



**JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY,
JAIPUR**

**Faculty of Education & Methodology
Department of Science & Technology**

SYLLABUS

**MASTER OF SCIENCE- CHEMISTRY
M.SC. CHEMISTRY**

SESSION – 2022-23

DURATION – 2 YEARS/4 SEMESTER

**SYLLABUS FOR:
I -II YEARS**



PROGRAM DETAIL

Name of Program	-	M.Sc.Chemistry
Program Code	-	M.Sc.
Mode of Program	-	Yearly /Semester
Duration of Program	-	2 yrs/ 4 Semester
Total Credits of Program	-	147
Curriculum Type and Medium Choice	-	English



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SYLLABUS DETAIL

FIRST SEMESTER

S. No.	Credit	Name of Course
1	9	Inorganic Chemistry
2	9	Organic Chemistry
3	9	Physical Chemistry
4	8	Biostatistics
Total	35	

SECOND SEMESTER

S. No.	Credit	Name of Course
1	9	Inorganic Chemistry
2	9	Organic Chemistry
3	9	Physical Chemistry
4	9	Spectroscopy
Total	36	

Third SEMESTER

S. No.	Credit	Name of Course
1	9	Biophysical, Bioinorganic, Bioorganic Chemistry
2	9	Organic Chemistry
3	9	Physical Chemistry
4	9	Natural product and heterocyclic chemistry
Total	36	

Fourth SEMESTER

S. No.	Credit	Name of Course
1	40	Dissertation
Total	40	



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SEMESTER- I

Course Name: Inorganic chemistry

Credits: 9(6+0+3+0)

Objectives

- How to identifies the symmetry of elements
- Measuring the point groups
- 3D representation of organic molecules.
- Determination of crystal field theory
- Electronic spectra, Orgel diagram

Unit I – I. Symmetry and group Theory in chemistry: (credit-2)

Symmetry element and operation, definition of mathematical group, sub group, cyclic group, conjugacy relation and classes, point symmetry group (Schonflies symbols), use of point group symmetry : optical activity, dipole moment, representation of group by matrices, character of representation, the great orthogonality theorem (without proof) and its importance, irreducible representation, character table and their use.

Unit II – Stereochemistry and Bonding in main group compounds: - (credit-2)

VSEPR, Walsh diagrams (tri-and penta-atomic molecules), $d\pi-p\pi$ bonds, Bent rule and energetics of Hybridization, some simple reaction of covalently bonded molecules..Metal-Ligand bonding

Limitation of crystal field theory, Molecular orbital theory, Octahedral, tetrahedral and square planar complexes, π -bonding and molecular orbital theory.

Unit III – Electronic Spectra and magnetic properties of transition metal complexes- (credit-2)

Spectroscopic ground states, correlation, Orgel and Tanabe-Sugano diagram for transition metal complexes ($d^1 - d^9$), calculation for Dq , and b parameter, charge transfer spectra, spectroscopic method for assignment of absolute configuration in optically active metal chelates and their stereochemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover. Isopoly and Heteropoly acid and salts of V, Mo, W.



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Practical (Credits- 3)

S.No.	Name of practical	Credits
1	Qualitative analysis of inorganic mixture of 8 radicals containing not more than Two of the following less common metals: Tl, Mo, W, Zr, Th, V, U.	0.25
2	Insoluble – oxides, sulfates and halides.	0.25
3	Chromatography Separation of cations and anions by a. Paper chromatography	0.25
4	Chromatography Separation of cations and anions by b. Column chromatography- Ion exchange	0.25

Recommended Text Books-

1. Advance Inorganic Chemistry, F.A. Cotton and Willikinson; John Wiley
2. Inorganic Chemistry, J.E. Huhuy, Harpes and Row
3. Chemistry of element, N.N. Greenwood and A. Earnshow, Prganon

Reference Books

1. Inorganic Electronic Spectroscopy, A.B.P. Levar, Elsevier.
2. Magnetochemistry, R.L. Carlin, Springer Verlog

Course outcomes-

- How to identifies the symmetry of elements
- Measuring the point groups
- 3D representation of organic molecules.
- Determination of crystal field theory
- Elctronic spectra, Orgel diagraphme



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Course Name: Organic chemistry

Credits: 9(6+0+3+0)

Objectives

- To understand how many types of bond exist in nature.
- Determination of hyperconjugation.
- Energy diagram of p orbitals.
- How to find chirality, what is the chiral plane, methods of resolution etc.
- How a reaction operates in reaction mechanism in different types of reactions

Unit I – I. Nature of bonding in organic molecules –

(credit-2)

Delocalized chemical bonding-conjugation, cross conjugation, resonance, hyperconjugation, bonding in fullerenes, tautomerism. Aromaticity in benzenoid and non-benzenoid compound, alternate and nonalternate hydrocarbon, Huckel rule, energy of p-molecular orbital, annulenes, antiaromaticity, Ψ -aromaticity homoaromaticity, PMO approach. Bond weaker than covalent-addition compound, crown ether complexes and cryptands, inclusion compound, cyclodextrins, catenanes and rotaxane.

