FACULTY OF SCIENCES

SYLLABUS

of

Master of Science (Chemistry)

(Semester: I - II)

(Under Credit Based Continuous Evaluation Grading System)

Session: 2024-25

The Heritage Institution

KANYA MAHA VIDYALAYA JALANDHAR

(Autonomous)

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)

SCHEME AND CURRICULUM OF EXAMINATION OF TWO YEAR DEGREE PROGRAMME

Master of Science (Chemistry)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Session: 2024-2025)

Semester I

Master of Science (Chemistry) Semester I										
Course Code	**Course Title**	**Course Type**	**Hours Per Week L-T-P**	**Credits L-T-P**	**Total Credits**	**Marks**				**Examination time (in Hours)**
						Total	**Th**	**P**	**CA**	
MCHL-1081	Ligand Field Theory	C	4-0-0	4-0-0	4	100	70	-	30	3
MCHL-1082	Organic Reaction Mechanism-I	C	4-0-0	4-0-0	4	100	70	-	30	3
MCHL-1083	Physical Chemistry – Thermodynamics	C	4-0-0	4-0-0	4	100	70	-	30	3
MCHL-1084	Spectroscopy A: Techniques for Structure Elucidation of Organic Compounds	C	4-0-0	4-0-0	4	100	70	-	30	3
MCHM-1135	Computer for Chemists	C	1-0-2	1-0-1	2	50	20	15	15	3+3
MCHP-1086	Inorganic Chemistry Practical (Quantitative Analysis)	C	0-0-6	0-0-3	3	100	-	70	30	3*2
MCHP-1087	Organic Chemistry	C	0-0-6	0-0-3	3					3*2

	Practical					100	-	70	30	
Student can opt any one of the following Interdisciplinary optional courses		IDE			-					
Total					**24**	**650**				
IDEC-1101*	Communication Skills		4-0-0			100	80	-	20	3
IDEM-1362*	Basics of Music (Vocal)		2-1-1			100	40	40	20	
IDEH-1313*	Human Rights and Constitutional Duties		4-0-0			100	80	-	20	
IDEI-1124*	Basics of Computer Applications		2-0-4			100	50	30	20	3+3
IDEW-1275	Indian Heritage: Contribution to the world		4-0-0			100	80	-	20	3
(*Credits of these ID courses will not be added to SGPA)										

C- Compulsory Course

IDE- Inter Disciplinary Elective Course

Programme Specific Outcomes

On successful completion of this Programme, students will have ability to:

PSO1: do global level research, pursue Ph.D. programme and targeted approach of CSIR-NET examination and competitive exams conducted by service commission

PSO2: attain enormous job opportunities at all levels of chemical, pharmaceutical, food products and life oriented material industries.

PSO3: get recruitment in R and D and synthetic division of polymer industries and Allied division.

PSO4: apply modern methods of analysis to chemical systems in a laboratory setting.

PSO5: work effectively and safely in a laboratory environment, use technologies/instrumentation to gather and analyse data and work in teams as well as independently.

PSO6: think critically, develop scientific temper and analyse various chemical.

Master of Science (Chemistry)
(Semester-I)
Session 2024-25
COURSE CODE: MCHL-1081
Course Title: Ligand Field Theory

Course outcomes:

Students will be able to

CO1: learn mathematical rules for the formation of symmetry point groups

CO2: construct the Character table for various point groups and to determine the

symmetry of hybrid orbitals

CO3: analyze Tanabe – Sugano /Orgel diagrams and determine the magnetic properties of complexes.

CO4: analyze and understand the electronic spectra of octahedral and tetrahedral metal complexes.

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Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHL-1081
COURSE TITLE: Ligand Field Theory

Exam Time: 3Hrs **Max. Marks: 100**
Credit (L-T-P): 4-0-0 **(Theory: 70, CA: 30)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (Fourteen each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Symmetry

Symmetry elements, symmetry operations and their matrix representation, group postulates and types, multiplication tables, point group determination, determination of reducible and irreducible representations, character tables, construction of character tables for C_{2v}, C_{3v} (non-abelian group), use of symmetry in obtaining symmetry of orbitals in molecules, use of character table to determine which metal orbitals are used in σ and π bond formation in octahedral, tetrahedral and square planar transition metal complexes, qualitative splitting of s, p, d, f orbitals in octahedral, tetrahedral and square planar fields using character tables and without the use of character Tables.

UNIT-II

Molecular Orbital Theory for Metal Complexes:

Recapitulations, ligands symmetry orbitals and metal orbitals involved in molecular orbitals formation in octahedral complexes, MOEL diagrams for octahedral tetrahedral and square planar complexes showing σ and π bonding in transition metal complexes.

InterelectronicRepulsions:

Spin-spin, orbital-orbital and spin orbital coupling, LS and jj coupling schemes, determination of all the spectroscopic terms of p^n, d^n ions, determination of the ground state terms for p^n, d^n, f^n ions using L.S. scheme, determination of total degeneracy of terms, order of interelectronic repulsions and crystal field strength in various fields, two type of electron repulsion parameters, spin orbit coupling parameters (λ) energy separation between different j states, The effect of octahedral and tetrahedral fields on S, P, D and F terms (with help of the character table), splitting patterns of and G, H and I terms

UNIT-III

Free Ions in Medium and Strong Crystal Fields:

Strong field configurations, transition from weak to strong crystal fields, evaluation of strong crystal field terms of d^2 configuration in octahedral and tetrahedral crystal fields (using group theory), construction of the correlation energy level diagrams of d^2 configuration in octrahedral field, study of energy level diagrams for higher configurations, selection rules of electronic transitions in transition metal complexes, their proof using group theory, relaxation of the selection rule in centrosymmetric and non-centrosymmetric molecules, Orgel diagrams, Tanabe Sugano diagrams

Magnetic Properties:

Van Vlecks formula for susceptibility, first order Zeeman effect, second order Zeeman effect, KT states, quenching of orbitals angular momentum by ligand field, the magnetic properties of A and E terms, the magnetic properties of T terms, electronic delocalization, magnetic properties of d^n and f^n metal ions**.**

UNIT-IV

Electronic Spectra of Transition Metal Complexes:

