



Hindi Vidya Prachar Samiti's
Ramniranjan Jhunjhunwala College
of Arts, Science & Commerce
(Empowered Autonomous College)

Affiliated to
UNIVERSITY OF MUMBAI

Syllabus for the T.Y.B.Sc.
Program: B.Sc (Chemistry)
Program Code: RJSUCHE

(NEP 2020)
Level 5.5
(CBCS 2025-2026)

T.Y.B.Sc. CHEMISTRY SEMESTER V**Discipline Specific Core (DSC) - Theory**

Course Code	Unit	Topic Headings	Credits	Duration
RJDSCCHE351	Paper Title: Chemistry-IX (Physical and Analytical Chemistry)			60 hours
	I & II	Physical Chemistry	04	30 hours
	III & IV	Analytical Chemistry		30 hours

Course Code	Unit	Topic Headings	Credits	Duration
RJDSCCHE352	Paper Title: Chemistry-X (Inorganic and Organic Chemistry)			60 hours
	I & II	Inorganic Chemistry	04	30 hours
	III & IV	Organic Chemistry		30 hours

Discipline Specific Core (DSC) – Practical

Course Code	Topic Headings	Credits	Duration
RJDSCCHEP351	Physical and Analytical Chemistry	02	30 hours
RJDSCCHEP352	Inorganic and Organic Chemistry	02	30 hours

T.Y.B.Sc. CHEMISTRY SEMESTER VI**Discipline Specific Core (DSC) - Theory**

Course Code	Unit	Topic Headings	Credits	Duration
RJDSCCHE361	Paper Title: Chemistry-XI (Physical and Analytical Chemistry)			60 hours
	I & II	Physical Chemistry	04	30 hours
	III & IV	Analytical Chemistry		30 hours

Course Code	Unit	Topic Headings	Credits	Duration
RJDSCCHE362	Paper Title: Chemistry-XII (Inorganic and Organic Chemistry)			60 hours
	I & II	Inorganic Chemistry	04	30 hours
	III & IV	Organic Chemistry		30 hours

Discipline Specific Core (DSC) - Practical

Course Code	Topic Headings	Credits	Duration
RJDSCCHEP361	Physical and Analytical Chemistry	02	60 hours
RJDSCCHEP362	Inorganic and Organic Chemistry	02	60 hours

SEM V SYLLABUS

DSC-THEORY

PAPER - IX

SEMESTER		SEM – V
TITLE OF THE SUBJECT / COURSE		PHYSICAL AND ANALYTICAL CHEMISTRY
COURSE CODE		RJDSCCHE351
CEDITS		04
DURATION		60 Hrs.
LEARNING OBJECTIVE		
1.	Learn the fundamentals terms and concepts of nuclear chemistry.	
2.	Understand the principle and working of different nuclear counters.	
3.	Explain the nuclear energy, nuclear fission, nuclear fusion and nuclear reaction.	
4.	Understand the working of nuclear reactor and nuclear reaction on earth and stellar bodies.	
5.	understand complexometric titrations using EDTA, including its standardization, metal-EDTA complex formation, and methods to enhance selectivity.	
6.	Able to demonstrate precipitation titrations, including Mohr and Volhard methods, and their applications in quantitative analysis	
7.	Explain the principles, instrumentation, and quantification methods of Flame Emission Spectroscopy (FES) and Atomic Absorption Spectroscopy (AAS), along with their advantages and limitations.	
8.	Explain the principles, instrumentation, and applications of turbidimetry and nephelometry, emphasizing factors affecting light scattering.	

COURSE OUTCOME NUMBER	ON COMPLETION OF THE COURSE, STUDENT WILL BE ABLE TO:	PSO ADDRESSED	BLOOMS LEVEL
CO1	Explain the fundamentals of nuclear reactions, nuclear fusion and nuclear fission.	PSO1	Understand (L2)
CO2	Understand the working and principle of GM counter and scintillation counter.	PSO2	Analyze (L4)
CO3	Explain the Q energy and its applications.	PSO1,2	Apply (L3)
CO4	Learn the principle and working of nuclear power reactor.	PSO3	Understand (L2)
CO5	Explain the fundamental principles of redox titrations, including the construction of titration curves and E-system calculations for single-electron and multi-electron systems.	PSO1, PSO2	Understand (L2)
CO6	Apply the principles of complexometric titrations using EDTA, understand its standardization, metal complex formation, and techniques to improve selectivity.	PSO1, PSO3	Apply (L3)
CO7	Analyze precipitation titrations (Mohr and Volhard methods) and their role in quantitative analysis.	PSO1, PSO2	Analyze (L4)

T.Y.B.Sc.	SEMESTER V THEORY
COURSE CODE RJDSCCHE351 PAPER -IX PHYSICAL AND ANALYTICAL CHEMISTRY	COURSE OUTCOME: ON SUCCESSFUL COMPLETION OF THIS COURSE, STUDENTS WILL BE ABLE TO: 1. Explain the concepts of nuclear fission, nuclear fusion and nuclear reactions. Understand the principles, working limitations of nuclear counter. 2. Apply the principles and working of nuclear power reactor and nuclear reactions happening on earth and stellar bodies. 3. Use the principles of Rotational and Vibrational spectroscopy to correlate the structural aspects of molecules. 4. Investigate the structure of molecules based on polarizability. Understand the concept of chemical environment. 5. Compare molecular fluorescence and phosphorescence spectroscopy, their influencing factors, and applications in analytical chemistry. 6. Explain the principles and applications of turbidimetry and nephelometry, emphasizing factors affecting light scattering and instrumentation. LEARNING OUTCOME: ON SUCCESSFUL COMPLETION OF THIS COURSE, STUDENTS WILL BE ABLE TO: 1. Understand nuclear chemistry, principles of nuclear counters and nuclear reactions 2. Learn the significance of Q energy, principles of power reactors, nuclear fusion and nuclear reactions occurring on earth and stellar bodies. 3. Learn the principles of Rotational and Vibrational spectroscopy to solve the structure of molecules. 4. Learn the scattering phenomenon affecting polarizability and the structure of molecules. Learn the principles of NMR and ESR 5. Describe complexometric titrations using EDTA, including its standardization, metal-EDTA complex formation, and methods to enhance selectivity. 6. Demonstrate knowledge of precipitation titrations, including Mohr and Volhard methods, and their applications in quantitative analysis. 7. Explain the principles, instrumentation, and quantification methods of Flame Emission Spectroscopy (FES) and Atomic Absorption Spectroscopy (AAS), along with their advantages and limitations. 8. Explain the principles, instrumentation, and applications of turbidimetry and nephelometry, emphasizing factors affecting light scattering.