Unit II – Conformational analysis of cycloalkanes, diastereomers, effect of conformation on reactivity

(credit-2)

Conformation of sugars, steric strain due to unavoidable crowding. Element of symmetry, chirality, molecules with more than one chiral center, threo and erythro isomer, methods of resolution, optical purity, enantiotopic and diastereotopic atoms, group of faces, stereospecific and stereoselective synthesis, asymmetric synthesis, optical activity in absence of chiral carbon (biphenyls, allenes and spiranes), chirality due to helical shape. Stereochemistry of compound containing nitrogen, sulphur and phosphorus.

Unit III – Reaction mechanism: structure and reactivity

(credit-2)

Types of mechanism, types of mechanism, thermodynamics and kinetic requirements, kinetic thermodynamic control, Hammonds postulate, Curtinhammett principle. Potential energy diagram, transition state and intermediates, methods of determining mechanism, isotope effect. Hard and soft acids and bases. Generation, structure, stability and reactivity of carbocations, carbanions, free radicals, carbenes Effect of structure on reactivity – resonance and field effect, steric effect, quantitative treatment. The Hammett equation and linear free energy relationship, substituent and reaction constants, Taft equation.

Practical



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(Credits- 3)

S.No.	Name of practical	Credits
1	Separation , Purification and identification of compound of two component mixture using the and column chromatography,	0.1
2	chemical tests. IR spectra to be used for functional group identification.	0.1
3	Quantitative analysis	0.1
4	Determination of percentage or number of hydroxyl group in an organic compound by acetylation method.	0.1
5	Estimation of amines/phenols using bromate bromide solution/or acetylation method.	0.1
6	Determination of iodine and saponification value of an oil sample.	0.25
7	Determination of DO, COD and BDO of water sample.	0.25

Recommended Text Books-

1. Advanced organic chemistry reaction, Mechanism and structure, Jerry March, John Wiley.
2. Advance organic chemistry, F.A. Carey and R.J. Sundberg, plenum..
3. A guide book to mechanism in organic chemistry, Peter Sykes, Longman.
4. Structure and mechanism in organic chemistry, C.K. Ingold, Cornell University Press

Reference Books-

1. Organic chemistry, R.T. Morrison and R.N. Boyd, Prentice-Hall.
2. Modern organic reaction, H.O. House, Benjamin.
3. Principle of organic synthesis, R.O.C. Norman and J.M. Coxon, Blackie Academic and Professional.
4. Pericyclic reaction, S.M. Mukherjee, Macmillan, India

Course outcomes-

- Understanding how many types of bond exist in nature.
- Determination of hyperconjugation.
- Energy diagram of p orbitals.
- How to find chirality, what is the chiral plane, methods of resolution etc.
- How a reaction operates in reaction mechanism in different types of reactions



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Course Name: Physical chemistry-

Credits: 9(6+0+3+0)

Objectives

- To understand In this unit students learn how two reaction operate in many ways.
- Thermodynamic of rate of reaction.
- Kinetics of many reactions.
- What is the surface tension, how to identify the absorbance.
- How many types of polymer exist in nature, types of polymers, preparation of polymers.

Unit I-I. Chemical dynamics

(credit-2)

Theory of reaction rate: collision, activated complex and unimolecular reaction i.e. Lindemann and preliminary ideas (Hinshelwood, Rice Ramsperger and RKKM theories), thermodynamics of reaction rate. The ideas of action kinetics in solution with special reference to kinetic salt effects. The fast reaction kinetics, fundamental aspects of NMR, Relaxation methods, flow and flash photolysis. Preliminary ideas of molecular dynamics. Simple ideas of Oscillatory chemical reaction, Belousov-Zhabotinsky reaction. Photochemical reaction: Chain reaction involving Hydrogen Chlorine, Hydrogen-bromine reaction and pyrolysis of acetaldehyde. Kinetics of enzyme reaction.

Unit II -Surface chemistry

(credit-2)

Adsorption Surface tension, capillary action, pressure difference across curved surface (Laplace equation), vapor pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation surface area (BET equation), surface film of liquids (electro-kinetic phenomenon), catalytic activity at surface Micelles Surface active agent, classification of surface active agent, micellization, hydrophobic interaction, critical micellar concentration (CMC), factors affecting the CMC of surfactant, counter ion binding to micelles, thermodynamics of micellization - phase separation and mass action models, solubilization, micellization, reverse micelles.

Unit III - . Macromolecules- ,

(credit-2)

Polymer -definition, classification of polymer, electrically conducting polymer, liquid crystal polymer, kinetics and mechanism of polymerization (Chain reaction and step growth), molecular mass, number and mass average molecular mass, molecular mass determination (Osmometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculation of average dimensions of various chain structures.