Variation of the Racah parameter, nephlauxetic effect -central field covalency, symmetry restricted covalency, differential radial expansion, spectrochemical series, band intensities, factors influencing band widths, discussion of electronic spectra of octahedral and tetrahedral d^1 – d^9 metal ions, calculation of 10Dq and B with use of Orgel and Tanabe Sugano diagrams, low spin complexes of Mn^{3+}, Mn^{2+}, Fe^{3+}, Co^{3+}, Fe^{2+}, comment on the spectra of second and third transition series, spectra of K_3MoCl_6 and $[Rh(NH_3)_6]^{3+}$, spectra of cis and trans$[Co(en)_2X_2]^+$, $[Mn(H_2O)_6]^{2+}$, $CuSO_4.5H_2O$ and its anhydrous complex, comparison of d–d band with f–f bands. Introduction to Charge Transfer Spectra**.**

Books Recommended:

1. F.A. Cotton, Chemical Application of Group Theory, WileyEastern.
2. G. L. Miessler, D. A. Tarr, Inorganic Chemistry, 3rd edition, PearsonEducation.
3. B.N. Figgis, Introduction to Ligand Field, Wiley Eastern.
4. A.B.P. Lever, Inorganic Electronic Spectroscopy,Elsevier.
5. A. Earnshaw, Introduction to Magnetochemistry, Academic Press.
6. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity,Harper Interscience.
7. R.S. Drago, Physical Method in Chemistry, W.B. SaundersCompany.
8. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, WileyInter-science.

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHL-1082
COURSE TITLE: Organic Reaction Mechanism- I

Course outcomes:

Students will be able to

CO1: understand the concept and various types of aromaticity and acquire the skills for correct stereochemical assignment and interpretation in simple organic molecules.

CO2: basics of reaction mechanism and understand the various types of aliphatic nucleophilic substitution reaction and their mechanism

CO3: understand the various types of aliphatic nucleophilic substitution reaction and discuss their mechanism and predict the product of the reactions

CO4: understand the various types of aromatic electrophic and nucleophilic substitution reaction and their mechanism alongwith identification and application of various rearrangemet reactions

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHL-1082
COURSE TITLE: Organic Reaction Mechanism- I

Exam Time: 3Hrs **Max. Marks: 100**
Credit (L-T-P): 4-0-0 **(Theory: 70, CA: 30)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (fourteen each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Nature of Bonding in Organic Reactions:
Aromaticity in Benzenoid and non-benzenoid compounds. Huckel's Rule, Alternant and non-alternant hydrocarbons. Energy levels of π(pi) molecular orbitals in simple systems. Annulenes, Antiaromaticity, Homoaromaticity, PMO approach.

Stereochemistry:
Elements of symmetry, chirality, molecules with more than one chiral center.Threo and erythro isomers, methods of resolution, optical purity.Prochirality – enantiotopic and diastereotopic atoms, groups and faces. Stereospecific and stereoselective synthesis.Asymmetric synthesis.Optical activity in absence of chiral carbon (Biphenyls, Allenes, Spiranes).Chirality due to helical shape.

UNIT-II

Reaction Mechanism, Structure andReactivity:
Types of mechanisms, types of reactions, thermodynamic and kinetic requirements, Kinetic and thermodynamic control in product formation. Transition states and reaction intermediates, Isotope effects, Hard and Soft Acid Base concept, Study of reactive intermediates – Types of intermediates, isolation and detection of intermediates (including use of spectral techniques), trapping ofintermediates.

Aliphatic Nucleophilic Substitution –A:
The SN^2, $SN^1$and SNi mechanisms, mixed $SN^1$and SN^2 mechanism SET mechanism. The neighboring group mechanism (anchimeric assistance).Neighboring group participation by pi and sigma bonds.

UNIT-III

Aliphatic Nucleophilic Substitution – B:
Classical, non-classical andphenonium cations, Rearrangements in carbocations (general survey).Ester hydrolysis.Nucleophilic substitution at allylic, aliphatic trigonal and vinylic carbon.Effect on the reactivity due to – substrate structure, attacking nucleophile, leaving group and reaction medium.Ambident nucleophiles and substrates, regioselectivity. Meyer's synthesis of aldehydes, ketones, acids and esters.Alkylation by organoboranes.

Aliphatic Electrophilic Substituion:
Bimolecular mechanism – SE2 and SEi. The SE1 mechanism, Hydrogen exchange, electrophilic substitution accompanied by double bond shifts, diazo-transfer reaction, formation of sulphur ylides, effect of substrates, leaving group and solvent polarity on the reactivity.

UNIT-IV

Aromatic Electrophilic Substitution:
The arenium ion mechanism, orientation and reactivity in mono substituted and di substituted aromatics. Energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazo coupling, Vilsmeir reaction, Gattermann-Koch reaction, Pechmann reaction, Houben – Hoesch reaction, Fries rearangement.

Aromatic Nucleophilic Substitution:
SNAr, SN^1, benzyne and SRN^1 mechanisms. Reactivity effect of substrate structure, leaving group and nucleophile. The von Richter, Sommelet-Hauser, and Smiles rearrangements.

Books Recommended:

1. Stereochemistry -Eliel
2. Advanced Organic Chemistry – JerryMarch.
3. Advanced Organic Chemistry, F. A. Carey, R. J. Sundberg, Volume I andII
4. Highlights of Organic Chemistry, W.J. L. Nobel; An Advanced TextBook.
5. Stereochemistry conformation and Mechanism – P. S.Kalsi

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHL-1083
COURSE TITLE: Physical Chemistry – Thermodynamics

Course outcomes:

Students will be able to

CO1: calculate change in thermodynamic properties, equilibrium constants, partial molar quantities, chemical potential.

CO2: apply phase rule and, draw phase diagrams for one, and two component systems, identify the dependency of temperature and pressure on phase transitions, and identify first/second order phase transitions, solve problems based on Debye-Huckel limiting law, calculate excess thermodynamic properties.

CO3: predict heat capacity (C_v, C_p) of an ideal gas of linear and non-linear molecules from the number of degrees of freedom, rotational and vibrational wave numbers, explain T^3 dependence of heat capacity of solids at low temperatures (universal feature) using Debye and Einstein theory of heat capacity of solids.

CO4: understand non-equilibrium states, apply Onsager's reciprocity relations and irreversible thermodynamics for biological systems.

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHL-1083
COURSE TITLE: Physical Chemistry –Thermodynamics

Exam Time: 3Hrs **Max. Marks: 100**
Credit (L-T-P): 4-0-0 **(Theory: 70, CA: 30)**
Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (fourteen each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Classical Thermodynamics
Brief resume of concepts of thermodynamics, free energy, chemical potential and entropy. Partial molar properties, partial molar free energy, partial molar volume and partial molar heat content and their significances. Determination of these quantities. Concept of fugacity and determination of fugacity.

