Department of Chemistry

Govt M H College of Home Science & Science Jabalpur

Syllabus

Postgraduate

MSc I, II, III, & IV Semester

Academic Session 2023-2024

Department of Chemistry
Govt. M H College of Home Science & Science for Women Jabalpur
ACADEMIC SESSION 2023 – 2024
Scheme of Marks Distribution

M.Sc.I SEMESTER				
Course No.	**Paper No.**	**Title of the**	**Max. Marks (Th + CCE)**	**Min. Pass Marks**
THEORY COURSES				
Course MCH 101	Paper I	Inorganic Chemistry	35 +15	12
Course MCH 102	Paper II	Organic Chemistry	35 +15	12
Course MCH 103	Paper III	Physical Chemistry	35 +15	12
Course MCH 104	Paper IV	Spectroscopy	35 +15	12
Course MCH 105		Continuous Evaluation (Internal Assessment) on Mathematics (bio group)/Biology (math's group); and subject matter of above four papers.	35 +15	17
PRACTICAL COURSES				
Course MCH 106		Inorganic Chemistry	34	12
Course MCH 107		Organic Chemistry	33	12
Course MCH 108		Physical Chemistry	33	12
Total Marks I Semester			**350**	

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Dr. A. Dave.

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ACADEMIC SESSION 2023 – 2024
Scheme of Marks Distribution

M.Sc. II SEMESTER				
Course No.	**Paper No.**	**Title of the Paper**	**Max. Marks (Th+CCE)**	**Min. Pass Marks**
THEORY COURSES				
Course MCH 201	Paper I	Inorganic Chemistry	35 + 15	12
Course MCH 202	Paper II	Organic Chemistry	35 + 15	12
Course MCH 203	Paper III	Physical Chemistry	35 + 15	12
Course MCH 204	Paper IV	Spectroscopy & Diffraction Methods	35 + 15	12
Course MCH 205		Continuous Evaluation (Internal Assessment) on Computers for Chemists (practical exercises); and subject matter of above four papers.	35 +15	12
PRACTICAL COURSE				
Course MCH 206		Inorganic Chemistry	34	12
Course MCH 207		Organic Chemistry	33	12
Course MCH 208		Physical Chemistry	33	12
Total Marks, II Semester			**350**	

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Scheme of Marks Distribution

M.Sc. SEMESTER III				
Course No.	**Paper No.**	**Title of the Paper**	**Max. Marks (Th + CCE)**	**Min. Pass Marks**
THEORY COURSES				
Course MCH 301	Paper I	Inorganic Chemistry	35 +15	12
Course MCH 302	Paper II	Organic Chemistry	35 +15	12
Course MCH 303	Paper III	Physical Chemistry	35 +15	12
Course MCH 304	Paper IV	Elective 1.MCH 304C (ELECTIVE PAPER IV): Photochemistry	35 +15	12
Course MCH 305	Paper V	Elective 2. Course MCH 304B (ELECTIVE PAPER IV): Analytical Chemistry	35 +15	12
PRACTICAL COURSES				
Course MCH 307		Inorganic Chemistry (6 Hrs.; 1 day)	34	12
Course MCH 308		Organic Chemistry (6 Hrs.; 1 day)	33	12
Course MCH 309		Physical Chemistry (6 Hrs.; 1 day)	33	12
Total Marks, III Semester			**350**	

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Scheme of Marks Distribution

M.Sc. SEMESTER IV					
Course No.	**Paper No.**	**Title of the Paper (duration of examination)**	**Teaching Hrs.**	**Max. Marks (Th + CCE)**	**Min. Pass Marks**
THEORY COURSES					
Course MCH 401	Paper I	Inorganic	60	35 +15	12
Course MCH 402	Paper II	Organic Chemistry	60	35 + 15	12
Course MCH 403	Paper III	Physical Chemistry	60	35 + 15	12
Course MCH 404	Paper IV	Elective 3. One from 404A to 404D Polymer Chemistry 404B	60	35 + 15	12
Course MCH 405	Paper V	Elective 4. One from 405A to 405D Chemistry of Natural Product	60	35 + 15	12
PRACTICAL COURSE					
Course MCH 407		Inorganic Chemistry	90	34	12
Course MCH 408		Organic Chemistry)	90	33	12
Course MCH 409		Physical Chemistry	90	33	12
Total Marks, IV Semester				**350**	
Project / Internship				**100**	
Grand Total of Marks				**1500**	

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Syllabus

MSc I Semester

Academic Session 2023-2024

M.Sc. I Semester
Course: MCH 101Paper:I Inorganic Chemistry

Maximum Marks 35

UNIT I

Stereochemistry and Bonding in Main Group Compounds. VSEPR theory and its application for treating structures of inorganic molecules and ions containing lone pairs of electrons, shortcomings of VSEPR model. MO treatment of polyatomic molecules, e.g., ozone, nitrite, nitrate, hydarzoic acid and benzene.

Bent's Rule, Walsh diagram (triatomic molecules – BeH_2, H_2O), d_π - p_π bonds (thiazyltrifuoride – NSF_3)

UNIT II

Reaction Mechanism of Transition Metal Complexes. Inert and labile complexes, interpretation of lability and inertness of transition metal complexes on the basis of valence bond and crystal field theories. Kinetics of octahedral substitution: acid hydrolysis, factors affecting acid hydrolysis.

UNIT III

Metal-Ligand Bonding. Molecular orbital theory. Qualitative aspects of metal-ligand σ-bonding in octahedral, tetrahedral and square planar complexes. Jahn-Teller Effect

Electronic Spectra of Transition Metal Complexes. Spectroscopic term, terms and microstates for the p^2 and d^2 configurations, Hund's rules for ground state terms, the correlation of spectroscopic terms into Mulliken symbols, electronic transition selection rules, Orgel diagrams for transition metal complexes (d^1-d^9 states). Jahn-teller effect and electronic spectra of complexes.

UNIT IV

Metal π-Complexes. Metal carbonyls: structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation. Dioxygen complexes, Wilkinson's catalyst

UNIT V

Borane Chemistry Metal Clusters. Bonding and topology of boranes, 4-digit coding (s, t, y, x) numbers for B_2H_6, B_4H_{10}, B_5H_9, B_5H_{11} and B_6H_{10} and their utilities. Acquaintance with carboranes and metallocarboranes. Metal clusters: synthesis, reactivity and bonding.

Books Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetiochemistry, R.1. Carlin, Springer Verlag.
6. Comprehensive Coordiantion Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.

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M.Sc. I Semester
Course MCH 102Paper:IIOrganic Chemistry

Maximum Marks 35

UNIT I

Structure and Bonding. Bonding in organic molecules. Delocalized chemical bonding-conjugation, cross conjugation, Conjugation, resonance, hyperconjugation.

Aromaticity in benzenoid and non-benzenoid compounds, alternate and non-alternate hydrocarbons.

Hückel rule, anti-aromaticity, homo-aromaticity.

Bonds weaker than covalent bond. Hydrogen bonding, crown ether complexes, and cyclodextrin

UNIT II

Stereochemistry. Chirality, elements of symmetry, molecules with more than one chiral center, threo and erythro isomers. R and S configuration. Separation of enantiomers. Regioselective, stereospecific and stereoselectiverections. Asymmetric synthesis. Optical activity in the absence of chiral carbon (atropisomerism)-biphenyls, allenes and spiranes, and their nomenclature.

Conformational analysis of cyclohexanes and decalins. Effect of conformation on reactivity.

UNIT III

Reaction Mechanism. Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, and control, Potential energy diagrams, transition states and intermediates, methods of determining mechanisms, isotope effects.

Effect of structure on reactivity -resonance and field effects, steric effect. The Hammett equation and linear free energy relationship, substituent and reaction constants. Taft equation.

UNIT IV

Aliphatic Nucleophilic Substitution. The S_N2, S_N1, mixed S_N2 and S_N1, and SET mechanisms. The S_Ni mechanism. Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium. The neighbouring group mechanism, neighbouring group participation by π and σ bonds. Classical and nonclassicalcarbocations, norbornyl system, carbocation rearrangements.

UNIT V

Ultraviolet and Visible Spectroscopy. Electromagnetic radiation, wavelength, wave number, frequency, and energy calculation. Electronic transitions (185-800 nm), Beer-Lambert law, effect of solvent on electronic transitions, Fieser-Woodward rules for conjugated dienes and carbonyl compounds.

Optical Rotatory Dispersion (ORD) and Circular Dichroism (CD). Concept of ORD and CD, deduction of absolute configuration, octant rule for ketones.

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M.Sc. I Semester

CourseMCH 103 Paper: III Physical Chemistry

Maximum Marks 35

UNIT I

Introduction to exact quantum mechanical results. The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to systems such as particle in a box, the harmonic oscillator, the rigid rotor, the hydrogen atom.

UNIT II

Approximate Methods. The variation theorem, linear variation principle. Perturbation theory (introductory idea). Application of variation method to the Helium atom.

Angular Momentum. Ordinary angular momentum, generalized angular momentum, eigen functions for angular momentum, eigen values of angular momentum, addition of angular momenta, spin, antisymmetry and Pauli exclusion principle.

UNIT III

Classical Thermodynamics. Brief resume of concepts of laws of thermodynamics, free energy, chemical potential and entropies. Partial molar properties; partial molar free energy, partial molar volume and partial molar heat content and their significance. Determinations of these quantities. Concept of fugacity and determination of fugacity.Derivation of phase rule and its application to three component systems, second order phase transitions.

UNIT IV

Chemical Dynamics (Part I). Methods of determining rate laws, Arrhenius equation, collision theory of reaction rates, steric factor, activated complex theory, ionic reactions, kinetic and thermodynamic control of reactions.

UNIT V

Chemical Dynamics (Part II). Dynamic chain (hydrogen-bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane), photochemical (hydrogen-bromine and hydrogen-chlorine reactions) and oscillatory reactions, homogeneous catalysis, kinetics of enzyme reactions.

Books Suggested

1. Physical Chemistry, P.W. Atkins, ELBS.
2. Introduction to Quantum Chemistyry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentice Hall.
4. Coulson's Valence, R.McWeen y, ELBS.
5. Chemical Kinetics, K.J. Laidler, McGraw-Hill.
6. Kinetics and Mechanism of Chemical Transformation J.Rajaraman and J. Kuriacose, McMillan.
7. Micelles, Theoretical and Applied Aspects, V. MOraoi, Plenum.
8. Modern Electrochemistry Vol. I and Vol II J.O.M. Bockris and A.K.N. Reddy, Planum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
10. Introduction to Quantum Chemistry-R.K. Prasad, New Age Publication.

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M.Sc. I Semester

Course MCH 104 Paper IV: Spectroscopy

Maximum Marks 35

UNIT I

Unifying Principles. Electromagnetic radiation, interaction of electromagnetic radiation with matter-absorption, emission, transmission, reflection, refraction, dispersion, polarisation and scattering. Uncertainty relation and natural line width and natural line broadening, transition probability, transition moment, selection rules, intensity of spectral lines.

UNIT II

Microwave Spectroscopy. Classification of molecules, rigid rotor model, effect of isotopic substitution on the transition frequencies, intensities, non-rigid rotor. Stark effect, nuclear and electron spin interaction and effect of external field. Applications.

UNIT III

Infrared Spectroscopy. Review of linear harmonic oscillator, vibrational energies of diatomic molecules, zero point energy, force constant and bond strengths; anharmonicity, Morse potential energy diagram, vibration-rotation spectroscopy, P,Q,R branches. Vibrations of polyatomic molecules. Selection rules, normal modes of vibration, group frequencies, overtones, hot bands, factors affecting the band positions and intensities, far IR region.

UNIT IV

Raman Spectroscopy. Classical and quantum theories of Raman effect. Pure rotational, vibrational and vibrational-rotational Raman spectra, selection rules, mutual exclusion principle. Resonance Raman spectroscopy, coherent anti Stokes Raman spectroscopy (CARS).

UNIT V

Electronic Spectroscopy.Atomic Spectroscopy. Energies of atomic orbitals, vector representation of momenta and vector coupling, spectra of hydrogen atom and alkali metal atoms.

Molecular Spectroscopy. Energy levels, molecular orbitals, vibronic transitions, vibrational progressions and geometry of the excited states, Franck-Condon principle, electronic spectra of polyatomic molecules. Emission spectra; radiative and non-radiative decay, internal conversion, charge-transfer spectra.

Books suggested

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for chemical analysis d. H. Windawi and F.L. Ho, Wiley Interscience.
3. NMR, NQR, EPr and Mossbauer Spectroscopy in Inorganic Chemistry, R.V. Parish, Ellis Harwood.
4. Physical Methods in Chemistry, R.S. Drago, Saunders College.
5. Chemical Applications of Group Theory, F.A. Cotton.
6. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
7. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
8. Theory and Application of UV Spectroscopy, H.H. Jaffe and M. Orchin, IBH Oxford.
9. Introduction to Photoelectron Spectroscopy, P.K. Ghosh, John Wiley.
10. Introduction to Magnetic Resonance. A Carrington and A.D. Maclachalan, Harper & Row

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CONTINUOUS EVALUATION (Internal Assessment)

M.Sc. I SEMESTER
Course MCH 105 (a)
Mathematics for Chemists
(For students without Mathematics in B.Sc.)

Maximum Marks 35

Unit I

Vectors. Vectors, dot, cross and triple products etc. gradient, divergence and curl, Vector Calculus. *Matrix Algebra.* Addition and multiplication; inverse, adjoint and transpose of matrices.

Unit II

Differential Calculus. Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc.).

