduction, Instrumentation, Ilkovic equation and its verification. Derivation of wave equation, Determination of half wave potential, qualitative and quantitative applications.

Amperometry: Basic principles, instrumentation, nature of titration curves and analytical applications.

Theory of Electrogravimetric analysis, electrode reactions, overpotential, completeness of deposition, electrolytic separation of metals with controlled cathode potential.

Textbooks

1. Skoog, D.A, West,D.M and Holler,F.J and Crouch,S.R (2007): Fundamentals of Analytical Chemistry, 8thEdn., Saunders College Pub.
2. Miller, J.C and Miller,J.N (1988): Statistics for Analytical Chemistry – Ellis Horwood. Chichester..
3. Skoog, Willard and Dean (1988): Instrumental methods of analysis. 8th Edition, East West Press, New Delhi. 1988.

References

1. Christian, G.D andJ.E. O'Reilly (1986): Instrumental Analysis, Allyn& Bacon.
2. Sivasankar,B (2012): Instrumental methods of analysis, Oxford University Press
3. Kaur,H (2001): Instrumental methods of Chemical analysis, PragatiPrakashan, 1st Edition, Meerut

SEMESTER II

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15E52	Skill Based Elective-2b (Advanced Analytical Methods)	2	2	-	4	4

INSTRUCTIONAL OBJECTIVES	
(i)	To know the principle and applications of electrochemical techniques.
(ii)	To elucidate the molecular structure by applications of chemical spectroscopy.
(iii)	To understand the basic concepts in surface imaging
(iv)	To know about biochemical analysis and the applications of sensors.

UNIT I Advanced Electrochemical Techniques

Principles, Instrumentation-Electrochemical scanning tunneling microscopy and Electrochemical Atomic force microscopy. Spectro-electrochemistry - Principle, applications. Impedance measurements, Chronomethods - Principles, Chrono-potentiometric – amperometric and coulometric measurements - Instrumentation and Applications.

UNIT II Applications of Chemical Spectroscopy

Infrared Spectroscopy: Fourier Transform infrared spectroscopy - Applications. Combined Applications - UV, IR, NMR and Mass in the elucidation of molecular structure. Chemical Analysis- Non-destructive techniques- Wavelength and energy dispersive X-ray fluorescence spectroscopy (WDS and EDS)-X-ray absorption spectroscopy (XANES and EXAFS)-Destructive technique- inductively coupled plasma-atomic emission spectroscopy (ICP-AES).

UNIT III Surface Analytical Techniques

Basic concepts in surface imaging - Electron Spectroscopy for Chemical Analysis (ESCA): Principles, Instrumentation, and Analytical Applications. Auger electron spectroscopy: Principles, Instrumentation, Applications. Surface enhanced Raman Spectroscopy (SERS): Principles, Instrumentation, Nanoparticulate SERS substrates, Surface enhanced resonance Raman scattering (SERRS), SERRS of Ag and Au metal colloids, Thin solid films, Langmuir-Blodgett Monolayers, SERRS mapping and imaging, Applications.

UNIT IV Chemiluminescence

Introduction, principle, types. Measurement of chemiluminescence, Instrumentation quantitative chemiluminescences. Gas phase chemiluminescence's analysis. Electro-chemiluminescence.

UNIT V Bioanalytical Chemistry

Relevance of Bioassaying and Biochemical Analysis-Spectroscopic methods and fluorimetric methods-Quantitation of Enzymes and Optical Methods of Detection of Enzymes, Immobilization Methods, Mass Spectrometry of Biomolecules, Matrix-assisted laser desorption/ionization (MALDI); Electrochemical Sensors and Biosensors in Bioanalysis-Immunoassaying.

