SRI VENKATESWARA UNIVERSITY

Department of Chemistry

M.Sc. CHEMISTRY

NEP-2020 NHEQP as per guidleines APSCHE

Under Choice Based Credit System (CBCS)

(w.e.f. the academic year 2024–25)

Syllabus for I, II, III & IV SEMESTERS

SRI VENKATESWARA UNIVERSITY :: TIRUPATI
SVU COLLEGE OF SCIENCES
Department of Chemistry
Re-Structured P.G. Programme (CBCS) as per NEP 2020, (NHEQF) and Guidelines of APSCHE
(With effect from the batch of Students admitted from the academic year 2024-25)

M.Sc CHEMISTRY

SEMESTER - I								
S. No	**Course**	**Code**	**Title of the Course**	**H/ W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	101	Core course –1: Inorganic Chemistry-I	4	4	70	30	100
2		102	Core Course –2(A): Organic Chemistry-I Core Course –2(B): Analytical Chemistry-I	4	3	50	25	75
3		103	Core Course –3(A): Physical Chemistry-I Core Course–3(B): Pharmaceutical Quality Control and Quality Assurance	4	3	50	25	75
4	*P	104	Practical I (related to CC 2 & 3)	6	2	35	15	50
5	SOC	105	Skill Oriented Course –1(A): Inorganic Materials in Industry Skill Oriented Course –1(B): Chemotherapy and Drug Analysis	4	3	50	25	75
6		106	Skill Oriented Course –2(A): Industrial Chemistry Skill Oriented Course –2(B): Applied Methods of Chemical Analysis	4	3	50	25	75
7	*P	107	Practical II (related to SOC 1 & 2)	6	2	35	15	50
8	Audit Course	109	Indian Knowledge Systems - 1	4	0	0	100	0
			Total	**36**	**20**	**340**	**160**	**500**

- **CC (Core Courses) - 1st Core Course is mandatory and 2nd & 3rd Core Courses Student can choose one from each code**
- ***SOC (Skill Oriented Courses) – Student can choose one from each code**
- ***Practical – I relating to 2nd & 3rd Core Courses and Practical - II relating to 1st & 2nd Skill Oriented Courses (SOC)**
- **Audit Course – Zero Credits but mandatary with only a Pass**

SEMESTER - II								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	201	Core course – 4: Inorganic Chemistry-II	4	4	70	30	100
2		202	Core Course –5(A): Organic Chemistry-II Core Course–5(B): Industrial Methods of Chemical Analysis	4	3	50	25	75
3		203	Core Course –6(A): Physical Chemistry-II Core Course –6(B): Main Group Chemistry & Spectroscopic Characterizations of Inorganic Compounds	4	3	50	25	75
4	P	204	Practical III (related to CC 5 & 6)	6	2	35	15	50
5	SOC	205	Skill Oriented Course –3(A): Instrumental Methods Skill Oriented Course –3(B): Materials Chemistry	4	3	50	25	75
6		206	Skill Oriented Course –4(A): Heterocyclic Chemistry Skill Oriented Course – 4(B): Bio-organic Chemistry	4	3	50	25	75
7	P	207	Practical IV (related to SOC 3 & 4)	6	2	35	15	50
8	OOTC	208	Open Online Transdisciplinary Course – 1	-	2	-	100	100
9	Audit Course	209	Indian Knowledge Systems - 2	4	0	0	100	0
			Total	**36**	**22**	**340**	**260**	**600**

- **CC (Core Courses) – 4th Core Course is mandatory and 5th & 6th Core Courses Student can choose one from each code**
- ***SOC (Skill Oriented Courses) – Student can choose one from each code**
- ***Practical - III relating to 5th & 6th Core Courses and Practical - IV relating to 3rd & 4th Skill Oriented Courses (SOC)**
- ***Open Online Transdisciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc.,**
- **Audit Course – Zero Credits but mandatary with only a Pass**

SEMESTER – III (Analytical Chemistry)								
S. No	**Course**	**Code**	**Title of the Course**	**H/ W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	301	Core course – 7: Instrumental Methods of Analysis	4	4	70	30	100
2		302	Core Course – 8(A): Quality Control and General Principles Core Course – 8(B): Biotechnology and Environmental Management Laws and Protection	4	3	50	25	75
3		303	Core Course – 9(A): Inorganic Spectroscopy & Thermal Methods of Analysis Core Course – 9(B): Chemistry of Transition and Non-Transition Elements	4	3	50	25	75
4	P	304	Practical V (related to CC 8 & 9)	6	2	35	15	50
5	SOC	305	Skill Oriented Course – 5(A): Fundamentals of Spectroscopy and Applications Skill Oriented Course – 5(B): Bioinorganic, Bioorganic, Biophysical Chemistry	4	3	50	25	75
6		306	Skill Oriented Course – 6(A): X- Ray Diffraction, Kinetics in Solutions, Electroanalytical Chemistry Skill Oriented Course – 6(B): Inorganic Materials for Electronic Industry	4	3	40	25	75
7	P	307	Practical VI (related to SOC 5 & 6)	6	2	35	15	50
8	OOTC	308	Open Online Transdisciplinary Course – 2	-	2	-	100	100
*	Seminar / tutorials / remedial classes and Quiz as part of internal assessment			4	-	-	-	-
			Total	**36**	**22**	**340**	**260**	**600**

- **CC (Core Courses) – 7th Core Course is mandatory and 8th & 9th Core Courses Student can choose one from each code**
- ***SOC (Skill Oriented Courses) – Student can choose one from each code**
- ***Open Online Transdisciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc.,**
- ***Practical - V relating to 5th & 6th Core Courses and Practical - VI relating to 5th & 6th Skill Oriented Courses (SOC)**

SEMESTER – III (Environmental Chemistry)								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	301	Core course – 7: Energy, Environment and Soils	4	4	70	30	100
2		302	Core Course – 8(A): Water Pollution Monitoring And Environment Laws Core Course – 8(B): Quality Control and General Principles	4	3	50	25	75
3		303	Core Course – 9(A): Spectral Techniques in Inorganic Chemistry Core Course – 9(B): Group theory and spectroscopy	4	3	50	25	75
4	P	304	Practical V (related to CC 8 & 9)	6	2	35	15	50
5	SOC	305	Skill Oriented Course – 5(A): Fundamentals of Spectroscopy and Applications Skill Oriented Course – 5(B): Bioinorganic, Bioorganic, Biophysical Chemistry	4	3	50	25	75
6		306	Skill Oriented Course – 6(A): X- Ray Diffraction, Kinetics in Solutions, Electroanalytical Chemistry Skill Oriented Course – 6(B): Inorganic Materials for Electronic Industry	4	3	40	25	75
7	P	307	Practical VI (related to SOC 5 & 6)	6	2	35	15	50
8	OOTC	308	Open Online Transdisciplinary Course – 2	-	2	-	100	100
*	Seminar / tutorials / remedial classes and Quiz as part of internal assessment			4	-	-	-	-
			Total	**36**	**22**	**340**	**260**	**600**

- **CC (Core Courses) – 7th Core Course is mandatory and 8th & 9th Core Courses Student can choose one from each code**
- ***SOC (Skill Oriented Courses) – Student can choose one from each code**
- ***Open Online Transdisciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc.,**
- ***Practical - V relating to 5th & 6th Core Courses and Practical - VI relating to 5th & 6th Skill Oriented Courses (SOC)**

SEMESTER – III (Inorganic Chemistry)								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	301	Core course – 7: Inorganic Spectroscopy & Thermal Methods of Analysis	4	4	70	30	100
2		302	Core Course – 8(A): Co-Ordination Compounds, Organometallic Chemistry and Chemistry of Non- Transition Elements Core Course – 8(B): Energy Resources and Green Chemistry	4	3	50	25	75
3		303	Core Course – 9(A): Instrumental Methods of Analysis Core Course – 9(B): Pollution and Control Methods	4	3	50	25	75
4	P	304	Practical V (related to CC 8 & 9)	6	2	35	15	50
5	SOC	305	Skill Oriented Course – 5(A): Fundamentals of Spectroscopy and Applications Skill Oriented Course – 5(B): Bioinorganic, Bioorganic, Biophysical Chemistry	4	3	50	25	75
6		306	Skill Oriented Course – 6(A): X- Ray Diffraction, Kinetics in Solutions, Electroanalytical Chemistry Skill Oriented Course – 6(B): Inorganic Materials for Electronic Industry	4	3	40	25	75
7	P	307	Practical VI (related to SOC 5 & 6)	6	2	35	15	50
8	OOTC	308	Open Online Transdisciplinary Course – 2	-	2	-	100	100
*	Seminar / tutorials / remedial classes and Quiz as part of internal assessment			4	-	-	-	-
			Total	**36**	**22**	**340**	**260**	**600**

- **CC (Core Courses) – 7th Core Course is mandatory and 8th & 9th Core Courses Student can choose one from each code**
- ***SOC (Skill Oriented Courses) – Student can choose one from each code**
- ***Open Online Transdisciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc.,**
- ***Practical - V relating to 5th & 6th Core Courses and Practical - VI relating to 5th & 6th Skill Oriented Courses (SOC)**

SEMESTER – III (Organic Chemistry)								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	301	Core course – 7: Organic Synthesis-I	4	4	70	30	100
2		302	Core Course – 8(A): Organic Synthesis-II Core Course – 8(B): Organic Reagents In Quality Control and Analysis	4	3	50	25	75
3		303	Core Course – 9(A): Inorganic Spectroscopy & Thermal Methods of Analysis Core Course – 9(B): Group Theory and Polymer Chemistry	4	3	50	25	75
4	P	304	Practical V (related to CC 8 & 9)	6	2	35	15	50
5	SOC	305	Skill Oriented Course – 5(A): Fundamentals of Spectroscopy and Applications Skill Oriented Course – 5(B): Bioinorganic, Bioorganic, Biophysical Chemistry	4	3	50	25	75
6		306	Skill Oriented Course – 6(A): Chemistry of Natural Products Skill Oriented Course – 6(B): X- Ray Diffraction, Kinetics in Solutions, Electroanalytical Chemistry	4	3	40	25	75
7	P	307	Practical VI (related to SOC 5 & 6)	6	2	35	15	50
8	OOTC	308	Open Online Transdisciplinary Course – 2	-	2	-	100	100
*	Seminar / Tutorials / Remedial classes and Quiz as part of Internal Assessment			4	-	-	-	-
			Total	**36**	**22**	**340**	**260**	**600**

- **CC (Core Courses) – 7th Core Course is mandatory and 8th & 9th Core Courses Student can choose one from each code**
- ***SOC (Skill Oriented Courses) – Student can choose one from each code**
- ***Open Online Transdisciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc.,**
- ***Practical - V relating to 5th & 6th Core Courses and Practical - VI relating to 5th & 6th Skill Oriented Courses (SOC)**

SEMESTER – III (Physical Chemistry)								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	CC	301	Core course – 7: Physical Chemistry-III	4	4	70	30	100
2		302	Core Course – 8(A): Advanced Electrochemistry Core Course – 8(B): Principles in Quality Control And Quality Measurements	4	3	50	25	75
3		303	Core Course – 9(A): Inorganic Spectroscopy & Thermal Methods of Analysis Core Course – 9(B): Natural Resources-Pollution and Green Chemistry	4	3	50	25	75
4	P	304	Practical V (related to CC 8 & 9)	6	2	35	15	50
5	SOC	305	Skill Oriented Course – 5(A): X- Ray Diffraction, Kinetics in Solutions, Electroanalytical Chemistry Skill Oriented Course – 5(B): Crystal Structures, Kinetics of Electrodes, Electrode Chemistry	4	3	50	25	75
6		306	Skill Oriented Course – 6(A): Fundamentals of Spectroscopy and Applications Skill Oriented Course – 6(B): Bioinorganic, Bioorganic, Biophysical Chemistry	4	3	40	25	75
7	P	307	Practical VI (related to SOC 5 & 6)	6	2	35	15	50
8	OOTC	308	Open Online Transdisciplinary Course – 2	-	2	-	100	100
*	Seminar / tutorials / remedial classes and Quiz as part of internal assessment			4	-	-	-	-
			Total	**36**	**22**	**340**	**260**	**600**

- **CC (Core Courses) – 7th Core Course is mandatory and 8th & 9th Core Courses Student can choose one from each code**
- ***SOC (Skill Oriented Courses) – Student can choose one from each code**
- ***Open Online Transdisciplinary Course (OOTC) - Students can choose any relevant course of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc.,**
- ***Practical - V relating to 5th & 6th Core Courses and Practical - VI relating to 5th & 6th Skill Oriented Courses (SOC)**

SEMESTER – IV (Analytical Chemistry, Environmental Chemistry, Inorganic Chemistry, Organic Chemistry, Physical Chemistry)								
S. No	**Course**	**Code**	**Title of the Course**	**H/W**	**C**	**SEE**	**IA**	**Total Marks**
1	OOSDC	401	Open Online Skill Development Courses	-	8	-	200	200
2	PW	402	Project Work – Orientation classes	24	12	300	0	300
*	Conducting classes for competitive exams, communication skills, UGC / CSIR and NET / SLET examinations			12	-	-	-	-
			Total	**36**	**20**	**300**	**200**	**500**
Total IV Semesters (for each specialisation)				**144**	**84**	**1320**	**880**	**2200**

- Open Online Skill Development Course (OOSDC) - Students can choose any **Two** relevant courses of his / her choice from the online courses offered by governmental agencies like SWAYAM, NPTEL, etc., **to get 8 credits (with 4 credits from each course)**

FIRST SEMESTER

CC101-CORE COURSE 1: INORGANIC CHEMISTRY-I

UNIT-I: COORDINATION COMPOUNDS & METAL-LIGAND BONDING THEORIES 15 Hrs

Introduction to Crystal field Theory, CFSE and its calculation, Paring energy, Splitting of 'd' orbitals in Trigonal bi pyramidal, square planar, square pyramid and pentagonal bipyramidal geometries, Jahn –Teller effect, Application of CFT, OSSE, site Selection in Spinels, Short comings of CFT, Evidence for covalency, Nephelauxetic effect. MOT of co-ordinate bonds – M.O. Diagrams for octahedral, tetrahedral and square planar complexes. Experimental evidences for π- bonding – Crystallography, Infrared spectroscopy and Photoelectron spectroscopy.

UNIT-II: CHEMISTRY OF NON-TRANSITION ELEMENTS 15 Hrs

General characteristics of the non- transition elements special features of individual elements; Synthesis' properties and structure of their Halides and Oxides, Polymorphism of Carbon, Phosphorus and Sulphur, Synthesis, properties and structure of boranes, Carboranes, borazines, Silicates, Carbides, Sulphur-nitrogen compounds. Electron counting in boranes, Wade's rules (Polyhedral skeletal electron pair theory), Isopopoly and hetero poly acids.

UNIT-III: REACTION MECHANISMS IN COMPLEXES AND THEORY OF HSAB 15 Hrs

Reactivity of metal complexes. Inert and Labile complexes. Concept of Labile and Inert complexes in terms of Valence bond and Crystal Field theories. Taube's classification of complexes as labile and inert complexes. Dissociative (D) and Dissociative interchange Mechanism (Id) & Associative (A) and Associative interchange Mechanism (Ia). Substitution reactions in octahedral complexes - Acid Hydrolysis -factors affecting Acid Hydrolysis - Base Hydrolysis-conjugate Base Mechanisms - Anation Reactions -Substitution Reactions in Square Planar complexes- Trans effect – Mechanisms of Trans effect: polarization and π-bonding theories. Electron Transfer Reaction-Inner Sphere and outer Sphere Mechanisms- Marcus theory. **Theory of HSAB :** Hard and soft acids and bases, Classification, Acid-base strength and hardness, Symbiosis, Electronegativity and hardness, Application of HSAB: Biological functions and toxicology of metals, and medicinal applications.

UNIT-IV: TRANSITION METAL CARBONYL AND METAL NITROSYL COMPLEXES 15 Hrs

Nature of π bonding, Classification of π ligands, π donor ligands and π -acceptor ligands.

Metal Carbonyls: Synthesis of metal carbonyls, Structures of metal carbonyls of the types $M(CO)_n$ (M= Cr, Fe, Ni; n=4-6), $M_2(CO)_n$ (M=Co, Fe, Mn; n=8-10), $M_3(CO)_{12}$ (M=Fe, Ru and Os), $M_4(CO)_{12}$ (M=Co, Rh, Ir). IR Spectra of metal carbonyls (i) Detection of bridging and terminal CO ligand, (ii) Synergistic effect, EAN and 18-electron rule. Electron counting methods (i) Oxidation state method and (ii) Neutral Atom method.

Metal Nitrosyls: Synthesis of metal Nitrosyls, bonding, Electron donation by nitric oxide, Models for NO bonding (i) Covalent model and (ii) Ionic models, Structures of metal nitrosyls (1) $[Fe_4S_3(NO)]$ (2)$[Fe_2(NO)_2I_2]$ (3) $[(\phi_3P)_2Ir(CO)Cl(NO)]^+$ (4) $[(\phi_3P)_2Ru(NO)_2Cl]$, Detection of bridging NO ligand, Applications of metal nitrosyls.

Books suggested:

1. F.A.Cotton and G. Wilkinson, Advanced In-organic chemistry VI Edition, 1999.John wiley & sons. Inc., New York.
2. James E. Huheey, Inorganic chemistry- Principles of structure and reactivity, VI Edition 1993.Harper Collins College Publishers, New York.
3. J.D. Lee: Concise Inorganic Chemistry (Blackwell)
4. Gary Wolfsburg: Inorganic Chemistry (5^{th} Ed. (Viva Books)
5. W.L. Jolly: Modern Inorganic Chemistry (McGraw-Hill)
6. B.N Figgis: Introduction to Ligand Fields (John-Willey)
7. S.F.A. Kettle: Coordination compounds.
8. Coordination Chemistry. Bassalo & Jahnson.

CC102-CORE COURSE 2(A): ORGANIC CHEMISTRY-I

UNIT-I: REACTIVE INTERMEDIATES **15 Hrs**

Introduction, generation, structure, stability and reactivity of carbocations, carbanions, free radicals. carbenes, nitrenes and arynes. Thermodynamic and kinetic requirements, kinetic and thermodynamic control, potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.

UNIT-II: SUBSTITUTION REACTIONS **15 Hrs**

Aliphatic Nucleophilic Substitution: Introduction to S_N1, S_N2, mixed S_N1 and S_N2, SET mechanisms. Factors effecting S_N1 and S_N2 reactions The neighbouring group participation (NGP) - anchimeric assistance, NGP by σ and π-bonds, phenonium ions, norbornyl and norbornenyl systems, Classical and nonclassical carbocations, NGP by halogens and heteroatoms (O,N,S). The S_N^i and S_N2' mechanisms. Nucleophilic substitution at an allylic, and vinylic carbons.

Aromatic Nucleophilic Substitution: Addition-Elimination reaction (S_NAr), benzyne and S_NAr1 mechanisms. Substitution and electronic effects, Reactivity - effect of substrate, structure, leaving group and attacking nucleophile. The Von Richter, Sommelet - Hauser and Smiles rearrangements.

UNIT-III: ADDITION AND ELIMINATION REACTIONS **15 Hrs**

Addition Reactions:

Electrophilic addition to carbon carbon double bond: Stereoselective addition to carbon carbon double bond; anti addition-Bromination and Epoxidation followed by ring opening. Syn addition of OsO_4 and $KMnO_4$. **Addition to Carbon – Hetero Multiple Bonds:** Steric course of addition reactions C=O and C=N, Cram's rule, Aldol condensation, Cannizzaro, Perkin, Knoevenagel, Claisen – Schmidt, Claisen, Dieckman, Benzoin and Stobbe condensations. Wittig, Grignard, Mannich reactions. Hydrolysis of Carbon-Nitrogen bond, Isocyanates and Isothiocynates.

Elimination reactions: E_2, E_1, E_{1CB} mechanisms. Orientation and Stereochemistry in E_2 eliminations, Hofmann and Saytzeff rules, Syn elimination and Anti-elimination, Elimination Vs Substitution, Factors influencing elimination reactions. Pyrolytic eliminations.

UNIT-IV: **STEREOCHEMISTRY AND CONFORMATIONAL ANALYSIS** **15 Hrs**

Stereoisomerism- Introduction to Stereochemistry

Molecular Symmetry & Chirality: Symmetry operations and symmetry elements (Cn & Sn). Criteria for Chirality. Dissymmetrization.

Optical isomerism: Molecular Symmetry and Chirality, Cahn-Ingold-Prelog rules (R,S-nomenclature), stereoisomerism resulting from more than one chiral center, meso and pseudoasymmetric compounds - **Axial Chirality:** Stereochemistry of allenes, spiranes – **Atropisomerism-** biphenyl derivatives. - **Planar chirality** - Ansa compounds and trans - Cycloalkenes - **Helicity**. Helically chiral compounds.

Geometrical isomerism: E,Z - nomenclature - Physical and Chemical methods of determining the configuration of geometrical isomers.

Conformational Analysis: Conformations of dimethyl substituted cyclohexanes and decalins

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J. Sundberg, Plenum.
3. Structure and Mechanism in Organic Chemistry C.K. Inglod, Cornell University Press.
4. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
5. Principles of Organic Synthesis, R.O.C Norman and J. M. Coxon, Blackie Academic.
6. Stereochemistry, P.S. Kalsi, Wiley Eastern.
7. Stereochemistry of Organic compounds: principles and applications, D.Nasipuri, New age international publishers.
8. Text book of Organic Chemistry, M.C. Murry
9. Organic Chemistry, Vol I, I.L. Finar, ELBS Eds.

CC102-CORE COURSE 2(B): ANALYTICAL CHEMISTRY-I

UNIT-I: PHYSICAL METHODS OF DRUG ANALYSIS & QUALITY MANAGEMENT SYSTEM **15 Hrs**

Physical methods of Drug Analysis : Identification, Melting point, Solubility, Polymorphism, Water content or moisture content, Residue on ignition, Heavy metals for drug products, Disintegration test, Hardness test, Hardness Measurements.

Quality Management System: The laboratory product, Laboratory process, Laboratory Customer, Satisfaction, Improvement, Documentation Requirements, Management Responsibility-Quality Policy, Responsibility, Authority and Communication, Resource Management, Product Realization, Measurement, Analysis and Improvement, Tools and Mechanism, Laboratory Environment.

UNIT-II : GRAVIMETRY **15 Hrs**

Gravimetric Analysis : Methods of precipitation, Theory of relative supersaturation and precipitate formation, Purity of the precipitate- Co-precipitation, Post precipitation, occlusion, surface adsorption. Precipitation from homogeneous solution (PFHS) - effect of pH, Ion release method, change in oxidation state etc. Examples-homogeneous precipitation methods of Al, Fe, Bi, Cu, Ba, homogeneous precipitation of Mg with oxine (8-hydroxy quinoline), Ni with DMG, Cu precipitation with benzoin oxime. Change of oxidation state, Ce^{3+}. Precipitation of Pb as chromate by oxidation of Cr^{+3}.

Organic reagents in Inorganic Analysis: Theoretical principles involved in the use of organic reagents in inorganic precipitation analysis. (i) DMG (ii) Cuferon (iii) 8-hydroxy quinoline.

UNIT-III : TITRIMETRIC ANALYSIS **15 Hrs**

Complexometric Titrations: Introduction, Stability of complexes, factors influencing the stability of complexes, stability constants of EDTA complexes. Titration curves, Types of EDTA curves, Representative methods, Qualitative applications. Titration of mixtures, Sensitivity, Masking and Demasking agents.

Precipitation Titrations: Titration curves, feasibility of precipitation titration, factors affecting shape-titrant and analyte concentration, volhard, Mohr and Fazan's titration methods, Selection and Evaluation of External and Adsorption Indicators of end points. Quantitative application of precipitation titrations.

UNIT-IV : REDOX AND DIAZOTIZATION TITRATIONS **15 Hrs**

Redox Titrations: Analytical chemistry of some selected redox systems. Formal and Standard potentials in various media, stability of solutions, species responsible for oxidizing and reducing properties, standardization, requirement for the selection of oxidants and reductants.

Oxidizing Systems: Ce(IV) and iodate.

Reducing Systems: Cr(II), V(II), Ti(III). Selection of Suitable Indicators for Oxidant and Reductant systems. Estimation of Drugs and Pesticides by volumetric method. Applications of Redox titrations by using CAS.

Diazotization Titrations: Principles, Preparation and standardization of 0.1 M $NaNO_2$ solution, Procedure for diazotization titrations, Types of diazotization titrations-Direct, Reverse, Special methods, Applications of diazotization titrations-Direct titrations Conversion to amino group by chemical reactions by reduction and by Hydrolysis.

Books suggested

1. Analytical Chemistry by Gary D. Christian, 6th Edition.
2. Analytical Chemistry and Principles by T.H. Kennedy, 2nd Edition.
3. Fundamentals of Analytical chemistry by David Harvey, Mc Graw Hill – 2003.
4. Vogel's text book of Quantitative analysis, III Edition, Longman publications.
5. Principles and methods of chemical Analysis by Walton 3rd Edition.
6. Text book of Pharmaceutical Analysis by Dr. S. Ravi Sankar, Rx Publications.

CC103-CORE COURSE 3(A): PHYSICAL CHEMISTRY-I

UNIT-I : QUANTUM CHEMISTRY – I **15Hrs**

Introduction to Exact Quantum Mechanical Results

Comparison of Classical and Quantum mechanics, Operator algebra, Eigen values and Eigen functions, Operators for momentum and energy, Degeneracy, well behaved wave functions, Postulates of Quantum Mechanics

Applications of Schrodinger wave equation: Derivation of Schrodinger wave equation. Particle in one dimensional and three dimensional box, harmonic oscillator, hydrogen atom and its applications, hydrogen like orbitals and their representation, Polar plots, Contour plots and Boundary diagram.