Unit III

Integral calculus. Basic rules for integration, integration by parts, partial fractions and substitution. Reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar).

Unit IV

Elementary Differential equations. First-order and first degree differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry etc. second order differential equation and their solutions.

Unit V

Permutation and Probability. Permutations and combinations, probability and probability theorems average, variance root means square deviation examples from the kinetic theory of gases etc., fitting (including least squares fit etc with a general polynomial fit).

Book Suggested

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1. The chemistry Mathematics Book, E.Steiner, Oxford University Press.
2. Mathematics for chemistry, Doggett and Suiclific, Logman.
3. Mathematical for Physical chemistry : F. Daniels, Mc. Graw Hill.
4. Chemical Mathematics D.M. Hirst, Longman.
5. Applied Mathematics for Physical Chemistry, J.R. Barante, Prentice Hall.
6. Basic Mathematics for Chemists, Tebbutt, Wiley.
7. Mathematics for Chemists: Bhupendra Singh, PragatiPrakashan

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CONTINUOUS EVALUATION (Internal Assessment)

M.Sc. I SEMESTER

Course MCH 105 (b)

Biology for Chemists

(For students without Biology in B.Sc.)

Maximum Marks 35

Unit I

Cell Structure and Functions. Structure prokaryotic and eukaryotic cells, intracellular organelles and their functions, comparison of plant and animal cells. Overview and their functions, comparison of plant and animal cells. Overview of metabolic processes-catabolism and anabolism. ATP – the biological energy currency. Origin of life-unique properties of carbon chemical evolution and rise of living systems. Introduction to bio-molecules, building blocks of biomacromolecules.

Unit II

Carbohydrates. Conformation of monosaccharides, structure and functions of important derivatives of mono-saccharides like glycosides, deoxy sugars, myoinositol, amino sugars. Nacetylmuramic acid, sialic acid disaccharides and polysaccharides. Structural polysaccharides cellulose and chitin. Storage polysaccharides-starch and glycogen. Structure and biological function of glucosaminoglycans of mucopolysaccharides. Carbohydrates of glycoporteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid.

Unit III

Lipid. Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, cholesterol, bile acids, prostaglandins. Liproproteins-compositiion and function, role in atherosclerosis. Properties of lipid aggregates-micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism-boxidation of fatty acids.

Unit IV

Amino-acids, Peptides and Proteins. Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins. force responsible for holding of secondary structures. α- helix , β-sheets, super secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domina structure. Quaternary structure. Amino acid metabolism-degradation and biosynthesis of amino acids, sequence determination, chemical/enzymatic/mass spectral, racemization/detection. Chemistry of oxytocin and tryptophan releasing hormone (TRH).

Unit V

Nucleic Acids. Purine and pyrimidine bases of nucleic acids, base pairing via Hbounding. Structure of ribonucleic acids (RNA) and deoxyribonucleic acid (DNA), double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

Book Suggested

1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers.
2. Biochemistry, L. Stryer, W.H. Freeman.
3. Biochemistry, J. David Rawan, Neil Patterson.
4. Biochemistry, Voet and Voet, John Wiley.
5. Outlines of Biochemistry E.E. Conn and P.K. Stumpf, John Wiley.

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Practical Courses
M. Sc. I Semester

Laboratory Courses MCH 106, MCH 107 and MCH 108

Emphasis should be placed on physical principles, reaction chemistry and the technique involved in experiments. Attention should be placed on stoichiometric calculations and statistical analysis of results. In regular classes, each student should perform all the experiments as selected by the Department from the list in the syllabus. In examination, students should be given different experiments or combination of experiments.

Course MCH 106: Inorganic Chemistry		Max. Marks 34
1.	Practical	18
2.	Viva voce	10
3.	Sessional	06

Course MCH 107: Organic Chemistry		Max. Marks 33
1.	Practical	18
2.	Viva voce	10
3.	Sessional	05

Course MCH 108: Physical Chemistry		Max. Marks 33
1.	Practical	18
2.	Viva voce	10
3.	Sessional	05

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M.Sc. I Semester

Course MCH 106: Inorganic Chemistry

Course MCH 106: Inorganic Chemistry (6 hours; 1 day)		Max. Marks 34
1.	Practical	18
2.	Viva voce	10
3.	Sessional	06

Qualitative and Quantitative Analysis

a. Less common metal ions: Ti, Mo, W, Tl, Zr, Th, V, U (two metal ions in cationic/anionic forms).

b. Insoluble- Oxides, sulphates and halides.

Chromatography

Separation of cations and anions by Paper Chromatography

Preparations

Preparation of selected inorganic compounds and their studies by measurements of decomposition temperature, molar conductance, IR and electronic spectra.

$[Zn(acac)_2(H_2O)]$	$[Co(acac)_2(H_2O)_2]$
$[Ni(acac)_2(H_2O)_2]$	$[Cu(acac)_2].H_2O)$
$[Co(Meacac)_2(H_2O)_2]$	$[Ni(NH_3)_6]Cl_2$
$[Cu(Meacac)_2]H_2O$	cis-$K[Cr(C_2O_4)_2(H_2O)_2]$

IR Spectra of synthesized compound

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Practical Courses
M.Sc. I Semester
Course MCH 107: Organic Chemistry

Course MCH 107: Organic Chemistry (6 hours; 1 day)		Max. Marks 33
1.	Practical	18
2.	Viva voce	10
3.	Sessional	06

Qualitative Analysis

Separation, purification and identification of compounds of binary mixture (one solid and one liquid/solid) using chemical separation and sublimation/distillation, etc. Their analysis by semi-micro chemical tests and spot tets. IR spectra to be used for functional group identification. Preparation of one derivative of each compound.

Emphasis should be placed on physical principles, reaction chemistry and the technique involved in analysis.

Organic Synthesis

Purification of compounds by TLC and column chromatography.

Aromatic electrophilic sustitutions:

Acetylation of primary amine by green procedure.
Synthesis of m-dinitrobenzene from nitrobenzene
Synthesis of 2,4-dinitro-1-chlorobenzene from chlorobenzene
Synthesis of 4-bromoaniline from acetanilide

Reduction reaction:

Synthesis of m-nitroaniline from m-dinitrobenzene

Quantitative Analysis

Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method

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Practical Courses
M.Sc. I Semester
Course MCH 108: Physical Chemistry

Course MCH 108: Physical Chemistry (6 hours; 1 day)		Max. Marks 33
1.	Practical	18
2.	Viva voce	10
3.	Sessional	06

A list of experiments under different headings is given below. Typical experiments are to be selected from each type.

Adsorption

i. To study surface tension -concentration relationship for solutions (Gibb's equation).
ii. To Study adsorption of acetic acid on activated charcoal.

Phase Equilibria

iii To construct the phase diagram for three component system (e.g., chloroform-acetic acid-water).

Chemical Kinetics

iv Determination of the effect of (a) Change of temperature (b) Change of concentration of reactants and catalyst and (c) Ionic strength of the media on the velocity constant of hydrolysis of an ester/ionic reaction.

v Determination of the primary salt effect on the kinetics of ionic reactions and testing of the Bronsted relationship (iodide ion is oxidized by persulphate ion)

Solutions

vi Determination of molecular weight of non-volatile and non-electrolyte/electrolyte by cryoscopic method and to determine the activity coefficient of an electrolyte.

vii Enzyme kinetics -inversion of sucrose

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Books Suggested

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.
2. Analytical Chemistry, S.M. Khopkar, New Age International Ltd., New Delhi.
3. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall
4. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall
5. Macroscale and Microscale Organic Experiments, K. L. Williamson, D. C. Heath.
6. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
7. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clarke, Adward Arnold.
8. Vogel's Textbook of Practical Organic Chemistry, ELBS.
9. F.G. Mann and B.C. Saunders, Practical Organic Chemistry, Orient Longman.
10. Findley's Practical Physical Chemistry, B. P. Levitt, Longman
11. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
12. Practical Physical Chemistry, A. M. James and F. E. Prichard, Longman

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Syllabus

MSc II Semester

Academic Session 2023-2024

Govt. M H College of Home Science & Science for Women Jabalpur
As recommended by Central Board of Studies and approved by the Governor of M.P.
Syllabus: Chemistry Academic Session 2023– 2024

M.Sc. II Semester

Course MCH 201

PAPER I: Inorganic Chemistry

Maximum Marks 35

Unit I

Metal-Ligand Equilibria in Solution. Stepwise and overall formation constants and their relationship, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by Bjerrum method , Job's and Mole ratio methods.

UNIT II

Reaction Mechanism of Transition Metal Complexes. Base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism. Substitution reactions in square planar complexes: The *Trans* effect and the *trans* influence: Polarization and π-Bonding theories, applications of *Trans* effect in synthesis, Kurnakove's test of distinguishing *cis* and *trans* isomers using the concept of trans effect, mechanism of substitution reactions in square planar complexes, factors affecting substitution reactions. Acquaintance of*Trans* effect in octahedral complexes

UNIT III

Metal-Ligand Bonding. Molecular orbital theory: Qualitative aspect of metal-ligand π-bonding in octahedral complexes, tetrahedral and square planar complexes.

Electronic Spectra and Magnetic Properties of Transition Metal Complexes. Calculations of Dq, B and β parameters for Cr(III), Co(II) and Ni(II) complexes using electronic spectral data. Charge transfer spectra: ligand to metal and metal to ligand.

UNIT IV

Metal π-Complexes. Metal nitrosyls: Nitrosylating agents for synthesis of metal nitrosyls, vibrational spectra and x-ray diffraction studies of metal nitrosyls for bonding and structure elucidation, important reactions of transition metal nitrosyl complexes pertaining to potentiality in air pollution control, biomedical applications. Dinitrogen complexes, Vaska's compound.

UNIT V

Group Theory. Symmetry elements and symmetry operations, symmetry groups or point groups, Schoenflies symbols, point group classifications, matrix representation of symmetry operations, group, necessary conditions for any set of elements to form a group, subgroups, classes in a group.

Books Suggested

1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley.
2. Inorganic Chemistry, J.E. Huhey, Harpes& Row.
3. Chemistry of the Elements,N.N. Greenwood and A. Earnshow, Pergamon.
4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier.
5. Magnetochemistry, R.L. Carlin, Springer Verlag.
6. Comprehensive Coordination Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. McCleverty, Pergamon.
7. Synthesis and characterization of some novel nitrosyl compounds, R. C. Maurya Pioneer Publications, Jabalpur, 2000.
8. Chemical Applications of Group Theory, F.A. Cotton, John Wiley.

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M.Sc. II Semester

Course MCH 202

PAPER II: Organic Chemistry

Maximum Marks 35

UNIT I

Aliphatic Electrophilic Substitution. Bimolecular mechanisms, S_E2 and S_Ei mechanisms. The S_E1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and solvent polarity on the reactivity.

Aromatic Electrophilic Substitution. The arenium ion mechanism, orientation and reactivity. The ortho/para ratio, ipso attack. Vilsmeier reaction, Fries rearrangement.

UNIT II

Free Radicals. Free radical reactions and their stereochemistry.

Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, hydroperoxide formation, replacement of diazonium group. Hunsdiecker reaction.

Electron spin resonance (ESR) spectroscopy. Electron paramagnetism, derivative curves, g values and hyperfine splitting.

UNIT III

Addition to Carbon-Carbon Multiple Bonds. Mechanistic and stereochemical aspects of addition reactions. Hydroboration. Michael reaction. Sharpless asymmetric epoxidation.

Addition to Carbon-Hetero atom Multiple Bonds. Mechanism of metal hydride reduction of carbonyl compounds, acids, esters and nitriles. Wittig reaction.

Mechanism of condensation reactions involving enolates. Mannich, Benzoin, Perkin, and Stobbe reactions.

UNIT IV

Aromatic Nucleophilic Substitution. The S_NAr, S_N1, benzyne and $S_{RN}1$ mechanisms. Reactivity, effect of substrate structure, leaving group and attacking nucleophile. Bucherer reaction, alkylation, and amination. The Bamberger rearrangement. The von Richter rearrangement.

UNIT V

Infrared and Raman Spectroscopy. Instrumentation and sample handling. Calculation of vibrational frequencies. Characteristic vibrational frequencies of alkanes, alkenes, alkynes, carbonyl compounds, alcohols, ethers, amines, phenols and aromatic compounds. Finger-print region. Effect of hydrogen bonding and solvent effect on vibrational frequencies, overtones, combination bands and Fermi resonance. FT-IR.

Resonance Raman effect. Concept and factors that influence group frequencies.

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Books Suggested

1. Organic Chemistry, J. Claden, N. Greeves, S. Warren, P. Wothers, Oxford University Press.
2. Advanced Organic Chemistry-Reactions, Mechanism and Structure, Jerry March, Wiley-Interscience.
3. Organic Chemistry, P.Y. Bruice, Pearson Education Asia.
4. Advanced Organic Chemistry, F. A. Carey and R. J. Sundberg, Plenum.
5. Organic Chemistry, J. McMurry, Thomson Asia.
6. Organic Chemistry, T.W.G. Solomons and C.B. Fryhle, John Wiley (Asia).
7. Organic Chemistry, L.G. Wade, Jr., Pearson Education.
8. A Guide Book to Mechanism in Organic Chemistry, Peter Sykes, Longman.
9. Organic Chemistry, R. T. Morrison and R. N. Boyd, Prentice-Hall.
10. Stereochemistry of Organic Compounds, E.L. Eliel and S.H. Wilen, John Wiley (Asia).
11. Stereochemistry of Organic Compounds, D. Nasipuri, New Age International.
12. Stereochemistry of Organic Compounds, P .S. Kalsi, New Age International.
13. Introduction to Spectroscopy, D.L. Pavia, G.M. Lampman and G.S. Kriz, Thomson, Brooks/Cole.
14. Organic Spectroscopy, W. Kemp, ELBS, Macmillan.
15. Spectrometric Identification of Organic Compounds, R. M. Silverstein, G. C. Bassler and T. C. Morrill, John Wiley
16. Application of Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall.
17. Spectroscopic Methods in Organic Chemistry, D. H. Williams, I. Fleming, Tata McGraw-Hill.