UNIT-II

Non-ideal systems
Excess functions for non-ideal solutions. Activity, activity coefficients, Debye-Huckel theory for activity coefficient of electrolytic solutions, determination of activity and activity coefficients, ionic strength. Application of phase rule to three component system, second order phase transitions.

Statistical Thermodynamics:
Concept of distribution law, thermodynamic probability and most probable distribution, Ensemble averaging, postulates of ensemble averaging. Canonical, grand canonical and micro canonical ensembles, corresponding distribution laws (using Lagrange's method of undetermined multipliers).

UNIT-III

Partition functions

Translational, rotational, vibrational and electronic partition function, calculation of thermodynamic properties in terms of partition functions. Application of partition functions.
Heat capacity behavior of solids-chemical equilibria and equilibrium constants in terms of partition functions, Fermi-Dirac statistics, distribution laws, and application to metals. Bose-Einstein statistics- distribution law and application to helium.

UNIT-IV

Non Equilibrium Thermodynamics:

Thermodynamic criteria for non-equilibrium states, entropy production and entropy flow, entropy balance equations for different irreversible processes (e.g., heat flow, chemical reaction etc.) transformations of generalized fluxes and forces, non-equilibrium stationery states, phenomenological equations, microscopic reversibility and Onsager's reciprocity relations, electro kinetic phenomena, diffusion, electric conduction, irreversible thermodynamics for biological systems, coupled reactions.

Books Recommended:

1. I F Nash: Elements of classical and statistical thermodynamics
2. Lee Bot: Irreversible thermodynamics
3. Thermodynamics of Biological Processes, D. Jou and J.E. LeeBot
4. I Prigogine: Introduction to thermodynamics of irreversible processes
5. T L Hill: Introduction to statistical thermodynamics.

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHL-1084
COURSE TITLE: SPECTROSCOPY – A: Techniques for Structure Elucidation of Organic Compounds

Course outcomes:

Students will be able to

CO1: know about the Nuclear magnetic resonance spectroscopy. Proton chemical shift, spin-spin coupling, coupling constants and its applications to determine organic structures

CO2: to understand different cleavage patterns of organic compounds in Mass spectrometry and apply the knowledge for interpretation of the spectrum of an unknown compound and the principle and applications of ultraviolet and apply Woodward Fisher Rule to calculate λ_{max}

CO3: understand the concepts of Vibrational spectroscopy, Vibrational coupling overtones and Fermi resonance and its application in Organic Chemistry

CO4: apply NMR, IR, MS, UV-Vis spectroscopic techniques in solving structure of organic molecules and in determination of their stereochemistry.

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHL-1084
COURSE TITLE: SPECTROSCOPY – A: Techniques for Structure Elucidation of Organic Compounds

Exam Time: 3Hrs **Max. Marks: 100**
Credit (L-T-P): 4-0-0 **(Theory: 70, CA: 30)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (fourteen each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Nuclear Magnetic Resonance

The Nuclear spin, Larmor frequency, the NMR isotopes, population of nuclear spin level, spin and spin lattice relaxation. Measurement techniques (CW and FT method), solvent used. Chemical shift, reference compounds, shielding constant, range of typical chemical Shifts simple application of chemical shifts, ring current and aromaticity.Shifts for ^{1}H. - Spin-spin interactions. Effect of chemical exchange, fluxional molecules, Hindered rotation on NMR spectrum Karplus relationship, nuclear magnetic double resonance, chemically induced dynamic nuclear polarization, Application of structure elucidation of simple organic molecules Lanthanide shift.

UNIT-II

Mass Spectroscopy

Elementary theory - Measurement techniques (EI, CI, FD, FAB), Resolution, Molecular ions, isotope ions, fragment ions of odd and even electron types, rearrangement ions, Factors affecting cleavage patterns, simple cleavage, cleavages at a hetero atom, multicentre fragmentations rearrangements, Reteroiels – Alder fragmentation. Cleavage associated with common functional groups (Aldehydes, ketones cyclic and acyclic esters, alcohols, olefins, aromatic compounds amines). Interpretation of the spectrum of an unknown.

Ultraviolet and VisibleSpectroscopy

The energy of electronic excitation, measurement techniques, Beer-Lambert Law, Molar extinction coefficient.The Frank Condon Principle. Different types of transition noticed in UV spectrum of organic functional groups and their relative energies. Chromophore, auxochromes, factors affecting max, Effect of steric hindrance to coplanarity, Solvent Effects. Applications of U.V. spectroscopy.

UNIT-III

Infrared Spectroscopy

Vibrational Energy Levels, Selection Rules, Force Constant, Fundamental Vibration Frequencies, Factors influencing Vibrational Frequencies (Vibrational Coupling, Hydrogen Bonding, Electronic effect, Bond Angles, Field Effect). Sampling Techniques, Absorption of Common functional Groups, Interpretation, Finger print Regions.

Applications in Organic Chemistry

(a) Determining purity and quantitative analysis.
(b) Studying reaction kinetics.
(c) Determining purity and quantitative analysis.
(d) Studying hydrogen bonding.
(e) Studying molecular geometry and conformational analysis.
(f) Studying reactive species

UNIT-IV

1. **Solution of Structural Problems by Combined Use of the following Spectroscopic Techniques:**

(a) Electronic spectra
(b) Vibrational spectroscopy
(c) NMR (^{1}H) spectroscopy
(d) Mass Spectroscopy

Books Recommended:

1. W. Kemp. OrganicSpectroscopy.
2. W. Kemp. N.M.R.Spectroscopy.
3. D.H. Williams and I. Fleming. Spectroscopic Methods in OrganicChemistry.
4. R.M. Silverstein and G.C. Bassler, Spectrometric Identification of OrganicCompounds.
5. Introduction to Spectroscopy –Pavia

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHM-1135
COURSE TITLE: Computer for Chemists

Course outcomes:

The students will be able to:

CO1: Comprehend various programming constructs like variables, data-types, operators, etc of C programming language.
CO2: Apply various control statements of C Programming Language for designing solutions to different real world problems.
CO3: Comprehend signature, declaration, definition and calling of functions in C for modularization of problem.
CO4: Implement single and multidimensional arrays for representing complex data collections.

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHM-1135
COURSE TITLE: Computer for Chemists

Total Marks: 50
Exam Time: (3+3) Hrs **(Theory: 20, CA:15)**
Credit (L-T-P): 1-0-1 **Practical Marks: 15**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:
Eight questions of equal marks (four each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

1. Computer Programming in C language

UNIT-I

Introduction to programming, Data Types, assignment statement, arithmetic operators, algorithms and flowcharts.Elementary programming, a typical C program, printf function. Introduction of declarations, assignments and variables: concept of an integer, concept of a variable, rules for naming variables, assignment statement, arithmetic operators.