Text Books

1. Sharma, Y. R. (2007): Elementary Organic Spectroscopy-Principles and Applications, 5th Edition S. Chand Publishers.
2. Kamalesh Bansal, (2009): Analytical spectroscopy ,Campus Book International,

References

1. Fritz Scholz, (2010): Electroanalytical Methods: Guide to Experiments and Applications, 2nd Edition, Springer,.
2. D J O'Connor, Brett A Sexton, Roger S C Smart (Eds), (2010): Surface Analysis Methods in Materials Science, 2nd Edition, Springer,.
3. John F Watts, John Wolsten holme, (2011): An Introduction to Surface Analysis by XPS and AES, 2nd Edition, Wiley VCH,.
4. Susan R. Mikkelsen and Eduardo Cortón, (2004) :Bio Analytical Chemistry, John Wiley & Sons Inc.

SEMESTER II

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15204	Organic Chemistry Practical	-	1	4	5	3
INSTRUCTIONAL OBJECTIVES						
(i)	To understand the separation methods of organic mixtures.					
(ii)	To impart knowledge in the synthesis of organic compounds.					

Qualitative Analysis of an organic mixture containing two components.

Pilot separation, bulk separation, analysis, derivatization.

- Detection of elements (N, Cl, S) by Lassaigne's test
- Detection of the following functional groups by systematic chemical analysis: Aromatic amino ($-NH_2$), aromatic nitro ($-NO_2$), Amido ($-CONH_2$, including imide), Phenolic –OH, Carboxylic acid (-COOH), Carbonyl (>C=O); only one test for each functional group is to be reported.

Preparation of Organic compounds (Single stage).

(a) 2,4,6-trinitrophenol(picric acid)from phenol (nitration)
(b) Benzophenoneoxime from Benzophenone (addition reaction)
(c) Benzophenoneoxime to Benzanilide(rearrangement)
(d) 4-nitrobenzoic acid to 4-nitrobenzanilide (Substitution)
(e) o-chlorobenzoic acid from anthranillic acid (Sandmeyer reaction)
(f) p-benzoquinone from hydroquinone (oxidation)
(g) 2,4,6-tribromophenol from phenol (bromination)

General scheme for distribution of marks in practical examination

Time: 6 h (One day Examination) Marks: 50 (External) + 50 (Internal)
Qualitative analysis: 10 Marks
Preparation : 10 Marks
Procedure : 10 Marks
Record : 10 Marks
Viva-Voce : 10 Marks
Internal : 50 Marks
Total : 100

Text Books

1. Vogel (1996): A Textbook of Practical Organic Chemistry, 5th edition, Prentice Hall,
2. Fieser and Fieser (2006): Reagents in Organic Synthesis, Wiley, 2006

References

1. Mann & Saunders (1960): Practical Organic Chemistry, 4th edition, Longmans.
2. Clarke.H. T (1975): A Handbook of Quantitative & Qualitative Analysis, Arnold Heinemann.
3. March,J (2000): Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 5th edition, Wiley.

SEMESTER II

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15205	Physical Chemistry Practical	-	1	4	5	3

INSTRUCTIONAL OBJECTIVES	
(i)	To motivate the students to understand the principles of chemical kinetics, potentiometric and conductometric titrations.
(ii)	To impart knowledge with respect to the phase transformation of different systems.

LIST OF EXPERIMENTS

1. Determination of rate constant of Acid hydrolysis of an ester.
2. Determination of molecular weight of substances by Rast method.
3. Determination of Critical Solution Temperature (CST) of phenol- water system and effect of impurity on CST.
4. Study of phase diagram of two components forming a simple eutectic.
5. Distribution of benzoic acid between water and benzene.
6. Adsorption of oxalic acid/acetic acid on charcoal.
7. Determination of E_a of saponification of Ester by conductometry method.
8. Determination of equivalent conductance, degree of dissociation and dissociation constant of weak acid by conductometry.
9. Determination of relative strength of two acids by conductance measurements.
10. Titration of $AgNO_3$vs Halide mixture by potentiometry.
11. Redox titrations (MnO_4^- vs I^- / $Cr_2O_7^{2-}$vs Fe^{2+}) by potentiometry.
12. Determination of dissociation constant of weak acids by potentiometry.

