Shivaji University, Kolhapur

Department of Applied Chemistry

M. Sc. Part-II Syllabus
as Per New CBCS PATTERN

To be implemented from June 2020-2021

M. Sc. Programme structure (CBCS PATTERN)

M. Sc. Part I
(Inorganic, Organic, Physical, Analytical, Applied and Industrial Chemistry)

Semester I

	Course code	**Paper No.**		**Title of course**	
CGPA	CC-101	I	CH.1.1	Inorganic Chemistry - I	All courses are compulsory
	CC-102	II	CH.1.2	Organic Chemistry - I	
	CC-103	III	CH.1.3	Physical Chemistry - I	
	CC-104	IV	CH.1.4	Analytical Chemistry - I	
	CCPR-105		CHP.1.1	Practical- I	
Non-CGPA	AEC -106				

Semester II

	Course code	**Paper No.**		**Title of course**	
CGPA	CC-201	V	CH.2.1	Inorganic Chemistry – II	All courses are compulsory
	CC-202	VI	CH.2.2	Organic Chemistry – II	
	CC-203	VII	CH.2.3	Physical Chemistry – II	
	CC-204	VIII	CH.2.4	Analytical Chemistry - II	
	CCPR-205		CHP.2.1	Practical -II	
Non-CGPA	SEC - 206				

M. Sc. Part II (Applied Chemistry)

Semester III

	Course code	Paper No.		Title of course	
CGPA	CC-301	IX	APCH 3.1	Applied Inorganic Chemistry - I	Compulsory course
	CCS-302	X	APCH 3.2	Applied Organic Chemistry - I	
	CCS-303	XI	APCH 3.3	Applied Physical Chemistry - I	
	DSE-304(A)	XII(A)	APCH 3.4(A)	Advanced Organic Chemistry - I	Choose any one
	DSE-304(B)	XII(B)	APCH 3.4(B)	Applied Analytical Chemistry- I	
	DSE-304(C)	XII(C)	APCH 3.4(C)	Bioorganic Chemistry - I	
	CCPR-305		APCHP 3.1	Practical - III	Compulsory course
Non-CGPA	AEC-306				
	EC (SWMMOOC) - 307				

Semester IV

	Course code	Paper No.		Title of course	
CGPA	CC-401	XIII	APCH 4.1	Applied Inorganic Chemistry – II	Compulsory course
	CCS-402	XIV	APCH 4.2	Applied Organic Chemistry – II	
	CCS-403	XV	APCH 4.3	Applied Physical Chemistry - II	
	DSE-404(A)	XVI(A)	APCH 4.4(A)	Inorganic Chemical Industries	Choose any one
	DSE-404(B)	XVI(B)	APCH 4.4(B)	Pollution and Monitoring and Control	
	DSE-404(B)	XVI(C)	APCH 4.4(C)	Applied Analytical Chemistry- II	
	CCPR-405		APCHP 4.1	Practical –IV	Compulsory course
Non-CGPA	SEC-406				
	GE-407				

M. Sc. Part-II Applied Chemistry

SEMESTER- III

Core Papers

Paper No. IX, APCH.3.1 : Applied Inorganic Chemistry – I

Paper No. X, APCH. 3.2 : Applied Organic Chemistry – I

Paper No. XI, APCH. 3.3 : Applied Physical Chemistry

Elective Papers

Paper No. XII, APCH. 3.4 (A) : Advanced Organic Chemistry – I

Paper No. XII, APCH. 3.4 (B) : Applied Analytical Chemistry

Paper No. XII, APCH. 3.4 (C) : Bioorganic Chemistry

Practical Course : APCHP 3.1 Practical - III

SEMESTER-IV

Core Papers

Paper No. XIII, APCH.4.1 : Applied Inorganic Chemistry- II

Paper No. XIV, APCH.4.2 : Applied Organic Chemistry – II

Paper No. XV, APCH.4.3 : Advanced Organic Chemistry – II

Elective Papers

Paper No. XVI, APCH.4.4 (A) : Inorganic Chemical Industries

Paper No. XVII, APCH.4.4 (B) : Pollution Monitoring and Control

Paper No. XVIII, APCH.4.4(C) : Chemical Engineering in Applied Chemistry

Practical Course : APCHP 4.1 Practical –IV

Equivalence in accordance with titles and contents of the papers

M. Sc. Semester III and Semester IV Applied Chemistry

Old Course(2019)	**New Course(2020)**
SEMESTER III	
Core Papers	
Paper No. IX, APCH.3.1 : Applied Inorganic Chemistry – I	Paper No. IX, APCH.3.1 : Applied Inorganic Chemistry – I
Paper No. X, APCH. 3.2 : Applied Organic Chemistry – I	Paper No. X, APCH. 3.2 : Applied Organic Chemistry – I
Paper No. XI, APCH. 3.3 : Applied Physical Chemistry	Paper No. XI, APCH. 3.3 : Applied Physical Chemistry
Elective Papers	
Paper No. XII, APCH. 3.4 (A) : Advanced Organic Chemistry – I	Paper No. XII, APCH. 3.4 (A) : Advanced Organic Chemistry – I
Paper No. XII, APCH. 3.4 (B) : Applied Analytical Chemistry	Paper No. XII, APCH. 3.4 (B) : Applied Analytical Chemistry
Paper No. XII, APCH. 3.4 (C) : Bioorganic Chemistry	Paper No. XII, APCH. 3.4 (C) : Bioorganic Chemistry
SEMESTER IV	
Core Papers	
Paper No. XIII, APCH.4.1 : Applied Inorganic Chemistry- II	Paper No. XIII, APCH.4.1 : Applied Inorganic Chemistry- II
Paper No. XIV, APCH.4.2 : Applied Organic Chemistry – II	Paper No. XIV, APCH.4.2 : Applied Organic Chemistry – II
Paper No. XV, APCH.4.3 : Advanced Organic Chemistry – II	Paper No. XV, APCH.4.3 : Advanced Organic Chemistry – II
Elective Papers	
Paper No. XVI, APCH.4.4 (A) : Inorganic Chemical Industries	Paper No. XVI, APCH.4.4 (A) : Inorganic Chemical Industries
Paper No. XVII, APCH.4.4 (B) : Pollution Monitoring and Control	Paper No. XVII, APCH.4.4 (B) : Pollution Monitoring and Control
Paper No. XVIII, APCH.4.4(C) : Chemical Engineering in Applied Chemistry	Paper No. XVIII, APCH.4.4(C) : Chemical Engineering in Applied Chemistry

M. Sc. Part II - APPLIED CHEMISTRY
SEMESTER III

Paper No. IX, APCH. 3. 1: Applied Inorganic Chemistry – I **60 h**

UNIT-I: Electronic Properties of Transition Metal Complexes (15)

Energy terms, states, microstates, splitting of terms in weak octahedral and weak tetrahedral ligand field, spin selection rule, Laporte selection rule, relaxation of selection rule, band intensities and band widths, Orgel diagrams of d^n - configurations in octahedral and tetrahedral environments, Tanabe-Sugano diagrams (d^2 and d^3 configuration), calculation of Dq, B and β values, adjusted crystal field theory, MO diagrams for octahedral and tetrahedral complexes (with and without π-bonding), charge-transfer spectra, spectral properties of lanthanides and actinides.