Integer arithmetic expressions, relative priority of arithmetic operators, use of parenthesis, modulus operator.

UNIT-II

Input/Output Fuctions , Decision making in C, scanf function, relational operators, logical operators, if statement, if else statement, nesting of if statement.

UNIT-III

The while loop, do while loop, for loop, nesting of for loop.
Type char and ASCII code, character strings and how to print them, octal and hexadecimal notation.
User defined functions, returning value from a function, functions with more than one parameters.

UNIT-IV

Arrays, declaring an array, initializing an array, break statement, strings and character arrays, sorting an array, finding maximum and minimum in an array, multidimensional arrays.

Input and output.

2. Computer programs in Chemistry

(These are also be done in the practical class):

Development of small computer codes involving simple formulae in chemistry:

UNIT-I

1. Calculation of mean, median,mode.
2. Solution of a quadratic equation.
3. Calculation of linear regression.
4. Calculation of curve linear regression.

UNIT-II

5. Calculation of Bohr orbit from de Broglie Lambda for electron.
6. Calculation of wave number and frequency from value of wavelength.
7. Calculation of van der Waals radii.
8. Radioactive decay.
9. Rate constant of a 1st order reaction, 2nd order reaction.
10. Calculation of lattice energy using Born Lande equation.

UNIT-III

11. Addition, multiplication and solution of inverse of 3 X 3matrix.
12. Calculation of average molecular weight of a polymer containing n1 molecules of molecular weight m1, n2 molecules of molecular weight m2 and soon.
13. Program for calculation of molecular weight of organic compound containing C, H, N, O and S.
14. Calculation of reduced mass of diatomic molecule.
15. Calculate the RMS and most probable velocity of a gas.

UNIT-IV

16. Calculate the ionic mobility from ionic conductance values.
17. Determine the thermodynamic parameters for isothermal expansion of monoatomic ideal gas.
18. Calculation of value of g- factor from value of J and S.
19. Calculate the bond length and bond angles using crystal structure data.

Books Recommended:

1. K.V. Raman, Computers in Chemistry, Tata McGraw Hill, 1993.
2. Henry Mullish, Herbert L. Cooper, The Spirit of C: An Introduction to Modern Programming, Jaico Publications, 1987.
3. Anshuman Sharma, Learn Programming in C, Lakhanpal Publishers,7th Edition.

4. E Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2002.
5. YashvantKanetkar, Let Us C, BPB Publications, 2016.
6. Byron Gottfried, Schaum's Outline Programming with C, McGraw Hill, 1996.

Note: The latest editions of the books should be followed

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHP-1086
COURSE TITLE: INORGANIC CHEMISTY (PRACTICAL)
(Quantitative Analysis)

Course outcomes:

Students will be able to

CO1: Experimental observation of Inorganic Quantitative Analysis

CO2: determine the strength of ions by Oxidation reduction titrations

CO3: estimate the amount of ions by precipitation titrations

CO4: estimate the amount of ions by complexometric and gravimetric methods

Master of Science (Chemistry)
(Semester-I)
Session: 2024-25
COURSE CODE: MCHP-1086
COURSE TITLE: INORGANIC CHEMISTY (PRACTICAL)
(Quantitative Analysis)

Exam Time: 6 Hrs **Max. Marks: 100**

Credit (L-T-P): 0-0-3 **(P: 70, CA: 30)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

I. Oxidation-ReductionTitrations

1. Standardization with sodium oxalate of $KMnO_4$ and determination of Ca^{2+}ion.
2. Standardization of ceric sulphate with Mohr's salt and determination of NO_3^{-1} and $C_2O_4^{-2}$ ions.
3. Standardization of $K_2Cr_2O_7$ with Fe^{2+} and determination of Fe^{3+} (Ferricalum)
4. Standardization of hypo solution with potassium iodate / $K_2Cr_2O_7$ and determination of available Cl_2 in bleaching powder, Sb^{3+} andCu^{2+}.
5. Determination of hydrazine with KIO_3titration.

II. Precipitation Titrations

1. $AgNO_3$ standardization by Mohr's method by using adsorptionindicator.
2. Volhard's method for Cl^-determination.
3. Determination of ammonium / potassiumthiocyanate.

III. ComplexometricTitrations

1. Determination of Mg^{2+} and Mn^{2+} in a mixture using fluoride ion as a demaskingagent.
2. Determination of Ni^{2+} (backtitration).
3. Determination of Ca^{2+} (by substitutionmethod).

IV. GravimetricAnalysis

1. Determination of Ba^{2+} as its chromate.
2. Estimation of lead as its leadmolybdate.
3. Estimation of chromium (III) as its leadchromate.
4. Estimation of Cu^{2+} using Ammonium/Sodiumthiocyanate.

Books Recommended:

Vogel's book on Inorganic Quantitative Analysis

Master of Science (Chemistry)
(Semester I)
Session: 2024-25
COURSE CODE: MCHP-1087
COURSE TITLE: ORGANIC CHEMISTRY (PRACTICAL)

Course outcomes:

The students will be able to

CO1: independently perform two step organic synthesis.

CO2: identify the synthesized compounds by TLC

CO3: perform analysis of common analgesic drugs by TLC

CO4: extract, identify and characterize the compounds isolated from naturalproducts

Master of Science (Chemistry)
(Semester I)
Session: 2024-25
COURSE CODE: MCHP-1087
COURSE TITLE: ORGANIC CHEMISTRY
(PRACTICAL)

Exam Time: 6Hrs **Max. Marks: 100**

Credit (L-T-P): 0-0-3 **(P: 70, CA: 30)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

UNIT–I

1. **Purification and Characterization of Organic Compounds**, the student is expected to carry out the experiments of purification (fractional crystallization, fractional distillation, chromatography) separation, purification and identification of the compounds of binary organic mixture (liquid-liquid, liquid-solid and solid-solid), using chemical analysis and IR and PMR spectral data. The student should also check the purity of the separated components on TLCplates.
2. To carry out the analysis of common analgesic drugs by thin layer chromatography, Acetaminophen, Aspirin, caffeine, phenacetin, salicylamide. (Learn to check purity of the given samples and completion of the chemical reactions).

