

A<sup>++</sup>" Accredited by NAAC(2021) With CGPA 3.52

To,

### SHIVAJI UNIVERSITY, KOLHAPUR - 416 004, MAHARASHTRA

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शिवाजी विद्यापीठ, कोल्हापूर - ४१६ ००४,महाराष्ट्र

दूरध्वनी - ईपीएबीएक्स - २६०९०००, अभ्यासमंडळे विभाग दुरध्वनी ०२३१—२६०९०९३/९४



#### SU/BOS/Science/576

#### Date: 02/08/2023

The Principal,	The Head/Co-ordinator/Director
All Concerned Affiliated Colleges/Institutions	All Concerned Department (Science)
Shivaji University, Kolhapur	Shivaji University, Kolhapur.

Subject: Regarding syllabi under the Faculty of Science and Technology of as per NEP-2020

#### Sir/Madam,

With reference to the subject mentioned above, I am directed to inform you that the university authorities have accepted and granted approval to the revised syllabi, nature of question paper and equivalence of degree programme under the Faculty of Science and Technology.

	M.ScPart II (Sem. III & IV) as per NEP-2020		
1.	M.Sc. Part II Chemistry		
	(Inorganic, Organic, Physical, Analytical, Industrial, Applied)		

This syllabus, nature of question and equivalence shall be implemented from the academic year 2023-2024 onwards. A soft copy containing the syllabus is attached herewith and it is also available on university website <u>www.unishivaji.ac.in</u> > Online Syllabus.

The question papers on the pre-revised syllabi of above-mentioned course will be set for the examinations to be held in October /November 2023 & March/April 2024. These chances are available for repeater students, if any.

You are, therefore, requested to bring this to the notice of all students and teachers concerned.

Thanking you,

**Dy Registrar** Dr. S. M. Kubal

#### Copy to:

1	The Dean, Faculty of Science & Technology	5	P.G. Admission/Seminar Section
2	Director, Board of Examinations and Evaluation	6	Computer Centre/ Eligibility Section
3	The Chairman, Respective Board of Studies	7	Affiliation Section (U.G.) (P.G.)
4	B.Sc. Exam/ Appointment Section	8	Centre for Distance Education



# Shivaji University, Kolhapur Department of Applied Chemistry

Revised M.Sc. Part-II Syllabus as Per NEP-2020

To be implemented from June 2023-2024

(Applied Chemistry)

#### M. Sc. Programme structure (CBCS PATTERN) M. Sc. Part II (Applied Chemistry)

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

#### Semester III

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

#### M. Sc. Part-II Applied Chemistry

#### **SEMESTER-III**

Core PapersPaper No. IX, APCH.3.1: Applied Inorganic Chemistry–IPaper No. X, APCH. 3.2: Applied Organic Chemistry–IPaper No. XI, APCH. 3.3: Applied Physical ChemistryElective PapersPaper No. XII, APCH. 3.4 (A) : Advanced Organic Chemistry–IPaper No. XII, APCH. 3.4 (B) : Applied AnalyticalChemistryPaper No. XII, APCH. 3.4 (C) : Bioorganic ChemistryPaper No. XII, APCH. 3.4 (C) : Bioorganic ChemistryPaper No. XII, APCH. 3.4 (C) : Bioorganic Chemistry

#### **SEMESTER-IV**

#### **Core Papers**

Paper No. XIII, APCH.4.1: Applied Inorganic Chemistry-IIPaper No. XIV, APCH.4.2: Applied Organic Chemistry-IIPaper No. XV, APCH.4.3: Advanced Organic Chemistry-IIElective PapersPaper No. XVI, APCH.4.4 (A) : InorganicChemicalIndustriesPaper No. XVII, APCH.4.4 (B): Pollution MonitoringandControlPaper No. XVIII, APCH.4.4(C): Chemical Engineering inApplied ChemistryPractical Course