UNIT-II: Magnetic Properties of Transition Metal Complexes (15)

Origin of magnetism, types of magnetic behavior, energy terms, splitting of terms in weak octahedral and weak tetrahedral ligand field, magnetic behavior of transition metal complexes: valence bond approach and crystal field approach, quenching of orbital angular momentum, temperature-dependent magnetism, measurement of magnetic susceptibility using Gouy and Faraday methods, magnetic properties of lanthanides and actinides.

UNIT III: Reaction of Transition Metal Complexes (15)

Labile and inert complexes, ligand substitution reactions: nucleophilic substitution ($S_N1$and S_N2, dissociative and associative mechanism), electron transfer reactions (redox reactions): outer sphere and inner sphere mechanism, two electron transfers mechanism, reactions of coordinated ligands, isomerization reactions: isomerization involving geometrical isomers.

UNIT-IV: Nanoscience and Nanotechnology (15)

Introduction to nanoscience and nanomaterials and emergence of nanotechnology; Moore's law, classification of nanomaterials, 1D, 2D, 3D with their examples, experimental methods for preparation of nanomaterials: chemical and physical, synthesis of nanoparticles of gold, rhodium, silica, palladium, platinum, and silver; size dependent properties of nanoparticles: optical properties, M. P., surface to volume ratio, carbon: fullerenes and nanotubes, applications of nanotechnology and nanomaterials: nanobiotechnology, nanosensors, nanomedicines (drug delivery and idiagnosis), nanophotonics, environmental remediation etc., implications of nanotechnology.

References:

1. Cotton and Willkinsons - Advanced Inorganic Chemistry
2. J. D. Lee - Concise Inorganic Chemistry
3. Puri, Sharma and Kalia - Principles of Inorganic Chemistry
4. R. Gopalan and V. Ramalingam - Concise Coordination Chemistry
5. Asim K. Das and Madhua Das - Fundamental Concepts of Inorganic Chemistry, Volume 5 and 6
6. G. S. Manku - Theoretical Principles of Inorganic Chemistry

7. Datta and Shymal - Elements of Magnetochemistr
8. Alen Sharp - Inorganic Chemistry
9. Sulbha Kulkarni - Nanotechnology: Principles and Practice
10. J. Schulte - Nanotechnology: Global Strategies, Industry Trends and Applications
11. G. Schmid - Nanotechnology, Volume 1: Principles and Fundamentals
12. L. E. Smart, E. A. Moore - Solid State Chemistry: An Introduction
13. C. Kittel - Introduction to solid state Physics

Paper No. X, APCH. 3.2: Applied Organic Chemistry – I **60 h**

Unit I: Molecular Orbital Theory **(15)**

Introduction, aromaticity in benzonoids, alternant and non-alternant hydrocarbon, Huckels rule, energy level of pi molecular orbital and the concept of aromaticity, calculation of energies of orbitals in cyclic and acyclic systems and the stabilities of different systems. Calculation of charge densities, 'PMO' theory and reactivity index.

Unit II: Organic Synthesis **(15)**

Wolff rearrangement, Sommelet-Hauser rearrangement, Stevens's rearrangement, Smiles rearrangement, Robinson ring annulations reaction, Simmon-Smith reaction, McMurry reaction, Heck reaction and Vilsmeier-Haack reaction.

Unit III: Organic Photochemistry **(15)**

Introduction, photochemical processes. energy transfer, sensitization and quenching. singlet and triplet states and their reactivity, photoreaction of carbonyl compounds, enes, dienes, and arenes, Norrish reactions of acyclic ketones. Patterno-Buchi, Barton, photo-Fries and Di- Pi methane rearrangement reactions. photoreactions of vitamin-D. Photochemistry of vision and photosynthesis, singlet oxygen generation and reactions, applications of photoreactions and their applications for industrial synthesis.

Unit IV: Free radical reactions **(15)**

Introduction, types of free radical reactions, detection by ESR, free radical substitution mechanism, mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridge-head, reactivity in attacking radicals, the effect of solvent on reactivity, allylic hydrogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salt, Sandmeyers reaction. Hunsdiecker reaction.

References:

1. J. March - Advanced Organic Chemistry, Wiley
2. R. O. C. Norman and A. Coxon - Modern Synthetic Reactions (Chapman and Hall)
3. M. B. Smith - Organic synthesis (McGraw-Hill)
4. Clayden, Greeves, Warren and Woothevs - Organic Chemistry
5. R. K. Bansal - Synthetic application in organic chemistry (Narosa)
6. Peter Sykes - A Guide Book to Mechanism in Organic Chemistry (Orient-Longmans)
7. Benjomin R. Breslow - Organic Reaction Mechanism
8. B. S. Gould -Mechanism and Structure in Organic Chemistry

9. Hendrikson, Cram and Hammond - Organic Chemistry
10. J. D. Roberts and M. C. Caeserio - Basic Principles of Organic Chemistry
11. N. S. Issacs - Reactive Intermediates in Organic Chemistry (J. Wiley)
12. R. K. Bansal - Organic Reaction Mechanism (McGraw Hill)
13. K. K. Rohtgi-Mukherji - Fundamentals of Photochemistry (Wiley-Eastern)
14. J. Kagan - Organic Photochemistry (Academic press)
15. J. M. Coxon and B. Holton - Organic photochemistry (Cambridge University Press)
16. C. H. Dupuoy and O. L. Chapman - Molecular Reaction and Photochemistry (Prentice Hall)
17. A. Gilbert and J. Baggott - Essentials of molecular Photochemistry (Blackwell Scientific publication)
18. N. J. Urro and W. A. Benjamin - Molecular photochemistry
19. Cox and T. Camp - Introductory photochemistry (McGraw-Hill)
20. R. P. Kundall and A. Gilbert – Photochemistry (Thomson Nelson)
21. J. Coxon and B. Hallon - Organic Photochemistry (Cambridge University press)

Paper No. XI, APCH. 3.3: Applied Physical Chemistry 60 h

Unit I : Equilibrium Properties of Electrolytes (15)

Non-ideal behavior of electrolyte solutions, Debye – Huckel theory of inter-ionic attraction, ionic atmosphere, time of relaxation, relaxation and electrophoretic effects, Debye – Huckel-Onsagar equation, validity of Debye – Huckel equation, Debye – Falkenhagen effect, Wein effect, Debye - Huckel limiting law equation, ionic mobility, determination of dissociation constant by EMF method, experimental determination of ionic mobility, osmotic coefficient, Bjerrum theory, association constant, numerical problems.

Unit II: Catalysis : Principles and Applications (15)

Basic principles of catalysis, adsorption isotherms, surface area pore size and acid strength measurement (TPD, pyridine IR acid base titration), Enthalpy and entropy of adsorption, interpretation of chemisorptions based on the structure and the nature of the solid – solid state theories – role of defects in catalysis, selection, preparation and evaluation of catalysts – test reaction, promoters, carriers and stabilizers, mechanism of selected reactions, hydrogenation and dehydrogenation reaction – dehydration of alcohols, olefin hydrogenation, decomposition of nitrous oxide, oxidation of CO-etonization of carboxylic acids, cracking of hydrocarbons.