SEMESTER V (DSC – THEORY I)		Hrs.	Cr.
PAPER – IX: PHYSICAL AND ANALYTICAL CHEMISTRY		60	04
PAPER CODE: RJDSCCHE351			
Unit No.	Name of the topic	No. of Hrs.	Credits
I	1.1 Nuclear chemistry (12 L) 1.1.1 Radioactivity, types and characteristics of nuclear radiations, types of radioactive decay, the group displacement law, activity, specific activity, units of radioactivity, kinetics of radioactive decay, decay constant, half-life, average life. 1.1.2 Detection and measurement of radioactivity: behavior of ion pairs in electric field, detection and measurement of nuclear radiations using Geiger-Muller Counter and Scintillation Counter. 1.1.3 Application of use of radioisotopes as tracers: chemical reaction mechanism, age determination - dating by ^{14}C . 1.1.4 Mass defect and binding energy of a nucleus. 1.1.5 Nuclear reactions: nuclear transmutation (one example for each projectile), artificial radioactivity, Q - value of nuclear reaction, threshold energy. 1.1.6 Fission process: Fissile and fertile material, nuclear fission, chain reaction, factor controlling fission process. multiplication factor and critical size or mass of fissionable material, nuclear power reactor and breeder reactor. 1.1.7 Fusion Process: Thermonuclear reactions occurring on stellar bodies and earth. 1.2 Surface chemistry (03 L) 1.2.1 Physical and chemical adsorptions, adsorption isotherm, types of adsorption isotherms. 1.2.2 Langmuir's adsorption isotherm (postulates and derivation expected). 1.2.3 BET equation for multilayer adsorption (derivation not expected), determination of surface area of an adsorbent using BET equation.	15	01
II	2.1 Molecular spectroscopy (15 L) 2.1.1 Rotational spectra Introduction to dipole moment, polarization of a bond, bond moment, molecular structure, rotational spectrum of a diatomic molecule, rigid rotor, moment of inertia, energy levels, conditions for obtaining pure rotational spectrum, selection rule, nature of spectrum, determination of internuclear distance and isotopic shift. 2.1.2 Vibrational spectra Vibrational motion, degrees of freedom, modes of vibration, vibrational spectrum of a diatomic molecule, simple harmonic oscillator, energy levels, zero-point energy, conditions for obtaining vibrational spectrum, selection rule, nature of spectrum. 2.1.3 Vibrational-rotational spectrum of diatomic molecule Energy levels, selection rule, nature of spectrum, P and R branch lines, anharmonic oscillator- energy levels, selection rule, fundamental band,	15	01

	overtones, application of vibrational-rotational spectrum in determination of force constant and its significance, infrared spectra of simple molecules like H₂O and CO₂. 2.1.4 Raman Spectroscopy Scattering of electromagnetic radiation, Rayleigh scattering, Raman scattering, nature of Raman spectrum, Stoke's lines, anti-Stoke's lines, Raman shift, quantum theory of Raman spectrum, comparative study of IR and Raman spectra, rule of mutual exclusion- CO₂ molecule. 2.1.5 Nuclear magnetic resonance (NMR) spectroscopy Principle, nuclear spin, magnetic moment, nuclear 'g' factor, energy levels, Larmor precession, relaxation processes (spin -spin relaxation and spin - lattice relaxation), instrumentation 2.1.6 Electron spin resonance (ESR) spectroscopy Principle, fundamental equation, g-value – dimensionless constant or electron g-factor, hyperfine splitting, instrumentation, ESR spectrum of hydrogen and deuterium.		
III	3.1 Redox Titrations (4 L) 3.1.1 Introduction 3.1.2 Construction of the titration curves and calculation of E_{system} in aqueous medium in case of: (1) One electron system (2) Multielectron system (numerical problems expected) 3.1.3 Theory of redox indicators, criteria for selection of an indicator, use of diphenyl amine and ferroin as redox indicators 3.2 Complexometric Titrations (9 L) 3.2.1 Introduction, construction of titration curve 3.2.2 Use of EDTA as titrant and its standardization, Absolute and conditional formation constants of metal EDTA complexes. 3.2.3 Types of EDTA titrations. Methods of enhancing selectivity of EDTA as a titrant 3.2.4 Advantages and limitations of EDTA as a titrant. 3.2.5 Metallochromic indicators, theory, examples, and applications 3:3 Precipitation titrations (2L) 3.3.1 Mohr and Volhard methods	15	01
IV	4.1 Atomic Spectroscopy: Flame Emission spectroscopy (FES) and Atomic Absorption Spectroscopy (AAS) (6L) 4.1.1 Flame Photometry – Principle, instrumentation (flame atomizers, types of burners, wavelength selectors, detectors). 4.1.2 Atomic Absorption Spectroscopy – Principle, instrumentation (source, chopper, flame and electrothermal atomizer). 4.1.3 Quantification methods of FES and AAS – calibration curve method and standard addition method. 4.1.4 Comparison between FES and AAS 4.1.5 Applications, advantages, and limitations 4.2 Molecular Fluorescence and Phosphorescence Spectroscopy (5L)	15	01

	4.2.1 Introduction and principle 4.2.2 Relationship of fluorescence intensity with concentration 4.2.3 Factors affecting fluorescence and phosphorescence 4.2.4 Instrumentation and applications 4.2.5 Comparison of fluorimetry and phosphorimetry 4.2.6 Comparison with absorption methods 4.3 Turbidimetry and Nephelometry (4L) 4.3.1 Introduction and principle 4.3.2 Factors affecting scattering of radiation: concentration, particle size, wavelength, refractive index 4.3.3 Instrumentation and applications		
REFERENCES FOR UNIT I & II 1. Fundamental of Molecular Spectroscopy, 4 th Edn., Colin N Banwell and Elaine M McCash Tata McGraw Hill Publishing Co.Ltd. New Delhi, 2008. 2. The Elements of Physical Chemistry, P.W. Atkins, 2 nd Edition,Oxford Universtity Press Oxford.			
REFERENCES FOR UNIT III & IV) 1. Principles of Instrumental Analysis , 5th Edition, By Skoog, Holler, Nieman 2. Instrumental Methods of Chemical Analysis by B.K. Sharma Goel Publishing House 3. Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication 4. Instrumental methods Of Analysis, by Willard Merritt Dean, 7thEdition, CBS Publisher and distribution Pvt Ltd			

PAPER - X

SEMESTER		SEM – V
TITLE OF THE SUBJECT / COURSE		INORGANIC AND ORGANIC CHEMISTRY
COURSE CODE		RJDSCCHE352
CEDITS		04
DURATION		60 Hrs.
LEARNING OBJECTIVE		
1.	Identify symmetry elements, classify molecules into point groups, apply molecular orbital theory to heteronuclear and polyatomic molecules, and explain metallic bonding using band theory.	
2.	Study the elements of f block, their electronic configuration, their physical properties and separation methods.	
3.	Explain the basic principles and applications of UV-Visible spectroscopy and mass spectrometry.	
4.	Apply IUPAC nomenclature rules to name bicyclic compounds, biphenyls, cumulenes, quinolines, and isoquinolines.	
5.	Understand the principles of green organic synthesis and apply them to the selection of reagents, solvents, and catalysts.	
6.	Describe concepts of stereochemistry, catalysts, reagents, and molecular rearrangements with their functional applications.	