Equivalence in accordance with titles and contents of the papers
M. Sc. Semester III and Semester IV Applied Chemistry

Old Course(2022)	New Course(2023)			
SEMES	TER III			
Core	Papers			
Paper No. IX, APCH.3.1 :	Paper No. IX, APCH.3.1 :			
Applied Inorganic Chemistry – I	Applied Inorganic Chemistry – I			
Paper No. X, APCH. 3.2 :	Paper No. X, APCH. 3.2 :			
Applied Organic Chemistry – I	Applied Organic Chemistry – I			
Paper No. XI, APCH. 3.3 :	Paper No. XI, APCH. 3.3 :			
Applied Physical Chemistry	Applied Physical Chemistry			
Elective	e Papers			
Paper No. XII, APCH. 3.4 (A) : Advanced	Paper No. XII, APCH. 3.4 (A) : Advanced			
Organic Chemistry–I	Organic Chemistry–I			
Paper No. XII, APCH. 3.4 (B) : Applied	Paper No. XII, APCH. 3.4 (B) : Applied			
Analytical Chemistry	Analytical Chemistry			
Paper No. XII, APCH. 3.4 (C) : Bioorganic	Paper No. XII, APCH. 3.4 (C) : Bioorganic			
Chemistry	Chemistry			
SEMES	TER IV			
Core	Papers			
Paper No. XIII, APCH.4.1 : Applied	Paper No. XIII, APCH.4.1 : Applied			
Inorganic Chemistry- II	Inorganic Chemistry- II			
Paper No. XIV, APCH.4.2 : Applied	Paper No. XIV, APCH.4.2 : Applied			
Organic Chemistry – II	Organic Chemistry – II			
Paper No. XV, APCH.4.3 : Advanced	Paper No. XV, APCH.4.3 : Advanced			
Organic Chemistry – II	Organic Chemistry – II			
Elective Papers				
Paper No. XVI, APCH.4.4 (A):	Paper No. XVI, APCH.4.4 (A):			
InorganicChemicalIndustries	InorganicChemicalIndustries			
Paper No. XVII, APCH.4.4 (B) :	Paper No. XVII, APCH.4.4 (B) :			
Pollution Monitoring and Control	Pollution Monitoring and Control			
Paper No. XVIII, APCH.4.4(C) :	Paper No. XVIII, APCH.4.4(C) :			
Chemical Engineering in Applied Chemistry	Chemical Engineering in Applied Chemistry			

#### M. Sc. Part II- APPLIED CHEMISTRY SEMESTER III

#### Paper No. IX, APCH. 3. 1: Applied Inorganic Chemistry – I

#### 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<sup>n</sup>- configurations in octahedral and tetrahedral environments, Tanabe-Sugano diagrams(d<sup>2</sup> and d<sup>3</sup>configuration), calculation of Dq, B and  $\beta$  values, adjusted crystal field theory, MO diagrams for octahedral and tetrahedral complexes (with and without  $\pi$ -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 ( $S_N$ 1 and  $S_N$ 2, 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**

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 andnanomaterials: 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, Vol. 5 and 6
- 6. G. S. Manku- Theoretical Principles of Inorganic Chemistry
- 7. Datta and Shymal Elements of Magnetochemistr
- 8. AlenSharp 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

#### **Unit I: Molecular Orbital Theory**

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

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**

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**

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, Warrenand 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)

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

#### **Unit I : Equilibrium Properties of Electrolytes**

Non-ideal behavior of electrolyte solutions, Debye – Huckeltheory 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**

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**

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,moltencarbonate fuel cell (MCFC),solidpolymer fuel cell (SPFC), applications of fuel cell.

#### UNIT- IV: Corrosion

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 CrystallinePolymers

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, 11<sup>th</sup> 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

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## 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

### Unit II: NMR Spectroscopy:

gaseous, solids and polymeric materials.

Unit I: UV and IR Spectroscopy

steric effect in biphenyls.

