SRM UNIVERSITY
(Under section 3 of UGC Act 1956)

M.Sc. INORGANIC CHEMISTRY
(For students admitted from the academic year 2014-2015)
CURRICULUM AND SYLLABUS

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

M.Sc. INORGANIC CHEMISTRY
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SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	Total of L+T+P	C
SEMESTER I						
PCY14101	Inorganic Chemistry-I	3	3	-	6	4
PCY14102	Organic Chemistry-I	3	3	-	6	4
PCY14103	Physical Chemistry-I	3	3	-	6	4
PCY14104	Nanochemistry	3	3	-	6	3
PCY14105	Inorganic Chemistry Practical	-	-	6	6	3
Total		12	12	6	30	18
SEMESTER II						
PCY14201	Inorganic Chemistry-II	4	1	-	5	4
PCY14202	Organic Chemistry-II	4	1	-	5	4
PCY14203	Physical Chemistry-II	4	1	-	5	4
PCY14204	Analytical Chemistry	4	1	-	5	4
PCY14205	Organic Chemistry Practical	-	-	5	5	3
PCY14206	Physical Chemistry Practical	-	-	5	5	3
Total		16	4	10	30	22

SEMESTER III						
PCY14311	Organometallic Chemistry	4	1	-	5	4
PCY14312	Photoinorganic Chemistry	4	1	-	5	4
xxxxxxxx	Elective - 1(List IA)	4	1	-	5	4
xxxxxxxx	Elective - 2 (List II)	3	1	-	4	3
PCY14313	Advanced Inorganic Chemistry Practical	-	-	6	6	3
PCY14305	Applications of Computer in Chemistry	2	1	-	3	2
PCY14306	Mini Project*	-	-	2	2	2
Total		17	5	8	30	22
SEMESTER IV						
xxxxxxxx	Elective- 3 (List IA)	4	1	-	5	4
PCY14402	Career Comprehensive Course*	2	-	-	2	2
PCY14403	Project Work	-	-	12	12	12
Total		6	1	12	19	18
Total number of credits to be earned for the award of degree		80				

LIST - I (A) (MAJOR ELECTIVES)

SEMESTER	SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	Total of L+T+P	C
III	PCY14E01	Bioinorganic Chemistry	4	1	-	5	4
	PCY14E02	Materials Technology	4	1	-	5	4
IV	PCY14E51	Solid state Chemistry	4	1	-	5	4
	PCY14E52	Medicinal Inorganic Chemistry	4	1	-	5	4

LIST - II (INTERDISCIPLINARY ELECTIVES)

SEMESTER	SUBJECT CODE	TITLE OF THE SUBJECT	L	T	P	Total of L+T+P	C
III	PCY14E07	Scientific research methodology	3	1	-	4	3
	PCY14E08	Chemistry of nano science and Technology	3	1	-	4	3
	PCY14E09	Industrial Chemical Analysis and Quality Control	3	1	-	4	3
	PCY14E10	Environmental Chemistry	3	1	-	4	3
	PCY14E11	Industrial Chemistry	3	1	-	4	3

Note:

* - Continuous Assessment (Full Internals)

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

SEMESTER I

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14101	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 Periodic Table

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 Periodic Table- 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 of MO and VB 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-Ncompounds, 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 stereoisomers. 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, NewYork.
3. Basolo, F. and Pearson, R.G (1967): Mechanism of Inorganic Reactions, John Wiley, New York.

SEMESTER I

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14102	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_N^i 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
PCY14103	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
PCY14104	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 bionanotechnology - Some important recent discoveries innanoscience and technology.

UNIT II Techniques in Nanochemistry

Techniques for characterisation of nanoscale materials (Basic aspects): Atomic force microscopy (AFM)-Transmission electron microscopy (TEM)-Resolution and scanning transmission electron microscopy (STEM) Scanning Tunneling Microscopy (STM) Scanning nearfield 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: Discovery of C60 – Alkali doped C60 – Superconductivity in C60 – Larger and smaller fullerenes. Carbon nanotubes: Synthesis – Single walled carbon nanotubes –Structure and characterization – Mechanism of formation – Chemically modified carbon nanotubes – Doping – Functionalizing nanotubes – Application of carbon nanotubes. Nanowires – Synthetic strategies – Gas phase and solution phase growth – Growth control – Properties.

UNIT V Organic Films and Supramolecular Assembly

Organic films - insulating and passivating layers – electron transfer – Organicnanostructures – Optical properties – Organic semiconductors – Active organic devices. Polymerization – Sizes of polymers – Nanocrystals – Conductivepolymers – 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 field and 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
PCY14105	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
PCY14201	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 – Oxy acids – Organic acids – Acetic acid and the Inductive Effect, Aromatic Acids and Resonance Effects – Hydrolysis and Aquo acids – Basic precipitations – Amphoteric oxides – Nonprotonic concepts of Acid – Base reactions – Lux Concept – Solvent Ion theory of Acids and Bases – Liquid Ammonia, Acetic acid as a solvent, Bromine trifloride, Dinitrogen tetraoxide, 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 per cm^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^9transition 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 Darl H.McDaniel (1970): Concepts and Models in Inorganic Chemistry, Indian Edition, Oxford & IBHPublishing Co, New Delhi.
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, NewYork.
2. James E. Huheey, Ellen A Keiter and Richard L. Keiter (2006):Inorganic Chemistry –Principles of Structures and Reactivity,4thed, Addison-Wesley, NewYork.