UNIT III: Fuel cell (15)

Fuel cell : concept, importance of fuel cells, different types of fuel cell, Hydrogen – oxygen fuel cells, hydrocarbon - air fuel cell, alkaline fuel cells, phosphoric acid fuel cell (PAFC), proton exchange membrane fuel cells (PEMFC), solid oxide fuel cells, molten carbonate fuel cell (MCFC), solid polymer fuel cell (SPFC), applications of fuel cell.

UNIT- IV: Corrosion **(15)**

Introduction of corrosion, theories of corrosion, comparison between dry and wet corrosion, factors affecting corrosion: nature of the metal, nature of corroding environment, prevention of corrosion: material selection and design, protective coatings, corrosion inhibitors, types of corrosion, passivity: oxide or protective layer theory.

References:

1. G. W. Castellan - Physical Chemistry (Addision-Lesley Publishing Co.)
2. E. A. Moelwyn Hughes - Physical Chemistry (Pergamon Press)
3. L. C. Chapoy - Recent Advances in Liquid Crystalline Polymers
4. D. R. Crow - The Principles of Electrochemistry - (Chapman and Hall)
5. J. O. M. Bokris and A. K. N. Reddy - Modern Electrochemistry (Plenum Rosatta)
6. A. W. Adamson - Physical Chemistry of Surfaces
7. D. J. Shaw - Introduction to Colloid and Surface Chemistry
8. J. J. Bikermann - Surface Chemistry
9. Gurdeep Raj - Advanced Physical Chemistry (Goel Publishing House, Krishna Prakashan Media (P) Ltd., Meerut
10. Pahari S. - Physical Chemistry (New Central Book Agency (P) Ltd.) Kolkata
11. J. N. Gurtu and A. Gurtu – Advanced Physical Chemistry, 11th Edition (Pragati Prakashan)
12. D. N. Bajpai - Advanced Physical Chemistry (S. Chand Publications)
13. Arun Bahl, B S Bahl, G D Tuli - Essentials of Physical Chemistry (S Chand Publication)
14. S H Maron and C F Prutton - Principles of Physical Chemistry
15. B. Viswanathan, S. Sivasanker and A. V. Ramaswamy - Catalysis: Principles and Applications
16. Shashi Chawla - A Text Book of Engineering Chemistry
17. S. Galsstone – An Introduction to Electrochemistry

Paper No. XII, APCH. 3.4 (A): Advanced Organic Chemistry – I **60h**

Unit I: UV and IR Spectroscopy **(15)**

UV: Introduction, principle, Woodward- Fisher rules for conjugated dienes and carbonyl compounds, calculation of λmax, ultraviolet spectra of aromatic and heterocyclic compounds, steric effect in biphenyls.

IR: Introduction, principle, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines, detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds), effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance, FT-IR of gaseous, solids and polymeric materials.

Unit II: NMR Spectroscopy: **(15)**

General introduction and principle, definition, chemical shift, anisotropic effects and coupling constants in organic compounds, spin –spin interaction in typical systems, analysis of 1st order spectra, simplification methods for complex spectra,

use of high field NMR, shift reagents, chemical exchange and double resonance, introduction of FT that's pulse NMR NOE, DEPT and 2DNMR, Karplus curve variation of coupling constant with dihedral angle, simplification of complex spectra, shift reagent, solvent effect, Fourier transform technique, nuclear overhauser effect (NOE).

Unit III: Mass Spectroscopy (15)

Introduction and principle, ion production methods: EI, CI, and FAB, electrospray and MALDI, magnetic, TOF, quandrupole and ion cyclotron mass analyzers, MS technique, characteristic EIMS fragmentation modes and MS rearrangements.

Unit IV: Carbon-13 NMR Spectroscopy and Structural problems (15)

General considerations; chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl compounds); problems associated with ^{13}C, FT-NMR, proton decoupled off resonance, structural problems based on UV, IR, NMR, Mass and carbon-13 NMR spectroscopy.

References:

1. V. M. Parikh - Application spectroscopy of organic molecules (Mehta)
2. D. H. Williams and Fleming - Spectroscopic methods of organic compound.
3. Silverstein and Basslar - Spectroscopic identification of organic compounds.
4. V. M. Parikh - Aborption spectroscipy of organic molecules (J. Wiley)
5. P. S. Kalsi - Spectroscope of organic compounds (New Age Publisher)
6. Jackman and Sterneil - Application of NMR spectroscopy
7. J. D. Roberts - Nuclear magnetic resonance. (J. Wiley)
8. Jafee and Orchin - Theory and application of U.V.
9. K. Benjamin - Mass spectroscopy.
10. Beynon J. H. - The mass spectra of organic molecules.
11. Wehli F.W, Marchand A. P. - Interpretation of carbon 13 NMR (J. Wiley)
12. W. Kemp - Organic Spectroscopy, ELBS
13. Das and Jame - Mass Spectroscopy.
14. J. B. Lambert, S. Gronert, H. F. Shurvell, D. Lightneli, R. G. Cooks - Organic structural spectroscopy (Prentice Hall 2nd edition)

Paper No. XII, APCH. 3.4 (B): Applied Analytical Chemistry– I 60h

Unit I: Fundamentals of Polymers and Their Processing (15)

Basic concepts, classification, importance of polymers, monomers, initiators, inhibitors, retarders, techniques of polymerization: mass, solution, suspension, emulsion and gas phase; control of molecular weight and their determination, step polymerization, radical/chain polymerization, living and non-living chain polymerization, co-ordination polymerization, co-polymerization, ionic polymerization, ring opening polymerization, introduction, compounding of plastics and rubber, type, nature and role of additives, pre- compounding operations, mixing of polymers and additives, compression molding, transfer, injection and blow molding, extrusion, calendering, thermoforming, roto- molding, casting, sintering and compaction, deep coating, mold design, analysis of defects in molded products.

Unit II: Analytical Principles **(15)**

Evaluation of analytical data: Accuracy and precision. Standard deviation, variance and coefficient of variation. Student 't' test. Confidence limits. Estimation of detection limits. Errors: Classification, distribution, propagation, causes and minimization of error. Significant figures and computation rules. Correlation analysis: Scatter diagram. Correlation coefficient, r. Calculation of r by the method of least squares.

Volumetric methods: Classification of reactions in volumetry. Theories of indicators: Acid-base, redox, adsorption, metallochromic, fluorescent and chemiluminescent indicators. Complexation titrations: Titrations using EDTA, NTA and Titriplex. Precipitation titrations. Redox titrations. Gravimetric methods: Mechanism of precipitate formation. Aging of precipitates. Precipitation from homogeneous solutions. Coprecipitation and postprecipitation. Contamination of precipitates. Washing, drying and ignition of precipitates. Organic reagents used in gravimetry: Oxine, dimethylglyoxime and cupferron.

Thermal methods of analysis: Principles and instrumentation of TG and DTA. Complementary nature of TG and DTA. Differential scanning calorimeter (DSC). Applications of thermal methods in analytical chemistry and in the study of minerals and polymers.