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M.Sc. II Semester

Course MCH 203

PAPER III: Physical Chemistry

Maximum Marks 35

UNIT I

Chemical Dynamics (Part III). General features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis and the nuclear magnetic resonance method. Dynamics of molecular motions and of barrierless chemical reactions in solution, probing the transition state. Dymanics of unimolecular reactions; Lindemann-Hinshelwood and Rice-Ramsperger-Kassel-Marcus and Slater theories of unimolecular reactions.

UNIT II

Adsorption. Surface tension, capillary action, pressure difference across curved surface, Laplace equation, vapour pressure of droplets, Kelvin equation; Gibbs adsorption isotherm. Multilayer adsorption, BET equation. Calculation of surface area, catalytic activity at surfaces.

Surface films on liquids;electrokineticphenomena; surface active agents. Micellisation, hydrophobic interaction. Critical micellar concentration. Solubilisation. Donnan's membrane equilibria.

UNIT III

Electrochemistry of solutions. Debye-Huckel -Onsager treatment and its extension to concentrated solutions. Ion size factor and ion-solvent interactions. Concept of activity. Determination of mean ionic activity and activity coefficient.

*Lippmannelectrocapillary phenomenon.*Electrocapillary curves of mercury and their interpretation. Structure of electrified interfaces. Helmholtz, Guoy and Chapmann and Stern models. Introductory idea of advancements in electrified surfaces. Electrokinetic potential, its determination and significance.

UNIT IV

Macromolecules and Colloids. Polymers, types of polymers, kinetics of polymerization, mechanism of polymerization reactions. Molecular mass of macromolecues, number and mass average molecular mass; molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain structures and their configuration.

Emulsions. Theories of emulsification, coagulation, slow and rapid coagulation. Kenitics of coagulation. Von Smoluchouski equation and its verification.

UNIT V

Irreversible electrode phenomenon. Decomposition voltage and overvoltage. Consecutive electrode processes. Exchange current density. Butler-Volmer's equation. Tafel's plot. Theory of polarography. Ilkovic equation. Half wave potential and its significance.

Introduction to corrosion. Forms of corrosion. Corrosion monitoring and prevention.

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Books Suggested

1. Physical Chemistry, P. W. Atkins, ELBS. .
2. Introduction to Quantum Chemistry, A.K. Chandra, Tata McGraw Hill.
3. Quantum Chemistry, Ira N. Levine, Prentce Hall.
4. Coulson's Valence, R. McWeeny, ELBS.
5. Chemical Kinetics, K. J. Laidler, Mcgraw-Hill.
6. Kinetics and Mechanism of Chemical Transformations, J. Rajaraman and J. Kuriacose, McMillan.
7. Micelles, Theoretical and Applied Aspects, V. Morol, Plentm
8. Modern Electrochemistry Vol. I and Vol. II, J.O.M. Bockris and A.K.N. Reddy, Plenum.
9. Introduction to Polymer Science, V.R. Gowarikar, N.V. Vishwanathan and J. Sridhar, Wiley Eastern.
10. Physical Chemistry, W.J. Moore, Prentice-Hall, India.
11. Physical Chemistry, P.C. Rakshit.
12. Quantum Chemistry, Eyring and Kimball.

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M.Sc. II Semester

Course MCH 204

PAPER IV: Spectroscopy & Diffraction Methods

Maximum Marks 35

UNIT I

Photoelectron Spectroscopy. Basic principles; photo-electric effect, ionization process, Koopman's theorem. Photoelectron spectra of simple molecules, ESCA, chemical information from ESCA. Auger electron spectroscopy -basic idea.

Photoacoustic Spectroscopy. Basic principles of photoacoustic spectroscopy (PAS), chemical and surface applications.

UNIT II

X-ray Diffraction. Bragg condition, Miller indices, Laue method, Bragg method, Debye-Scherrer method of X-ray structural analysis of crystals, index reflections, identification of unit cells from systematic absences in diffraction pattern. Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density. Description of the procedure for an X-ray structure analysis.

UNIT III

Electron Diffraction. Scattering intensity vs. scattering angle, Wierl equation, measurement technique, elucidation of structure of simple gas phase molecules. Low energy electron diffraction and structure of surfaces.

Neutron Diffraction. Scattering of neutrons by solids and liquids, magnetic scattering, measurement techniques. Elucidation of structure of magnetically ordered unit cell.

UNIT IV

Biological Cell and its Constituents. Biological cell. Structure and functions of proteins, enzymes, DNA and RNA in living systems. Helix coil transition.

Bioenergetics. Standard free energy change in biochemical reactions; exergonic and endergonic reactions. Hydrolysis of ATP. Synthesis of ATP from ADP.

Statistical Mechanics in Biopolymers. Chain configuration of macromolecules, statistical distribution end to end dimensions. Polypeptide chain binding and proteins, introduction to protein folding problem.

UNIT V

Thermodynamics of Biopolymer Solutions. Thermodynamics of biopolymer solutions, osmotic pressure, membrane equilibrium.

Transport of Ions. Biopolymers and their molecular weights. Structure and functions of cell membrane, ion transport through cell membrane, Nerve conduction; Evaluation of size, shape and molecular weight of biopolymers by various experimental techniques.

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Course MCH 204 (PAPER IV): Spectroscopy & Diffraction Methods

Books Suggested

1. Modern Spectroscopy, J.M. Hollas, John Wiley.
2. Applied Electron Spectroscopy for Chemical Analysis Ed. H. Windawi and F.L. Ho, Wiley Interscience.
3. Physical Methods in Chemistry, R.S. Drago, Saunders College.
4. Introduction to Molecular Spectroscopy, G.M. Barrow, McGraw Hill.
5. Basic Principles of Spectroscopy, R. Chang, McGraw Hill.
6. Introduction to Photoelectron Spectroscopy: P. K. Ghosh, John Wiley.
7. Principles of Biochemistry, A. L. Lehninger, Worth Publishers.
8. Biochemistry, L.Stryer, W.H.Freeman.
9. Biochemistry, J. David Rawn, Neil Patterson.
10. Biochemistry, Voet and Voet, John Wiley.
11. Outlines of Biochemistry, E. E. Conn and P. K. Stumpf, John Wiley.
12. Bioorganic Chemistry: A Chemical Approach to Enzyme Action, H. Dugas and C. Penny, Springer-Verlag.
13. Macromolecules: Structure and Function, F. Wold, Prentice Hall.
14. Fundamentals of molecular spectroscopy, C.N. Banwell, Tata McGraw-Hill, New Delhi.
15. Instrumental Methods of Analysis, Willard, Meritt and Dean.

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Govt. M H College of Home Science & Science for Women Jabalpur
As recommended by Central Board of Studies and approved by the Governor of M.P.
Syllabus: Chemistry Academic Session 2023– 2024

CONTINUOUS EVALUATION (Internal Assessment)

M.Sc. II SEMESTER

Course MCH 205: Computers for Chemists

Maximum Marks 35

This is a theory cum-laboratory course with more emphasis on laboratory work.

Unit I

Introduction to Computers and Computing. Basic structure and functioning of computer with a PC as illustrative example. Memory I/O devices. Secondary storage Computer languages. Operating systems with DOS as an example Introduction to UNIX and WINDOWS. Principles of programming Alogrithms and flow-charts.

Unit II

Computer Programming in FORTRAN/C/BASIC. (the language features are listed here with reference to FORTRAN. The instructor may choose another language such as BASIC or C the features may be replaced appropriately). Elements of the compute language. Constants and variables. Operations and symbols Expressions. Arithmetic assignment statement. Input and output Format statement. Termination statements. Branching statements as IF or GO TO statement. LOGICAL variables. Double precession variables. Subscripted variables and DIMENSION. DO statement FUNCTION AND SUBROUTINE. COMMON and DATA statement (Student learn the programming logic and these language feature by hands on experience on a personal computer from the beginning of this topic.)

Unit III

Programming in Chemistry. Developing of small computer codes using any one of the languages FORTRAN/C/BASIC involving simple formulae in Chemistry, such as Van der Waals equation. Chemical kinetics (determination of Rate constant) Radioactive decay (Half Life and Average Life). Determination Normality, Molarity nd Molality of solutions. Evaluation Electronegativity of atom and Lattice Energy from experimental determination of molecular weight and percentage of element organic compounds using data from experimental metal representation of molecules in terms of elementary structural features such as bond lengths, bond angles.

Unit IV

Use of Computer programmes. Operation of PC. Data Processing. Running of standard Programs and Packages such as MS WORD, MS EXCEL -special emphasis on calculations and chart formations. X-Y plot. Simpson's Numerical Integration method. Programmes with data preferably from physical chemistry laboratory.

Unit V

Internet. Application of Internet for Chemistry with search engines, various types of files like PDF, JPG, RTF and Bitmap. Scanning, OMR, Web camera.

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Book Suggested

1. Fundamentals of Computer: V. Rajaraman, Prentice Hall.
2. Computers in Chemistry: K.V. Raman, Tata McGraw Hill).
3. Computer Programming in FORTRAN IV-V Rajaraman, Prentice Hall.
4. Computers and Common Sense, R. Hunt and J. Shelley, Prentice Hall.
5. Computational Chemistry, A.C. Norris.
6. Microcomputer Quantum Mechanics, J.P. Killngbeck, Adam Hilger.
7. An Introduction to Digital Computer Design, V. Rajaraman and T. Radhakrishnan, Prentice Hall.

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PRACTICAL COURSES
M.Sc. II SEMESTER
LABORATORY COURSE MCH 206, MCH 207 and MCH 208

Emphasis should be placed on physical principles, reaction chemistry and the technique involved in experiments. Attention should be placed on stoichiometric calculations and statistical analysis of results. In regular classes, each student should perform all the experiments as selected by the Department from the list in the syllabus. In examination, students should be given different experiments or combination of experiments.

Course MCH 206: Inorganic Chemistry		Max. Marks 34
1.	Practical	18
2.	Viva voce	10
3.	Sessional	06

(iii) **Course MCH 207: Organic Chemistry**		Max. Marks 33
1.	Practical	18
2.	Viva voce	10
3.	Sessional	05

(iii) **Course MCH 208: Physical Chemistry**		Max. Marks 33
1.	Practical	18
2.	Viva voce	10
3.	Sessional	05

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Practical Courses

M.Sc. II Semester

Course MCH 206:Inorganic Chemistry

		Max. Marks 34
1.	Practical	18
2.	Viva voce	10
3.	Sessional	06

Time 06 Hrs

*Chromatography*Separation of cations and anions by Column Chromatography; Ion exchange.

Separation and determination of two metal ions Cu – Ni, Ni – Zn, Cu – Fe etc. Involving volumetric and gravimetric methods.

Estimation of Ni – Fe, Ni (Gravimetrically), Fe (Volumetrically)

Preparations

Preparation of selected inorganic compounds and their studies by measurements of decomposition temperature, molar conductance, I.R., electronic spectra, and magnetic susceptibility measurements.

1. $[Co(NH3)6]\ [Co(NO2)_6]$
2. cis-$[Co(trien)\ (NO2)_2]Cl.H_2O$
3. $Hg[Co(SCN)_4]$
4. [Co(Py)2Cl2]
5. $[Ni(NH3)_6]Cl2$
6. $[Ni(dmg)_2]$
7. $[Cu(NH3)_4]SO_4\ H2O$

Interpretation of TG and NMR spectra of some known compounds

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Practical Courses

M.Sc. II Semester

Course MCH 207:Organic Chemistry

		Max. Marks 33
1.	Practical	18
2.	Viva voce	10
3.	Sessional	06

Organic Synthesis

Oxidation reaction:

Synthesis of 9,10-anthraquinone by oxidation of anthracene by chromium trioxide

Synthesis of 4-nitrobenzaldehyde by oxidation of 4-nitrotoluene by chromium trioxide

Cannizzaro reaction

Synthesis of benzyl alcohol from benzaldehyde

Claisen-Schmidt reaction:

Synthesis of dibenzylideneacetone (1,5-diphenylpenta-1,4-dien-3-one) from acetone and benzaldehyde

Sandmeyer reaction:

Synthesis of 2-chloroanthranilic acid from anthranilic acid

Methylation:

Synthesis of methyl 2-naphthyl ether (2-methoxynaphthalene, nerolin) by methylation of 2-naphthol by dimethyl sulphate.

Preparation of phenyl azo – β – naphthol from aniline.

Quantitative Analysis

Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method

Determination of aromatic amines or phenols using bromate-bromide mixture

Determination of number of double bonds in an organic compound

Determination of percentage or number of ester groups in an organic compound by saponification

Interpretation of NMR and mass spectra of some known compounds

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Practical Courses

M.Sc. II Semester

Course MCH 208:Physical Chemistry

		Max. Marks 33
1.	Practical	18
2.	Viva voce	10
3.	Sessional	06

Course MCH 208: Physical Chemistry

A list of experiments under different headings is given below. Typical experiments are to be selected from each type.