SEMESTER II

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14202	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 chemoselectivity, 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
PCY14203	Physical Chemistry - II	4	1	-	5	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
PCY14204	Analytical Chemistry	4	1	-	5	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 and J.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, Pragati Prakashan, 1st Edition, Meerut.

SEMESTER II

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14205	Organic Chemistry Practical	-	-	5	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
PCY14206	Physical Chemistry Practical	-	-	5	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
PCY14311	Organometallic Chemistry	4	1	-	5	4

INSTRUCTIONAL OBJECTIVES	
(i)	To study in depth the properties of organometallic compounds
(ii)	To gain knowledge in various catalytic processes of organometallic compounds
(iii)	To understand the various reactions of organometallic compounds
(iv)	To identify the applications of organometallic compounds

UNIT I Introduction

Compounds with transition metal to carbon bonds: classification of ligands, nomenclature, eighteen electron rule; transition metal carbonyls: range of compounds and structure, bonding, vibrational spectra, preparation, reactions; transition metal organometallics: square planar complexes, metal alkyls, metal alkylidenes, metal alkylidynes and metal arenes.

UNIT II π Complexes of Unsaturated Molecules

Synthesis, structure, bonding and reactivity of transitional metal complexes with alkenes, cyclopentadienyl (Metallocenes), Benzenoid, π- allyl, and enyl systems. Complexes with cyclic π donors: Cyclopentadiene, benzene, cycloheptatriene and cyclooctatetraene complexes.

UNIT III Catalytic Processes

Hydrosilation reaction, hydride elimination, abstraction, cyclooligomerisation, olefin isomerisation, ethylene dimerization using $RhCl_3$ catalyst. Fischer Tropsch process, water gas shift reaction. Oxidation of Aldehydes, Cyclohexanol, Cyclohexanone, p-Xylene.

UNIT IV Properties and Reactions of Organometallic Compounds

Complex formation, reactions with active oxygen compounds, reactions with halogen, reactions with alkyl halides, acid halides, reactions with oxygen, carbonyls and others.
Metal carbonyls, isocyanides and acetylides: Preparation, structure, reactions of metal carbonyls with alkyl halides, reactions of metalcarbonyls with metal alkyls, cyanides and isocyanides complexes, acetalynide complex adduct formation. Complexes: 2, 3,4,5,6 and 7 electron donor carbametallic compounds, aromaticity of cyclopentadienyls.

UNIT V Applications of Organometallic Compounds

Introduction, organometallics in medicine, organometallic compounds in agriculture and horticulture, organometallics in Industry and environmental aspects of organometallic compounds.

Text Books

1. Mehrotra,R. C and Singh,A (2000): Organometallic Chemistry: A Unified Approach, Wiley Eastern.
2. Rochow, E. G (1964): Organometallic Chemistry, Reinhold, New York.
3. Zeiss,H (1960):Organometallic chemistry, Reinhold, New York.

References

1. Stone, F. G. A. and West, R(1988):Advances in Organometallic Chemistry, volume 42,Academic Press, London.
2. Powell, P (1991): Principles of Organometallic Chemistry, 2nd Edition., ELBS.
3. Lippord,S. J (1983): Progress in Inorganic Chemistry, Vol. 30, John Wiley.

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14312	Photo Inorganic Chemistry	4	1	-	5	4
INSTRUCTIONAL OBJECTIVES						
(i)	To educate students on the principles of photochemistry					
(ii)	To understand the various photochemical properties of transition metal complexes					
(iii)	To acquire knowledge in charge transfer photochemistry					
(iv)	To know the various photochemical reactions taking place on solid surfaces					

UNIT I Principles of Photochemistry

Absorption, excitation, photochemical laws, quantum yield.Absorption and emission for complexes with different ground state /excited state for ML_6complexes.Potential energy function and energy levels for ML_6complexes.Flash photolysis, stopped flow techniques. Energy dissipation by radiative and non-radiative processes, absorption spectra. Frank-Codon principle, photochemical stages – primary and secondary processes. Jablonski diagram for photochemical process

UNIT II Photochemical Properties of Transition Metal Complexes

Photo physical process, Photochemical process, Photo substitution reactions, photoredox reactions, Photorearrangement reaction, Prompt and Delayed Photochemical reactions, Photolysis rules and ligand field theory

UNIT III Charge Transfer Photochemistry

Introduction, charge transfer absorption spectra, types of charge transfer excitations and their energy level scheme for charge transfer excitations, Types of reactions observed by charge transfer metal complexes.