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Practical (Credits- 3)

S.No.	Name of practical	Credits
1	Calibration of fractional weights.	0.07
2	Calibration of volumetric apparatus-burette, pipette and standard flask. Conductance measurement	0.07
3	Determine the cell constant of a given conductivity cell at a given temp.	0.07
4	Determine the equivalent conductance of a strong electrolyte at several concentration at a given temperature and test the validity of Onseger's equation . <u>Electrochemistry (EMF -Measurements) - Potentiometry / pH-metry</u>	0.07
5	Determine the EMF of Daniel Cell. Zn/ZnSO ₄ (C ₁) CuSO ₄ /Cu+ By potentiometer taking C ₁ and C ₂ (i) same concentration (ii) Different concentration and hence to see the effect of dilution	0.07
6	Determination of iodine and saponification value of an oil sample.	0.07
7	Determine the solubility of a sparingly soluble salt in water by EMF method. 7. Determination of the strength of strong and weak acid in a given mixture by using pH -meter. Chemical kinetics	0.07
8	. Determination of the rate constant and order of reaction for the hydrolysis of the methyl acetate catalyzed by an acid at different ionic strengths at a given temp.	0.07
9	Determine the rate constant of hydrolysis of an ester in micellar media at a given temperature. Cryoscopy	0.07
10	. Determination of apparent molecular weight of an electrolyte in water and hence calculate the Vant Hoff factor and degree of dissociation of the electrolytes by cryoscopic method.	0.07
11	Determination of degree of dissociation / hydrolysis of weak electrolyte by cryoscopic method. Adsorption	0.07
12	To study the adsorption of oxalic acid on activated charcoal and test the validity of Freundlich/ Langmuir adsorption isotherm. Partition coefficient	0.07
13	To study the distribution of I ₂ between CCl ₄ and calculate the partition coefficient	0.08
14	Determination of the partition coefficient of benzoic acid between water and benzene and comment on the molecular state of benzoic acid in benzene	0.08



Recommended Text Books-

1. Modern spectroscopy, J.M.Holias, John Wiley.
2. Applied electron spectroscopy for chemical analysis Ed. H.Windwal and F.L.Ho, Wiley interscience

Reference book-

1. Physical methods in chemistry, R.S.Drago, SaundersCollege.
2. Chemical application of group theory, F.A.Cotten.
3. Introduction to molecular spectroscopy, G.M.Barrow.
4. Basic principles of spectroscopy, R.Change, McGraw Hill.

Course outcomes-

- Understanding In this unit students learn how two reaction operate in many ways.
- Thermodynamic of rate of reaction.
- Kinetics of many reactions.
- What is the surface tension, how to identify the absorbance.
- How many types of polymer exist in nature,types of polymers, prepration of polymers.



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Course Name: Biostatistics

Credits: 8(6+0+2+0)

UNIT I (Basics of Algebra & Probability)

(Credit-2)

Laws of indices, Trigonometric Ratios, Arithmetic Progression, Geometric Progressions, and Harmonic progression (General term and sum), Logarithms, Elementary Differentiation and Integration. Descriptive Statistics (averages, dispersion), Elementary Probability theory, Probability Distribution: Poisson distributions and their applications in biology, Gaussian probability models.

UNIT II (Correlation, Regression & Sampling)

(credit- 2)

Classification and tabulation of data, Frequency distribution, Histogram, Frequency polygon and frequency curve, cumulative frequency curves, Measures of central tendency: mean, median, mode; Measures of dispersion: range, quartile deviation, mean deviation, variance and standard deviation. Correlation: Positive and negative correlation and calculation of Karl Pearson's coefficient of correlation. Regression: Linear regression equations and Prediction of an unknown variable using regression equation. Sampling: concept of population and sample, Sampling distribution and standard error. Hypotheses testing: null and alternative hypothesis, Type I and Type II errors, test of significance, test for proportions, Small sample test, T-test, Chi-square test, goodness of fit test and homogeneity of samples, F-test.

Practicals: (credit- 2)

Sr. no.	Name of practical	Credit
1	To find out Mean	0.5
2	To find out Median	0.025
3	To find out Mode	0.025

UNIT III (Vital Statistics & ANOVA)

(credit - 2.0)

Concept and Importance of Vital statistics, Vital Index, Death Rates: Crude death rate, Specific death rate, Standardized death rate, Life Tables, Method of construction of life tables, and their applications, Birth rates: Crude birth rate, specific birth rate, general fertility rate, and Total fertility rate. ANOVA: one way and two way analysis of variance, Design of experiments. Use of statistical packages for data analysis (SPSS).

Recommended Text Books-

1. Elements of Mathematical Statistics; S.C. Gupta and V.K. Kapur; Sultan Chand & Sons, New Delhi
2. Elements of Biostatistics; S. Prasad; Rastogi Publications, Meerut

Suggested Readings:

1. Basic Statistics:-B.L.Agarwal
2. Principles and Procedure of Statistics:-A Biometrical Approach:-R.G.D. Steel and J.H.torrie
3. Fundamentals of Applied Statistics, S.C. Gupta and V.K. Kapur; Sultan Chand & Sons, New Delhi.