UNIT–2

Organic Synthesis and Extraction of Organic Compounds from Natural Sources. The student is expected to carry out 4 to 6 organic preparations (usually involving not more than two steps), some of the illustrative experiments are listed below:-

1. *Extraction of Caffeine from tealeaves*
   (Ref. Experiment Organic Chemistry, (H. Dupont Durst, George W. Gokel, P 464 McGraw Hill Book Co., New York).
   Student would be asked to purity crude sample, check the purity on a TLC single spot and get the NMR scanned and interpret (Three methyl singlets and I methane singlet).
2. *Isolation of casein from milk* (try some typical colour reactionsproteins).
3. *Synthesis of 2-phenyllndole-Fischer Indole Synthesis*. Book 1, p.852
   Aim: To Study condensation and cyclization reactions.
4. *Synthesis of 3-nitrobenzoic from benzoic acid* (Rf. Ibid., p.245-247 and 443-448). **Aim:** To demonstrate the process of meta nitration, esterification and saponification of an ester. Make a comparative study of IR and PMR spectra of benzoic acid, methyl benzoate, methyl3-nitrobenzoate.
5. *Cannizaro's reaction of 4-chlorobenzaldehyde.*. Book 1, p760
   Aim: To demonstrate technique of isolation of two products from the reaction mixture and the procedure of intermolecular hydride transfer. Make a comparative study of IR and PMR spectra of 4 chlorobenzadehyde, 4-chlorobenzoic acid 4-chlorobenzyl alcohol.
6. *Synthesis of 1,3,5-Tribromobenzene from aniline*. **Aim:** To demonstrate: Bromination, Diazotization andReduction.

Books Recommended:

Vogel's Text book of practical organic chemistry, 5th edition.

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)
SCHEME AND CURRICULUM OF EXAMINATION OF TWO YEAR DEGREE PROGRAMME

Master of Science (Chemistry)

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session: 2024-2025)

Semester II

Master of Science (Chemistry) Semester II										
Course Code	**Course Title**	**Course Type**	**Hours Per Week L-T-P**	**Credits L-T-P**	**Total Credits**	**Marks**				**Examination time (in Hours)**
						Total	**Th**	**P**	**CA**	
MCHL-2081	Organometallics Chemistry	C	4-0-0	4-0-0	4	100	70	-	30	3
MCHL-2082	Organic Reaction Mechanism -II	C	4-0-0	4-0-0	4	100	70	-	30	3
MCHL-2083	Physical Chemistry – Quantum Chemistry	C	4-0-0	4-0-0	4	100	70	-	30	3
MCHL-2084	Reaction Mechanisms and Metal clusters	C	4-0-0	4-0-0	4	100	70	-	30	3
MCHL-2085	Spectroscopy B: Techniques for Structure Elucidation of Inorganic Compounds	C	4-0-0	4-0-0	4	100	70	-	30	3
MCHL-2336 MCHL-2056	Mathematics for Chemists Biology for Chemists	C	2-0-0	2-0-0	2	50	35	-	15	3
MCHP-2087	Organic Chemistry Practical	C	0-0-6	0-0-3	3	100	-	70	30	3*2
MCHP-2088	Physical Chemistry Practical	C	0-0-6	0-0-3	3	100	-	70	30	3*2
Total					**28**	**750**				

C- Compulsory Course

Note: Mathematics for Chemists: For Medical Students
Biology for Chemists: For Non-Medical Students

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2081
COURSE TITLE: ORGANOMETALLICS CHEMISTRY

Course outcomes:

Students will be able to

CO1: demonstrate basic principles and illustrate stability of organometallic compounds.

CO2: identify the structure and bonding aspects of simple organometallic compounds

CO3: identify different types of organometallic reactions and apply the above concepts to explain different catalytic reactions

CO4: understand the role of pi acid ligands in organometallic chemistry

Master of Science (Chemistry) (Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2081
COURSE TITLE: ORGANOMETALLICS CHEMISTRY

Exam Time: 3Hrs **Max. Marks: 100**
Credit (L-T-P): 4-0-0 **(Theory: 70, CA: 30)**
Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (fourteen each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Organometallics

Energy polarity and reactivity of M-C bond, Stability of Main group organometallics: Methods of preparation in perspective-organolithium compounds: structure and bonding and reaction-carbolithiatic organometallics of group 2 and 12 e.g. Mg and Zn, Cd and Hg: Preparation and structure of organoaluminium compounds, Technical applications of Tris (alkyl)aluminium compounds. η^2- ligands: olefenic and acetylenic complexes, chelating olefenic ligands – synthesis and structure. η^2 – ligands: Allylic and η^4– complexes ofcyclopentadiene.

UNIT-II

Synthesis and structure. η^4 –ligands: Butadiene, cyclobutadiene, heterocyclic pentadiene (S, Se, Te). Classification, Nomenclature of cyclopentdienyl complex.MO treatment of ferrocene. η^6 – ligands: Benzene and its derivatives. Multideckersandwichcompounds.

UNIT-III

Homogeneous hydrogenation of unsaturated compounds, reversible cis-dihydrocatalysis, monohydrido compounds, asymmetrical hydrogenation, hydrosilation of unsaturated compounds, hydrocyanation of alkenes, alkane metathesis, Ziegler-Natta polymerization of ethylene and propylene, water gas shift reaction, acetic acid synthesis by carbonyls, Oxopalladation reactions. Organometallic Reagents in Organic synthesis.

Reaction at Coordinated ligands

The role of metal ions in the hydrolysis of amino acid esters, peptides, and amides Molecular orbital concept of role of metal ions participation, Modified aldol condensation, Imine formation, Template and Macrocyclic effect in detail.

UNIT-IV

p-acid ligands

pi-acceptor character of CO, O_2, N_2, NO, PH_3 molecules in terms of MOEL diagram, Metal carbonyls; structure and bonding; vibration spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reactions of transition metal nitrosyl, dinitrogen and dioxygen complexes; tertiaryphosphine as ligand.