UNIT IV Ligand Field Photo chemistry of Transition Metal Complexes

Photochemistry Cr(III) of complexes : Photo-substitutions, properties of ligand field excited states, Photo aquation reactions, photolysis rule , photoisomerization , photo racimization, photoanation reactions, sensitizer, energy transfer process, Mechanism of photosensitization, photo reactive excited state. The Doublet hypothesis, Role of quartet excited states, Photochemistry of Co(III) complexes : Introduction, energy level diagram, Photo aquations in Co(III) amine, Co(III) cyanide complexes, Fe(II) low spin

complexes, Ru(II) ammine derivative complexes, Photo redox properties of Ce(III)and Ce(IV) complexes, photochemistry of Cu(II) (1,3 diketone) complexes

UNIT V Photochemical Reactions on Solid Surface

Introduction, photo electron transfer mechanism, energy level diagram of solid acceptor anddonor levels, Examples of photo catalytic metal/mixed metal oxides and their applications,semiconductor supported metal oxides for photolysis of water, Decomposition of organic pollutants, experimental setup, end product of organic products, carbon dioxide reduction, nitrogen fixations, solar energy conversion and its storage. Chemiluminescence's in coordination complexes, Thexi state and Franck condon state.

Text Books

1. Adamson, A.W and Fleischauer, P.D (1975): Concepts of Inorganic Photochemistry, Wiley, New York.
2. Ferraudi , G.J (1988): Elements of Inorganic Photochemistry, Wiley, New York.

References

1. Lever, A. B. P (1984): Inorganic Electronic Spectroscopy, Elsevier Science.
2. Veera Reddy, K (1998): Symmetry and Spectroscopy of Molecules, New Age International.
3. Huheey, J. E (1983): Inorganic Chemistry, 3rd Edition, Harper and Row Publisher, Singapore.

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14313	Advanced Inorganic Chemistry Practical	-	-	6	6	3

INSTRUCTIONAL OBJECTIVES	
(i)	To motivate the students to understand separation and gravimetric techniques.
(ii)	To impart knowledge of synthesis and characterization of the inorganic complexes.
(iii)	To practice the estimation of metal ions by spectrophotometric methods.

A. Quantitative analysis:

Separation and estimation of mixtures by volumetric and gravimetric methods: some typical recommended mixtures are:

(i) Cu-Ni (ii) Cu- Fe (iii) Cu-Zn (iv) Ba-Ca(v) Ni-Zn.

B. Inorganic complex preparation and characterization:

1. tris-triphenylphosphine copper(I) nitrate
2. tris-acetylacetonato iron (III)
3. cisandtrans-dichlorobis (ethylenediamine) cobalt (III) chloride
4. bispyridine iodide nitrate
5. trans-bisglycinato copper(II)
6. Prussian blue
7. Tetrammine copper(II)
8. Hexamine cobalt(II) chloride
9. Hexamine nickel(II) chloride

C. Spectrophotometric estimation:(any three)

Cu, Mn, Ni, Fe, V, Cr, Co.

General scheme for distribution of marks in practical examination

Time: 6 h (One day Examination) Marks: 50 (External) + 50 (Internal)

Quantitative analysis (A)	: 20 Marks
Preparation (B)	: 10 Marks
Record	: 10 Marks
Viva-Voce	: 10 Marks
Internal	: 50 Marks
Total	**: 100**

References

1. Bassett et al, J (1989):Text Book of Quantitative Chemical Analysis, 5th Edition, ELBS, Longmann, U.K.
2. Vogels (2002): Textbook of Quantitative Chemical Analysis, 6th Edition.
3. Gurdeepraj (2001): Advanced Practical Inorganic Chemistry, Goel Publishing House.

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14305	Applications of Computer in Chemistry	2	1	-	3	2

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 interscience (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.

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14306	Mini Project*	2	-	-	2	2

PURPOSE

To under take project in the relevant field of study

The student is free to pickup any topic for the mini project under the supervision of faculty member the project internally will be evaluated by the supervisor and the end semester assessment by duly appointed examiner (s)

Assessment Tool Weightage

Review I – 25 Marks

Review II –25 Marks

Review I & II Mark Distribution

Novelty	: 5 Marks
Submission of hard copy	: 20 Marks
Presentation	: 20 Marks
Interactive session	: 5 Marks
Total	: 50Marks
Total	**100 Marks**

LIST-II (INTERDISCIPLINARY ELECTIVES)

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14E07	Scientific Research Methodology	3	1	-	4	3

INSTRUCTIONAL OBJECTIVES	
(i)	To know the purpose and importance of research for future development in science.
(ii)	To familiarize the methodology behind the laboratory techniques
(iii)	To learn the ways of carrying out literature review
(iv)	To know the methodology of writing thesis and journal articles.

UNIT I Introduction

Nature and importance of research - aims, objective, principles and problems - selection of research problem - survey of scientific literature - primary and secondary sources - citation index for scientific papers and journals - patents.

UNIT II Conduct of Research Work

Physical properties useful in analysis and methods of separation prior to analysis - Isolation techniques - extraction - Soxhlet extraction, crystallization, sublimation - methods for vacuum sublimation and distillation under reduced pressure.

Chemistry of working with hazardous materials - acid / water sensitive, corrosive, toxic, expolsive and radioactive materials.

UNIT III Data Collection and Analysis

Execution of research –observation and collection of data -Methods of data collection: Experimental data, field data, data from other sources-Sampling method –Data processing and analyzing: Precision and accuracy - Reliability - determinate and random errors - distribution of random errors - normal distribution curve. Statistical treatment of finite samples - the student's t test and F test - Criteria for rejection of an observation - the Q test, significant figures and computation rules - data plotting - least square analysis.

UNIT IV Scientific Writing

Scientific writings: research reports, theses, journal articles, and books.