Unit III: Science of Corrosion and Corrosion Control **(15)**

Corrosion, theories of corrosion. Kinetics of corrosion, Evan's diagram, thermodynamics of corrosion-Pourbaix diagram. Forms of corrosion. Corrosion prevention: modification of materials, corrosion inhibitors, protective coatings, cathodic and anodic protection.

Corrosion testing techniques: Evaluation of corrosion effect- XRD, ESCA, FTIR and surface techniques Corrosion in industries with special reference to oil and mining industries.

Unit IV: Electroanalytical Methods **(15)**

Potentiometric methods: Reference electrodes and indicator electrodes. The hydrogen, calomel, Ag-AgCl electrodes. The glass electrode – its structure, performance and limitations. Measurement of pH. Petentiometric titrations. Redox and precipitation titrations. Electrogravimety: Principle and method. Determination of Cu. Separation of metals. Conductometry: Principle and method. Conductance measurements. Conductometric titrations. Coulometry: Principle and method. Coulometric titrations.

References:

1. M.C.Day and j.Selbin, "Theoretical Inorganic Chemistry", Affiliated East-West Press
2. F.A.Cotton and G.Wilkinson, "Advanced Inorganic Chemistry, John Wiley & Sons
3. J.E.Huheey, "Inorganic Chemistry – Principles of Structure and Reactivity", Harper Collins College Publishers.
4. A.I.Vogel, "A Text Book of Quantitative Inorganic Anaysis", Longman
5. D.A.Skoog, D.M.West and F.J.Holler, "Fundamentals of Analytical chemistry", Saunders College Publishing.
6. W.W.Wendlandt, "Thermal Methods of Analysis", John Wiley & Sons
7. G.Friedlander and J.W.Kennady, "Introduction to Radiochemistry", John

Wiley & Sons
8. Injection Moulds & Moulding, J.B Dym, Van Ronstrandt-Reinhold, New York, 1980.
9. Polymer Process Engineering, E.A Grulke, PTR Prentice Hall, Eaglewood Chiffs, New Jersey, 1994.
10. Principles of Polymer Engineering, N.G Mccrum, C.P Buckley & C.P Bucknell, Oxford Engineering Press, Oxford, 1988.
12. Extrusion of Plastics, E.G Fisher, Newness-Butterworth, London, 1976.
14. Principles of Polymer Processing, R.T. Fenner, Macmillan, London, 1979

Paper No. XII, APCH. 3.4 (C): Bioorganic Chemistry-I 60 h

UNIT I: Cell structure and metabolism (15)

Prokaryotic and eukaryotic cells; Intracellular organelles and their functions; Comparison of plant and animal cells; Metabolic processes – catabolism and anabolism; ATP – currency of biological energy; Energy-rich and energy-poor phosphates.

Carbohydrates

Structure and function of sugar derivatives (deoxy, amino, branched chain sugars); Polysaccharides of biological importance,dextran, sialic acid; Cell-cell recognition andblood group substances.

UNIT II: Metabolic Reactions (15)

Fatty acid metabolism: Biological importance of fatty acidsand lipids, even chain and odd chain fatty acids, saturated and unsaturated fats, ketone bodies, fatty acid metabolism, calorific value of foods, bological membranes, properties and function of lipid bilayers and liposomes. Protein-related transformations: Amino acid degradation (C3, C4, C5family), urea cycle, uric acid and ammonia formation; Enzymatic hydrolysis of proteins to peptides; Amino acid sequencing; amino acid metabolism (biosynthesis and degradation).

UNIT III Nucleic Acids (15)

Chemical and enzymatic hydrolysis of nucleic acids; Structure and function of mRNA, tRNA, rRNA; Polymorphic nature of DNA, B- and Z-DNA, multi-stranded DNA; DNA sequence determination by chemical and enzymatic methods, Genetic code – origin, salient features, wobble hypothesis; Gene expression – transcription and translation; Gene mutation and carcinogenesis

UNIT IV Enzymes and Co-enzymes (15)

(a) Co-enzyme chemistry:Cofactors derived from vitamins, coenzymes, prosthetic groups, apoenzymes; Structure & biological function ofcoenzyme A,thiamine pyrophosphate, pyridoxal phosphate, NAD+, NADP+, FMN, FAD, lipoic acid and vitamin B12; Mechanisms of reactions catalyzed by above co-factors.

(b) Enzyme models: Host-guest chemistry, chiral recognition and catalysis, molecular recognition, diometric chemistry, crown ether, cryptates; Cyclodextrins, cyclodextrin-based enzyme models, calixarenes, ionophores, micelles, synthetic enzymes.

References:

1. Stryer, L. Biochemistry(4th edn.), W. H. Freeman & Co. (1995).

2. Zubay, S.. Biochemistry, Addison-Wesley (1983).
3. Sindell, R. P. DNA Structure and Function, Academic Press (1994).
4. Saenger, W. Principles of Nucleic Acid Structure, Springer-Verlag (1984).
5. Gringauz, A. Introduction to Medicinal Chemistry: How Drugs Act and Why? John Wiley & Sons (1997).
6. Dugas, H. & Penny, C. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, Springer Verlag (1998).
7. Palmer, T. Understanding Enzymes, Prentice Hall (1995).
8. Price, N. C. & Stevens, L. Fundamentals of Enzymology, Oxford University Press (1989)
9. Trevan, M. D. Immobilized Enzymes: An Introduction and Applications Biotechnology, John Wiley (1980).
10. Fersht, A. & Freeman, W. H. Enzyme Structure and Mechanism, W.H. Freeman, New York (1985).
11. Metzler, D. E. Biochemistry: The Chemical Reactions of Living Cells, Academic Press (2001).

M.Sc. Part II Semester-III

Applied Inorganic Chemistry Practicals

A: Non-instrumentation Practicals

1. Ore Analysis - 2
2. Alloy Analysis - 2
3. Preparation of coordination complexes (four)
4. Ion exchange study of separation of mixtures & estimations
5. Solvent extraction
6. Soil analysis
7. Data analysis
8. Synthesis and Characterization of transition metal nanoparticles

B: **Instrumentation Practicals**

1. Spectrophotometry
2. Nephelometry
3. Potentiometry
4. Conductometry
5. Thermal analysis
6. Magnetic properties of transition metal complexes
7. Spectro Fluorimetry
8. pH Metry
9. Polarography
10. Electrogravimetry
11. Nuclear and radiochemistry

(Any other experiments may be added when required)

References:

1. A.I.Vogel, “A Textbook of Quantitative Inorganic Anaysis”, Longman
2. Gurudeep Raj, Advanced Practical Inorganic Chemistry, Krishna Prakashan.
3. W.G.Palmer, “Experimental Inorganic Chemistry”, Cambridge University Press

4. Shikha Gulathi, J. L. Sharma and Shagun Manocha, Practical Inorganic Chemistry, CBS publisher and Distributors.
5. J. B. Yadav, Advanced Practical Physical Chemistry, Krishna Publishers.
6. I.M.Kolthoff, V.J.Elving and Sandell, "Treatise on Analytical Chemistry", Interscience.
7. I.M.Kothoff and Strenger, "Volumetric Analysis", Interscience
8. Fruman and Welcher, "Standard Methods of Inorganic Analysis", Van Nostrand
9. G.Schwarzenback, "Complexomtric Titrations", Interscience
10. D.A.Skoog and D.M.West, "Analytical Chemistry – An Introduction", Reinholdt.
11. R.S.Drago, "Physical Methods in Inorganic Chemistry", Affiliated East-West Press
12. Instrumental Methods for Chemical Analysis-H. Kaur
13. Spectroscopy- B. K. Sharma
14. Instrumental Methods of Analysis-Willard, Merritt, Dean, Settle
15. Nanotechnology: Principles and Practices- Sulbha Kulkarni
16. Principles of Inorganic Chemistry-Puri, Sharma, Kalia
17. Concise Coordination Chemistry-R. Gopalan, V. Ramalingam
18. Elements of Magnetochemistry-Datta and Shymal
19. G.Zhong Cao. Nanostructures and Nanomaterials: Synthesis, Properties and Applications, Imperial College Press (2004).
20. T. Pradeep, Nano The Essentials: Understanding Nanoscience and Nanotechnology.