COURSE OUTCOME NUMBER	ON COMPLETION OF THE COURSE, STUDENT WILL BE ABLE TO:	PSO ADDRESSED	BLOOMS LEVEL
CO1	Classify and analyze molecules using symmetry principles, apply molecular orbital theory, and explain metallic bonding through band theory.	PSO1, PSO2, PSO3, PSO4.	remember, understand, apply and analyze (L1,2,3,4.)
CO2	Understand the placing of lanthanides in the f block, based on electronic configuration, their physical properties, lanthanide contraction and its impact on the post lanthanide elements, difficulties in their separation and methods of separation.	PSO1, PSO2, PSO3.	remember, understand, apply (L1,2,3)
CO3	Understand the principles and applications of spectroscopy, green synthesis, and stereochemistry.	PSO-1, PSO-2, PSO-5	Understand (L2)
CO4	Apply IUPAC nomenclature to name various organic compounds systematically.	PSO-2, PSO-3	Apply (L3)
CO5	Analyze functional group transformations using catalysts, reagents, and molecular rearrangements.	PSO2, PSO3, PSO5.	Analyze (L4)
CO6	Utilize green chemistry principles in organic synthesis and reaction planning.	PSO5, PSO6, PSO8.	Apply (L3)

T.Y.B.Sc.	SEMESTER V THEORY
COURSE CODE RJDSCCHE352 PAPER -X INORGANIC AND ORGANIC CHEMISTRY	COURSE OUTCOME: ON SUCCESSFUL COMPLETION OF THIS COURSE, STUDENTS WILL BE ABLE TO: 1. Understand molecular symmetry, apply molecular orbital theory, and explain metallic bonding using band theory. 2. Understand the placing of lanthanides in the f block, based on electronic configuration, their physical properties, lanthanide contraction and its impact on the post lanthanide elements, difficulties in their separation and methods of separation. 3. Understand the principles and applications of spectroscopy, green synthesis, and stereochemistry. 4. Apply IUPAC nomenclature to name various organic compounds systematically. 5. Analyze functional group transformations using catalysts, reagents, and molecular rearrangements. 6. Utilize green chemistry principles in organic synthesis and reaction planning. LEARNING OUTCOME: ON SUCCESSFUL COMPLETION OF THIS COURSE, STUDENTS WILL BE ABLE TO: 1. Understand molecular symmetry, apply molecular orbital theory, and explain metallic bonding using band theory. 2. understand the placing of lanthanides in the f block, based on electronic configuration, their physical properties, lanthanide contraction and its impact on the post lanthanide elements, difficulties in their separation and methods of separation. 3. Identify and explain key concepts of UV-Visible spectroscopy, mass spectrometry, and molecular rearrangements. 4. Assign correct IUPAC names to organic compounds with different structural features. 5. Utilize green chemistry principles in organic synthesis and reaction planning. 6. Recognize the role of catalysts and reagents in selective organic transformations.

SEMESTER V (DSC – THEORY II)		Hrs.	Cr.
PAPER – X: INORGANIC AND ORGANIC CHEMISTRY	PAPER CODE: RJDSCCHE352	60	04

Unit No.	Name of the topic	Hrs.	Credits
I	Chemical Bonding (15L) 1.1 Molecular Symmetry 1.1.1 Introduction and Importance of symmetry in chemistry 1.1.2 Symmetry elements and symmetry operations. 1.1.3 Concept of a Point Group with illustrations using the following point groups: (i) $C_{\infty v}$ (ii) $D_{\infty h}$ (iii) C_{2v} (iv) C_{3v} (v) C_{2h} and (vi) D_{3h} . 1.2 Molecular Orbital Theory for Heteronuclear Diatomic Molecules and Polyatomic Species 1.2.1 Comparison between homonuclear and heteronuclear diatomic molecules. 1.2.2 Heteronuclear diatomic molecules like CO, NO and HCl 1.2.3 Molecular orbital approach for bonding in AB ₂ molecules. Application of symmetry concepts for linear and angular species considering σ -bonding only. (Examples like: BeH ₂ , ii) H ₂ O. (Terms such as: Symmetry Adapted Linear Combinations (SALCs), Ligand Group orbitals (LGOs), Walsh correlation diagram, transformation of atomic orbitals into appropriate symmetry types, expected to be discussed in unit 1.2) 1.3 Metallic bonding: 1.3.1 Band theory, explanation of electrical properties of conductors, insulators and semiconductors, intrinsic and extrinsic semiconductors.	15	01
II	Chemistry of elements (Inner transition elements) 2.1 Introduction Definition, position in periodic table and electronic configuration of lanthanides and actinides. 2.2 Chemistry of Lanthanides (i) Lanthanide contraction (ii) Oxidation states (iii) Magnetic and spectral properties, (iv) Occurrence, extraction and separation of lanthanides by Solvent extraction. (v) Applications of lanthanides. 2.3 Chemistry of Actinides 2.3.1 Comparison between lanthanides and actinides. 2.3.2 Chemistry of uranium with reference to occurrence and isolation (solvent extraction method) 2.3.3 Properties and applications of Uranium.	15	01
III	3.1 Spectroscopy (6L) 3.1.1 Introduction: Electromagnetic spectrum, units of wavelength and frequency	15	01