Approximate Methods: The variation Theorem, Linear variation principle, perturbation Theory (first Order and non-degenerate), Application of variation Method and perturbation theory to the helium atom. The Born-Oppenheimer approximation.

UNIT-II: CHEMICAL DYNAMICS – I **15Hrs**

Homogeneous and Heterogeneous Catalysis. Homogeneous catalysis; catalysis by transition metal ions and their complexes; industrially important processes; supported transition metal complexes as catalysts; bimolecular reactions; electronic theories of chemisorption and heterogeneous catalysis.

Acid Base Catalysis. Specific acid catalysis and general acid catalysis (hydrolysis of ester and vinyl ether); specific base catalysis and general base catalysis (the alcohol reaction and hydrolysis of acetic anhydride); protolytic and prototropic mechanism.

Introduction to Enzyme Catalysis. Michaeles - Menton Kinetics - Effect of pH and effect of temperature on the rates of enzyme reactions.

UNIT-III: THERMODYNAMICS – I **15 Hrs**

Brief review of Thermodynamic concepts: Entropy change and phase change – Entropy of mixing – Entropy and disorder. Free energy and Gibbs – Helmholtz equation. Chemical Potential and Gibbs – Duhem equation.

Statistical thermodynamics: Partial molar properties: their significance and determination of partial molar properties, fugacity and its determination. Concept of distribution, thermodynamic probability and most probable Distribution, Ensemble averaging, postulates of ensemble averaging, canonical, grand canonical and micro- canonical ensembles, partition functions, translational, rotational, vibrational and electronic partition functions, Entropy of monatomic gases (Sackur-Tetrade equation).

UNIT-IV: ELECTROCHEMISTRY – I **15Hrs**

Thermodynamic and Kinetic concept of Electrochemistry

Thermodynamic and Kinetic Derivation of Nernst Equation, Chemical and Concentration Cells with and without Transference, Liquid Junction Potential, Derivation of the Expression for Liquid Junction Potentials-its determination and elimination, Applications of EMF Measurements: (i) Solubility product, (ii) pH Determination, (iii) Potentiometric Titrations.

Conductivity: Theory of Electrolytic Conductance, Derivation of Debye-Huckle Equation and its Verification, Debye- Falkenhagen Effect, and Wein Effect, kohlrausch law. Calculation of Solubility of Sparingly soluble Salt from Conductance Measurements.

Books suggested

1. Physical Chemistry, P. W. Atkins (ELBS).
2. Introduction to quantum Chemistry, A. K. Chandra (Tata McGraw Hill).
3. Quantum Chemistry, Ira N. Levine (Prentice Hall).
4. Atomic Structure and chemical bond, Manas Chandra.
5. Chemical Kinetics, K.J.Laidler (McGraw Hill).
6. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose (Mcmilan)
7. Thermodynamics for Chemists, S. Glasstone.
8. Chemical Thermodynamics, I. M. Klotz.
9. Statistical Thermodynamics, M. Dole.
10. Modern Electrochemistry, vol. I & II, J. O. M. Bockris and A. K. N. Reddy (Plenum).
11. An Introduction to Electrochemistry (3rd ed.), S. Glasstone (Afffilated East-West).

CC103-CORE COURSE 3(B): PHARMACEUTICAL QUALITY CONTROL AND QUALITY ASSURANCE

UNIT-I: QUALITY AUDIT, DOCUMENTATION AND HANDLING 15 Hrs

Quality audit. Standard operating procedure (SOP): international conference harmonization (ICH); ISO-9000; ISO-14000, WHO specifications, USFDA guidelines and ICMR.

Documentation and Handling : Manufacturing documents, Master Formula, batch formula, Record, Distribution of records, Handling of returned goods, Recovered materials and Reprocessing.

UNIT-II: ORGANIZATION AND PERSONNEL RESPONSIBILITIES 15 Hrs

Training, Hygiene, Premises: Location, Design, Plant layout, Construction, Maintenance and Sanitations. Environmental control, Sterile areas, control of contamination.

UNIT-III: REGULATORY ASPECTS AND QUALITY CONTROL 15Hrs

Regulatory aspects. Validation of Personnel, Equipment and cleaning methods, regulatory aspects of pharmaceutics.

Quality Control. In-process quality Control on various dosage forms, Sterile and non- sterile operations.

UNIT-IV: BASIC CONCEPTS OF QUALITY ASSURANCE 15 Hrs

Basic concepts, principles or prescription, Needs, requirements and expectations, characteristics of quality, Achieving, sustaining and improving quality, Quality dimensions and costs of quality. Elements of quality Assurance, Quality Management System, Quality management concepts and principles: ISO 9001:2000, QMS Case studies on ISO 9001: 2000 in chemical industries.

Books Suggested

1. R. Pannerselvam, Production and Operations Management, Prentice Hall India Learning Pvt. Ltd. 3rd Ed., 2012.
2. M. Savsar, Quality Assurance and Management, InTech-Croatia, 2012.
3. D.C. Montgomery, Statistical Quality Control, John Wiley & Sons, 5th Ed., 2005.
4. M. K. Starr, Production and Operations Management, Biztantra, Delhi, 2004.
5. D.H. Shah, QA Manual, Business Horizons, 2000.
6. D.H. Besterfield, C. Besterfield-Michna, G.H. Besterfield, M. Besterfield-Sacre, Total Quality Management, Pearson Education, Inc., 3rd Ed., 2003.
7. P. Konieczka, J. Namiesnik, Quality Assurance and Quality Control in the Analytical Chemical Laboratory: A Practical Approach, 1st Ed., CRC press 2009.
8. D. Hoyle, ISO 9000 Quality Systems Handbook, 5th Ed., Butterworth Heinemann-Elsevier, New York, 2006.

P-104: Practical I (related to CC102 and CC103)

CC102-CORE COURSE-2(A) PRACTICAL: ORGANIC CHEMISTRY-I

Methods of separation of binary mixture of organic compounds using solvent extraction.

1. Ether Insoluble Neutral (Carbohydrate) + Acidic / Basic / Phenolic components
2. Ether Soluble Neutral (Carbonyl Compounds / Hydrocarbons) + Acidic / Basic / Phenolic components.

CC103-CORE COURSE – 3(A) PRACTICAL: PHYSICAL CHEMISTRY – 1

1. Determination of Eutectic composition and temperature of binary system.
2. Determination of Distribution Coefficient of benzoic acid between water and benzene.
3. Determination of rate constant of acid hydrolysis of an ester and investigate the effect of catalyst concentration, rate constant concentration and temperature.

SOC105-SKILL ORIENTED COURSE 1(A) : INORGANIC MATERIALS IN INDUSTRY

UNIT-I: MINERALS, ORES AND CERAMICS **15 Hrs**

Minerals and Ores: Definition, types, differences between minerals and ores, methods and procedures for the analysis of Limestone, Ilmenite, Chalcopylites and Beryl.

Ceramics: General Properties of Ceramics- Basic Raw materials-Manufacture of Ceramics-Glaring in Ceramics. Applications of colors to the pottery-Porcelain-Raw Materials-Manufacture of Porcelain.

UNIT-II: INORGANIC PIGMENTS **15 Hrs**

Definition, types and classification of inorganic pigments, general properties of inorganic pigments. Preparation, properties and industrial applications of White pigements: TiO_2, ZnO; Colored pigments: Iron oxide, chromium trioxide; Black pigments: Carbon black, Iron oxide black pigments; Special pigments: Anticorrosive pigments, Luminiscent pigments.

UNIT-III: METAL OXIDE PHOTOCATALYSTS **15 Hrs**

Metal oxide photocatalysts design and synthesis, appplication of photocatalysis, Self cleaning, purification of water and air, photoreduction of CO_2 and fuel production. Characterization of metal oxide photocatalysts by X-ray diffraction, transmission electron microscopy, X-ray photoelectron spectroscopy.

UNIT-IV: INORGANIC FERTILIZERS **15 Hrs**

Definition, types of inorganic fertilizers, analysis of ammonical fertilizers, phosphate fertilizers, nitrate fertilizers, estimation of micro nutrients in fertilizers.

Books suggested:

1. H.W.Willard, LL.Merritt and J.A.Dean: Instrumental Methods of Analysis
2. Instrumental Methods of Analysis H.Kaur
3. Industrial Chemistry by B.K.Sharma, Goel Publishing House, Meerut, 11th Edition, 2000.
4. Environmental Chemistry by S.C.Bhatia, CBS Publisheres, New Delhi,1st Edition, 2002.
5. Environmental Chemistry by A.K.DE, New Age International(P)Limited, 6th Edition, 2007.
6. A Textbook of Environmental Chemistry and Pollution Control by S.S. DARA, S.Chand & Company Ltd.,5th revised edition, 2002.
7. Advanced Inorganic Chemistry by Cotton and Wilkinson, 5th Edition.

SOC105- SKILL ORIENTED COURSE 1(B): CHEMOTHEROPY AND DRUG ANALYSIS

UNIT-I: CHEMOTHERAPY **15 Hrs**

Definition, History, and Evolution of Chemotherapy; Discovery, Classification, Nomenclature, Mode of action and synthesis of the following classes of compounds with special references to specific drugs mentioned under each class

Sulfa drugs- Sulfanilamide and Sulfamethoxazole.

Antibiotics- Lactum group of antibiotics – Penicillin, Ampicillin and Amoxycillin. Cephalosporin-C and Ciprofloxacin. **Anticancer drugs –** 5-Flurouracil, Methotrexate. **Antifungals –** Griseofulvin **Antimalarials –** Chloroquin

UNIT-II: CHEMICAL AND BIOCHEMICAL ANALYSIS OF DRUGS **15 Hrs**

Qualitative and Quantitative Analysis of drugs: Uses of IR, UV, GLC and HPLC methods.

Drug Assay by Biochemical Analysis – ELISA (Cortisol, alcohol, opiates). Radio Immuno Assay (RIA) – Enalapril, Insulin

Kidney, Lungs and Liver function tests; Use of isotopes in the Bioanalysis of drugs and in drug design programmes.

UNIT-III: PRINCIPLES OF PHARMACOKINETICS, PHARMACODYNAMICS AND DRUG DELIVERY **15 Hrs**

Absorption, distribution, metabolism and excretion of drugs (ADME); nature of drug - receptor interactions; theories of drug action: occupancy theory, rate theory, Induced-fit theory, drug synergism and antagonism and clinical trials and Concepts of Drug Delivery

UNIT-IV: PRODRUG DESIGN AND COMMON DRUGS **15 Hrs**

Principles of prodrug design. Structure, uses, mechanism of action of following drugs.

i) sulfamethoxazole, ii) mechlorethamine, iii) fluconazole, iv) omeprazole, v) amrinone, vi) captopril, vii) paracetamol and viii) levodopa

Book Suggested

1. Medicinal Chemistry and Pharmaceutical Chemistry – Harikishan Singh and Kapur
2. Medicinal Chemistry and Biochemistry – R.L.Nath
3. Introduction to Medicinal Chemistry – Patrick
4. The Organic Chemistry of Drug Synthesis Vols. 1-6 - Ledneicer Top drugs top syntheti routes – John Saunders
5. Medicinal Chemistry – Ashutoshkar
6. Synthetic Organic Chemistry and Drugs – Gurideep R Chetwal
7. Bergers Medicinal Chemistry Vols. 1-5 – Manfred E. Wolf

8. Prinicples of Medicinal chemistry – William Foye

SOC106-SKILL ORIENTED COURSE 2(A) : INDUSTRIAL CHEMISTRY

UNIT – I: NUCLEAR CHEMISTRY: 15 Hrs

Basic concepts of nuclear chemistry; radioactive decay and equilibrium; nuclear reactions; Q value; cross sections; types of nuclear reactions; radioactive techniques: counting techniques such as G. M. ionization and proportional counter, isotopic dilution, neutron activation analysis, radiometric titration; radiopharmaceuticals: radioimmunoassay, immunoradiometric assay, classification of radiopharmaceuticals, labeled compounds preparation, PET studies.

UNIT – II: NANOCHEMISTRY: 15 Hrs

Terminology in Nano materials, Nanoscale, Quantum dots, Nano synthesis (sol-gel method and chemical vapor deposition method), Nano applications, Supramolecules, optical, electrical, transport and magnetic properties of nano materials, applications of nano materials (Biology, energy storage and fuel cells).

UNIT-III: INDUSTRIAL APPLICATIONS OF POLYMERS 15 Hrs

Plastics, Fibres, Elastomers- Polyethylene, Polystyrene, Poly Esters, PolyAcrylonitrile, Polyurethanes, Polyvinyl Chloride, Polyisoprenes. Resins – Phenol Formaldehyde Resin, Urea Formaldehyde and Melamine – Formaldehyde Resins, Epoxy Polymers, Silicon Polymers, poly Carbonates and poly urethanes .

UNIT-IV: SURFACE CHEMISTRY 15 Hrs

Structural and theoretical treatment of liquid interfaces; thermodynamics of binary system; Gibbs equation and verification of Gibbs equation by microtome method and tracer method; spreading of one liquid on anther; states of monomolecular films; the surface area of solids; mixed films; Gibbs adsorption isotherm; the Longmuir adsorption isotherm; BET adsorption isotherm; estimation of surface area (BET equation, theoretical concept); adsorption time.

Books suggested:

1. P.T.K. Kissinger, W.R.Heinemann. Laboratory Techniques in Electro analytical Chemistry, Marsal Debber, Inc.
2. Willard, Merit. Instrumental methods of analysis, Welowarth Publiching Co.,
3. Silbey, Alberty, Bawendi. Physical chemistry. Jhon-Wiley & sons. 4th edition-2006.
4. Introduction to polarography and allied Technique by Dr.K. Zutshi
5. Text Book of Polymer Science, F. W. Billmeyer, Jr. (Wiley Inter Science)
6. Polymer Sciences by V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar.
7. Essentials of Nuclear Chemistry, 4th Ed., 1995, H. J. Harnikar (Weily Eastern)
8. Hand book nano structured materials and nano technology by HS Nalwa- 2000
9. Engineering Chemistry by Jain & Jain.

SOC106-SKILL ORIENTED COURSE 2(B): APPLIED METHODS OF CHEMICAL ANALYSIS

UNIT-I: ANALYSIS OF PAINT PIGMENTS AND PORTLAND CEMENT 15 Hrs

Analysis of paint pigments: Preliminary inspection of the sample, non-volatile matter, water contents in the paint, used paint products. General separation of pigment binder and thinner of solvent types and latex type of paint products. Analysis of lamp black and carbon black. General procedure for analysis of white tinted pigments.

Analysis of Portland Cement: Loss on ignition, insoluble residue; Chief constituents of Portland cement-total silica, sesquioxide, lime, magnesia, ferric oxide, sulphuric anhydride etc. Air and dust pollution from cement plant, atmospheric dispersion of pollutants in cement industry.

UNIT-II: ANALYSIS OF FOOD AND DAIRY PRODUCTS & FORENSIC ANALYSIS 15 Hrs

Food Analysis: Moisture, ash, crude fibres, fat, protein, carbohydrate, calcium, potassium, sodium and phosphate, common Food adulterants of main food stuffs, microscopic examination of adulterants in some common food stuffs, contamination of food stuffs. Pesticides Analysis in food products – BHC residues in foodstuffs, determination of DDT residues in food grains, determination of methyl parathion residues in food grains and vegetables, estimation of malathion residues in food grains.

Analysis of Dairy products : Composition of the milk, determination of some physical chemical properties of milk, determination viscosity, pH by chemical methods, determination of fat, alcohol test, estimation of calcium, magnesium, potassium, sodium, minerals separation and identification. Analysis of fat and butter.

Forensic analysis: General discussion of poisons, organo phosphates and snake venom, estimation of poisonous materials such as lead, Hg and Barbiturates in biological materials.

UNIT-III: CLINICAL CHEMISTRY 15 Hrs

Clinical Chemistry: Analysis of Blood-Composition of blood, Collection and Preservation of samples, Clinical analysis-serum electrolytes, blood glucose and blood urea nitrogen (BUN), uric acid, albumin and globulin. Immunoassay, blood gas analysis, trace elements in the body.

UNIT-IV: ANALYSIS OF DRUGS AND ANTIBIOTICS 15 Hrs

Drug Analysis: Introduction, sources of drugs, classification and nomenclature of drugs, drug screening test and investigating the drugs-complexometric titrations, acid base titrations, polarimetry, determination of thiamine and riboflavin by fluorimetry, determination of the concentration of alcohol in pharmaceutical preparations and alcoholic bevarages.

Antibiotics and Sulpha Drugs: Classification of antibiotics, structures, properties and assay of some antibiotics-Chloramphenicol, Penicillin, Streptomycin and Cibazole.

Books Suggested

1. Standard methods of Chemical analysis by Welcher.
2. Text book of quantitative analysis by A. I. Vogel, 3rd Edition.
3. Food Chemistry by Lillian Hoagland Meyer, CBS Publishers.
4. Introduction to the chemical analysis of foods by Suzanne Nielson, CBS Publishers.
5. Fundamental of Analytical Chemistry by Gary D. Christian.
6. Standard Methods of Chemical analysis by Scott and Ferman.
7. Food Science experiments and Applications by Mohini Sethi, Eram S. Rao, CBS Publications.
8. Comprehensive experimental Chemistry by V. K. Ahluwalia and Sudha Ragav, New Age International, New Delhi.
9. Fundamental of Dairy Chemistry by Webb Johnson and Alford, CBS Publication second Edition.
10. Analytical Chemistry by Gary D. Christian, Fifth Edition, John Wiley & Sons, INC.
11. The chemical Analysis of Foods by Henry Edward Cox, Second Edition, J. & A. Churchill Ltd.

FIRST SEMESTER

P 107: Practical II (related to SOC105 & SOC106)

SOC105-SKILL ORIENTED COURSE 1(A) PRACTICALS: INORGANIC MATERIALS IN INDUSTRY

1. Ore analysis: Analysis of limestone, dolomite, magnesite.
2. Semi micro qualitative inorganic analysis.
3. Analysis of fertilizers: determination of moisture, determination of ammonia, nitrogen, determination of total phosphates as phosphorous pentoxide.

SOC106-SKILL ORIENTED COURSE 2(A) PRACTICAL: INDUSTRIAL CHEMISTRY

1. Detemination of Critical Solution Temperature of phenol-water system
2. Detemination of Isotherm for Adsorption of Acetic acid by Charcoal
3. Detemination of surface tension

SECOND SEMESTER

CC 201- CORE COURSE 4: INORGANIC CHEMISTRY-II

UNIT-I: ORGANOMETALLIC CHEMISTRY 15 Hrs

Organometallic Reagents in Synthesis

Stoichiometric reactions in catalysis, Homogeneous catalytic hydrogenation, Hydroformylation (oxo reaction), Isomerisation, Zeigler-Natta polymerization of olefins, Oxopalladation reactions, Activation of small molecules by coordination.

Fluxional Organometallic Compounds

Fluxionality and dynamic equilibria in compounds such as η2-olefin, η3-allyl and dienyl complexes

UNIT-II: TRANSITION METAL π – COMPLEXES 15 Hrs

Transition metal π – complexes with unsaturated organic molecules – alkenes, alkynes, diene, dienyl and Cyclopentadienyl complexes and arene complexes-general methods of preparation, properties, nature of bonding and structural features – Important reactions relating to Nucleophilic and Electrophilic attack on ligands and to organic synthesis.

UNIT-III: ELECTRONIC SPECTRA OF METAL COMPLEXES 15 Hrs

Free Ion Terms and Energy Levels: Configurations, Terms, States and Microstates. Calculation of Microstates for p^2 and d^2 configuration, L-S (Russell-Saunders) Coupling Schemes, J-J Coupling scheme, derivation of terms for p^2 and d^2 configuration. Hole Formulation, Energy ordering of terms (Hund's Rules), Splitting of energy levels and spectroscopic states in Octahedral field, Selection rules – Break – down of selection rules, Orgel diagrams, Definition and utility–Orgel Diagrams for d^1 to d^9 configurations in Octahedral and tetrahedral fields. Interpretation of electronic spectra of high spin octahedral and tetra hedral complexes of Ti(III), V(III), Cr(III), Mn(III), Mn(II), Fe(II), Fe(III), Co(III), Co(II), Ni(II) and Cu(II) complexes, Calculation of Dq and B^1 parameters for Cr(III) and Ni(II) complexes. Tanabe – Sugano diagrams, Differences between Orgeldiagrams and Tanabe – Sugano diagrams, Tanabe – Sugano diagrams of d^2 to d^6 and d^8 configurations. Charge transfer spectra- LMCT and MLCT.

UNIT-IV: MAGNETIC PROPERTIES OF TRANSITION METAL COMPLEXES 15 Hrs

Diamagnetism and paramagnetism-orbital and spin contributions, spin-orbit coupling, Hund's third rule and Energies of J levels – Curie law and Curie – Weiss law- Ferromagnetism and antiferromagnetism – Temperature independent magnetism Magnetic susceptibility and its determination by Gouy's and Faraday methods. Calculation of magnetic moment from magnetic susceptibility, spin-only formula, Orbital contribution to magnetic moment (Oh and Td Complexes) –Paramagnetism and crystalline fields – Ti (III), V (III), VO^{2+}, Cr (III), Mn (II), Fe (III), Co(II), Ni (II) and Cu (II). Magnetic Exchange in copper acetate and other dimmers – spin

cross over in complexes.

Books suggested

1. The Organometallic Chemistry of the Transition Metals, R. H. Crabtree, 3rd and 4th Ed. (Wiley Interscience).
2. Organometallic Chemistry: A Unified Approach, R. C. Mehrotra and A. Singh, 2nd Ed. (New Age International).
3. Principles of Organometallic Chemistry, P. Powell, 2nd Ed. (ELBS)Concise Coordination Chemistry, R.Gopalan, and V.Ramalingam, Vikas publishing house, second Edition, 2007
4. Inorganic Chemistry, A.G.Sharpe, Pearson Education, 3rd Edition, 1999
5. Advanced Inorganic Chemistry, F.A.Cotton and G.Wilkinson, John Wiley Inter science publishers, 5th edition, 1989.
6. Organometallic Chemistry, Ayodhya Singh, Ratheesh singh, Campus books international, 1st Edition, 2006
7. Inorganic Chemistry: Principles of Structure and Reactivity, J. E. Huheey, E. A. Keiter & R. L. Keiter. 4thedition, Harper Collins publications, New York, 1993.

SECOND SEMESTER

CC 202- CORE COURSE 5(A): ORGANIC CHEMISTRY-II

UNIT-I: REAGENTS IN ORGANIC SYNTHESIS **15 Hrs**

Use of the following reagents in organic synthesis: Anhydrous $AlCl_3$, Boran trifluoride, N-Bromosuccinimide, Diazomethane, Dicyclohexylcarbodiimide, Lead tetraacetate, Zieglar- Natta catalysts, DDQ, Dithianes, Merrifield resin.

UNIT-II: MOLECULAR REARRANGEMENTS **15 Hrs**

Rearrangements to electron deficient Carbon atom:

Pinacol-Pinacolone, Wagner-Meerwein, Dienone-Phenol and Demjanov Rearrngements

Rearrangements to electron deficient Nitrogen atom:

Hofmann, Curtius, Schimidt and Beckmann Rearrangements.

Rearrangements to electron deficient Oxygen atom: Baeyer-Villiger and Dakins Rearrangements

Rearrangements to electron rich Carbon atom: Favorski and Neber Rearrangements

Aromatic and Sigmatropic Rearrangements: Fries and Claisen Rearrangements

UNIT III: OXIDATIONS AND REDUCTIONS **15 Hrs**

Oxidations: (a) Alcohols to carbonyls-Chromium (iv) oxidants-Dimethyl sulfoxide oxidation, periodate oxidation, Oppenauer oxidation, oxidation with manganese dioxide, silver carbonate **(b)** Alkenes to epoxides-peroxide induced epoxidations. **(c)** Alkenes to diols-oxidation with

potassium permanaganate, osmium tetraoxide, Prevost reaction **(d)** Ketones to esters-Bayer-Villiger oxidation **(e)** Oxidative bond cleavage-cleavage of alkenes by transition metals. **(f)** Oxidation of alkyl or alkenyl fragments-selenium dioxide and chromium trioxide oxidations.

Reductions : Reduction with lithium aluminium hydride, sodium borohydride, alkoxides, bis-methoxy ethoxy aluminium hydride, Boran aluminium hydride and derivatives-catalytic hydrogenation-dissolving metal reductions, Non-Metallic reducing agents including enzymatic and microbial reductions.

UNIT IV: ASYMMETRIC SYNTHESIS **15 Hrs**

Topocity – Prochirality - Substrate selectivity - Diastereoselectivity and enantioselectivity-Substrate controlled methods-use of chiral substrates - examples

Auxiliary controlled methods - Use of chiral auxiliaries-Chiral enolates-alkylation of chiral imines – Stereoselective Diels-Alder reaction

Reagent controlled methods - Use of chiral reagents-Asymmetric oxidation-Sharpless epoxidation-Asymmetric reduction - Use of lithium aluminium hydride and borate reagents.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J Sundberg, Plenum.
3. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
4. Structure and Mechanism in Organic Chemistry, C.K.Inglod, Cornell University Press.
5. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
6. Name reactions and reagents in organic synthesis, B.P. Muway and M.G Ellord, John Wiley.
7. Modern Organic Reactions, H.O. House, Benjamin.
8. Principles of Organic Synthesis, R.O.C Norman and J.M Coxon, Blackie Academic & Professional.
9. Reaction Mechanism in Organic Chemistry, P.S. Kalsi, New Age International.
10. Principles of organometallic chemistry, P. Powell, ELBS.
11. Organo transition metal chemistry-Applications to organic synthesis, S.G. Davis, Pergmon.
12. Stereochemistry to Organic Compounds, E.L. Eliel and others, John Wiley.
13. Stereochemistry to Organic Compounds, D. Nasipuri, New Age International.
14. Stereochemistry, P.S.Kalsi, Wiley Eastern.