M.Sc. Part II Semester-III
Applied Physical Chemistry Practicals

1) Statistical representation of given experimental data: Estimation of errors in measured and derived properties, reporting data with appropriate significant figures, graphical representation of data with x- and y-error bars.
2) Determination of indicator constant and isobestic point of an indicator.
3) Determination of stoichiometry and instability constant silver ammonia complex.
4) Determination of Thermodynamic Parameters for electrochemical reactions. (To determine ΔG^0, $\Delta H^0$and ΔS^0 for the formation of 1 mole of cadmium in 1 wt. % amalgam at 25 °C).
5) Determination of equivalent conductance at infinite dilution and dissociation constant for weak acid using Kolharausch Law of independent ionic mobility.
6) pH-metric determination of dissociation constant of carbonic acid.
7) To determine the dissociation constant of orthophoshoric acid by pH metrically.
8) Determination of order of reaction for iodination of acetone catalyzed by acid with reference to acetone, iodine and acid catalyst.
9) Determination of apparent and partial molar volumes of 1:1 electrolytes in aqueous solutions using pyknometric method of density measurements.
10) Indexing X-ray diffractometer pattern of CsBr.
11) To determine equilibrium constant of reaction $KI + I_2 \rightarrow KI_3$ spectrophotometrically
12) Determination of latent heat of fusion of a given solid.

References:

1. A Text Book of Quantitative inorganic analysis : A.I. Vogel.
2. Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan, 2nd edition, (2012).
3. Systematic Experimental Physical Chemistry :S.W. Rajbhoj and T.K. Chondhekar.
4. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.R. Denko. R.M.W. Richett (Pergamon Press).
5. Experiments in Physical Chemistry by Carl Garland, Joseph Nibler , David Shoemaker 8th Edition, Kindle Edition.
6. Laboratory manual of physical chemistry by H.D. Crockford, J.W. Nowell John Wiley & Sons, INC.

M.Sc. Part II Semester-III
Applied Organic Chemistry Practicals

A. Qualitative analysis:

Separation, purification and identification of compounds of ternary mixtures using Semi-microanalysis, TLC, column chromatography and chemical tests, IR spectra to be used for functional group identification.

B. Estimation of Sulphur & Nitrogen

C. Quantitative Analysis:

1. Two step preparation

a) Preparation of m-nitroaniline
b) Preparation of Benzaanilide from benzophenone
c) Preparation of pthalimide
d) Preparation of N-bromosuccinimide
e) Preparation of 4-methyl-7-acetoxy coumarin
f) Preparation of 1,2,3,4-Tetrahydro carbazole
g) Preparation of p-ethoxy acetanilide

D. Colorimetry & P^H metry experiments

E. Experiment on Hammet equation

F. Structure elucidation by using given spectral data.

G. Any other suitable experiment may be added.

RECOMMONDED BOOKS:

1. A Textbook of Practical Organic Chemistry – A. I. Vogel
2. Practical Organic Chemistry
3. Handbook of Quantitative and Qualitative Analysis- H. T. Clarke
4. Organic Synthesis Collective Volumes by Blat.

M. Sc. Part-II APPLIED CHEMISTRY

SEMESTER IV

Paper No. XIII, APCH. 4. 1: Applied Inorganic Chemistry- II 60h

Unit I: a) Infrared and Raman Spectroscopy (15)

Molecular vibrations, force constants, diatomic model, simple harmonic oscillator, an harmonic oscillator, Raman spectroscopy, classical and quantum mechanical theory of Raman effect, use of symmetry considerations to determine the number of lines in IR and Raman Spectra: mutual exclusion rule, selection rule in inorganic structure determinations: hydrogen bonding and infrared spectra, metal ligand and related vibrations, applications of Raman and Infrared spectroscopy.

b) Microwave spectroscopy

Basic concept, rotation spectra of simple inorganic compounds, classification of molecules, rigid rotor model, effect of isotopic substitution on transition frequencies & intensities non rigid rotor, stark effect nuclear and electron spin interaction and effect of external field. Applications of micro wave spectroscopy.

Unit II: Electron Spin Resonance Spectroscopy (15)

Principle, fine, hyperfine, super-hyperfine and zero field splitting, ESR of d^1 and d^9 transition metal ions; g values and factors affecting on g values, instrumentation and applications.

Mossbaur Spectroscopy: Introduction, Principles, Mossbaur nuclei, Mossbaur effect, Instrumentation, isomer shift, Quadrapole splitting and hyperfine interactions, applications.

Unit III: Spectroscopic & Microscopic Characterization techniques of Inorganic Materials (15)

Spectrometric techniques: UV-VIS-NIR spectroscopy, Energy dispersive X-ray spectroscopy (EDS), X-ray photoelectron spectroscopy (XPS)

Microscopic techniques: Transmission Electron Microscopy [TEM]; High resolution Transmission Microscopy [HRTEM]; Scanning Electron Microscopy [SEM];Scanning Tunneling Microscopy [STM]; Atomic Force Microscopy [AFM]

Unit IV: Instrumentation for Characterization of Inorganic Materials (15)

a) X-ray Diffraction (XRD)

b) Superconducting Quantum Interface (SQUID) Maganetometry

c) Brunauer-Emmett-Teller Gas Absorption Surface Area Measurement and Pore Structure Analysis (BET Method)

d) Dynamic light scattering (DLS)

Reference:

1. Instrumental Methods for Chemical Analysis-H. Kaur
2. Spectroscopy (Atomic and molecular)- Gurudeep R. Chatwal and Sham K. Anand
3. R. S. Drago, Physical Methods in Chemistry, Saunders College Publishers (1977).
4. Spectroscopy- B. K. Sharma
5. Instrumental Methods of Analysis-Willard, Merritt, Dean, Settle
6. Nanotechnology: Principles and Practices- Sulbha Kulkarni
7. K J Klabunde, Nanoscale materials in Chemistry, Wiley Interscience 2001
8. A R West, Basic Inorganic Chemistry, II Ed, Jhon Wiley & Sons (1999)

9. C. N. Benwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, TataMcgraw Hill, New Delhi (2006).
10.

Paper No. XIV, APCH. 4. 2: Applied Organic Chemistry – II **60 h**

Unit I : Chemistry of Biopolymers **(15)**

Amino acids: Introduction and classification, protection and deprotection of N-terminus and C-terminus of amino acids, Peptides and their synthesis. Solid phase peptide synthesis (SPPS)

Proteins: Structure and classification, Chemistry of nucleic acid bases A.G.C.T and U and their synthesis, structure of DNA. Structure of starch, cellulose Glycogen and Chitin.

