PG & RESEARCHDEPARTMENT OF CHEMISTRY

M.Sc., (Chemistry)-SYLLABUS

(Effect from the Academic Year 2019-2020)

NEHRU MEMORIAL COLLEGE

(Autonomous)

Nationally Accredited with 'A' Grade by NAAC

Puthanampatti – 621 007

M.Sc., CHEMISTRY

SEM	Course	Subject Title	Subject Code	Hrs/ Week	Credit	Int	Ext	Total
I	CC-I	Inorganic Chemistry-I		6	4	25	75	100
	CC-II	Organic Chemistry-I		6	4	25	75	100
	CC-III	Physical Chemistry-I		6	4	25	75	100
	CC-IV	Organic Chemistry Practical-I		6	4	40	60	100
	CC-V	Physical Chemistry Practical- I		6	4	40	60	100
II	CC-VI	Inorganic Chemistry-II		5	4	25	75	100
	CC-VII	Organic Chemistry-II		5	4	25	75	100
	CC-VIII	Inorganic Chemistry Practical-I		5	4	40	60	100
	CC-IX	Physical chemistry Practical-II		5	4	40	60	100
	EC-I	Advanced Topics in Physical Chemistry		5	5	25	75	100
	OEC-I*	Green & Industrial Chemistry/Forensic Science		5	4	25	75	100
III	CC-X	Inorganic Chemistry-III		5	4	25	75	100
	CC-XI	Organic Chemistry-III		5	4	25	75	100
	CC-XII	Physical Chemistry-III		5	4	25	75	100
	CC-XIII	Inorganic Chemistry Practical-II		5	4	40	60	100
	CC-XIV	Organic Chemistry Practical-II		5	4	40	60	100
	EC-II	Instrumentation and Material Chemistry		5	5	25	75	100
IV	EC-III	Special Topics in Organic Chemistry		6	5	25	75	100
	EC-IV	Electro and Surface Chemistry		6	5	25	75	100
	PW	Project Work**		18	10	25	75	100
		Grand Total		**120**	**90**	**500**	**1500**	**2000**

****Dissertation:**

Two Reviews (20+20) = 40 Marks
Report Valuation = 40 Marks
External Viva-Voce = 20 Marks

- CC-Core Course; EC-Elective Course
- OEC-I* to be offered by the Chemistry Department
  (Green &Industrial Chemistry (or) Forensic science).
- Except for Practical (6 hrs), End Semester Examination Hours for each course – 3 Hrs

PG & RESEARCH DEPARTMENT OF CHEMISTRY

NEHRU MEMORIAL COLLEGE (AUTONOMOUS)

PUTHANAMPATTI - 621007

M.Sc., PROGRAMME IN CHEMISTRY (CBCS)

(For the candidate to be admitted from the year 2019 onwards)

Semester	Courses	No. of Credits
I	5 Core courses	20
II	4 Core course 1 Elective Core 1 Open Elective course	25
III	5Core courses 1Elective courses	25
IV	2 Elective courses 1 Project	20
TOTAL	**20 courses**	**90 credits**

NEHRU MEMORIAL COLLEGE (AUTONOMOUS)

(Nationally Accredited with 'A' Grade)

PUTHANAMPATTI - 621007.

PG Programme (Chemistry)

(For the candidates admitted from 2019 – 2020 onwards)

Bloom's Taxonomy Based Assessment Pattern

Knowledge Level

K1 – Acquire/Remember; **K2** – Understanding; **K3** – Apply; **K4** – Evaluate; **K5** – Analyze

1. Part I, II and III

(a) Theory (External + Internal = 75 + 25 = 100 marks)

External/Internal					
Knowledge Level	**Section**	**Marks**	**Hrs**	**Total**	**Passing Mark**
K1-K4	A (Answer all)	20 × 1= 20	3	75	38
K3-K5	B (Either or pattern)	5 × 5 = 25			
K1, K3-K5	C (Answer 3 out of 5)	3 × 10 = 30			
Internal					
Components	**Maximum Marks**	**Conversion**	**Hrs**	**Total**	**Passing Mark**
CA 1	75	10	3	25	12
CA 2	75	10	3		
Seminar	20	5	-		
			Total	**100**	**50**

(b) Lab (External + Internal = 60 + 40 = 100 marks)

External					
Knowledge Level	**Section**	**Marks**	**Hrs**	**Total**	**Passing Mark**
K3,K4,K5	Part A	20	3	60	30
K3,K4,K5	Part B	30			
---	Record	10			
Internal					
Knowledge Level	**Section**	**Marks**	**Hrs**	**Total**	**Passing Mark**
K3, K4, K5	Practical	40	3	40	10
			Total	**100**	**40**

PROGRAMMEEDUCATIONAL OBJECTIVE (PEO):

PEO 1:Technical Proficiency:

The program gives success in getting employment in different areas, such as government, public and private sectors.

PEO 2: Professional Growth:

- Display to a high level a symmetric and in depth knowledge of their chosen areas of chemistry discipline.
- Demonstrate the standard and specialized technical skills required to safely operate in a research environment related to the chosen specialism.
- Demonstrate and ability to take significant responsibility and work in a self-directed manner both along and in groups and be able to act in a wide variety of professional levels and context both within and outside the discipline.
- Develop learning skills that allow then to self-evaluate and take responsibility for self-directed for their study within or outside the discipline all in continuous professional development

PEO 3: Management Skills:

- Be aware of and be able to manipulate online recourses for the collections and collation of literatures
- Demonstrate ability in critically analyzing and communicating complex sets of data verbally and in written form and have the insight to be able to scrutinize and reflect on aspects of the discipline
- This program helps each individual in developing personality skills like time management, crisis management, stress management, interviews and working as a team and group.

Programme Outcome (PO):

PO: 1 Theory and knowledge upon completion of the general chemistry sequence, chemistry major snare able to recognize and apply the principlesof atomic and molecular structure to predict chemical properties and chemical reactivity.

PO: 2 Laboratory skills, upon completion of a degree, chemistry majors are able to employ critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments, at a level suitable to succeed at an entry-level position in chemical industry or a chemistry graduate programme.

PO: 3 Quantitative skills; upon completion of a chemistry degree, chemistry majors are able to interpret and analyze quantitative data.

PO: 4 Students should be able to work in a chemical or related field.

PO: 5 Students should be able to do the research opportunities to pursue Ph.D. programme targeted approach of CSIR – NET examination. Enormous job opportunities at the level of chemical, pharmaceutical, food products, life oriented material industries.

Programme Specific outcome (PSO):

PSO: 1Gains complete knowledge about all fundamental aspects of all the elements of chemistry.

PSO: 2 Understands the backgrounds of organic reaction mechanism, complex chemical structures, and instrumental method of chemical analysis, molecular rearrangements and separation techniques.

PSO:3 Appreciates the importance of various elements present in the periodic table, coordination chemistry and structure of molecules, properties of compounds, structural determination of the complexes using theory and instruments

PSO: 4 Gathers attention about the physical aspects of atomic structure, dual behavior, reaction pathway with respect to time , various energy transformations, molecular assembly in Nano level, significance of electrochemistry, molecular segregation using the each symmetry

PSO: 5 Learns about the potential uses analytical Industrial chemistry, Medical chemistry and Green chemistry. Carryout experiments in the area of organic analysis, estimation, Separation, derivative process, inorganic, semi micro analysis, preparation, conductometric and potentiometric analysis.

Course code & Title	CC-I- INORGANIC CHEMISTRY -I		
I M.Sc., Chemistry	Semester -I	Credits: 4	Hrs/Wk: 6
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim • understand the basic concepts of Inorganic Chemistry including nomenclature, structure and bonding • to familiar the acid and base concept • Outline the concepts of main group chemistry such as B, P, S and inter-halogens. • To know about the oxy acids of sulphure and phosphorous • Provide and introduce the concepts of solid state and crystal chemistry.		

UNIT – I - Basic Concepts of Inorganic Chemistry

1.1 The periodic properties of elements –Ionic radii, ionization potential, electron affinity, electronegativity.

1.2 Structure and bonding: Atomic orbitals- shapes and orientation, electronic configuration of atoms(L-S Coupling);basic concepts of hybridization; Molecular orbitals and electronic configuration of homonuclear diatomic molecules H_2,N_2,O_2,F_2;VSEPR theory–Shapes of poly atomic molecules (CO_2, SO_3, NH_4, H_2O). Types of chemical bond, intermolecular forces (weak and strong).

UNIT – II - Acids and Bases

2.1 Acid-base concepts - Bronsted and Lowry, Arrhenius, Luxflood, Usanovich, Lewis, solvent system and generalized acid- base concepts; measure of acid base strength – pH, pK_a and pK_b scales; steric effect and solvation effects ; effect of substitutes on acidity of carboxylic acid.

2.2 Hard and soft acids and bases – principles, theories of hardness and softness and application of HSAB. Non – aqueous solvents – liquid ammonia, liquid HF, liquid SO_2, liquid dinitrogen tetroxide.

Unit III - Main Group Chemistry - I

3.1 Boranes- Classification, preparation of higher boranes by Stock's method and pyrolysis of diborane, reactions of diboranes with Lewis bases- symmetric and unsymmetric cleavage - types of bonds in higher boranes- the styx number, Wades rule as applied to boranes. Geometrical structures of B_4H_{10}, B_5H_9, B_5H_{11}, B_6H_{10} and $B_{10}H_{14}$. Carboranes- classification, structures of CB_5H_9, $C_2B_4H_8$, $C_3B_3H_7$ and $C_4B_2H_6$.

3.2 Borazines- Preparation, properties and structure. Difference between borazine and benzene using chemical properties. Preparation and structure of boron nitride.

3.3 Phosphazenes-Classification, Cyclophosphazenes-$(NPCl_2)_3$ and $(NPCl_2)_4$- preparation and structure .Sulphur-nitrogen compounds- Preparation and structures of S_4N_4 and S_2N_2, (SN)x.

Unit – IV - Main group chemistry – II

4.1 Nomenclature of simple inorganic compounds and its salts – Oxy acids (hypo, ous, ic, per acids), Ortho, meta and pyro acids. Oxy acids of nitrogen and their salts – Hyponitrous acids-nitrous acid – calcium ammonium nitrate (CAN) – Ammonium sulphate nitrate

4.2 Oxyacids of Phosphorus and their salts –pyrophosphorus acid – orthophosphoric acid – Triphosphoric acid - Ammonium dihydrogen phosphate – Sodium ammonium hydrogen phosphate (or) micro cosmic salt.

4.3 Oxyacids of sulphur and their salts — hyposulphurous acid – pyrosulphuric acid– Dithionic acid – Barium dithionate- polythionic acids – differences between dithionic acid and polythionic acids.

4.4 Oxyacids of halogens and their salts – hypochlorous acid –Bleaching powder – perchoric acid– potassium perchlorate – hypoiodous acid – Meta periodic acid – para periodic acid.

Unit - V - Solid State,Interhalogen and Pseudo-halogens

5.1 Lattice energy – Born – Lande equation, Kapustinski equation – structures of one, two, three- dimensional silicates - molecular sieves; structure of simple ionic-NaCl,CsCl,$CdCl_2$ and covalent solid-diamond,graphite and SiO_2; defects in solids – Schottky and Frenckel defects.

5.2 Radius ratio rule – shapes of ionic crystal – structures of metallic crystals – structures of ionic crystals – TiO_2,CaF_2, ZnS.

5.3 Inter-halogens - Preparation, reactivity, structure and hybridization of ICl, ClF_3, IF_5 and IF_7; Pseudo-halogens – Preparation, properties, structure and uses of cynogen, thiocyanogen, selenocyanogen, azido carbon disulphide.