CC 202- CORE COURSE 5(B): INDUSTRIAL METHODS OF CHEMICAL ANALYSIS

UNIT-I: **GAS ANALYSIS** **15 Hrs**

Gas sampling-tubes, pumps, containers, gas-volumetirc methods of analysis for solid and liquids-lunge nitro meter, absorbing reagents of gas, types of gas analyzers. Analysis of gaseous mixtures (CO_2, O_2, CO and hydrocarbons) by Orsat and Elliot apparatus; Thermal conductivity methods.

UNIT-II: **SEWAGE AND HAZARDOUS WASTE DISPOSAL** **15 Hrs**

Sewage and Sewage Disposal: Introduction, Important definitions, Sewage and its composition, Bacteriology of sewage and sewage treatment, properties of sewage, purpose of sewage treatment, methods of sewage treatment, primary or mechanical treatment, secondary or biological treatment, cycle of decomposition, analysis of sewage-physical tests, chemical tests, biological tests; sewage disposal, methods of sewage disposal.

Hazardous waste and Disposal: Introduction, effect on health, Nature and sources of hazardous substances and wastes, classification of hazardous substances and wastes, chemical classes of hazardous substances, physical and chemical methods of waste treatment, preparation of wastes for disposal and ultimate disposal of waste, biodegradation, enzymes in waste degradation.

UNIT-III: ANALYSIS OF FERTILIZERS AND PESTICIDES 15 Hrs

Introduction, determination of moisture, determination of ammonia, nitrogen and albunoid nitrogen, determination of total phosphates as phosphorous pentoxide and estimation of micro nutrients in fertilizers. Analysis of organo chlorine pesticides by gas chromatography, analysis of organo phosphorous. Determination of DDT residue in vegetable and food grains. Analysis of cation and anions present in different fertilizer.

UNIT-IV: ANALYSIS OF INDUSTRIAL PRODUCTS 15 Hrs

Analysis of steel: (Carbon, Silicon, Sulphur and phosphorus), Analysis of non ferrous alloys, brass, Bronze, solder. Analysis of Ferro manganese, ferro-silicon, Ferro-vanadium and silico-manganese.

Analysis of Fats and Oils: Natural fats, edible and industrial oils, unsaturated oils, acid value, saponification value, Iodine value, refractive index values.

Analysis of Explosives and Propellants: Explosives, classifications of explosives, primary explosives, low explosives, high explosives, nitrocellulose or smokeless powder, ammonium nitrate, 2,4,6-Trinitrotoluene(TNT), Pentaerythritol tetranitrate (PETN), Cylonite or RDX or cyclotrimethylene trinitroamine, Picric acid, Tetryl or nitroaryl nitroamine, Dynamites, Lead azide, Nitroglycerine, black powder or gun powder, Cordite, Lead azide, Tetracene, Diazodinitro phenol.

Rocket Propellants: Introduction, Characteristics, classification-solid, liquid propellants.

Suggested Books

1. Vogel's Text book of Quantitative analysis 3rd Edition.
2. Environmental Chemistry by Stanley E. Manahan, 6th Edition.
3. Environmenal Chemistry by A. K. De.
4. Solid chemical Analysis by M. L. Jackson, Printice-Hall, London.
5. Environmental Chemical Analysis by B. K. Sharma, H. Kaur, Goel Publications.
6. Standard chemical analysis by Velchear.
7. Water and water analysis by M. V. Subba Rao, Published by Environmental research academy International.
8. Engineering Chemistry by Jain & Jain.
9. Environmental Chemistry by Moore & Moore.

CC 203- CORE COURSE 6(A): PHYSICAL CHEMISTRY-II

UNIT-I: QUANTUM CHEMISTRY – II **15 Hrs**

Angular momentum: Importance of Angular momentum, Rotations and Angular momentum, Eigen functions and Eigen values of Angular momentum, Ladder operator, Spin, Spin angular momentum, Addition of angular momenta, Pauli Exclusion principle, Slater determinant. ;

Molecular Orbital Theory: Huckel theory of conjugated systems, π-bond order and charge density calculations, application of Huckel theory to ethylene, butadiene and benzene

UNIT-II: THERMODYNAMICS-II **15 Hrs**

Phase Equilibria: Equilibrium between two phases of one component; the Clapeyron equation; the Clausius Clapeyron equation, applications; integrated form of Clapeyron equation.

Phase rule: Thermodynamic derivation of phase rule, Solid-liquid equilibria – Thermal analysis, simple eutectic, congruent fusion, incongruent fusion and systems consisting of both. Application of phase rule to three component system, Stokes and Roozeboom plots.

UNIT-III: ELECTROCHEMISTRY – II **15 Hrs**

Theory, classification , principle , Instrumentation of Polarography, DME, HMDE diffusion current, Ilkovic equation, DC-Polarography, AC-Polarography, Controlled Potential Electrolysis, Millicoulometry, Equation for half-wave potentials, for reversible system when oxidant alone, reductant alone and both are present. Amperometric titrations - Anodic stripping voltammetry, chronoamperometry, chronopotentiometry, Cyclic Voltammetry, Differential Pulse Polarography, linear sweep voltammetry, square wave voltammetry.

UNIT-IV: SYMMETRY & GROUP THEORY **15 Hrs**

Definitions of a group, sub-group; relation between orders of a finite group and its sub-group; conjugacy relation and classes, Symmetry elements and symmetry operation; - symmetry point group; Schonflies symbols; representation of groups by matrices; character of a representation; the great orthogonality theorem (without proof). Character tables of H_2O and NH_3.

Books Suggested:

1. Physical Chemistry, P. W. Atkins, (ELBS).
2. Introduction to quantum Chemistry, A. K. Chandra (Tata McGraw Hill).
3. Quantum Chemistry, Ira N. Levine, (prenticxe Hall).
4. Coulson's Valence, R. Mcweeny, (ELBS).
5. Modern Electrochemistry, vol.I& II, J. O. M. Bockris and A. K. N. Reddy (Plenum).
6. D.A. Skoog and D.M. West: Principles of Instrumental Analysis (Holt, Rinehart and Wilson).
7. An Introduction to Electrochemistry (3rd ed.), S. Glasstone (Affiliated East-West).

8. Micelles, theoretical and applied aspects, V. Moroi (Plenum).
9. A text Book of Physical Chemistry (2nd Ed.), S. Glasstone (Macmilan).
10. Principles of Physical Chemistry, Maron and Prutton.
11. Theoretical Electrochemistry, L. I. Antropov.

12. Thermodynamics for Chemists, S. Glasstone.
13. Chemical Thermodynamics, I. M. Klotz.
14. Statistical Thermodynamics, M. Dole.
15. Introduction to Group Theory by Prof. G. Veera Reddy
16. Applications of group theory to spectroscopy by Dr. P. K. Mohanty.

CC 203- CORE COURSE 6(B): MAIN GROUP CHEMISTRY AND SPECTROSCOPIC CHARACTERIZATIONS OF INORGANIC COMPOUNDS

UNIT-I: STRUCTURE AND BONDING OF MAIN GROUP ELEMENTS 15 Hrs

Structure and bonding in polyhedral boranes and carboranes, styx notation; Wade's rule; electron count in polyhedral boranes; synthesis of polyhedral boranes; isolobal analogy; boron halides; phosphine-boranes; borazine. Organyls of Al, Ga, In and Tl. Silanes, silicon halides, silicates, silanols; germanium, tin and lead organyls; phosphorous halides, acids and oxyacids, phosphazenes; sulphur halides, oxo acids of sulphur; structural features and reactivity of reactivity of S-N heterocycles; chemistry of halogens and group 18 elements. Structural elucidation using the following spectroscopic techniques: Symmetry and Point group analysis of simple inorganic compounds. Electronic spectroscopy: electronic transitions in inorganic and organometallic compounds.

UNIT-II: IR AND RAMAN SPECTROSCOPY OF SIMPLE INORGANI COMPOUNDS 15 Hrs

Infrared and Raman spectroscopy of simple inorganic molecules; predicting number of active modes of vibrations, analysis of representative spectra of metal complexes with various functional groups.

UNIT-III: ^{1}H AND ^{13}C NMR OF ORGANOMETALLICS 15 Hrs

Applications of ^{1}H and ^{13}C NMR in inorganic and organometallic chemistry, fluxionality and dynamics; deriving activation and thermodynamic parameters; NMR spectral analyses of B, Al, Si, F and P containing compounds. Elementary aspects of Electron paramagnetic resonance (EPR) spectroscopy of inorganic compounds - g-values, hyperfine and super hyperfine coupling constants; selected applications in inorganic chemistry.

UNIT-IV: MASS SPECTROMETRY OF INORGANIC AND ORGANOMETALLICS 15 Hrs

Mass spectrometry, basic principles, ionization techniques, isotope abundance, molecular ion; illustrative examples from supramolecules, inorganic/coordination and organometallic compounds.

Books suggested:

1. M. Weller, T. Overton, J. Rourke and F. Armstrong, Inorganic Chemistry, 6th Edition, Oxford University Press, 2014. (South Asia Edition 2015)
2. J. E. Huheey, E. A. Keiter, R.L. Keiter and O. K. Mehdi, Inorganic Chemistry, Principles of Structure and Reactivity, 4th Edition, Pearson, 2006.
3. F. A. Cotton, G. Wilkinson, C. A. Murillo and M. Bochmann, Advanced Inorganic Chemistry, 6th Edition, Wiley, 2007.
4. A. Abragam and B. Bleaney, Electron Paramagnetic Resonance of Transition Ions, Oxford University Press, 1970. (Reprint Edition 2013)
5. R. S. Drago, Physical Methods for Chemists, 2nd Edition,Saunders, 1992.
6. C. N. Banwell and E. M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, McGraw-Hill, 1994.
7. H. Gunther, NMR Spectroscopy, Basic Principles, Concepts and Applications in Chemistry, 3rd Edition, Wiley VCH, 2013.
8. F. A. Cotton, Chemical Applications of Group Theory, Wiley, 3rd Edition, 1990

P 204: Practicals III (related to CC 202 and CC 203)

CC 202- CORE COURSE 5(A) PRACTICALS: ORGANIC CHEMISTRY-II

MULTISTEP SYNTHESIS OF ORGANIC COMPOUNDS

1. Synthesis of Benzanilide from Benzophenone: Benzophenone → Benzophenone oxime → Benzanilide
2. Synthesis of Benzilic acid from Benzoin: Benzoin → Benzil → Benzilic acid
3. Synthesis of symmetrical Tribromobenzene from Aniline.
4. Aniline → 2,4,6-Tribromoaniline → symmetrical tribromobenzene

CC 203- CORE COURSE 6(A) PRACTICALS: PHYSICAL CHEMISTRY-II

Conductometry

1. Determination of cell constant
2. Titration of a strong acid with a strong base
3. Titration of a weak acid with a strong base

Potentiometry:

4. Titration of a strong acid with a strong base
5. Titration of a weak acid with a strong base

SOC 205- SKILL ORIENTED COURSE 3(A): INSTRUMENTAL METHODS

UNIT-I: CHROMATOGRAPHY-I 15 Hrs

Introduction - Classification of Chromatographic methods – Column chromatography-Adsorption phenomenon: Nature of adsorbents-Solvent systems-Differential migration-Separation of mixture of *o*- or *p*-nitro anilines

Thin layer chromatography: Classification, principle, experimental technique, sample application,development of plate, retardation factor.

UNIT-II: CHROMATOGRAPHY-II 15 Hrs

Gas liquid chromatography: Gas liquid chromatography - instrumentation (columns and detectors), retention time and retention volume. Chromatographic behaviour of solutes, column efficiency and resolution, column processes and band broadening, time of analysis and resolution, Van-Deemter equation.

UNIT-III: FLAME EMISSION SPECTROSCOPY 15 Hrs

Flame Emission Spectroscopy: Principles, chemical reactions in flames, Interferences, evaluation methods, flame photometer and experimental technique, procedure for determinations, limitations and disadvantages. Applications of Flame Emission Spectroscopy.

UNIT-IV: ATOMIC ABSORPTION SPECTROSCOPY 15Hrs

Atomic Absorption Spectroscopy: Flame AAS: Principle, Instrumentation – Sources of radiation (HCL and EDL), Different types of burners, Interferences- Physical, Chemical, spectral and back ground correction, and methods of minimization

Graphite Furnace AAS: Principle and technique –Comparison between Flame AAS and furnace AAS, Applications of AAS, Comparison between Atomic Absorption & Flame Photometry.

Books Suggested

1. H.W. Willard, LL. Merrit and J.A.Dean: Instrumental Methods of Analysis. Affiliated East- West).
2. G.H. JefferyJ. Bassett,J. Mendham and R.C. Denny Vogel"s Text Book of Quantitative Chemical Analysis (ELBS).
3. D.A. Skoog and D.M. West: Principles of Instrumental Analysis (Holt, Rinehart and Wilson).
4. J.G. Dick : Analytical Chemistry (McGraw Hill).
5. Instrumental Methods of Analysis H. Kaur

SOC 205- SKILL ORIENTED COURSE 3(B): MATERIALS CHEMISTRY

UNIT-I: PREPARATION METHODS **15 Hrs**

Chemical precipitation and co-precipitation; metal nanocrystals by reduction; sol-gel synthesis; microemulsions or reverse micelles; solvothermal synthesis; microwave heating synthesis; sonochemical synthesis.

UNIT-II: CHARACTERIZATION OF MATERIALS **15 Hrs**

X-Ray diffraction (XRD); scanning electron microscopy (SEM); transmission electron microscopy (TEM); atomic force microscopy (AFM).

UNIT-III: MAGNETIC AND OPTICAL PROPERTIES OF MATERIALS **15 Hrs**

Magnetic properties - dia, para, ferro, anti-ferro and ferri magnetism; measurements - magnetic moment and magnetic susceptibility; optical properties - optical absorption and band gaps; luminescence: principle, characteristics and materials.

UNIT-IV: MATERIALS FOR FUEL CELLS AND BATTERIES **15 Hrs**

Proton exchange membrane fuel cells; material aspects; lithium battery materials; electrode and electrolyte materials.

Books Suggested:

1. Nanochemistry: A Chemical Approach to Nanomaterials; G.A. Ozin, A.C. Arsenault and L. Cademartiri (RSC, London).
2. Nanocomposite Science and Technology; P.M. Ajayan, L.Z. Schadler and P.V. Brown (Wiley).
3. Characterization of Nanophase Materials; Z.L. Wang (ed.) (Wiley-VCH).

SOC 206- SKILL ORIENTED COURSE 4(A) : HETEROCYCLIC CHEMISTRY

UNIT-I: THREE MEMBERED HETEROCYCLIC COMPOUNDS **15 Hrs**

Definition, Classification and Nomenclature (Hantzsch Widman System) of heterocycles. Synthesis and reactivity of Aziridines, Oxiranes and Thiiranes.

UNIT-II: FOUR MEMBERED HETEROCYCLIC COMPOUNDS **15 Hrs**

Synthesis and reactivity of Azitidines, Oxetanes, Thietanes.

UNIT-III: NOMENCLATURE AND FIVE MEMBERED HETEROCYCLES **15 Hrs**

Systematic nomenclature (Hantzsch-Widman nomenclature) for fused and bridged heterocycles, Five membered heterocycles with two heteroatoms: Synthesis and reactions of Pyrazole, Imidazole, Isoxazole, Oxazole, Isothiazole and Thiazole.

UNIT-IV: BENZOFUSED FIVE MEMBERED AND SIX MEMBERED HETEROCYCLES **15 Hrs**

Benzofused five membered heterocycles: Synthesis and reactions of Benzopyrazoles, Benzimidazoles and Benzoxazoles. Six Membered heterocycles with two or more heteroatoms: Synthesis and reactions of diazines (Pyridazine, Pyrimidine & Pyrazine) and Triazines (1,2,3-, 1,2,4- 1,3,5- Triazines)

Books Suggested:

1. Heterocyclic chemistry Vol. 1-3, R.R. Gupta, M.Kumar and V. Gupta, Springer Verlag.
2. The Chemistry of Heterocycles, T. Eicher and S. Hauptmann, Thieme.
3. Heterocyclic Chemistry, J.A. Joule, K. Mills and G.F. Smith, Chapman and Hall.
4. Heterocyclic Chemistry, T.L. Gilchrist, Longman Scientific Technical.
5. Contemporary Heterocyclic Chemistry, G.R. Newkome and W.W. Paudler, Wiley-Inter Science.
6. An Introduction to the Heterocyclic Compounds, R.M. Acheson, Jonn Wiley.
7. Comprehensive Heterocyclic Chemistry, A.R. Katritzky and C.W. Rees, eds. Pergamon Press.

SOC 206- SKILL ORIENTED COURSE 4(B): BIO-ORGANIC CHEMISTRY

UNIT-I: AMINO ACIDS AND PEPTIDES 15 Hrs

Synthesis and reactions of amino acids; classification and nomenclature of peptides; Sanger and Edman methods of sequencing; cleavage of peptide bond by chemical methods; peptide synthesis: protection of amino group (Boc-, Cbz- and Fmoc-) and carboxyl group as alkyl and aryl esters; use of DCC, T3P, HOBt and active esters; acid halides; acid azides; anhydrides in peptide bond formation reactions; deprotection and racemization in peptide synthesis; solution and solid phase techniques; synthesis of oxytocin; introduction to peptidomimetics.

UNIT-II: CARBOHYDRATES 15 Hrs

Types of naturally occurring sugars: deoxy sugars, amino sugars, branched chain sugars, methyl ethers and acid derivatives of sugars; general methods of structure elucidation and ring size determination with particular reference to maltose, lactose and sucrose; structure, degradation and biological functions of starch, cellulose and chitin.

UNIT-III: VITAMINS 15 Hrs

Structure and synthesis of vitamin B complex: vitamin B_1 (aneurin), vitamin B_2 (riboflavin), vitamin B_5 (pantothenic acid), vitamin B_9 (folic acid), vitamin H (biotin), vitamin B_6 (pyridoxine), vitamin B_{12} (cyanocobalamin) structure only - vitamin C (Ascarbic acid), vitamin E (α-tocopherol) – vitamin K_1 (phylloquinone) and vitamin K_2.

UNIT-IV: NUCLEIC ACIDS AND PROSTAGLANDINS 15 Hrs

Nucleic acids. Purine and pyrimidine bases; structure of nucleosides and nucleotides; methods of formation of internucleotide bonds (DCC and phosphotriester approaches); structure of DNA (WatsonCrick model) and RNAs; biological importance of DNA and RNA; protein-nucleic acid interaction; chromatin and viral nuclear capsid.

Prostaglandins. Nomenclature and classification; structure and biological role of PGE_1, PGE_2 and PGE_3.

Books Suggested

1. Peptides Chemistry: A practical text book, M. Bodansky, Springer-Verlag NY, (1988).
2. Solid-phase peptide synthesis: A practical approach-E. Artherton, R.C. Sheppard, Oxford University Press (1989).
3. Peptides: Chemistry and Biology, N. Selwad, H.-D. Jakubke, Wiley-VCH, (2002).
4. Biochemistry, J. David Rawn, Neil Pattuson publishers, North Carolina, (USA), (1989).
5. Organic Chemistry. Vol I and II, I. L. Finar, 6th Ed., ELBS & Longman (London), (1975).
6. Introduction to Lipids, D. Chapman, McGraw-Hill, (1969).
7. Advanced General Organic Chemistry, S. K. Ghosh, D.K. and Allied publishers (UBS), Calcutta (1998).
8. Text book of Biochemistry, E. S. West, W. R. Todd, H. S. Mason, J. T. Van Bugen, 4th Ed., Amerind Publishing Co. (New Delhi) (1974).
9. Total Synthesis of Natural Products Vol. IV, Apsimon, John Wiley, New York (1981).

P 207: Practical IV(related to SOC205 and SOC206)

SOC 205- SKILL ORIENTED COURSE 3(A): INSTRUMENTAL METHODS

1. TLC/Paper chromatographic separation.
2. Flame Photometry: Determination of Na and K, Ca and Li in Water and Soil.

SOC 206- SKILL ORIENTED COURSE 4(A) PRACTICALS: HETEROCYCLES AND NATURAL PRODUCTS

Preparation and identification of the following Heterocycles

1. Knorr synthesis of 5-methyl-2,4-dihydro-3H-pyrazol-3-one
2. Synthesis of pyrazolines from chalcones
3. Synthesis of isoxazolines from chalcones

CC 301-CORE COURSE 7 : INSTRUMENTAL METHODS OF ANALYSIS

UNIT –I SPECTROSCOPIC METHODS-I **15 Hrs**

Emission Spectroscopy:

(i) ICP-AES: Principles, instrumentation, AES detectors, applications in the analysis of trace and toxic metals in water, geological and industrial samples.

(ii) ICP-MS: Principles, instrumentation, quadrupole mass spectrometers, applications

UNIT –I SPECTROSCOPIC METHODS-II **15 Hrs**

Fluorescence Spectroscopy:

i) Molecular Fluorescence Spectroscopy: Principle, Theory of fluorescence, phosphorescence, relation between intensity of fluorescence and concentration, Correlation of fluorescence with molecular structure, Fluorescence quenching, Instrumentation and applications.

ii) X-ray Fluorescence Spectroscopy: Principle, energy dispersive X-ray fluorescence (EDXRF), Wavelength dispersive X-ray fluorescence (WDXRF), applications.

UNIT – II: CHROMATOGRAPHIC METHODS **15 Hrs**

High Performance Liquid Chromatography (HPLC): Principles, Stationary phases, Instrumentation, Solvent delivery system, sample introduction, gradient elution, columns and detectors.Partition Chromatography, adsorption chromatography, Gel permeation chromatography.

Capillary Electrophoresis: Principle, Electroosmotic flow, Instrumentation, Applications to separation of small ions, separation of Molecular Species, DNA sequencing

Supercritical-fluid chromatography: Supercritical-fluids, Instrumentation and Applications

UNIT –III: HYPHENATED TECHNIQUES **15 Hrs**

Mass Spectroscopy: Principle, basic instrumentation, resolution, Ionization sources- Electron impact and Chemical ionization, Mass Analyzers- Quadrupole Mass analyzer and Time- of-Flight Analyzer.

Gas Chromatography- Mass spectrometry: Introduction, GC – MS interface, processing of GC – MS data – ion chromatogram. Quantitative measurement – sample preparation, Selected ion monitoring – Application of GC-MS for Trace constituents. Drugs analysis, Environmental analysis and others.

Liquid chromatography- Mass spectrometry – Introduction – Instrumentation – liquid chromatography – Mass spectrometer Interface – Instrumental details – Processing LC-MS data – ion chromatograms, Sample preparation – selected ion monitoring. Application of LC-MS for Drug analysis, Environmental samples and others.

Books Suggested

1. Analytical Chemistry, Gary D. Christian, John Laliley and Senes, New York, 6th Ed., 2007.
2. Fundamentals of Analytical Chemistry, Skoog, West, Holler; 7th Editin 2001.
3. Analytical Chemistry Principles and Techniques, I.G. Harge, Prentice Hall.
4. Principles of Instrumental analysis, D.A. Skoog and J.L. Loacy, W.B. Saunders.
5. Handbook of Instrumental Techniques for Analytical Chemistry, F. Serlie, Prentice Hall.
6. Vogels Text book of Quantitative Chemical Analysis, Basett, Denny Jebbary, 5th Ed. ELBs 1990.
7. Instrumental Methods of Chemical Analysis, Willard Merrit, Dean, Stella Jr 6th Edition.
8. P.W Scott, Techniques and practice of Chromatography, Marel Dekker Inc., New York
9. Separation methods, M.N. Sastri, Himalaya Publishing Company, Mumbai
10. E. Helfman, Chromatography, Van Nostrand, Reinhold, New York
11. E. Lederer and M. Lederer, Chromatography, Elsevier, Amsterdam.

THIRD SEMESTER (ANALYTICAL CHEMISTRY)

CC 302-CORE COURSE 8 (A): QUALITY CONTROL AND GENERAL PRINCIPLES

UNIT-I: QUALITY CONTROL IN ANALYTICAL CHEMISTRY **15 Hrs**

Definition of analytical terms: Accuracy, precision, limit of detection, sensitivity, selectivity and specificity, ruggedness, principles of Ruggedness test, validating the Method as a Standard Method.

Quality assurance and management systems: Elements of quality assurance, Quality and quantity management system,. ISO 9000 and ISO 14000 series.

Good laboratory practices (GLP): Elements of Good Laboratory Practice, Laboratory accreditation, GLP status in India.

UNIT-II: ORGANIC REAGENTS IN INORGANIC ANALYSIS 15 Hrs

Theoretical basis for the use of organic reagents in inorganic analysis: Application of the following reagents in inorganic analysis: dimethylglyoxime, salicylaldehyde, cupferron, d-benzoin, 1,10 phenanthroline, 8-hydroxy quinoline, nitron, tannin, pyridine, 8-hydroxy quinoldine, dithizone, Acetylacetone, theonyl, trifluoroacetone, 8-hydroxy quinoline, tri-M-octylphosphine oxide.

