SHRI RAM SINGH DHONI RAJKIYA MAHAVIDYALAYA, JAINTI (ALMORA)

Academic Session 2022-23

Course Outline

Subject: Chemistry

Class: B.Sc. 2nd Year

PAPER	TOTAL NO. OF HOURS	MAX. MARKS
Theory: Inorganic Chemistry – Paper I	60 (2 hrs/week)	33
Theory: Organic Chemistry – Paper II	60 (2 hrs/week)	33
Theory: Physical Chemistry – Paper III	60 (2 hrs/week)	34
Practical: Lab Course	06 hrs/week	50

TEACHING PLAN: B.Sc. 2nd Year

Paper I: Theory: Inorganic Chemistry

Max. Marks = 33 Marks

UNITS	TOPICS	NO. OF HOURS = 60
1. Chemistry of Transition Elements (First Transition Series)	Characteristic properties of the elements; ionic radii, oxidation states, complex compound formation and magnetic properties. Their binary compounds, illustrating relative stability of their oxidation states, coordination number and geometry.	10
2. Chemistry of Transition Elements (Second and Third Series)	General characteristics, comparative treatment with their analogues in respect of ionic radii, oxidation state, magnetic behaviour and stereochemistry.	10
3. Oxidation and Reduction	Standard electrode potential, Reference electrode, determination of electrode potential, electrochemical series, uses of electrode potential data, reaction feasibility and computation of equivalent weight.	08
4. Coordination Chemistry	Werner's theory for coordination compounds; its experimental verification, effective atomic number concept, chelates. Nomenclature of coordination compounds (IUPAC system), isomerism in coordination compounds, stability of	10

	complexes and factors contributing to the stability. Valence bond theory for coordination compounds.	
5. Chemistry of Lanthanides	Electronic structure, oxidation states, ionic radii, lanthanide contraction and its consequences, complex formation, methods of separation of lanthanides- fractional crystallization, fractional precipitation, change in oxidation state, solvent extraction and ion exchange methods.	06
6. Chemistry of Actinides	General features of actinides-electronic configuration, atomic and ionic radii, ionization potential, oxidation states and complex formation.	04
7. Acids and Bases	Arrhenius concept, Bronsted-Lowry concept, Lux-Flood and Lewis concept of acids and bases, role of the solvent and strength of acids and bases.	06
8. Non Aqueous Solvents	Classification of solvents, their general characteristics, physical properties of the solvents, reaction in non-aqueous solvents-liquid NH3 and SO2 (auto-ionization, precipitation reactions, acid-base reaction, oxidation-reduction reactions, salvation and solvolysis, complex formation, merits and demerits.	06

Books Recommended:

- R. L. Madan, "Chemistry for Degree Students, B. Sc. Second Year", S. Chand Publishing, New Delhi, India.
- B. R. Puri, L. R. Sharma, and K. C. Kalia, "Principles of Inorganic Chemistry", Vishal Publishing Co., India.
- R. D. Madan, U. M. Malik and G. D. Tuli, "Selected topics in Inorganic Chemistry", S. Chand Publishing, New Delhi, India.
- S. Prakash, G. D. Tuli, S. K. Basu and R. D. Madan, "Advanced Inorganic Chemistry", S. Chand Publishing, New Delhi, India.
- J. D. Lee, "Concise, Inorganic Chemistry", Oxford University Press, 2008, India, 5th edition.

COURSE OUTCOMES: PAPER I: Inorganic Chemistry

This paper provides detailed knowledge of chemistry of transition elements including first transition series, second transition series, third transition series, lanthanides and actinides. The students will be able to describe the concepts of oxidation, reduction, coordination chemistry in detail. Students will be able to define the acids and bases on the basis of various concepts/ theories in addition to non- aqueous solvents.