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Details of Training/Visit/Dissertation/Internship: Industrial visit Semester II INORGANIC CHEMISTRY

Credits: 9(6+0+3+0)

Objectives

- To understand Difference between stepwise and overall formation constant.
- Reaction mechanism of transition metal complexes.
- What is the infrared spectroscopy and its work, rigid rotor molecules, overtones.
- What is the vibrational spectra, example of vibration spectra.

Unit I -Metal ligand equilibria in solution (Credit-2)

Stepwise and overall formation constant, tends in stepwise constant, factor affecting the stability if metal complex with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin.

Reaction mechanism of transition metal complexes: Energy profile of reaction, reactivity of metal complexes, inert and labile complexes, kinetics of octahedral substitution, substitution of square planar complexes, the trans effect, mechanism of the substitution eaction, redoxreaction, electron transfer reaction, outer sphere type reactions, cross reaction and Marcus-Hush theory, inner sphere type reaction.

Practical (Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Quantitative analysis Separation and determination of two metal ion Cu-Ni, Cu-Zn., Cu-Fe etc. involving volumetric and gravimetric methods.	Practical		

Unit II -Metal Clusters- (Credit-2)

Higher boranes, carboranes, metalloboranes and metallocarboranes.Metal carbonyls and halide clusters.

Compounds with metal-metal multiple bonds Microwave spectroscopy -Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequency, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications. vibrational Spectroscopy

Infra red spectroscopy:Review of linear harmonic oscillator, vibrational energies of diatomic molecules,

zero point energy, force constant and bond strength, vibration of polyatomic molecules, selection rules, normal modes of vibration, group frequencies,overtones, hot bands, factor affecting the band position and intensities, Far IR region metal ligand vibrations, normal coordinate analysis.



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Practical(Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Preparation of selected inorganic compound and their studies by I.R., electronic spectra, Mossbaure, E.S.R. and magnetic susceptibility measurements. Handling of air and moisture sensitive compound. 1. $\text{TiO}(\text{C}_9\text{H}_8\text{NO})_2 \cdot 2\text{H}_2\text{O}$ 2. $\text{Ni}(\text{dmg})_2$ 3. $[\text{Cu}(\text{NH}_3)_4]\text{SO}_4 \cdot \text{H}_2\text{O}$	Practical		

Unit III –Metal π -Complexes(Credit-2)

Metal carbonyls, structure and bonding, vibrational spectra of metal carbonyls for bonding and structure elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiary phosphine as ligand.

Practical(Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Water Analysis: Analysis of water samples for the following parameters (I)BOD (ii)COD (iii) Dissolved oxygen	Practical		

Text Books-

1. Chemistry of element, N.N. Greenwood and A. Earnshaw, Pergamon.
2. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier

Reference Books

- 1-Magnetochemistry, R.L. Carlin, Springer Verlag
2. Comprehensive Coordination Chemistry, eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon

Course outcomes-

- Understanding Difference between stepwise and overall formation constant.
- Reaction mechanism of transition metal complexes.
- What is the infrared spectroscopy and its work, rigid rotor molecules, overtones.
- What is the vibrational spectra, example of vibration spectra.



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Organic chemistry

(Credit-9(6+0+3+0))

Objectives

- To understand Different type of energy profile diagraph.
- Nucleophilic substitution reactions, free radicals reactions.
- What is the region selectivity, chemoselectivity different type of examples.
- Organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds Wittig reaction. Mechanism of condensation reaction involving enolates aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Sotobbe reaction. Hydrolysis of ester and amides, ammonolysis of esters.

Unit I - Aromatic Electrophilic substitution: -

(Credit-2)

The arenium ion mechanism, Orientation and reactivity, energy profile diagram The ortho / para ratio, ipso attack, orientation in other ring system, quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeier reaction, Gatterman-Koch reaction. Aromatic Nucleophilic substitution The S_NAr , S_N1 , benzyne and $S_{RN}1$ mechanisms. Reactivity-effect of substrates structure, leaving group and attacking nucleophile. The Von Richter, Sommelet – Houser and Smiles rearrangements. Free Radical Reactions Types of free radical reactions, free radical substitution mechanism, mechanism at an aromatic substrate, neighboring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in attacking radicals. The effect of solvent on reactivity. Alicyclic halogenation (NBS), oxidation of aldehyde to carboxylic acid, autooxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salt. Sandmeyer reaction. Free radical rearrangement. Hunsdiecker reaction.

Practical (Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Acetylation: Acetylation of cholesterol and separation of cholesteryl acetate by column chromatography.	Practical		
2	Oxidation: Adipic acid by chromic acid oxidation of cyclohexenol.	Practical		

Unit II Addition to Carbon-Carbon multiple bonds:

(Credit-2)

Mechanistic and stereochemical aspects of addition reaction involving electrophiles. Nucleophiles and free radicals, regio- and chemoselectivity, orientation and reactivity. Addition to cyclopropane ring. hydrogenation of double and triple bonds, Hydrogenation of aromatic ring. Hydroboration. Michael's reaction. Sharpless asymmetric epoxidation.