UNIT – III: KINETIC METHODS OF TRACE ANALYASIS 15 Hrs

Rate laws, Analytical use of reaction rates, First and second order reactions, relative rate of reactions. Determination of reaction rates. Analytical utility of first and pseudo first order reactions. Types of kinetic methods, differential, integral, logarithmic, extrapolation method. Evaluation of kinetic methods – Scale of Operation, Catalyzed reactions, measurement method for catalyzed reaction. Micro determination of Inorganic species like Iodine and Hg in complex materials. Determination of organic species. Kinetics of enzyme, catalyzed reactions. Michael's constant factors affecting the rate of enzyme, Catalyzed reactions, Enzyme characteristics and applications of Kinetic methods of trace analysis**.**

UNIT-IV:REDOX AND COMPLEXOMETRIC TITRATIONS: 15Hrs

Redox Titrations: Standard reduction potential, equilibrium constants of oxidation-reduction reactions, change of electrode potential during the titration of reductant with an oxidant. Formal potential primary standard substance. Standard solutions. Preparation and storage. Oxidations with cerium (IV) sulphate solutions. Theory and use of (i) acid-base, (ii) Oxidation-reduction **(iii)** Metal ion indicators.

Complexometric titrations: Introduction, complexones, stability constants of EDTA complexes, conditional stability constants, titration curves, types of EDTA titration's, titration of mixtures.

Books Suggested

1. Vogel's Text book of Quantitative Chemical Analysis, Basselt, Denmy, Jaffery and Merdhan, ELBS, Orientlong- Manan, 5th Ed.1990.
2. Analytical Chemistry, Gary D. Christian, John Laliley and Senes, New York, 6th Ed., 2007.
3. Fundamentals of Analytical Chemistry, Skoog, West, Holler; 7th Editin 2001
4. Fundamentals of Analytical Chemistry, D.A. Skoog & D.M. West, Holf-Saunderrs, 5th Ed., 1991.
5. Principles and Methods Chemical Analysis: H.F. Walton, Prentice Hall, New Delhi.
6. Chemical Analysis, H.A. Laitinan, Mc.Graw Hill Book Company.
7. Technical methods of analysis – Griffin, Mc Graw Hill Book Co.
8. K.V.S.G Murali Krishna, An Introduction ISO 9000, ISO 1400 Series,
9. Environmental Management Quality Assurance and Good Laboratory Practices, Prof. Y. Anjaneyulu, In Now Publication, New York
10. Quality Assurance in Analytical Chemistry – G.Kateman and F.W Pijpers, John Wiley and Sons, New York

CC 302-CORE COURSE 8(B): BIOTECHNOLOGY AND ENVIRONMENTAL MANAGEMENT LAWS AND PROTECTION

UNIT I: BIOTECHNOLOGY AND ITS APPLICATION IN ENVIRONMENTAL PROTECTION **15 Hrs**

Introduction- Bio-informatics- Bio-Technology and pollution control,-Bioremediation-Biological de-odourisation- Biological purification of contaminated air-microorganisms and energy of mankind-use of microorganisms role in petroleum augmentation and recovery.

UNIT-II: WATER POLLUTION **15 Hrs**

Basic aspects of water-general principles of water(physical and chemical)-criteria of water quality.Types of water pollutants: sewage and domestic wastes-industrial wastes-agriculture discharges- toxic metals-oxygen demanding wastes-disease causing agents-oils- detergents and phosphates. Sampling: Basics of Sampling, sampling procedure, statistics, sampling and physical state, crushing and grinding, hazards waste of sampling, pre-concentration methods

UNIT-III: WASTE WATER TREATMENT **15 Hrs**

Basic process of water treatment- primary treatment pretreatment – sedimentation – Flotation-secondary (Biological) Treatment – Active sludge process – Trickling filters – sludge Treatment and disposal – Advanced waste water Treatment – Removal of suspended solids – Removal of dissolved solids – Nitrogen removal – phosphorous removal – Advanced Biological systems – chemical oxidation .

UNIT IV: ENVIRONMENTAL MANAGEMENT AND IMPORTANT ENVIRONMENTAL LAWS **15 Hrs**

Environmental Management: Introduction-objectives-components-environmental impact assessment (EIA)-historical background-elements of EIA process-participants in EIA processes-contents of EIS-design of EIA.

Important Environmental Laws: the world life act-the forest conservation act-the water and control pollution act-air prevention& control act—the environment act-environmental quality management standard-ISO 14000 series.

Books Suggested

1. Environmental Chemistry by W. Moore and J.Moore
2. Environmental chemistry by J.O.M. Bokriss
3. Environmental by BK Sharma
4. Environmental chemistry by SS Dara
5. Environmental chemistry by Mahajan
6. Environmental chemistry by a.K.De
7. Lodge (1994) Methods of air sampling and analysis.Publications, Jaipur
8. Kudesia, V.P. (1985) Water Pollution, Pragati Prakashan
9. Elements of biotechnology by PK Gupta and Rastogi

CC 303-CORE COURSE 9 (A): INORGANIC SPECTROSCOPY & THERMAL METHODS OF ANALYSIS

UNIT-I: THERMAL METHODS OF ANALYSIS **15 Hrs**

Thermo garaviemetry – Principle, Factors affecting the results, instrumentation. Application with special reference to $CuSO_45H_2O$, $CaC_2O_4\ 2H_2O$. Different thermal analysis – principle, instrumentation, difference between TG and DTA, applications with special reference to the clays and minerals. Different scanning calorimetry – principle, and applications to inorganic materials like chlorates and perchlorates, ammonium nitrate.

UNIT-II: MOSSBAUER SPECTROSCOPY AND NQR **15 Hrs**

Mossbauer spectroscopy: Basic principles, Recoil energy, Doppler shift, Chemical shift, Quadrapoleeffects, Magnetic effects. Instrumentation, spectral parameters and spectrum display. Aapplication of the technique to the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds, (2) Sn^{2+} and Sn^{4+} compounds.

NQR spectroscopy: Basic principles of NQR spectroscopy, quadrupole nuclei, quadrupole moments,electric field gradient, coupling constant and applications.

UNIT-III: ELECTRON SPIN RESONANCE SPECTROSCOPY **15 Hrs**

ESR: Basic Principles, Hyper fine splitting, Factors affecting the 'g' value. Isotropic and anisotropic hyperfinecoupling constants, Hamiltonian and spin densities. Zero field splitting and Kramer's degeneracy,Relaxation process and line widths. Instrumentation and Applications.The EPR spectrum of bis(salicylidimine)-copper(II) complex, study of inorganic free radicals, biological applications of Electron Spin Resonance (Study of free radicals and Iron-sulfur proteins)

UNIT-IV: PHOTOELECTRON SPECTROSCOPY **15 Hrs**

Photoelectric effect, Koopmans's theorem, ionization energy.

X-ray photoelectron spectroscopy (ESCA): Principle, Binding energies, Chemical shift, Applications of XPES to Qualitative analysis, to surface studies and structural analysis. Ultraviolet photoelectron spectroscopy- Principle, application of UPES in studying the molecular orbitals of O_2 and N_2 molecules. Block diagram of photoelectron spectrophotometer. Sources of radiation, detectors. Auger spectra – Principle, Applications of Auger spectra to surface studies and use of Auger spectra as a finger print tool.

Books suggested:

1. F.A. Cotton and G. Wilkinson, Advanced In-organic chemistry VI Edition, 1999. John wiley &sons. Inc., New York.
2. J.E. Huheey, E.A. Keiter and R.L. Keiter: Inorganic Chemsitry, Principles of Structure andReactivity (4^{th} Ed.) (Addison-Wesley)
3. Gary Wulfsberg: Inorganic Chemistry (5^{th} Ed. Viva Books)
4. J.D. Lee: Concise Inorganic Chemistry (Blackwell)
5. W.L. Jolly: Modern Inorganic Chemsitry (McGraw-Hill)

THIRD SEMESTER(ANALYTICAL CHEMISTRY)

CC 303-CORE COURSE 9(B): CHEMISTRY OF TRANSITION AND NON- TRANSITION ELEMENTS

UNIT-I: ORGANOMETALLIC CHEMISTRY OF TRANSITION ELEMENTS 15 Hrs

1. Dinitrogen complexes of Ru(II) , Os (II),Co(I) and Mo(0)
2. Dioxygen complexes of Ir (I) and Rh (I)
3. Cycloheptatriene and Tropylium complexes –Oxidative addition and Reductive Elimination. Insertion and Elimination reaction –Nucleophilic and Electrophilic attack of coordinated ligands.

UNIT –II: CHEMISTRY OF NON-TRANSITION ELEMENTS 15 Hrs

General characteristics of the non-transition elements, special features of individual elements: Synthesis, properties and structure of their Halides and oxides, polymorphism of carbon, Phosphorus and Sulphur. Synthesis, properties and structure of boranes, carboranes. borazines, silicates, carbides, Sulphur-nitrogen compounds, peroxo compounds of boron, carbon and sulphur, oxyacids of nitrogen, phosphorus, sulphur and halogens, inter halogens pseudo halides.

UNIT –III: APPLICATIONS OF ORGANOMETALLIC COMPOUNDS 15 Hrs

Catalytic applications –Fischer –Tropsch synthesis, Olefin hydrogenation (Wilkinson catalyst). Olefin oxygenation (Wacker process or Smidt reaction) Olefin hydroformylation (Ziegler-NattaCatalysis).

Synthetic applications of Organo–Lithium, –Magnesium and Aluminium compounds.Biological applications of organometallic compounds in medicine, agriculture and horticulture.

UNIT –IV: METAL-TO METAL BONDS AND METAL ATOM CLUSTERS 15 Hrs

Introduction, metal carbonyl clusters –low –nuclearity (M and M) clusters, isoelectronic and isolobal relationships, High nuclearity, carbonyl clusters (HNCC'S), Hetero stomes in metal atom clusters, electron counting scheme for HNCC'S, HNCC'S of the Fe, Ru and Os group HNCC'S of the Cu, Rh and Ir group, HNCC'S of the Ni, Pd, and Pt group. Compounds with M-M multiple bonds, Major structural types, quadruple bonds, relation of clusters to multiple bonds and one dimensional solids.

Books Suggested

1. F.A. Cotton and G.Wilkinson, Advanced Inorganic Chemistry VI Edition,1999.John wiley & sons. Inc., New York.
2. James E. Huheey, Inorganic chemistry- Principles of Structure and Reactivity, IV Edition 1993. Harper Collins College Publishers, New York.
3. J.D.Lee, Concise Inorganic chemistry, V Edition 1996, ELBS, Chapman and Hall, London.
4. Concise Inorganic chemistry by J.D. Lee V Edition ELBS, Chapman and Hall, London.
5. Organometallic Chemistry by R.C. Mehrotra and Singh.

THIRD SEMESTER(ANALYTICAL CHEMISTRY)

P 304: Practical V(related to CC302and CC303)

CC 302-CORE COURSE 8 (A) PRACTICALS: QUALITY CONTROL AND GENERAL PRINCIPLES

1. Estimation of Ferrous ion by using 1, 10-phenanthroline.
2. Determination of metal ions using DMG

CC 303-CORE COURSE 9 (A) PRACTICALS: INORGANIC SPECTROSCOPY & THERMAL METHODS OF ANALYSIS

1. Determination of metal ions by flame photometry.

SOC 305-SKILL ORIENTED COURSE 5 (A): FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

UNIT-I: ULTRAVIOLET AND VISIBLE SPECTROSCOPY: 15Hrs

Various electronic transitions (185-800 nm), effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fisher-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

UNIT-II: INFRARED SPECTROSCOPY 15Hrs

Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, 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

UNIT-III: ^{1}H NMR & ^{13}C NMR SPECTROSCOPY 15Hrs

^{1}H NMR: Magnetic properties of nuclei, Principles of NMR. Instrumentation, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin-spin coupling: vicinal, germinal and long range, Coupling constants and factors affecting coupling constants.

^{13}C NMR: General considerations, chemical shift (aliphatic, olefinic, alkyne, carbonyl carbon aromatic and heteroaromatic), coupling constants. Two dimensional NMR spectroscopy-HOMO COSY & HETERO COSY.

UNIT-IV: MASS SPECTROMETRY 15Hrs

Introduction, ion production, type of ionization, EI, CI, FD, and FAB-factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak, Mc. Lafferty rearrangement. Nitrogen rule, isotope labeling. High resolution mass spectrometry, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Books suggested:

1. Organic spectroscopy, W. Kemp 5th Ed, ELBS
2. Spectroscopy of organic compounds, RM Silversteen and others, 5th Ed,John Wiley
3. Spectroscopy of organic compounds, P.S. Kalsi, Wiley, 1993.
4. NMR in chemistry-A multi nuclear introduction, William Kemp, Mc Millan, 1986.
5. Spectroscopic methods in Organic chemistry, DH Williams & I Flemmi,

SOC 305-SKILL ORIENTED COURSE 5 (B): BIOINORGANIC, BIOORGANIC, BIOPHYSICAL CHEMISTRY

UNIT-I: BIO-INORGANIC CHEMISTRY- I 15 Hrs

Metal complexes as oxygen carriers – Heme proteins – Hemoglobin and myoglobin – Non heme proteins – hemerythrin and hemocyanin – model synthetic complexes of iron, cobalt and copper.Co-enzymes Vitamin B_{12},carboxy peptidase and superoxidedismutase.

Electron Transfer in Biology: Structure and functions of metalloproteins in electron transfer processes – catalase – peroxidose – cytochromes and iron – sulphur proteins – synthetic models.

UNIT – II: BIOINORGANIC CHEMISTRY- II 15 Hrs

Metal ion transport and storage in biological systems**,** Metal ions in Biology, Molecular mechanism of ion transport across membranes: ionophores, photosynthesis.

Hydrolytic metalloenzymes: Carbonic anyhdrase, carboxy peptidase, calcium in control processes, calcium and muscle contraction, calcium and secretion, calcium in blood clotting mechanisms. Therapeutic uses of enzymes.

Importance of trace metals in biology: Metal ions as chelating agents in medicine, trace metal ions and metal and non-metal deficiency. Biological nitrogen fixation, in-vivo and in-vitro nitrogen fixation.

UNIT-III: BIOORGANIC CHEMISTRY 15 Hrs

Carbohydrates: Structure and biological functions of mucopolysaccharides, glycoproteins, and glycolipids- Role of sugars in biological recognition- Blood group substances

Lipids: Essential fatty acids-structure and function of triglycerols, Glycerophospholipids, cholesterol, bile acids prostaglandins- composition and functioning of lipoproteins

Enzymes: Nomenclature and classification, properties, factors affecting enzyme catalysis, enzyme inhibition- reversible and irreversible inhibition. Uses of enzymes in food drink industry and clinical laboratories.

UNIT-IV: BIOPHYSICAL CHEMISTRY 15 Hrs

Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, calculation of average dimensions. Membrane equilibrium, ion transport through cell membrane.dialosis and its function. Structure and functions of proteins, enzymes, DNA and RNA in living systems, forces involved in bio polymer interactions, electrostatic forces, hydrophobic forces, molecular expansion, and dispersion forces.

Books Suggested

1. M.N. Hughes, The Inorganic chemistry of Biological Processes, John wiley and Sons, New York 2nd Edition, 1981.
2. A Text book of Biochemistry , A.V.S.S.Rama Rao
3. Physical chemistry by Atkenes
4. Physical chemistry by Albertz.
5. Bio physical chemistry by Van Holde
6. Bio Physics by Narayanam
7. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
8. Chemistry of Natural Products, P.S.Kalsi, Kalyani Publishers.
9. Chemistry of Organic Natural Products, O. P. Agarwal, Vols., 1 & 2, Geol Pubs.
10. Natural products Chemistry K.B.G. Torssell, John Wiley, 1983.
11. Burger's Medicinal Chemistry, M.E. Wolff, John Wiley
12. Medicinal Chemistry, A. Kar, New Age International

SOC 306-SKILL ORIENTED COURSE 6 (A): X- RAY DIFFRACTION , KINETICS IN SOLUTIONS, ELECTROANALYTICAL CHEMISTRY

UNIT-I POWDER X-RAY DIFFRACTION 15 Hrs

Powder x-ray diffraction, indexing the powder XRD patterns, Systematic absences, Structure factor, determination of lattice type, unit cell parameter and density for α-Po, fcc, bcc and hcp metals, NaCl, ZnS, diamond, CuZn, CuAu, $AuCu_3$ and other simple compounds. Neutron diffraction.

UNIT-II REACTIONS IN SOLUTIONS 15 Hrs

Linear Free Energy relationships, Theory of absolute reaction rates, Influence of Internal pressure, Influence of Solvation, Influence of Ionic strength, The Taft- Equation, Polymerisation Reactions (Molecular mechanism, Free radical Mechanism] Emulsion Polymerisation reactions.

UNIT III: ION SELECTIVE ELECTRODES 15 Hrs

Ion-sensitive electrodes – types of ion sensitive electrodes –metal based cation and anion sensitive electrodes, solid membrane electrodes. Liquid ion-exchange electrodes, gas sensing membrane electrodes.

UNIT IV: TYPES AND CLASSIFICATION OF ELECTRO ANALYTICAL METHODS 15 HRS

Potentiometry – Types of electrodes, Hydrogen gas, Calomel, Quin hydrone and glass electrodes. Determination of pH. Potentiometric titrations.

Conductometry – Definition of terms – conductivity, specific conductivity, cell constant. Mobility of ions, Conductometric titrations.

Books suggested:

a. R. West, Solid State Chemistry and its Applications, John Wiley & Sons, 1984. (Reprint Edition)
b. L. E. Smart and E. A. Moore, Solid State Chemistry - An Introduction, 4th Edition, CRC Press, 2012.
c.H. V. Keer, Principles of the Solid State, 2nd Edition, New Age International, 2017.
d.M. Weller, T. Overton, J. Rourke and F. Armstrong, Inorganic Chemistry, 6th Edition, Oxford University Press, 2014. (South Asia Edition 2015)

SOC 306-SKILL ORIENTED COURSE 6(B): INORGANIC MATERIALS FOR ELECTRONIC INDUSTRY

Unit-I MATERIALS FOR SOLAR CELLS **15 Hrs**

Introduction to solar cells, types of solar cells, functions of Si, CdTe, copper indium gallium diselenide (CIGS) as materials for solar cells.

UNIT-II PIEZOELECTRIC MATERIALS **15 Hrs**

Principle of piezoelectricity, materials involved in piezoelectric ceramics, perovskyte piezoelectric ceramics, piezoelectric sensors, piezoelectric actuators, piezoelectric piezoelectric polymers.

UNIT-III INORGANIC PHOSPHORS AND LASERS **15 Hrs**

Definition, types of inorganic phosphors, phosphor function in light emitting diodes, chemical composition and structure of inorganic lasers. Applications of inorganic phosphors and lasers.

UNIT-IV QUANTUM DOT LEDS (QD-LEDS) **15 Hrs**

Definition, types of QD-LEDs, structure, mechanism, materials used in QD-LEDs, applications in biomedical imaging, cancer diagnosis and treatment environmental remediation.

Books suggested:

1. Industrial Chemistry by B.K.Sharma, Goel Publishing House, Meerut, 11th Edition, 2000.
2. Electrochemistry by G.Milazo, Elseview Publishing Company.
3. Environmental Chemistry by S.C.Bhatia, CBS Publisheres, New Delhi,1st Edition, 2002.
4. Theoretical Basis of Inorganic Chemistry by A.K. Barnard, Tata McGraw-Hill Publishing Company Ltd.
5. Advanced Inorganic Chemistry by Cotton and Wilkinson, 5th Edition.
6. Inorganic Polymers, J.E. Mark, H.R. Allock and R. West, Prentice Hall 1992.

P 307: Practical VI (related to SOC 305 & SOC 306)

SOC 305-SKILL ORIENTED COURSE 5(A) PRACTICAL: FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

Spectral analysis

1. Propose the structures for compounds that fit the given spectral data and assign the spectral values.
2. Extract data from the given spectra and elucidate the structure from the obtained data with appropriate discussion.

SOC 306-SKILL ORIENTED COURSE 6(A) PRACTICALS: X- RAY DIFFRACTION, KINETICS IN SOLUTIONS, ELECTROANALYTICAL CHEMISTRY

1. **Chemical Kinetics:**

   Study of the kinetics of halogenations of acetone.
   Determination of activation energy of reaction between iodide and Persulphate Determination rate constant of oxidation of iodide ion by persulphate ion and study the effect of neutral salt (KCl).

2. Estimation of Metals by Flamephotometry
3. **Estimation of Metals by Colorimetry**
4. **Polarography:**

a. Determination of E1/2 of Zn and Cd
b Determination of Zn and Cd in mixture
c. Amperometric titration
d.Determination of density of liquid mixtures by using densitometer.

2. Study of the kinetics of halogenations of acetone.
3. X-ray powder diffraction analysis of cubic compound.
4. Determination of lattice constants, Partical Size and geometry.

CC 301- CORE COURSE 7: ENERGY, ENVIRONMENT AND SOILS

UNIT-I: SOURCES OF ENERGY **15 Hrs**

Fossil fuels- Nuclear fission and fusion- Solar energy-use of solar energy in space heating and water heating- production of electricity using solar energy- solar trough collectors- power tower- solar pond- solar energy for driving vehicles- power from indirect solar energy – Hydropower- wind power- Biomass energy- production of ethanol from biomass- production of methane from biomass- photosynthesis- photo electro chemistry- Geothermal energy.

UNIT-II:WATER RESOURCES AND AIR **15Hrs**

Hydrological cycle- physical and chemical properties of water-complexation in natural and waste water,-Anomalous properties-water pollutants-Types-Sources- Heavy metals- metalloids- organic – Inorganic – Biological and Radio active-Types of reactions in various water bodies including marine environment-Eutrophication-Ground water- Potable water standards.Treatment for portable water.

Air: Chemical reactions in the atmosphere – Aerosols types- Production and distribution – Aerosols and Radiation – structure and composition of atmosphere- temperature inversion – Global warning- Ozone depletion – Green house effect, "CFC"s- Acid rain.

UNIT-III: SOIL AND GREEEN CHEMISTRY **15 Hrs**

Soil: Composition of soil- lithosphere- inorganic and organic contaminants in the soil- Biodegradation- Nondegrdable waste and its effect on the environment- Bioremediation –of surface soils- Fate and transport of contaminants on soil system– Bioindicators- Soil parameters- soil destruction- Erosion- Soil conservation – Nitrogen pathways and NPK in soil .

Green Chemistry: Goals of Green chemistry- Significance and basic components of Green chemistry research - industrial applications of Green chemistry-products from natural materials- Green fuels and E-Green propellants- Zeolites- Biocatalysts.

UNIT IV: SOIL POLLUTION **15Hrs**

Introduction – soil pollution by industrial wastes. soil pollution by urban wastes, Radio active pollutants and Agricultural waste- chemical and metallic pollutants-Biological agents – mining - Detrimental effects of soil pollutants – Effects of industrial pollutants- Effects of sewage and domestic wastes- Effects of heavy metals- Effects of radio active pollutants- Effects of modern agro- technology – Diseases caused by soil pollution – solid waste management – sources and classification -public Health Aspects – methods of collection- Disposal methods – potential methods of disposal.

Books Suggested:

1. Daniel D.Chiras (1994), Environmental Science, 4th Ed.
2. Environmental Chemistry by W. Moore and J.Moore
3. Environmental chemistry by J.O.M. Bockariss
4. Environm,ental by BK SHArma
5. Environmental chemistry by SS Dara
6. Environmental chemistry by Mahajan
7. Environmental chemistry by a.K.De

CC 302- CORE COURSE 8(A): WATER POLLUTION MONITORING AND ENVIRONMENT LAWS

UNIT-I: WATER POLLUTION **15 Hrs**

Basic aspects of water-general principles of water(physical and chemical)-criteria of water quality.Types of water pollutants: sewage and domestic wastes-industrial wastes-agriculture discharges- toxic metals-oxygen demanding wastes-disease causing agents-oils- detergents and phosphates. Sampling: Basics of Sampling, sampling procedure, statistics, sampling and physical state, crushing and grinding, hazards waste of sampling, pre-concentration methods

UNIT-II: WASTE WATER TREATMENT **15 Hrs**

Basic process of water treatment- primary treatment pretreatment – sedimentation – Flotation- secondary (Biological) Treatment – Active sludge process – Trickling filters – sludge Treatment and disposal – Advanced waste water Treatment – Removal of suspended solids – Removal of dissolved solids – Nitrogen removal – phosphorous removal – Advanced Biological systems – chemical oxidation .

UNIT III: BIOTECHNOLOGY AND ITS APPLICATION IN ENVIRONMENTAL PROTECTION **15 Hrs**

Introduction- Bio-informatics- Bio-Technology and pollution control,-Bioremediation- Biological de-odourisation- Biological purification of contaminated air-microorganisms and energy of mankind-use of microorganisms role in petroleum augmentation and recovery.

UNIT IV: ENVIRONMENTAL MANAGEMENT & IMPORTANT ENVIRONMENTAL LAWS **15 Hrs**

Environmental Management: Introduction-objectives-components-environmental impact assessment (EIA)-historical background-elements of EIA process-participants in EIA processes- contents of EIS-design of EIA.

Important Environmental Laws: the world life act-the forest conservation act-the water and control pollution act-air prevention& control act—the environment act-environmental quality management standard-ISO 14000 series.