Text books:

1. Purcell and Kotz, “Inorganic Chemistry”, Saunders Golden Sunburst Series, W.B.Saunders Company, Philadelphia.
2. F.A. Cotton and G. Wilkinson, “Advanced Inorganic Chemistry “, 4th ed., A Wiley – Interscience Publication, John – Wiley & Sons, USA.
3. G.D.Tuli, S.K.Basu and R.D.Madan, “Advanced Inorganic Chemistry”, S.Chand & company Ltd.19th ed., vol 1 & 2, 2006.

References:

1. M.C. Day and J.Selbin , “Theoretical Inorganic Chemistry “ , Affiliated East West Press Pvt. Ltd. 2nd ed., 1985.
2. J.E.Huheey, Inorganic chemistry “, 3rd ed., Harper & Row publisher, Singapore.
3. S.Glasstone, “Source Book on Atomic Enertgy “, D.Van Nostrand , New York 1967(Affiliated East-West Press ,New Delhi 1969)
4. J.D.Lee,A New Concise Inorganic Chemistry, 4th ed., ELBS, 1995.

Course Outcome:

CO: 1 To know the structure and bonding in molecules/ions and predict the structure of molecules/ions.

CO: 2 To learn the different definition of acids/bases and predict the reactions between acids and bases.

CO: 3 To know the preparation and reactions of Boron group elements.

CO: 4 To learn the selected crystal structure and to explain what kind of parameters that affects the crystal structure of the compound.

CO: 5 To become familiar with some application of oxy acids of Sulphur, phosphorous and interhalogen compounds.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	W	W	S	M	M	M	M	S
CO 2	S	S	W	W	S	M	M	M	M	S
CO3	S	M	W	W	M	M	M	M	M	S
CO 4	S	M	W	W	S	M	S	M	S	S
CO 5	S	M	S	S	W	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-II - ORGANIC CHEMISTRY -I		
I M.Sc., Chemistry	Semester –I	Credits: 4	Hrs/Wk: 6
Cognitive Level	K1 Acquire K2 Understand K3 Apply K4 Evaluate K5 Analyze		
Course Objectives	The course aim • Identify the nomenclature of Organic compounds, Structure and bonding • Compare the Aromaticity of various compounds • Predict the configurational nomenclature • Formulate the aliphatic Nucleophilic & Electrophilic substitution. • To familiarize the correlation analysis		

UNIT – I

1.1 **Nomenclature of organic compounds :**

IUPAC system of nomenclature – Naming of linear and branched alkanes, alkenes, alkynes without and with functional groups by IUPAC method. Aromatic and hetero aromatic systems – nomenclature of hetero cycles having not more than two hetero atoms such as oxygen, nitrogen and sulphur. Nomenclature of alicyclic, bicyclic and tricyclic compounds.

1.2. **Structure and Bonding:**

Inductive and Field effects; Delocalized chemical bonding – Bond energies and bond distances in compounds containing delocalized bonds, cross conjugation, resonance – steric inhibition of resonance, hyper-conjugation, keto – enol tautomerism.

UNIT – II

2.1 **Aromaticity:**

Aromaticity – definition – Huckel's and Craig's rules – effects of aromaticity on bond lengths and ring currents; aromatic characters in 3,4,5,6,7,8 member rings and non-benzenoid molecules; Anti-aromaticity; alternant and non-alternant hydrocarbons; Aromaticity of annulene – 10, 12, 14, 16and 18 annulene, sydnones and fullerenes.

2.2 **Reactive intermediates:**

Generation, stability, structure and reactivity of carbocations, non- classical carbocations, carbanions, free radicals, carbenes,nitrenes and arynes.

UNIT -III

3.1 **Stereochemistry- I:**

Stereoisomerism – definition and classification. Molecular representations – Wedge, Fischer, Newmann and Saw-horse formulae – their representations and

interconvertibility. Optical activity and chirality – types of molecules exhibiting optical activity. Dissymmetric and asymmetric molecules – Fischer projection.

3.2 **Configurational nomenclature:**

D-L and R-S configuration, Cahn-Ingold- Prelog rules for simple acyclic and cyclic chiral molecules, stereochemistry of allenes, spiranes and biphenyls – Walden inversion – asymmetric synthesis based on Cram's rule – Enantiotopic behavior and prochiral centres.

3.3 **Configuration of cyclic and bicyclic ring systems:**

Cis and Trans isomerism of three, four and five membered substituted cyclic systems- E and Z nomenclature – determination of configuration of the geometrical isomers.

UNIT – IV

4.1 **Aliphatic Nucleophilic substitution:**

S_N1 , S_N2 & S_Ni - mechanisms - effect of substrate structure, leaving group, attacking nucleophile and solvent – neighboring group participation – substitutions at allylic carbons and reactivity – ambident nucleophiles.

4.2 **Aliphatic Electrophilic substitution:**

S_E1, S_E2& S_Ei – mechanisms – effect of substrate structure, leaving group, attacking electrophile and solvent – Stark –enamine reaction – decarboxylation of aliphatic acids – halogenations of aldehydes and ketones.

UNIT – V

5.1 **Methods of determining reaction mechanisms:**

Homolytic and heterolytic cleavages of bonds – types of reaction – thermodynamic and kinetic aspects of organic reactions – energy profile diagrams – intermediate versus transition state – Hammond's postulate – isotope effects – kinetic and non – kinetic methods of determining reaction mechanisms – kinetic isotopic effect (primary and secondary) – product analysis and its importance. Cross-over experiments – stereochemical studies – isotopic labeling studies.

5.2 **Correlation analysis:**

Linear free energy relationship – Hammett equation – significance of substituent and reaction constants (σ, σ^+, σ^- and ρ) – applications and limitations of Hammett equation. Taft, Swain – Scott , Grunwald – Winstein equation and their applications.

Text books:

1. R.T. Morrison and R.N.Boyd, Organic Chemistry 6th edition, Prentice – Hall of India, 2007.
2. E.L.Eliel and S.H.Wilen, Stereochemistry of Organic Compounds, John – Wiley, 2003.
3. D. Nasipuri, Stereochemistry of Organic Compounds, 2nd edition, new age international, 1994.
4. R.K.Bansal, Organic Reaction Mechanisms, 3rd edition, Tata McGraw Hill, 2005.
5. P.S.Kalsi, Organic Reactions and their mechanisms, 4th edition, new age international, 2006.
6. P.S. Kalsi , Stereochemistry conformation and mechanism, 5th edition, new age international , 2003.

7. J.March, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 4th edition, Wiley, 1992.
8. O.P. Agarwal, Organic chemistry of Natural Products, volume I & II , 29th edition, Goel publishing houses, 2005.

References:

1. R.Panico, WH. Powell, L.Jean , C.Richer, A guide of IUPAC Nomenclature of organic compounds, 1993.
2. R.S.Cahn and O.C.Dermer, Introduction to chemical Nomenclature, 5th edition, Butterworths, 1997.
3. I.L.Finar, Organic Chemistry, Vol.II , 6th edition , pearson education, 2005.
4. F.A.Carey and R.J.Sunberg , Advanced Organic Chemistry , Parts A&B, Plenum,1984.
5. Stanley H Pine, Organic Chemistry, 5th edition, Tata McGraw –Hill, 2007.
6. Bernard Miller and Rajendra Prasad, Advanced Organic Chemistry, Reaction and Mechanisms, 2nd edition, pearson education, 2006.

Course Outcome:

CO: 1 To learnt the nomenclature of the heteronuclear aromatic compounds.

CO: 2 To learnt the concept of stereochemistry and its importance

CO: 3 To know what is aliphatic nucleophilic substitution.

CO: 4 To familiarize the various types of aliphatic nucleophilic substitution reaction and their mechanism.

CO: 5 To know the aliphatic electrophilic substitution reactions and their mechanisms and the concept of aromaticity.

Mapping

PO/PSO CO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	W	W	S	M	M	M	M	S
CO 2	S	S	M	W	S	M	M	M	M	S
CO3	S	M	W	W	M	M	M	M	M	S
CO 4	S	M	S	W	S	M	S	M	S	S
CO 5	M	S	M	S	M	W	S	S	W	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-III - PHYSICAL CHEMISTRY -I		
I M.Sc., Chemistry	Semester -I	Credits: 4	Hrs/Wk: 6
Cognitive Level	K1 Acquire K2 Understand K3 Apply K4 Evaluate K5 Analyze		
Course Objectives	The course aim • To study about the concept and theory of chemical kinetrics.. • Study the reaction rate theories and applications in chemical kinetics • Understand concept of group theory • Discuss the third law of thermodynamics. • To understand the material science		

UNIT – I - Chemical Kinetics – I

1.1 Theories of reaction rates – classical collision theory, absolute reaction rate theory (ARRT) -Statistical and thermodynamical approach – Potential energy surface – Kinetic isotopic effect. Opposing, parallel, chain and consecutive reactions.

1.2 Hinshelwood's theory – Kassel Rice and Ramsperger Theory (KRRT) – KRRM method – Slater treatment – principle of microscopic reversibility – steady state approximation – kinetical reactions between Hydrogen and bromine – gas phase auto-oxidation – hydrogen – oxygen reactions

UNIT –II - Chemical Kinetics – II

1.1. Applications of ARRT - reactions in ideal solution, reaction between ions, primary and secondary salt effect – significance of pressure on reaction rates in solution – significance of volume of activation – enzyme catalysis mechanism of single substrate reactions – Michaelis Menton law.

1.2. Fast reaction: introduction - chemical relaxation methods, T and P – jump methods, Shock tubes method, continuous and stopped flow methods, flash photolysis reaction.

UNIT – III – Thermodynamics.

1.1 Third law of thermodynamics: Need for the third law – Nernst heat theorem. Thermodynamics quantities at absolute zero – exceptions to the third law.

1.2 Gibb's free energy – Gibb's Helmholtz equation – thermodynamics of systems of variable composition – partial molar properties – chemical potential –variation of chemical potential with temperature and pressure – Gibbs Duhem equation (the experimental determination of partial molar properties not included).

1.3 Thermodynamic properties of real gases – fugacity concept – calculation of fugacity of real gas – activity and activity coefficient – definition – standard states and

experimental determinations of activity and activity coefficient of electrolytes by freezing points methods.

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.UNIT – IV - Group Theory

4.1 Elements of group theory – Group axioms, similarity transformations, conjugate elements and classes, group and subgroup, group multiplication tables, isomorphism groups.

4.2 Symmetry elements, symmetry operations and point groups, point group of molecules and their systematic identification.

4.3 Representation theory of finite groups – Matrix representation of symmetry operations – characters – reducible representations – Great orthogonality theorem – construction of character tables (C_2V&C_3V) – symmetry adapted linear combinations – projection operators.

UNIT – V - Material Science

5.1 Band Theory – introduction – conductors, insulators and semiconductors – Types of semiconductors. Solid State Defects – Types of defects. Superconductors and their applications.

5.2 Liquid crystals – classification – smectic liquid crystals, nematic liquid crystals, cholesteric liquid crystals and polymer liquid crystals.

5.3 Internal structure of crystals – X-ray diffraction of crystals – X-ray spectrophotometer method, Bragg's spectrometer.

Text books:

1. F.Albert Cotton, "Chemical Applications of Group Theory", 3rd Edition John Wiley & Sons, Singapore, 2003.
2. K.J. Laidler, "Chemical Kinetics", 2nd ed., Tata McGraw Hill, 1975.
3. Gurdeep Raj, "Advanced Physical Chemistry", 32 Ed, Goel Publishing House, Delhi, 2006.
4. B.R.Puri., L.R.Sharma., "Principles of Physical Chemistry" Vishal Publishings Co, Jalandhar, 2005.