TEACHING PLAN: B.Sc. 2nd Year

Paper II: Theory: Organic Chemistry

Max. Marks = 33 Marks

UNITS	TOPICS	NO. OF HOURS = 60
1. Electromagnetic Spectrum; Absorption Spectroscopy	Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert law), molar absrptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of conjugation, concept of chromophore and auxochrome. Bathochromic, hypochromic, hyperchromic and hypsochromic shifts. UV spectra of conjugated enes and enones. Infra Red (IR) absorption spectroscopy- molecular vibrations, Hook's Law, selection rules, intensity and position of IR bands, measurement of IR spectrum, finger print region, characteristic absorptions of various functional groups and interpretation of IR spectra of simple organic compounds.	08
2. Alcohols	Classification and nomenclature. Monohydric alcohols; methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters. Hydrogen bonding. Acidic nature. Reactions of alcohols. Dihydric alcohols-methods of preparation, chemical reactions of vicinal glycols, oxidative cleavage [Pb(OAc)4 and HIO4] and pinacol-pinacolone rearrangement. Trihydric alcohols-methods of formation, chemical reactions of glycerol.	06
3. Phenols	Nomenclature, structure and bonding. Preparation of phenols, physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols-electrophilic aromatic substitution, acylation and carboxylation. Mechanism of Fries rearrangement, Claisen condensation, Gatterman synthesis, Houben-Hoesch reaction, Lederer-Manasse reaction and Reimer-Tiemann reaction.	06
4. Ethers and Epoxides	Nomenclature, methods of preparation. Physical properties. Chemical reactions-cleavage and auto-oxidation, Ziesel's method. Synthesis of epoxides. Acid and base catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organo-lithium reagents with epoxides.	03

5. Aldehydes and Ketones	Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the synthesis from acid chlorides, synthesis using 1,3-dithianes, synthesis of ketones from nitriles and carboxylic acids. Physical properties. Mechanism of nucleophilc additions to carbonyl groups with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensation. Condensation with ammonia and its derivatives; Wittig reaction, Mannich reaction. Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemensen, Wolf-Kishner, LiAlH4 and NaBH4 reductions. Halogenation of enolizable ketones. An introduction to α-, β-unsaturated aldehydes and ketones.	10
6. Carboxylic Acids and their Derivatives	Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids. Reactions of carboxylic acids, Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides. Reduction of carboxylic acids, mechanism of decarboxylation. Methods of formation and chemical reactions of halo acids, hydroxy acids- malic, tartaric, and citric acids. Methods of preparation and chemical reactions of unsaturated monocarboxylic acids. Dicarboxylic acids-methods of preparation and effect of heat and dehydrating agents. Carboxylic acid derivatives- Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution. Preparation of carboxylic acid derivatives, chemical reactions. Mechanism of esterification and hydrolysis (acid and base)	09
7. Nitrogen Containing Organic Compounds	Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes. Mechanism of nucleophilic substitution in nitroarenes and their reactions in acidic, neutral and alkaline media. Picric acid. Halonitroarenes-reactivity, structure and nomenclature of amines. Physical properties. Separation of mixture of primary, secondary and tertiary amines. Structural features affecting basicily of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl and aryl amines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction.	12

	Reaction of amines, electrophilic aromatic substitution in aryl amines, reaction of amines with nitrous acid. Synthetic transformations of aryl diazonium salts, azo coupling.	
8. Organic Synthesis via Enolates	Acidity of hydrogen, alkylation of diethylmalonate and ethylacetoacetate. Synthesis of ethylacetoacetate, the Claisen condensation. Keto-enol tautomerism of ethylacetoacetate.	06

Books Recommended:

- I. L. Finar, "Organic Chemistry", Pearson Education India.
- Boyd, Morrison and Bhattacharjee, "Organic Chemistry", Pearson Education India.
- A. Bahl and B. S. Bahl, "Advanced Organic Chemistry", S. Chand Publishing, India.
- J. Singh and L. D. S. Yadav, "Undergraduate Organic Chemistry" Pragati Prakashan, India.
- S. M. Mukerji, "Reaction mechanism in Organic Chemistry", Laxmi Publications.