Books Suggested

1. Environmental Chemistry by W. Moore and J.Moore
2. Environmental chemistry by J.O.M. Bokriss
3. Environmental by BK Sharma
4. Environmental chemistry by SS Dara
5. Environmental chemistry by Mahajan
6. Environmental chemistry by a.K.De
7. Lodge (1994) Methods of air sampling and analysis.Publications, Jaipur
8. Kudesia, V.P. (1985) Water Pollution, Pragati Prakashan
9. Elements of biotechnology by PK Gupta and Rastogi

CC 302- CORE COURSE 8(B): QUALITY CONTROL IN ANALYTICAL CHEMISTRY

UNIT-I: QUALITY CONTROL IN ANALYTICAL CHEMISTRY **15 Hrs**

Definition of analytical terms: Accuracy, precision, limit of detection, sensitivity, selectivity and specificity, ruggedness, principles of Ruggedness test, validating the Method as a Standard Method.

Quality assurance and management systems: Elements of quality assurance, Quality and quantity management system,. ISO 9000 and ISO 14000 series.

Good laboratory practices (GLP): Elements of Good Laboratory Practice, Laboratory accreditation, GLP status in India.

UNIT – II: KINETIC METHODS OF TRACE ANALYASIS 15 Hrs

Rate laws, Analytical use of reaction rates, First and second order reactions, relative rate of reactions. Determination of reaction rates. Analytical utility of first and pseudo first order reactions. Types of kinetic methods, differential, integral, logarithmic, extrapolation method. Evaluation of kinetic methods – Scale of Operation, Catalyzed reactions, measurement method for catalyzed reaction. Micro determination of Inorganic species like Iodine and Hg in complex materials. Determination of organic species. Kinetics of enzyme, catalyzed reactions. Michael's constant factors affecting the rate of enzyme, Catalyzed reactions, Enzyme characteristics and applications of Kinetic methods of trace analysis**.**

UNIT-III: ORGANIC REAGENTS IN INORGANIC ANALYSIS 15 Hrs

Theoretical basis for the use of organic reagents in inorganic analysis: Application of the following reagents in inorganic analysis: dimethylglyoxime, salicylaldehyde, cupferron, d-benzoin, 1,10 phenanthroline, 8-hydroxy quinoline, nitron, tannin, pyridine, 8-hydroxy quinoldine, dithizone, Acetylacetone, theonyl, trifluoroacetone, 8-hydroxy quinoline, tri-M-octylphosphine oxide.

UNIT-IV:REDOX AND COMPLEXOMETRIC TITRATIONS: 15Hrs

Redox Titrations: Standard reduction potential, equilibrium constants of oxidation-reduction reactions, change of electrode potential during the titration of reductant with an oxidant. Formal potential primary standard substance. Standard solutions. Preparation and storage. Oxidations with cerium (IV) sulphate solutions. Theory and use of (i) acid-base, (ii) Oxidation-reduction (iii) Metal ion indicators.

Complexometric titrations: Introduction, complexones, stability constants of EDTA complexes, conditional stability constants, titration curves, types of EDTA titration's, titration of mixtures.

Books Suggested

1. Vogel's Text book of Quantitative Chemical Analysis, Basselt, Denmy, Jaffery and Merdhan, ELBS, Orientlong- Manan, 5th Ed.1990.
2. Analytical Chemistry, Gary D. Christian, John Lalilley and Senes, New York, 6th Ed., 2007.
3. Fundamentals of ANALYTICAL CHEMISTRY, Skoog, West, Holler; 7th Editin 2001
4. Fundamentals of Analytical Chemistry, D.A. Skoog & D.M. West, Holf-Saunderrs, 5th Ed., 1991.
5. Principles and Methods Chemical Analysis: H.F. Walton, Prentice Hall, New Delhi.
6. Chemical Analysis, H.A. Laitinan, Mc.Graw Hill Book Company.
7. Technical methods of analysis – Griffin, Mc Graw Hill Book Co.
8. K.V.S.G Murali Krishna, An Introduction ISO 9000, ISO 1400 Series,
9. Environmental Management Quality Assurance and Good Laboratory Practices, Prof. Y. Anjaneyulu, In Now Publication, New York
10. Quality Assurance in Analytical Chemistry – G.Kateman and F.W Pijpers, John Wiley and Sons, New York

THIRD SEMESTER(ENVIRONAMENTAL CHEMISTRY)

CC 303- CORE COURSE 9(A): SPECTRAL TECHNIQUES IN INORGANIC CHEMISTRY

UNIT-I: THERMAL METHODS OF ANALYSIS 15 Hrs

Thermo garaviemetry – Principle, Factors affecting the results, instrumentation. Application with special reference to $CuSO_45H_2O$, $CaC_2O_4\ 2H_2O$. Different thermal analysis – principle, instrumentation, difference between TG and DTA, applications with special reference to the clays and minerals. Different scanning calorimetry – principle, and applications to inorganic materials like chlorates and perchlorates, ammonium nitrate.

UNIT-II: MOSSBAUER SPECTROSCOPY AND NQR 15 Hrs

Mossbauer spectroscopy: Basic principles, Recoil energy, Doppler shift, Chemical shift, Quadrapoleeffects, Magnetic effects. Instrumentation, spectral parameters and spectrum display. Aapplication of the technique to the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds, (2) Sn^{2+} and Sn^{4+} compounds.

NQR spectroscopy: Basic principles of NQR spectroscopy, quadrupole nuclei, quadrupole moments,electric field gradient, coupling constant and applications.

UNIT-III: ELECTRON SPIN RESONANCE SPECTROSCOPY 15 Hrs

ESR: Basic Principles, Hyper fine splitting, Factors affecting the 'g' value. Isotropic and anisotropic hyperfinecoupling constants, Hamiltonian and spin densities. Zero field splitting and Kramer's degeneracy,Relaxation process and line widths. Instrumentation and Applications.The EPR spectrum of bis(salicylidimine)-copper(II) complex, study of inorganic free radicals, biological applications of Electron Spin Resonance (Study of free radicals and Iron-sulfur proteins)

UNIT-IV: PHOTOELECTRON SPECTROSCOPY 15 Hrs

Photoelectric effect, Koopmans's theorem, ionization energy.

X-ray photoelectron spectroscopy (ESCA): Principle, Binding energies, Chemical shift, Applications of XPES to Qualitative analysis, to surface studies and structural analysis. Ultraviolet photoelectron spectroscopy- Principle, application of UPES in studying the molecular orbitals of O_2 and N_2 molecules. Block diagram of photoelectron spectrophotometer. Sources of radiation, detectors. Auger spectra – Principle, Applications of Auger spectra to surface studies and use of Auger spectra as a finger print tool.

Books suggested:

1. F.A. Cotton and G. Wilkinson, Advanced In-organic chemistry VI Edition, 1999. John wiley &sons. Inc., New York.
2. J.E. Huheey, E.A. Keiter and R.L. Keiter: Inorganic Chemsitry, Principles of Structure andReactivity (4^{th} Ed.) (Addison-Wesley)
3. Gary Wulfsberg: Inorganic Chemistry (5^{th} Ed. Viva Books)
4. J.D. Lee: Concise Inorganic Chemistry (Blackwell)
5. W.L. Jolly: Modern Inorganic Chemsitry (McGraw-Hill)

THIRD SEMESTER(ENVIRONAMENTAL CHEMISTRY)

CC 303- CORE COURSE 9(B): GROUP THEORY AND SPECTROSCOPY

UNIT-I: APPLICATION OF GROUP THEORY 15 Hrs

Mulikan Character tables, Determination of Character Coordinate of C_{2V} point group based on $_{3N}$ Coordinates. Standard reduction formula, Determination of normal modes of vibrations of SO_2, NH_3, $POCl_3$, $PtCl_4^{2-}$,molecules. Mutual exclusion Principle, Direct Product, Accidental Degeneracy and Fermi resonance. **Group Theory and Spectroscopy:** selection rules, symmetry Criteria for optical activity, symmetry restrictions on dipole moments, symmetry and stereo isomerism.

UNIT-II: THERMODYNAMICS-III: 15 Hrs

Thermodynamic Properties of Liquid Mixtures: Activity and activity coefficients-excess free energy-excess enthalpy-excess volume-excess entropy-relation between excess functions and activity coefficients –Application of Gibbs-Deuhem equation-regular solutions –van Laar theory and Scachard-Hildebrand theory.

Phase rule: Three component liquid systems – formation of one pair, two pairs and three pairs of partially miscible liquids; two salts and water – no chemical combination, double salt formation, one salt forms hydrate and two salts form hydrates.

UNIT-III: SPECTROSCOPHY 15 Hrs

Microwave spectroscopy: classification of molecules, rigid rotator model, effect of isotopic substitution on the transition frequencies, intensities- stark effect.

Vibrational spectroscopy: Linear harmonic oscillator, zero point energy, anharmonity, Mores potential energy diagram, fundamental and overtone transitions, hot bands and combinations bands. Vibration-rotation spectroscopy, PQR branches, selection rules, factors affecting the band positions and intensities for IR region.

Raman spectroscopy: Classical and quantum theories of Raman effect, Pure rotational, Vibrational Raman spectroscopy, Vibrational- Rotational Raman spectroscopy, Selection rules, Mutual Exclusion Principle.

UNIT-IV: POLYMER CHEMISTRY 15 Hrs

Monomers; repeat units; degree of polymerization; linear, branched and network polymers; classification of polymers. Polymerization Methods: Condensation, addition, radical chain, ionic and coordination, copolymerization Thermodynamics of polymer dissolution, effect of molecular weight on solubility, solubility of crystalline and amorphous polymer, heat of dissolution. Molecular weight determination by Viscosity, light scattering, ultra centrifugation and sedimentation equilibrium method.

Books Suggested

1. Physical methods in Chemistry, R. S. Drago (Saunders College).
2. Advanced Physical Chemistry by GurudeepRaj, Goel Publishers House, Meerut.
3. Essentials of Nuclear Chemistry, 4th Ed., 1995, H. J. Harnikar (Weily Eastern)
4. Text Book of Polymer Science, F. W. Billmeyer, Jr. (Wiley Inter Science)
5. Polymer Sciences by V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar.
6. Simons. An Introduction to theoretical chemistry. The press Syndicate of the University of Cambridge.
7. D.N. Bajpai: Advanced physical Chemistry: S. Chand & Company, 1998.
8. Silbey, Alberty, Bawendi. Physical Chemistry.Jhon-Wiley & Sons. 4th edition-2006.
9. Maron and prutton: principles of physical Chemistry.

P 304: Practical V (related to CC 302 & CC 303)

CC 302- CORE COURSE 8(A PRACTICALS): WATER POLLUTION MONITORING AND ENVIRONMENT LAWS

Water Analysis

1. Alkalinity
2. Acidity
3. Sulphate
4. Phosphorus
5. Nitrites
6. Cholorides
7. Determination of Hardness (Total, Permanent & Temporary)
8. Determination of Chlorine in Bleaching powder
9. Determination of DO level in Water Samples

CC 303- CORE COURSE 9 (A) PRACTICALS: SPECTRAL TECHNIQUES IN INORGANIC CHEMISTRY

1. Estimation of Ferrous ion by using 1, 10-phenanthroline.
2. Determination of the amount of Iron by Photometric titration method.

SOC 305- SKILL ORIENTED COURSE 5 (A): FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

UNIT-I: ULTRAVIOLET AND VISIBLE SPECTROSCOPY: 15Hrs

Various electronic transitions (185-800 nm), effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fisher-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

UNIT-II: INFRARED SPECTROSCOPY 15Hrs

Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, 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 **UNIT-III: ^{1}H NMR & ^{13}C NMR SPECTROSCOPY 15Hrs**

^{1}H NMR: Magnetic properties of nuclei, Principles of NMR. Instrumentation, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin-spin coupling: vicinal, germinal and long range, Coupling constants and factors affecting coupling constants.

^{13}C NMR: General considerations, chemical shift (aliphatic, olefinic, alkyne, carbonyl carbon aromatic and heteroaromatic), coupling constants. Two dimensional NMR spectroscopy-HOMO COSY & HETERO COSY.

UNIT-IV: MASS SPECTROMETRY **15Hrs**

Introduction, ion production, type of ionization, EI, CI, FD, and FAB-factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak, Mc. Lafferty rearrangement. Nitrogen rule, isotope labeling. High resolution mass spectrometry, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Books suggested:

1. Organic spectroscopy, W. Kemp 5th Ed, ELBS
2. Spectroscopy of organic compounds, RM Silversteen and others, 5th Ed,John Wiley
3. Spectroscopy of organic compounds, P.S. Kalsi, Wiley, 1993.
4. NMR in chemistry-A multi nuclear introduction, William Kemp, Mc Millan, 1986.
5. Spectroscopic methods in Organic chemistry, DH Williams & I Flemmi,

SOC 305- SKILL ORIENTED COURSE 5 (B): BIOINORGANIC, BIOORGANIC, BIOPHYSICAL CHEMISTRY

UNIT-I: BIO-INORGANIC CHEMISTRY- I **15 Hrs**

Metal complexes as oxygen carriers – Heme proteins – Hemoglobin and myoglobin – Non heme proteins – hemerythrin and hemocyanin – model synthetic complexes of iron, cobalt and copper.Co-enzymes Vitamin B12,carboxy peptidase and superoxidedismutase.

Electron Transfer in Biology: Structure and functions of metalloproteins in electron transfer processes – catalase – peroxidose – cytochromes and iron – sulphur proteins – synthetic models.

UNIT – II: BIOINORGANIC CHEMISTRY- II **15 Hrs**

Metal ion transport and storage in biological systems**,** Metal ions in Biology, Molecular mechanism of ion transport across membranes: ionophores, photosynthesis.

Hydrolytic metalloenzymes: Carbonic anyhdrase, carboxy peptidase, calcium in control processes, calcium and muscle contraction, calcium and secretion, calcium in blood clotting mechanisms. Therapeutic uses of enzymes.

Importance of trace metals in biology: Metal ions as chelating agents in medicine, trace metal ions and metal and non-metal deficiency. Biological nitrogen fixation, in-vivo and in-vitro nitrogen fixation.

UNIT-III: BIOORGANIC CHEMISTRY **15 Hrs**

Carbohydrates: Structure and biological functions of mucopolysaccharides, glycoproteins, and glycolipids- Role of sugars in biological recognition- Blood group substances

Lipids: Essential fatty acids-structure and function of triglycerols, Glycerophospholipids, cholesterol, bile acids prostaglandins- composition and functioning of lipoproteins

Enzymes: Nomenclature and classification, properties, factors affecting enzyme catalysis, enzyme inhibition- reversible and irreversible inhibition. Uses of enzymes in food drink industry and clinical laboratories.

UNIT-IV: BIOPHYSICAL CHEMISTRY **15 Hrs**

Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, calculation of average dimensions. Membrane equilibrium, ion transport through cell membrane.dialosis and its function. Structure and functions of proteins, enzymes, DNA and RNA in living systems, forces involved in bio polymer interactions, electrostatic forces, hydrophobic forces, molecular expansion, and dispersion forces.

Books Suggested

1. M.N. Hughes, The Inorganic chemistry of Biological Processes, John wiley and Sons, New York 2nd Edition, 1981.
2. A Text book of Biochemistry , A.V.S.S.Rama Rao
3. Physical chemistry by Atkenes
4. Physical chemistry by Albertz.
5. Bio physical chemistry by Van Holde
6. Bio Physics by Narayanam
7. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
8. Chemistry of Natural Products, P.S.Kalsi, Kalyani Publishers.
9. Chemistry of Organic Natural Products, O. P. Agarwal, Vols., 1 & 2, Geol Pubs.
10. Natural products Chemistry K.B.G. Torssell, John Wiley, 1983.
11. Burger's Medicinal Chemistry, M.E. Wolff, John Wiley
12. Medicinal Chemistry, A. Kar, New Age International

SOC 306- SKILL ORIENTED COURSE 6 (A): X- RAY DIFFRACTION , KINETICS IN SOLUTIONS, ELECTROANALYTICAL CHEMISTRY

UNIT-I POWDER X-RAY DIFFRACTION **15 Hrs**

Powder x-ray diffraction, indexing the powder XRD patterns, Systematic absences, Structure factor, determination of lattice type, unit cell parameter and density for α-Po, fcc, bcc and hcp metals, NaCl, ZnS, diamond, CuZn, CuAu, $AuCu_3$ and other simple compounds. Neutron diffraction.

UNIT-II REACTIONS IN SOLUTIONS **15 Hrs**

Linear Free Energy relationships, Theory of absolute reaction rates, Influence of Internal pressure, Influence of Solvation, Influence of Ionic strength, The Taft- Equation, Polymerisation Reactions (Molecular mechanism, Free radical Mechanism] Emulsion Polymerisation reactions.

UNIT III: ION SELECTIVE ELECTRODES **15 Hrs**

Ion-sensitive electrodes –types of ion sensitive electrodes –metal based cation and anion sensitive electrodes, solid membrane electrodes. Liquid ion-exchange electrodes, gas sensing membrane electrodes.

UNIT IV: TYPES AND CLASSIFICATION OF ELECTRO ANALYTICAL METHODS **15 HRS**

i) Potentiometry – Types of electrodes, Hydrogen gas, Calomel, Quin hydrone and glass electrodes. Determination of pH. Potentiometric titrations.

ii) Conductometry – Definition of terms – conductivity, specific conductivity, cell constant. Mobility of ions, Conductometric titrations.

Books suggested:

1. A.R. West, Solid State Chemistry and its Applications, John Wiley & Sons, 1984. (Reprint Edition)
2. L. E. Smart and E. A. Moore, Solid State Chemistry - An Introduction, 4th Edition, CRC Press, 2012.
3. H. V. Keer, Principles of the Solid State, 2nd Edition, New Age International, 2017.
4. M. Weller, T. Overton, J. Rourke and F. Armstrong, Inorganic Chemistry, 6th Edition, Oxford University Press, 2014. (South Asia Edition 2015)

SOC 306- SKILL ORIENTED COURSE 6(B): INORGANIC MATERIALS FOR ELECTRONIC INDUSTRY

Unit-I MATERIALS FOR SOLAR CELLS **15 Hrs**

Introduction to solar cells, types of solar cells, functions of Si, CdTe, copper indium gallium diselenide (CIGS) as materials for solar cells.

UNIT-II PIEZOELECTRIC MATERIALS **15 Hrs**

Principle of piezoelectricity, materials involved in piezoelectric ceramics, perovskyte piezoelectric ceramics, piezoelectric sensors, piezoelectric actuators, piezoelectric piezoelectric polymers.

UNIT-III INORGANIC PHOSPHORS AND LASERS **15 Hrs**

Definition, types of inorganic phosphors, phosphor function in light emitting diodes, chemical composition and structure of inorganic lasers. Applications of inorganic phosphors and lasers.

UNIT-IV QUANTUM DOT LEDS (QD-LEDS) **15 Hrs**

Definition, types of QD-LEDs, structure, mechanism, materials used in QD-LEDs, applications in biomedical imaging, cancer diagnosis and treatment environmental remediation.

Books suggested:

1. Industrial Chemistry by B.K.Sharma, Goel Publishing House, Meerut, 11th Edition, 2000.
2. Electrochemistry by G.Milazo, Elseview Publishing Company.
3. Environmental Chemistry by S.C.Bhatia, CBS Publisheres, New Delhi,1st Edition, 2002.
4. Theoretical Basis of Inorganic Chemistry by A.K. Barnard, Tata McGraw-Hill Publishing Company Ltd.
5. Advanced Inorganic Chemistry by Cotton and Wilkinson, 5th Edition.
6. Inorganic Polymers, J.E. Mark, H.R. Allock and R. West, Prentice Hall 1992.

P 307: Practical VI (related to SOC 305 & SOC 306)

SOC 305- SKILL ORIENTED COURSE 5 (A) PRACTICAL: FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

Spectral analysis

1. Propose the structures for compounds that fit the given spectral data and assign the spectral values.
2. Extract data from the given spectra and elucidate the structure from the obtained data with appropriate discussion.

SOC 306- SKILL ORIENTED COURSE 6(A) PRACTICALS: X- RAY DIFFRACTION, KINETICS IN SOLUTIONS, ELECTROANALYTICAL CHEMISTRY

1. **Chemical Kinetics:**
   Study of the kinetics of halogenations of acetone.
   Determination of activation energy of reaction between iodide and Persulphate
   Determination rate constant of oxidation of iodide ion by persulphate ion and study the effect of neutral salt (KCl).
2. **Estimation of Metals by Flamephotometry**
3. **Estimation of Metals by Colorimetry**
4. **Polarography:**
   a. Determination of $E_{1/2}$ of Zn and Cd
   b. Determination of Zn and Cd in mixture
   c. Amperometric titration
5. Determination of density of liquid mixtures by using densitometer.
6. Study of the kinetics of halogenations of acetone.
7. X-ray powder diffraction analysis of cubic compound.
8. Determination of lattice constants, Partical Size and geometry.

CC 301- CORE COURSE 7: INORGANIC SPECTROSCOPY & THERMAL METHODS OF ANALYSIS

UNIT-I: THERMAL METHODS OF ANALYSIS **15 Hrs**

Thermo garaviemetry – Principle, Factors affecting the results, instrumentation. Application with special reference to $CuSO_45H_2O$, $CaC_2O_4\ 2H_2O$. Different thermal analysis – principle, instrumentation, difference between TG and DTA, applications with special reference to the clays and minerals. Different scanning calorimetry – principle, and applications to inorganic materials like chlorates and perchlorates, ammonium nitrate.

UNIT-II: MOSSBAUER SPECTROSCOPY AND NQR **15 Hrs**

Mossbauer spectroscopy: Basic principles, Recoil energy, Doppler shift, Chemical shift, Quadrapoleeffects, Magnetic effects. Instrumentation, spectral parameters and spectrum display. Aapplication of the technique to the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds, (2) Sn^{2+} and Sn^{4+} compounds.

NQR spectroscopy: Basic principles of NQR spectroscopy, quadrupole nuclei, quadrupole moments,electric field gradient, coupling constant and applications.

UNIT-III: ELECTRON SPIN RESONANCE SPECTROSCOPY **15 Hrs**

ESR: Basic Principles, Hyper fine splitting, Factors affecting the 'g' value. Isotropic and anisotropic hyperfinecoupling constants, Hamiltonian and spin densities. Zero field splitting and Kramer's degeneracy,Relaxation process and line widths. Instrumentation and Applications.The EPR spectrum of bis(salicylidimine)-copper(II) complex, study of inorganic free radicals, biological applications of Electron Spin Resonance (Study of free radicals and Iron-sulfur proteins)

UNIT-IV: PHOTOELECTRON SPECTROSCOPY **15 Hrs**

Photoelectric effect, Koopmans's theorem, ionization energy.

X-ray photoelectron spectroscopy (ESCA): Principle, Binding energies, Chemical shift, Applications of XPES to Qualitative analysis, to surface studies and structural analysis. Ultraviolet photoelectron spectroscopy- Principle, application of UPES in studying the molecular orbitals of O_2 and N_2 molecules. Block diagram of photoelectron spectrophotometer. Sources of radiation, detectors. Auger spectra – Principle, Applications of Auger spectra to surface studies and use of Auger spectra as a finger print tool.

Books suggested:

1. F.A. Cotton and G. Wilkinson, Advanced In-organic chemistry VI Edition, 1999. John wiley &sons. Inc., New York.
2. J.E. Huheey, E.A. Keiter and R.L. Keiter: Inorganic Chemsitry, Principles of Structure andReactivity (4^{th} Ed.) (Addison-Wesley)
3. Gary Wulfsberg: Inorganic Chemistry (5^{th} Ed. Viva Books)
4. J.D. Lee: Concise Inorganic Chemistry (Blackwell)
5. W.L. Jolly: Modern Inorganic Chemsitry (McGraw-Hill)

CC 302- CORE COURSE 8(A): CO-ORDINATION COMPOUNDS, ORGANOMETALLIC CHEMISTRY AND CHEMISTRY OF NON-TRANSITION ELEMENTS

UNIT-I: ORGANOMETALLIC CHEMISTRY OF TRANSITION ELEMENTS 15 Hrs

1. Dinitrogen complexes of Ru(II) , Os (II),Co(I) and Mo(0)
2. Dioxygen complexes of Ir (I) and Rh (I)
3. Cycloheptatriene and Tropylium complexes –Oxidative addition and Reductive Elimination. Insertion and Elimination reaction –Nucleophilic and Electrophilic attack of coordinated ligands.

UNIT –II: APPLICATIONS OF ORGANOMETALLIC COMPOUNDS 15 Hrs

Catalytic applications –Fischer –Tropsch synthesis, Olefin hydrogenation (Wilkinson catalyst).Olefin oxygenation (Wacker process or Smidt reaction) Olefin hydroformylation (Ziegler-NattaCatalysis).

Synthetic applications of Organo–Lithium, –Magnesium and Aluminium compounds.Biological applications of organometallic compounds in medicine, agriculture and horticulture.

UNIT –III: METAL TO METAL BONDS AND METAL ATOM CLUSTERS 15 Hrs

Introduction, metal carbonyl clusters –low –nuclearity (M and M) clusters, isoelectronic and isolobal relationships, High nuclearity, carbonyl clusters (HNCC'S), Hetero stomes in metal atom clusters, electron counting scheme for HNCC'S, HNCC'S of the Fe, Ru and Os group HNCC'S of the Cu, Rh and Ir group, HNCC'S of the Ni, Pd, and Pt group. Compounds with M-M multiple bonds, Major structural types, quadruple bonds, relation of clusters to multiple bonds and one dimensional solids.