References:

1. R.L. Flowry, Jr,symmetry Groups – Prentice Hall, New Jersy, 1980.
2. K.V. Raman, Group theory and its Applications in Chemistry, TMH, 1990.
3. A.A.Frost and R.G.Pearson, "Kinetics and Mechanisms", John Wiley & Sons, New York, 1953.
4. I.Amdur and G.G. Hammes,"Chemical Kinetics Principles and selected Topics", McGraw Hill, NewYork, 1966.
5. P.K. Bhattacharya, "Group Theory and its Chemical Applications", 2nd Edition. Himalaya Publishing House, 2003.
6. V.Ramakrishnan & M.S. Gopinathan, "Group Theory in Chemistry", 2nd Edition. Vishal Publications, 1995.

Course Outcome:

CO: 1 To study symmetry elements and symmetry operations.

CO: 2 To know the orthogonality theorem and its consequences

CO: 3 To learnt the determination of IR and Raman activity of vibrational modes in nonlinear molecules and to study selection rules for electronic transition.

CO: 4 To know the detailstudy of Simultaneous reactions and study the kinetics of different types of reactions

CO: 5 To learnt the reaction rate theories and reactions in solution and to know the concept of activity and activity coefficients and determination of activity coefficients.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	W	W	S	M	M	M	M	S
CO 2	S	S	S	W	S	M	M	M	M	S
CO3	S	M	W	M	M	M	M	M	M	S
CO 4	S	M	W	W	S	M	S	M	S	S
CO 5	M	S	M	M	M	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-IV- ORGANIC CHEMISTRY PRACTICAL-I		
I M.Sc., Chemistry	Semester–I	Credits: 4	Hrs/Wk: 6
Cognitive Level	K1 Acquire K2 Understand K3 Apply K4 Evaluate K5 Analyze		
Course Objectives	The course aim • The techniques and separation of binary organic mixture using pilot and bulk separation. • Qualitative organic analysis for identification of various functional groups. • To prepare the derivative for the respective functional group • Students will be prepare simple organic compounds • To prepare the recrystalization of the sample.		

A. Qualitative analysis of Binary organic mixture :

i) Pilot separation-
ii) Bulk separation-
iii) Analysis
iv) Derivatives

B. Single stage preparation of organic compounds :

a) Bromination : 2,4,6-tribromophenol from phenol
b) Osazonisation : Glucosazone from Glucose.
c) Acetylation : Resacetophenone from Resorcinol.
d) Oximation : Benzophenone oxime from Benzophenone
e) Oxidation : p- benzoquinone from Hydroquinone
f) Diazotisation : Phenyl – azo – 2-naphthol from aniline.
g) Sandmeyer reaction : o- chlorobenzoic acid from Anthranillic acid.

Text Books:

1. V.Venkateswaran, R. Veerasamy and A.R.Kulandaivelu, Basic Principles of practical cheamistry , Second edition , sultan chand & sons, (1997).
2. K.K.Sharma and O.S.Sharma , An introduction to practical chemistry, Vani Educational Books , 2nd edition (1982).

References:

1. ARTHUR I. VOGEL, Elementary pracatical organic chemistry qualitative organic analysis, CB Publishers and distributors, Delhi.
2. B.S.Furniss, A.J.Hnnaford, V.Rogers, P.W.G. Smith and A.R.Tatchell, Vogel's Text Book of Practical Organic chemistry, Longman, London (1978).

Course outcome:

CO: 1 To familiarize the solubility nature of organicsubstance of different functional group.

CO: 2 To learnt the pilot separation of bimixtures

CO: 3 To familiarize the systematic procedures of organic substance analysis

CO: 4 To learnt two stage preparation involving nitration and bromination and involving molecular rearrangement oxidation.

CO: 5 To learnt the preparation of derivative all functional groups and know the techniques involving drying and Recrystallization

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	W	M	S	M	M	M	M	S
CO 2	S	S	M	W	S	M	M	M	M	S
CO3	S	M	W	S	M	M	M	M	M	S
CO 4	S	M	W	W	S	M	S	M	S	S
CO 5	M	M	S	M	M	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-V - PHYSICAL CHEMISTRY PRACTICAL-I		
I M.Sc., Chemistry	Semester –I	Credits: 4	Hrs/Wk: 6
Cognitive Level	K1 Acquire K2 Understand K3 Apply K4 Evaluate K5 Analyze		
Course Objectives	• To provide a basic training in laboratory skills for physical chemistry. • To relate the experimental work to the scientific theory behind the experiment and thus give a fuller understanding of the theory. After studying this unit the student should be able to • Make essential observations accurately and estimate the possible errors. • Produce a scientific report of their work. • Gain a critical appreciation of the purpose, significance and limitations of any experimental study.		

1. Comparison of strength of acids by the study of kinetics of hydrolysis of an ester.
2. Determination of the velocity constant, catalytic coefficient, temperature coefficient, energy of activation and Arrhenius parameters for the acid hydrolysis of an ester.
3. Determination of Molecular weight of substances by Rast's method.
4. Determination of Molecular weight of substances by transition temperature method.
5. Study of phase diagram of two components forming simple eutectic.
6. Study of phase diagram of two components forming compound.
7. Conductometric titration of mixture of weak and strong acids.
8. Conductometric precipitation titration of $BaCl_2$ with $MgSO_4$ and K_2SO_4.
9. Conductometric determination of dissociation constant of weak acid.
10. Potentiometric titration of mixture of weak and strong acids.
11. Potentiometric determination of dissociation constant of weak acid.
12. Determination of Onsagar parameters for a strong electrolyte by conductometry.

Text Books:

1. Findlay's Practical Physical Chemistry, Revised and edited by B.P.Levitt 9^{th} ed., Longman, London, 1985.

2. J.N. Gurtu and R. Kapoor, "Advanced Experimental Chemistry", Vol.1, S Chand & Co., Ltd., New Delhi.

References Books:

1. Findlay's Practical Physical Chemistry, Revised and edited by B.P.Levitt 9th ed., Longman, London, 1985.
2. J.N. Gurtu and R. Kapoor, "Advanced Experimental Chemistry", Vol.1, S Chand & Co., Ltd., New Delhi.
3. S.R. Palit and D.E. Sadhan Kumar, "Practical Physical Chemistry", 1st Ed., Science Book Agency, 1971.

Course outcome:

CO: 1 To the preparation for each experiment and links therein.

CO: 2 To know about the safety requirements and lab skills to perform physic-chemical experiments.

CO: 3 Methods to measure equilibrium concentration and equilibrium constants for acid-base, solubility and complexation reactions by varying concentration and temperature

CO: 4 To the preparation of buffer solutions at a required pH, given a choice of solution of acid/conjugate base pairs

CO: 5 To know the principle and mechanism of conductometric and potentiometric titrations.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	M	M	S	M	M	M	M	S
CO 2	S	S	S	M	S	M	M	M	M	S
CO3	S	M	M	S	M	M	M	M	M	S
CO 4	S	M	W	M	S	M	S	M	S	S
CO 5	M	S	M	M	S	M	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-VI- INORGANIC CHEMISTRY - II		
I M.Sc., Chemistry	Semester–II	Credits: 4	Hrs/Wk: 5
Cognitive Level	K1 Acquire K2 Understand K3 Apply K4 Evaluate K5 Analyze		
Course Objectives	The course aim • Depth knowledge in co-ordination chemistry. • Compare the reaction mechanism of co-ordination compounds • Discuss the photo chemistry of co-ordination compounds • Formulate the co-ordination compounds and organometallic chemistry. • To get knowledge in organometallic compounds		

UNIT –I - Coordination Chemistry:

1.1 Theories of Metal –Ligand bond - Crystal Field Theory – splitting of d orbitals under various geometries. Factors affecting splitting – CFSE; spectro-chemical series – Jahn -Teller distortion – spectral and magnetic properties of complexes – site preferences – spinal and inverse spinal – limitations of CFT – Ligand Field theory – MO theory – sigma and pi bonding in complexes – nephelauxetic effect – the angular overlap model.

1.2 Studies of coordination compounds in solution –stability constants – stepwise and overall formation constants – simple methods (Potentiometric and Photometric methods) of determining the formation constants – factors affecting the stability - statistical and chelate effects.

UNIT II - Reaction Mechanism of Coordination Compounds:

2.1 Reactions of metal complexes – labile and inert complexes –types of coordination reactions - ligand substitution reactions- SN_1,SN_2, SN_1CB – Electron transfer reactions -Inner sphere and outer sphere processes,complementary and non-complementary reactions.

2.2 Reactions of coordinated ligands –Isomerization and recemisation reaction – acid hydrolysis, base hydrolysis and anation reactions – Transeffect –theory and applications –template effect

UNIT III - Photochemistry of Coordination Compounds:

3.1 Photochemical reactions of coordination and organometallic compounds – photo oxidation, photo reduction, photo substitution and photo isomerisation reactions.

3.2 18 - electron rule,EAN rule applied to metal carbonyls –preparation and properties of metal carbonyls – $Ni(CO)_4$, $Fe_2(CO)_9$, $Cr(CO)_6$ and$Re_2(CO)_{10}$ –carbonylate anions - cabonyl hydrides – nitrosyl complexes - preparation – bridging and terminal nitrosyls.

UNIT – IV - Applications of Coordination Compounds:

4.1 Metal complexes in medicinal chemistry – complexation in food poisoning – metal complexes in therapy - Metal complexes in industrial process; electroplating, complexation in metallurgy, complexes in water softening.

4.2 Magnetic properties of metal complexes –types of magnetic character, Determination of magnetic susceptibility - magnetic properties of complex ions- magnetic criterion of bond type in complexes – orbital contribution to magnetic moment – Quenching of orbital contribution – spin- orbit coupling and magnetic moments –magnetic character of poly nuclear complexes**.**

UNIT – V - Organometallic Chemistry:

5.1 Organometallic Chemistry of Transition Elements: Preparation, properties, structure and bonding of ferrocene.

5.2 Organometallic reagents in organic synthesis and in homogeneous catalytic reactions- hydrogenation, hydroformylation, isomerisation and polymerization – pi-acid metal complexes.

Text books:

1. R.H.Crabtree, “The Organometallic Chemistry of Transition Metals” 4 edition 2005.
2. A.W.Adamson and P.D.Fleischaur, “Concepts of Inorganic Photochemistry “, Wiley,New York,1975.
3. Purcell and Kotz, “Inorganic Chemistry”,Saunders Golden Sunburst Series, W.B.Saunders Company ,Philadelphia
4. J.D.Lee, “A New Concise Inorganic Chemistry”,4th ed., ELBS,1995.

References:

1. S.F.A.Kettle, Physical Inorganic Chemistry, A coordination chemistry Approach,spectrum Academic Publishers,Oxford,1996.
2. J.E.Huheey, Inorganic Chemistry “, 3rd ed., Harper & Row publisher,Singapore.
3. F.A. Cotton and G. Wilkinson, “Advanced Inorganic Chemistry”, 4th ed., A Wiley – Interscience Publication, John – Wiley & Sons, USA.
4. S.Glasstone, “Source Book on Atomic Energy”, D.Van Nostrand , New York 1967(Affiliated East-West Press ,New Delhi 1969)

Course Outcome:

CO: 1 To be able to use Crystal Field Theory to understand the magnetic properties of coordination compounds.

CO: 2 To be able to describe the stability of metal complexes by the use of formation constants and to calculate thermodynamic parameters

CO: 3 To become familiar with some applications of coordination compounds and to be able predict the geometries of simple molecules.

CO: 4 To be able recognize the types of isomers in coordination compounds.