General scheme for distribution of marks in practical examination

Time: 6 h (One day Examination) Marks: 50 (External) + 50 (Internal)
Observations including tables and figures: 20 Marks
Procedure : 10 Marks
Record : 10 Marks
Viva-Voce : 10 Marks
Internal : 50 Marks
Total : 100

Text Books

1. Yadav, J. B (2005): Advanced Practical Physical Chemistry, 22nd edition, Goel publishing House, Krishna Prakashan Media Ltd.
2. Venkatesan, V, Veeraswamy, R and Kulandaivelu, A.R (1997): Basic Principles of Practical Chemistry", 2nd edition, Sultan Chand and Sons Publication, New Delhi.

References

1. Findlay's (1985): Practical Physical Chemistry, Revised and edited by B.P. Levitt 9th edition, Longman, London.
2. Chatwal, G.R. and Anand, S.K (2000): Instrumental Methods of Chemical Analysis, Himalaya Publishing House, Delhi.

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15321	Natural Products	4	2	-	6	4
INSTRUCTIONAL OBJECTIVES						
(i)	To gain knowledge in the area of terpenoids and carotenoids and their structure elucidation					
(ii)	To acquire knowledge in the area of alkaloids and their structural elucidation					
(iii)	To understand about the structural aspects of steroids					
(iv)	To acquire knowledge in the fields of flavonoids and isoflavonoids					
(v)	To gain knowledge in peptides, proteins and their structures					

UNIT I Terpenoids and Carotenoids

Classification, nomenclature, occurrence, isolation, isoprene rule and special isoprene rule general methods of structure determination. Structure determination, stereochemistry and synthesis of the following representative molecules: Citral, Geraniol, Terpineol, Farnesol and Zingiberene.

UNIT II Alkaloids

Definition, nomenclature and physiological action, occurrence, classification, isolation, general methods of structure elucidation, degradation. Structure determination, stereochemistry and synthesis of the following: Ephedrine, Nicotine, Atropine and Morphine

UNIT III Steroids

Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry. Isolation, structure determination and synthesis of Cholesterol (total synthesis not expected, but partial synthesis is expected)Bile acids, Androsterone, Testosterone, Progesterone.

UNIT IV Flavonoids and Isoflavonoids

Occurrence, nomenclature, Isolation, structure determination and synthesis of Apigenine, Luteoline, Quercetin, Butein.

UNIT V Peptides and Proteins

Peptides and proteins, methods of peptide synthesis, sequence determination, structure of Oxytocin, proteins-classification, structure, conformation and properties, peptide synthesis (using Merrifield resin)

Text Books

1. Finar,I.L. (2002): Organic chemistry, Vol-I&II, 6th Edition, Pearson
2. Clayden,J, Greeves,N, Warren, S. and Wothers,P (2001): Organic Chemistry, Oxford University Press.

References

1. Tsuji,J. (2003): Palladium Reagents and Catalysts, NewPerspectives forthe 21st Century, John Wiley & Sons.
2. Ojima,I.(2000): Catalytic Asymmetric Synthesis, 2nd edition, Wiley−VCHNew York.
3. Carruthers,W. (1996):Modern Methods of Organic Synthesis, Cambridge University Press,
4. Noyori, R. (1994):Asymmetric Catalysis in Organic Synthesis, JohnWiley& Sons.

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15322	Spectroscopy of Organic Compounds	4	2	-	6	4

INSTRUCTIONAL OBJECTIVES	
(i)	To gain knowledge in UV-Visible spectroscopy and its application to conjugated systems
(ii)	To acquire knowledge in identifying the organic functional groups and their stretching frequencies
(iii)	To understand about the proton environment and its chemical shift values
(iv)	To acquire knowledge about carbon chemical shift values
(v)	To gain knowledge in fragmentation of organic molecules

UNIT I UV-Visible Spectroscopy

Beer-Lamberts law- various electronic transitions-instrumentation and sampling - Effect of solvent on electronic transitions - Fieser-Woodward rules - Ultraviolet spectrum of carbonyl and unsaturated carbonyl compounds - Ultraviolet spectra of aromatic and heterocyclic compounds

UNIT II IR Spectroscopy

Principle-vibrational frequencies –instrumentation-sampling-fingerprint region-FTIR spectra of organic functional groups- Effect of hydrogen bonding and solvent effect on vibrational frequencies.