UNIT –IV: CHEMISTRY OF NON-TRANSITION ELEMENTS 15 Hrs

General characteristics of the non-transition elements, special features of individual elements: Synthesis, properties and structure of their Halides and oxides, polymorphism of carbon, Phosphorus and Sulphur. Synthesis, properties and structure of boranes, carboranes. borazines, silicates, carbides, Sulphur-nitrogen compounds, peroxo compounds of boron, carbon and sulphur, oxyacids of nitrogen, phosphorus, sulphur and halogens, inter halogens pseudo halides.

Books Suggested

1. F.A.Cotton and G.Wilkinson, Advanced In-organic chemistry VI Edition,1999.John wiley & sons. Inc., New York.
2. James E. Huheey, Inorganic chemistry- Principles of structure and reactivity, IV Edition 1993. Harper Collins College Publishers, New York.
3. J.D.Lee, Concise Inorganic chemistry, V Edition 1996, ELBS, Chapman and Hall, London.
4. Concise Inorganic chemistry by J.D.Lee V Edition ELBS, Chapman and Hall, London.
5. Organometallic Chemistry by R.C.Mehrotra and Singh.

CC 302- CORE COURSE 8(B): ENERGY RESOURCES AND GREEN CHEMISTRY

UNIT-I: SOURCES OF ENERGY **15 Hrs**

Fossil fuels- Nuclear fission and fusion- Solar energy-use of solar energy in space heating and water heating- production of electricity using solar energy- solar trough collectors- power tower- solar pond- solar energy for driving vehicles- power from indirect solar energy – Hydropower- wind power- Biomass energy- production of ethanol from biomass- production of methane from biomass- photosynthesis- photo electro chemistry- Geothermal energy.

UNIT-II: SOIL AND GREEEN CHEMISTRY **15 Hrs**

Soil: Composition of soil- lithosphere- inorganic and organic contaminants in the soil- Biodegradation- Nondegrdable waste and its effect on the environment- Bioremediation –of surface soils- Fate and transport of contaminants on soil system– Bioindicators- Soil parameters- soil destruction- Erosion- Soil conservation – Nitrogen pathways and NPK in soil .

Green Chemistry: Goals of Green chemistry- Significance and basic components of Green chemistry research - industrial applications of Green chemistry-products from natural materials- Green fuels and E-Green propellants- Zeolites- Biocatalysts.

UNIT-III:WATER RESOURCES AND AIR **15Hrs**

Hydrological cycle- physical and chemical properties of water-complexation in natural and waste water,-Anomalous properties-water pollutants-Types-Sources- Heavy metals- metalloids- organic – Inorganic – Biological and Radio active-Types of reactions in various water bodies including marine environment- Eutrophication- Ground water- Potable water standards.Treatment for portable water.

Air: Chemical reactions in the atmosphere – Aerosols types- Production and distribution – Aerosols and Radiation – structure and composition of atmosphere- temperature inversion – Global warning- Ozone depletion – Green house effect, “CFC”s- Acid rain.

UNIT IV: SOIL POLLUTION **15Hrs**

Introduction – soil pollution by industrial wastes. soil pollution by urban wastes, Radio active pollutants and Agricultural waste- chemical and metallic pollutants-Biological agents – mining - Detrimental effects of soil pollutants – Effects of industrial pollutants- Effects of sewage and domestic wastes- Effects of heavy metals- Effects of radio active pollutants- Effects of modern agro- technology – Diseases caused by soil pollution – solid waste management – sources and classification -public Health Aspects – methods of collection- Disposal methods – potential methods of disposal.

Books Suggested:

1. Daniel D.Chiras (1994), Environmental Science, 4th Ed.
2. Environmental Chemistry by W. Moore and J.Moore
3. Environmental chemistry by J.O.M. Bockariss
4. Environm,ental by BK SHArma
5. Environmental chemistry by SS Dara
6. Environmental chemistry by Mahajan
7. Environmental chemistry by a.K.De

CC 303- CORE COURSE 9(A): INSTRUMENTAL METHODS OF ANALYSIS

UNIT –I SPECTROSCOPIC METHODS-I 15 Hrs

Emission Spectroscopy:

(i) ICP-AES: Principles, instrumentation, AES detectors, applications in the analysis of trace and toxic metals in water, geological and industrial samples.

(ii) ICP-MS: Principles, instrumentation, quadrupole mass spectrometers, applications

UNIT –I SPECTROSCOPIC METHODS-II 15 Hrs

Fluorescence Spectroscopy:

i) Molecular Fluorescence Spectroscopy: Principle, Theory of fluorescence, phosphorescence, relation between intensity of fluorescence and concentration, Correlation of fluorescence with molecular structure, Fluorescence quenching, Instrumentation and applications.

ii) X-ray Fluorescence Spectroscopy: Principle, energy dispersive X-ray fluorescence (EDXRF), Wavelength dispersive X-ray fluorescence (WDXRF), applications.

UNIT – II: CHROMATOGRAPHIC METHODS 15 Hrs

High Performance Liquid Chromatography (HPLC): Principles, Stationary phases, Instrumentation, Solvent delivery system, sample introduction, gradient elution, columns and detectors.Partition Chromatography, adsorption chromatography, Gel permeation chromatography.

Capillary Electrophoresis: Principle, Electroosmotic flow, Instrumentation, Applications to separation of small ions, separation of Molecular Species, DNA sequencing

Supercritical-fluid chromatography: Supercritical-fluids, Instrumentation and Applications

UNIT –III: HYPHENATED TECHNIQUES 15 Hrs

Mass Spectroscopy: Principle, basic instrumentation, resolution, Ionization sources- Electron impact and Chemical ionization, Mass Analyzers- Quadrupole Mass analyzer and Time- of- Flight Analyzer.

Gas Chromatography- Mass spectrometry: Introduction, GC – MS interface, processing of GC – MS data – ion chromatogram. Quantitative measurement – sample preparation, Selected ion monitoring – Application of GC-MS for Trace constituents. Drugs analysis, Environmental analysis and others.

Liquid chromatography- Mass spectrometry – Introduction – Instrumentation – liquid chromatography – Mass spectrometer Interface – Instrumental details – Processing LC-MS data – ion chromatograms, Sample preparation – selected ion monitoring. Application of LC-MS for Drug analysis, Environmental samples and others.

Books Suggested

1. Analytical Chemistry, Gary D. Christian, John Laliley and Senes, New York, 6th Ed., 2007.
2. Fundamentals of ANALYTICAL CHEMISTRY, Skoog, West, Holler; 7th Editin 2001
3. Analytical Chemistry Principles and Techniques, I.G. Harge, Prentice Hall.
4. Principles of Instrumental analysis, D.A. Skoog and J.L. Loacy, W.B. Saunders.
5. Handbook of Instrumental Techniques for Analytical Chemistry, F. Serlie, Prentice Hall.
6. Vogels Text book of Quantitative Chemical Analysis, Basett, Denny Jebbary, 5th Ed. ELBs 1990.
7. Instrumental Methods of Chemical Analysis, Willard Merrit, Dean, Stella Jr 6th Edition.
8. P.W Scott, Techniques and practice of Chromatography, Marel Dekker Inc., New York
9. Separation methods, M.N Sastri, Himalaya Publishing Company, Mumbai
10. E. Helfman, Chromatography, Van Nostrand, Reinhold, New York
11. E. Lederer and M. Lederer, Chromatography, Elsevier, Amsterdam.

S.V. UNIVERSITY, TIRUPATI :: SVU COLLEGE OF SCIENCES
M.Sc. CHEMISTRY
NEP – 2020 under CBCS (Effective from Academic year 2024-2025)
THIRD SEMESTER(INORGANIC CHEMISTRY)
CC 303- CORE COURSE 9(B): POLLUTION AND CONTROL METHODS

UNIT-I: WATER POLLUTION **15 Hrs**

Basic aspects of water-general principles of water(physical and chemical)-criteria of water quality.Types of water pollutants: sewage and domestic wastes-industrial wastes-agriculture discharges- toxic metals-oxygen demanding wastes-disease causing agents-oils- detergents and phosphates. Sampling: Basics of Sampling, sampling procedure, statistics, sampling and physical state, crushing and grinding, hazards waste of sampling, pre-concentration methods

UNIT-II: TREATMENT OF WASTE WATER **15 Hrs**

Basic process of water treatment- primary treatment pretreatment – sedimentation – Flotation-secondary (Biological) Treatment – Active sludge process – Trickling filters – sludge Treatment and disposal – Advanced waste water Treatment – Removal of suspended solids – Removal of dissolved solids – Nitrogen removal – phosphorous removal – Advanced Biological systems – chemical oxidation .

UNIT III: BIOTECHNOLOGY AND ITS APPLICATION IN ENVIRONMENTAL PROTECTION **15 Hrs**

Introduction- Bio-informatics- Bio-Technology and pollution control,-Bioremediation-Biological de-odourisation- Biological purification of contaminated air-microorganisms and energy of mankind-use of microorganisms role in petroleum augmentation and recovery.

UNIT IV: ENVIRONMENTAL MANAGEMENT AND IMPORTANT ENVIRONMENTAL LAWS **15 Hrs**

Environmental Management: Introduction-objectives-components-environmental impact assessment (EIA)-historical background-elements of EIA process-participants in EIA processes-contents of EIS-design of EIA.

Important Environmental Laws: the world life act-the forest conservation act-the water and control pollution act-air prevention& control act—the environment act-environmental quality management standard-ISO 14000 series.

Books Suggested

1. Environmental Chemistry by W. Moore and J.Moore
2. Environmental chemistry by J.O.M. Bokriss
3. Environmental by BK Sharma
4. Environmental chemistry by SS Dara
5. Environmental chemistry by Mahajan
6. Environmental chemistry by a.K.De
7. Lodge (1994) Methods of air sampling and analysis.Publications, Jaipur
8. Kudesia, V.P. (1985) Water Pollution, Pragati Prakashan
9. Elements of biotechnology by PK Gupta and Rastogi

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THIRD SEMESTER(INORGANIC CHEMISTRY)
P 304: Practical V (related to CC 302 & CC 303)

CC 302- CORE COURSE 8(A) PRACTICALS: CO-ORDINATION COMPOUNDS, ORGANOMETALLIC CHEMISTRY AND CHEMISTRY OF NON-TRANSITION ELEMENTS

Preparation of Inorganic complexes and characterization:

1. Tetrammine Copper (II) Sulphate
2. Tris Thiourea Zinc (II) Sulphate
3. Tris Thiourea Copper(I) Sulphate
4. Hexamine Nickel (II) Chloride
5. Chloropentamanine Cobalt (III) Chloride
6. Cis Potassium Diaquodioxalato Chromate (III)
7. Tris (acetylacetonato) Manganese (III)
8. Sodium Trioxalato Ferrate (III)
9. Potassium Hexathiocyanato Chromate (III) Tetrahydrate

CC 303- CORE COURSE 9(A) PRACTICALS: INSTRUMENTAL METHODS OF ANALYSIS

1. Separation of Metal ion by Solvent Extraction /Ion exchange.
2. Determination of Pesticide residues by gas chromatographic method
3. Atomic Absorption Spectroscopy: Determination of transition metal ions (Cd, Cr, Cu, Pb, Zn etc.) by AAS.

THIRD SEMESTER(INORGANIC CHEMISTRY)

SOC 305-SKILL ORIENTED COURSE 5(A): FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

UNIT-I: ULTRAVIOLET AND VISIBLE SPECTROSCOPY: 15Hrs

Various electronic transitions (185-800 nm), effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fisher-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

UNIT-II: INFRARED SPECTROSCOPY 15Hrs

Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, 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

UNIT-III: ^{1}H NMR & ^{13}C NMR SPECTROSCOPY 15Hrs

^{1}H NMR: Magnetic properties of nuclei, Principles of NMR. Instrumentation, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin-spin coupling: vicinal, germinal and long range, Coupling constants and factors affecting coupling constants.

^{13}C NMR: General considerations, chemical shift (aliphatic, olefinic, alkyne, carbonyl carbon aromatic and heteroaromatic), coupling constants. Two dimensional NMR spectroscopy-HOMO COSY & HETERO COSY.

UNIT-IV: MASS SPECTROMETRY 15Hrs

Introduction, ion production, type of ionization, EI, CI, FD, and FAB-factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak, Mc. Lafferty rearrangement. Nitrogen rule, isotope labeling. High resolution mass spectrometry, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Books suggested:

1. Organic spectroscopy, W. Kemp 5th Ed, ELBS
2. Spectroscopy of organic compounds, RM Silversteen and others, 5th Ed,John Wiley
3. Spectroscopy of organic compounds, P.S. Kalsi, Wiley, 1993.
4. NMR in chemistry-A multi nuclear introduction, William Kemp, Mc Millan, 1986.
5. Spectroscopic methods in Organic chemistry, DH Williams & I Flemmi,

THIRD SEMESTER(INORGANIC CHEMISTRY)

SOC 305- SKILL ORIENTED COURSE 5(B): BIOINORGANIC, BIOORGANIC, BIOPHYSICAL CHEMISTRY

UNIT-I: BIO-INORGANIC CHEMISTRY- I 15 Hrs

Metal complexes as oxygen carriers – Heme proteins – Hemoglobin and myoglobin – Non heme proteins – hemerythrin and hemocyanin – model synthetic complexes of iron, cobalt and copper.Co-enzymes Vitamin B_{12},carboxy peptidase and superoxidedismutase.

Electron Transfer in Biology: Structure and functions of metalloproteins in electron transfer processes – catalase – peroxidose – cytochromes and iron – sulphur proteins – synthetic models. **UNIT – II: BIOINORGANIC CHEMISTRY- II 15 Hrs**

Metal ion transport and storage in biological systems**,** Metal ions in Biology, Molecular mechanism of ion transport across membranes: ionophores, photosynthesis.

Hydrolytic metalloenzymes: Carbonic anyhdrase, carboxy peptidase, calcium in control processes, calcium and muscle contraction, calcium and secretion, calcium in blood clotting mechanisms. Therapeutic uses of enzymes.

Importance of trace metals in biology: Metal ions as chelating agents in medicine, trace metal ions and metal and non-metal deficiency. Biological nitrogen fixation, in-vivo and in-vitro nitrogen fixation.

UNIT-III: BIOORGANIC CHEMISTRY 15 Hrs

Carbohydrates: Structure and biological functions of mucopolysaccharides, glycoproteins, and glycolipids- Role of sugars in biological recognition- Blood group substances

Lipids: Essential fatty acids-structure and function of triglycerols, Glycerophospholipids, cholesterol, bile acids prostaglandins- composition and functioning of lipoproteins

Enzymes: Nomenclature and classification, properties, factors affecting enzyme catalysis, enzyme inhibition- reversible and irreversible inhibition. Uses of enzymes in food drink industry and clinical laboratories.

UNIT-IV: BIOPHYSICAL CHEMISTRY 15 Hrs

Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, calculation of average dimensions. Membrane equilibrium, ion transport through cell membrane.dialosis and its function. Structure and functions of proteins, enzymes, DNA and RNA in living systems, forces involved in bio polymer interactions, electrostatic forces, hydrophobic forces, molecular expansion, and dispersion forces.

Books Suggested

1. M.N. Hughes, The Inorganic chemistry of Biological Processes, John wiley and Sons, New York 2nd Edition, 1981.
2. A Text book of Biochemistry , A.V.S.S.Rama Rao
3. Physical chemistry by Atkenes
4. Physical chemistry by Albertz.
5. Bio physical chemistry by Van Holde
6. Bio Physics by Narayanam
7. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
8. Chemistry of Natural Products, P.S.Kalsi, Kalyani Publishers.
9. Chemistry of Organic Natural Products, O. P. Agarwal, Vols., 1 & 2, Geol Pubs.
10. Natural products Chemistry K.B.G. Torssell, John Wiley, 1983.
11. Burger's Medicinal Chemistry, M.E. Wolff, John Wiley
12. Medicinal Chemistry, A. Kar, New Age International

SOC 306- SKILL ORIENTED COURSE 6(A): X- RAY DIFFRACTION , KINETICS IN SOLUTIONS, ELECTROANALYTICAL CHEMISTRY

UNIT-I POWDER X-RAY DIFFRACTION **15 Hrs**

Powder x-ray diffraction, indexing the powder XRD patterns, Systematic absences, Structure factor, determination of lattice type, unit cell parameter and density for α-Po, fcc, bcc and hcp metals, NaCl, ZnS, diamond, CuZn, CuAu, $AuCu_3$ and other simple compounds. Neutron diffraction.

UNIT-II REACTIONS IN SOLUTIONS **15 Hrs**

Linear Free Energy relationships, Theory of absolute reaction rates, Influence of Internal pressure, Influence of Solvation, Influence of Ionic strength, The Taft- Equation, Polymerisation Reactions (Molecular mechanism, Free radical Mechanism] Emulsion Polymerisation reactions.

UNIT III: ION SELECTIVE ELECTRODES **15 Hrs**

Ion-sensitive electrodes –types of ion sensitive electrodes –metal based cation and anion sensitive electrodes, solid membrane electrodes. Liquid ion-exchange electrodes, gas sensing membrane electrodes.

UNIT IV: TYPES AND CLASSIFICATION OF ELECTRO ANALYTICAL METHODS **15 HRS**

i) Potentiometry – Types of electrodes, Hydrogen gas, Calomel, Quin hydrone and glass electrodes. Determination of pH. Potentiometric titrations.

ii) Conductometry – Definition of terms – conductivity, specific conductivity, cell constant. Mobility of ions, Conductometric titrations.

Books suggested:

1. R. West, Solid State Chemistry and its Applications, John Wiley & Sons, 1984. (Reprint Edition)
2. L. E. Smart and E. A. Moore, Solid State Chemistry - An Introduction, 4th Edition, CRC Press, 2012.
3. H. V. Keer, Principles of the Solid State, 2nd Edition, New Age International, 2017.
4. M. Weller, T. Overton, J. Rourke and F. Armstrong, Inorganic Chemistry, 6th Edition, Oxford University Press, 2014. (South Asia Edition 2015)

SOC 306- SKILL ORIENTED COURSE 6(B): INORGANIC MATERIALS FOR ELECTRONIC INDUSTRY

Unit-I MATERIALS FOR SOLAR CELLS **15 Hrs**

Introduction to solar cells, types of solar cells, functions of Si, CdTe, copper indium gallium diselenide (CIGS) as materials for solar cells.

UNIT-II PIEZOELECTRIC MATERIALS **15 Hrs**

Principle of piezoelectricity, materials involved in piezoelectric ceramics, perovskyte piezoelectric ceramics, piezoelectric sensors, piezoelectric actuators, piezoelectric piezoelectric polymers.

UNIT-III INORGANIC PHOSPHORS AND LASERS **15 Hrs**

Definition, types of inorganic phosphors, phosphor function in light emitting diodes, chemical composition and structure of inorganic lasers. Applications of inorganic phosphors and lasers.

UNIT-IV QUANTUM DOT LEDS (QD-LEDS) **15 Hrs**

Definition, types of QD-LEDs, structure, mechanism, materials used in QD-LEDs, applications in biomedical imaging, cancer diagnosis and treatment environmental remediation.

Books suggested:

1. Industrial Chemistry by B.K.Sharma, Goel Publishing House, Meerut, 11th Edition, 2000.
2. Electrochemistry by G.Milazo, Elseview Publishing Company.
3. Environmental Chemistry by S.C.Bhatia, CBS Publisheres, New Delhi,1st Edition, 2002.
4. Theoretical Basis of Inorganic Chemistry by A.K. Barnard, Tata McGraw-Hill Publishing Company Ltd.
5. Advanced Inorganic Chemistry by Cotton and Wilkinson, 5th Edition.
6. Inorganic Polymers, J.E. Mark, H.R. Allock and R. West, Prentice Hall 1992.

P 307: Practical VI (related to SOC 305 & SOC 306)

SOC 305- SKILL ORIENTED COURSE 5(A) PRACTICAL: FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

Spectral analysis

1. Propose the structures for compounds that fit the given spectral data and assign the spectral values.
2. Extract data from the given spectra and elucidate the structure from the obtained data with appropriate discussion.

SOC 306- SKILL ORIENTED COURSE 6 (A) PRACTICALS: X- RAY DIFFRACTION, KINETICS IN SOLUTIONS, ELECTROANALYTICAL CHEMISTRY

1. **Chemical Kinetics:**
   Study of the kinetics of halogenations of acetone.
   Determination of activation energy of reaction between iodide and Persulphate
   Determination rate constant of oxidation of iodide ion by persulphate ion and study the effect of neutral salt (KCl).
2. **Estimation of Metals by Flamephotometry**
3. **Estimation of Metals by Colorimetry**

4. **Polarography:**

    a. Determination of $E_{1/2}$ of Zn and Cd

    b. Determination of Zn and Cd in mixture

    c. Amperometric titration

5. Determination of density of liquid mixtures by using densitometer.
6. Study of the kinetics of halogenations of acetone.
7. X-ray powder diffraction analysis of cubic compound.
8. Determination of lattice constants, Partical Size and geometry.

CC 301- CORE COURSE 7: ORGANIC SYNTHESIS-I

UNIT-I: CHEMISTRY OF ORGANO BORAN, PHOPHORUS, SULFUR AND SILICON REAGENTS **15Hrs**

Electronic structure and bonding in Boron, Phosphorus, Sulphur and Silicon compounds-Their reactivity and applications in Organic Synthesis.

Boron Reagents-Hydroboration-Organoboranes in the formation of C-C bonds, alcohols, amines, halogen and carbonyl compounds-Free radical reactions of organoboranes.

Phosphorus Reagents- Formation of carbon-carbon double bonds-Functional group transformations – deoxygenation reactions-reactivity as electrophiles- conversion of alcohols to alkyl halides, Witting reaction and nucleophiles - Corey-Winters reaction, Michaelis-Arbusov reaction-Perkow reaction and Mitsnobu reaction.

Sulphur Reagents- Sulphur ylides, stabilized and non-stabilized – Preparation and reactivity-Pummerer reaction – sulphonyl carbanions-Julia reaction

Silicon reagents-Peterson's olefination, influence of trialkyl silyl reagents in electrophilic reactions, aryl silanes, alkenyl silanes, alkynyl silanes, allyl silanes.

UNIT-II: PHOTOCHEMISTRY **15Hrs**

Photochemical energy, photochemical excitations, Franck-Condon principle, electronic transitions, Jablonski diagram, singlet and triplet states, energy transfer in photochemical reactions - photosensitization reactions and quantum yield.

Photochemistry of carbonyl compounds - Norrish Type-I and Norrish Type-II reactions, Photo Reduction and Paterno-Buchi reaction. Photochemistry of α,β-unsaturated ketones, enones, dienones and p-benzoquinones.

Photochemistry of unsaturated systems (olefins), cis-trans isomerization and dimerization reactions, Photochemistry of conjugated dienes - 1,3-butadiene, aromatic compounds, Photoaddition (1,2- & 1,4- additions) and Photosubstitution reactions of benzene derivatives. Photo-Fries rearrangement and Barton reaction.

UNIT III: PERICYCLIC REACTIONS **15 Hrs**

Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3 butadiene, 1,3,5-hexatriene and allyl and pentadienyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO (Mobius Huckel) approach. Electrocyclic reactions-Conrotatory and disrotatory. 4n, 4n+2 and allyl systems. Cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketene, 1,3- dipolar cycloadditions and cheleotropic reactions.

Sigmatropic rearrangements - Suprafacial and antarafacial shifts of H, Sigmatropic shifts involving carbon moieties, 3,3- and 5,5- Sigmatropic rearrangements. Claisen, Cope and Oxy-Cope rearrangements. Ene reaction

UNIT-IV: GREEN CHEMISTRY **15Hrs**

Concept of green chemistry, constituent principles of green chemistry, green synthetic methods – **Organic reactions in aqueous media:** advantages and applications in pinacol coupling, Mukaiyama-aldol reaction, and Trost-Tsuji reaction; **Ionic liquids in organic synthesis:** introduction, composition, and application in stereoselective halogenation, Friedel-Craft reaction and Hydroformylation; **Microwave assisted reactions:** principle, conditions, advantages over conventional heating, and application in Fischer-indole synthesis, Paal-Knorr pyrrole synthesis, Baylis-Hillman and Benzil-Benzilic acid rearrangement; **Phase transfer catalysis:** introduction, types of phase transfer catalysts, mechanism of catalytic action, and application in benzoin condensation, Wittig, Wittig-Horner and Michael addition reactions; **Ultrasound assisted synthesis:** introduction, advantages, applications in the synthesis of Diels-Alder, hydroboration and Reformatsky reactions. **Bio-transformations** : Enzyme catalyzed reactions.

Books Suggested:

1. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, John Wiley.
2. Advanced Organic Chemistry, F.A. Carey and R.J Sundberg, Plenum.
3. Structure and Mechanism in Organic Chemistry C.K. Inglod, Cornell University Press.
4. Organic Chemistry, R.T Morrison and R.N. Boyd, Prentice - Hall.
5. Modern Organic Reactions, H.O. House, Benjamin.
6. Principles of Organic Synthesis, R.O.C Norman and J. M. Coxon, Blackie Academic.
7. Stereochemistry, P.S. Kalsi, Wiley Eastern.
8. Text book of Organic Chemistry, M.C. Murry
9. Text book of Organic Chemistry, Fessendon and Fessendon.
10. Text book of Organic Chemistry, T.W. Solomon,
11. Organic Chemistry, Vol II, I.L. Finar, ELBS Eds.
12. Heterocyclic chemistry T.L Gilchrist, Longman Scientific Technical
13. An Introduction to the Heterocyclic compounds, R M Acheson, John Wiley.