CO: 5 To familiarize the preparation and properties of organometallic compounds.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	W	S	S	M	M	M	M	S
CO 2	S	S	M	M	S	M	M	M	M	S
CO3	S	M	M	W	M	M	M	M	M	S
CO 4	S	M	W	W	S	M	S	M	S	S
CO 5	M	S	M	S	M	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-VII- ORGANIC CHEMISTRY - II		
I M.Sc., Chemistry	Semester –II	Credits: 4	Hrs/Wk: 5
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim • To impart basic ideas about elimination reactions, electrophilic aromatic substitution. • To get knowledge in molecular rearrangements. • To enable the students to elucidate the structure of organic compounds using UV & IR spectroscopy techniques. • To help students understand the reaction kinetics and method of determining reaction mechanisms. • To familiarize the topic carbohydrate		

UNIT – I

1.1 **Elimination Reactions:**

E_1, E_2 and E_1CB mechanisms –Influence of structure, leaving group, base and solvent. Orientation of the double bond – Hoffmann and Saytzeff rules – Competition between elimination and substitution reactions – Typical eliminations to be studied – dehydration of alcohols, dehydro halogenation and Hoffmann degradation. Mechanisms of pyrolytic eliminations – examples - Chugaev and Cope eliminations.

1.2 **Aromatic Electrophillic Substitution:**

Arenium ion mechanism – Isotopic effect - orientation and reactivity – nitration, halogenation, sulphonation, Friedel - Crafts reaction – Gattermann, Kolbe-Schmitt, Reimer- Tiemann, Houben-Hoesch reactions, Aromatic nucleophilic substitution – benzyne mechanism and Chichibabin reaction.

UNIT – II

2.1 **Rearrangements:**

Wagner-Meerwein rearrangement, Wolf rearrangement, Benzil benzilic acid rearrangement, Hofmann rearrangement, Beckmann rearrangement, Schimdt rearrangement,Bayer villager oxidation, Dakin reaction,Favorskii rearrangement, Stevens rearrangement, Wittig rearrangement, Neber rearrangement, Dienone-phenol rearrangement, Benzidine rearrangement, Gruvenstein and Zimmermann rearrangements.

2.2 **Oxidation:**

Selectivity and synthetic uses of the following oxidants - chromyl chloride, periodic acid, selenium dioxide, lead tetraacetate, Dessmartin, osmium tetroxide, PCC (pyridinium chloro chromate), DDQ, phase transfer catalysts(PTC),crown ethers, Baker's yeast, Swern, and Oppenaur Oxidation .

UNIT – III- Stereochemistry – II:

3.1 **Conformation Analysis:** Conformation of n-butane and cyclo hexane. Conformation, optical activity and stability considerations of mono and disubstituted cyclohexanes.

3.2 **Dynamic Stereochemistry:** Quantitative correlation betweenconformation and reactivity - Winstein-Eliel equation, Curtin Hammet principle, saponification of an ester, esterification of an alcohol, chromic acid oxidation of cyclohexanols, neighbouring group participation, deamination of 2-amino cyclohexanol, Stereo-selective and stereo-specific reactions.

UNIT –IV

4.1 **Ultraviolet and Visible Spectroscopy:**

Basic principles of electronic transitions – correlation of energy change with electronic transitions – Instrumentation and sample handling techniques – Applications of UV – visible spectroscopy – Woodward Fisher Scott rules – applications to conjugated dienes, unsaturated carbonyl compounds – conjugated cyclic ketones – acetophenones – benzene and its substituted derivatives– stereochemical factors affecting electronic spectra of biphenyl and binaphthyls – cis - trans isomers – angular distortion – cross conjugation.

4.2 **Infrared Spectroscopy:**

Basic principles of IR spectroscopy, types of stretching and bending vibrations; number of fundamental vibrations; Factors influencing vibrational frequencies – coupled and Fermi resonance, electronic effects, Hydrogen bonding; Instrumentation and sampling techniques; finger print region; Applications of IR spectroscopy; identification of the functional groups - alcohols, phenols, carbonyl compounds, carboxylic acids, amides, amines, nitro compounds,

UNIT –V

5.1 **Carbohydrates:**

Polysaccharides – structure of starch and cellulose (elucidation not required). Configurations of carbohydrates – photosynthesis.

5.2 **Peptides and Proteins:**

Synthesis of peptides – Primary, Secondary, tertiary and quaternary structure of proteins. Protection of N and C – terminal groups of proteins, biosynthesis of proteins.

5.3 **Nucleic Acids:**

Chemistry of nucleic acids – structure of DNA, properties, biological implications of DNA, Replication of DNA, structure of RNA - types of RNA and their functions.

Text Books:

1. R.T. Morrison and R.N.Boyd, "Organic Chemistry", 6th ed., PHI private limited, 1990.
2. E.L.Eliel, "Stereochemistry of Carbon Compounds", McGraw Hill, 1962.

3. D. Nasipuri , Stereochemistry of Organic Compounds , 2nd edition, New AgeInternational, 1994.
4. P.S. Kalsi , Organic Reactions and their mechanisms, 4th edition, New age international Publisher, 2006.
5. R.K. Bansal, "Organic Reaction Mechanisms", Tata McGraw Hill,1975.
6. Y.R.Sharma, Elementary Organic Spectroscopy- Principles and Chemical Applications, S.Chand, 1992.
7. J.March, Advanced Organic Chemistry: Reactions, Mechanisms and Structure, 4th edition, Wiley, 1992.
8. P.S. Kalsi, Spectroscopy of Organic Compounds, New Age International Publishers.

References:

1. R.M. Silverstein, F. X. Wester, "Spectroscopic Identification of Organic Compounds", 6 th ed., Wiley, 1998.
3. J.R.Dyer, "Applications of Absorption Spectroscopy of Organic Compounds", Prentice Hall, 1965.
4. W.Kemp, Organic Spectroscopy, ELBS, 1991.
5. I.L.Finar, Organic Chemistry Vol II, 5th End., ELBS, 1975.

Course outcome:

CO: 1 To learnt about the some specific examples of elimination reactions.

CO: 2 The students should be able to know the basic mechanism of oxidation reactions

CO: 3 To become familiarize the conformational analysis and dynamic stereo chemistry

CO: 4 To know about the preparation and properties of carbohydrate, protein and peptides

CO: 5 The students should be able to know about the nucleic acid and structure of DNA and RNA

Mapping

PO/PSO CO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	W	S	S	M	M	M	M	S
CO 2	S	S	M	W	S	M	M	M	M	S
CO3	S	M	M	S	M	M	M	M	M	S
CO 4	S	M	W	W	S	M	S	M	S	S
CO 5	M	S	S	M	S	M	M	S	S	S

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC – VIII -INORGANIC CHEMISTRY PRACTICAL-I		
I M.Sc., Chemistry	**Semester -II**	**Credits: 4**	**Hrs/Wk: 5**
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim • Separation and identification of a mixture containing two common and two rare cations. • Colorimetric estimation.		

A. **Semimicro qualitative analysis** of a mixture containing two common and two rare cations.

B. **Complexometric titration**

- Standardization of EDTA.
- Determination of Ca^{2+}, Ni^{2+}, Mg^{2+}, Zn^{2+}.

Text Books:

1. V.Venkateswaran, R. Veerasamy and A.R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, Second Edition, 1997.

2. K.K.Sharma and O.S.Sharma, An introduction to Practical Chemistry, Vani Educational Books, Second Edition, 1982.

References:

1. ARTHUR I.VOGEL, A Text Book of Macro and Semi-micro Qualitative Inorganic Analysis, Longman Group Ltd., First Indian Edition, 1975

.

2. V.V. Ramanujam, Inorganic Semi-micro Qualitative Analysis, The National Publishing Co., Madras, Second Edition, 1970.

Course outcome:

The students should be able to:

CO: 1 Well trained to analyze simple acid radicals, basic radicals and interfering radicals.

CO: 2 Get skilled to separate inorganic mixture and identified as individual cations and anions through the experiments.

CO: 3 To know the colorimetric experiments and analysis the colored solutions.

CO: 4 To gain knowledge in analysis of inorganic mixture

CO: 5 To get analyzing capacity of inorganic samples.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	W	W	S	M	M	M	M	S
CO 2	S	S	M	M	S	M	M	M	M	S
CO3	S	M	S	W	M	M	M	M	M	S
CO 4	S	M	W	M	S	M	S	M	S	S
CO 5	M	S	M	S	M	M	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-IX- PHYSICAL CHEMISTRY PRACTICAL - II		
I M.Sc., Chemistry	**Semester –II**	**Credits: 4**	**Hrs/Wk: 5**
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	• To provide a basic training in laboratory skills for physical chemistry. • It is an exercise in various experiments in physical chemistry that will provide a deeper understanding of basic concepts in physical chemistry. • To get knowledge in chemical calculations • To familiarize the electrical experiments • To get knowledge in the preparation of solutions in different concentrations.		

1. Distribution law – study of iodine – iodide equilibrium.
2. Construction of adsorption isotherm for the adsorption of oxalic acid on charcoal using Freundlich isotherm.
3. Study of phase diagram of three components system (Acetic acid, Benzene and Water)
4. Conductometric titration of mixture of alkali against HCl.
5. Conductometric titration of KCl and KI against $AgNO_3$.
6. Conductometry-Solubility product of sparingly soluble salts.
7. Potentiometric titrations- Redox titrations.
8. Potentiometric estimation of mixture of halides.
9. Potentiometry-Determination of Activity and activity coefficient of ions.
10. Polarimetric study of the kinetics of acid catalyst inversion of sucrose.
11. Determination of velocity constant between potassium persulphate and potassium iodide.

Text Books:

1. Findlay's Practical Physical Chemistry, Revised and edited by B.P.Levitt 9th ed., Longman, London, 1985.
2. J.N.Gurtu and R. Kapoor, "Advanced Experimental Chemistry", Vol1, S Chand & Co., Ltd., New Delhi.

References:

1. Findlay's Practical Physical Chemistry, Revised and edited by B.P.Levitt 9th ed., Longman,London, 1985.
2. J.N.Gurtu and R. Kapoor, "Advanced Experimental Chemistry", Vol1, S Chand & Co., Ltd., New Delhi.
3. S.R.Palit and D.E.Sadhan Kumar, "Practical Physical Chemistry", 1st Ed., Science Book Agency, 1971.

Course Outcome:

CO: 1 The students should be able to know about the distribution law and principles of CST experiment.

CO: 2 To familiarize the conductometric titrations.

CO: 3 To know about the determination of activity and activity coefficient.

CO: 4 To get knowledge about the adsorption properties.

CO: 5 To familiarize the critical solution temperature

Mapping

PO/PSO CO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	M	S	S	M	M	M	M	S
CO 2	S	S	S	M	S	M	M	M	M	S
CO3	S	M	M	S	M	M	M	M	M	S
CO 4	S	M	S	M	S	M	S	M	S	S
CO 5	M	S	M	S	M	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	EC-I – (ELECTIVE COURSE) ADVANCED TOPICS IN PHYSICAL CHEMISTRY		
I M.Sc., Chemistry	Semester–II	Credits: 5	Hrs/Wk: 5
Cognitive Level	K1 Acquire K2 Understand K3 Apply K4 Evaluate K5 Analyze		
Course Objectives	The course aim • To impart in depth knowledge of group theory, quantum chemistry. • .To get knowledge in the applications of quantum chemistry • To impart theoretical knowledge on physical aspects of Raman, NMR, ESR spectroscopy to students. • Introduce the EPR spectroscopy • To get knowledge in photochemistry and radiation chemistry		

UNIT – I - Quantum Chemistry – I

1.1 Inadequacy of classical mechanics, black body radiation, Planck's quantum concept, photoelectric effect. Bohr's theory of hydrogen atom-Hydrogen spectra, wave particle dualism, uncertainty principle.

1.2 Schrodinger equation, postulatory basis of quantum mechanics. Operator algebra: operator, linear and Hermitian, Eigen functions and Eigen values, angular momentum operator, commutation relations.