General introduction and principle, definition, chemical shift, anisotropic effects and coupling constants in organic compounds,spin –spin interaction in typical systems, analysis of 1<sup>st</sup> 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).

UV: Introduction, principle, Woodward- Fisher rules for conjugated dienes and carbonyl compounds, calculation of  $\lambda$ max, ultraviolet spectra of aromatic and heterocyclic compounds,

**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,

#### Unit III: Mass Spectroscopy

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

General considerations; chemical shift (aliphatic, olefinic, alkyne, aromatic, heteroaromatic and carbonyl compounds); problems associated with <sup>13</sup>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 Aborptionspectroscipy 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.
- J. B. Lambert, S. Gronert, H. F. Shurvell, D. Lightneli, R. G. Cooks Organic structural spectroscopy (Prentice Hall 2<sup>nd</sup> edition)

# Paper No. XII, APCH. 3.4 (B): Applied Analytical Chemistry– I60hUnit 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

#### Paper No. XII, APCH. 3.4 (A): Advanced Organic Chemistry – I60h

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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**

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 andcupferron.

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

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 anodicprotection.

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**

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 CollegePublishers.
- 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, NewYork, 1980.
- 9. Polymer Process Engineering, E.A Grulke, PTR Prentice Hall, Eaglewood Chiffs, NewJersey, 1994.

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- 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

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.

#### **UNITII: Metabolic Reactions**

Fatty acid metabolism: Biological importance of fatty acidsandlipids, 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 anddegradation).

#### **UNIT IIINucleicAcids**

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 EnzymesandCo-enzymes

(a) Co-enzyme chemistry:Cofactors derived from vitamins, coenzymes, prostheticgroups, apoenzymes; Structure & biological function of coenzymeA, 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

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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 ShagunManocha, 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  $\Delta G^0$ ,  $\Delta H^0$  and  $\Delta S^0$  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 Semimicroanalysis, 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<sup>H</sup>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

(15)

#### Paper No. XIII, APCH. 4. 1: Applied Inorganic Chemistry- II60h Unit I:a) Infrared and Raman Spectroscopy

Molecular vibrations, force constants, diatomic model, simple harmonic oscillator, anharmonic 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, selectionrule 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 ofmolecules, rigid rotor model, effect of isotopic substitution on transitionfrequencies & 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 resolutionTransmission 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
- A R West, Basic Inorganic Chemistry, II Ed, Jhon Wiley & Sons (1999) 8.

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

#### **Unit I : Chemistry of Biopolymers**

Amino acids: Introduction and classification, protection and deprotection of N-terminus and Cterminus 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**

Molecular orbital symmetry, Frontier orbitals of ethylene 1, 3butadiene, 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**

Drugs: Classification of drugs based on activity. Synthetic procedure for the present A) 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**

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:**

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

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- 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 (60h)

#### Unit I: Aromaticity and some reaction

**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

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<sub>4</sub>, Pb(OAc)<sub>4</sub>, mercuric acetate, SeO<sub>2</sub>, DDQ.

#### **Unit III: Chemistry of Natural Products**

**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, 3dipolar cycloaddition and chelotropic reactions, sigmatropicrearrangement, 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

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- 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(60h)

#### **UNIT I: Special materials for electronic Industry**

High purity Silicon, Germanium, Gallium Arsenide (GaAs) Indium phosphide(InP) etc. preparation using Zone refining, Crystal growth and there use inelectronic industry. High temperature materials, High alumina, alumina, SiC, Chromite, Zirconia, Magnesite etc. Ionic & Superionic conductors,  $\beta$ -alumina oxide ion conductors, halideconductors superionic, Fastion conductors- RbAg<sub>4</sub>I<sub>5</sub>, Arrhenious equation.

#### **UNIT II: Fertilizer Industries**

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 andproperties 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 inIndia.