COURSE OUTCOMES: PAPER II: Organic Chemistry

This paper provides detailed knowledge of different functional groups like alcohols, phenols, ethers, epoxides, aldehydes, ketones, carboxylic acids and their interconversion. The students will be able to describe organic synthesis which is the most important branch of organic chemistry which provides jobs in production & QC departments related to chemicals, drugs, medicines, FMCG etc.

TEACHING PLAN: B.Sc. 2nd Year

Paper III: Theory: Physical Chemistry

Max. Marks = 34 Marks

UNITS	TOPICS	NO. OF HOURS = 60
1. Thermodynamics II	Second law of thermodynamics, need of the law, different statements of the law. Carnot cycle and its efficiency, Carnot theorem. Thermodynamic scale of temperature. Concept of entropy: entropy as a state function, entropy as a function of V and T, entropy as a function of P and T, entropy change in physical and chemical processes, entropy change in reversible and irreversible processes. Clausius inequality, entropy as a criteria of spontaneity and equilibrium. Entropy change in ideal gases and mixing of gases. Gibbs and Helmoltz functions. Gibbs function (G) and Helmoltz function (A) as thermodynamic quantities, A and G as criteria for thermodynamic equilibrium and spontaneity, their advantage over entropy change. Variation	18

	of G and A with P, V and T. Gibbs-Helmoltz equation, Clapeyron equation, Clausius-Clapeyron equation, reaction isotherm and reaction isochore.	
2. Chemical Equilibrium	The law of mass action, free energy and equilibrium constant, factors influencing equilibrium constant, relationship between Kp and Kc. Thermodynamic derivation of the law of mass action, application of law of mass action to some homogenous and heterogeneous equilibrium, Le-Chatelier's principle.	06
3. Phase Equilibrium	Statement and meaning of the terms: phase, component and degree of freedom, derivation of Gibbs phase rule, phase equilibria of one component systems- water, carbon dioxide and sulphur. Phase equilibria of two component systems: solid-liquid equilibra, simple eutectic; Bi-Cd, Pb-Ag systems, desilverisation of lead. Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H2O, FeCl3-H2O and CuSO4-H2O systems). Freezing mixtures, acetone- dry ice. Liquid-liquid mixtures: ideal liquid mixtures, Raoult's and Henry's law. Non-ideal systems-azeotropes; HCl-H2O and ethanol-water systems. Partially miscible liquids; phenol-water, trimethylamine-water, nicotine-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature; immiscible liquids, steam distillation. Nernst distribution law: its thermodynamic derivation and applications.	10
4. Electrochemistry I	Electrical transport-conduction in metals and electrolytic solutions, specific conductance and equivalent conductance, measurement of equivalent conductance, variation of equivalent and specific conductance with dilution. Arrhenius theory of electrolytic dissociation and its limitations, weak and strong electrolytes, Ostwald's dilution law, its uses and limitations. Debye-Hückel theory, equation for strong electrolytes (elementary treatment only). Migration of ions, Transport number, definition and determination by Hittorf and moving boundary methods, Kohlrausch's law. Application of conductivity measurements-determination of degree of dissociation, Ka of acids, solubility product of sparingly soluble salts, conductometric titrations.	12
5. Electrochemistry II	Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt anion and redox electrodes. Electrode reactions, Nernst equation, derivation of cell	10