	3.1.2 UV–Visible spectroscopy: Basic theory, solvents, nature of UV-Visible spectrum, concept of chromophore, auxochrome, bathochromic and hypsochromic shifts, hyperchromic and hypochromic effects, chromophore- chromophore and chromophore-auxochrome interactions. 3.2.3 Mass spectrometry: Basic theory. Nature of mass spectrum. General rules of fragmentation. Importance of molecular ion peak, isotopic peaks, base peak, nitrogen rule, rule of 13 for determination of empirical formula and molecular formula. Fragmentation of alkanes and aliphatic carbonyl compounds. 3.2 IUPAC (5L) IUPAC nomenclature of the following classes of compounds (including compounds up to 2 substituents / functional groups): 3.2.1 Bicyclic compounds – spiro, fused and bridged (upto 11 carbon atoms) saturated and unsaturated compounds. 3.2.2 Biphenyls 3.2.3 Cumulenes with up to 3 double bonds 3.2.4 Quinolines and isoquinolines. 3.3 Green Organic Synthesis (4L) 3.3.1 Green synthesis: Introduction: Twelve principles, concept of atom economy and E-factor, calculations and their significance, numerical examples. i) Green reagents: dimethyl carbonate. ii) Green starting materials: D-glucose iii) Green solvents: supercritical CO₂ iv) Green catalysts: Bio catalysts. 3.3.2 Planning of organic synthesis i) o & p – Nitroanilines ii) halobenzoic acid iii) alcohols (primary / secondary / tertiary) using Grignard reagents. iv) alkanes (using organolithium compounds)		
IV	4.1 Stereochemistry - I (4L) 4.1.1 Molecular chirality and elements of symmetry: Mirror plane symmetry, inversion center, rotation-reflection (alternating) axis. 4.1.2 Chirality of compounds without a stereogenic centre: cumulenes and biphenyls. 4.2 Catalysts and reagents (7L) Study of the following catalysts and reagents with respect to functional group transformations and selectivity (no mechanism). 4.2.1 Catalysts: Catalysts for hydrogenation: a. Raney Nickel b. Pt and PtO₂(C=C, CN, NO₂, aromatic ring) c. Pd/C: C=C, COCl→CHO (Rosenmund) d. Lindlar catalyst: alkynes.	15	01

4.2.2 Reagents: a. LiAlH_4 (reduction of CO, COOR, CN, NO_2) b. NaBH_4 (reduction of CO) c. SeO_2 (oxidation of CH_2 alpha to CO) d. mCPBA (epoxidation of $\text{C}=\text{C}$) e. NBS (allylic and benzylic bromination) 4.3 Molecular Rearrangement (4L) Mechanism of the following rearrangements with examples and stereochemistry wherever applicable. 4.3.1 Migration to the electron deficient carbon: Pinacol-pinacolone rearrangement. 4.3.2 Migration to the electron deficient nitrogen: Beckmann rearrangement. 4.3.3 Migration involving a carbanion: Favorski rearrangement.		
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REFERENCES FOR UNIT I & II

1. Modern Inorganic chemistry Satya prakash, R.D.Madan, 1986, S.Chand & Company Ltd.
2. Solid State Chemistry and its applications 2nd edition by A.R. West
3. Advanced Inorganic Chemistry, 3rd edition, F.A. Cotton and G. Wilkinson
4. Concise Inorganic chemistry 5th edition, J.D. Lee, 2005, Blackwell Science Publication.
5. Inorganic chemistry principles of structure and reactivity, 4th Edition. J.E.Huheey, 1993, Addison-Wesley Publication Company.

REFERENCES FOR UNIT III & IV

1. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson.
2. Organic chemistry, 8th edition, John McMurry

DSC-PRACTICALS

SEMESTER V		Hrs.	Cr.
DSC PRACTICAL -I: PHYSICAL AND ANALYTICAL CHEMISTRY		60	02
PAPER CODE: RJDSCCHEP351			
Sr. No.	Name of the topic	No. of Hrs.	Credits
1	1.1 Surface chemistry: 1. Investigation of the adsorption of acetic acid on activated charcoal. 2. Determination of surface area of adsorbents by BET method.	60	02
2	2.1 Molecular spectroscopy: 1. Analysis of the given vibration-rotation spectrum of HCl (g). 2. Analysis of IR and Raman spectra of CO ₂ & SO ₂ . 3. Recording of IR spectrum of a compound (that is prepared during regular practical). 4. NMR / ESR spectral analysis of a compound (that is prepared during regular practical).		
3	3.1 Titrations (redox, complexometric & precipitation): 1. Determination of the amount of persulphate in the given sample solution by back titration with standard Fe(II) ammonium sulphate solution. 2. Estimation of the amount of glucose in honey by Willstatter's method. 3. Determination of the number of electrons in the redox reaction between ferrous ammonium sulphate and ceric sulphate potentiometrically. 4. Determination of the amounts of iodide, bromide, and chloride in the mixture by potentiometric titration with silver nitrate solution. 5. Estimation of oxalic acid and sodium oxalate in a given mixture.		
4	4.1 Flame photometry: 1. Determination of the sodium content of a fertilizer by flame photometry (calibration curve method). 2. Estimation of the amount of potassium in the given commercial salt sample by flame photometry (regression method).		
5	5.1 Turbidimetry: 1. Determination of the amount of sulphate present in the given water sample turbidimetrically (calibration curve method). 2. Determination of Cl ⁻ by turbidimetric titration method.		
REFERENCES: 1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels, 3rdEd. ELBS (1964) 2. Vogel's textbook of quantitative chemical analysis, Sixth Ed. Mendham, Denny, Barnes, Thomas, Pearson education			

SEMESTER V (DSC PRACTICAL -II)		Hrs.	Cr.
DSC PRACTICAL -II: INORGANIC AND ORGANIC CHEMISTRY		30	02
PAPER CODE: RJDSCCHEP352			
Sr. No.	Name of the topic	No. of Hrs.	Credits
1	1.1 Inorganic Preparations: 1. Preparation of tris-(acetylacetonato)iron (III) 2. Preparation of bis-(dimethylglyoximate)nickel (II) 3. Preparation of Mercury tetrathiocynato cobaltate(II) 4. Preparation of potassium trioxalatoferrate(III) 1.2 Inorganic Estimations / Analysis: 1. Estimation of copper Iodometrically. 2. Estimation of magnesium from the supplied commercial sample of milk of magnesia 3. Estimation of Pb^{2+} by Complexometric titration. 2.1 Separation of solid-solid mixture (2.0 g mixture given) 1. Minimum Six mixtures to be completed by the students.	60	02
2	2. Components of the mixture should include water soluble and water insoluble acids (carboxylic acid), water insoluble phenols(2-naphthol, 1-naphthol), water insoluble bases (nitroanilines) , water soluble(urea ,thiourea) and water insoluble neutral compounds(anilides , amides, m-DNB, hydrocarbons) 3. A sample of the mixture to be given to the student for detection of the chemical type of the mixture. 4. After correct determination of chemical type, the fixing reagent should be decided by the student for separation. 5. After separation into component A and component B, a) One component (decided by the examiner) is to be analyzed and detected. This component is not to be weighed. b) The other component is dried, weighed and the m.p. is to be determined.		
REFERENCES: 1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels, 3rdEd. ELBS (1964) 2. Vogel's textbook of quantitative chemical analysis, Sixth Ed. Mendham, Denny, Barnes, Thomas, Pearson education			

SEM VI SYLLABUS

DSC-THEORY

PAPER - XI

SEMESTER		SEM – VI
TITLE OF THE SUBJECT / COURSE		PHYSICAL AND ANALYTICAL CHEMISTRY
COURSE CODE		RJDSCCHE361
CEDITS		04
DURATION		60 Hrs.