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Practical (Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Synthesis of triphenylmethanol from benzoic acid.	Practical		
2	Aldol condensation: Dibenzal acetone from benzaldehyde.	Practical		

Unit III - Addition to Carbon-Hetero multiple bonds: (Credit-2)

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds, acids, esters and nitriles. Addition of Grignard reagents, Organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds Witting reaction. Mechanism of condensation reaction involving enolates-aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Sotobbe reaction. Hydrolysis of ester and amides, ammonolysis of esters.

Practical (Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Synthesis of acetanilide from aniline.	Practical		
2	Determination of iodine and saponification value of an oil sample.	Practical		

Text Books: 1- Structure and mechanism in organic chemistry, C.K.Ingold, Cornel University Press.
2. Organic chemistry, R.T.Morrison and R.N.Boyd, Prentice-Hall.
3. Modern organic reaction, H.O. House, Benjamin

Reference Books

1-Reaction mechanism in organic compound, S.M.Mukherjee and S.P.Singh, Macmillan.
2. Stereochemistry of organic compound, D..Nasipuri, New Age International.
3. Stereochemistry of organic compound, P.S. Kalsi, New Age International.

Course outcomes-

- Understanding Different type of energy profile diagram.
- Nucleophilic substitution reactions, free radicals reactions.
- What is the region selectivity, chemoselectivity different type of examples.
- Organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds Witting reaction. Mechanism of condensation reaction involving enolates-aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Sotobbe reaction. Hydrolysis of ester and amides, ammonolysis of esters.



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

PHYSICAL CHEMISTRY

(Credit-9(6+0+3+0))

Objectives

- To understand Basic principles of quantum chemistry.
- Determination of 1D box, simple harmonic oscillator, rigid rotor, perturbation theory, Schrodinger equation
- What is thermodynamics, basic laws of thermodynamics, spontaneous and non-spontaneous system.
- Ideal and Non-ideal solutions, Raoult's law

UNIT -I Quantum Chemistry:

(Credit-2)

Introduction to exact quantum Mechanical Results: The Schrodinger equation and the postulates of quantum mechanics. Discussion of solution of the Schrodinger equation to the some model system viz. particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom. Approximate methods The variation theorem, linear variation principle. Perturbation theory (first order and non-degenerate). Simple application of variation method and perturbation theory. Angular Momentum Ordinary angular momentum, eigen functions for angular momentum, eigenvalues of angular momentum.

Practical (Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Error and statistical analysis - 1. Draw a straight line using method of least squares from given data. 2. Test the validity of student's t test by F-test approach.	Practical Practical		

UNIT- THERMODYNAMICS-I (Credit-2)

Introduction, revision of basic concepts. Second law of thermodynamics. Physical significance of entropy (Direction of spontaneous change and dispersal of energy), Carnot cycle, efficiency of heat engine, coefficient of performance of heat engine, refrigeration and problems. Maxwell relations, thermodynamic equation of state, chemical potential, variation of chemical potential with temperature & pressure. Applications of chemical potential, phase rule, lowering of vapor pressure (Raoult's law) and elevation in boiling point.



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Practical(Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Determine the pH a given buffer solution using given hydrogen electrode.	Practical		
2	Determination of dissociation constant of monobasic/polybasic acid using pH meter.	Practical		

UNIT-III THERMODYNAMICS-II

(Credit-2)

Ideal solutions, Rault's law, Duhem-Margules equation and its applications to vapor pressure curves (Binary liquid mixture), determination of activity coefficients from vapor pressure measurements, Henry's law. Nonideal solutions : deviations from ideal behaviour of liquid mixtures, liquid vapor compositions, conditions for maximum.

Practical(Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Determine the EMF of a given a concentration cell by potentiometer and find out the effect of dilution on the EMF of cell.	Practical		

Recommended Text Books-

- 1-Physical methods in chemistry, R.S.Drago, SaundersCollege.
- 2- Chemical application of group theory, F.A.Cotten.

References Books-

- 1-Introduction to molecular spectroscopy, G.M.Barrow.
2. Basic principles of spectroscopy, R.Change, McGraw Hill.
3. Theory and application of UV spectroscopy, H.H.Jaffe and M.Orchin, IBHOxford

Course outcomes-

- Understanding Basic principles of quantum chemistry.
- Determination of 1 D box, simple harmonic oscillator, rigid roator, perturbation theory, schrodinger equation
- What is the thermodynamics, basics laws of thermodynamics, spontaneous and non-spontaneous system.
- Ideal and Non- ideal solutions, Raults law



Spectroscopy

(Credit-9(6+0+3+0))

Objectives

- To understand Theories of Raman spectra Stokes and anti Stokes Raman spectroscopy.
- Slater Condon parameter, Molecular Orbital Theory Huckel theory of conjugated system.
- Interaction of electromagnetic radiation with matter absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering.
- Born Oppenheimer approximation, rotational, vibrational and electronic energy level.