Steps to publishing a scientific article in a journal: types of publications communications, articles, reviews; when to publish, where to publish, specific format required for submission, organization of the material.

Documenting: abstracts-indicative or descriptive abstract, informative abstract, footnotes, end notes, referencing styles, bibliography-journal abbreviations (CASSI), abbreviations used in scientific writing. Patent writing and filing

UNIT V Computer Usage in Research

Searches of Literature: ASAP Alerts, CA Alerts, SciFinder, ChemPort, ScienceDirectSTN International. Journal home pages. Preparing research papers: Using word processing software – MS office/Latex/others, Drawing graphs and diagrams – Origin/Excel/others. Seminar presentations – Power point for oral and poster presentations. Different file formats particularly useful in research communication (pdf, jpg, jpeg, djvu etc)

Text Books

1. Kothari, C.R (1990): Research Methodology: Methods and Techniques, New Age International.
2. Sinha, S.C. and Dhiman, A.K (2002): Research Methodology, 2 volumes, Ess Publications.
3. Coley, S.M. and Scheinberg, C. A. (1990):Proposal Writing, Sage Publications.

References

1. Fink, A (2009): Conducting Research Literature Reviews: From the Internet to Paper. Sage Publications.
2. Douglas A. Skoog, Donald, M. West, F. James Holler & Stanley R. Crouch (2013): Fundamental of analytical chemistry, 9th Edition, Mary Finch.
3. H. F. Ebel, C. Bliefert and W. E. Russey (1988): The Art of Scientific Writing, VCH, Weinham.

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14E08	Chemistry of Nanoscience and Technology	3	1	-	4	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 –nanopatterning surfaces by self-assembly - Templated nanostructures.

UNIT II Characterization Methods

X-ray diffraction - XPS Working Principle, Instrumentation and Applications.Impedance Analysis - Micro hardness - nanoindentation– 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, Imperial College Press .

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14E09	Industrial Chemical Analysis and Quality Control	3	1	-	4	3

INSTRUCTIONAL OBJECTIVES	
(i)	To study in detail about toxic and hazardous chemicals
(ii)	To gain knowledge about green chemistry
(iii)	To understand the basics of clinical health and first aid safety

UNIT I Environmental Management of Toxic and Hazardous Chemicals

Introduction to toxic and hazardous chemicals, Procedure for working with substances that pose flammable or explosive hazards, Incineration of hazardous chemicals.Identification, classification and segregation of industrial toxic/hazardous chemicals, Recovery, recycling and reuse of industrially important chemicals.

UNIT II Small Scale Industry and R & D Technology Transfer

Need and scope of small scale, Industry, SSI rules and regulations, Registration, Licensing, Incentives, Factory act, Labor laws, FDA, export-import regulations, and tax benefits, Role of R and D, Functional structure of R&D Unit, Research strategies and manufacturing interface

UNIT III Green Chemistry

Introduction, Twelve principles of Green Chemistry with their explanations and examples; designing a Green Synthesis using these principles; Prevention of Waste/byproducts; maximum incorporation of the materials used in the process into the final products (Atom Economy); prevention/minimization of hazardous/toxic products. Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, urethane, and aromatic amines(4-aminodiphenylamine), benzyl bromide, disodium iminodiacetate (alternative to strecker synthesis), citral, ibuprofen, paracetamol.

UNIT IV Clinical Health and First aid Safety

Definition of Health, WHO standard, Sterilization of surgical instruments.Biochemical analysis of urine and serum. Blood - Composition, grouping and Rh factor. Treatment of shock, haemorrage, cuts and wounds. Burns – classification and first aid. Asbestos,

silica, lead paints, cement, welding fumes and gases - Hazard alert and precautions for safety.

UNIT V Indian Industrial Scenario and Quality Control in Industries

Survey of Indian chemical industries, Indian mineral resources, ferrous metallurgy, heavy chemical industries, nonferrous metals Fine chemicals and pharmaceuticals, natural products and agro-based chemicals, contribution of fertilizers and pesticide, Quality Control Role, Government standards like ISI, MINAS, Agmark, I. P., D. P., U.S.P concepts of quality and quality control.

Text Books

1. Mukharjee,R. R (1984): Elements of Quality Control (Vani Ed Books).
2. Tulsi, S. K (1980): Incentives for Small Scale Industries (ESRS).

References

1. Gerstenfield , A (1980): Effective Management of R & D.
2. Ahluwalia, V.K. &Kidwai M.R (2005): New Trends in Green Chemistry, Anamalaya Publishers.
3. Matlack, A.S. (2001): Introduction to Green Chemistry, Marcel Deckkar

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14E10	Environmental Chemistry	3	1	-	4	3

INSTRUCTIONAL OBJECTIVES	
(i)	To study in detail about ecosystem and biodiversity
(ii)	To gain knowledge about the energy resources
(iii)	To discuss in detail the various social issues

UNIT I Energy and Environment

Energy resources and their exploitation, Sun as source of energy- nature of its radiation, Conventional energy sources: coal, oil, biomass and nature gas, non-conventional energy sources: hydroelectric power, tidal, wind, geothermal energy, solar collectors, photovoltaic, solar ponds, nuclear-fission and fusion, magneto-hydrodynamic power (MHD), Energy use pattern in different parts of the world and its impact on the environment. CO_2 emission in atmosphere.