	EMF and single electrode potential, standard hydrogen electrode-reference electrode, standard electrode potential, sign conventions, electrochemical series and its significance. Electrolytic and Galvanic cells-reversible and irreversible cells, conventional representation of electrochemical cells. EMF of a cell and its measurements. Computation of cell EMF. Calculation of thermodynamic quantities of cell reactions (ΔG, ΔH and K), polarization decomposition potentials, over potential and hydrogen over voltage. Definition of pH and pKa, determination pH using hydrogen, quinhydrone and glass electrodes by potentiometric methods. Mechanism of buffer action, Henderson equation. Hydrolysis of salts.	
6. Surface Chemistry	Types of adsorption, Freundlich's and Langmuir's adsorption isotherms and their applications, charge on the colloidal particle, size of the colloidal particle, Perrin's method of determination of the Avogadro's number.	04

Books Recommended:

- B. R. Puri, M. S. Pathania, and L.R. Sharma, "Principles of Physical Chemistry", Vishal Publishing, India.
- A. Bahl, B. S. Bahl and G. D. Tuli, "Essential of Physical Chemistry", S. Chand Publishing, India.
- P. W. Atkins, "Atkin's Physical Chemistry: International", Oxford University Press.

COURSE OUTCOMES: PAPER III: Physical Chemistry

This paper provides detailed knowledge to students so that they can learn the basic concepts of spontaneity, chemical and phase equilibrium and will be able to solve the numerical problems based on these concepts. Along with this students will gain knowledge to describe the concepts of electrochemistry in detail and its applications including the concept of surface chemistry.

TEACHING PLAN: B.Sc. 2nd Year

Practical: Lab Course

Max. Marks = 50 Marks; Hours = 06 hours /week

S. NO.	TOPICS
1.	Laboratory hazards and safety precautions.
2.	Inorganic quantitative analysis-gravimetric estimation of Ba2+, Fe3+ Ni2+, Cu2+ and Zn2+.

3.	Inorganic synthesis – cuprous chloride, potash alum, chrome alum, ferrous oxalate, ferrous ammonium sulphate, tetraamminecopper(II) sulphate and hexaamminenickel(II) chloride. Crystallization of compounds.
4.	Organic qualitative analysis- Preparation of sodium extract, identification of special elements, identification of simple organic compounds-hydrocarbons (aliphatic & aromatic)- their derivatives.

Books Recommended:

- O. P. Pandey, D. N. Bajpai and S. Giri, Practical Chemistry for B. Sc. I, II and III Year Students of All Indian Universities, S. Chand Publishing, New Delhi, India.
- S.M. Khopkar, Basic Concepts of Analytical Chemistry. New Age International Publisher.
- J. Mendham, Vogel's Quantitative Chemical Analysis, Pearson.

COURSE OUTCOMES: PRACTICAL: Lab Course

After completing this course, the students will know the laboratory hazards and safety precautions that must be taken in the laboratory while performing the experiments. The students will gain knowledge to synthesize inorganic compounds like cuprous chloride, potash alum, chrome alum, ferrous ammonium sulphate. Along with this the students will able to identify simple aliphatic and aromatic organic compounds.

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Academic Session 2022-23

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PAPER	TOTAL NO. OF HOURS	MAX. MARKS
Theory: Inorganic Chemistry – Paper I	60 (2 hrs/week)	33
Theory: Organic Chemistry – Paper II	60 (2 hrs/week)	33
Theory: Physical Chemistry – Paper III	60 (2 hrs/week)	34
Practical: Lab Course	06 hrs/week	50

TEACHING PLAN: B.Sc. 3rd Year

Paper I: Theory: Inorganic Chemistry

Max. Marks = 33 Marks

UNITS	TOPICS	NO. OF HOURS = 60
1. Hard and Soft Acid-Base Theory	Classification of acids and bases as hard and soft. Pearson's hard and soft acid base concept, acid base strength and hardness and softness. Symbiosis, theoretical basis of hardness and softness, electronegativity and hardness and softness.	07
2. Metal-Ligand bonding in transition metal complexes	Limitations of valence bond theory, an elementary idea about crystal field theory; crystal field splitting octahedral, tetrahedral and square planar complexes, factors affecting the crystal-field parameters.	10
3. Magnetic Properties of Transition Metal Complexes	Types of magnetic behaviour, methods of determining magnetic susceptibility; Gouy's and Quincke's methods, spin only formula, correlation of μs and μeff values, orbital contribution to magnetic moments, application of magnetic moment data for 3d metal complexes.	07
4. Electronic Spectra of Transition Metal Complexes	Types of electronic transitions, selection rules for d-d transitions, spectroscopic ground states, spectrochemical series. Orgel energy level diagram for d1, d2 and d8, d9 states, discussion of the electronic spectrum of [Ti(H2O)6]3+ complex ion.	07