1.3 Applications of wave mechanics to simple systems – particle in a box, one and three dimensional, distortion of the box and Jahn-Teller effect. Orthogonalisation and normality, finite potential barrier – tunneling.

UNIT – II - Quantum Chemistry –II:

2.1 Applications of wave mechanics, the rigid rotator, harmonic oscillator – Hydrogen atom solution – shapes and nodal properties of orbitals – space quantization – electron spin – many electron atoms – one electron orbitals – Pauli principle – determinantal form of wave function , helium atom and effective nuclear charge.

2.2 Approximation methods – variation methods, application to Hydrogen and Helium atoms – perturbation method for nondegenerate systems.

2.3 Angular momentum in many electron systems – spin orbit interaction, L-S and J-J coupling schemes. Atomic structure calculation –Hartee and Hartee fock Self consistent Field method for atoms.

UNIT – III - Molecular Spectroscopy – I:

3.1 Microwave spectroscopy – rotational spectra of diatomic molecules, rigid and non-rigid rotors- intensity of spectral lines – effect of isotopic substitution – microwave spectra of polyatomic molecules – linear and symmetric top molecules.

3.2 Electronic spectra: Born- Oppenheimer approximation – Vibrational coarse structure – Franck-Condon Principle, dissociation energy – rotational fine structure of electronic vibrational transitions – Fortrat diagram. Various types of transitions.

3.3 Infrared spectroscopy: Vibrational spectra – selection rules – harmonic and Anharmonic oscillators – vibrational spectra of diatomic molecules – vibrational spectra of polyatomic molecules (CO_2, H_2O) – Fermi resonance –parallel and perpendicular bands.

UNIT – IV - Spectroscopy – II:

4.1 **Raman Spectroscopy:**

Raman effect – elastic and inelastic scattering – selection rules – rotational and vibrational Raman spectra – polarization of light and Raman effect - comparison of IR and Raman spectra – structure determination from Raman spectra(H_2O& CO_2) – exclusion principle - Fermi resonance – Laser Raman spectroscopy.

4.2 **NMR Spectroscopy:**

Spin and applied magnetic field – Larmor precession – Relaxation process – PMR chemical shift – spin interaction – FT - NMR – Multiple pulses NMR - C^{13} NMR spectroscopy – chemical exchange.

4.3 **ESR Spectroscopy:**

Basic principles – presentation of spectrum – Hyperfine splitting, Factors affecting hyperfine splitting –ESR spectra of methyl radicals, CD_3 and Naphthalene negative ion.

UNIT – V

5.1. Photo Chemistry:

Photo physical process– Luminescence, photosensitization and energy transfer process – Jablonski diagram – Stern - Volmer equation– Photoelectric effect – Chemical actinometers – Lasers and their applications.

5.2. Radiation chemistry:

Differences between radiation chemistry and photochemistry – primary and secondary process of radiolysis – radiolysis of water, solvated electron. Definitions of G value, rad, Linear Energy Transfer (LET) and Rontgen – chemical dosimetry and uses of radiation chemistry.

Text Books:

1. A.K.Chandra, Intoductory Quantum Chemistry, 4th ed., Tata McGraw Hill,1994.

2. C.N.Banwell,Fundamentals of molecular Spectroscopy, 3rd ed., TMH,New Delhi, 1983.
3. J.Rajaram and J.C.Kuriacose,Thermodynamics for students of Chemistry : Classical, Statistical and Irreversible, shoban Lal Nagin, New Delhi, 1981.
4. L.K.Nash,Elements of Chemical Thermodynamics, Addision Wesley, 1962.
5. S.Glasstone,Thermodynamics for chemists, Affiliated East West Press, New Delhi, 1960.

References:

1. R.S.Drago,Physical Methods in Chemistry, W.B.Saunders Company, Philadelphia, London, 1976.
2. B.P. Straughan and S.Walker"Spectroscopy" Vol.3, Chapman Hall London,1976.
3. G.M.Barrow,Introduction to Molecular Spectroscopu, McGraw Hill, New York,1964.
4. R.Chang,Basic Principles of Spectroscopy , McGraw Hill Pub., Ltd., 1971.
5. B.P.Strangham and S.Walker,Spectroscopy Vol 1, Chapman Hall, London,1976.
6. A.A.Frost and R.G.Person,kinetics and Mechanisms, John wiley & Sons, New York,1953.
7. I.Amdur and G.G.Hammes,Chemical Kinetics Principles and Selected Topics, McGraw Hill, New York, 1966.
8. R.K.Prasad,Quantum Chemistry, New Age International Ltd, 2006.
9. D.A.Mcquarrie,Quantum Chemistry, University Science Books,1998.
10. F.L.Pillar, Elementary Quantum Chemistry, McGraw Hill,1968.

Course outcome:

CO: 1 The students should be able to know about the basics concept of quantum mechanics and orthogonality theorem

CO: 2 To learnt about the application of wave mechanics and approximation methods.

CO: 3 To understand the molecular spectroscopy

CO: 4 To familiarize the basic principles, instrumentations and applications of IR, NMR and ESR spectroscopy

CO: 5 To know the detail study of the photo chemistry and Radiation chemistry.

Mapping

PO/PSO CO	**PO**					**PSO**				
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CO 2	S	S	M	M	S	M	M	M	M	S
CO3	S	M	M	S	M	M	M	M	M	S
CO 4	S	M	W	M	S	M	S	M	S	S
CO 5	M	S	S	S	M	S	S	M	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	**OEC – I*(OPEN ELECTIVE COURSE) GREEN AND INDUSTRIAL CHEMISTRY**		
I M.Sc., Chemistry & Other Departments	**Semester -II**	**Credits: 4**	**Hrs/Wk: 5**
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim • To give them understanding of environment and eco system • .To get knowledge in green chemistry • To learn some of the industrial products and their manufacturing processers. • To become aware of the application of the industrial products. • Introduction of fuel gases		

UNIT – I

1.1 Environment and Eco system – origin – big-bang Nucleo synthesis – evolution of life on the earth – cosmic evolution – elements of life and biodistribution of elements – environment and its components.

1.2 Ecosystem – Ecology – ecological factors – classifications and components of ecosystems - productivity and energy flow in an ecosystem – food chain and food web- pollution of environment – concept and scope.

UNIT – II

2.1 Green Chemistry- Introduction – twelve principles – green chemistry in action – replacement of wood preservative – production of bio diesel, biopolymers and bioplastics.

2.2 Waste management – sources and types of waste –waste treatment – integrated waste management of plastics.

UNIT – III

3.1 Water in industry – pollution of water by fertilizers, detergents, pesticides andindustries – BOD, COD – water treatment – ion exchange, reverse osmosis andsoftening of hard water.

3.2 Chemical explosives – origin of explosive, preparation and chemistry of lead azide, nitroglycerine, nitro cellulose, TNT, dynamite, cordite, picric acid and gunpowder.

UNIT – IV

4.1 Rubber industries – natural rubber – synthetic rubber – polymerization – butadiene – styrene – neoprene – urethane rubber.

4.2 Plastics – manufacture – types – condensation polymerization – polyamides – nylon-66,polyester – terelene.

UNIT – V

5.1 Coal – varities of coal – composition – coal gasification – carbonization – coal – tar and coal - tar based chemicals– coal mines in India.

5.2 Petroleum – refining – cracking – knocking – octane number – LPG – synthetic petrol by Bergius process

5.3 Fuel gases – manufacture and uses of coal gas, water gas, producer gas and oil gas.

Text books:

1. Rashmi Sanghi , M.M. Srivaslava , Green chemistry environment friendly alternatives, S.Chand &Company Ltd, New Delhi, 1998.
2. J.L. Jain, Sunjay Jain, Nitin Jain, Fundamentals of Biochemistry, 6th Ed., S.Chand & Company Ltd, New Delhi, 2005.
3. B.N.Chakrabarathy, Industrial chemistry , Oxford and IBH publishing Co., New Delhi , 1981.

References:

1. Asim k. Das , Environmental chemistry with green chemistry,1st Ed., Books and allied (P) ltd., 2010.
2. V.K. Ahluwalia , Rajender. S.Varma, Green solvents for Organic synthesis , 3rd Ed., S.Chand &Company Ltd, New Delhi, 2003.
3. B.K.Sharma , Industrial Chemistry, Goel publishing House, Meerut, 1996.

Course Outcome:

CO: 1 The students should be able to understand the environment eco system, food chain and environmental pollutions

CO: 2 To know about the green chemistry and water management and waste management.

CO: 3 To learnt about the water chemistry and chemistry of explosive

CO: 4 The students should be able to know about the Rupper, plastics and polymers.

CO 5 To leant about the types of fuels and manufactures

Mapping

PO/PSO CO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	W	W	S	M	M	M	M	S
CO 2	S	S	W	W	S	M	M	M	M	S
CO3	S	M	W	W	M	M	M	M	M	S
CO 4	S	M	W	W	S	M	S	M	S	S
CO 5	M	S	S	M	S	M	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	OEC-I*(OPEN ELECTIVE COURSE) FORENSIC SCIENCE		
I M.Sc., Chemistry &Other Departments	Semester –II	Credits: 4	Hrs/Wk: 5
Cognitive Level	K1 Acquire K2 Understand K3 Apply K4 Evaluate K5 Analyze		
Course Objectives	The course aim • To study about the introduction of forensic science and sampling • Introduction of Forensic science • To understand the finger print and case study • To learnt about the biological sampling and taxins • To know about the types of drug dependence		

UNIT – I BASIC CONCEPTS

1.1. Introduction to forensic science – History – Types of crimes - Arsons – Accidents – Recording – Scene.

1.2. Identification data collection – Race and Religion – Sex – Age – Stature – Complexion of the victim – Sampling – Preservation samples – Tools for sample colletion.

UNIT – II ESSENTIALS OF FORENSIC EXAMINATION:

2.1. Finger prints – Classification – individuality – Modes of production – Techniques of finger printing – Gatttons – finger print system –Case studies.

2.2. Examination foot prints – Bullet marks – fibers – paints – metals.

UNIT – III - BIOLOGICAL SAMPLING

3.1 Blood stains – Collection- Rust stain – synthetic dye mineral and vegetable stain comparison – chemical examination of blood. Benzidine test – Phenolphthalein test – Ortho toludine test – Haemin crystal test – Takayama test.

3.2 Spectra Haemoglobin – Blood groups – Agglutins – Agglutinogens – Case studies.

3.3 Collection and sampling for analysis of body tissues, saliva, fluids, urine, hair and nails.

3.4 Structure of hair – Microscopic examination of comparison with other fibre – human and animals hair differences – case study.

UNIT – IV - TOXINS AND NARCOTICS

4.1 Poisin – Domestic poisons – Sanitary poison – Garden poison and Therapeutic poisons (Toxic substances present in them) – Nature of poisoning – Therapeutic index.

Analytical procedures for Gases – Steam volatile poisons and nonvolatile organic poisons.

4.2 Narcotics and Stimulants: CNS, Depresents – Barbiturates – Paraldehydes – Alcohols – Opium alkaloids (Natural – Semisynthetic and synthetic) – (only dosage, sign and symptoms of administration, lethal blood level and fatal periods).

UNIT – V - DRUG DEPENDENCE

5.1.Types of drug dependence – Symptoms – Psychedelics – Hallucinogen – LSD – amphetencine – Cocaine – Morphine.

5.2. Chemical analysis of stomach contents – liver kidney – bile and nasal secretions.

References:

1. Encyclopedia of War and Crime, John Willey & Sons, New York. 1999.
2. The Essential Forensic Medicine and Toxicology, K.S. Narayan Reddy, 24th Edition, Medical Book Company, Hydrabad, 2005.