UNIT III H^1NMR Spectroscopy -I

Principle-instrumentation-sampling- nuclear spin-nuclear resonance-saturation-shielding and deshielding magnetic nuclei-shielding mechanism-chemical shift and its measurements-factors influencing chemical shifts-chemical shift values. Interpretation of standard representative organic molecules.

UNIT IV H^1NMR Spectroscopy-II and ^{13}C NMR Spectroscopy

Spin-Spin interaction-coupling constant(J)-complex-classification-spin-spin interaction between two, three, four and five nuclei(ABC, ABX, AMX, A_2B_2etc)-Hindered rotation-Karplus curve variation of coupling constant with dihedral angle-contact shift reagents- double irradiation-nuclear overhauser effect (NOE).

^{13}C-NMR Spectroscopy: General considerations - Chemical shift (aliphatic, olefinic, alkyne, carbonyl carbon, aromatic).

UNIT V Mass Spectrometry

Principle-Instrumentation-ion production -Types of ionization; EI, CI, FD, and FAB - Nitrogen rule- Molecular-ion peak - Metastable peak Factors affecting fragmentation-- Mass spectral fragmentation of organic compounds - Mc. Lafferty rearrangement-Isotope labeling/identification.

Text Books

1. Kemp, W (1994): Organic Spectroscopy, 3rd Ed., MacMillan
2. Kalsi,P.S (2007): Spectroscopy of Organic Compounds, 6th Edition, New age international publishers.

References

1. Silverstein, P.M and Wester, F. X(1988): Spectroscopic Identification of Organic Compounds, 6th ed., Wiley .
2. Sharma Y.R(1992): Elementary Organic Spectroscopy – Principles and Chemical applications, S.Chand.
3. Glusker, J.P and True blood,K.N. (1972): Crystal structure analysis: A primer., Oxford university press, New York,

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15323	Heterocyclic Chemistry	4	2	-	6	4
INSTRUCTIONAL OBJECTIVES						
(i)	To gain knowledge on nomenclature of heterocyclic systems					
(ii)	To acquire knowledge about synthesis, reactivity and applications					
(iii)	To gain knowledge on the synthesis and applications of heterocycles with two heteroatoms					

UNITI Heterocyclic Compounds

Replacement and systematic nomenclature (Hantzsch-Widman system) of monocyclic, fused and bridged heterocycles

UNITII Three and Four membered Heterocycles with one Heteroatom

Synthesis and reactions of aziridines, oxiranes, thiiranes, aziridines, oxetanesthietanes, and applications

UNIT III Five membered Heterocycles with one/multiple Heteroatom

Synthesis and reactions of Pyrrole, furan, thophene, pyrazole and imidazole, oxazole and isoxazole, thiazole, isothiazoles, and applications.

UNIT IV Fused Heterocycles

Synthesis and reactions including medicinal applications of indole, quinoline, isoquinoline, benzopyroles,benzofurans, benzothiophenes, benzimidazoles, purins and pyrimidines application

UNIT V Heterocycles with multiple Heteroatoms

Synthesis and reactions of pyridazine, pyrimidine,pyrazine, pyrane, thiopyrane, diazines, thiazines, dioxane, oxazine, quinazoline application

Text Books

1. Bansal R K(1999):Heterocyclic Chemistry, New Age International
2. Acheson R H, (1976): An introduction to the chemistry of Heterocyclic compounds, Wiley

References

1. Trivedi J J, Gwynn P., (2001) Chemistry of Heterocyclic Compounds, Ellis –
2. Gupta R R, Kumar M and Gupta V., Heterocyclic Chemistry, Springer
3. Eicher T and Hauptmann S.,(2003): The Chemistry of Heterocycles, Siegfried,
4. Joule J A, Mills K and Smith G F., (1998) :Heterocyclic Chemistry, , Chapman and Hall, London,

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15324	Multistep Synthesis of Organic Compounds and Estimations	-	-	6	6	2
INSTRUCTIONAL OBJECTIVES						
(i)	To gain skill in the estimation of organic compounds					
(ii)	To gain experimental skill in multi step organic synthesis					

Quantitative analysis of organic compounds
Estimation of phenol, aniline, ketone, glucose.