5. Thermodynamic and Kinetic Aspects of Coordination Compounds.	A brief outline of thermodynamic and kinetic stability of metal complexes and factors affecting the stability of coordination compounds. Substitution reactions in square planar complexes.	05
6. Organometallic chemistry	Definition, nomenclature and classification based on nature of metal-carbon bond. Metal carbonyls. Mononuclear carbonyls, nature of bonding, structure and preparation. EAN and 18-electron rule. Definition, nomenclature, classification, general methods of preparation of organometallic compounds and a brief account of metal-ethylenic complexes.	10
7. Bioinorganic Chemistry	Role of metal ions in biology, essential and trace elements in biological systems, toxic elements, elementary idea of structure and oxygen binding mechanism in metallo-porphyrins with special reference to haemoglobin and myoglobin. Alkali and alkaline earth metal ions in biological system-mechanism of transport across cell membrane, biochemistry of magnesium and calcium.	10
8. Inorganic Polymers of Silicon and Phosphorus	Silicones and Phosphazenes as examples of inorganic polymers, nature of bonding in triphosphazenes.	04

Books Recommended:

- R. L. Madan, "Chemistry for Degree Students, B. Sc. Third Year", S. Chand Publishing, New Delhi, India.
- B. R. Puri, L. R. Sharma, and K. C. Kalia, "Principles of Inorganic Chemistry", Vishal Publishing Co., India.
- R. D. Madan, U. M. Malik and G. D. Tuli, "Selected topics in Inorganic Chemistry", S. Chand Publishing, New Delhi, India.
- S. Prakash, G. D. Tuli, S. K. Basu and R. D. Madan, "Advanced Inorganic Chemistry", S. Chand Publishing, New Delhi, India.
- J. D. Lee, "Concise, Inorganic Chemistry", Oxford University Press, 2008, India, 5th edition.

COURSE OUTCOMES: PAPER I: Inorganic Chemistry

This paper provides detailed knowledge of different theories like hard and soft acid-base theory, valence bond theory and crystal field theory. Along with this, the student will gain complete knowledge of transition metal complexes which includes metal-ligand bonding, magnetic properties and electronic spectra. The students will be able to describe the role of metal ions in biology which covers essential and trace elements including different topics of organometallic chemistry.

TEACHING PLAN: B.Sc. 3rd Year

Paper II: Theory: Organic Chemistry

Max. Marks = 33 Marks

UNITS	TOPICS	NO. OF HOURS = 60
1. Spectroscopy	Nuclear magnetic resonance (NMR) spectroscopy; Proton magnetic resonance (1H NMR) spectroscopy, nuclear shielding and deshielding, chemical shift and molecular structure, spin-spin splitting and coupling constants, areas of signals, interpretation of pmr spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromoethane, ethyl acetate, toluene and acetophenone, Problems pertaining to the structure elucidation of simple organic compounds using UV, IR and PMR spectroscopic techniques.	08
2. Organo-metallic Compounds	Organomagnesium compounds; the Grignard reagents-formation, structure and chemical reactions. Organozinc compounds; formation and chemical reactions.	04
3. Organo-sulphur compounds	Nomenclature, structural features, methods of formation and chemical reactions of thiols, thioethers, sulphonic acid, sulphonamides and sulphaguanidine.	04
4. Hetrocyclic compounds	Introduction: Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution. Mechnism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction of condensed five- and six membered heterocycles. Preparation and reactions of quinolene and isoquinolene with special reference to Fischer-Indole synthesis, Skraups synthesis and Bischler-Napieralski synthesis. Mechnaism of electrophilic substitution reactions of quinolene and isoquinolene.	08
5. Carbohydrates	Classification and nomenclature. Monosaccharides, mechanism of osazone formation, inetrconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into	08

	mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)-glucose. Mechanism of mutarotation. General study of disaccharides (structure determination not required). General introduction of structure of ribose and deoxyribose.	
6. Amino Acids, Peptides, Proteins and Nucleic Acids	Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α -amino acids. Nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Levels of protein structure. Protein denaturation/renaturation. Nucleic acids: introduction, constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.	08
7. Fats, Oils and Detergents	Natural fats and common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value and acid value. Soaps, synthetic detergents, alkyl and aryl sulphonates.	02
8. Synthetic Polymers	Addition or chain-growth polymerization. Free radical vinyl polymerization, ionic vinyl polymerization, Ziegler-Natta polymerization and vinyl polymers. Condensation or step-growth polymerization. Polyesters, polyamides, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes. Natural and synthetic rubber.	04
9. Synthetic Dyes	Colour and constitution (electronic concept), classification of dyes. Synthesis and uses of Methyl orange, Malachite green, Phenolphthalein, Fluorescein, Alizarin and Indigo.	06
10. Natural Products	Classification, extraction and general methods of structure determination of terpenoids (limonene, citral) and alkaloids (nicotine, cocaine).	08

Books Recommended:

- I. L. Finar, "Organic Chemistry", Pearson Education India.
- Boyd, Morrison and Bhattacharjee, "Organic Chemistry", Pearson Education India.
- A. Bahl and B. S. Bahl, "Advanced Organic Chemistry", S. Chand Publishing, India.
- J. Singh and L. D. S. Yadav, "Undergraduate Organic Chemistry" Pragati Prakashan, India.
- S. M. Mukerji, "Reaction mechanism in Organic Chemistry", Laxmi Publications.

COURSE OUTCOMES: PAPER II: Organic Chemistry

This paper provides detailed knowledge of different compounds like organo-metallic, organo-sulphur, heterocyclic compounds. The students will be able to define carbohydrates, amino acids, peptides, proteins, nucleic acids, fats, oils, detergents, synthetic polymers, synthetic dyes and natural products. All these topics are quite interesting and possess several applications.

TEACHING PLAN: B.Sc. 3rd Year

Paper III: Theory: Physical Chemistry

Max. Marks = 34 Marks

UNITS	TOPICS	NO. OF HOURS = 60
1. Elementary Quantum Mechanics	Black-body radiation, Plank's radiation law, photoelectric effect, Bohr's model of hydrogen atom (no derivation) and its defects. Compton effect, de Broglie hypothesis, Heisenberg's uncertainty principle, operator concept, Hamiltonian operator, Schrödinger wave equation and its importance, physical interpretation of the wave function.	12
2. Spectroscopy	Introduction; electromagnetic radiation, regions of the spectrum, basic features of different spectrometers, statement of the Born-Oppenheimer apporoximation. Degrees of freedom, types of energies in linear and non-linear molecules, derivation and applications of Maxwell-Boltzmann distribution law. Rotational spectrum Diatomic molecules, energy levels of a rigid rotor (semi-classical principle), selection rules, special intensity, determination of bond length, qualitative description of non-rigid rotor, isotopic effect. Vibrational spectrum Infrared spectrum, energy levels of simple harmonic oscillator, selection rules, pure vibrational spectrum, intensity, determination of force constant and qualitative relation of force constant and bond energies, effect of harmonic motion and isotope on the spectrum, idea of vibrational frequencies of different functional groups. Raman spectrum, concept of polarizability, pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules. Electronic spectrum Concept of potential curves for bonding and antibonding molecular orbitals, qualitative description od selection rules and Frank-Condon principle, Qualitative description of σ,	20