CC 302- CORE COURSE COURSE 8(A): ORGANICSYNTHESIS-II

UNIT-I: DESIGNING OF ORGANIC SYNTHESIS-I **15 Hrs**

Disconnection Approach- Classification of organic reactions. Functionalisation and interconversion of functional groups, formation of carbon-carbon single and double bonds, general strategy, disconnection and synthon approach, retrosynthetic analysis, key intermediates and starting materials in designing a synthesis, linear and convergent synthesis, reconnections. The importance of the order of events in organic synthesis, **Protecting Groups**- Principles of protection of alcohol, amine, carbonyl and carboxyl groups. One group C-X and two group C-X disconnections, chemoselectivity, regioselectivity, reversal of polarity, cyclization reactions, amine synthesis.

UNIT-II: DESIGNING OF ORGANIC SYNTHESIS-II **15 Hrs**

One Group C-C Disconnections- Alcohols and carbonyl compounds, Alkene synthesis, use of acetylenic compounds in organic synthesis.

Two Group C-C Disconnections-Diels-Alder reaction, 1,3-difunctionalised compounds, unsaturated carbonyl compounds, control in carbonyl condensations, 1,5-difunctionalised compounds, Michael addition and Robinson annulation.

Retrosynthesis- Retrosynthetic analysis of Longifolene, Taxol, Juvabione and Fredericamycin A.

UNIT-III: ORGANOMETALLIC REAGENTS **15 Hrs**

Synthesis and applications of Grignard reagents, Organolithium, Zinc, Copper, Mercury, Palladium and Rhodium compounds in Organic Synthesis, Homogeneous catalytic hydrogenation and Hydroformylation reactions.

UNIT-IV: METHODS IN ORGANIC SYNTHESIS **15 Hrs**

Enamines: introduction, generation, Stork enamine reaction, applications of enamines in organic synthesis; **Multi Component Reactions (MCR):** introduction, Strecker synthesis, Ugi reaction, Mannich reaction, Biginelli reaction, and Hantzsch synthesis; **Tandem synthesis:** definition, advantages, polyene cationic cyclizations, conjugate addition - Aldol reaction, Mannich-cation olefin cyclization, Knoevenagal, hetero-Diels-Alder reaction. **Electro-organic synthesis:** introduction, anodic oxidation, cathodic reduction and cross coupling reactions.

Books Suggested:

1. Designing of Organic Synthesis. S. Warren, Wiley.
2. Organic synthesis – Concept, Methods and starting materials, J, Fuhrhop and G. Perzillin, Verlage VCH.
3. Modern Synthetic Reactions, H.O.House, W.A Benjamin.
4. Some Modern Methods of Organic Synthesis, W.Carruthers, Cambridge University Press.
5. Advanced Organic Chemistry, F.A.Carey and R.J Sundberg, Plenum.
6. Advanced Organic Chemistry, Reactions Mechanisms and Structure J. March, JohnWiley.
7. Principles of Organic Synthesis, R.O.C. Norman and J.M Coxon, Blackie
8. Advanced Organic Chemistry Part A & B, F.A Carey and R.J Sunderg, Plenum Press.
9. Reaction Mechanism in Organic Chemistry, P.S.Kalsi, New Age International.
10. Text book of organic chemistry Vol.2, I.L. Finar, ELBS.
11. New Trends in Green Chemistry by V.K.Ahluwalia, M.Kidwai.
12. Green Solvents for Organic Synthesis by V.K. Ahluwalia, Rajender S.Varma
13. Stereochemistry to Organic Compounds, E.L. Eliel and others, John Wiley.
14. Stereochemistry to Organic Compounds, D. Nasipuri, New Age International.

15. Stereochemistry, P.S. Kalsi, Wiley Eastern.

CC 302- CORE COURSE COURSE 8(B): ORGANIC REAGENTS IN QUALITY CONTROL AND ANLAYSIS

UNIT-I: ORGANIC REAGENTS IN INORGANIC ANALYSIS 15 Hrs

Theoretical basis for the use of organic reagents in inorganic analysis: Application of the following reagents in inorganic analysis: dimethylglyoxime, salicylaldehyde, cupferron, d-benzoin, 1,10 phenanthroline, 8-hydroxy quinoline, nitron, tannin, pyridine, 8-hydroxy quinoldine, dithizone, Acetylacetone, theonyl, trifluoroacetone, 8-hydroxy quinoline, tri-M-octylphosphine oxide.

UNIT-II: QUALITY CONTROL IN ANALYTICAL CHEMISTRY 15 Hrs

Definition of analytical terms: Accuracy, precision, limit of detection, sensitivity, selectivity and specificity, ruggedness, principles of Ruggedness test, validating the Method as a Standard Method.

Quality assurance and management systems: Elements of quality assurance, Quality and quantity management system,. ISO 9000 and ISO 14000 series.

Good laboratory practices (GLP): Elements of Good Laboratory Practice, Laboratory accreditation, GLP status in India.

UNIT – III: KINETIC METHODS OF TRACE ANALYASIS 15 Hrs

Rate laws, Analytical use of reaction rates, First and second order reactions, relative rate of reactions. Determination of reaction rates. Analytical utility of first and pseudo first order reactions. Types of kinetic methods, differential, integral, logarithmic, extrapolation method. Evaluation of kinetic methods – Scale of Operation, Catalyzed reactions, measurement method for catalyzed reaction. Micro determination of Inorganic species like Iodine and Hg in complex materials. Determination of organic species. Kinetics of enzyme, catalyzed reactions. Michael's constant factors affecting the rate of enzyme, Catalyzed reactions, Enzyme characteristics and applications of Kinetic methods of trace analysis**.**

UNIT-IV:REDOX AND COMPLEXOMETRIC TITRATIONS: 15Hrs

Redox Titrations: Standard reduction potential, equilibrium constants of oxidation-reduction reactions, change of electrode potential during the titration of reductant with an oxidant. Formal potential primary standard substance. Standard solutions. Preparation and storage. Oxidations with cerium (IV) sulphate solutions. Theory and use of (i) acid-base, (ii) Oxidation-reduction **(iii)** Metal ion indicators.

Complexometric titrations: Introduction, complexones, stability constants of EDTA complexes, conditional stability constants, titration curves, types of EDTA titration's, titration of mixtures.

Books Suggested

1. Vogel's Text book of Quantitative Chemical Analysis, Basselt, Denmy, Jaffery and Merdhan, ELBS, Orientlong- Manan, 5th Ed.1990.
2. Analytical Chemistry, Gary D. Christian, John Laliley and Senes, New York, 6th Ed., 2007.
3. Fundamentals of ANALYTICAL CHEMISTRY, Skoog, West, Holler; 7th Editin 2001
4. Fundamentals of Analytical Chemistry, D.A. Skoog & D.M. West, Holf-Saunderrs, 5th Ed., 1991.
5. Principles and Methods Chemical Analysis: H.F. Walton, Prentice Hall, New Delhi.

6. Chemical Analysis, H.A. Laitinan, Mc.Graw Hill Book Company.
7. Technical methods of analysis – Griffin, Mc Graw Hill Book Co.
8. K.V.S.G Murali Krishna, An Introduction ISO 9000, ISO 1400 Series,
9. Environmental Management Quality Assurance and Good Laboratory Practices, Prof. Y. Anjaneyulu, In Now Publication, New York
10. Quality Assurance in Analytical Chemistry – G.Kateman and F.W Pijpers, John Wiley and Sons, New York

CC 303- CORE COURSE COURSE 9(A): INORGANIC SPECTROSCOPY & THERMAL METHODS OF ANALYSIS

UNIT-I: THERMAL METHODS OF ANALYSIS 15 Hrs

Thermo garaviemetry – Principle, Factors affecting the results, instrumentation. Application with special reference to $CuSO_45H_2O$, $CaC_2O_4\ 2H_2O$. Different thermal analysis – principle, instrumentation, difference between TG and DTA, applications with special reference to the clays and minerals. Different scanning calorimetry – principle, and applications to inorganic materials like chlorates and perchlorates, ammonium nitrate.

UNIT-II: MOSSBAUER SPECTROSCOPY AND NQR 15 Hrs

Mossbauer spectroscopy: Basic principles, Recoil energy, Doppler shift, Chemical shift, Quadrapoleeffects, Magnetic effects. Instrumentation, spectral parameters and spectrum display. Aapplication of the technique to the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds, (2) Sn^{2+} and Sn^{4+} compounds.

NQR spectroscopy: Basic principles of NQR spectroscopy, quadrupole nuclei, quadrupole moments,electric field gradient, coupling constant and applications.

UNIT-III: ELECTRON SPIN RESONANCE SPECTROSCOPY 15 Hrs

ESR: Basic Principles, Hyper fine splitting, Factors affecting the 'g' value. Isotropic and anisotropic hyperfinecoupling constants, Hamiltonian and spin densities. Zero field splitting and Kramer's degeneracy,Relaxation process and line widths. Instrumentation and Applications.The EPR spectrum of bis(salicylidimine)-copper(II) complex, study of inorganic free radicals, biological applications of Electron Spin Resonance (Study of free radicals and Iron-sulfur proteins)

UNIT-IV: PHOTOELECTRON SPECTROSCOPY 15 Hrs

Photoelectric effect, Koopmans's theorem, ionization energy.

X-ray photoelectron spectroscopy (ESCA): Principle, Binding energies, Chemical shift, Applications of XPES to Qualitative analysis, to surface studies and structural analysis. Ultraviolet photoelectron spectroscopy- Principle, application of UPES in studying the molecular orbitals of O_2 and N_2 molecules. Block diagram of photoelectron spectrophotometer. Sources of radiation, detectors. Auger spectra – Principle, Applications of Auger spectra to surface studies and use of Auger spectra as a finger print tool.

Books suggested:

1.F.A. Cotton and G. Wilkinson, Advanced In-organic chemistry VI Edition, 1999. John wiley &sons. Inc., New York.

2.J.E. Huheey, E.A. Keiter and R.L. Keiter: Inorganic Chemsitry, Principles of Structure andReactivity (4^{th} Ed.) (Addison-Wesley)

3.Gary Wulfsberg: Inorganic Chemistry (5^{th} Ed. Viva Books)

4.J.D. Lee: Concise Inorganic Chemistry (Blackwell)

5.W.L. Jolly: Modern Inorganic Chemsitry (McGraw-Hill)

CC 303- CORE COURSE COURSE 9(B): GROUP THEORY AND POLYMER CHEMISTRY

UNIT-I: APPLICATION OF GROUP THEORY 15 Hrs

Mulikan Character tables, Determination of Character Coordinate of C_{2V} point group based on $_{3N}$ Coordinates. Standard reduction formula, Determination of normal modes of vibrations of SO_2, NH_3, $POCl_3$, $PtCl_4^{2-}$,molecules. Mutual exclusion Principle, Direct Product, Accidental Degeneracy and Fermi resonance. **Group Theory and Spectroscopy:** selection rules, symmetry Criteria for optical activity, symmetry restrictions on dipole moments, symmetry and stereo isomerism.

UNIT-II: POLYMER CHEMISTRY 15 Hrs

Monomers; repeat units; degree of polymerization; linear, branched and network polymers; classification of polymers. Polymerization Methods: Condensation, addition, radical chain, ionic and coordination, copolymerization Thermodynamics of polymer dissolution, effect of molecular weight on solubility, solubility of crystalline and amorphous polymer, heat of dissolution. Molecular weight determination by Viscosity, light scattering, ultra centrifugation and sedimentation equilibrium method.

UNIT-III: THERMODYNAMICS-III: 15 Hrs

Thermodynamic Properties of Liquid Mixtures: Activity and activity coefficients-excess free energy-excess enthalpy-excess volume-excess entropy-relation between excess functions and activity coefficients –Application of Gibbs-Deuhem equation-regular solutions –van Laar theory and Scachard-Hildebrand theory.

Phase rule: Three component liquid systems – formation of one pair, two pairs and three pairs of partially miscible liquids; two salts and water – no chemical combination, double salt formation, one salt forms hydrate and two salts form hydrates.

UNIT-IV: SPECTROSCOPHY 15 Hrs

Microwave spectroscopy: Classification of molecules, rigid rotator model, effect of isotopic substitution on the transition frequencies, intensities- stark effect.

Vibrational spectroscopy: Linear harmonic oscillator, zero point energy, anharmonity, Mores potential energy diagram, fundamental and overtone transitions, hot bands and combinations bands. Vibration-rotation spectroscopy, PQR branches, selection rules, factors affecting the band positions and intensities for IR region.

Raman spectroscopy: Classical and quantum theories of Raman effect, Pure rotational, Vibrational Raman spectroscopy, Vibrational- Rotational Raman spectroscopy, Selection rules, Mutual Exclusion Principle.

Books Suggested

1. Physical methods in Chemistry, R. S. Drago (Saunders College).
2. Advanced Physical Chemistry by GurudeepRaj, Goel Publishers House, Meerut.
3. Essentials of Nuclear Chemistry, 4th Ed., 1995, H. J. Harnikar (Weily Eastern)
4. Text Book of Polymer Science, F. W. Billmeyer, Jr. (Wiley Inter Science)
5. Polymer Sciences by V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar.
6. Jack Simons. An Introduction to theoretical chemistry. The press Syndicate of the University of Cambridge.
7. D.N. Bajpai: Advanced physical Chemistry: S. Chand & Company, 1998.
8. Silbey, Alberty, Bawendi. Physical Chemistry.Jhon-Wiley & Sons. 4th edition-2006.
9. Maron and prutton: principles of physical Chemistry.

THIRD SEMESTER(ORGANIC CHEMISTRY)

P 304: Practical V (related to CC 302& CC 303)

CC 302- CORE COURSE 8(A) PRACTICALS: ORGANICSYNTHESIS-II

Organic Estimations

1. Estimation of Glucose
2. Estimation of Phenol
3. Estimation of percentage purity of Aspirin

CC 303- CORE COURSE 9(A) PRACTICALS: INORGANIC SPECTROSCOPY & THERMAL METHODS OF ANALYSIS

1. Estimation of Ferrous ion by using 1, 10-phenanthroline.
2. Determination of the amount of Iron by Photometric titration method.

THIRD SEMESTER(ORGANIC CHEMISTRY)

SOC 305- SKILL ORIENTED COURSE 5(A): FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

UNIT-I: ULTRAVIOLET AND VISIBLE SPECTROSCOPY: 15Hrs

Instrumentation- Beer-Lamberts Law-Various electronic transitions (185-800 nm), effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fisher-Woodward rules for conjugated dienes and α,β- unsaturated carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

UNIT-II: INFRARED SPECTROSCOPY 15Hrs

Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, 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

UNIT-III: ^{1}H NMR & ^{13}C NMR SPECTROSCOPY 15Hrs

^{1}H NMR: Magnetic properties of nuclei, Principles of NMR. Instrumentation, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin-spin coupling: vicinal, geminal and long range. Coupling constants and factors affecting coupling constants.

^{13}C NMR: General considerations, chemical shift (aliphatic, olefinic, alkyne, carbonyl carbon aromatic and heteroaromatic), coupling constants. Two dimensional NMR spectroscopy-HOMO COSY & HETERO COSY.

UNIT-IV: MASS SPECTROMETRY 15Hrs

Introduction, ion production, type of ionization, EI, CI, FD, and FAB-factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak, Mc. Lafferty rearrangement. Nitrogen rule, ortho effect, isotope labeling. High resolution mass spectrometry, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Books suggested:

1. Organic spectroscopy, W. Kemp 5th Ed, ELBS
2. Spectroscopy of organic compounds, RM Silversteen and others, 5th Ed,John Wiley
3. Spectroscopy of organic compounds, P.S. Kalsi, Wiley, 1993.
4. NMR in chemistry-A multi nuclear introduction, William Kemp, Mc Millan, 1986.
5. Spectroscopic methods in Organic chemistry, DH Williams & I Flemmi,

THIRD SEMESTER(ORGANIC CHEMISTRY)

SOC 305- SKILL ORIENTED COURSE 5(B): BIOINORGANIC, BIOORGANIC, BIOPHYSICAL CHEMISTRY

UNIT-I: BIO-INORGANIC CHEMISTRY- I **15 Hrs**

Metal complexes as oxygen carriers – Heme proteins – Hemoglobin and myoglobin – Non heme proteins – hemerythrin and hemocyanin – model synthetic complexes of iron, cobalt and copper.Co-enzymes Vitamin B_{12},carboxy peptidase and superoxidedismutase.

Electron Transfer in Biology: Structure and functions of metalloproteins in electron transfer processes – catalase – peroxidose – cytochromes and iron – sulphur proteins – synthetic models.

UNIT – II: BIOINORGANIC CHEMISTRY- II **15 Hrs**

Metal ion transport and storage in biological systems, Metal ions in Biology, Molecular mechanism of ion transport across membranes: ionophores, photosynthesis.

Hydrolytic metalloenzymes: Carbonic anyhdrase, carboxy peptidase, calcium in control processes, calcium and muscle contraction, calcium and secretion, calcium in blood clotting mechanisms. Therapeutic uses of enzymes.

Importance of trace metals in biology: Metal ions as chelating agents in medicine, trace metal ions and metal and non-metal deficiency. Biological nitrogen fixation, in-vivo and in-vitro nitrogen fixation.

UNIT-III: BIOORGANIC CHEMISTRY **15 Hrs**

Carbohydrates: Structure and biological functions of mucopolysaccharides, glycoproteins and glycolipids - Role of sugars in biological recognition - Blood group substances.

Lipids: Essential fatty acids-structure and function of triglycerols, Glycerophospholipids, cholesterol, bile acids prostaglandins-composition and functioning of lipoproteins.

Enzymes: Nomenclature and classification, properties, factors affecting enzyme catalysis, enzyme inhibition - reversible and irreversible inhibition. Uses of enzymes in food drink industry and clinical laboratories.

UNIT-IV: BIOPHYSICAL CHEMISTRY **15 Hrs**

Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, calculation of average dimensions. Membrane equilibrium, ion transport through cell membrane.dialosis and its function. Structure and functions of proteins, enzymes, DNA and RNA in living systems, forces involved in bio polymer interactions, electrostatic forces, hydrophobic forces, molecular expansion, and dispersion forces.

Books Suggested

1. M.N. Hughes, The Inorganic chemistry of Biological Processes, John wiley and Sons, New York 2nd Edition, 1981.
2. A Text book of Biochemistry , A.V.S.S.Rama Rao
3. Physical chemistry by Atkenes
4. Physical chemistry by Albertz.

5. Bio physical chemistry by Van Holde
6. Bio Physics by Narayanam

7. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
8. Chemistry of Natural Products, P.S.Kalsi, Kalyani Publishers.
9. Chemistry of Organic Natural Products, O. P. Agarwal, Vols., 1 & 2, Geol Pubs.
10. Natural products Chemistry K.B.G. Torssell, John Wiley, 1983.
11. Burger's Medicinal Chemistry, M.E. Wolff, John Wiley
12. Medicinal Chemistry, A. Kar, New Age International

THIRD SEMESTER(ORGANIC CHEMISTRY)

SOC 306- SKILL ORIENTED COURSE 6(A): CHEMISTRY OF NATURAL PRODUCTS

UNIT-I: ALKALOIDS **15 Hrs**

Occurrence, isolation, general methods of structure elucidation and physiological action, degradation, classification based on nitrogen heterocyclic ring, structure elucidation and synthesis of the following: Atropine, Papaverine and Quinine.

UNIT-II: TERPENOIDS **15 Hrs**

Classification of terpenoids, occurrence, isolation, general methods of structure determination. Isoprene and special isoprene rule. Structure determination and synthesis of the following: Farnesol, Zingeberine and α-Cadinene.

UNIT-III: FLAVONOIDS AND ISOFLAVONOIDS **15 Hrs**

Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin, Kaempferol, Quercetin, Butein, Daidzein, Biosynthesis of flavonoids and isoflavonoids: Acetate Pathway and Shikimic acid Pathway. Biological importance of flavonoids and isoflavonoids.

UNIT-IV: STEROIDS AND HORMONES **15 Hrs**

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

Books Suggested

1. Introduction to Flavonoids TA Geissman
2. Organic Chemistry. Vol I and Vol II, I. L. Finar, 6th Ed., ELBS & Longman (London), (1975).
3. Advanced General Organic Chemistry, S. K. Ghosh, D.K. and Allied publishers (UBS), Calcutta (1998).
4. Total Synthesis of Natural Products Vol. IV, Apsimon, John Wiley, New York (1981).

THIRD SEMESTER(ORGANIC CHEMISTRY)

SOC 306- SKILL ORIENTED COURSE 6(B): X- RAY DIFFRACTION, KINETICS IN SOLUTIONS, ELECTROANALYTICAL CHEMISTRY

UNIT-I POWDER X-RAY DIFFRACTION **15 Hrs**

Powder x-ray diffraction, indexing the powder XRD patterns, Systematic absences, Structure factor, determination of lattice type, unit cell parameter and density for α-Po, fcc, bcc and hcp metals, NaCl, ZnS, diamond, CuZn, CuAu, $AuCu_3$ and other simple compounds. Neutron diffraction.

UNIT-II REACTIONS IN SOLUTIONS **15 Hrs**

Linear Free Energy relationships, Theory of absolute reaction rates, Influence of Internal pressure, Influence of Solvation, Influence of Ionic strength, The Taft- Equation, Polymerisation Reactions (Molecular mechanism, Free radical Mechanism] Emulsion Polymerisation reactions.

UNIT III: ION SELECTIVE ELECTRODES **15 Hrs**

Ion-sensitive electrodes –types of ion sensitive electrodes –metal based cation and anion sensitive electrodes, solid membrane electrodes. Liquid ion-exchange electrodes, gas sensing membrane electrodes.

UNIT IV: TYPES AND CLASSIFICATION OF ELECTRO ANALYTICAL METHODS **15 HRS**

i) Potentiometry – Types of electrodes, Hydrogen gas, Calomel, Quin hydrone and glass electrodes. Determination of pH. Potentiometric titrations.

ii) Conductometry – Definition of terms – conductivity, specific conductivity, cell constant. Mobility of ions, Conductometric titrations.

Books suggested:

1. A.R. West, Solid State Chemistry and its Applications, John Wiley & Sons, 1984. (Reprint Edition)
2. L. E. Smart and E. A. Moore, Solid State Chemistry - An Introduction, 4th Edition, CRC Press, 2012.
3. H. V. Keer, Principles of the Solid State, 2nd Edition, New Age International, 2017.
4. M. Weller, T. Overton, J. Rourke and F. Armstrong, Inorganic Chemistry, 6th Edition, Oxford University Press, 2014. (South Asia Edition 2015)

THIRD SEMESTER(ORGANIC CHEMISTRY)

P 307: Practical VI (related to SOC 305& SOC 306)

SOC 305- SKILL ORIENTED COURSE 5(A) PRACTICAL: FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

Spectral analysis

1. Propose the structures for compounds that fit the given spectral data and assign the spectral values.
2. Extract data from the given spectra and elucidate the structure from the obtained data with appropriate discussion.

SOC 306- SKILL ORIENTED COURSE 6(A) PRACTICALS: CHEMISTRY OF NATURAL PRODUCTS

Isolation and identification of Natural Products

1. Isolation of caffeine from tea leaves
2. Isolation of eugenol from cloves

CC 301- CORE COURSE 7: PHYSICAL CHEMISTRY-III

UNIT-I: APPLICATION OF GROUP THEORY **15 Hrs**

Mulikan Character tables, Determination of Character Coordinate of C_{2V} point group based on 3N Coordinates. Standard reduction formula, Determination of normal modes of vibrations of SO_2, NH_3, $POCl_3$, $PtCl_4^{2-}$,molecules. Mutual exclusion Principle, Direct Product, Accidental Degeneracy and Fermi resonance. **Group Theory and Spectroscopy:** selection rules, symmetry Criteria for optical activity, symmetry restrictions on dipole moments, symmetry and stereo isomerism.

UNIT-II: THERMODYNAMICS-III: **15 Hrs**

Thermodynamic Properties of Liquid Mixtures: Activity and activity coefficients-excess free energy-excess enthalpy-excess volume-excess entropy-relation between excess functions and activity coefficients –Application of Gibbs-Deuhem equation-regular solutions –van Laar theory and Scachard-Hildebrand theory.

UNIT-III: SPECTROSCOPHY **15 Hrs**

Microwave spectroscopy: Classification of molecules, rigid rotator model, effect of isotopic substitution on the transition frequencies, intensities- stark effect.

Infrared spectroscopy: Linear harmonic oscillator, zero point energy, anharmonity, Mores potential energy diagram, fundamental and overtone transitions, hot bands and combinations bands. Vibration-rotation spectroscopy, PQR branches, selection rules, factors affecting the band positions and intensities for IR region.

Raman spectroscopy: Classical and quantum theories of Raman effect, Pure rotational, Vibrational Raman spectroscopy, Vibrational- Rotational Raman spectroscopy, Selection rules, Mutual Exclusion Principle.

UNIT-IV: POLYMER CHEMISTRY **15 Hrs**

Monomers; repeat units; degree of polymerization; linear, branched and network polymers; classification of polymers. Polymerization Methods: Condensation, addition, radical chain, ionic and coordination, copolymerization Thermodynamics of polymer dissolution, effect of molecular weight on solubility, solubility of crystalline and amorphous polymer, heat of dissolution. Molecular weight determination by Viscosity, light scattering, ultra centrifugation and sedimentation equilibrium method.