Preparation of organic compounds (Double stage)
a. p-bromo acetanilide from aniline (acetylation and bromination).
b. acetyl salicylic acid from methyl salicylate (hydrolysis and acetylation).
c. 1,3,5-tribromobenzene from aniline (bromination, diazotization and hydrolysation).
d. p-nitroaniline from acetanilide (nitration and hydrolysis).
e. benzilic acid from benzoin (rearrangement).
f. p-amino benzoic acid from p-nitro toluene (oxidation and reduction).
g. benzanilide from benzophenone (rearrangement).
h. p-bromoaniline from acetanilide (bromination and hydrolysis).
i. m-nitroaniline from nitrobenzene (nitration and reduction).
j. 1,2,4-triacetoxy benzene from hydroquinone (oxidation and acylation).

Text Books
1. Vogel (1996): A Textbook of Practical Organic Chemistry, 5th edition, Prentice Hall,
2. Fieser and Fieser (2006): Reagents in Organic Synthesis, Wiley, 2006

References
1. Mann & Saunders, (1960): Practical Organic Chemistry, 4thed,Longmans,
2. Clarke, H. T (1975): A Handbook of Quantitative & Qualitative Analysis- Arnold Heinemann
3. Blat. (2004): Organic Synthesis Collective Volumes, Wiley,
4. March, J. (2000): Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 5th edition, Wiley
5. Vogel, A. I (1996): A Textbook of Practical Organic Chemistry, 5th ed., Prentice Hall
6. Fieser and Fieser. (2006):Reagents in Organic Synthesis, Wiley, 2006

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15E53	Skill based Elective-2 Applications of Computer in Chemistry	2	2	-	4	4

INSTRUCTIONAL OBJECTIVES	
(i)	To introduce the basics of computers.
(ii)	To learn C language and its applications in solving problems in Chemistry

UNIT I Recapitulation of Computer Basics

PC hardware, operating systems, data storage and backup, networks, information technology.Basic operations using windows.

UNIT II Computer Programming

Constants, variables, bits, bytes, binary and ASCII formats, arithmetic expressions, hierarchy of operations, inbuilt functions. Elements of the BASIC language. BASIC keywords and commands.Logical and relative operators.Strings and graphics.Compiled versus interpreted languages.

UNIT III Word Processing- I

Handling numeric data: spreadsheet software (Excel), simple calculations, statistical analysis, plotting graphs using a spreadsheet (radial distribution curves for hydrogenic orbitals, gas kinetic theory, spectral data, pressure-volume curves of van der Waals gas, data from phase equilibria studies), graphical solution of equations, solving equations numerically (e.g. pH of a weak acid ignoring/ not ignoring the ionization of water, volume of a van der Waals gas, equilibrium constant expressions).

Word Processing- II

Numeric modelling, numerical curve fitting, linear regression (rate constants from concentration- time data, molar exinction coefficients from absorbance data), numerical differentiation (e.g. handling data from potentiometric titrations), integration (e.g. entropy/enthalpy change from heat capacity data).Numerical solution of differential equations (e.g. kinetics).

UNIT IV Molecular Modelling

Visualization of 3D structures, calculation of molecular structures and properties (e.g., conformational energies of butane, rotation of 1,3-butadiene, distribution of isomers, energies of orbitals and total energy as a function of bond angle for H_2O, simulation of Diels-Alder reaction, SN_2 reactions).

UNIT V Chemical Information on the Web

Chemical abstracts. Structures and properties.