LEARNING OBJECTIVE	
1.	To understand the concept of ionic strength, activity and activity coefficient. Able to explain concept of concentration cells.
2.	To apply the electrochemistry concept to real electrochemical problems including decomposition potential and overvoltage.
3.	Explain the principles, theory, and key terminologies of Gas Chromatography (GC).
4.	Explain the principle of Ion Exchange Chromatography, types of ion exchangers, and ideal resin properties.
5.	Understand the principles and significance of HPLC in analytical chemistry.
6.	Explain the principles, stationary phases, sample applications, and mobile phases of HPTLC.

COURSE OUTCOME NUMBER	ON COMPLETION OF THE COURSE, STUDENT WILL BE ABLE TO:	PSO ADDRESSED	BLOOMS LEVEL
CO1	Learn to understand the ionic strength and determine ionic strength of the mixtures of electrolytes. Calculate the activity and activity coefficient of different types of solutions of electrolytes.	PSO1, PSO2.	remember, understand, (L1,2)
CO2	Understand the concepts of different types of concentration cells.	PSO1, PSO2, PSO4.	remember, understand, apply (L1,2,3)
CO3	Determine the Nernst equations for electrolyte and electrode concentration cells. Apply the decomposition potential and overvoltage problems.	PSO-1, PSO-2, PSO-5	Understand (L2)
CO4	Apply the decomposition potential and overvoltage problems.	PSO-1, PSO-2, PSO8	Understand (L2)
CO5	Explain the principles, instrumentation, and applications of Gas Chromatography (GC), including different detectors and comparisons between GSC and GLC.	PSO1, PSO2, PSO5.	Understand (L2)
CO6	Describe the principles and mechanisms of Ion Exchange Chromatography, including equilibria, selectivity factors, and its applications in demineralized	PSO1, PSO2, PSO8.	Understand (L2)

	water preparation and amino acid separation.		
CO7	Explain the fundamental principles of D.C. Polarography, including electrode behaviour, diffusion current, Ilkovic equation, and analytical applications.	PSO2, PSO3, PSO5.	Apply (L3)
CO8	Apply quantitative techniques in polarography using calibration curves and standard addition methods for chemical analysis.	PSO1, PSO2, PSO5.	Analyse (L4)

T.Y.B.Sc.	SEMESTER VI THEORY
COURSE CODE RJDSCCHE361 PAPER -XI PHYSICAL AND ANALYTICAL CHEMISTRY	COURSE OUTCOME: ON SUCCESSFUL COMPLETION OF THIS COURSE, STUDENTS WILL BE ABLE TO: 1. Understand ionic strength, activity and activity coefficient. 2. Learn the concept of concentration cells and calculate EMF for concentration cells using Nernst equation. 3. Learn the basic principles of Solid State Chemistry. 4. Learn the phenomenon dealing with number of solute particles. Understand the techniques to determine the molecular weights from colligative measurements. 5. Apply knowledge of High-Performance Liquid Chromatography (HPLC) instrumentation and its use in qualitative and quantitative analysis. 6. Analyze High-Performance Thin Layer Chromatography (HPTLC) techniques, including its detectors, advantages, and comparison with conventional TLC. 7. Describe the basic principles and instrumentation of mass spectrometry, focusing on the magnetic sector analyzer and its applications. 8. Analyze thermal methods, including thermogravimetric analysis (TGA), and their applications in material characterization LEARNING OUTCOME: ON SUCCESSFUL COMPLETION OF THIS COURSE, STUDENTS WILL BE ABLE TO: 1. Understand and evaluate the concept of ionic strength, activity and activity coefficient of different electrolyte solution. Learn the basics of concentration cells, types of concentration cells and to evaluate the emf of these cells. 2. Understand the principle of salt bridge and liquid junction potential. Apply the principles of decomposition potential, overvoltage and polarization in electrochemical cells. 3. Learn the mathematical correlation between structure and X-ray diffractogram. 4. Apply colligative measurements in determining the molecular weight of solute. 5. Perform qualitative and quantitative analysis using GC and compare Gas-Solid Chromatography (GSC) and Gas-Liquid Chromatography (GLC).

	6. Analyze ion exchange equilibria, selectivity coefficients, and factors affecting ion separation. 7. Describe HPLC instrumentation, including solvent reservoirs, degassing systems, pumps, precolumns, sample injection systems, columns, and detectors (UV-Visible, RI). 8. Evaluate the advantages, disadvantages, and applications of HPTLC and compare it with conventional Thin Layer Chromatography (TLC).
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SEMESTER VI (DSC – THEORY I)		Hrs.	Cr.
PAPER – XI: PHYSICAL AND ANALYTICAL CHEMISTRY		60	04
PAPER CODE: RJDSCCHE361			
Unit No.	Name of the topic	No. of Hrs.	Credits
I	1.1 Electrochemistry – II (15 L) 1.1.1 Activity and activity coefficient: Lewis concept, ionic strength, mean ionic activity and mean ionic activity coefficient of an electrolyte, expression for activities of electrolytes. Debye - Huckel limiting law (No derivation). 1.1.2 Classification of cells: Chemical cells and concentration cells. Chemical cells with and without transference, Electrode Concentration cells, Electrolyte concentration cells with and without transference (derivations and numerical problems are expected). 1.1.3 Determination of thermodynamic parameter (ΔG , ΔH & ΔS) for cell reactions. 1.1.4 Polarization: Definition, concentration polarization and its elimination. 1.1.5 Decomposition potential: Definition, experimental determination, and factors affecting decomposition potential. 1.1.6 Overvoltage: Definition, Tafel's equation for hydrogen overvoltage, experimental determination of overvoltage.	15	01
II	2.1 Solid State (5L) 2.1.1 Laws of crystallography. 2.1.2 Derivation and problems based on Braggs equation. 2.1.3 Different lattices: SC, BCC, FCC and interplanar spacing. X-ray tube, density of crystals. Structure of NaCl. 2.2 Colligative Properties of Dilute Solutions (10 L) 2.2.1 Relative lowering of vapour pressure, measurement of lowering of vapour pressure – static and dynamic methods. 2.2.2 Elevation in boiling point of a solvent in solution, thermodynamic derivation relating elevation in boiling point and molar mass of non-volatile solute. 2.2.3 Depression in freezing point of a solvent in solution, thermodynamic derivation relating the depression in the freezing point and the molar mass of the non-volatile solute. Beckmann method and Rast method.	15	01