UNIT-I

(Credit-2)

Raman spectroscopy:

Classical theories of Raman effect. Pure vibrational, vibrational-rotational Raman spectra, selection rule, mutual exclusion principle. Resonance Raman spectroscopy, Coherent Anti Stokes Raman spectroscopy (CARS)

Practical

(Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	To apply the Beer Lambert relationship to an aqueous solution containing an absorbing substance and thus determine its respective concentration.	Practical		

UNIT- II-Electronic Spectra And Molecular Orbital Theory

(Credit-2)

Electronic structure of atom Electronic configuration, Russell-Saunders term and coupling schemes, Slater Condon parameter, term separation energy of pn configuration, term separation energy for the dn configuration, magnetic effects: spin-orbit coupling and Zeeman splitting Molecular Orbital Theory Huckel theory of conjugated system, bond order and charge density calculation. Application to ethylene, butadiene etc. Introduction to extended Huckel theory.



Practical(Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Spectrophotometric (UV/VIS) Estimation - Amino acids - Proteins	Practical		

UNIT-III Unifying Principal: (Credit-2)

Electromagnetic radiation, interaction of electromagnetic radiation with matter absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, results of the time dependent perturbation theory, transition moment, selection rules, intensity of spectral line, bornOppenheimer approximation, rotational, vibrational and electronic energy level.

Practical

(Credit-1)

Sr. no.	Name of practical	Nature	Credit	P.S
1	Spectrophotometric Determinations Of Stability constant by Bjerrum's method.	Practical		

Course outcomes-

- Understanding Theories of Raman spectra stocks and anti stocks Raman spectroscopy.
- Slater Condon parameter, Molecular Orbital Theory Huckel theory of conjugated system.
- Interaction of electromagnetic radiation with matter absorption, emission, transmission, reflection, refraction, dispersion, polarization and scattering.
- Born Oppenheimer approximation, rotational, vibrational and electronic energy level.



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

SEMESTER-III

Course Name **ORGANIC CHEMISTRY**

Credits: **9(6+0+3+0)**

Objectives

1. To understand Oxidation of different type of molecules like alcohol, ketones, ketals, carbonic acid etc.
2. Reduction of Alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds- aldehydes, ketones, acids and their derivatives.
3. Mechanistic aspects, nature of the migration, migratory aptitudes, memory effects.
4. A detailed study of the following rearrangements, Pinacol-pinacolone, Wagner Meerwein, The Favorskii rearrangement, The Neber rearrangement, The Beckmann rearrangement, Hoffmann rearrangement, The Wolf rearrangement and many others.

Unit I - Oxidation:

(credit-2)

Introduction different oxidative processes. Hydrocarbons-alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids. Amines, hydrazines and sulphides. Oxidation with ruthenium tetroxide, iodobenzenediacetate and thallium (III)nitrate.

Practical

Sr. no.	Name of practical	Nature	Credit	P.S
1	Separation , Purification and identification of compound of three component mixture using the and column chromatography, chemical tests. IR spectra to be used for functional group identification.	Practical		

UNIT-II

Reduction

Introduction. Different reductive processes. Alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds-aldehydes, ketones, acids and their derivatives. Epoxides, nitro, nitroso, azo and oxime groups. Hydrogenolysis.



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Practical

Sr. no.	Name of practical	Nature	Credit	P.S
1	two and three steps synthesis of organic compounds.	Practical		

UNIT-III

Molecular Rearrangements

Mechanistic aspects, nature of the migration, migratory aptitudes, memory effects.

A detailed study of the following rearrangements, Pinacol-pinacolone, Wagner-Meerwein, The Favorskii rearrangement, The Neber rearrangement, The Beckmann rearrangement, Hoffmann rearrangement, The Wolf rearrangement, The Curtius rearrangement, The Lossen rearrangement, The Baeyer-Villiger rearrangement, The Witting rearrangement, The Fritsch-Buttenberg-Wiechell rearrangement, The Stevens rearrangement, The Chapman rearrangement and The Wallach rearrangement.

Practical

Sr. no.	Name of practical	Nature	Credit	P.S
1	Backmann rearrangement - Acetanilide from Acetophenone	Practical		
2	Benzoylation - Benzoylation of phenol/aniline/glycine	Practical		

Recommended Text Books-

1. Modern Synthetic Reactions, H.O. House, W.A Benjamin
2. Some Modern Methods of Organic Synthesis, W. Carruthers, Cambridge Univ. Press.
- 3 Principles of Organic Synthesis, R.O.C Norman and J.M. Coxon, Blackie Academic & Professional
4. Advanced Organic Chemistry, F.A Carey and R.J. Sundberg.

Course outcomes-

- Understanding Oxidation of different type of molecules like alcohol, ketones, ketals, carbonic acid etc.
- Reduction of Alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds- aldehydes, ketones, acids and their derivatives.
- Mechanistic aspects, nature of the migration, migratory aptitudes, memory effects.
- A detailed study of the following rearrangements, Pinacol-pinacolone, Wagner-Meerwein, The Favorskii rearrangement, The Neber rearrangement, The Beckmann rearrangement, Hoffmann rearrangement, The Wolf rearrangement and many others.