Books Recommended:

1. C. Elschenbroich and A. Salzer, Organometallics: A Concise Introduction, 2nd Ed., VCH 1992.
2. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity, Harper Interscience.
3. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, Ed. V andVI.Wiley Inter-science.
4. G. L. Miessler, D. A. Tarr, Inorganic Chemistry, 3rd edition, PearsonEducation

Master of Science (Chemistry) (Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2082
COURSE TITLE: Organic Reaction Mechanism – II

Course outcomes:

Students will be able to

CO1: understand the types, mechanism and factors affecting free radical reactions, apply the knowledge to predict the product of free radical reactions and to obtain an outline about elimination reactions and some specific examples of elimination reactions

CO2 : understand the mechanistic and stereochemical aspects of addition to Carbon – Carbon multiple bonds alongwith the reaction and mechanism of some named reactions of this type

CO3: understand the mechanism of metal hydride reduction of saturated/ unsaturated organic compounds learn its basic mechanism and to predict the mechanism of condensation reactions involving enolates and reactions involving carbon- carbon bond formation

CO4: acquire knowledge about the reagents used for oxidation and reduction of various organic compounds

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2082
COURSE TITLE: Organic Reaction Mechanism – II

Exam Time: 3Hrs **Max. Marks: 100**
Credit (L-T-P): 4-0-0 **(Theory: 70, CA: 30)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (fourteen each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

1.Free Radical Reactions

Types of free radial reactions, free radical substitution mechanism.Mechanism at an aromatic substrate, neighbouring group assistance.Reactivity for aliphatic and aromatic substrates at a bridgehead.Reactivity in the attacking radicals.Effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to acids, auto-oxidation, coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction, Free radical rearrangement, Hunsdiecker reaction, Kolbe reaction, Hydroxylation of aromatics by Fenton's reagent.

2. **Elimination Reactions**

The E2, E1, E1cB mechanisms. Orientation of the double bond.Effects of substrate structure, attacking base, leaving group and medium on reactivity.Mechanism and orientation in pyrolytic eliminations.

UNIT-II

3. Addition to Carbon – Carbon MultipleBonds

Mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles and free radicals, regio and chemoselectivity, orientation and reactivity.Addition to cyclopropane ring.Hydroboration, Michael reaction.Sharpless asymmetric epoxidation, Hydrogenation of double and triple bonds. Hydrogenation of aromatic rings.

4. Addition to Carbon – Hetero Multiple Bonds

Mechanism of condensation reactions involving enolates – Aldol, Kneoevenagel, Claisen, Mannich, Benzoin, Stobbe reactions, Reformatski reaction.

UNIT-III

5. Formation of Carbon-Carbon Bond

Principle, disconnections and synthons, electrophilic and nucleophilic carbon species. Base-catalyzed condensations; Perkin reaction, Stobbe condensation, Darzen condensation. Use of malonic, acetoacetic and cyanoacetic esters, Micheal addition, Use of acetylides, Acid-catalyzed condensation – self condensation of olefins, Friedal-Craft's reactions, Fries reactions, Diels-Alder reaction, 1-3 Dipolaradditions.

UNIT-IV

6. Oxidation

Introduction**.**Different oxidative processes. Hydrocarbons - alkenes, aromatic rings, saturated C-H groups (activated and unactivated). Alcohols, diols, aldehydes, ketones, ketals and carboxylic acids.Amines, hydrazines, and sulphides. Oxidations with ruthenium tetraoxide, iodobenzene diacetate and thallium(III) nitrate.

7. Reduction

Introduction**,** Different reductive processes. Hydrocarbons - alkanes, alkenes, alkynes and aromatic rings. Carbonyl compounds – aldehydes, ketones, acids and their derivatives. Epoxides.Nitro, nitroso, azo and oxime groups. Hydrogenolysis.

Books Recommended:

1. Principles of Organic Synthesis – Norman andCoxon

2. Advanced Organic Chemistry – JerryMarch.

3. Advanced Organic Chemistry, F.A. Carey, R.J.Sunberg.

4. Highlights of Organic Chemistry, W, J.L. Nobel; An Advanced TextBook.

5. Hand Book of Reagents for Organic Synthesis - Oxidizing and Reducing Reagents. S. D. Burke and R. L. Danheiser (John Wiley andSons)

6. Organic Synthetic reactions by William Carruthers

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2083
COURSE TITLE: Physical Chemistry-Quantum Chemistry

Course outcomes:

Students will be able to

CO1: have basic idea about quantum chemistry and the mathematics associated with quantum statistics including certain aspects of linear algebra, apply this knowledge to atomic structure

CO2: use mathematical techniques in linear algebra for eigen values and eigen vectors and first and second order differential equations not only in quantum chemistry but in other areas of chemistry

CO3: relate concepts that were originally introduced purely as modern atomic physics to molecular systems through harmonic oscillator, spin and rigid rotator

CO4**:** solve all the model problems in quantum mechanics for which exact analytical methods and solutions are available and will apply them to analyze the basis behind the postulatory method of quantum mechanics and which forms the foundations for advanced study of the subject.

Master of Science (Chemistry)

(Semester-II)
Session: 2024-25

COURSE CODE: MCHL-2083

COURSE TITLE: Physical Chemistry – Quantum Chemistry

Exam Time: 3Hrs **Max. Marks: 100**
Credit (L-T-P): 4-0-0 **(Theory: 70, CA: 30)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (fourteen each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

1. Quantum Theory: Introduction and Principles:
Black body radiations, Planck's radiation law, photoelectric effect, Compton effect, De- Broglie hypothesis, the Heisenberg's uncertainty principle, Rydberg relation for explaining atomic spectrum of hydrogen. Bohr's Theory and its limitation solution of classical wave equation by separation of variables method.

UNIT-II

2. Operators and observations, normal and orthogonal functions, hermitian and UNITary operators, introduction to differentiation and integration, Eigen value equation. Hamiltonian operator, interpretation of wave function, postulates of quantum mechanics.

UNIT-III

3. Applications of Quantum Postulates
Solution of particle in one and three dimensional box, degeneracy, the linear harmonic oscillator, rigid rotators, quantization of vibrational and rotational energy levels, hydrogen and hydrogen like atoms.

4. Angular Momentum
Commutative laws, need of polar coordinates, transformation of Cartesian coordinate into polar coordinate, angular momentum of one particle system, orbital angular momentum, the ladder operator method for angular momentum, spin angular momentum and their relations

UNIT-IV

5. General Orbital Theory of Conjugated Systems

Chemical bonding, linear combination of atomic orbital, overlap integral, coulomb's integral, bond order, charge density calculations for ethylene, allyl system,butadiene system, cyclo butadiene cyclopropenylsystem.

6. The ApproximateMethods

Need for approximation methods, Perturbation and Variation methods and their application to Helium atom.

Books Suggested:

1. Physical Chemistry, A Molecular Approach by MacQuarrieandSimon.
2. Quantum Chemistry, Ira N. Levine, PrenticeHall.
3. Quantum Chemistry, H. Eyring, Kimball andWalter.
4. Quantum Chemistry,Atkin.
5. Fundamentals of Quantum Chemistry, Anantharaman.R.