Electrochemistry

A. Conductometry

(i) Determination of the velocity constant, order of the reaction and energy of activation for saponification of ethyl acetate by sodium hydroxide conductometrically.

(ii) Determination of solubility and solubility product of sparingly soluble salts (e.g., $PbSO_4$, $BaSO_4$) conductometrically.

(iii) Determination of the strength of strong and weak acids in a given mixtureconductometrically.

(iv) Determination of the activity coefficient of zinc ions in the solution 0.002 M of zinc sulphate using Debye-Huckel's limiting law.

B. Potentiometry/pH merry

(i) Determination of strengths of halides in a mixture potentiometrically.

(ii) Determination of the valency of mercurous ions potentiometrically.

(iii) Determination of the strength of strong and weak acids in a given mixture usi potentiometer/pH meter.

(iv) Determination of activity and activity coefficient of electrolytes.

C. *Polarimetry*

(i) Determination of rate constant for hydrolysis/inversion of sugar using a polarimeter.

(ii) Enzyme kinetics -inversion of sucrose

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MSc Practical Books Suggested

1. Vogel's Textbook of Quantitative Analysis, revised, J. Bassett, R. C. Denney, G. H. Jeffery and J. Mendham, ELBS.
2. Analytical Chemistry, S.M. Khopkar, New Age International Ltd., New Delhi.
3. Synthesis and Characterization of Inorganic Compounds, W. L. Jolly, Prentice Hall
4. Experiments and Techniques in Organic Chemistry, D. Pasto, C. Johnson and M. Miller, Prentice Hall
5. Macroscale and Microscale Organic Experiments, K. L. Williamson, D. C. Heath.
6. Systematic Qualitative Organic Analysis, H. Middleton, Adward Arnold.
7. Handbook of Organic Analysis- Qualitative and Quantitative, H. Clarke, Adward Arnold.
8. Vogel's Textbook of Practical Organic Chemistry, ELBS.
9. F.G. Mann and B.C. Saunders, Practical Organic Chemistry, Orient Longman.
10. Findley's Practical Physical Chemistry, B. P. Levitt, Longman
11. Experimental Physical Chemistry, R.C. Das and B. Behera, Tata McGraw Hill.
12. Practical Physical Chemistry, A. M. James and F. E. Prichard, Longman

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Syllabus

BSc Part III

Academic Session 2023-2024

CBCS Annual Pattern
B.Sc. III year
CHEMISTRY– DSE 1
Syllabus of Theory Paper

Part A Introduction				
Program: Degree		Class': B. Sc.	Year: Third	Session: 2023-2024
Subject: Chemistry				
1	Course Code	S3-CHEMID		
2	Course Title	Green and Agricultural Chemistry		
3	Course Type (Core Course/Elective/Generic Elective/Vocational/ ....)	Discipline Specific Elective (DSE) Group A Paper 1		
4	Pre-requisite (if any)	To study this course, a student must have passed diploma or equivalent course/qualification with Chemistry as a subject.		
5	Course Learning outcomes (CLO)	By the end of this course students will acquire the knowledge of following aspects of green and agricultural chemistry: • Basic principles of green and sustainable chemistry. • Understand stoichiometric calculations and relate them to green process metrics. • Learn alternative solvent media, green catalysis and energy sources for chemical processes. • Understand the requirements of manures and fertilizers for various crops and their proper time of application. • Understand to maintain soil fertility for better crop Production.		
6	Credit Value	04		
7	Total Marks	Max. Marks: 30 + 70	Min. Passing Marks : 35	

Part B- Content of the Course

Total No. of Lectures-Tutorials-Practical (in hours per week):
L-T-P:

Unit	Topics	No. of Lectures
Unit - I	**Concepts and Principles of Green Chemistry** History and evolution of Twelve principles of greenchemistry and their explanations with examples. Tools of green chemistry-green solvents, green catalysts, energy efficient processes, environmentally benign products, dry media synthesis (use of sun light, UV, microwaves and ultrasonic energy). Metrices of green chemistry-different metrics relating to the principles of green chemistry, atom economy, percentage yield, reaction mass efficiency, effective mass efficiency, environmental factor, eco scale and biologic tool plots, difference between mass based and impact-based matrices, life cycle assessment (LCA) and environment foot print. Challenges and scope of green chemistry in India. **Keywords/Tags:** Green chemistry, green solvents, green catalysts, atom economy, environmental factor.	12

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Unit - 2	**Green Catalysis and Processes** Heterogeneous catalysis, use of zeolites, silica and alumina supported catalysis, biocatalysis: Enzymes, microbes. Phase transfer catalysis (micellar/surfactant). Prevention of chemical accidents, designing greener processes, Strengthening/development of analytical techniques to prevent and minimize the generation of hazardous substances in chemical processes. Cutting Edge Research in pharma, paint, detergent and other synthetic industries. Green Synthesis of the following compounds: adipic acid & catechol, Microwave assisted reaction in water – Hoffmann elimination, oxidation of toluene and alcohols. **Keywords/Tags:** Heterogeneous catalysis, zeolites, silica, Phase transfer, greener processes, green synthesis.	**12**
Unit - 3	**Soil Fertility** Soil fertility evaluation and soil testing. Critical levels of different nutrients in soil. Forms of nutrients in soil, plant analysis, rapid plant tissue tests, Indicator plants. Methods of fertilizer recommendations to crops. Factors influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. **Keywords/Tags:** Soil fertility, plant analysis, indicator plants, crop, rainfed.	**12**
Unit - 4	**Organic Manuring** Classification and importance of organic manures, properties and methods of preparation of bulky manures. Green/leaf manuring. Transformation reactions of organic manures in soil and importance of C:N ratio in rate of decomposition. **Keywords/Tags:** organic manure, bulky manures, leaf manuring, C:N ratio, decomposition.	**12**
Unit - 5	**Fertilizers** Chemical fertilizers: classification, composition and properties of major nitrogenous, phosphatic, potassic fertilizers, secondary and micronutrient fertilizers, complex fertilizers, nano fertilizers. Soil amendments, fertilizer storage and fertilizer control order. History of soil fertility and plant nutrition. Criteria of essentiality. Role, deficiency and toxicity symptoms of essential plant nutrients. Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants.	**12**

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	Chemistry of soil nitrogen, phosphorus, potassium, calcium, magnesium, sulphur and micronutrients. Use of Bio-fertilizers in Agriculture and their Advantages. **Keywords/Tags:** Chemical fertilizers, nitrogenous, micronutrient, soil, nano fertilizer.	

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Matlack A.S., Marcel Dekker, "An Introduction to Green Chemistry", 2001.
2. Anastas P.T. and Wavner J.C., "Green Chemistry: Theory and Practice", Oxford University Press, 1998.
3. Lancaster M., "An Introductory Text on Green Chemistry", Royal Society of Chemistry, Cambridge, 2002.
4. R. A. Sheldon, I. Arends, U. Hanefeld, "Green Chemistry and Catalysis", Wiley-VCH, 2007.
5. Kolb V. M., "Green Organic Chemistry and its Interdisciplinary Applications", CRC Press, 2016.
6. Das P. C., "Manures and fertilizers", Kalyani Publishers Pvt. Ltd., New Delhi Rept. 2015.
7. Gupta A. K. and Varshney M. L., "Practical manual for Agril. Chemistry", Kalyani Publishers Pvt. Ltd., New Delhi.
8. Nagomny V. D. and Raghav J. S., "Soil Fertility Management", Kalyani Publishers Pvt. Ltd., New Delhi, Rept. 2015.

Suggested equivalent online courses:

Part D-Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100

Continuous Comprehensive Evaluation (CCE): 30 marks University Exam (UE): 70 marks

Internal Assessment: Continuous Comprehensive Evaluation (CCE): 30	Class Test Assignment/Presentation	**30**
External Assessment: University Exam Section: 70	**Section(A):** Very Short Questions **Section (B):** Short Questions **Section (C):** Long Questions	**70**

Any remarks/ suggestions:

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CBCS Annual Pattern
B.Sc. III year
CHEMISTRY– DSE 1
Syllabus of Practical Paper

Part A Introduction			
Program: Degree	Class`: B. Sc.	Year: Third	Session: 2023-2024
Subject: Chemistry			

1	Course Code	S3-CHEM1Q
2	Course Title	Green and Agricultural Chemistry
3	Course Type (Core Course/Elective/Generic Elective/Vocational/....)	Discipline Specific Elective Group A Paper 1
4	Pre-requisite (if any)	To study this course, a student must have passed Diploma or equivalent course/qualification with Chemistry as a subject.
5	Course Learning outcomes (CLO)	By the end of this course students will acquire the knowledge of following aspects of green chemistry: • To learn green synthesis of organic and inorganic compounds. • To learn to prepare green ionic liquids. • To understand soil profile, sampling and study minerals present in soil. • To learn to estimate organic matter content of soil.
6	Credit Value	02
7	Total Marks	Max. Marks: 30 +70 / Min. Passing Marks: 35

Part B- Content of the Course

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Practical	Topics	No. of Lectures
Part - A	1. **Green preparations:** (i) Manganese(III) acetylacetonate complex by using potassium permanganate and acetylacetone in water. (ii) Green preparation of Iron(III) acetylacetonate complex by using ferric trichloride and potassium hydroxide in water. (iii) Preparation of ionic liquid, 1-Pentyl-3-methylimidazolium bromide [pmIm]Br. 2. Green bromination of *trans*-stilbene by sodium bromide – sodium bromate. 3. Diels-Alder reaction between furan and maleic acid. 4. Benzoin condensation - Coenzyme (Thiamine hydrochloride) catalyzed synthesis of benzoin. **Keywords/Tags:** Green bromination, Diels-Alder, Coenzyme, Benzoin condensation, green inorganic preparation.	10

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Part - B	5. Study of soil profile in the field. 6. Study of soil sampling tools, collection of representative soil sample, its processing and storage. 7. Study of soil forming rocks and minerals. 8. Estimation of organic matter content of soil. **Keywords/Tags:** Soil profile, soil sampling, rock, minerals, organic matter.	10
Part - C	9. Determination of soil pH and electrical conductivity. 10. Determination of cation exchange capacity of soil. 11. Determination of soil density, moisture content and porosity. 12. Determination of soil texture by feel and Bouyoucos methods. **Keywords/Tags:** Soil, pH, electrical conductivity, cation exchange, soil density, soil texture.	10

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Rana B. C. (Co-ordinator), "Monograph on Green Chemistry Laboratory Experiments", Green Chemistry Task Force Committee, DST, India.
2. Chopra S.L., Kanwar J.S. Rakshit A., "Analytical Agricultural Chemistry", Kalyani Publishers, India, 2019, Sixth Edition.
3. Jackson M. L., "Soil Chemical Analysis", Pentice Hall, New Delhi, 1973.
4. Piper C. S., "Soil and Plant Analysis", Hans Publication, 1950.

Suggested equivalent online courses:

Part D-Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	30	Viva Voce on Practical	70
Attendance		Practical Record File	
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)		Table work / Experiments	

Total Marks: 100

Any remarks/ suggestions:

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CBCS Annual Pattern
B.Sc. III year
CHEMISTRY– DSE 2
Syllabus of Theory Paper

Part A – Introduction			
Program: Degree	Class: B.Sc.	Year: III	Session:2023-24
Subject: Chemistry			
1	Course code	S3-CHEM2D	
2	Course title	Laboratory skill, techniques & management	
3	Course type (Core Course/Elective/Generic Elective/Vocational/.....)	Discipline Specific Elective (DSE) Group A Paper II	
4	Pre-requisite (if any)	To study this course, a student must have the subject chemistry in Diploma Course of BSc or equivalent.	
5	Course Learning Outcomes (CLO)	**OBJECTIVES** This course/paper is intended for persons employed as or aspiring for employment as laboratory technician / attendant in school / college/ other scientific laboratories. **MAIN LEARNING OUTCOMES** **At the end of the course, the learners will be-** • Familiarized with the basic facilities available in laboratories. • Expected to gain knowledge of the basic skill of organization and management of science laboratories. • Enabled to expertise in the procedures of procurement and storage of laboratory equipment & material. • Trained in the operation and maintenance of simple instruments used in science laboratories. • Enabled to develop skills in common laboratory techniques. • Trained to adopt appropriate disposal procedures and safety methods suitable for Laboratories.	
6	Credit Value	4 (Theory)	
7	Total Marks-100	Max. Marks (30+70):	Min. Passing Marks:35

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Part B – Content of the course

Total No. of Lectures (In hours per week):60

Unit	Topic	No. of Lectures
1	**Laboratory organization and management-** • **Science laboratory**: scientific temper, scientific reporting, significance values/ accuracy/ attitude, interaction with pupil present in the lab, dignity of work of lab staff • **Important components of a science laboratory:** features of a science laboratory, services in a science laboratory • **Organization of science labs:** preparation room, arrangement of stores, safety provisions, Labels- a cautionary note • **Day-to-day management of laboratories:** day to day cleaning up, routine inspection and maintenance of laboratory, cleaning of laboratory and preparation rooms, colour coding of services, emergency switch services, security and vandalism. • **Stock control and purchase:** arranging stock, naming and maintenance of stock register, receiving of goods, processing of bills, accounting, controlling budget, information about equipment & miscellaneous records, purchase rules. • **File and records:** sources of information in the lab, filing system for chemicals, requests for equipment & special files • **Use of computer in science laboratory:** component of a computer, overall function & application software. *Key words*- Colour coding, Vandalism, Budget, overall function, safety provisions, stock register, purchase rules	12
2	**HAZARDS IN LABORATORY & LABORATORY SAFETY-** • **Electricity and gas hazards:** electricity hazards in the laboratory (selection of proper fuse, selection of proper flex, safe conduct, earthing & other dangers associated with electrical equipment's), Gas hazards in the laboratory (LPG, high pressure gas hazards, detection and handling of gas leakage & low pressure gas hazards). • **Fire hazards:** fire hazards in the laboratory, classification of fire, precaution of fire prevention & extinguishing a fire and types of fire extinguishers. • **Chemical hazards:** classification of hazardous chemicals, handling of chemicals, storage of chemicals, transport of bulk chemicals & transfer from large containers. • **Personal safety:** Code of behavior for the laboratory staff, personal protective devices, disposal of waste materials, check-in & shut - down sequences & shifting load • **Accidents and first aids:** accident reporting, procedure, first aid box, general features of first aid procedure, first aid procedures for chemical accidents, first aid treatment for shock & first aid treatment of localized injuries. *Keywords*- Gas hazards, proper flex, LPG, Fire Extinguisher, code of behaviour, First aids.	12