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Course Name Biophysical, Bioinorganic, Bioorganic Chemistry

Credits: 9(6+0+3+0)

Objectives

1. To understand Structure and function of haemoglobin, myoglobin, haemocyanin and hemeruthrin, electron transport process. . Chemical nitrogen fixation.
2. specificity and regulation, nomenclature and classification, extraction and purification
3. Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis.

UNIT-I

Bioinorganic Chemistry

Transport and Storage of Dioxygen

Haeme proteins and oxygen uptake, structure and function of haemoglobin, myoglobin, haemocyanin and hemeruthrin, model synthetic complexes of iron, cobalt and copper.

Electron Transfer in Biology

Structure and function of metalloproteins in electron transport processes cytochromes and iron-sulphur proteins and synthetic models.

Nitrogen fixation: Biological nitrogen fixation and its mechanism, nitrogenase. Chemical nitrogen fixation.

Practical

Sr. no.	Name of practical	Nature	Credit	P.S
1	Quantitative determinations of a three component mixture: One volumetrically and two Gravimetrically Cu ⁺² , Ni ⁺² , Zn ⁺² Cu ⁺² , Ni ⁺² , Mg ⁺²	Practical		

UNIT-II

Bioorganic Chemistry

Enzymes:

Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation, nomenclature and classification, extraction and purification. Fischer's lock and key and koshland's induced fit hypothesis, concept and identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site-directed mutagenesis. Enzyme kinetics.



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Mechanism of Enzyme Action: Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis. Strain or distortion. Examples of some typical enzyme mechanism for chymotrypsin, Ribonuclease, lysozyme and carboxypeptidase.

Practical

Sr. no.	Name of practical	Nature	Credit	P.S
1	Chromatographic Separation <ul style="list-style-type: none">Cadmium and zincZinc and magnesium	Practical Practical		

UNIT-III

Biophysical Chemistry

Biological Cell and its Constituents: Biological cell, structure and functions of proteins, enzymes DNA and RNA in living system. Helix coil transition.

Bioenergetics: Standard free energy change in biochemical reactions, exergonic, endergonic. Hydrolysis of ATP, synthesis of ATP from ADP.

Practical

Sr. no.	Name of practical	Nature	Credit	P.S
1	Flame photometric determination- <ul style="list-style-type: none">Sodium and potassium when present together.Lithium/Calcium/Barium/Strontium.Cadmium and Magnesium in tap water.	Practical		

Books recommended

1. M. N. Hughes, Inorganic Chemistry of Biological Processes, 2nd Ed.(1981), John-Wiley & Sons, New York.
2. W. Kaim and B. Schwederski, Bioinorganic Chemistry: Inorganic Elements in the Chemistry of Life, An Introduction and Guide, Wiley, New York (1995).

Course outcomes-

- Understanding structure and function of haemoglobin, myoglobin, haemocyanin and hemeruthrin, electron transport process. . Chemical nitrogen fixation.
- specificity and regulation, nomenclature and classification, extraction and purification
- Transition-state theory, orientation and steric effect, acid-base catalysis, covalent catalysis.



JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Course Name PHYSICAL CHEMISTRY

Credits: 9(6+0+3+0)

Objectives

- To understand General principles, Crystal Defects and Non-Stoichiometry, Electronic Properties and Band theory, Optical properties- Application of optical and electron microscopy. Magnetic properties- Classification of materials.
- Photochemical Reaction: Interaction of electromagnetic radiation with matter, Types of photochemical reactions, photo-dissociation, gas-phase photolysis.
- Photochemistry of Alkenes, Photochemistry of Carbonyl Compound, Photochemistry of Aromatic Compound.
- Mass spectral fragmentation of organic compound, common functional groups, molecular ion peak, metastable peak. McLafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation.

UNIT-I

Solid state

Solid State Reaction: General principles, experimental procedure, co-precipitation as a precursor to solid state reaction, kinetics of solid state reactions. Crystal Defects and Non-Stoichiometry: Perfect and imperfect crystal, intrinsic and extrinsic. Defects-point defects, line and plane defects, vacancies-Schottky defects and Frenkel defects. Thermodynamics of Schottky defects and Frenkel defect formation, colour centers. Electronic Properties and Band theory: Metals, insulators and semiconductors, electronic structure of solids, band theory, band structure of metals, insulators and semiconductors, intrinsic and extrinsic semiconductors, doping semiconductors, p-n junctions, superconductors. Optical properties- Application of optical and electron microscopy. Magnetic properties- Classification of materials. Effect of temperature, calculation of magnetic moment, mechanism of Ferro and antiferromagnetic ordering super exchange.