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Master of Science (Chemistry)

(Semester-II)

Session: 2024-25

COURSE CODE: MCHL-2084

COURSE TITLE: REACTION MECHANISMS AND METAL CLUSTERS

Course outcomes:

Students will be able to

CO1:learn the mechanism of substitution reaction and explain the parameters that affects the crystal structure of a compound

CO2: learn the application of electron transfer reactions in chemical kinetics

CO2:describe the stability of metal complexes by the use of formation constants

And calculate thermodynamic parameters from them

CO4:understand the chemistry of inorganic rings , chains and metal clusters

Master of Science (Chemistry)

(Semester-II)
Session: 2024-25

COURSE CODE: MCHL-2084

COURSE TITLE: REACTION MECHANISMS AND METAL CLUSTERS

Exam Time: 3Hrs **Max. Marks: 100**
Credit (L-T-P): 4-0-0 **(Theory: 70, CA: 30)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (fourteen each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Reaction Mechanism of Transition Metal Complexes

Inert and labile complexes, mechanisms of substitution (dissociative, associative interchange mechanism, the conjugate mechanism, substitution in *trans* complexes, substitution in *cis* complexes, isomerism of chelate rings), *trans* effect, explanation for *trans* effect, Ligand replacement reactions of square planar and octahedral complexes: their factors and mechanism of substitution, orbital occupation mechanisms. Anation reaction, Metal carbonyl reactions species with 17 electrons.

UNIT-II

Electron transfer processes with mechanism, key ideas concerning electron transfer reactions between transition Metals. Cross reactions and thermodynamics. Marcus theory, its kinetics and applications.

UNIT-III

Doubly bridged inner sphere transfer and other electron transfer reactions. Two electron transfer, non-complementary reactions. Stereochemical nonrigidity of coordinate and orgonometallic compounds, trigonal bypyramid, system with six or more coordination number. Isomerization and recemization of trischelates, metal carbonylscrambling.

Metal-ligand Equilibria in Solution

Stepwise and overall formation constant and their interaction, trends in step wise constant, factors affecting the stability of metal complex with reference to the nature of metal ion and ligand chelate effect and its thermodynamic origin. Determination of binary formation constants

by pH-meter, Job's method and spectrophotometry.

UNIT-IV

Inorganic Rings, Chains and Metal Cluster

Borazines, Phosphazenes and other heterocyclic inorganic ring, systems, homocyclic inorganic systems, cages of P and S, oxides andsulphides, Higher boranes and carboranes, methods of classifying boranes, Molecular orbit view of chlorohydroborane ions and carboranesmetallocarboranes, isopoly and heteropoly acids and salts; metal-metal bonds and bi-, tri-, tetra-, penta-, and hexanuclear clusters, electron counting schemes for HNCC's. Approaches to systematic cluster synthesis; mention of seven, eight and nine atom clusters. Isolobal analogy and examples of application of analogy.

Books Recommended:

1. K.P. Purcell and J. V. Kotz: Inorganic Chemistry W.B. Saunders Co. London,(1977).
2. G. L. Miessler, D. A. Tarr, Inorganic Chemistry, 3rd edition, PearsonEducation.
3. F.A. Cotton and Wilkinson: Inorganic Chemistry V and VI Ed. Willy Eastern –(1999).
4. J.E. Huheey: Inorganic Chemistry III and IV Ed. Pearson Education Asia –(2002).

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2085
COURSE TITLE: SPECTROSCOPY – B: Techniques for Structure Elucidation of Inorganic Compounds

Course outcomes:

Students will be able to

CO1: identify symmetry elements and symmetry operations

CO2: determine the rotational spectra of linear molecules

CO3: determine IR and Raman activity of linear molecules

CO4: understand the principle and spectra interpretation of photoelectron spectroscopy, electron spin resonance spectroscopy, nuclear quadrupole resonance spectroscopy, Mossbauer spectroscopy

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2085
COURSE TITLE: SPECTROSCOPY – B: Techniques for Structure Elucidation of Inorganic Compounds

Exam Time: 3Hrs **Max. Marks: 100**
Credit (L-T-P): 4-0-0 **(Theory: 70, CA: 30)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (fourteen each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT – I

Vibration and Rotation Spectroscopy: Infrared, Raman and Microwave

Harmonic and Anharmonic oscillators, vibrational energies of diatomic molecules. Potential energy function for a chemical bond. Absorption of radiations by molecular vibration. Selection rules, force constant. Rotational energies of linear molecules. Rotational energy level populations, merits and demerits of microwave spectroscopy, rotational spectra of rigid, linear molecules, non-rigid rotators. Determination of moment of inertia and bond length from rotational spectra, relative intensities of spectral lines. Rotational spectra of non-linear molecules (brief mention), vibrations in polyatomic molecules. Effects giving rise to absorption bonds. Group vibrations and limitations of group vibration concepts.

UNIT – II

Vibration and Rotation Spectroscopy: Infrared, Raman and Microwave

- Polarisations of light. Theories of Raman Effect, Merits and demerits of Raman spectroscopy. Pure rotational Raman spectra of linear molecules. Vibrational Raman spectra selection rules. Rule of mutual exclusion. Rotational Fine IR spectra, vibronic coupling.
- Sample handling. Factors affecting absorption frequencies. Interpretation and finger printing
- regions.

UNIT-III

Photo Electron Spectroscopy

Introduction, excitation and ejection of electrons, electronic energy levels in atoms and molecules, Core level photoelectron spectroscopy, symmetry and molecular orbitals, valence electron photo electron spectroscopy, valence excitation spectroscopy. Dissociation, Predissociation, change of shape on excitation.

Electron Spin Resonance Spectroscopy

Features of ESR spectra, measurement technique hyperfine coupling in isotropic system (C_5H_5, C_6H_6, $C_{14}H_{10}$, biphenyl) Anisotropic splitting, Electron – electron interaction, Transition metal complexes g-value and factors affecting g-value, zerofield splitting, Kramer's degeneracy, Rate of electron exchange, Application to p – benzoseniquinone DPPH, pyrazine. Double resonance technique ENDOR, ELDOR.

UNIT – IV

Nuclear Quadrupole Resonance Spectroscopy

Introduction, effects of magnetic field on the spectra. Relationship between the electric field gradient and molecular structure. Interpretation of eQ, data, the effect of crystal lattiee on the magnitude of eQ4, double resonance technique, Application ($PFCI_4.PCI_5$), $(NH_4)_2TeCl_6$,

Mossbauer Spectroscopy

Introduction, principles, conditions of MB spectra, parameters from MB spectra. Isomer shift electric quadrupole interaction, magnetic interaction, use of additive partial quadrupole splittings to predict quadrupole coupling.