	π, and n M.Os, their energy levels and the respective transitions.	
3. Photochemistry	Interaction of radiation with matter, difference between thermal and photochemical processes. Laws of photochemistry; Grothuss-Drapper law, Lambert's law, Lamber-Beer's law, Stark-Einstein law, Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing), quantum yield, photosensitized reactions-energy transfer processes (simple examples).	08
4. Physical Properties and Molecular Structure	Optical properties and their relation with chemical constitution, polarization, Clausius-Mossotti equation, orientation of dipoles in an electric field, dipole moment, induced dipole moment, measurement of dipole moment-temperature method and refractivity method, dipole moment and its application in determining the structure of molecules.	06
5. Solutions and Colligative Properties	Ideal and non-ideal solutions, methods of expressing concentrations of solutions, activity and activity coefficient. Dilute solutions, colligative properties, Raoult's law, relative lowering of vapour pressure, molecular mass determination. Osmosis, law of osmotic pressure and its measurement, determination of molecular mass from osmotic pressure. Elevation of boiling point and depression in freezing point. Experimental methods for determining various colligative properties. Abnormal molar mass, degree of dissociation and association of solutes.	08
6. Thermodynamics III	Statement and concept of residual entropy, third law of thermodynamics, unattainability of absolute zero, Nernst heat theorem. Evaluation of absolute entropy from heat capacity data.	06

Books Recommended:

- B. R. Puri, M. S. Pathania, and L.R. Sharma, "Principles of Physical Chemistry", Vishal Publishing, India.
- A. Bahl, B. S. Bahl and G. D. Tuli, "Essential of Physical Chemistry", S. Chand Publishing, India.
- P. W. Atkins, "Atkin's Physical Chemistry: International", Oxford University Press.

COURSE OUTCOMES: PAPER III: Physical Chemistry

This paper provides detailed knowledge to students so that they can learn the basic concepts of quantum mechanics, spectroscopy and photochemistry. The quantum mechanics will help them to praise the beauty of behavior of fundamental particles. It will assist them to get a suitable job in the relevant industrial and scientific field. Their understanding of Photochemistry and Solutions will help him to explain the day today phenomenon of the relevant field. Thermodynamics will help them to understand the natural flow of energy.

TEACHING PLAN: B.Sc. 3rd Year

Practical: Lab Course

Max. Marks = 50 Marks; Hours = 06 hours /week

S. NO.	TOPICS
1.	Laboratory hazards and safety precautions.
2.	Organic qualitative analysis; binary mixture of organic compounds separable by H2O and NaHCO3
3.	Organic synthesis; through nitration, halogenation, acetylation, sulphonation and simple oxidation.
4.	Physical chemistry experiments based on solubility, transition temperature and phase equilibria, thermochemistry and electrochemistry
5.	Demonstrative chromatographic experiments; Paper chromatography/TLC (analytical separation of simple organic molecules).

Books Recommended:

- O. P. Pandey, D. N. Bajpai and S. Giri, Practical Chemistry for B. Sc. I, II and III Year Students of All Indian Universities, S. Chand Publishing, New Delhi, India.
- S.M. Khopkar, Basic Concepts of Analytical Chemistry. New Age International Publisher.
- J. Mendham, Vogel's Quantitative Chemical Analysis, Pearson.

COURSE OUTCOMES: PRACTICAL: Lab Course

After completing this course, the students will know the laboratory hazards and safety precautions that must be taken in the laboratory while performing the experiments. The students will gain knowledge of organic synthesis through nitration, halogenation, sulphonation etc. Upon completion of this course, the students will have the knowledge and skills to determine solubility, transition temperature and the heat of neutralization. The

chromatographic exercise will train them to interpret the chromatograms of organic compounds which will make them ready for industrial jobs.