Books Suggested

1. Physical methods in Chemistry, R. S. Drago (Saunders College).
2. Advanced Physical Chemistry by GurudeepRaj, Goel Publishers House, Meerut.
3. Essentials of Nuclear Chemistry, 4th Ed., 1995, H. J. Harnikar (Weily Eastern)
4. Text Book of Polymer Science, F. W. Billmeyer, Jr. (Wiley Inter Science)
5. Polymer Sciences by V. R. Gowariker, N. V. Viswanathan and Jayadev Sreedhar.
6. Jack Simons. An Introduction to theoretical chemistry. The press Syndicate of the University of Cambridge.
7. D.N. Bajpai: Advanced physical Chemistry: S. Chand & Company, 1998.
8. Silbey, Alberty, Bawendi. Physical Chemistry.Jhon-Wiley & Sons. 4th edition-2006.

9. Maron and prutton: principles of physical Chemistry.

CC 302- CORE COURSE 8(A): ADVANCED ELECTROCHEMISTRY

UNIT-I: INDUSTRIAL ELECTROCHEMISTRY **15 Hrs**

Deposition of metals, Factors influencing physical nature of electrodeposited metals – current density, concentration of electrolyte, temperature, colloidal matter, electrolyte and basis metal. Throwing power, simultaneous discharge of cations. Separation of metals by electrolysis. Electrochemical passivity. Passivity and current density. Chemical passivity. Theories of passivity. Mechanical passivity.The corrosion of metals. Hydrogen evolution type of corrosion, corrosion in presence of depolarizer. Differential oxygenation corrosion. Methods of corrosion protection.

UNIT- II: ELECTROCHEMICAL DEVICES: **15 Hrs**

Batteries- their performance – characteristics – considerations in the selection and applications, Chemistry of primary batteries – Zinc – Carbon, Mercuric oxide, silver oxide and lithium cells – Solid electrolyte cells.

Chemistry of secondary batteries – Lead acid , Nickel cadmium batteries, Water activated batteries, Fuel cells – Their thermodynamics- performance. Advantages of fuel cells.

UNIT-III: ELECTROKINETIC'S AND ELECTRO CAPILLARY PHENOMENA: 15 Hrs

Electrical double layer, Helmholtz – Perrin, Gouy – Chapman and Stern theories of electrical double layer. Lipmann equation.

Electrokinetic effect: Electro osmosis, Electrophoresis, streaming potential , sedimentation potential and their relation to zeta potential. Determination of zeta potential from electrophoresis measurements. Tiselius apparatus. Electro capillary curves, Null points of metals and their experimental determination.

UNIT-IV: **ELECTROCHEMICAL OXIDATION-REDUCTION** **15 Hrs**

(A) Oxidation-Reduction systems

Oxidation-Reduction potentials, types of reversible Oxidation-Reduction systems, determination of standard Oxidation-Reduction potentials, Oxidation-Reduction Indicators, Indicators of Biological systems, Indicator for volumetric analysis.

(B) Electrolytic Oxidation-Reductions

Electrolytic Oxidation-Reduction, Reversible oxidation-reduction process, Non-Reversible process, Oxidation of Fatty acids: The Kolbe reaction, The Brown-Walker Electrosynthesis, Formation of Chromate and Periodate.

Books suggested:

1. S. Glasstone. An introduction to Electrochemistry. Affiliated East-West Press Pvt. Ltd.
2. P.T.K.Kissinger, W.R.Heinemann. Laboratory Techniques in Electro analytical Chemistry, Marsal Debber, Inc.
3. Willard, Merit. Instrumental methods of analysis, Welowarth Publiching Co.,
4. L.Antropov. Theoretical Electrochemistry. Mir Publications.
5. Silbey, Alberty, Bawendi. Physical chemistry. Jhon-Wiley & sons. 4th edition-2006.
6. V.S. Bagotsky. Fundamental of Electrochemistry. Jhon Wiley & Sons. 2nd editions-2006.
7. Introduction to polarography and allied Technique by Dr.K. Zutshi

CC 302- CORE COURSE 8(B): PRINCIPLES IN QUALITY CONTROL AND QUALITY MEASUREMENTS

UNIT-I: QUALITY CONTROL IN ANALYTICAL CHEMISTRY 15 Hrs

Definition of analytical terms: Accuracy, precision, limit of detection, sensitivity, selectivity and specificity, ruggedness, principles of Ruggedness test, validating the Method as a Standard Method.

Quality assurance and management systems: Elements of quality assurance, Quality and quantity management system,. ISO 9000 and ISO 14000 series.

Good laboratory practices (GLP): Elements of Good Laboratory Practice, Laboratory accreditation, GLP status in India.

UNIT-II: ORGANIC REAGENTS IN INORGANIC ANALYSIS 15 Hrs

Theoretical basis for the use of organic reagents in inorganic analysis: Application of the following reagents in inorganic analysis: dimethylglyoxime, salicylaldehyde, cupferron, d-benzoin, 1,10 phenanthroline, 8-hydroxy quinoline, nitron, tannin, pyridine, 8-hydroxy quinoldine, dithizone, Acetylacetone, theonyl, trifluoroacetone, 8-hydroxy quinoline, tri-M-octylphosphine oxide.

UNIT – III: KINETIC METHODS OF TRACE ANALYASIS 15 Hrs

Rate laws, Analytical use of reaction rates, First and second order reactions, relative rate of reactions. Determination of reaction rates. Analytical utility of first and pseudo first order reactions. Types of kinetic methods, differential, integral, logarithmic, extrapolation method. Evaluation of kinetic methods – Scale of Operation, Catalyzed reactions, measurement method for catalyzed reaction. Micro determination of Inorganic species like Iodine and Hg in complex materials. Determination of organic species. Kinetics of enzyme, catalyzed reactions. Michael's constant factors affecting the rate of enzyme, Catalyzed reactions, Enzyme characteristics and applications of Kinetic methods of trace analysis**.**

UNIT-IV:REDOX AND COMPLEXOMETRIC TITRATIONS: 15Hrs

Redox Titrations: Standard reduction potential, equilibrium constants of oxidation-reduction reactions, change of electrode potential during the titration of reductant with an oxidant. Formal potential primary standard substance. Standard solutions. Preparation and storage. Oxidations with cerium (IV) sulphate solutions. Theory and use of (i) acid-base, (ii) Oxidation-reduction (iii) Metal ion indicators.

Complexometric titrations: Introduction, complexones, stability constants of EDTA complexes, conditional stability constants, titration curves, types of EDTA titration's, titration of mixtures.

Books Suggested

1. Vogel's Text book of Quantitative Chemical Analysis, Basselt, Denmy, Jaffery and Merdhan, ELBS, Orientlong- Manan, 5th Ed.1990.
2. Analytical Chemistry, Gary D. Christian, John Lalilley and Senes, New York, 6th Ed., 2007.
3. Fundamentals of ANALYTICAL CHEMISTRY, Skoog, West, Holler; 7th Editin 2001
4. Fundamentals of Analytical Chemistry, D.A. Skoog & D.M. West, Holf-Saunderrs, 5th Ed., 1991.
5. Principles and Methods Chemical Analysis: H.F. Walton, Prentice Hall, New Delhi.
6. Chemical Analysis, H.A. Laitinan, Mc.Graw Hill Book Company.
7. Technical methods of analysis – Griffin, Mc Graw Hill Book Co.
8. K.V.S.G Murali Krishna, An Introduction ISO 9000, ISO 1400 Series,
9. Environmental Management Quality Assurance and Good Laboratory Practices, Prof. Y. Anjaneyulu, In Now Publication, New York
10. Quality Assurance in Analytical Chemistry – G.Kateman and F.W Pijpers, John Wiley and Sons, New York

CC 303- CORE COURSE 9 (A): INORGANIC SPECTROSCOPY & THERMAL METHODS OF ANALYSIS

UNIT-I: THERMAL METHODS OF ANALYSIS **15 Hrs**

Thermo garaviemetry – Principle, Factors affecting the results, instrumentation. Application with special reference to $CuSO_45H_2O$, $CaC_2O_4\ 2H_2O$. Different thermal analysis – principle, instrumentation, difference between TG and DTA, applications with special reference to the clays and minerals. Different scanning calorimetry – principle, and applications to inorganic materials like chlorates and perchlorates, ammonium nitrate.

UNIT-II: MOSSBAUER SPECTROSCOPY AND NQR **15 Hrs**

Mossbauer spectroscopy: Basic principles, Recoil energy, Doppler shift, Chemical shift, Quadrapoleeffects, Magnetic effects. Instrumentation, spectral parameters and spectrum display. Aapplication of the technique to the studies of (1) bonding and structures of Fe^{2+} and Fe^{3+} compounds, (2) Sn^{2+} and Sn^{4+} compounds.

NQR spectroscopy: Basic principles of NQR spectroscopy, quadrupole nuclei, quadrupole moments,electric field gradient, coupling constant and applications.

UNIT-III: ELECTRON SPIN RESONANCE SPECTROSCOPY **15 Hrs**

ESR: Basic Principles, Hyper fine splitting, Factors affecting the 'g' value. Isotropic and anisotropic hyperfinecoupling constants, Hamiltonian and spin densities. Zero field splitting and Kramer's degeneracy,Relaxation process and line widths. Instrumentation and Applications.The EPR spectrum of bis(salicylidimine)-copper(II) complex, study of inorganic free radicals, biological applications of Electron Spin Resonance (Study of free radicals and Iron-sulfur proteins)

UNIT-IV: PHOTOELECTRON SPECTROSCOPY **15 Hrs**

Photoelectric effect, Koopmans's theorem, ionization energy.

X-ray photoelectron spectroscopy (ESCA): Principle, Binding energies, Chemical shift, Applications of XPES to Qualitative analysis, to surface studies and structural analysis. Ultraviolet photoelectron spectroscopy- Principle, application of UPES in studying the molecular orbitals of O_2 and N_2 molecules. Block diagram of photoelectron spectrophotometer. Sources of radiation, detectors. Auger spectra – Principle, Applications of Auger spectra to surface studies and use of Auger spectra as a finger print tool.

Books suggested:

1.F.A. Cotton and G. Wilkinson, Advanced In-organic chemistry VI Edition, 1999. John wiley &sons. Inc., New York.

2.J.E. Huheey, E.A. Keiter and R.L. Keiter: Inorganic Chemsitry, Principles of Structure andReactivity (4^{th} Ed.) (Addison-Wesley)

3.Gary Wulfsberg: Inorganic Chemistry (5^{th} Ed. Viva Books)

4.J.D. Lee: Concise Inorganic Chemistry (Blackwell)

5.W.L. Jolly: Modern Inorganic Chemsitry (McGraw-Hill)

CC 303- CORE COURSE 9(B): NATURAL RESOURCES – POLLUTION AND GREEN CHEMISTRY

UNIT-I:WATER RESOURCES AND AIR **15Hrs**

Hydrological cycle- physical and chemical properties of water-complexation in natural and waste water,-Anomalous properties-water pollutants-Types-Sources- Heavy metals- metalloids-organic – Inorganic – Biological and Radio active-Types of reactions in various water bodies including marine environment- Eutrophication- Ground water- Potable water standards.Treatment for portable water.

Air: Chemical reactions in the atmosphere – Aerosols types- Production and distribution – Aerosols and Radiation – structure and composition of atmosphere- temperature inversion – Global warning- Ozone depletion – Green house effect, "CFC"s- Acid rain.

UNIT-II: SOURCES OF ENERGY **15 Hrs**

Fossil fuels- Nuclear fission and fusion- Solar energy-use of solar energy in space heating and water heating- production of electricity using solar energy- solar trough collectors- power tower-solar pond- solar energy for driving vehicles- power from indirect solar energy – Hydropower-wind power- Biomass energy- production of ethanol from biomass- production of methane from biomass- photosynthesis- photo electro chemistry- Geothermal energy.

UNIT III: SOIL POLLUTION **15Hrs**

Introduction – soil pollution by industrial wastes. soil pollution by urban wastes, Radio active pollutants and Agricultural waste- chemical and metallic pollutants-Biological agents – mining - Detrimental effects of soil pollutants – Effects of industrial pollutants- Effects of sewage and domestic wastes- Effects of heavy metals- Effects of radio active pollutants- Effects of modern agro- technology – Diseases caused by soil pollution – solid waste management – sources and classification -public Health Aspects – methods of collection- Disposal methods – potential methods of disposal.

UNIT-IV: SOIL AND GREEEN CHEMISTRY **15 Hrs**

Soil: Composition of soil- lithosphere- inorganic and organic contaminants in the soil-Biodegradation- Nondegrdable waste and its effect on the environment- Bioremediation –of surface soils- Fate and transport of contaminants on soil system– Bioindicators- Soil parameters-soil destruction- Erosion- Soil conservation – Nitrogen pathways and NPK in soil .

Green Chemistry: Goals of Green chemistry- Significance and basic components of Green chemistry research - industrial applications of Green chemistry-products from natural materials-Green fuels and E-Green propellants- Zeolites- Biocatalysts.

Books Suggested:

1. Daniel D.Chiras (1994), Environmental Science, 4th Ed.
2. Environmental Chemistry by W. Moore and J.Moore
3. Environmental chemistry by J.O.M. Bockariss
4. Environm,ental by BK SHArma
5. Environmental chemistry by SS Dara
6. Environmental chemistry by Mahajan
7. Environmental chemistry by a.K.De

P 304: Practical V (related to CC 302& CC 303)

CC 302- CORE COURSE 8(A) PRACTICALS: ADVANCED ELECTROCHEMISTRY

1. **Conductometry:**
   i. Titration of mixture of halides
   ii. Titration of mixture of HCl+ACOH
2. **Potentiometry**
3. Titration of mixture of acids
4. Titration of mixture of halides
5. Titration of ferrous ammonium sulphate with potassium dichromate
6. Redox titrations
7. Solubility of Sparingly soluble salt.
8. Formula and instability constant of a complex
9. Dissociation constant of acetic acid

CC 303- CORE COURSE 9 (A) PRACTICALS: INORGANIC SPECTROSCOPY & THERMAL METHODS OF ANALYSIS

1. Estimation of Ferrous ion by using 1, 10-phenanthroline.
2. Determination of the amount of Iron by Photometric titration method.

SOC 305- SKILL ORIENTED COURSE 5(A): X- RAY DIFFRACTION, KINETICS IN SOLUTIONS, ELECTROANALYTICAL CHEMISTRY

UNIT-I POWDER X-RAY DIFFRACTION **15 Hrs**

Powder x-ray diffraction, indexing the powder XRD patterns, Systematic absences, Structure factor, determination of lattice type, unit cell parameter and density for α-Po, fcc, bcc and hcp metals, NaCl, ZnS, diamond, CuZn, CuAu, $AuCu_3$ and other simple compounds. Neutron diffraction.

UNIT-II REACTIONS IN SOLUTIONS **15 Hrs**

Linear Free Energy relationships, Theory of absolute reaction rates, Influence of Internal pressure, Influence of Solvation, Influence of Ionic strength, The Taft- Equation, Polymerisation Reactions (Molecular mechanism, Free radical Mechanism) Emulsion Polymerisation reactions.

UNIT III: ION SELECTIVE ELECTRODES **15 Hrs**

Ion-sensitive electrodes –types of ion sensitive electrodes –metal based cation and anion sensitive electrodes, solid membrane electrodes. Liquid ion-exchange electrodes, gas sensing membrane electrodes.

UNIT IV: TYPES AND CLASSIFICATION OF ELECTRO ANALYTICAL METHODS **15 Hrs**

i) Potentiometry – Types of electrodes, Hydrogen gas, Calomel, Quin hydrone and glass electrodes. Determination of pH. Potentiometric titrations.

ii) Conductometry – Definition of terms – conductivity, specific conductivity, cell constant. Mobility of ions, Conductometric titrations.

Books suggested:

1. A. R. West, Solid State Chemistry and its Applications, John Wiley & Sons, 1984. (Reprint Edition)
2. L. E. Smart and E. A. Moore, Solid State Chemistry - An Introduction, 4th Edition, CRC Press, 2012.
3. H. V. Keer, Principles of the Solid State, 2nd Edition, New Age International, 2017.
4. M. Weller, T. Overton, J. Rourke and F. Armstrong, Inorganic Chemistry, 6th Edition, Oxford University Press, 2014. (South Asia Edition 2015)

THIRD SEMESTER(PHYSICAL CHEMISTRY)

SOC 305- SKILL ORIENTED COURSE 5(B): CRYSTAL STRUCTURES, KINETICS OF ELECTRODES, ELECTRODE CHEMISTRY

UNIT-I CRYSTAL STRUCTURES OF CRYSTALLINE AND AMORPHOUS SOLIDS 15 Hrs

Crystalline and amorphous solids; One and two dimensional lattices, crystal systems, Bravais lattices, point groups: α-Po, fcc, bcc and hcp metals and their packing efficiency, ionic radii ratios; structure types of ionic solids: CsCl, NaCl, ZnS, Na_2O, CaF_2, $CdCl_2$, NiAs, ZnO, CdI_2, Cs_2O, PbO, TiO_2, ReO_3, perovskite ABO_3, $YBa_2Cu_3O_7$, K_2NiF_4, Ag_2HgI_4, spinel and olivine.

Polyhedral structure description of solid state compounds. Frenkel and Schotky defects, colour centers, Crystallographic shear (CS) in WO_{3-x}

UNIT-II KINETICS OF SOME ELECTRODE PROCESS 15 Hrs

The Hydrogen evolution over voltage, Hydrogen over voltage, Catalytic activity, Effect of Solution Composition on ηH, Effect of pH on ηH Effect lamp on ηH ,Theories of Hydrogen over Voltage, Bubble formation as The slow process, Combination of atoms of slow process, Ion Discharge as the slow process, proton transfer as the slow process, oxygen over Voltage, Experimental data and factors affecting oxygen over Potentials, Theory of oxygen over Voltage, General description of redox reaction. The Effect of Electrode material and the Electrode potential, effect of solution composition, The Theory of Electrochemical reduction and oxidation reaction.

UNIT III : D.C POLAROGRAPHY 15 Hrs

Dropping mercury electrode- Instrumentation-polarogram. Types of Currents : Residual, Migration, Limiting. Two and Three electrode assemblies. Ilkovic equation (derivation not necessary) and its consequences. Types of limiting Currents: Adsorption, Diffusion, Kinetic. Applications of polarography in qualitative and quantitative analysis. Analysis of mixtures. Application to inorganic and organic compounds. Determination of stability constants of complexes.

UNIT III: ANALYTICAL TECHNIQUES 15 Hrs

(i) A.C.polarography (ii) Square-wave polarography (iii) Pulse polarography (iv) Differential pulse polarography (v) Cyclic Voltammetry: Principle, instrumentation, reversible and irreversible cyclic voltammograms.

Books Suggested

1. H.W. Willard, LL.Merrit and J.A.Dean: Instrumental Methods of Analysis. Affiliated East-West).
2. G.H. Jeffery J. Bassett, J. Mendham and R.C. Denny. Vogel"s Text Book of Quantitative Chemical Analysis (ELBS).
3. D.A. Skoog and D.M. West: Principles of Instrumental Analysis (Holt, Rinehart and Wilson).
4. J.G. Dick : Analytical Chemistry (Mc Graw Hill).

SOC 306- SKILL ORIENTED COURSE 6(A): FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

UNIT-I: ULTRAVIOLET AND VISIBLE SPECTROSCOPY: 15Hrs

Various electronic transitions (185-800 nm), effect of solvent on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes. Fisher-Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic and heterocyclic compounds. Steric effect in biphenyls.

UNIT-II: INFRARED SPECTROSCOPY 15Hrs

Instrumentation and sample handling. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, 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

UNIT-III: ^{1}H NMR & ^{13}C NMR SPECTROSCOPY 15Hrs

^{1}H NMR: Magnetic properties of nuclei, Principles of NMR. Instrumentation, Chemical shifts, factors affecting the chemical shifts, electronegativity and anisotropy, shielding and deshielding effects, Signal integration, Spin-spin coupling: vicinal, germinal and long range, Coupling constants and factors affecting coupling constants.

^{13}C NMR: General considerations, chemical shift (aliphatic, olefinic, alkyne, carbonyl carbon aromatic and heteroaromatic), coupling constants. Two dimensional NMR spectroscopy-HOMO COSY & HETERO COSY.

UNIT-IV: MASS SPECTROMETRY 15Hrs

Introduction, ion production, type of ionization, EI, CI, FD, and FAB-factors affecting fragmentation, ion analysis, ion abundance. Mass spectral fragmentation of organic compounds, common functional groups, molecular-ion peak, metastable peak, Mc. Lafferty rearrangement. Nitrogen rule, isotope labeling. High resolution mass spectrometry, Examples of mass spectral fragmentation of organic compounds with respect to their structure determination.

Books suggested:

1. Organic spectroscopy, W. Kemp 5th Ed, ELBS
2. Spectroscopy of organic compounds, RM Silversteen and others, 5th Ed,John Wiley
3. Spectroscopy of organic compounds, P.S. Kalsi, Wiley, 1993.
4. NMR in chemistry-A multi nuclear introduction, William Kemp, Mc Millan, 1986.
5. Spectroscopic methods in Organic chemistry, DH Williams & I Flemmi,

SOC 306- SKILL ORIENTED COURSE 6(B): BIOINORGANIC, BIOORGANIC, BIOPHYSICAL CHEMISTRY

UNIT-I: BIO-INORGANIC CHEMISTRY- I 15 Hrs

Metal complexes as oxygen carriers – Heme proteins – Hemoglobin and myoglobin – Non heme proteins – hemerythrin and hemocyanin – model synthetic complexes of iron, cobalt and copper.Co-enzymes Vitamin B_{12},carboxy peptidase and superoxidedismutase.

Electron Transfer in Biology: Structure and functions of metalloproteins in electron transfer processes – catalase – peroxidose – cytochromes and iron – sulphur proteins – synthetic models. **UNIT – II: BIOINORGANIC CHEMISTRY- II 15 Hrs**

Metal ion transport and storage in biological systems**,** Metal ions in Biology, Molecular mechanism of ion transport across membranes: ionophores, photosynthesis.

Hydrolytic metalloenzymes: Carbonic anyhdrase, carboxy peptidase, calcium in control processes, calcium and muscle contraction, calcium and secretion, calcium in blood clotting mechanisms. Therapeutic uses of enzymes.

Importance of trace metals in biology: Metal ions as chelating agents in medicine, trace metal ions and metal and non-metal deficiency. Biological nitrogen fixation, in-vivo and in-vitro nitrogen fixation.

UNIT-III: BIOORGANIC CHEMISTRY 15 Hrs

Carbohydrates: Structure and biological functions of mucopolysaccharides, glycoproteins, and glycolipids- Role of sugars in biological recognition- Blood group substances

Lipids: Essential fatty acids-structure and function of triglycerols, Glycerophospholipids, cholesterol, bile acids prostaglandins- composition and functioning of lipoproteins

Enzymes: Nomenclature and classification, properties, factors affecting enzyme catalysis, enzyme inhibition- reversible and irreversible inhibition. Uses of enzymes in food drink industry and clinical laboratories.

UNIT-IV: BIOPHYSICAL CHEMISTRY 15 Hrs

Standard free energy change in biochemical reactions, exergonic and endergonic reactions, hydrolysis of ATP, thermodynamics of biopolymer solutions, chain configuration of bio polymers, calculation of average dimensions. Membrane equilibrium, ion transport through cell membrane.dialosis and its function. Structure and functions of proteins, enzymes, DNA and RNA in living systems, forces involved in bio polymer interactions, electrostatic forces, hydrophobic forces, molecular expansion, and dispersion forces.

Books Suggested

1. M.N. Hughes, The Inorganic Chemistry of Biological Processes, John wiley and Sons, New York 2nd Edition, 1981.
2. A Text book of Biochemistry, A.V.S.S.Rama Rao
3. Physical chemistry by Atkenes
4. Physical chemistry by Albertz.
5. Bio physical chemistry by Van Holde
6. Bio Physics by Narayanam
7. Organic Chemistry, Vol. 2, I. L. Finar, ELBS.
8. Chemistry of Natural Products, P.S. Kalsi, Kalyani Publishers.
9. Chemistry of Organic Natural Products, O. P. Agarwal, Vols., 1 & 2, Geol Pubs.
10. Natural products Chemistry K.B.G. Torssell, John Wiley, 1983.
11. Burger's Medicinal Chemistry, M.E. Wolff, John Wiley
12. Medicinal Chemistry, A. Kar, New Age International

THIRD SEMESTER(PHYSICAL CHEMISTRY)

P 307: Practicals VI (related to SOC 305& SOC 306)

SOC 305- SKILL ORIENTED COURSE 5(A) PRACTICALS: X- RAY DIFFRACTION, KINETICS IN SOLUTIONS, ELECTROANALYTICAL CHEMISTRY

1. **Chemical Kinetics:**
   Study of the kinetics of halogenations of acetone.
   Determination of activation energy of reaction between iodide and Persulphate
   Determination rate constant of oxidation of iodide ion by persulphate ion and study the effect of neutral salt (KCl).

2. **Estimation of Metals by Flamephotometry**

3. **Estimation of Metals by Colorimetry**

4. **Polarography:**

   a) Determination of $E_{1/2}$ of Zn and Cd

   b) Determination of Zn and Cd in mixture

   c) Amperometric titration

5. Determination of density of liquid mixtures by using densitometer.
6. Study of the kinetics of halogenations of acetone.
7. X-ray powder diffraction analysis of cubic compound.
8. Determination of lattice constants, Partical Size and geometry.

SOC 306- SKILL ORIENTED COURSE 6(A) PRACTICAL: FUNDAMENTALS OF SPECTROSCOPY AND APPLICATIONS

Spectral analysis

1. Propose the structures for compounds that fit the given spectral data and assign the spectral values.
2. Extract data from the given spectra and elucidate the structure from the obtained data with appropriate discussion.

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