Unit II: Pericyclic Reactions **(15)**

Molecular orbital symmetry, Frontier orbitals of ethylene 1, 3 butadiene, 1, 3, 5, hexatriene and allyl system, classification of pericyclic reactions, Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions – conrotatory and disrotatory motion, 4n, 4n+2 and allyl systems. Cycloadditions – antarafacial and suprafacial addition, 4n and 4n+2 systems, 2+2 addition of ketens, 3, 3, dipolar cycloadditions. Sigmatropic rearrangements – Suprafacial and antarafacial shifts of H, sigmatropic shifts involving carbon moieties, 3, 3, and 5, 5 sigmatropic rearrangements. Ene reaction.

Unit III: Chemistry of Drugs & Pharmaceuticals **(15)**

A) **Drugs:** Classification of drugs based on activity. Synthetic procedure for the present commonly used dregs of each type, Manufacturing of few important drugs.
B) **Vitamins:** Type of vitamins, synthetic of Vit – A and Vit – E, Vitamine – II of niacinamide.

Unit IV: Heterocycles **(15)**

Six membered Heterocycles with one heteroatom: Synthesis and reactions of pyrillium salts and pyrones and their comparison pyridinium and thiopyrylium salts and pyridines. Synthesis and reactions of coumarins, chromones.

Six membered heterocycles with two and more heterocycles: Synthesis and reactions of diazines and triazines.

Seven membered heterocycles: Synthesis and reactions of azepines, oxepines and thiepines.

References:

1. Text book of polymer science, F. W. Billmeyers Jr Wiley
2. Polymer science, V. R. Gowarikar, N. V. Vishwanathan and J Shreedhar, Wiley
3. Functional monomers and polymers, K. Takemote, Y. Inkiand R. M. Ottanbrite.
4. Contemporary polymer chemistry, H. R. Alcoek and F. W. Lambe, Practice Hall.
5. H. Arora, Organic Photochemistry and Pericyclic Reactions
6. Lendieer and Mitscher: The organic chemistry of drug synthesis (I. W.)
7. Burger Medicinal Chemistry.
8. A. Kar: Medicinal Chemistry.
9. W. O. Foye: Principles of Medicinal Chemistry.

10. R. M. Acheson : An introduction to chemistry of heterocyclic compounds (Interscience)
11. Joule and Smith: Heterocyclic Chemstry (Van Nostrand).
12. R. K. Bansal: Heterocyclic Chemistry (Wiley E).
13. L. A. Paquitte: Principles of Modern Heterocyclic Chemistry.
14. M. H. Palamer: The structure and reactions of heterocyclic compounds.
15. A. R. Katritzky: Advances in heterocyclic chemistry
16. Finar: Organic Chemistry (Vol. 1 & 2)
17. Cohn and Stumpt: Outline of Biochemistry.
18. Williams: Introduction to the chemistry of enzyme action.
19. The organic chemistry of drug design and drug action, R. B. Silverman Academic press.
20. Strategies for organic drug synthesis and design, D. Lednicer, J. Willey.

Paper No. XV, APCH. 4. 3: Advanced Organic Chemistry – II (60 h)

Unit I: Aromaticity and some reaction (15)

Non benzenoid aromatic compounds: Aromaticity in Non- benzenoids compounds Annulenes and heteroannulenes, fullerenes, tropone, tropolone, azulene, fulvene, tropylium salts, ferrocene, three and five membered systems. Crown ether complexes, cyclodextrins, cryptands, catenanes and rotaxanes, bonding in fullerenes.

Reaction mechanism: Alkyne metathesis reaction, Weinreb ketone synthesis, Petasis reaction, Henry reaction, Corey Kim oxidation. Reactions of carboxylic acids and esters.

Unit II: Kinetic and thermodynamic control of reactions (15)

Nitration and Sulphonation of naphthalene, Wittig reaction, Enolization, Friedel-Crafts and Diels Alder reactions.

Oxidation: Oxidation with Cr and Mn Compounds: oxidation of alcohol, aldehyde, C=C, C-H bonds in organic molecules, Pyridinium chloro chromate (PCC), Oxidation with peracids and other peroxides: C=C, Sharpless epoxidation.

Other types: Prevost and Woodward hydroxylation, cis and trans-hydroxylation, glycol cleavage reagent. HIO_4, $Pb(OAc)_4$, mercuric acetate, SeO_2, DDQ.

Unit III: Chemistry of Natural Products (15)

A) **Terpenoids:** Structure and synthesis of alpha-Pinene, Camphor, Cadenine and Caryophyllene. Hofmann, Emde and von Braun degradation.

B) **Alkaloids:** Structure elucidation of Papaverine, Quinine and Morphine. Synthesis of quinine and Papaverine. Structure and synthesis of beta-carotene, classification and structure of lipids and their biofunctions.

C) **Prostaglandings:** Nomenclature, structure (not elucidation) and biosynthesis of Prostaglandins PGE_2, and PGF_{IV}.

Unit IV: Selected Organic Reactions and Reagents (15)

Lithium dimethyl cuprate, Trimethyl silyl iodide, Baker Yeast, Phase-transfer catalysts. 1, 3-dipolar cycloaddition and chelotropic reactions, sigmatropic rearrangement, supra and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties, (3,3) and (5,5) sigmatropic rearrangement and Claisen and Cope and Aza Cope rearrangement, Ene reaction.

References:

1. L. M. Hardwood, Polar rearrangements, Oxford University
2. J. March, Advanced Organic Chemistry, Wiley
3. S. N. Issacs, Physical Organic Chemistry, Longman
4. P. Y. Bruice, Organic Chemistry, Prentice Hall
5. H. Arora, Organic photochemistry and Pericyclic reactions
6. C. H. Dupuoy, and O. L. Chapman, Molecular reactions and Photochemistry, Prentice Hall
7. J. M. Cozon and B. Holton, Organic Photochemistry, Cambridge University Press
8. S. H. Pine, Organic Chemistry by McGraw-Hill
9. I. L. Finar, Organic Chemistry Vol W, Longman

Paper No. XVI, APCH. 4. 4 (A): Inorganic Chemical Industries (60 h)

UNIT I: Special materials for electronic Industry (15)

High purity Silicon, Germanium, Gallium Arsenide (GaAs) Indium phosphide(InP) etc. preparation using Zone refining, Crystal growth and there use in electronic industry. High temperature materials, High alumina, alumina, SiC, Chromite, Zirconia, Magnesite etc. Ionic & Superionic conductors, β-alumina oxide ion conductors, halide conductors superionic, Fastion conductors- $RbAg_4I_5$, Arrhenious equation.