Software: Microsoft Office, Chem Office, Microcal Origin, Scifinder, scopus, literature search (ACS, RSC, Wiley inter science (Free alternatives: Open Office (www.openoffice.org), ISIS Draw (http://www.mdli.com; registration required), ArgusLab (www.planaria-software.com).

Text Books

1. Noggle, J. H (1985): Physical chemistry on a Microcomputer. Little Brown & Co.
2. Venit, S.M (1996): Programming in Basic: Problem solving with structure and style. Jaico Publishing House,Delhi.

References

1. Engel, T. & Reid, P (2010): Physical Chemistry, 2nd Ed. Pearson.

MAJOR ELECTIVE- 2a

SEMESTER IV

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15E04	Advanced Experimental Techniques in Organic Synthesis	3	-	-	3	3

INSTRUCTIONAL OBJECTIVES	
(i)	To gain knowledge on newer methods in organic synthesis
(ii)	To acquire knowledge on the applications of organometallic compounds
(iii)	To gain knowledge about the oxidation and reduction reaction strategies

UNIT I Techniques in Organic Synthesis-I

Phase –Transfer Catalysis- Solid-Solid, Solid-Liquid Systems- mechanism of catalytic action, types of catalysis, application in few important reactions

UNITII Techniques in Organic Synthesis-II

Bio-tranformatons – Enzyme catalysed reactions

Microwave induced reactions-Principle, conditions, advantages over conventional heating methods- Applications, sonication.

UNITIII Organometallic Reagents

Synthesis and applications of Grignard reagents-organolithium,Zinc, Copper, Palladium, Nickel compounds in organic synthesis- Homogeneous catalytic reactions-hydrogenation, hydroformylation

UNIT IVMethods of Organic Synthesis-I

Alcohols to Carbonyls – Chromium (IV) oxidants- Dimethyl sulfide oxidation, peroxide oxidation, Oppenauer oxidation, oxidation with manganese dioxide

Alkenes to epoxides- peroxide induce epoxidations

Alkenes to diols-oxidation withpotassium permanganate, osmium tetraoxide, Prevost reaction

Oxidative bond cleavages- cleavages of alkenes by transition metals

UNIT V Methods of Organic Synthesis-II

Reduction with lithium aluminium hydride, sodium borohydride, alkoxides, bis-methoxyethoxyaluminium hydride, boron aluminium hydride and derivatives-catalytic metal hydrogenation-dissolving metal reductions, Non-metallic reducing agents including enzymatic and microbial reductions

Text Books

1. Cary, F. A and Sundberg,R. I. (2009) :Advanced Organic Chemistry, Part A and B, 5th Edition, Springer.
2. Smith,M. B. (2005):Organic Synthesis, 2nd Edition, McGraw-Hill: New York

References

1. Warren, S. (2004) :Organic Synthesis, The disconnection Approach,JohnWiley & Sons
2. Tsuji,J(2003): Palladium Reagents and Catalysts, NewPerspectives forthe 21st Century, John Wiley & Sons
3. Carruthers,W.(1996): Modern Methods of Organic Synthesis,Cambridge University Press
4. Clayden,J. Greeves, N, Warren, S. and Wothers,P(2001):Organic Chemistry, Oxford University Press

MAJOR ELECTIVE- 2b

SEMESTER IV

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15E07	Bio-Organic Chemistry	3	-	-	3	3
INSTRUCTIONAL OBJECTIVES						
(i)	To gain knowledge on the structure and applications					
(ii)	To acquire knowledge about the structure, synthetic route and applications					

UNIT I Lipids and Fatty Acids

Definition and classification of lipids.Fatty acids - classification, nomenclature, structure and properties.Classification, structure and function of prostaglandins, triacyiglycerols. Chemical properties of fats - iodine value, Sop value, acid number, Rancidity, Rm value

UNIT II Phospholipids

Structures-funtions-Chemical properties of phospholipids.Lecithins, cephalins, phosphatidyl serine, phosphatidyl inositol, plasmalogens, glycolipids(cerebrosides and gangliosides), isoprenoids and sterols (cholesterol and zymosterol),

UNIT III DNA and RNA-I

Nature of genetic material.Isolation of RNA and DNA. Composition of RNA and DNA.Structure of purine and pyrimidines, nucleosides and nucleotides-genetic code-sequencing.