Text book:

1. Synopsis of forensic medicine, K. S. Narayan Reddy, Medical Book Company, Hydrabad, 2004.

Course outcome:

CO: 1 The students should be able to understand the introduction to forensic science and collection of sampling

CO: 2 To know the detail study of classification and techniques of finger printing

CO:3 To familiarize biological sampling and know about the structure of blood and hemoglobin

CO: 4 To know about the types of poison and analytical procedure.

CO: 5 To clear understand about the types of drug dependence.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	W	M	S	M	M	M	M	S
CO 2	S	S	M	S	S	M	M	M	M	S
CO3	S	M	M	M	M	M	M	M	M	S
CO 4	S	M	S	S	S	M	S	M	S	S
CO 5	M	S	M	S	M	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-X- INORGANIC CHEMISTRY – III		
II M.Sc., Chemistry	Semester –III	Credits: 4	Hrs/Wk: 5
Cognitive Level	K1 Acquire K2 Understand K3 Apply K4 Evaluate K5 Analyze		
Course Objectives	The course aim • Introduction of electronic spectroscopy in inorganic chemistry • Students get knowledge on EPR, electronic spectroscopy and magnetic properties of complexes. • Various analytical techniques and their applications in Quantitative estimation will enable student to get practical idea about the use of such equipments. • To get knowledge in electro analytical techniques • Special unit on bio chemistry give insight about metals in biology and also about medicinal bio inorganic chemistry		

UNIT –I - Electronic Spectroscopy:

1.1 Electronic configuration, terms, states and microstates. Derivation of term symbols (p^2, d^2) and arranging the various terms according to their energies. Spectroscopic terms – Effect of inter electronic repulsion and spin –orbit coupling.. R-S coupling.

1.2 Selection rules and the breakdown of selection rules –splitting of orbital's in octahedral field. Ground state and excited state term symbols for d^n systems in Oh and Td systems with the corresponding energy level diagrams.

1.3 Orgel diagram – characteristics – prediction and assignment of orgel diagram for transitions metal complexes from d1 to d9 both strong and weak field ligand. Tanabe – Sugano diagram - Racah parameters B and C (calculation not required).

UNIT –II - EPR spectroscopy:

2.1 Basic principles– Hyperfine splitting simple systems and Bis(salicylaldiamine)copper(II), characteristics of 'g', factors affecting the magnitude of the 'g' values, zero field spitting and Kramer's degeneracy, Anisotropy in the hyperfine coupling constant, nuclear quadrupole interaction, line widths in solid state epr, Applications of epr spectroscopy.

2.2 EPR spectrum for first transition series. Spin - lattice relaxation – spin-spin relaxation – exchange processes. Calculation of g(parallel), g(perpendicular), g(average) and information obtained from them.

UNIT –III - Chromatographic techniques:

3.1 Principles and instrumentation of gas-liquid and gas-solid chromatography – Principles and application of column chromatography.

3.2 Principles, instrumentation and uses of Thin Layer Chromatography, High Performance Liquid Chromatography andIon exchange chromatography.

UNIT –IV - Electro analytical methods:

4.1 Principles and applications of electrogravimetry, conductometry, coloumetry, pH meter and amperometry.

4.2 Working and applications of cyclic voltametry, anodic stripping voltametry, TGA, DTA, DSC, SEM and TEM.

UNIT –V - Bio Inorganic Chemistry:

5.1 **Heme and Non-heme Proteins:** Hemoglobin and Myoglobin – Oxygen transport and storage – Electron transfer and Oxygen activation. Cytochromes, Ferredoxins and Rubredoxins – Model systems, mononuclear non-heme iron enzymes.

5.2 **Copper Containing Proteins:** Classification and examples - Electron transfer – Oxygen transport - Oxygenation – oxidases and reductases – Cytochrome C oxidase – Superoxide dismutase (Cu, Zn).

Text Books:

1. E.A.V.Ebsworth,Structural Method's in inorganic chemistry , 3rd ed., ELBS,Great Britain,1987.
2. G.Friedlander, J.W. Kennady and J.Miller, "Nuclear and Radiochemistry,3rd ed., Wiley interscience Publications, John Wiley & sons New York.
3. S.J.Lippard and J.M.Berg,principles of bioinorganic chemistry ,Panima Publishing company,New Delhi,1997.
4. S.M.Khopkar, Basic concepts of analytical chemistry,New Age International (P) Ltd,New Delhi,1998.

References:

1. R.S.Drago, Physical Methods in inorganic chemistry ; 3rd ed., Wiley Eastern Company (units I,II,III &IV)
2. R.S.Drago, "physical methods in chemistry", W.B.Saunders Company, Philadelphia,London.
3. F.A. Cotton and G. Wilkinson, "Advanced Inorganic Chemistry "3rd ed., Wiley – Eastern company, New Delhi, 1990.
4. D.A.Skoog and D.M.West, Fundamentals of analytical chemistry,W.B.Saunders,New York,1982.
5. Lehn, J.M. Transition metals in supramolecular chemistry: John Wiley & sons: New York, 1999.

Course outcome:

CO: 1 The students should be able to know about the principle, instrumentation and applications of electronic spectroscopy

CO: 2 To familiarize the principle and applications of EPR spectroscopy

CO: 3 To learnt about the Macrocyclic molecules and catalysis

CO: 4 To understand the principles, analytical techniques and applications of TLC, HPLC, TGA, DTA , SEM and TEM

CO: 5 To familiarize the Bioinorganic chemistry reaction mechanism and its applications.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	M	M	S	M	M	M	M	S
CO 2	S	S	S	S	S	M	M	M	M	S
CO3	S	M	M	M	M	M	M	M	M	S
CO 4	S	M	S	M	S	M	S	M	S	S
CO 5	M	S	S	M	S	M	S	M	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-XI - ORGANIC CHEMISTRY -III		
II M.Sc., Chemistry	**Semester –III**	**Credits: 4**	**Hrs/Wk: 5**
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim • To get knowledge in addition and condensation reactions • To familiarize the reagents involved in organic synthesis and how to protect functional groups. • This paper gives exposure to retro-synthetic analysis • They also highlight NMR spectroscopy (^{13}C, Proton NMR) techniques and their use in interpreting and arriving at the structure of organic compounds. • A unit on terpenes and alkaloids will help students to learn natural products.		

UNIT – I - Addition and condensation reactions:

1.1 **Addition to carbon –carbon multiple bonds:**

Electrophilic, nucleophilic and free radical additions – orientation and reactivity. Stereochemical factors influencing the addition of bromine and hydrogen bromide, hydroxylation, 1,2- dihydroxylation (Woodward and Prevost hydroxylations) and hydroboration leading to formation of alcohols, oxidation and ozonolysis. Addition to conjugated dienes – Diels - Alder reaction.

1.2 **Addition to carbon – hetero multiple bonds:**

Addition mechanism and reactivity - Selected name reactions involving addition to carbonyl group – Aldol, Reformatsky, Perkin, Stobbe, Darzen's glycidic ester, Knoevenagel , Dieckmann and Benzoin condensations. Michael reactions and Robinson ring annulations – Mannich reaction- wittig reaction and its stereo selectivity.

UNIT – II - Reagent and Protecting groups in Organic synthesis:

2.1 Lithium diisopropylamide (LDA), Dicyclohexyl carbodimide , (DCC), Tri-n-butyl tinhydride,Peterson's olefination,Merrifield resin, Gilman's reagent, 1,3- dithiane (reactivity umpolung) and trimethylsilyl iodide.

2.2 Protection of alcohol, amine, aldehydes , ketone and carboxylic acid. Deprotection, Resistivity of protecting group.

UNIT – III Reterosynthetic analysis:

3.1. Definition of reterosynthetic analysis. Simple definition of terms – synthon, refron, synthetic equivalence, transform , synthetic tree , umpolung. Different synthetic approaches (i) relay approach (ii) Convergent approach and (iii) Disconnection approach.

3.2 Disconnection approach**:**Reterosynthetic analysis of monofunctional and 1,2 ; 1,3 ; 1,4 and 1,5 - difunctional compounds. Protection and deprotection during synthesis – functional group strategy – retero – Diels – Alder Strategy. C-C disconnection – functional group addition, removal and modification.

UNIT – IV - NMR Spectrometry:

4.1. Chemical and magnetic non – equivalence – chemical shift – coupling constant – factors that influence δand J coupling constant - first and second order proton spin – spin interaction – dependence of J on dihedral angles – vicinal and geminal coupling constants – karplus equation – long range coupling constants – influence of stereo chemical factors on chemical shift of protons – simplification of complex spectra – double resonance techniques – shift reagents – chemical spin decoupling of rapidly exchangeable protons – OH, COOH, SH, NH_2 – an elementary treatment of NOE phenomenon- two dimensional NMR techniques H-H-COSY, C-H-COSY, NOESY.

4.2 **C^{13} NMR spectroscopy:** Basic principles – FT–NMR explanation –main differences between H^1&C^{13} NMR spectroscopy - broadband decoupling – off resonance decoupling – Factors that influence C^{13} chemical shifts – additivity of chemical shifts for simple aliphatic and aromatic compounds – conformation and chemical shift correlation – peak assignments – importance of NOE phenomenon in ^{13}C NMR spectroscopy.

UNIT – V -Natural Products– II

5.1 **Alkaloids**

Synthesis and reactions of the following: Tropine, Cinchonine, Morphine, Papaverene and structural elucidation of Reserpine (synthesis not expected).

5.2 **Terpenes**

Structural elucidation, medicinal values and synthesis of alpha – pinene, camphor and zingiberene.

Text books :

1. R.T. Morrison and R.N.Boyd, organic chemistry, 6th edition, Prentice – Hall of India, 2007.
2. R.K. Bansal, Organic Reaction Mechanisms, 3rd edition , Tata McGraw Hill, 2005.
3. P.S.Kalsi, Organic Reaction and their mechanisms, 4th edition, New Age International Publishers, 2006.

4. Y.R.Sharma, elementary Organic spectroscopy – Principles and Chemical applications, S.Chand, 1992.
5. P.S.Kalsi, Spectroscopy of organic compounds, New age international publishers, 2003.
6. O.P.Agarwal,Organic chemistry of Natural Products, Volume I & II, 29th edition, Goel Publishing House, 2005.

References:

1. R.M. Silverstein, F.X.Webster , Spectrometric identification of Organic compounds, 6th edition, Wiley , 1998.
2. J.R.Dyer, Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall , 1965.
3. W.Kemp , Organic Spectroscopy, ELBS,1991.
4. I.L.Finar, Organic Chemistry, Vol. II , 6th edition, Pearson Education, 2005.
5. F.A.Carey and R.J. Sunberg, Advanced Organic Chemistry, Part – A & Part-B, Pienum Press, 1990.

Course outcome:

CO: 1 To learnt the addition and carbon-carbon multiple bon reactions and mechanisms

CO: 2 To understand the properties of protecting functional groups

CO: 3 To know about the principles and reaction mechanisms of retrosynthesis

CO: 4 To know about the Nuclear magneticresonance spectroscopy, proton chemical shift, spin-spin coupling, coupling constants and application to organic structures ^{13}C resonance spectroscopy

CO: 5 To learnt about the synthesis and reactions of alkaloids and Terpenes

Mapping

PO/PSO CO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	M	M	S	M	M	M	M	S
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CO3	S	M	M	M	M	M	M	M	M	S
CO 4	S	M	S	S	S	M	S	M	S	S
CO 5	M	S	M	M	S	M	S	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC – XII - PHYSICAL CHEMISTRY – III		
II M.Sc., Chemistry	Semester –III	Credits: 4	Hrs/Wk: 5
Cognitive Level	K1 Acquire K2 Understand K3 Apply K4 Evaluate K5 Analyze		
Course Objectives	The course aim • This course provides an introduction to Thermodynamics. • Students will be able to demonstrate an understanding the statistical thermodynamic. • Students should be able to understand the partition functions. • To learn the basics of Nano chemistry • Students should be able to understand the data analysis.		