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3	**BASIC LABORATORY APPARATUS AND EQUIPMENT IN CHEMISTRY** • **BASIC APPARATUS:** Identification of apparatus, apparatus for heating (Bunsen burner, water bath, Oil bath, hot plate & heating mantle), laboratory glassware, laboratory centrifuge, use and description • **Measuring Apparatus:** Measurement in chemistry lab, errors, precision and accuracy of measurement, volume, types of volume, measuring devices, burettes & pipettes, accuracy of burettes & pipettes, volumetric flask, mass and weight, balances analytical and electronic, pH meter and conductometer • **Common laboratory glassware:** laboratory glass ware and its types, cleaning methods, storage and handling of glass apparatus, assembly of glass apparatus, gas pressure in glass, safety measures for storage, caring & handling of glassware *Keywords*- Water bath, heating mantle, centrifuge, precision, gas pressure	12
4	**BASIC LABORATORY TECHNIQUES IN CHEMISTRY** • **Solutions and their preparation:** Water and its types, types of solution, solubility, concentration of solutions- percentage, molarity, molality, normality & ppm , calculation of mass and volumes to prepare solutions, general guidelines for preparation of solution, general methods of preparation, labeling, exceptions to the general method, notes on other solution reagents for chemistry, bench reagents, standard solutions • **Common laboratory techniques:** Heating, refluxing, filtration, small scale methods, recrystallization and determination of melting point, distillation and determination of boiling point *Keywords*- Concentration units, labelling, bench reagents, refluxing, recrystallization, melting point, boiling point	12
5	**GOOD LABORATORY PRACTICES: BASIC EXERCISES** • Ex. 1 procedure for purchase of laboratory related items, inventory management • Ex. 2 supply of gas, electricity and water in a laboratory • Ex. 3 fire safety measures in a laboratory • Ex. 4 Classification and handling of hazardous chemicals • Ex. 5 disposal of unserviceable and obsolete items • Ex. 6 safe disposal of laboratory wastes • Ex. 7 attending to emergency situation • Ex. 8 preparation of standard of oxalic acid solution • Ex. 9 determination of strength of NaOH • Ex. 10 preparation of stock solutions and dilution • Ex. 11 preparation of water and alcohol based reagents (Fehling A & B, starch solutions) • Ex. 12 preparation of distilled water • Ex. 13preparation of buffer solution • Ex. 14 determination of pH using pH paper *Keywords*- Inventory, unserviceable, obsolete, Fehling A & B, distilled water	12

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Part C – Learning Resources
Text Books, Reference Books, Other resources
Suggested Reading: 1. Robert H Hill, David C Finster, " Laboratory Safety for chemistry, Willey 2. Sveinbjorn gizurarson, Benjamin R, "Hand book for Laboratory Safety" Elsevier 3. Anthony A Fuscaldo, "Laboratory Safety Theory & Practice" Elsevier 4. Steven I, Brown, " Laboratory Techniques for general chemistry" Hayden Mcneil 5. http://ncert.nic.in, kelm202, " Basic Laboratory Techniques" 6. Abigail , " laboratory note book, Slater Press

Part D-Assessment and Evaluation		
Suggested Continuous Evaluation Methods: Maximum Marks : 100 Continuous Comprehensive Evaluation (CCE) : 30 marks University Exam (UE) 70 marks		
Internal Assessment : Continuous Comprehensive Evaluation (CCE):30	Class Test Assignment/Presentation	30
External Assessment : University Exam Section:70	**Section(A)** : Very Short Questions **Section (B)** : Short Questions **Section (C)** : Long Questions	70

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CBCS Annual Pattern
B.Sc. III year
CHEMISTRY– DSE 2
Syllabus of Practical Paper

Part A Introduction			
Program: Degree	Class`: BSc	Year: Third	Session: 2023-24
Subject: Chemistry			

1	Course Code	S3-CHEM2Q
2	Course Title	Exercises for Development of Lab Skills
3	Course Type (Core Course/Elective/Generic Elective/Vocational/.....)	Discipline Specific Elective (DSE) Group A Paper II
4	Pre-requisite (if any)	To study this course the students must have had the subject Chemistry in Diploma Course of B.Sc. or equivalent
5	Course Learning outcomes (CLO)	On completion of this course, learners will be able to: Handle and run any chemistry lab skillfully. Students will be able to perform general exercises like- • Preparation of standard solutions • Determination of concentration • Determination of MP, pH, Conductivity • Preparation of stock Solutions • Preparation of various reagents
6	Credit Value	2 (Practical)
7	Total Marks	Max. Marks: 30+70 / Min. Passing Marks:35

Part B- Content of the Course

Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P:

Unit	Topics	No. of Lectures
Unit I	1. Preparation of standard of oxalic acid solution 2. Determination of strength of NaOH 3. Determination of concentration of solutions- percentage, molarity, molality, normality & ppm	06
Unit II	4. Determination of melting point 5. Distillation 6. Determination of boiling point	06

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Unit III	7. Preparation of stock solutions and dilution 8. Preparation of water based and alcohol-based reagents (Fehling A & B, starch solutions) 9. Preparation of distilled water	**06**
Unit IV	10. Preparation of buffer solution-Acidic and Basic Buffers 11. Preparation of Nesseler's reagent, Molisch reagent, Schiff's base	**06**
Unit V	12. Determination of pH using pH paper, pH meter 13. Conductometric titration-Acid Base	**06**

Keywords/Tags: Standard, Distillation, boiling point, stock solutions, buffer, Conductometric titration, pH

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. "A Skills Training Manual in Basic Chemical Laboratory Techniques", by SoffiantiniVic, Seller-AtlanticPublishers, Publisher: Lulu.com ISBN: 9781471090998, 9781471090998
2. ICSE Chemistry Lab Skills - Laboratory Ethics • Viva Voce, Neha Sharma, ISBN : 9789388653510, 2020, Viva Education
3. Chemistry Laboratory Skills - 1: Alternative to Practical, Shirly Bandarawatta, ISBN-10 : 9554114206 Summer Gate Education; 2nd edition (July 22, 2013)
4. Fundamentals of Chemistry: Laboratory Studies, Third Edition, 1975, Frank Brescia, John Arents, .. Eugene Weiner, Science Direct

Suggestive digital platforms web links:

https://www.valpo.edu/chemistry/experiential-learning/lab-skills/

https://www.cademix.org/chemistry-lab-skills-and-various-strategies-for-developing-them/

Suggested equivalent online courses:

https://onlinecourses.swayam2.ac.in/ntr20_ed14/preview

https://www.classcentral.com/course/swayam-analytical-techniques-13896

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Part D-Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	30	Viva Voce on Practical	70
Attendance		Practical Record File	
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)		Table work / Experiments	
TOTAL MARKS: 100			
Any remarks/ suggestions:			

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CBCS Annual Pattern
B.Sc. III year
CHEMISTRY– DSE 3
Syllabus of Theory Paper

Part A Introduction				
Program: Degree		Class: B.Sc.	Year: III	Session: 2023-24
Subject: CHEMISTRY				
1	Course Code	S3-CHEM3D		
2	Course Title	INSTRUMENTAL TECHNIQUES IN CHEMISTRY		
3	Course Type (Core Course/Elective/Generic Elective/Vocational/.....)	Discipline Specific Elective (DSE) Group B Paper I		
4	Pre-requisite (if any)	To study this course the students must have the subject Chemistry in Diploma Course of B.Sc. or equivalent.		
5	Course Learning outcomes (CLO)	By the end of this course students will learn the following aspects of Instrumental Techniques in Chemistry: • Preparation of standard samples for analysis. • Instrumentation for analytical methods of Chemistry. • Instrumentation for various spectroscopic techniques. • Principles and instrumentation of various electro analytical techniques. • Instrumentation used in optical methods of analysis. • Advanced chromatographic techniques.		
6	Credit Value	4 (Theory)		
7	Total Marks: 100	Max. Marks: 30+70		Min. Passing Marks:35

Part B- Content of the Course		
Total No. of Lectures-Tutorials-Practical (in hours per week): L-T-P: 60-0-30		
Unit	Topics	No. of Lectures
I	Practical Aspects of Chemical Analysis	6

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	1. Analysis of real samples: Choice of analytical method, Analysis of standard samples, preparing standard samples for analysis, moisture in sample, drying the analytical sample, decomposition and dissolution of sample, source of errors in decomposition and dissolution. **2. Automation in Laboratory:** Introduction, classification of analytical methods. Types of instrumental methods. Importance of instruments for analysis. Analog & Digital signals, planning for laboratory automation. An overview of automatic instruments & instrumentation. Good laboratory practices. Instrumental standardization, optimization of procedures. **Keywords/Tags:** *Sampling, Analog signals, Digital signals, Standardization*	
2	**Electronic & Vibrational-Rotational Spectroscopy** 1. **Electronic or Ultra-Violet Visible (UV-Vis) Spectroscopy:** Basic principles, Instrumentation and Techniques. 2. **Fourier-transform infrared (FTIR) Spectroscopy:** Introduction and basic principle of IR spectroscopy, Instrumentation. Working of FTIR Spectrophotometer, Advantages of FTIR Spectroscopy. 3. **Raman Spectroscopy:** Mechanism of Raman Effect – Quantum theory and classical theory. Instrumentation and techniques. Qualitative treatment of Rotational Raman effect, Effect of nuclear spin, Vibrational Raman spectra, Stokes and anti-Stokes lines, their intensity difference, rule of mutual exclusion. **Keywords/Tags:** *FTIR Spectroscopy, UV-Vis Spectroscopy, Raman Effect, Stokes lines, anti-Stokes lines.*	**8**
3	**Molecular Characterization Techniques** **1. Nuclear Magnetic Resonance Spectroscopy:** Basic principles of NMR, Instrumentation – Magnet, sweep generator, RF generator, RF receiver, signal recorder, calculation of NMR signals. **2. Electron Spin Resonance (ESR) spectroscopy:** Introduction, principle, instrumentation, selection rules, interpretation of Lande's factor 'g'. Hyperfine and super hyperfine coupling. **3. Mass Spectrometry:** Theory of mass spectrometry. Principle and operation of mass spectrometer. Ionization techniques- electron impact, chemical ionization, electrospray, electrical discharge, laser desorption, fast atom bombardment. Separation of ions on basis of mass-charge ratio. Analyzers- Magnetic-sector, Electric quadrupole and high-resolution multiple-reflection time of flight (MR-TOF). **Keywords/Tags:** *Sweep Generator, hyperfine coupling, superfine coupling, ionization, absorption, emission,* MR-TOF.	**12**
4	**Atom Characterization Techniques** **1. Flame photometry**: Flame emission spectroscopy, characteristics of flame, instrumentation & working of flame photometer.	**10**

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	2. **Atomic Absorption Spectroscopy (AAS):** Basic principles, Instrumentation, atomizer, monochromator, detector, sensitivity and detection limits. Interferences in AAS and their elimination. 3. **Atomic Emission Spectroscopy (AES):** Principles, Sources for excitation, Instrumentation. Qualitative and quantitative Analysis. **Keywords/Tags:** *Flame Spectroscopy, Monochromator, Atomizer, Detector*	
5	**Electro analytical techniques** 1. **Polarography:** General principles and instrumentation of polarography, half-wave potential, equations for reversible cathodic, anodic and cathodic-anodic waves, analysis of reversible polarographic wave. 2. **Voltametry:** General principles and instrumentation, Cyclic voltammetry, Linear-scan voltammetry, Pulse voltammetric methods, Voltammetry with ultra-micro electrodes, stripping methods. 3. **Amperometry:** Principles and amperometric titration techniques-Dropping mercury electrode, rotating platinum microelectrode. 4. **Potentiometry:** Introduction, reference and indicator electrodes, ion selective electrodes. Instrumentation and measurement of electro motive force of cell (EMF). Potentiometric titrations. 5. **Conductometry:** Principle, measurement of conductance, conductometric titrations. **Keywords/Tags:** *Cathodic waves, Anodic waves, Amperometric titration, Conductometric titration, Conductance, Electrode.*	12
6	**Optical and Advanced Chromatographic Techniques** 1. **Polarimetry:** Polarimeter, optical rotations, measurements of optical rotation. 2. **Refractometry:** Principle of refraction, Snell's law, Construction & working of refractometer. 3. **Gas Chromatography (GC):** Theory, Instrumentation-description of equipment and different parts, columns (packed and capillary columns) Detector specifications, Thermal conductivity detector, Flame ionization detector, electron capture detector, nitrogen-phosphorous detector or thermionic specific detector (TSD), photo ionization detector. Programmed temperature gas chromatography. 4. **High Performance Liquid Chromatography (HPLC):** Theory, Instrumentation, description of the different parts of the equipments, stationary phases (columns), mobile phase, detectors, UV detector, refractive index (RI) detector, Fluorescence detector, Photo Diode Array detector, Evaporative Light Scattering Detector (ELSD), conductometric detector and electrochemical detector. **Keywords/Tags:** *Optical Rotation, UV Detector, RI Detector, TSD, ELSD, Chromatograms.*	12

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Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

Text Books:

1. Kaur, H., "Instrumental Methods of Chemical Analysis", Pragati Prakashan, 2018
2. Sharma, B.K., "Instrumental Methods of Chemical Analysis", Goel Publishing House, 2011.
3. Khandpur R.S., "Analytical Instrumentation", Tata McGraw Hill, 2006
4. Skoog, D.A., Holler, F.J., Nieman, T.A., "Principles of Instrumental Analysis", Cengage Learning India Ed., 2017
5. Khopkar, S.M., "Instrumental Analysis in BioAnalytical Chemistry", New Age International, 2016.
6. Chatwal, A., "Instrumental Methodology of Analysis", Himalaya Publishing House, 2011.
7. Kalsi, P.S., "Spectroscopy of Organic Compounds", New Age International, 2016.