#### **UNIT III: Glass & Ceramics**

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

Industrial Gases: Manufacturing and industrial uses of H<sub>2</sub> O<sub>2</sub>, N<sub>2</sub>, CO<sub>2</sub>, Cl<sub>2</sub>& acetylene gases. Liquification of gases, production oflow temperature.

Chemicals of Utility: Inorganic fine chemicals, magnesia, alumina, AlCl<sub>3</sub>, CaCO<sub>3</sub>, Na<sub>2</sub>SiO<sub>3</sub>, MnO<sub>2</sub>, FeSO<sub>4</sub>, PbO<sub>2</sub> and NaOH.

#### **UNIT IV: Manufacturing of Inorganic Heavy Chemicals**

Introduction to chemical industry: Flow sheet preparation. Principles ofprocess selection and operation selection. Basic raw materials and routes tomajor inorganic products. Flow sheets and engineering aspects of themanufacture 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 IIIrdEdn Van NastradReinbold Co London

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- 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. RajankumarBasak, 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 itsControl

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.

#### UnitII: a] Removal of HeavyToxicMetals

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

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 particulatematter.

#### **Unit III: Removal ofNuclear Hazardous Materials**

es 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<sub>2</sub> and its hazard, Analysis of SO<sub>2</sub>, SO<sub>2</sub> control methods, desulphurization of fuels, Indian cola and Indian Crude oil. Economics of SO<sub>2</sub>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 inChemicalIndustry (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 inIndustry.

#### b]PolymerRecycling:

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)

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- 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 pollutionanalysis
- 9. A.K.Dey: EnvironmentalChemistry
- 10. W.Handley: Industrial safetyHandbook

#### Paper No. XVIII, APCH. 4. 4 (C): Chemical Engineering in Applied Chemistry60 h Unit I: Principle of Chemical Engineering

Introduction to chemical engineering. Comparison of academic and industrialChemistry. 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 exchangeand 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 ofresidence time, space time and spacevelocity.

#### Unit II: Polymers

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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 enzymesulphonate, 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 andManufacture ofdyes.

#### Unit IV: Manufacturing of InorganicHeavyChemicals

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 Portlandcement.

#### **References:**

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

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

- 1) Determination of stability constant of ferric thiocyanate complex.
- To determine stoichiometry and stability constant of ferric-salicylate complex by Job's 2) 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.
- Study of the effect of ionic strength on the reaction between persulphate and iodide by visual 5) method.
- 6) Indexing X-ray diffractometer pattern of NaCl.
- To determine pK value of methyl red indicator at room temperature spectrophotometrically 7)
- To determine half wave potential of a given ion using half height method, differential 8) method and wave equation method
- Characterization of the complexes by electronic and IR spectral data. 9)
- 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:**

- Findlay's Practical Chemistry Revised by J.A. Kitchner (V edition). 1.
- 2. Text Book of Quantitative inorganic analysis : A.I. Vogel.
- Practical Physical Chemistry : B. Viswanathan and P.S. Raghavan, 2nd edition, (2012). 3.
- 4. Systematic Experimental Physical Chemistry :S.W.Rajbhoj and T.K. Chondhekar.
- Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.R. Denko. R.M.W. 5. 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
- Data analysis 7.
- 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 alltimes.
- 2. Must wear Lab Aprons/Lab Jacket and propershoes.
- 3. Except in emergency, over hurried activities isforbidden.
- 4. Fume cupboard must be used whenevernecessary.
- 5. Eating, Drinking and Smoking in the laboratories strictlyforbidden.

#### Part: II: Use of Safety and Emergency Equipments:

- 1. First aidKits
- 2. Sandbucket
- 3. Fire extinguishers (dry chemical and carbon dioxideextinguishers)
- 4. Chemical Storage cabinet with properventilation
- 5. Material Safety Datesheets.
- 6. Management of Local exhaust systems and fumehoods.
- 7. Sign in register if using instruments.