UNIT – I - Statistical Thermodynamics – I

1.1 Calculation of thermodynamic probability of a system – derivation of the Maxwell – Boltzmann distribution equation (classical statistics) – derivation of S = Klnw – definition of Ergodic hypothesis – physical significance of partition function.

1.2 Quantum statistics – derivations of Bose – Einstein and Fermi – Dirac distribution equations – comparison of B.E and F.D statistics with Boltzmann statistics – concept of negative kelvin temperature.

UNIT – II - Statistical Thermodynamics – II

2.1 Partition functions – translational, rotational, vibrational and electronic partition function – Relation between partition function and thermodynamic properties like E, S, H, A, G – Calculation of the above thermodynamic properties from partition function – derivation of equilibrium constants.

2.2 Non – equilibrium Thermodynamics – postulates and methodologies, linear laws, Onsager reciprocal relation**.**

UNIT – III - Quantum Chemistry – III

3.1 The Born-oppenheimer approximation – The MO method for H_2^+.MO and valence bond treatment of H_2molecule. Ionic-covalent bond resonance - polarity of bonds – comparison of MO and VB methods.

3.2 Hybridizations, solving wave functions for sp^1, sp^2 and sp^3 hybrid orbitals, delocalized systems. Huckel theory of conjugated systems like ethylene and butadiene.

3.3 Bond order and charge density calculations – extended Huckel theory and its simple chemical applications. Fundamentals of density functional theory - basis set..

UNIT – IV - Nano Chemistry

4.1 Definitions of nano, nanoscience and nano technology - Fullerenes – synthesis and purification, Carbon nanotubes – definition, synthesis and purification – filling of nanotubes.

4.2 Nanosensor – definition – characterization – electrochemical sensor – sensor based physical properties. Some important recent discovery and history of nanoscience and technology.

UNIT – V - DATA ANALYSIS

5.1 Various types of errors, precision and accuracy, significant figures, mean value, variance and standard deviations – Student's – t- distribution and tests.

5.2 Comparison of mean with the expected value, comparison of results of two different methods. Comparisons of the precision of two methods of F-test – Linear regression, regression line, standard deviation, correlation coefficient.

Text Books:

1. F.W.Bilmayer, Jr., A Text Book of Polymer Science, John Wiley and Sons, New York, 1971.
2. A.Tager, Physical Chemistry of Polymers, Mir Publishers, Moscow, 1978.
3. R.Gopalan, P.S.Subramaniyan and K. Rengarajan, Elements of Analytical Chemistry, Sultan Chand & Sons, New Delhi, 1995.

References:

1. B.K.Sharma, Instrumental methods of Chemical analysis, Goel Publishing House,
2. T.Pradeep, 'Nano-The essentials' Tata-McGraw Hill, 2007.

Course outcome:

CO: 1 The students should be able to understand the derivation of Maxwell – Boltzmann distribution equation.

CO: 2 To know about the derivation of quantum statistics.

CO: 3 To learnt about the quantum mechanical applications of Molecular orbital theory and hybridization of molecules.

CO: 4 To familiarize the nanoscience and nanotechnology

CO: 5 To know the various types of errors and linear regression and standard deviations.

Mapping

PO/PSO CO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	S	M	S	M	M	M	M	S
CO 2	S	S	M	S	S	M	M	M	M	S
CO3	S	M	M	M	M	M	M	M	M	S
CO 4	S	M	S	S	S	M	S	M	S	S
CO 5	M	S	M	M	S	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	**CC-XIII - INORGANIC CHEMISTRY PRACTICAL- II**		
II M.Sc., Chemistry	**Semester -III**	**Credits: 4**	**Hrs/Wk: 5**
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim • To make students estimate the metal ions present in the mixture using titrimetric • To get knowledge in gravimetric methods. • To expose the students to various preparation steps in synthesizing inorganic complexes. • Four mixture of metal ions estimated • Five inorganic complexes are synthesized		

A. Titrimetry and Gravimetry

Only mixture(s) of solutions should be given for estimation

(i) Cu(V) and Ni(G)
(ii) Cu(V) and Zn(G)
(iii) Fe(V) and Zn(G)
(iv) Fe(V) and Ni(G)

B. Preparation of the following complexes

1. Tetrammine copper(II) sulphate.
2. Potassium trioxalato chromate(III)
3. Hexammine cobalt(III) chloride
4. Potassium trioxalato ferrate(III)
5. Tristhiourea copper (I)chloride

Text Books:

1. V.Venkateswaran, R.Veerasamy and A.R.Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, Second Edition, 1997.
2. K.K.Sharma and O.S.Sharma, An introduction to Practical Chemistry, Vani Educational Books, Second Edition, 1982.

References:

1. ATHUR I. VOGEL, A Text Book of Macro and Semi-micro Qualitative Inorganic Analysis, Longman Group Ltd., First Indian Edition, 1975.
2. V.V.Ramanujam, Inorganic Semicmicro Qualitative Analysis, The National Publishing Co., Madras, Second Edition, 1970.
3. J.Bassett, R.C.Denney, G.H.Jeffery and J.Mendhan, Vogel's Text Book of Inorganic Quatitative Analysis, ELBS-Longman, London, 4th Edition, 1978.

Course Outcome:

CO: 1 To know about the volumetric and gravimetric analysis of cations and anions.

CO: 2 Making informal choice among post graduate opportunities for work or further Education.

CO: 3 To know how to characterize products by physical and spectroscopic methods.

CO: 4 To learnt the preparations ofpotassium and cobalt complexes.

CO: 5 To familiarize the gravimetricand Titrimetric estimation ofmetal ions.

Mapping

PO/PSO CO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	M	M	S	M	M	M	M	S
CO 2	S	S	S	W	S	M	M	M	M	S
CO3	S	M	W	S	M	M	M	M	M	S
CO 4	S	M	W	M	S	M	S	M	S	S
CO 5	S	M	M	M	M	S	S	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	CC-XIV- ORGANIC CHEMISTRY PRACTICAL-II		
II M.Sc., Chemistry	**Semester –III**	**Credits: 4**	**Hrs/Wk: 5**
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim • To help students estimate quantitatively the amount of Phenol, Aniline, Ketone, Glucose present in given solution. • Also help them prepare compounds involving double stages. • Five organic compounds are prepared in the double stages. • Respective compounds are recrystalized • Students to get practical knowledge in organic chemistry		

1. **Quantitative analysis of organic compounds**

   Estimation of phenol, aniline, ketone, glucose, saponification value of oils and iodine value of oils.

2. **Preparation of Organic compounds: (Double stage)**

   a) P-bromo acetanilide from aniline

   b) Acetyl salicylic acid from methyl salicylate

   c) 1,3,5-tribromo benzene from aniline

   d) P-nitro aniline from acetanilide

   e) Benzillic acid from benzoin by rearrangement

   f) Benzanilide from benzophenone by rearrangement.

Text Books:

1. V.Venkateswaran, R.Veerasamy and A.R.Kulandaivelu, Basic Principles of practical chemistry , Second edition , sultan chand & sons, (1997).

2. K.K.Sharma and O.S.Sharma , An introduction to practical chemistry, Vani Educational Books , 2nd edition (1982).

References:

1. ARTHUR I. VOGEL, Elementary pracatical organic chemistry, qualitative organic analysis, CB Publishers and distributors, Delhi
2. B.S.Furniss, A.J.Hnnaford, V.Rogers, P.W.G. Smith and A.R.Tatchell, Vogel's Text Book of Pracatical Organic chemistry, Longman, London, (1978)

Course outcome:

CO: 1 To know about the estimation of phenol, aniline.

CO: 2 To learnt about the estimation of saponification of oils and iodine vaue of oils

CO: 3 To prepare p-bromo acetanilide from aniline

CO: 4 To prepare 1,3,5- tribromobenzene from benzene .

CO: 5 To familiarize the Preparation of p-nitroaniline fromacetanilide.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	M	S	S	M	M	M	M	S
CO 2	S	S	S	M	S	M	M	M	M	S
CO3	S	M	S	W	M	M	M	M	M	S
CO 4	S	M	W	M	S	M	S	M	S	S
CO 5	M	M	M	S	M	S	S	M	M	S

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	EC-II –INSTRUMENTATION AND MATERIAL CHEMISTRY		
II M.Sc., Chemistry	**Semester –III**	**Credits: 5**	**Hrs/Wk: 5**
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim • IR & Raman studies to give overall structural determination of complexes possible for students. • Introduction of NMR and NQR spectroscopy • To get knowledge in crystalographic studies • To introduce the Nuclear chemistry • Special focus on advanced Nano materials, method of preparation, structure and applications are provided to keep abreast of current development in material chemistry.		

UNIT –I

1.1 **IR and Raman spectroscopy:**

Combined uses of IR and Raman spectroscopy in the structural elucidation of simple molecules like H_2O, ClF_3, NO_3^- and ClO_3^-. Effect of co-ordination on ligand vibrations – uses of group vibrations in the structural elucidation of metal complexes of urea, thiourea, cyanide, thiocyanate, nitrate, sulphate and dimethyl sulphoxide. Effect of isotopic substitution on the vibrational spectra of molecules – vibrational spectra of metal carbonyls with reference to the nature of bonding, geometry and number of C-O stretching vibrations (group theoretical treatment).

1.2 **Mass Bauer Spectroscopy:**

Mass Bauer transition and Doppler effect – isomer shift – quadrapole effect of magnetic field on spectra – simple applications to iron compounds.

UNIT –II - NMR and NQR spectroscopy:

2.1 Chemical shift and coupling constants (spin-spin coupling involving different nuclei ^{1}H, ^{31}P, ^{13}C) interpretation and applications to inorganic compounds. NMR of paramagnetic molecules – isotopic shifts, contact and pseudo contact shift and their interactions – lanthanide shift reagents.

2.2 NQR – principle, effect of magnetic field on the spectra, Relationship between the electric field gradient and molecular structure, Halogen Quadrupole Resonance – applications.

UNIT –III - Crystallography

3.1 Crystal symmetry – combination of symmetry elements – crystal classes – screw axis and glide planes – space group – crystal axes – crystal systems, unit cell, Bravis lattices, asymmetric unit – space group, point group – equivalent positions – relationship between molecular symmetry and crystallographic symmetry - basic concepts and examples.

3.2 X-ray diffraction by single crystals – structure factor – determination of space group by systematic absences – phase problem in structure analysis – heavy atom method – Fourier synthesis – refinement of structure. Neutron diffraction – an elementary treatment - applications and comparison with X-ray diffraction, Electron diffraction – basic principles and applications to simple molecules – Ferrocene.

UNIT –IV - Nuclear chemistry:

4.1 Radioactive decay and equilibrium – nuclear reactions - Q-value – significance of nuclear reaction - cross sections – types of reactions – chemical effects of nuclear transformations – fission and fusion – fission products and fission yields.

4.2 Radioactive techniques – tracer techniques – neutron activation analysis – isotopic dilution analysis –hot atom chemistry –counting techniques such as GM, ionization and proportional counters.

UNIT –V - Inorganic Materials:

5.1 **Nanomaterials**

Introduction – Methods of preparation – CVD, electrodeposition,Sol- gel techniques. Nanotubes – synthesis and purification – electronic structure – properties – applications. Self-Assembled Monolayers –monolayers on gold – preparation – structure – applications – nanobiosensors.

5.2 **Dielectric Materials**

Semiconductors – super conductors – type –I and type-II - superconductors – temperature and frequency effects – electric breakdown – ferroelectric materials.