Practical

Sr. no.	Name of practical	Nature	Credit	P.S
1	Conductance measurement Determine the cell constant of a given conductivity cell at a given temp.	Practical		

UNIT-II

Photochemistry

Photochemical Reaction: Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry. Determination of Reaction Mechanism: Classification, rate constants and life times of reactive energy states. Determination of rate constant of reaction. Effect of light intensity on the rate of photochemical reactions. Types of photochemical reactions, photo-dissociation, gas-phase photolysis. Photochemistry of Alkenes: Intramolecular reaction of the olefinic bond, geometrical isomerism, cyclisation reaction, rearrangement of 1, 4 and 1, 5-dienes. Photochemistry of Carbonyl Compound: Intramolecular reaction of Carbonyl Compound- saturated, cyclic and acyclic, unsaturated compound. Intermolecular cycloaddition reactions-dimerisation and oxetane formation. Photochemistry of Aromatic Compound: Isomerisation, addition and substitutions.



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Practical

Sr. no.	Name of practical	Nature	Credit	P.S
1	Photochemistry (i) Photochromism in malachite green or potassium ferrocyanide-phenolphthalein system (ii) Determination of quantum yield	Practical		

UNIT-III

Mass Spectroscopy

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

Practical

Sr. no.	Name of practical	Nature	Credit	P.S
1	Spectrophotometric Determination Manganese/Chromium/Vanadium in steel sample. Fluoride/Nitrite/Phosphate.	Practical		

Books recommended

1. Photochemistry, J.G. Cavert and J.N. Pitts, Wiley (1966)
2. Molecular Photochemistry, N.J. Turro, Benjamin (1966)
3. Advanced Physical Chemistry Experiments, J. Rose

Course outcomes-

- Understanding general principles, Crystal Defects and Non-Stoichiometry, Electronic Properties and Band theory, Optical properties- Application of optical and electron microscopy. Magnetic properties- Classification of materials.
- Photochemical Reaction: Interaction of electromagnetic radiation with matter, Types of photochemical reactions, photo-dissociation, gas-phase photolysis.
- Photochemistry of Alkenes, Photochemistry of Carbonyl Compound, Photochemistry of Aromatic Compound.
- Mass spectral fragmentation of organic compound, common functional groups, molecular ion peak, metastable peak. Mclafferty rearrangement. Nitrogen rule. High resolution mass spectrometry. Examples of mass spectral fragmentation.



Course Name Natural product and heterocyclic chemistry

Credits: 9(6+0+3+0)

Objectives

- Classification, nomenclature, occurrence, isolation, general methods of structure determination of terpenoids and carotenoids. synthesis of the following representative molecules -Citral, Geraniol, α -Terpineol, Menthol. Porphyrins, what is the steroids, Bile acids, bio synthesis of steroids.
- Nomenclature of Hetero cycles, small ring synthesis, oxidation, reduction, synthesis and many more.
- Five, six and seven membered rings.

UNIT-I

Terpenoids and carotenoids - Classification, nomenclature, occurrence, isolation, general methods of structure determination, isoprene rule, structure determination, stereochemistry, biosynthesis and synthesis of the following representative molecules -Citral, Geraniol, α -Terpineol, Menthol.

Porphyrins - Structure and synthesis of haemoglobin and chlorophyll.

Steroids - Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, isolation, structure determination and synthesis of Cholesterol, Bile acids, Androsterone, Testosterone, Estrone, Progesterone, Aldosterone, biosynthesis of steroids.

UNIT-II

Heterocyclic chemistry-I

Nomenclature of heterocycles - Replacement and systematic nomenclature for monocyclic, fused and bridged heterocycles.

Small ring heterocycles - Three membered heterocycles with one and two hetero atoms- synthetic methods, physical and chemical properties of aziridines, oxiranes, thiiranes, diaziridines, diazirines, oxaziridines, four membered heterocyclic compounds - Synthetic methods, physical, spectroscopic and chemical properties of azetines, azetidines, oxetanes, thietanes and their carbonyl derivative.

UNIT-III

Heterocyclic chemistry-II

Benzo-fused five membered heterocycles - Synthetic methods, physical and chemical properties of benzopyrroles, benzofuranes and benzothiophenes.

Six-membered heterocycles - Synthetic methods, physical and chemical properties of pyrilium salts, pyrones, quinolinium salts, pyridazines, pyrimidines, pyrazines, acridines and phenanthridines

Seven membered heterocycles - Synthetic methods, physical and chemical properties of azepines, oxepines, thiepinines and diazepines.



References Books-

1. J.S. Bindra and R. Bindra, Prostaglandins Synthesis.
2. K. C. Nicolaou, Classics in Total Synthesis of Natural Products, Vol. I & II.
3. J.W. Apsimon, Total Synthesis of Natural Products, Vol. 1-6, Wiley-Interscience Publications, New York.
4. S.W. Pelletier, Chemistry of the Alkaloids, Van Nostrand Reinhold Co., New York (1970).
5. Chemistry of Natural Products, S.N. Bhat

Course outcomes-

- Classification, nomenclature, occurrence, isolation, general methods of structure determination of terpenoids and carotenoids. synthesis of the following representative molecules -Citral, Geraniol, α -Terpineol, Menthol. Porphyrins, what are the steroids, Bile acids, bio synthesis of steroids.
- Nomenclature of Hetero cycles, small ring synthesis, oxidation, reduction, synthesis and many more.
- Five, six and seven membered rings.

SEMESTER IV

DISSERTATION