	2.2.4 Osmotic pressure, thermodynamic derivation of van't Hoff equation, van't Hoff factor, measurement of osmotic pressure - Berkeley and Hartley's method.		
III	3.1 Gas Chromatography (Numerical and word problems are expected) (4L) 3.1.1 Introduction, principle, theory, and terms involved 3.1.2 Instrumentation: Block diagram and components. types of columns, stationary phases in GSC and GLC, detectors: TCD, FID, ECD. 3.1.3 Applications: Qualitative and quantitative analyses 3.1.4 Comparison between GSC and GLC. 3.2 Ion Exchange Chromatography (4L) 3.2.1 Introduction, principle 3.2.2 Types of ion exchangers, ideal properties of resin. 3.2.3 Ion exchange equilibria and mechanism, selectivity coefficient and separation factor, factors affecting separation of ions. 3.2.4 Application of ion exchange chromatography with reference to preparation of demineralized water, separation of amino acids. 3.3 High performance Liquid Chromatography (HPLC) (4L) 3.3.1 Introduction and principle 3.3.2 Instrumentation components with their significance: solvent reservoir, degassing system, pumps-(reciprocating pumps, screw driven-syringe type pumps, pneumatic pumps, advantages, and disadvantages of each pump). precolumn, sample injection system, HPLC columns, detectors (UV - Visible detector, refractive index detector) 3.3.3 Qualitative and quantitative applications of HPLC 3.4 High Performance Thin Layer Chromatography (HPTLC): (3L) 3.4.1 Introduction and Principle Stationary phase, Sample application and mobile phase 3.4.2 Detectors (a) Scanning Densitometer-components, types of Densitometer-Single beam and Double beam (b) Fluorometric Detector 3.4.3 Advantages, disadvantages, and applications 3.4.4 Comparison of TLC and HPTLC	15	01
IV	2.1 D.C. Polarography (8 L) Polarizable and nonpolarizable electrodes, basic principles, residual current, diffusion current, limiting current, dropping mercury electrode, supporting electrolyte, half wave potential, derivation of the polarographic wave equation for a reversible reaction, Ilkovic equation, oxygen interference and its removal, maxima and maxima suppressors, polarographic cell, qualitative and quantitative analysis, calibration curve and standard addition method, applications. [numerical problems expected] 2.2 Introduction to mass spectrometry (3 L) Basic principle, instrumentation (magnetic sector analyser) and applications. 2.3 Thermal methods (4 L) Classification of thermal methods, thermogravimetric analysis, basic principles, instrumentation, factors affecting the TG curve, applications.	15	01

REFERENCES FOR UNIT I & II

1. Modern Electrochemistry, J.O.M Bockris & A.K.N. Reddy, Maria Gamboa – Aldeco 2nd Edition, 1st Indian reprint, 2006 Springer
2. Principles of Solid State, H. V. Keer, 3rd Edition, New Age international Publishers
3. Principles of Physical Chemistry, Puri, Sharma, Pathania, 49th edition, Vishal publishers.

REFERENCES FOR UNIT III & IV)

1. Analytical Chemistry Skoog, West, Holler, 7th Edition:
2. Analytical chemistry, R. K. Dave.
3. Analytical chemistry David Harvey, The McGraw Hill Companies, Inc.
4. Analytical Chromatography, Gurdeep R Chatwal, Himalaya publication
5. Basic Concepts of Analytical Chemistry, by S M Khopkar, new Age International (p) Limited

PAPER - XII

SEMESTER	SEM – VI
TITLE OF THE SUBJECT / COURSE	INORGANIC AND ORGANIC CHEMISTRY
COURSE CODE	RJDSCCHE362
CEDITS	04
DURATION	60 Hrs.

LEARNING OBJECTIVE	
1.	Understand the types of electronic transitions, selection rules, determine terms and microstates for transition metal atoms and ions and study the stability and reactivity of metal complexes based on thermodynamic and kinetic principles.
2.	Understand crystal field theory, splitting of d orbitals in different geometries, calculate crystal field stabilization energy, the effect of crystal field splitting on various properties of octahedral complexes and the molecular orbitals theory of octahedral complexes.
3.	Understand the principles and applications of IR and PMR spectroscopy in structure determination.
4.	Describe the properties, synthesis, and structure of biomolecules, including amino acids, polypeptides, and nucleic acids.
5.	Understand stereochemistry concepts, including stereoselectivity, stereospecificity, and reaction mechanisms.
6.	Analyse the reactivity, synthesis, and reactions of heterocyclic compounds like pyridine-N-oxide, quinoline, and isoquinoline.

COURSE OUTCOME NUMBER	ON COMPLETION OF THE COURSE, STUDENT WILL BE ABLE TO:	PSO ADDRESSED	BLOOMS LEVEL
CO1	Under and analyze electronic transitions, apply selection rules, determine terms and microstates for transition metal ions, and evaluate the stability and reactivity of metal complexes	PSO1, PSO2, PSO3, PSO4.	Remember, Understand, Apply, Analyse. (L1,2,3,4)
CO2	Understand crystal field theory, splitting of d orbitals in different geometries, calculate crystal field stabilization energy, analyze the effect of crystal field splitting on various properties of octahedral complexes and draw the molecular orbitals of octahedral complexes.	PSO1, PSO2, PSO3, PSO4.	Remember, Understand, Apply, Analyse. (L1,2,3,4)
CO3	Understand the principles and applications of IR and PMR spectroscopy in organic structure determination.	PSO-1, PSO-2, PSO-5	Understand (L2)
CO4	Explain the properties, synthesis, and structural aspects of biomolecules.	PSO-1, PSO-2, PSO8	Understand (L2)
CO5	Apply stereochemistry concepts to substitution, elimination, and addition reactions.	PSO2, PSO3, PSO5.	Apply (L3)
CO6	Utilize green chemistry principles in organic synthesis and reaction planning.	PSO1, PSO2, PSO5.	Analyse (L4)