Reference Books:

1. Galen, E., "Instrumental Methods & Chemical Analysis", McGraw-Hill Publishing Company Ltd., 1985.
2. Christian, G. D., "Analytical Chemistry", John Wiley and Sons. Inc, 1994.
3. Harris, D.C., "Quantitative Chemical Analysis", W.H. Freeman & Co. New York, 2003, 7th Edition.
4. Willard, H.H., Merritt, L.L., Dean, J.,Settoe, F.A., "Instrumental Methods of Analysis", Wadsworth Publishing Company Ltd., Belmont, California, USA, 2004,7th Edition.
5. Drago, R.S., "Physical Methods in Chemistry", W.B. Saunders Co, 1977.
6. Atkins, P.W., "Physical Chemistry", Oxford University Press, 2017.
7. Castellan, G.W., "Physical Chemistry", Narosa, 2004.
8. Day, R.A., Underwood, A.L., "Quantitative Analysis", Prentice-Hall of India Pvt. Ltd., 1985.
9. Jeffery, G.H., Bassett, J., Mendham, J., Denney, R.C., "Vogel's Textbook of Quantitative Chemical Analysis", Pearson, 2017.
10. Ewing, G.W., "Instrumental Methods of Analysis", McGraw Hill, 1992.
11. Kemp, W., "Organic Spectroscopy", Mc Millan,1991, 3rd edition.
12. Williams, D.H., Flemming, I., "Spectroscopic methods in Organic Chemistry", Mc Graw Hill, 2017, 4th Edition.
13. Banwell, C.N., McCash, E.M., "Fundamentals of Molecular Spectroscopy", Tata Mc Graw Hill,1995, 4th edition.
14. Webster, F.X., Silverstein, R.M., "Spectroscopic Identification of Organic Compounds", Wiley, 1981.

Web sources (Last Accessed on 07th June, 2021)

1. https://open.umn.edu/opentextbooks/textbooks/486
2. https://rb.gy/aicqvq
3. https://rb.gy/fhzlww

Suggested equivalent online courses:(Last Accessed on 07th June, 2021)

MOOC : https://freevideolectures.com/course/3029/modern-instrumental-methods-of-analysis

NPTEL:

1. https://nptel.ac.in/courses/104/105/104105084/
2. https://nptel.ac.in/content/syllabus_pdf/102101050.pdf

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Part D-Assessment and Evaluation

Suggested Continuous Evaluation Methods:
Maximum Marks: 100
Continuous Comprehensive Evaluation (CCE): 30 marks University Exam (UE): 70 marks

Internal Assessment: Continuous Comprehensive Evaluation (CCE):30	Class Test Assignment/Presentation	**30**
External Assessment: University Exam Section:70	**Section(A)**: Very Short Questions **Section (B)**: Short Questions **Section (C)**: Long Questions	**70**

Any remarks/ suggestions:

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CBCS Annual Pattern
B.Sc. III year
CHEMISTRY DSE 3
Syllabus of Practical Paper

Part A Introduction			
Program: Degree	Class: B.Sc.	Year: Third	Session:2023-24
Subject: Chemistry			

1	Course Code	S3-CHEM3Q
2	Course Title	Instrumental Analytical Techniques In Chemistry
3	Course Type (Core Course/Elective/Generic Elective/Vocational/.....)	Discipline Specific Elective (DSE) Group B Paper I
4	Pre-requisite (if any)	To study this course the students must have had the subject Chemistry in Diploma Course of B.Sc. or equivalent.
5	Course Learning outcomes (CLO)	By the end of this course students will learn the following aspects of instrumental techniques in chemical analysis: • Preparation of standard samples for analysis. • Determination of concentration of solutions spectrometrically. • Determination of stoichiometry and stability constant of complexes. • Potentiometric and conductometric titrations. • Advanced chromatographic techniques.
6	Credit Value	2 (Practical)
7	Total Marks	Max. Marks: 30+70 / Min. Passing Marks:35

Part B- Content of the Course

Total No. of Lectures-Tutorials-Practical (in hours per week): 4
L-T-P: 60-0-30

Unit	Topics	No. of Lectures
1	**Spectrophotometry** 1. Determination of concentration of ferric ions in ferric salicylate complex spectrophotometrically. 2. Simultaneous determination of chromium and manganese by spectrophotometry. 3. Determination of sulphate and phosphate by spectrophotometry. 4. Spectrophotometric determination of pK value of an indicator.	06

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	5. Determination of magnesium and calcium in tap water by flame photometry. 6. Spectrophotometric determination of the stoichiometry and stability constants of complexes.	
2	**Refractometry & Polarimetry** 1. Verification of law of refraction of mixtures (e.g. glycerol and water) using Abbe's refractometer. 2. Determination of the specific rotation of a given optically active compound by polarimetry. 3. Determination of specific rotation of glucose and fructose by polarimetry. 4. Determination of the enzyme catalyzed inversion of sucrose by polarimetry. 5. Determine the concentration of a solution of an optically active substance by polarimetry.	06
3	**Potentiometry** 1. Determination of the standard EMF and the standard free energy change of Daniel cell potentiometrically. 2. Potentiometric titration of a given hydrochloric acid solution with an alkali solution. 3. Potentiometric titration of given ferrous sulphate solution with potassium dichromate. 4. Determination of solubility product of a sparingly soluble substance.	06
4	**Conductometry** 1. Conductometric titration of hydrochloric acid with sodium hydroxide. 2. Conductometric titration of hydrochloric acid with ammonium hydroxide. 3. Conductometric titration of acetic acid with ammonium hydroxide.	06
5	**Polarography** 1. Determination of the half wave potential of metal ion by polarography. 2. Determination of the amount of Cd(II) ions in an unknown solution by polarography.	06

Keywords/Tags: Spectrophotometry, Potentiometry, Conductometry, Polarography, Abbe's refractometer

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

Text Books

1. Furniss, B.S., Hannaford, A.J., Smith, P.W. G., Tatchell, A.R., "Vogel's Text Book of Practical Organic Chemistry", Pearson Education, 2005, 5th Edn.

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2. Gurthu, J.N., Kapoor, R., "Advanced Experimental Chemistry", S. Chand and Co., 1987.
3. Sundaram, S., Krishnan, P., Raghavan, P.S., "Practical Chemistry (Part II)", S. Viswanathan Co. Pvt.,1996.
4. Shoemaker, D.P., Garland, C.W., Nibler, J.W., "Experiments in Physical Chemistry", McGraw- Hill Book Company, 1989, 5th Edn.
5. Yadav, J.B., "Advanced Practical Physical Chemistry", Goel Publishing House, 2015
6. Ghosh, J.C., "Experiments in Physical Chemistry", Bharati Bhawan Publisher, 2007
7. Kalsi, P.S., "Spectroscopy of Organic Compounds", New Age International, 2016.

Reference Books

1. Skoog, Douglas., Holler, F.J., Nieman, T.A., "Principle of Instrumental Analysis", Saunders College Publishing, 1998, 5th Edn.
2. Midgley, D., Torrance, K., "Potentiometric Water Analysis", John Wiley & Sons Ltd, 1991, 2nd Edn.
3. Weast, R.C., "CRC Handbook of Chemistry and Physics", CRC Press, 1997, 57th Edition.

Suggestive digital platforms web links

1. https://vlab.amrita.edu/?sub=2&brch=190&sim=338&cnt=1
2. http://www.columbia.edu/itc/barnard/biology/biobc2004/edit/experiments/Experiment1-Spec.pdf
3. http://web.pdx.edu/~ralfw/uploads/1/0/2/6/10260941/pulse_oximetry_laboratory_guide.pdf
4. https://www.chem.purdue.edu/courses/chm224/Lab-Experiments/expt4_GENESYS_v2.pdf
5. http://gervind.faculty.mjc.edu/biology_101/101_lab/spectrophotometry/4%20Spectrophotometer%20Fa17.pdf
6. https://www.edaq.com/w/images/6/6c/EXP011_The_pH_Electrode_and_Potentiometric_Titrations_PDF.pdf
7. https://www.philadelphia.edu.jo/academics/ajaber/uploads/CHEM%20540-Chapter%202-Potentiometry-061.pdf
8. https://www.tau.ac.il/~advanal/PotentiometricTitrations.htm
9. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Book%3A_Analytical_Chemistry_2.1_(Harvey)/11%3A_Electrochemical_Methods/11.02%3A_Potentiometric_Methods

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10. https://www.chem.purdue.edu/courses/chm224/Lab-Experiments/Exp8.pdf
11. https://www.shcollege.ac.in/wp-content/uploads/NAAC_Documents_IV_Cycle/Criterion-II/2.3.2/ppt/Dr_Ignatious_ConductometricTitration.pdf
12. https://www.analytik.ethz.ch/praktika/phys_anal/POL/Anleitung_ENG.pdf
13. https://nph.onlinelibrary.wiley.com/doi/pdf/10.1111/j.1469-8137.1948.tb05089.x
14. http://chemistry.du.ac.in/study_material/4103-A/MSc_Polarography.pdf
15. https://fac.ksu.edu.sa/sites/default/files/abbe_experiment.pdf
16. https://web.mst.edu/~tbone/subjects/tbone/chem224/riproc.pdf
17. http://www.fbml.ff.vu.lt/sites/default/files/7_4_en.pdf
18. https://wp.optics.arizona.edu/mnofziger/wp-content/uploads/sites/31/2016/05/OPTI202L-Lab10-OMD2.pdf
19. http://davjalandhar.com/dbt/chemistry/SOP%20LabManuals/B.Sc.%20BT%20SEM%20IV.pdf
20. https://vlab.amrita.edu/?sub=1&brch=195&sim=545&cnt=1

Suggested equivalent online courses:

1. https://www.my-mooc.com/en/mooc/basic-analytical-chemistry/
2. https://www.my-mooc.com/en/mooc/principles-electronic-biosensors-purduex-nano535x/

Part D-Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	30	Viva Voce on Practical	70
Attendance		Practical Record File	
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)		Table work / Experiments	
		Total Marks: 100	

Any remarks/ suggestions:

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CBCS Annual Pattern
B.Sc. III year
CHEMISTRY– DSE 4
Syllabus of Theory Paper

Part A - Introduction			
Program: Degree	Class: BSc	Year: III	Session:2023-24
Subject: Chemistry			

1	Course code	S3-CHEM4D
2	Course title	Bio Physical, Bio inorganic and organometallic Chemistry
3	Course type (Core Course/Elective/Generic Elective/Vocational/.....)	Discipline Specific Elective (DSE) Group B Paper II
4	Pre-requisite (if any)	To study this course the students must have the subject Chemistry in Diploma Course of B.Sc. or equivalent.
5	Course Learning Outcomes (CLO)	On completion of this course the students will be able to understand: • Biophysical concepts like pH, biological oxidation, bioenergetics. • Magnetic properties and electronic spectra of transition metal complexes. • Structure and bonding analysis of organometallic compounds using the MO theory • Organometallic compounds of main groupelements and their structure and bonding analysis • Bio inorganic chemistry and role of metal ions in biological systems.
6	Credit Value	4 (Theory)

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7	Total Marks	Max. Marks (30+70):	Min. Pass. Marks:35

Part B – Content of the course

Total No. of Lectures-Tutorials-Practical (In hours per week):

L-T-P:

Unit	Topic	No. of Lectures
1	**Water, pH & buffer**Water as a medium for biological reaction, concept of pH in terms of biological system, effect of pH on a biomolecule,biological buffers system Bonding in biomolecules hydrogen bond,VanderWaal interaction,ionic bond hydrophobic attraction,glycoside linkage peptide bond,phosphodiester linkage Role of different biological buffer system like -Phosphate Buffer,bicarbonate buffer protein amino acid buffer, hemoglobin buffer system **Biological oxidation**-definition,types of biological oxidation,reduction oxidation by direct action of oxygen,oxidation by loss of hydrogen Electron transport chain, inhibitors of ETC **Oxidative phosphorylation** - definition, theories inhibitors of oxidative phosphorylation, Un- couplers **Bioenergetics** -couple reactions,law of thermodynamics, free energy,relationship between standard free energy change and equilibrium constant, general introduction of high energy compounds Structure of ATP as universal currency of free energy in biological systems with example -in muscle contraction, free energy of ATP hydrolysis.	12
2	**Magnetic properties of transition metal complexes** Introduction, types of magnetic behaviour: diamagnetism, paramagnetic, ferro magnetism, antiferromagnetism, ferrimagnetism, origin and calculation of magnetism. methods of determining magnetic susceptibility guy, Bhatnagar Mathur, Quincke's, Curie and nuclear Magnetic resonance method, magnetic moment, LS coupling, determination of ground state terms symbol, orbital contribution to magnetic moments and application of magnetic moment data for 3D metal complexes	12
3	**An Introduction to Organometalic Compounds**-Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). **Metal Alkyls**: Important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer), concept of multicentre bonding in these compounds. Role of triethylaluminium in polymerisation of ethene (Ziegler – Natta Catalyst). **Organomagnesium compounds**- Grignard reagent, preparations, structure and chemical reactions.	12