Mechanism of radiation action on living systems- Stochastic and Non-stochastic effects; delayed effects, radioactivity from nuclear reactors, fuel processing and radioactive waste, hazards related to power plants, terrestrial and non terrestrial radiation, dose from environment and nuclear radiations, ultraviolet radiations, pathways analysis and dose assessment, radiologic age dating, radioactivity risk assessment, criterion for safe exposure.

UNIT II Ecosystem, Biodiversity and its Conservation

Biodiversity concepts and patterns, Microbial diversity, Plant diversity, Agrobiodiversity, Soil biodiversity, Economic value of biodiversity, biodiversity losses. Biodiversity hotspots and their characteristic flora and fauna, threatened plants and animals of India, ecosystem people and traditional conservation mechanisms, Biodiversity Convention and Biodiversity Act, IPRs, national and international programmes for biodiversity conservation.

Wildlife values and eco-tourism, wildlife distribution in India, problem in wildlife protection, role of WWF, WCU, CITES, TRAFFIC, Wildlife Protection Act 1972. In-situ conservation: sanctuaries, biospheres reserves, national parks, nature reserves, preservation plots. Ex-situ conservation: botanical gardens, zoos, aquaria, homestead garden; herbarium; In-vitro Conservation: germplasm and gene Bank; tissue culture: pollen and spore back, DNA bank.

UNIT III Energy Resources and Maintenance

Renewable and non-renewable energy resources, growing energy need, sun as source of energy, solar radiation and its spectral characteristics, fossil fuels classification, com position. Physico-chemical characteristics and energy content of coal, petroleum and natural gas. Principle of generation and conservation of conventional and non-conventional energy. Energy from biomass and biogas, an aerobic digestion, energy use pattern and future need projection in different parts of the world, energy conservation policies.

UNIT IV Solid and Hazardous Waste Management

Solid wastes: Definition, types, sources, characteristics, and impact on environmental health. Waste generation rates. Concepts of waste reduction, recycling and reuse. Collection, segregation and transport of solid wastes Handling and segregation of wastes at source. Collection and storage of municipal solid wastes. Solid waste processing technologies. Mechanical and thermal volume reduction. Biological and chemical techniques for energy and other resource recovery.

Composting, Vermicomposting, Incineration of solid wastes. Disposal in landfills: site selection, design, and operation of sanitary landfills; secure landfills and landfill bioreactors; leachate and landfill gas management; landfill closure and post-closure environmental monitoring; landfill remediation. Hazardous wastes: Definition, sources and characteristics: Hazardous waste categorization, generation, collection, transport, treatment and disposal. Legislation on management and handling of municipal solid wastes and hazardous wastes.

UNIT V Social Issues

Urban issues - Energy - water conservation - environmental ethics - global warming - resettlement and rehabilitation issues - environmental legislations - environmental production Act. 1986 - Air, Water, Wildlife and forest conservation Act - Population growth and Explosion - Human rights and Value education - environmental health - HIV/AIDS - Role of IT in environment and human health - Women and child welfare - Public awareness.

Text Books

1. Sharma,B.K. andKaur, H (1996): Environmental Chemistry, Goel Publishing House, Meerut, India.
2. Jadhav,H.V (1992): Elements of Environmental Chemistry, Himalaya.
3.Samir.K.Banerji (1999): Environmental Chemistry,PHI Learning Pvt. Ltd.

References

1. Moore, J. W. and Moore, E. A (1976): Environmental Chemistry, Academic Press, New York.
2. Lunn, G. and Sansone,E.B (1990): Destruction of hazards chemicals in the laboratory, Wiley, New York.
3. Dara, S.S (2005): A Text book of Environmental Chemistry and Pollution Control 8th Edn, Publisher, S. Chand & Company.

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14E11	Industrial Chemistry	3	1	-	4	3

INSTRUCTIONAL OBJECTIVES	
(i)	To study in detail about the raw materials and energy required for the chemical industry
(ii)	To gain knowledge about the surfactants, pesticides and explosives
(iii)	To gain in depth knowledge about the various spectroscopic techniques used in industrial analysis of samples.

UNIT I Raw Materials and Energy for Chemical Industry

Raw materials – Characteristics of raw materials and their resources – methods of raw material concentrations–integral utilization of raw materials.

Energy for chemical industry–Fuels–classification of fuels–coal–fuel gases and liquid fuels–petroleum–cracking–Octane number–cetane number–composition and uses of coal gas, water gas, producer gas, oil gas and gobar gas.

UNIT II Surfactants, Explosives, Pesticides

Surfactants: Classification with examples, Adsorption and micelle formation, Manufacture of anionic, cationic, zwitterionic and nonionic detergents, Applications in industries Applications as Foaming agent, Wetting agent, Dispersant, Solubilizers, Emulsifiers and Rheology modifiers, Detergent formulations, Detergent biodegradation, Biosurfactants.

Explosives: Classification, characteristics, preparation of nitrocellulose-T.N.T, Picric acid, Dynamite-cordite and Gunpowder, Dynamite, HMX, PETN, Cyclonite, plastic explosives, gelatin, RDX, cordite and seismic explosives, propellants-manufacture of liquid and solid propellants-hydrazine, incendiaries and smoke screens. Industrial applications.