T.Y.B.Sc.	SEMESTER VI THEORY
COURSE CODE RJDSCCHE362 PAPER -XII INORGANIC AND ORGANIC CHEMISTRY	COURSE OUTCOME: ON SUCCESSFUL COMPLETION OF THIS COURSE, STUDENTS WILL BE ABLE TO: 1. Understand electronic transitions, apply selection rules, determine terms and microstates for transition metal ions, and analyze the stability and reactivity of metal complexes. 2. Understand crystal field theory, splitting of d orbitals in different geometries, calculate crystal field stabilization energy, its consequences on various properties of complexes and molecular orbital theory of octahedral complexes. 3. Understand the principles and applications of IR and PMR spectroscopy in organic structure determination. 4. Explain the properties, synthesis, and structural aspects of biomolecules. 5. Apply stereochemistry concepts to substitution, elimination, and addition reactions. 6. Utilize green chemistry principles in organic synthesis and reaction planning. LEARNING OUTCOME: ON SUCCESSFUL COMPLETION OF THIS COURSE, STUDENTS WILL BE ABLE TO: 1. Understand electronic transitions, apply selection rules, determine terms and microstates for transition metal ions, and analyze the stability and reactivity of metal complexes. 2. Understand crystal field theory, splitting of d orbitals in different geometries, calculate crystal field stabilization energy, its consequences on various properties of complexes and molecular orbital theory of octahedral complexes. 3. Interpret IR and PMR spectra for identifying organic compounds. 4. Explain the structure, properties, and synthesis of biomolecules. 5. Apply stereochemistry concepts to various organic reactions. 6. Describe the synthesis and reactivity of heterocyclic compounds.

SEMESTER VI (DSC – THEORY II)		Hrs.	Cr.
PAPER – XII: INORGANIC AND ORGANIC CHEMISTRY		60	04
PAPER CODE: RJDSCCHE362			
Unit No.	Name of the topic	No. of Hrs.	Credits
I	Properties of Coordination compounds (15L) 1.1 Electronic Spectra 1.1.1 Origin of Electronic spectra 1.1.2 Types of electronic transitions in coordination compounds: intra–ligand, charge transfer and intra-metal transitions 1.1.3 Selection rules for electronic transitions: Spin and Laporte selection rules. 1.1.4 Electronic configuration and electronic micro states, Terms and terms symbols, coupling of spin momenta (M_s), orbital momenta (M_l) and spin orbit coupling or Russell-Saunders coupling. 1.1.5 Determination of terms for p^2 and d^2 electronic configurations. 1.1.6 Terms and micro states for transition metal atoms/ions. 1.1.7 Orgel Diagrams for D and F Terms (i.e, d^1 to d^9 electronic configurations in octahedral co-ordination compounds). 1.2 Stability of Complexes 1.2.1 Thermodynamic stability and kinetic stability of complexes with examples. 1.2.2 Stability constants: Stepwise and overall stability constants and their interrelationship. 1.2.3 Factors affecting thermodynamic stability. (Factors related to nature of central metal atom, nature of ligand, chelate effect to be discussed) 1.3 Reactivity of Metal Complexes: 1.3.1 Comparison between inorganic and organic reactions. 1.3.2 Types of reactions in metal complexes. 1.3.3 Inert and labile complexes: (Correlation between electronic configurations and lability of complexes.) 1.3.4 Ligand substitution reactions: Associative and Dissociative mechanisms. 1.3.5 Acid hydrolysis, base hydrolysis and anation reactions.	15	01
II	Co-ordination Chemistry: (15L) 2.1 Theories of the Metal-Ligand Bond 2.1.1 Limitations of VBT. 2.1.2 Crystal field theory and effect of crystal field on central metal valence orbitals in various geometries. 2.1.3 Splitting of d orbitals in octahedral, tetrahedral and square planar crystal fields. 2.1.4 Distortions from the octahedral geometry ;(i) effect of ligand field and (ii) Jahn-Teller distortions. 2.1.5 Crystal field splitting parameters Δ_o , its calculation and factors affecting it in octahedral complexes, spectrochemical series.	15	01

	2.1.6 Crystal field stabilization energy (CFSE), calculation of CFSE, for octahedral complexes with d^1 to d^{10} metal ion configuration. 2.1.7 Consequence of crystal field splitting on various properties such as ionic radii, hydration energy, lattice energy, enthalpies of formation, colour and magnetic properties. 2.1.8 limitations of CFT: Evidence for covalence in metal complexes: i) intensities of d-d transitions, ii) ESR spectrum of $[\text{IrCl}_6]_2$, iii) Nephelauxctic effect, iv) NMR spectra 2.2 Molecular Orbital Theory (MOT) of Coordination Compounds 2.2.1 Identification of central metal orbital's and their symmetry suitable for formation of π-bonds with ligands orbitals. 2.2.2 Construction of ligand group orbitals. 2.2.3 Construction of π-molecular orbitals for an ML_6 complex.		
III	3.1 Spectroscopy II (10 L) 3.1.1 IR Spectroscopy: Basic theory, nature of IR spectrum, selection rule, fingerprint region. Applications of IR spectroscopy. 3.1.2. PMR Spectroscopy: Basic theory of NMR, nature of PMR spectrum, chemical shift (δ unit), standard for PMR, solvents used. Factors affecting chemical shift: (1) inductive effect (2) anisotropic effect (with reference to $\text{C}=\text{C}$, $\text{C}\equiv\text{C}$, $\text{C}=\text{O}$ and benzene ring). Spin-spin coupling and coupling constant. Application of deuterium exchange. Application of PMR in structure determination. Spectral characteristics of following classes of organic compounds, including benzene and mono substituted benzenes, with respect to IR and PMR: (1) alkanes (2) alkenes (3) alkynes (4) halo alkanes (5) alcohols (6) carbonyl compounds (7) ethers (8) amines (broad regions characteristic of different groups are expected). Problems of structure elucidation of simple organic compounds using individual or combined use of IR, Mass and NMR spectroscopic technique are expected. (Index of hydrogen deficiency should be the first step in solving the problems). 3.2 Biomolecules (5L) 3.2.1 Properties: pH dependency of ionic structure, isoelectric point and Zwitter ion. Methods of preparations: Strecker synthesis, amidomalonate synthesis, Erlenmeyer azalactone synthesis. 3.2.2 Polypeptides and Proteins: Polypeptides: Peptide bond. Nomenclature and representation of polypeptides (di- and tri-peptides) with examples. Merrifield solid phase nucleotide synthesis. 3.2.3 Nucleic Acids Controlled hydrolysis of nucleic acids. sugars and bases in nucleic acids. Structures of nucleosides and nucleotides in DNA and RNA. Structures of nucleic acids (DNA and RNA) including base pairing.	15	01
IV	4.1 Stereochemistry-II (8L)	15	01