UNIT II: Fertilizer Industries (15)

General Principles of plant Nutrition: Essential plant nutrients, functions of the essential elements, classification of commercial nitrogenous fertilizers. manufacturing of ammonium sulphate, Urea, Ammonia nitrate Commercial phosphatic fertilizers. Manufacturing process and properties of phosphatic fertilizers, single super phosphate, triple superphosphate.

Commercial potassic fertilizers:

Chemicals of potassium compounds, classification, manufacturing process and properties of potasium fertilizer, muriate of potassium, potassium sulphate, mixed fertilizer.

Micronutrients:

Role and deficiency symptom of micronutrients.

Biofertilizers:

classification, demands and production, Present status of fertilizer Industries in India.

UNIT III: Glass & Ceramics (15)

Physical and chemical properties of glasses, Raw materials, manufacturing of special glasses. Ceramics and their properties, raw materials, manufacturing of ceramics, Applications of colours to pottery, use of ceramics.

Industrial Gases: Manufacturing and industrial uses of H_2 O_2, N_2, CO_2, Cl_2 & acetylene gases. Liquification of gases, production of low temperature.

Chemicals of Utility:Inorganic fine chemicals, magnesia, alumina, $AlCl_3$, $CaCO_3$, Na_2SiO_3, MnO_2, $FeSO_4$, PbO_2 and NaOH.

UNIT IV: Manufacturing of Inorganic Heavy Chemicals (15)

Introduction to chemical industry: Flow sheet preparation. Principles of process selection and operation selection. Basic raw materials and routes to major inorganic

products. Flow sheets and engineering aspects of the manufacture of sulphuric acid, sodium hydroxide, chlorine, ammonia, phosphoric acid, nitric acid and Portland cement.

References:

1. H. V. Keer, Principles of Solid state.
2. A. R. West, Solid State Chemistry and its applications, John Wiley & Sons, 2003.
3. B. K. Sharma, Engineering chemistry, Krishna Prakashan Media.
4. Lowenheim F A (1978) Electroplating MC Graw-Hill Book Company.
5. Gable, D: Principal of metal Treatment and protection. Pergaman, Press Oxford(1978)
6. G.A. Keneth: Electroplating for Engineering's A Hand Book IIIrd Edn Van Nastrad Reinbold Co London
7. F A Lowinbein: Modern Electroplating, Electroplating Publication New Jersey
8. Burke, Progess in ceramic science Vol. IV
9. R.R.Iash: afromulary of paints and other coating Vol. I
10. Industrial chemistry, B. K. Sharma.
11. Engineering chemistry, B. K. Sharma.
12. S. D. Shukla & G N Pandey: A text book of chemical technology Vol. 1
13. F A. Henglein: Chemical Technology (Pergamon)
14. D. Patranabis, Sensors and Transdusers, 2nd Edn, Prentice, Hall of India (2003).
15. Rajankumar Basak, Fertilizers, A text Book
16. R. Balsubramaniam, Materials Science and Engineering

Paper No. XVII, APCH. 4. 4 (B): Pollution Monitoring and Control 60 h

Unit I: Pollution and its Control (15)

Air pollution: Composition of air. Classification of pollutants. Sources of air pollutants. Industrial pollution: Power plants. Fertilizers. Petrochemicals. Automobile pollution. Water pollution: Water quality criteria for domestic and industrial uses. Analysis of water and wastewater. Principles of water and wastewater treatments. Removal of organics and harmful inorganics from water and wastewater. Biological treatment of wastewater: Theory and practice. Sludge treatment and disposal.

Unit II: a] Removal of Heavy Toxic Metals (15)

Chromium, Mercury, Lead, Cadmium, Arsenic analytical methods of determination of small amounts of the metal pollutants, copper recovery, treatment of waste to remove heavy metals, recovery techniques.

b] Removal of Particulate Matter: Particulate matter and dynamics of particles separations, Particulate matter in gas stream, filtering, gravity separation, liquid scrubbing cyclone separations, electrostatic precipitations safety of workers analysis of particulate matter.

Unit III: Removal of Nuclear Hazardous Materials (15)

Sources of Phenolic residues, Analytical methods, treatment by using stream gas stripping, ion – exchange, solvent extraction, oxidation methods, Microbiological treatment. Role of Vapor pressure, role of solubility, effect of pH on solubility,

extractive methods of recovery and recycle, Chemical methods of conversion to less soluble nontoxic or biodegradable and products carcinogens. Origin of SO_2 and its hazard, Analysis of SO_2, SO_2 control methods, desulphurization of fuels, Indian cola and Indian Crude oil. Economics of SO_2 control measures NOx, dissolved NOx, nitrites, ammonia, Urea and other nitrogen containing compounds in the effluents fertilizer explosive, industrial effluents, effluents from nitro aromatic industries.

Unit IV: a] Biotechnology in Chemical Industry (15)

Essential elements in biological system Mettallo – proteins and mettallo– enzymes. Metal ions as a charge carriers Health effects due to deficiency and excess of metals of non-metals Biotechnology for the production of chiral compounds. Role of biotechnology in Industry.

b] Polymer Recycling*:*

Environmental and polymer Industries. Recycling of polymers waste.

References:

1. S.P. Mahajan: Pollution control in processes iIndustries (J.W)
2. P.N.Chennsioff and R. A Young: Air Pollution control and design Hand Book and recovery (J.W)
3. J.R. Holmes: Refuse recycling and recovering (J.W)
4. M. Sitting: Resources recovery and recycling Hand Book and Industrial Wastes (NDS)
5. J.O. Niagh: Sulphur in the Environment Vol. I & II (J.W)
6. P.S.Minor: The Industry/EPA controntation (MGH)
7. R.B.Pojaselc: Toxic and Hazardous waste disposal Vol. I &II (AAS)
8. S.M.Khopkar: environmental pollution analysis
9. A.K.Dey: Environmental Chemistry
10. W.Handley: Industrial safety Handbook

Paper No. XVIII, APCH. 4. 4 (C): Chemical Engineering in Applied Chemistry 60 h

Unit I: Principle of Chemical Engineering (15)

Introduction to chemical engineering. Comparison of academic and industrial Chemistry. Material and energy balances. Units and dimensions, Fluid mechanics. Fluid statistics, Benoulli equation, Flow measurements, pipe fittings and valves. Heat transfer: Steady state heat conduction, unsteady state heat conduction, Heat flow by convection, Heat exchange and evaporators. Distillation: vapor-liquid equilibrium, fractionating column, Comparison of plate columns and packed columns, mass transfer operations, Principles of extraction, leaching and absorption. Chemical reactions: Batch and continuous reactors. Concept of residence time, space time and space velocity.

Unit II: Polymers (15)

Introduction, classification, characteristics and properties of polymers, co-polymerization, and addition polymerization: Free radical and ionic polymerization, Plastics: Thermoplastics, Thermosetting plastics, Elastomers or Rubber, Zeigler-Natta catalysts, condensation polymerization, conducting polymers and its application, importance of bio-polymers.

Unit III: Manufacturing of Organic Chemicals (15)

Raw materials and routes to major organic products. Flow sheets and engineering aspects of the manufacture of important products such as

nitrobenzene, linear alkyl enzyme sulphonate, chlorobenzene vinyl chloride, DMT, ethyl acetate, cummene, alkyl benzenes, cyclohexanone, Phallic acid, soaps, detergents and hydogenation of oils. Pharmaceuticals: Manufacturing processes of aspirin, vitamin-A and paracetamol. Pesticides: Manufacture of BHC, DDT, Carbaryl Malathion and Manufacture of dyes.