Text Books:

1. T.Pradeep , “Nano- The essentials” Tata – McGraw Hill,2007.
2. F.A. Cotton and G. Wilkinson, “Advanced Inorganic Chemistry” 3rd ed., Wiley – Eastern company, New Delhi, 1990.

References:

1. R.S.Drago, “Physical Methods in inorganic chemistry”, 3rd ed., Wiley Eastern Company (units I,II,III &IV)
2. E.A.V.Ebsworth, “Structural Method’s in inorganic chemistry”,3rded., ELBS,Great Britain,1987.
3. G.Friedlander, J.W. Kennedy and J.Miller, “ Nuclear and Radiochemistry,3rd ed., Wiley inter science Publications, John Wiley & sons New York.
4. K.Ragavan,Materials Science and Engineering.

Course Outcome:

CO: 1 The students should be able to learn about the structural elucidation of simple molecules and ions.

CO: 2 To learnt about the applications of mass bauer spectroscopy.

CO: 3 To know about the principles of NQR spectroscopy

CO: 4 To learnt about the principles of X-ray diffraction studies.

CO: 5 To familiarize the radioactive decay and isotopic dilution methods.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	S	M	S	M	M	M	M	S
CO 2	S	S	M	S	S	M	M	M	M	S
CO3	S	M	S	M	M	M	M	M	M	S
CO 4	S	M	M	S	S	M	S	M	S	S
CO 5	M	S	S	M	M	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	EC-III- SPECIAL TOPICS IN ORGANIC CHEMISTRY		
II M.Sc., Chemistry	**Semester –IV**	**Credits: 5**	**Hrs/Wk: 6**
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim • To get knowledge in organic photochemistry • Students to get indepth knowledge in pericyclic reactions. • Mass spectroscopy, ORD, CD curves helps the students to understand organic compounds and its structures. • Synthesis, structure, classification of antibiotics, steroids will play a greater role in current trends of bio technology. • To get knowledge in antibiotic and Steriods		

UNIT – I - Organic Photochemistry

1.1 Fundamental concepts – energy transfer characteristics of photo sensitization – characteristics of photo reactions of ketones - Norrish type I and II – reactions.

1.2 Photochemistry of alkenes, dienes and aromatic compounds – reactions of unactivated centres – photo additions – Patterno- Buchi reaction. Photo substitution Barton reaction – Hoffmann – Loffler - Freytag reaction. Photo rearrangement - Photo – Fries and di - π methane rearrangements.

UNIT – II - Pericyclic reactions

2.1. Concerted reactions – stereochemistry – orbital symmetry and correlation diagram - Frontier molecular orbital approach – Woodward – Hoffmann rules – electrocyclic reactions – cycloaddition reactions – selection rules.

2.2. Stereochemistry of electro cyclic, cycloaddition and sigmatropic shifts – 1,3 & 1,5 hydrogen shifts. Sommelet, Hauser, Cope and Claisen rearrangements – ene reactions.

UNIT – III

3.1 **Heterocycles:**Synthesis and reactivity and applications of the following heterocycles - Furan , thiophene Pyrrole, Pyridine, Indole, quinolines and isoquinolines.

3.2 **Reduction:**Catalytic Hydrogenation and dehydrogenation. Clemmensen, Wolff-Kishner, PV and Birch reductions. Reduction with $LiAlH_4$, $NaBH_4$, tritertiarybutoxyaluminium hydride, sodium cyanoborohydride, trialkyltin hydride, Wilkinson's catalyst.

UNIT – IV

4.1 **Mass spectroscopy:**

Basic principles – resolutions – EI and CI methods – base peak – isotopic peaks – metastable peaks – parent peaks – determination of molecular formula – recognition of molecular ion peak – fragmentation – general rules – nitrogen rule – pattern of fragmentation of various classes of compounds – McLafferty rearrangement – importance of metastable peaks.

4.2 **Optical Rotatory Dispersion (ORD) and circular dichroism (CD):**

Introduction to theory and terminology – cotton effect – ORD curves – axial haloketone rule and its applications – octant rule – its applications – applications of ORD to determine absolute configuration of monocyclic ketones – comparison between ORD and CD – their inter relationships.

UNIT – V - Natural Products– III

5.1 **Antibiotics:**Structure and synthesis of penicillin, Streptomycin – cephalosporin-C and chloramphenicol.

5.2 **Steroids:**Classification – conformational representation - alpha and beta representation of substituents – structural elucidation of cholesterol and ergosterol (synthesis not required) – synthesis and properties of vitamin D – esterone, progesterone.

Text Books:

1. S.M.Mukherji and S.P.Singh, Reaction Mechanism in Organic Chemistry, 3rd edition, Macmillan, 1984.
2. R.T.Morrison and R.N.Boyd, Organic Chemistry, 6th edition, Prentice- Hall of India, 2005.
3. R.K.Bansal, Organic Reaction Mechanisms, 3rd edition, Tata McGraw Hill, 2005
4. P.S.Kalsi, Organic Reactions and their mechanisms, 4th edition, New Age International, 2006.
5. Y.R.Sharma, Elementary Organic Spectroscopy - principles and chemical applications, S.chand,1992.
6. P.S.Kalsi, Spectroscopy of Organic comopounds, New Age International, 2003.
7. O.P.Agarwal, Organic Chemistry of Natural Products,Volume I and II, 29th edition, Goel Publishing House, 2005.

References:

1. C.H.Depuy and O.S.Chapman, Molecular Reactions and Photochemistry, Prentice Hall, 1975.
2. I.L.Finar, Organic Chemistry, Vol II, 6th ed, Pearson Education, 2005.
3. F.A.Carey and R.J.Sunberg, Advanced Organic Chemistry, Part-A & Part-B, Pienum Press, 1990.

Course outcome:

CO: 1 The students should be able to know about the fundamental concept of Jablonski diagram

CO: 2 To know about the photo chemical rearrangement reactions.

CO: 3 To know about the basic principles and mechanisms of pericyclic reactions.

CO:4 To learnt about the basic properties and reaction mechanisms of heterocyclic compounds

CO: 5 To familiarize about the principles of mass spectroscopy and ORD and CD.

Mapping

PO/PSO CO	PO					PSO				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	M	M	S	M	M	M	M	S
CO 2	S	S	S	M	S	M	M	M	M	S
CO3	S	M	M	S	M	M	M	M	M	S
CO 4	S	M	S	M	S	M	S	M	S	S
CO 5	M	S	M	S	M	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No

Course code & Title	EC- IV – (ELECTIVE COURSE) – ELECTRO AND SURFACE CHEMISTRY		
II M.Sc., Chemistry	**Semester –IV**	**Credits: 5**	**Hrs/Wk: 6**
Cognitive Level	**K1 Acquire** **K2 Understand** **K3 Apply** **K4 Evaluate** **K5 Analyze**		
Course Objectives	The course aim 1. To introduce the basic principles and some applications of electro chemistry. 2. After studying the unit, students should be able to • Understand the electro chemical cell • To know about the electro analytical methods. 3. To provide an introduction to the physical chemistry of interfaces and to demonstrate its significance in catalysis 4. After studying these units, students should be able to explain the qualitative and quantitative basics of catalysis and physical adsorption. 5. To get knowledge in the applications catalysis		

UNIT – I - ELECTRO CHEMISTRY – I

1.1 Cell terminology - Nernst equation – Types of electrode – electro chemical cells – chemical cells with and without transference – electrode, electrolyte concentration cells without transference – concentration cells with transference – liquid junction potentials.

1.2 Processes at the electrodes – the rate of electrode process & EMF – Butler-Volmer equation – Tafel equation – Theories of Electrical double layer - Helmholts, Gouy Chapmann and Stern's theory – Fuel cells – Hydrogen-oxygen fuel cell – Commercial cells – Leclanche cell and Lead storage cell.

UNIT – II - ELECTRO CHEMISTRY – II

2.1 **Electro Analytical Methods**

Principles and applications of polarography – advantages and disadvantages of dropping mercury electrode, techniques of polarography, Illkovic equation, half-wave potential.

2.2 Modern developments – Working of polarographic cells - Types of polarography – oscillographic, polarography, Chronopotentiometric titration – Colorimetric titration.

UNIT-III - ELECTRO CHEMISTRY-III

3.1 Debye Huckel theory-Radius of ionic atmosphere-Calculations of thickness of ionic atmosphere-Evidence of ionic atmosphere-Asymmetry effect-Electrophoretic effects- Falkenhagen effect-Wien effect-Debye-Huckel Onsager equation-Modification and verification of the equation-Debye Huckel limiting law (derivation only).

3.2 Activity, activity coefficients-activity coefficient with concentration-Finite ion size Model-Huckel-Bronsted equation-calculation of activity coefficient.Determination of ion size parameter-Solubility product of sparingly soluble salt-Common ion effect-Neutral salt effect.

UNIT – IV - Surface Chemistry

4.1. Surface phenomena – adsorption and free energy relation at interfaces – derivation of Gibb's adsorption isotherm – solid-liquid interfaces – contact angle and wetting – solid-gas interface – physisorption and chemisorptions.

4.2 Derivation and assumptions of Langmuir and BET isotherms – surface area determination- BET method, radioactive tracer method.

UNIT – V - Heterogeneous Catalysis

5.1 Role of surfaces in catalysis – semiconductor catalysis – n- and p-type surfaces – kinetics of surface reactions involving adsorbed species – Langmuir – Hinshelwood mechanism – Langmuir – Rideal mechanism – Rideal – Eley mechanism.

5.2 photo catalysis – types and applications. Mechanisms of a few specific catalyzed reactions – Fischer – Tropsch type reaction and hydrogenation of ethylene.

Text Books:

1. Classical,Statistical and Irreversible, Shoban Lal Nagin, New Delhi,1981.
2. L.K.Nash, Elements of Chemical Thermodynamics, AdditionWesley,1962.
3. S.Glasstone, Thermodynamics for Chemists, Affiliated East West Press, New Delhi, 1960.
4. F.W.Billmayer, Jr., A text Book of Polymer Science, John Wiley and Sons, New York, 1971.
5. S.Glasstone, Introduction of Electrochemistry, Affiliated East West Press, 1968.
6. G.C.Bond, Heterogeneous Catalysis – Principles and applications, Clarendon, 1974.

References:

1. S.Glasstone, Introduction to Electrochemistry, Affiliated East West Press, 1968.
2. J.Albery, Electrode Kinetics, Clarendon Press, Oxford Chemical Series, 1979.
3. J.O.Bockris and A.K.N.Reddy, Modern Electrochemistry,Vol I & II, Plenum, 1970.
4. L.I.Anthrapov, Theoretical Electrochemistry, Mir Publishers, Moscow, 1972.
5. A.W.Adamson, Physical Chemistry of Surface, 4^{th} ed., John Wiley and Sons, New York, 1982.

Course Outcome:

CO: 1 The students should be able to understand the basic theories at the electrolyte-electrode interfaces.

CO: 2 Outline electrochemical principles in corrosion and energy storage

CO: 3 To know about the solubility product, common ion effect and neutral salt effects.

CO: 4 To familiarize about the principles of chemisorption and physisorption.

CO: 5 To know about the role of surface in catalysis and photo catalysis.

Mapping

PO/PSO CO	**PO**					**PSO**				
	1	2	3	4	5	1	2	3	4	5
CO 1	S	S	S	M	S	M	M	M	M	S
CO 2	S	S	S	M	S	M	M	M	M	S
CO3	S	M	\M	W S	M	M	M	M	M	S
CO 4	S	M	S	M	S	M	S	M	S	S
CO 5	M	S	M	S	M	S	M	S	M	M

Correlation: S-Strong; M-Moderate; W-Week N-No