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	Organozinc compounds-Preparations and chemical reactions. **Organolithium compounds-** Preparations and chemical reactions. Organosulphur compounds.Nomenclature, structural characteristics. Thiol. thio-ether, sulphonic acid, sulphonamide and sulphaguanidine-methods of preparations and chemicalreactions.	
4	**Metal Carbonyls-**18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d series. General methods of preparation (direct combination, reductive carbonylation, thermal and photochemical decomposition) of mono and binuclear carbonyls of 3d series. Structures of mononuclear and binuclear carbonyls of Cr, Mn, Fe, Co and Ni using VBT. π-acceptor behaviour of CO (MO diagram of CO to be discussed), synergic effect and use of IR data to explain extent of back bonding. Zeise's salt: Preparation and structure, evidences of synergic effect and comparison of synergic effect with that in carbonyls.	**12**
5	**Bioinorganic Chemistry-** Metal ions present in biological systems, classification of elements according to their action in biological system. Geochemical effect on the distribution of metals. Sodium / K-pump, carbonic anhydrase and carboxypeptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity. Use of chelating agents in medicine. Iron and its application in bio-systems, Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting Hemoglobin; Storage and transfer of iron.	**12**

Part C – Learning Resources

Text Books, Reference Books, Other resources

Suggested Reading:

1. Vogel, A.I. Qualitative Inorganic Analysis, Longman, 1972 36
2. Svehla, G. Vogel's Qualitative Inorganic Analysis, 7th Edition, Prentice Hall, 1996-03-07.
3. Cotton, F.A. G.; Wilkinson &Gaus, P.L. Basic Inorganic Chemistry 3rd Ed.; Wiley India,
4. Huheey, J. E.; Keiter, E.A. &Keiter, R.L. Inorganic Chemistry, Principles of Structure and Reactivity 4th Ed., Harper Collins 1993, Pearson,2006.
5. Sharpe, A.G. Inorganic Chemistry, 4th Indian Reprint (Pearson Education) 2005
6. Douglas, B. E.; McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry3rd Ed., John Wiley and Sons, NY, 1994.
7. Greenwood, N.N. & Earnshaw, A. Chemistry of the Elements, Elsevier 2nd Ed, 1997 (Ziegler Natta Catalyst and Equilibria in Grignard Solution).
8. Lee, J.D. Concise Inorganic Chemistry 5th Ed., John Wiley and sons 2008.
9. Powell, P. Principles of Organometallic Chemistry, Chapman and Hall, 1988.

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10. Shriver, D.D. & P. Atkins, Inorganic Chemistry 2nd Ed., Oxford University Press, 1994.

11. Basolo, F. & Person, R. Mechanisms of Inorganic Reactions: Study of Metal Complexes in Solution 2nd Ed., John Wiley & Sons Inc; NY.

12. Purcell, K.F. &Kotz, J.C., Inorganic Chemistry, W.B. Saunders Co. 1977

13. Miessler, G. L. & Donald, A. Tarr, Inorganic Chemistry 4th Ed., Pearson, 2010. • Collman, James P. et al. Principles and Applications of Organotransition Metal Chemistry. Mill Valley, CA: University Science Books, 1987.

14. Crabtree, Robert H. The Organometallic Chemistry of the Transition Metals. j New York, NY: John Wiley, 2000.

15. Spessard, Gary O., &Gary L. Miessler. Organometallic Chemistry. Upper Saddle River, NJ: Prentice-Hall, 1996.

16. Elschenbroich, C., Salzer, A. Organometallics – A Concise Introduction, 2nd Edn., (VCH Publication, 1992).

17. Crabtree, R. H. The Organometallic Chemistry of the Transition Metals, 6th Edn., (John Wiley, 2014).

18. Powell, P. Principles of Organometallic Chemistry, 2nd Edn., (Chapman, London, 1988).

19. Bioinorganic Chemistry, Ivano Bertini, Harry B. Gray, Stephen J. Lippard, Joan Selverstone Valentine, Viva Book Private Books Limited.

20. Biophysical Chemistry, Avinash Upadhyay, Kakoli Upadhyay, Nirmalendu Nath, Himalaya Publishing House.

Suggested equivalent online:

Part D-Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks : 100

Continuous Comprehensive Evaluation (CCE) : 30 marks University Exam (UE) 70 marks

Internal Assessment : Continuous Comprehensive Evaluation (CCE):30	Class Test Assignment/Presentation	**30**
External Assessment : University Exam Section:70	**Section(A)** : Very Short Questions **Section (B)** : Short Questions **Section (C)** : Long Questions	**70**

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Govt. M H College of Home Science & Science for Women Jabalpur
As recommended by Central Board of Studies and approved by the Governor of M.P.
Syllabus: Chemistry Academic Session 2023– 2024

CBCS Annual Pattern

B.Sc. III year

CHEMISTRY– DSE 4
Syllabus of Practical Paper

Part A Introduction			
Program: Degree	Class`: B.Sc	Year: Third	Session: 2023-24
Subject: Chemistry			

1	Course Code	S3-CHEM4Q
2	Course Title	Synthesis and Analytical Techniques
3	Course Type (Core Course/Elective/Generic Elective/Vocational/.....)	Discipline Specific Elective (DSE) Group B Paper II
4	Pre-requisite (if any)	To study this course, a student must have the subject chemistry in Diploma of BSc or equivalent.
5	Course Learning outcomes (CLO)	On completion of this course, learners will be able to: 1. How to synthesis Ferrocene from $FeCl_3$ 2. How to Synthesis of $K_2[Fe(C_2O_4)_3]$ 3. How to Determine P^H of bio sample 4. How to Determine Sugar in blood sample by photometry
6	Credit Value	2 (Practical)
7	Total Marks	Max. Marks: 30+70 / Min. Passing Marks:35

Part B- Content of the Course

Total No. of Lectures-Tutorials-Practical (in hours per week):

L-T-P:

Unit	Topics	No. of Lectures
I	Synthesis 1. To synthesize Ferrocene from $FeCl_3$ 2. To Synthesize $K_2[Fe(C_2O_4)_2]$ Complex	10

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	3. synthesize of $Cr(C_5H_5)_2$ 4. Synthesis of Aceto-Fe Complex 5. Synthesis of triphenyl methanol from benzoic acid using Grignard reagent	
2	**Instrumentation** 1. Determination of P^H of the Bio sample 2. To determine the Sugar in Blood sample by Photometry Method 3. Determination of the Na^+, K^+ ions in water sample by flame photometry	08
3	**Chromatography** 1. Determination of R_f values of $Fe^{+3}/Co^{+3}/Pb^{+2}/Ag^+$ by column Chromatography 2. Determination of R_f Values of $Pb^{+2}/Cu^{+2}/Hg^{+2}$ by TLC	06
4	**Polarography** 1. To determine EMF of Fe^{+3} and Co^{+3} ions in Bio sample 2. To determine EMF of Pb^{+2}, Cd^{+2} and Hg^{+2} ions by Polarography method	06

Keywords/Tags: Synthesis, Ferrocene, Aceto-Fe Complex, Bio sample, Flame photometry, Chromatography, Polarography, EMF

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. Advanced Inorganic chemistry practical by Gurudeep Raj, Goel publishing house
2. Analytical chemistry and instrumentation Bilard, willey publication
3. Environmental chemistry by AK De S chand
4. Advanced Inorganic Chemistry by Jadhav

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Part D-Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	External Assessment	Marks
Class Interaction /Quiz	30	Viva Voce on Practical	70
Attendance		Practical Record File	
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report of Excursion/ Lab Visits/ Survey / Industrial visit)		Table work / Experiments	
TOTAL MARKS: 100			
Any remarks/ suggestions:			

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CBCS Annual Pattern
B.Sc. III year
CHEMISTRY– Minor/Elective
Syllabus of Theory Paper

Part A Introduction			
Program: Degree	Class`: B.Sc.	Year: III	Session: 2023-24
Subject: Chemistry			

1	Course Code	S3-CHEM2T
2	Course Title	Pharmaceutical and Medicinal Chemistry
3	Course Type (Core Course/Elective/Generic Elective/Vocational/.....)	Minor/Elective
4	Pre-requisite (if any)	To study this course the students must have the subject Chemistry in Diploma Course of B.Sc. or equivalent
5	Course Learning outcomes (CLO)	After successfully competing this course module students will be able to: • Understand importance of pharmaceutical chemistry and pharmacopeia. • Learn intellectual property rights, patents trademark and copyright. • Understand Definition, Classification of the drugs with examples and structures. • Describe the structure activity relation of some important class of drugs. • Describe the overall process of drug discovery and the role played by medicinal chemistry in this process. • Relate the structure and physical properties of drugs to their pharmacological activity. • Explain physio-chemical properties related to QSAR.
6	Credit Value	4 (Theory)

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7	Total Marks	Max. Marks: 30+70	Min. Passing Marks:35

Part B- Content of the Course

Total No. of Lectures-Tutorials-Practical (in hours per week): 60

L-T-P:

Unit	Topics	No. of Lectures
Unit 1: Pharmaceutical Chemistry	Introduction to pharmacy, career in pharmacy, codes of pharmaceutical ethics, importance of pharmaceutical chemistry, pharmacopeia and its history (IP, BP, USP, NF). Drug and cosmetic act with special reference to schedule M, GMP, GLP, GCP, USFDA, NDA, clinical trial. Concept of quality and total quality management, quality assurance and quality control, IPQA, IPQC. Documentation and maintenance of record, intellectual property rights, patents, trademark, copyright, patent act.	12
Unit 2: Pharmacognosy	Definition, history, scope and development of Pharmacognosy Classification and Sources of drugs: classification of drugs, sources and uses of natural drug products, biological (plants, animals and microbes), geographical, marine and mineral sources. Drug Receptors: Introduction to drug receptors, nature of drug receptors, different bonding involved in drug-receptor interaction, drug receptor theories. Drug absorption: routes of drug administration, absorption of drugs and factors affecting absorption.	12
Unit 3:Molecular Modeling and Drug Design	Drug design and development an overview, analogues and prodrugs structure and activityrelationship between chemical (SAR),factors governing drugdesign, approaches to drug design, receptor site theory, introduction to combinatorialsynthesis in drug discovery. factors affecting bioactivity. QSAR-Free-Wilson analysis,structure a biological activity Hansch analysis, relationship between Free Wilson analysis and Hansch analysis.	12

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Unit 4: Antibiotics and Antibacterials	Introduction, Antibiotic β-Lactam Type – Penicillin, Cephalosporins, Antitubercular – Streptomycin, Broad Spectrum Antibiotics – Tetracyclines, Anticancer – Dactinomycin (Actinomycin D)	12
Unit 5: Antifungal and Non-steroidal Anti-inflammatory Drugs	Antifungal: Polyenes, Antibacterial-Ciprofloxacin, Norfloxacin, Antiviral - Acyclovir Antimalarials: Chemotherapy of MalariaSAR, Chloroquine, Chloroguanideand Mefloquine. Non-steroidal Anti-inflammatory Drugs: Diclofenac Sodium, Ibuprofen and Netopam.	12

Keywords/Tags: Pharmacopeia, patents, trademark, copyright, QA, QC, pharmacognosy, drug design, QSAR, antibiotics, antibacterials, antifungal, anti-inflammatory drugs, antimalarials.

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

1. "Pharmaceutical Chemistry Inorganic Vol. I", Chatwal G. R., Himalaya Publishing House, Mumbai, 2010.
2. "Textbook of Pharmacognosy", Wallis T. E., CBS Publishers and Distributors, New Delhi, 2005, Fifth Edition.
3. "Pharmaceutical Chemistry", Choudhary N. C. and Gurbani N. K., Vallabh Prakashan, New Delhi, 2014.
4. "Pharmaceutical Chemistry", Watson D. G., Churchill Livingstone Elsevier, UK, 2011.
5. "Text Book of Professional Pharmacy", Jain N. K. and Sharma S. N., Vallabh Prakashan, New Delhi, 2009, Fifth Edition.
6. "Pharmacognosy and Pharmacobiotechnology", Kar A., New Age International Publishers, New Delhi, 2017, Third Edition.
7. "A Primer onQSAR/QSPR Modelling: Fundamental Concepts", Roy K., Kar S., Das R. N., Springer International Publishing AG Switzerland, 2015.
8. "Medicinal Chemistry", Kar A., New Age International Publishers, New Delhi, 2007, Fourth Edition.
9. "An Introduction to Medicinal Chemistry", PatrickG. L., Oxford University Press,UK, 2013, Fifth Edition.
10. "Medicinal Chemistry", Thomas G., John Wiley & Sons, Chichester, 2007, Second Edition.