	4.1.1 Stereoselectivity and stereospecificity: Idea of enantioselectivity (ee) and Diastereoselectivity (de), Topicity: enantiotopic and diastereotopic atoms, and faces. 4.1.2 Stereochemistry of – i) Substitution reactions: SN^i (reaction of alcohol with thionyl chloride) ii) Elimination reactions: $E2$–Base induced dehydrohalogenation of 1-bromo-1,2-diphenylpropane. iii) Addition reactions to olefins: a) bromination (electrophilic, anti-addition) b) Syn hydroxylation with OsO_4 and $KMnO_4$ c) Epoxidation followed by hydrolysis. 4.2 Heterocyclic chemistry: (7L) 4.2.1 Reactivity of pyridine-N-oxide, quinoline and iso-quinoline. 4.2.2 Preparation of pyridine-N-oxide, quinoline (Skraup synthesis) and iso- quinoline (Bischler- Napieralski synthesis). 4.2.3 Reactions of pyridine-N-oxide: halogenation, nitration and reaction with $NaNH_2$ / liq.NH_3, n-BuLi. 4.2.4 Reactions of quinoline and iso-quinoline; oxidation, reduction, nitration, halogenation and reaction with $NaNH_2$ / liq.NH_3, n-BuLi.		
REFERENCES FOR UNIT I & II 1. Modern Inorganic chemistry Satya Prakash, R.D.Madan, 1986, S.Chand & Company Ltd. 2. Solid State Chemistry and its applications 2nd edition by A.R. West 3. Advanced Inorganic Chemistry, 3rd edition, F.A. Cotton and G. Wilkinson 4. Concise Inorganic chemistry 5th edition, J.D. Lee, 2005, Blackwell Science Publication. 5. Inorganic chemistry principles of structure and reactivity, 4th Edition. J.E.Huheey, 1993, Addison-Wesley Publication Company.			
REFERENCES FOR UNIT III & IV) 1. Organic Chemistry, 7th Edition, R.T. Morrison, R. N. Boyd & S. K. Bhattacharjee, Pearson. 2. Organic chemistry, 8th edition, John McMurry			

DSC-PRACTICALS

SEMESTER VI		Hrs.	Cr.
DSC PRACTICAL -I: PHYSICAL AND ANALYTICAL CHEMISTRY		60	02
PAPER CODE: RJDSCCHEP361			
Sr. No.	Name of the topic	No. of Hrs.	Credits
1	1.1 Electrochemistry 1. Estimation of the amount of each base in a mixture containing a weak base and a strong base by titrating against a strong acid conductometrically. 2. Determination of isoelectric point of an amino acid (glycine) pH-metrically. 3. Potentiometric determination of the solubility product and solubility of AgCl by using a chemical cell.	60	02
2	2.1 Solid state 1. Analysis of crystal structure from X-ray diffraction spectra and calculation of interplanar spacing (d). (at least two compounds).		
3	3.1 Colligate properties 1. Determination of the elevation in boiling point /depression in freezing point of a solvent.		
4	4.1 GC 1. Interpretation of the gas chromatograms of H ₂ , CO, CO ₂ , CH ₄ and their mixtures.		
5	5.1 Ion exchange chromatography 1. Determination of the percentage purity of a sample of common salt using a cation exchange resin (Amberlite IR 120). 2. Separation of Zn ²⁺ and Mg ²⁺ by using an anion exchange resin and estimation of each in a mixture complexometrically. 3. Determination of the ion exchange capacity of a cation or an anion exchange resin.		
6	6.1 TGA 1. Interpretation of TGA curves (any two).		
7	7.1 Colorimetry/spectrophotometry 1. Estimation of the amount of Fe(III) in the complex formation with salicylic acid by static method. 2. Simultaneous determination of Cu ²⁺ and Ni ²⁺ ions colourimetrically/spectrophotometrically. 3. Determination of the composition of a mixture containing K ₂ Cr ₂ O ₇ and KMnO ₄ spectrophotometrically.		
REFERENCE: 1. Vogel's Textbook of Quantitative Chemical analysis, sixth edition, J.Mendham et.al.			

SEMESTER VI (DSC PRACTICAL -II)		Hrs.	Cr.
DSC PRACTICAL -II: INORGANIC AND ORGANIC CHEMISTRY		60	02
Sr. No.	Name of the topic	No. of Hrs.	Credits
2	Inorganic Preparations: 1. Preparation of Tris-(ethylenediamine) Ni (II)Thiosulphate 2. Preparation of Tetraammine copper (II)sulphate 3. Preparation of Magnesium oxinate 4. Calcium oxalate using PFHS technique 5. preparation of dichloro pyridinecobalt (II) i.e. [Co(py)₂Cl₂] Complexometric Titrations using EDTA 1. Estimation of Nickel. 2. Estimation of Copper. 3. Estimation of Magnesium 4. Estimation of Calcium 5. Estimation of cobalt (EDTA to be standardized) 2.1 Separation of liquid-liquid and liquid- solid mixture. 1. Minimum Six mixtures to be completed by the students. 2. Components of the liq-liq mixture should include volatile liquids like acetone, methylacetate, ethylacetate, isopropylalcohol,ethyl alcohol,EMK and non volatile liquids like chlorobenzene , bromobenzene, aniline, N,Ndimethylaniline, acetophenone, nitrobenzene, ethyl benzoate. 3. Components of the liq- solid mixture should include volatile liquids like acetone, methylacetate, ethylacetate, ethyl alcohol, IPA, EMK and solids such as water insoluble acids, phenols, bases, neutral. 4. A sample of the mixture one ml to be given to the student for detection of the physical type of the mixture. 5. After correct determination of physical type, separation of the mixture to be carried out by using distillation method. 6. After separation into component A and component B, a) In case of a liq-liq mixture, the volatile component is to be analysed and detected. The non-volatile component volume to be measured and the b.p. to be reported.(non-volatile component not to be analysed) b) In case of a liq-solid mixture, the compound to be identified can be decided by the examiner. The other component's vol/ weight and m.p/b.p to be reported.	6	02
REFERENCES: 1. Quantitative Inorganic Analysis including Elementary Instrumental Analysis by A. I. Vogels, 3rdEd. ELBS (1964) 2. Vogel's textbook of quantitative chemical analysis, Sixth Ed. Mendham, Denny, Barnes, Thomas, Pearson education.			