Pesticides: Introduction, classification, synthesis of few common pesticides of chlorinated (DDT, BHC, Chlordane, Aldrin), organophosphorus and carbamate (parathion, malathion, carbaryl) compounds family, Plant pesticides, Pesticide formulations.

UNIT III Cement, Ceramics, Polymeric Materials, Glass, Paints and Fertilizers

Cement: Manufacture – Wet Process and Dry process. Types, Analysis of major constituents, setting of cement, reinforced concrete. Cement industries in India.

Ceramics: Important clays and feldspar, glazing and verification.

Polymeric Materials: Industrial polymers (Thermoplastics polymers and thermosetting Polymers) and composite materials–their constitutions, chemical and physical properties, Industrial applications.

Glass: Types, Composition, manufacture of Optical glass, colored glasses, lead glass and neutron absorbing glass.

Fertilizers: Fertilizer industries in India, Manufacture of ammonia, ammonium salts, urea, superphosphate, triple superphosphate and nitrate salts.

Paints: Components of paints, pigments, thinner, binder, types of paints, water based paints, drying of paints

UNIT IV Industrial Chemical Analysis

Sampling procedures, sampling of bulk materials, techniques of sampling–solids, Liquids and gases. Collection and processing of data.

Chromatography: Principles, working and applications of paper chromatography, TLC, GLC, HPLC.

Particle size determination, rheological properties of liquids, plastics and their analysis. Modern Instrumental Methods of analysis–UV-visible spectroscopy-IR spectroscopy and non-dispersive IR- Raman spectroscopy-NMR Spectroscopy-Electron spin resonance spectroscopy-Atomic absorption spectroscopy-Flame photometry-Neutron diffraction-X-ray fluorescence-Ion chromatography

UNIT V Industrial Hygiene and Chemical Safety

(a) Industrial hygiene: Concept, air and biological monitoring, occupational disease, operational control measures, personal protective equipments; (b) Industrial hazards and Safety: Process hazards checklists, hazard surveys, safety program, Hazop safety reviews. c) Industrial pollution: Classification of hazards chemicals, storage, transportation, handling, risk assessments, challenges/solutions (d)Eco-friendly effluents disposal: Water pollutants, health hazards, sampling and analysis of water, water treatment, different industrial and domestic effluents and their treatment and disposal, advanced waste water treatment, effluent quality standards and laws, chemical industries, tannery, dairy, textile effluents, common treatment.

Text Books

1. Mukhlyonov (ed.) (1979): Chemical Technology, Vol.1, 3rd Edition, Mir publication, Moscow.
2. De.,A.K. (1989): Environmental Chemistry,WileyEasternLtd.,11th edn., Meerut.
3. Sharma, B.K (1997): Industrial Chemistry, Goel publishing house.

References

1. Norris Shreve, R. and J.A. Brink (1977): Jr. Chemical Process Industries. 4thedn.McGrawHill, Tokyo.
2. Chakrabarty, B.N (1981): Industrial Chemistry, Oxford & IBH Publishing Co., New Delhi.

LIST (1A) ELECTIVES

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14E01	Bioinorganic Chemistry	4	1	-	5	4
INSTRUCTIONAL OBJECTIVES						
(i)	To study in depth about the essential elements of life					
(ii)	To gain knowledge about oxygen carriers					
(iii)	To understand the basic concepts of enzymes and acquire knowledge about metalloenzymes					
(iv)	To study in detail about the characterization techniques					

UNIT I Introduction

Essential elements in biology, distribution of elements in biosphere, bio-availability, biostability, building blocks of the biosphere; sugars (carbohydrates), fatty acids (lipids),nucleotides (nucleic acids) and amino acids (proteins), Biological importance of water, and the chemistry of biopolymers.

UNIT II Oxygen Storage and Transport

O_2 binding properties of heme (haemoglobin and myoglobin) and non-heme proteins hemocyanin&hemerythrin), their coordination geometry and electronic structure, co-operativity effect, Hill coefficient and Bohr Effect; characterization of O_2 bound species by Raman and infrared spectroscopic methods; representative synthetic models of heme and non-heme systems.

UNIT III Electron Transfer Proteins and Nitrogen Fixation

Electron transfer proteins - active site structure and functions of ferredoxin, rubridoxin and cytochromes, and their comparisons.Cytochrome $P_{450}$and its mechanism of action.
Enzymetic reduction of Nitrogen to Ammonia - Nitrogenase Structure and mechanism.Transition-metal-dinitrogen complexes and insights into N_2 binding, reduction to ammonia.
Molybdenum Nitrogenase - Spectroscopic and other studies. Model Systems for Nitrogenase.

UNIT IV Enzymes and Metalloenzymes

Enzymes- Nomenclature and classification, chemical kinetics, the free energy of activation and the effects of catalysts, kinetics of enzyme catalyzed reactions- Michaelis-Menten constant equation- effect of pH, temperature on enzyme reactions, factors contributing to the catalytic efficiency of enzymes.