UNIT IV DNA and RNA-II

Size and structure of different types of DNA-A, B, Z. Structure and role of different types of RNA. Properties of nucleic acids - denaturing and annealing of DNA

UNIT V Enzyme Action

Mechanism of enzyme catalysis, factors influencing enzyme action, examples of typical enzyme mechanisms, chymotrypsin, ribonuclease. Enzyme catalysed addition, elimination, condensation, carboxylation. Structure and functions of coenzyme A, thiamine pyrophosphate, NAD, NADP and vitamin B_{12}

Text Books

1. Adam, R.L. (1992): The Biochemistry of nucleic acids Springer Netherlands.

2. Jain, J.L. (2004):Text book of biochemistry, S.Chand.

References

1. West and Todd, (1974) :Text book of biochemistry, Macmillan Publishing Co. Inc, Agarwal, O. P. (2007):Text book of biochemistry, Krishna PrakasanMedia(P), Ltd,
2. Lehninger, (2013): Principles of biochemistry.
3. SathyaNarayana,(2006):Text book of biochemistry, New Central Book Agency (p) Ltd

SEMESTER IV

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15401	Seminar*	-	-	1	1	1
INSTRUCTIONAL OBJECTIVES						
(i)	To make the student understand and present the topic of interest related to chemistry in a class room					

Purpose

To train the students in preparing and presenting technical topics.

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Mode of Assessment

The students are expected to give at least two presentations on their topics of interest which will be assessed by a committee constituted for this purpose. The students will be tested both in subject matter and mode of presentation. The components in the subject matter include :

Knowledge in the subject and plan of work, originality, logical development, answer to the questions, summary and references.

Component in the mode of presentation include:

1. Communication skill
2. Usage of audio visual aids
3. Language and diction

This course is mandatory and a student has to pass the course to become eligible for the award of degree.

The Committee constituted by the Head of the Department will evaluate the presentation and will award the marks based on

Economy of time
Voice as a tool of communication
Blackboard use and teaching aids
Comprehensible arguments and organization.
Accessible delivery
Accessible visuals in support of arguments.
Relating to the audience

Mark Distribution

Abstract submission	:05 Marks
Presentation	:10 Marks
Question session	:05 Marks
Total	**20Marks**

SEMESTER IV

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY15402	Project Work	-	-	28	28	14

PURPOSE

To undertake research in an area related to the program of study.

INSTRUCTIONAL OBJECTIVE

M.Sc. projects should be socially relevant and research oriented ones.

Each student is expected to do an individual project. The project work is carried out in two phases – Phase I in III semester and Phase II in IV semester.

The project internally will be evaluated by the concerned guide.

The student shall be capable of identifying a problem related to the program of study and carry out wholesome research on it leading to findings which will facilitate development of a new/improved product, process for the benefit of the society.

Phase II of the project work shall be in continuation of Phase I only. At the completion of a project the student will submit a project report, which will be evaluated (end semester assessment) by duly appointed examiner(s). This evaluation will be based on the project report and a viva voce examination on the project.

The method of assessment for both Phase I and Phase II is shown in the following table:

Assessment Tool Weightage

Review I: 40 Marks

Review II : 40 Marks

Review I & II Mark Distribution

Attendance	: 5 Marks
Novelty	: 5 Marks
Submission of hard copy	: 15 Marks
Presentation	: 10 Marks
Question session	: 5 Marks
Total	**40Marks**

Seminar- 20 Marks from III semester

Report evaluation	: 70 Marks
Viva	: 30 Marks
Total	**200 Marks**

Student will be allowed to appear in the final viva voce examination only if he / she has submitted his / her project work in the form of paper for presentation / publication in a conference / journal and produced the proof of acknowledgement of receipt of paper from the organizers / publishers.