Suggested equivalent online courses:

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CBCS Annual Pattern
B.Sc. III year
CHEMISTRY– Minor/Elective
Syllabus of Practical Paper

Part A Introduction				
Program: Degree		Class': B.Sc.	Year: III	Session: 2023-24
Subject: Chemistry				
1	Course Code	S3-CHEM2P		
2	Course Title	Pharmaceuticaland Medicinal Chemistry		
3	Course Type (Core Course/Elective/Generic Elective/Vocational/.....)	Minor/Elective		
4	Pre-requisite (if any)	To study this course the students must have the subject Chemistry in Diploma Course of B.Sc. or equivalent.		
5	Course Learning outcomes (CLO)	On completion of this course, learners will be able to: 1. How to prepare Acetanilide 2. How to Isolate the caffeine from tea leaves 3. To learn about preparation of simple syrup as per IP and USP		
6	Credit Value	2 (Practical)		
7	Total Marks	Max. Marks: 30+70		Min. Passing Marks:35

Part B- Content of the Course

Total No. of Lectures-Tutorials-Practical (in hours per week):
L-T-P:

Unit	Topics	No. of Lectures
I	Practical:- 1. Preparation of Pharmaceutical compounds - a) Acetanilide b) Aromatic water c) Lotion d) Aspirin	8
II	2. Preparation of pharmaceutical compound a) Tincture Iodine b) Alum c) Ferrous Ammonium sulphate d) Antimony potassium tartrate	6
III	3. Isolation of caffeine from tea leaves. 4. Extraction of active constituents from extraction method.	4

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IV	5. Identification of crude drug. 6. Morphology of turmeric, ginger, Mentha.	4
V	7. Preparation of suspension, Emulsions, ointment. 8. Preparation of simple syrup as per IP and USP. 9. Preparation of pharmaceutical buffer and study of its theoretical and calculated PH. 10 Inorganic preparation of compounds like Zinc Oxide, calcium carbonate, Magnesium Carbonate.	8

a) **Keywords/Tags:**caffeine. Tincture Iodine. pharmaceutical buffer

Part C-Learning Resources

Text Books, Reference Books, Other resources

Suggested Readings:

Practical book-

1. Practical Pharmaceutical chemistry by A.H. Beckett and J.B. stenlake, 4th Edition, Part-II continuum international publishing Group Ltd, 2000.
2. A Practical book of Pharmaceutical Inorganic chemistry by K.B. Patil, N.B. Patil and P.A. Patil, JP Innovative publication, 1st edition, 2019.
3. Pharmaceutical chemistry inorganic by G.R. Chatwal, Himalaya publication, Vol.1.
4. Experimental Pharmaceutical Chemistry by Aneesahmadsiddiqui, seemisiddiqui, Edition I.
5. Pharmacognosy by Dr. C.K. Kokate, volume-I, forty fifth edition, NiraliPrakashan.

Suggestive digital platforms web links

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Part D-Assessment and Evaluation			
Suggested Continuous Evaluation Methods:			
Internal Assessment	Marks	ExternalAssessment	Marks
ClassInteraction /Quiz	30	Viva Voceon Practical	70
Attendance		PracticalRecord File	
Assignments (Charts/ Model Seminar / Rural Service/ Technology Dissemination/ Report ofExcursion/ Lab Visits/ Survey / Industrial visit)		Tablework / Experiments	
TOTAL MARKS: 100			
Any remarks/ suggestions:			

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CBCS Annual Pattern
Chemistry-NEP (2020)
Third Year
Syllabus of Generic Elective-1

Part A - Introduction				
Program: Degree		Class:	Year: Third	Session: 2023-24
Subject: Chemistry				
1	Course code	S3-CHEM1G		
2	Course title	Processing of Fats and Oils		
3	Course type (Core Course/Elective/Generic Elective/Vocational/…..)	Generic Elective		
4	Pre-requisite (if any)	Open for all as an Generic elective		
5	Course Learning Outcomes (CLO)	After completing this course the student will – 1. Gain knowledge about traditional Indian oils and Traditional Indian Oil Processing Methods. 2. Gain the knowledge about importance, types, natural resources of fats and oils and their effect on health. 3. Learn the methods of refining and modifications of fats and oils. 4. Know about the nutritional aspects of fats and oils and their storage and handling. 5. Gain information regarding entreprenеurship in food processing and knowledge of local fat processing industries.		
6	Credit Value	6 (Theory)		
7	Total Marks	Max. Marks (70+30):	Min. Passing Marks:35	

Part B – Content of the course		
Total No. of Lectures-Tutorials-Practical (In hours per week): 60		
Unit	Topic	No. of Lectures
1	Indian Traditional oils- mustard, groundnut, sesame (til) and	18

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	coconut (Extraction, availability, properties and uses) **Traditional methods of oil processing in India**-Traditional Ghani technology, Recent evolution of oil processing, Advantages and disadvantages of ghani crushing **Keywords**- Extraction, Ghani, processing	
2	**Importance of Fats and Oils**- Importance of fats in food, Types of fats- Monounsaturated (olive oil, peanut oil), Polyunsaturated (PUFAs) (soybean oils, omega-3 eggs, walnuts), Saturated (full-fat dairy products, butter, coconut oil, ghee, vegetable ghee), Trans fats (burgers , cookies, cakes, chips, French fries), Their examples, Physical properties of Fats and Oils **Elementary idea of Chemistry of Fats and Oils** **Natural Sources**, Daily requirement in balanced diet and harmful effect of excess of fats and oils in the body. **Keywords**- Monounsaturated, PUFA, Trans fats	18
3	**Refining and modification of Fats and Oils**-Oil and fat processing methods: Pre-treatment, Extraction, Dehydration, hydrogenation, Fractionation, interesterification, Oil Refining **Functions of Fats and Oils** in Bakery products, Chocolate and confectionery coatings, Ice cream, Frying **Keywords**- Pre-treatment, hydrogenation, Oil Refining	18
4	**Nutritional aspect Fats and Oil**- Main nutrients of fats and oils: Vitamin A, D and E (antioxidant), triglycerides **Nutritional differences** in different types of fats **Oil storage and handling** – Methods to store cooking oil, rancidity-Definition and methods to avoid rancidity **Adulteration in oils and fats**- Common adulterants, identification and harmful effect **Keywords**- Vitamin, rancidity, adulteration	18
5	**Entrepreneurship Development in Food Industry**- scope, cold storage, Palm oil processing, Seed oil processing, fat and oil for biofuel processing, animal fat processing **Main fat and oil processing industries of the area.**	18

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	Keywords- Entrepreneurship, cold storage, oil processing.	

Part C – Learning Resources

Text Books, Reference Books, Other resources

Suggested Reading:

1. Fats and Oils Handbook. by Michael Bockisch, 1993
2. The Chemistry of Oils and Fats By F. D Gunstone and Frank D Gunstone 2004
3. Fats and Oils Handbook by Michael Bockisch 1993
4. Fats and Oils: Formulating and Processing for Applications, Third Edition - [Special Indian Edition - Reprint Year: 2020] (English, Richard D. O'Brien)
5. Hand Book of Oils, Fats & Derivatives with Refining and Packaging Technology (English, Board Em) Engineers India Research Institute
6. Chemistry and Technology of Oils and Fats Paperback – 1 January 2003 by M.M. Chakrabarty Allied Publishers Pvt. Ltd
7. Edible Oils And Fats 2007 by C Ainsworth Mitchell , Kessinger Pub Co

Suggested equivalent online:

https://www.ifst.org/resources/information-statements/oils-and-fats

Part D-Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks : 100

Continuous Comprehensive Evaluation (CCE) : 30 marks University Exam (UE) 70 marks

Internal Assessment : Continuous Comprehensive Evaluation (CCE):30	Class Test Assignment/Presentation	**30**
External Assessment : University Exam Section:70	**Section(A)** : Very Short Questions **Section (B)** : Short Questions **Section (C)** : Long Questions	**70**

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CBCS Annual Pattern
Third Year
Syllabus of Chemistry
Generic Elective-2

Part A - Introduction			
Program: Degree	Class:	Year: third	Session: 2023-24
Subject: Chemistry			

1.	Course Code	S3-CHEM2G
2.	Course Title	ENVIRONMENTAL TOXICOLOGY
3.	Course Type	Generic Elective
4.	Prerequisite	Open for all as an Generic elective.
5.	Course Learning Outcomes (CLO)	By the end of this course students are expected to- 1. Learn about definition and sources of toxicants 2. Learn about chemical toxicants, biological toxicants and its assessment 3. Learn about different parts of Eco-toxicology i.e Immunotoxicology, Xenobiotics, Neurotoxicology, bioaccumulation, biodegradation etc 4. Learn about the determination of acceptable risks and limits of environmental toxicants and utility of environmental benchmarks 5. Learn about environmental cytotoxicity and genotoxicity 6. Learn about what type of toxic chemicals effects in environment and solid waste management 7. Learn about which factors influence the toxicity
6.	Credit value	6 (Theory)
7.	Total Marks: 100	Max Marks: 70+30 / Min Passing Marks: 35

Part B – Content of the Course

Total No. of Lectures-90

Unit	Topics	No. of Lectures

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1	**Introduction to toxicology** • Introduction to toxicants - definition and concepts, sources of toxicants, mode of action of toxic substances, distribution on storage of toxins in Human tissues • Chemical toxicants - classes of chemical toxicants, exposure classes, water and soil pollutants, types of classes (food additives, detergents, cosmetics) • Biological toxicants - types of biological toxicants and food intoxication, classification of toxicants present in food, microbial agents; symptoms, effects on health and management, endotoxins and entrotoxins • Toxicity assessment - overview of toxicity assessment, toxic effects, dose responsive assessment, dose response curve, LD50 & LC50, assessing toxicity	17
2	**ECO-TOXICOLOGY** • Basis of eco- toxicology - definition, testing methodologies, immunotoxicology, hypersensitivity mediated by xenobiotics, neurotoxicology • Toxic - xenobiotics and their environmental persistence, bioaccumulation, biomagnification, assessment of bioaccumulation and biomagnification, biodegradation, biotransformation, bio remediation • Effects of toxicity - types of toxic effects, types of systematic toxic effects, organ specific toxicity, interactions. • Detoxification - definition and concept, mechanism of detoxification in human body, detoxification and excretion	17
3	**ENVIRONMENTAL TOXICITY RISK ASSESSMENT** • Acceptable limits of toxicants - acceptable limits and global scenario, determination of acceptable risks and limits of environmental toxicants, utility of environmental benchmarks, types of comparison possible in the benchmarking of environmental performance, benefits & limits of environmental benchmarking • Toxicity risk assessment planning - perceiving risk, estimating health risks, risk assessment planning, limitations of toxicity risk assessment, risk benefit analysis, risk management	16

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	• Toxicity remediation	
4	**ENVIRONMENTAL CYTOTOXICITY AND GENOTOXICITY** • Carcinogenicity - carcinogens, classes of carcinogens, carcinogenesis • Mutagenicity - effects of mutagens, types of mutations, origins of spontaneous mutation, mutagens, DNA repair systems • Teratogenicity - definition and concepts, sources of teratogens and their effects, teratogenesis • Cytotoxicity and Geno toxicity prevention - cytotoxicity, genotoxicity, in vitro • toxicology testing, in Vivo testing, bioassays, biomarkers, biosensors, microorganisms	16
5	**CHEMICAL TOXICOLOGY** • Toxic chemicals in the environment – effects of toxic chemicals – cyanide and its toxic effects – pesticides and its biochemical effects – toxicity of lead, mercury, arsenic and cadmium- Solid waste management.	12
6	**FACTORS INFLUENCE TOXICITY** • Selective toxicity-metabolic pathways-Enzyme activity-xenobiotic-metabolizing systems-Toxicity tests in animals-individual variations in responses to xenobiotics	12

Keywords/Tags: Chemical Toxicants, Biological Toxicants, Environmental Cytotoxicity, Environmental Toxicity, Chemical Toxicology, Xenobiotics, Eco-Toxicology, LC50, LD50

Part C-Learning Resources

E-Learning Resources	MOOCs, NPTEL, SWAYAM, HE E-Contents
Suggested Readings	NCERT Exemplar, Class XI Chemistry, Moderns ABC of Chemistry for class 11th and 12th, Modern Publications. Analysis of Foods – H.E. Cox: 13. Chemical Analysis of Foods – H.E.Cox and pearson. Foods: Facts and Principles. N. Shakuntala Many and S. Swamy, 4th ed. New Age International (1998) Science For 10th Class, by Manjit Kaur, Lakhmir Singh, S.Chand. Engineering Chemistry, by Jain and Jain, Dhanpatrai publishing company. Chemistry Class 10th ByDr.Parul Srivastava, Prachi India Pvt. Ltd. Environmental Chemistry, Anil Kumar De, Wiley Eastern ltd. Environmental analysis, SM Khopkar (IIT Bombay)

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	Environmental Chemistry by BK Sharma & H Kaur, Goel publishing house. Fundamentals of Environmental Chemistry, Manahan, Stanley. E Environmental Toxicology 3rd edition, Sigmund F. Zakrzewski, Oxford university Press

Part D-Assessment and Evaluation

Suggested Continuous Evaluation Methods:

Maximum Marks: 100

Continuous Comprehensive Evaluation (CCE): 30 marks University Exam (UE) 70 marks

Internal Assessment: Continuous Comprehensive Evaluation (CCE):30	Class Test Assignment/Presentation	**30**
External Assessment: University Exam Section:70	**Section(A)**: Very Short Questions **Section (B)**: Short Questions **Section (C)**: Long Questions	**70**

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