Metalloenzymes: Zinc enzymes - Carboxypeptidase and Carbonic anhydrase. Iron enzyme - Catalase, Peroxidase and Cytochrome P-450. Copper enzymes – Superoxide dismutase. Molybdenum enzymes -Oxatransferase enzymes, Xanthine oxidase. Vitamin B12 Coenzyme (Adenosyl Coenzyme).

UNIT V Characterisation Techniques

Physical techniques in bioinorganic chemistry: Brief description of the techniques – UV-Vis, Raman, X-Ray crystallography, paramagnetic NMR and EPR spectroscopy, EXAFS, magnetic susceptibility and electrochemistry

Text Books

1. Lippard and Berg (1994): Principles of Bioinorganic Chemistry, Univ. Science Books.
2. Kaim, W. and Schwederski (1994): Bioinorganic Chemistry: Inorganic perspective in the chemistry of Life, An Introduction and Guide, Wiley, Chichester.

References

1. David.E.Fention (1995): Biocoordination Chemistry, Oxford Chemistry Primer.
2. Bertini, Gray, Lippard and Valentine (1988): Bioinorganic Chemistry ,Viva books Pvt. Ltd.

SEMESTER III

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14E02	Materials Technology	4	1	-	5	4

INSTRUCTIONAL OBJECTIVES	
(i)	To study in about material selection and design
(ii)	To study in depth about refractories
(iii)	To acquire knowledge about biomaterials
(iv)	To educate students on the various material characterization techniques

UNIT I Materials Selection and Design

Criteria for selection of materials, application of statistics in materials selection, specification of steels, Composition, heat treatment, microstructure and properties of ferrous and non-ferrous alloys, ceramics and polymers for light and heavy structural, corrosion resistant, magnetic, electrical and electronic applications, medical implants and prostheses application.

UNIT II Composite Materials and Adhesives

Composites Materials: Introduction, Constitution (i) Matrix phase (ii) Dispersed phase. Characteristic properties of composite materials Classification – (A) Particle – reinforced composites (i) Large – particle composites (ii) Dispersion-Strengthened Composites. (B) Fiber – Reinforced Composites (i) Continuous aligned (ii) Discontinuous (short) (a) aligned b) Randomly oriented. (C) Structural Composites – (i) Laminates (ii) Sandwich Panels.

Adhesives: Introduction, adhesive action, physical factors influencing adhesive action, chemical factors influencing adhesive action, bonding processes by adhesives.

UNIT III Ceramics and Refractories

Ceramics: Introduction, ceramic materials, structure and polymorphism, Synthesis of ceramics, ceramic forming processes, silicates and non-silicate ceramics, structural and functional (electronic, optic) and bio-ceramics.

Refractories- Principles, properties and strength under load, thermal spalling, chemical properties. Fractures of refractories, corrosion of refractories, different refractory lines, Alumina-silica brick, magnesia refractories, Doloma refractories, carbonaceous refractories, spinel containing refractories. Manufacture of refractory: Preliminary

treatment, Blending and mixing, Forming or moulding, Drying firing, Common refractory bricks.

UNIT IV Biomaterials

Properties of Materials, Materials in Medical Applications, Stainless steel alloys, Cobalt based alloys, titanium based alloys, polymers, Bioresorbable and Bioerodible materials, bioceramics, porous ceramics, bioactive glasses, calcium phosphates, collagen, thin films, grafts and coatings, biological functional materials Latex products.

UNIT V Materials Characterization Techniques

Materials characterization techniques, principles of different microscopes (optical, electron microscopes, SEM, TEM and AFM) and the preparation of samples, different modes and their applications, Thermal methods (TGA and DSC) interpretation of data.

Text Books

1. Khanna, O.P (1999): A Text Book of Materials Science and Technology, DanpatRaiPublications.
2. Dara S.S (2003): A Text Book of Engineering Chemistry, S. Chand and Company Ltd.

References

1. Daniel Yesudian, C.D and Harris Samuel, D.G (2004): Materials Science and Metallurgy, Scitech Publications (India PVT LTD).
2. Ashby, M.F(2005): Engineering Materials, 4th Edition, Elsevier.
3. Ashby, M.F(2005): Materials Selection in Mechanical Design, Butterworth Heinemann.

SEMESTER IV

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14E51	Solid State Chemistry	4	1	-	5	4
INSTRUCTIONAL OBJECTIVES						
(i)	To study in depth about amorphous solids					
(ii)	To gain knowledge about ceramic and composite materials					
(iii)	To understand the mechanical properties of materials					
(iv)	To study the magnetic behavior of compounds					

UNIT I Introduction

Crystalline and amorphous solids-crystal systems, point groups, types of close packing - hcp and ccp, packing efficiency, radius ratios; polyhedral description of solids; structure types -NaCl, ZnS, Na_2O, $CdCl_2$, wurtzite, nickel arsenide, CsCl, CdI_2, rutile and Cs_2O, perovskite ABO_3, K_2NiF_4, spinels.

UNIT II Amorphous Solids and Semiconductor Devices

Amorphous solid, oxide glasses, chalcogenide glasses, amorphous carbon, graphite, diamond , alkaline graphite compounds.

Diodes, p-n junction, transistor, interstitial and cheverel compound, superconductivity compound, properties of super conductivite compounds.

UNIT III Ceramic and Composite Materials

Ceramic materials- Definition, types, polarization, polarizibility, electric properties, dielectric properties, piezoelectric, pyroelectric and ferroelectric effect.