Unit IV: Manufacturing of Inorganic Heavy Chemicals (15)

Introduction to chemical industry: Flow sheet preparation. Principles of process selection and operation selection. Basic raw materials and routes to major inorganic products. Flow sheets and engineering aspects of the manufacture of sulphuric acid, sodiumhydroxide, chlorine, ammonia, phosphoric acid, nitric acid, ammonium nitrate, urea, glass, ceramics, refractories and Portland cement.

References:

1. E.K.Rideal, "Concepts in catalysis", Academic Press
2. A.Clark, "The Theory of Adsorption and Catalysis", Academic Press
3. R.Pearce and W.R.Patterson (Eds.), "Catalysis and Chemical Processes.",Backie and sons
4. J.M.Betty, "Applied Industrial Catalysis", Academic Press
5. Coulson and Richardson, "Chemical Engineering", Vol. 1,2, & 3
6. McCabe, "Unit Opeartion of Chemical Engineering"
7. A. Pahari and B. Chauhan, Engineering Chemistry
8. Peter Wiseman, "Industrial Organic Chemistry"
9. N.R.Nerris Shreve, "Chemical Process Industries"
10. Dridens, "Outline of Chemical Technology"
11. B.K.Sharma, "Industrial Chemistry, Goel Publishing House

M. Sc. Part II Semester-IV
Applied Physical Chemistry Practicals

1) Determination of stability constant of ferric thiocyanate complex.
2) To determine stoichiometry and stability constant of ferric-salicylate complex by Job's Method and mole ratio method spectrophotometrically.
3) Determination of the critical micelle concentration of a given surfactant in aqueous and aqueous salt solutions.
4) Determination of isoeletric points and dissociation constants for neutral, acidic and basic amino acids using pH-metric technique.
5) Study of the effect of ionic strength on the reaction between persulphate and iodide by visual method.
6) Indexing X-ray diffractometer pattern of NaCl.
7) To determine pK value of methyl red indicator at room temperature spectrophotometrically
8) To determine half wave potential of a given ion using half height method, differential method and wave equation method
9) Characterization of the complexes by electronic and IR spectral data.
10) Determination of unknown concentration of Cd^{+2}/Zn^{+2} ions in the given solution by standard addition method.

11) Estimation of quinine as quinine sulfate from medicinal tablets by fluorimetrically.

References:

1. Findlay's Practical Chemistry – Revised by J.A. Kitchner (V edition).
2. Text Book of Quantitative inorganic analysis : A.I. Vogel.
3. Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan, 2nd edition, (2012).
4. Systematic Experimental Physical Chemistry :S.W. Rajbhoj and T.K. Chondhekar.
5. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.R. Denko. R.M.W. Richett (Pergamon Press).
6. Experimental Physical Chemistry by D. P. Shoemaker, Mc. Growhill, 7th Edition, 2003.
7. Experiments in Physical Chemistry by Carl Garland, Joseph Nibler , David Shoemaker 8th Edition, Kindle Edition.
8. Laboratory manual of physical chemistry by H.D. Crockford, J.W. Nowell John Wiley & Sons, INC.

M. Sc. Part II Semester-IV
Applied Inorganic Chemistry Practicals

A: Non-instrumentation Practicals

1. Ore Analysis - 2
2. Alloy Analysis - 2
3. Preparation of coordination complexes (four) and preparations of mixed metal oxides (two)
4. Ion exchange study of separation of mixtures & estimations
5. Solvent extraction
6. Soil analysis
7. Data analysis
8. Synthesis and Characterization of transition metal nanoparticles

B: **Instrumentation Practicals**

1. Spectrophotometry
2. Nephelometry
3. Potentiometry
4. Conductometry
5. Thermal analysis
6. Magnetic properties of transition metal complexes
7. Spectro Fluorimetry
8. pH Metry
9. Polarography
10. Electrogravimetry
11. Nuclear and radiochemistry

C: Interpretation exercises

1. X-ray powder diffraction analysis of cubic compound
    a. Determination of lattice constants and geometry
    b. Partical Size

c. Density

2. Interpretation of Mossbaur spectrum with reference to determination of
    a. Isomer shift
    b. Quadruple splitting
    c. Internal magnetic field
    d. general comment
3. Interpretation of IR spectrum with reference to stretching vibration C=N, C=O, N-, M-O
4. Interpretation of absorption spectra for
    a. Verification of position of ligands in spectrochemical series.
    b. Determination of gemetry (Octahedral, square planer, tetrahedral) of a given compound.
    c. Calculation of spectral splitting parameters.
5. Calculation of band gap of semiconductors with the help of plots of log & vs. 10 3/4.

In all 20 experiments with at least five experiments in each course should be completed. Addition of other experiments in place of existing one may be allowed. A variety of small projects designed by teacher based on the interest of students and capabilities should be worked out. (**Project** work or the review report (50 Marks) will be examined by internal and external examiners.

Study tour is compulsory for M.Sc. Part- II Students to visit Chemical Industries in India.

M. Sc. Part II Semester-IV
Applied Organic Chemistry Practicals

A. Two or Three stage preparations starting with 5g or less & TLC.
B. Organic Preparations

1. Preparation of anthranilic acid
2. Preparatin of p- Amino benzoic acid
3. Preparation of p- chloro nitrobenzene by Sandmeyer reaction
4. Preparation of p- Idonitrobenzene by Sandmeyer reaction
5. Preparation of Benzylamine
6. Preparation of Benzimidazole
7. Preparation of 2-acetyl cyclohexanone
8. Multicomponent synthesis.

C. Project:

Project shall be started at the beginning of Sem – III and will be accessed bimonthly for its progress and continuous evaluation will be made. High standard research work is expected from the project and students are encouraged to publish it in national or international journals of high repute. External and internal examiners will examine the project jointly at the time of practical examination.

REFERENCE BOOKS:

1. A Textbook of Practical Organic Chemistry – A. I. Vogel

2. Practical Organic Chemistry
3. Handbook of Quantitative and Qualitative Analysis- H. T. Clarke
4. Organic Synthesis Collective Volumes by Blat.

Note: 1. Any other experiments may be added when required.
2. **Study tour is compulsory for M.Sc. Part- II Students to visit Chemical Industries in India.**

Laboratory Safety Equipments:

Part: I Personal Precautions:

1. All persons must wear safety Goggles at all times.
2. Must wear Lab Aprons/Lab Jacket and proper shoes.
3. Except in emergency, over – hurried activities is forbidden.
4. Fume cupboard must be used whenever necessary.
5. Eating, Drinking and Smoking in the laboratories strictly forbidden.

Part: II: Use of Safety and Emergency Equipments:

1. First aid Kits
2. Sand bucket
3. Fire extinguishers (dry chemical and carbon dioxide extinguishers)
4. Chemical Storage cabinet with proper ventilation
5. Material Safety Date sheets.
6. Management of Local exhaust systems and fume hoods.
7. Sign in register if using instruments.