Composite- Definition, fiber, concrete, asphalt, wood, several other types of composite material.

UNIT IV Electrical and Optical Conductivity of Solids

Electrical conductivity, origin of valence and conduction band in solids, classification of material, time dependent of conductivity, mobility of charge carriers, metal-metal junction, metal– semiconductor junction, optical properties of material, refractive index, inorganic colored solid, LASER and photoluminescence.

UNIT V Mechanical Properties and Magnetic Behavior of Materials

Mechanical behaviour, mechanical properties, fractures of metal, ductile fracture, brittle fracture, toughness and impact testing.

Introduction to magnetism, behavior of substance in a magnetic field, magnetic moments, Diamagnetism, Paramagnetism, Experimental determinations of susceptibility, Ferromagnetism, Antiferromagnetism, Ferrimagnetions, Magnetizations of a ferromagnetic substance.

Text Books

1. Wells, A. F (1984) :Structural Inorganic Chemistry, 5thEdition .
2. Huheey,J. E (1983): Inorganic Chemistry, 3rd Edition, Harper and Row Publisher, Singapore.
3. West,A. R (1999): Basic Solid State Chemistry, 2ndEdition, John Wiley and Sons Ltd.

References

1. Hanney, N. B (1967): Solid State Physics, Prentice-Hall.
2. Keer,H. V (1993): Principles of Solid State, New Age International Publishers.
3. Pillai, S. O (2005): Solid State Physics, New Age International Publishers.

SEMESTER IV

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14E52	Medicinal Inorganic Chemistry	4	1	-	5	4
INSTRUCTIONAL OBJECTIVES						
(i)	To gain knowledge on various toxic metals					
(ii)	To acquire knowledge on the interactions of metal ions and its complexes					
(iii)	To identify the various metal complexes as drugs					
(iv)	To acquire knowledge on the mode of action of various therapeutic drugs					

UNIT I Introduction to Metal Ion Toxicity

Metal ion toxicity in humans and animals. General aspects of Pb(II), Cd(II), and Hg (II) toxicity, biochemical and physiological effects due to Pb(II), Cd(II), and Hg(II) ion toxicity. Detoxifications using chelating agents.

UNIT II Interactions of Metal Ions and Metal Complexes

Structure and functions of amino acids, proteins, peptides, enzymes, nucleosides, nucleotides and comparative study of structures and functions of these biomolecules. Metal ion binding sites present in amino acids, peptides, proteins, enzymes, nucleoside and nucleotide. Interactions of metal ion and metal complexes with these biomolecules.

UNIT III Metal Complexes as Drugs

Introduction to Pt(II) chemistry – Thermodynamic and kinetic principles – Cis and Trans influences.

Discovery applications and structure-effect relationships. Cis$Pt(NH_3)_2Cl_2$ and its mode of action. Drug resistance and DNA repair mechanism.

UNIT IV Bio-energetics and ATP cycle: Metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water, Model systems.

Metallo enzymes: Apoenzymes, Haloenzyme & Coenzyme. The principle involved and role of various metals in i) Zn-enzyme- Carboxyl peptidase & Carbonic anhydrase. ii) Fe-enzyme-Catalase Peroxidase & Cytochrome P-450 iii) Molybdenum-Oxatransferase enzymes, Xanthine oxidase.

UNIT V Metal Complexes in Clinical Chemistry

Theory and mode of action of therapeutic chelating agents, Single ligand Chelation Therapy – Aminopolycarboxylic acids, Desferrioxamine, pencillamine, triethylene tetramine Mixed ligand chelation therapy - Metallothionens in detoxification. Role of metal ions in the action of antibiotics-Bleomycin, adriamyacin and tetracyclines. Gold-Containing drugs used in therapy of Rheumatoid arthritis, Atherapeutic agent for Menkes disease: Copper-histidine - Anti viral chemotherapy and metal peptide interaction.

Text Books

1. Helmut Sigel (1973): Metal ions in biological system, Vol.9, Marcel Dekker INC, New York and Basel.
2. Helmut Sigel (1973): Metal ions in biological system (Concepts on metal ion toxicity), Vol.7 Marcel Dekker INC, New York and Basel.
3. Kaim, Wand Schewederski,B (1994):Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, John Wiley & Sons, NewYork, USA.

References

1. Guy Berthon (1995): Handbook of Metal-Ligand interactions in Biological fluid, Bioinorganic medicine, Vol.2, Marcel Dekker INC, New York and Basel.
2. Rosette M. Roat- Malone (2007): Bioinorganic Chemistry: A Short Course, Wiley.
3. Ivano Bertini (1994): Bioinorganic Chemistry, Mill Valley, CA: University Science Books.

SEMESTER IV

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14402	Career Comprehensive Course*	2	-	-	2	2
INSTRUCTIONAL OBJECTIVE						
(i)	To evaluate the subject knowledge and presentation skill of the candidate and to train them for their employability					

Courses covered under the syllabus from First Semester to Fourth Semester (including electives) will form the basis for Career Comprehensive Course.

SEMESTER IV

Subject Code	Title of the Subject	L	T	P	Total of L+T+P	C
PCY14403	Project Work	-	-	12	12	12

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.