Books Recommended:

1. E.A.V Ebsworth; W.H Renkin; Cradock, Structure Methods in InorganicChemistry.
2. R.S Drago, Physical Methods for Chemists (Ist and IInd Edition).
3. C.N Banwell, Fundamentals of MolecularSpectroscopy.
4. S. Walker and H. Straugh an Spectroscopy,Vol.I.
5. J.E. Wertz and J.R. Bolton, Electron Spin Resonance (p.49-65).
6. N.N. Greenwood and T.C Tibb, Mossbauer Spectroscopy.
7. K. Nakamoto, Infrared Spectra of Inorganic and co-ordination Compounds.

Master of Science (Chemistry) Semester-II
Session 2024-25
Course Title: Mathematics for Chemists
Course Code-MCHL-2336

Course outcomes:

Students will be able to

CO 1: Understand the trigonometric functions with the help of unit circle and application of trigonometric identities and able to solve determinants with the help of its various properties.

CO 2: Demonstrate the concept of matrices and type of matrices and how to calculate transpose, adjoint and inverse of matrices. Manage to solve problems related to addition, subtraction and multiplication.To understand the concept and solve system of linear equations.

CO 3: Solve Complex problems related to derivative of sum, difference, product and quotient of functions and also to find derivative of trigonometric functions, inverse trigonometric functions, logarithmic functions and exponential functions.

CO 4: Recognize integration as an inverse of differentiation and to calculate area under curve and understand integrals as limit of sum and its geometrical interpretation.

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2336
COURSE TITLE: MATHEMATICS FOR CHEMISTS
(For Medical Students)

Exam Time: 3 Hrs **Max. Marks: 50**

Credit (L-T-P): 2-0-0 **(Theory: 35, CA: 15)**

Instructions for the Paper Setters:
Eight questions of equal marks (seven each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from Units I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

Unit-I

Trigonometry and Determinants:
Definition of sin, cos, tan, cot, sec, cosec functions with the help of unit circle, values of sin x, cos x for x = 0, π/6, π /3, π /2. Trigonometric identities (without proofs) and their applications. Definition and expansion properties of determinants, product of two determinants of 3rd order.

Unit-II

Matrices:
Introduction to various forms of Matrices, row, column, diagonal unit, Submatrix, square, equal matrices, null, symmetric and skew symmetric matrices, transpose of a matrix, adjoint and inverse of matrices. Addition, multiplication, characteristic equation of a matrix, statement of Cayley Hamilton theorem. Rank of matrix, condition of consistency of a system of linear equations. Eigen vectors and Eigen values of matrices.

Unit-III

Differential Calculus
Differentiation of standard functions, theorems relating to the sum, difference, product and quotient of functions (without proofs), derivative of trigonometric functions, inverse trigonometric functions, logarithmic functions and exponential functions, differentiation of implict functions, logarithmic differentiation

Unit-IV

Integral Calculus
Integration as an inverse of differentiation, area under a curve, indefinite integrals of standard forms, method of substitution, method of partial fractions, integration by parts, definite integrals,definite integrals as limit of a sumand geometrical interpretation.

Reference Books:
1. Mathematics Textbook for class XI, NCERT
2 Mathematics Textbook for class XII, NCERT
3. J. B. Dence, Mathematical Techniques in Chemistry, John Wiley & Sons, First edition, 1975.

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2056
COURSE TITLE: BIOLOGY FOR CHEMISTS
(For Non-Medical Students)

Course outcomes:

Students will be able to

CO1: Gain knowledge about the biomolecules and cell structure.

CO2: Understand different types of tissues.

CO3: Understand Mendelian laws, structure of DNA and gene expression.

CO4: Understand Whittaker's system of classification and structure of virus.

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHL-2056
COURSE TITLE: BIOLOGY FOR CHEMISTS
(For Non-Medical Students)

Exam Time: 3 Hrs **Max. Marks: 50**

Credit (L-T-P): 2-0-0 **(Theory: 35, CA: 15)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setter

Eight questions of equal marks (seven each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from unit I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

The Organization of Life

Biologically important molecules: Carbohydrates, lipids, proteins and nucleic acids.
The life of cells – The cell theory, general characteristics of cells, difference between prokaryotic and eukaryotic cells, difference between plant and animal cells, cell organelles.

UNIT-II

Tissues, organs and organ systems: Animal tissues; epithelial tissues, connective tissues, muscle tissue, nervous tissue and neoplasias; plant tissue: meristematic tissue, permanent tissues.

UNIT-III

Genetics

The basic principle of heredity: Mendals law, monohybrid cross, dihybrid cross.
DNA – Double helix structure and replication.
Genes expression: Transcription and translation, genetic code.

UNIT-IV

The Diversity of Life

The classification of Living things – Criteria of classification, Whittaker's systems of classification, and their characteristics with are example of each.
Viruses, structure of Viruses.

Book Recommended:

1. Cord Biology - South Western Educational Publications, Texas, 200

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHP-2087
COURSE TITLE: ORGANIC CHEMISTRY (PRACTICAL)

Course outcomes:

The students will be able to

CO1: understand and perform multi step organic synthesis.

CO2: CO2: characterize organic molecules by physical and spectroscopic methods like M.P, B.P, and IR

CO3: design multistep synthesis

CO4: expertise the various techniques of analysis of organic substances

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHP-2087
COURSE TITLE: ORGANIC CHEMISTRY (PRACTICAL)

Exam Time: 6 Hrs **Max. Marks: 100**
Credit (L-T-P): 0-0-3 **(P: 70, CA: 30)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners.Two copies of the same should be submitted for the record to COE Office,Kanya Maha Vidyalaya, Jalandhar

Multistep Organic Synthesis

1. Synthesis of 2-chloro-4-bromoaniline from aniline (Bromination and chlorination) Book 1, page292.
2. Synthesis of methyl orange from aniline.
   (Aromatic electrophilic substitution and diazocoupling).Book 2, page 250.
3. Synthesis of benzpinacol and its pinacolrearrangement.
4. Synthesis of o-chlorobenzoic acid from phthalimide. Synthesis of acridone from o-chlorobenzoic acid. (Hofmann bromamide and Sandmeyer'sreaction).
5. Synthesis of 2,4-dinitrophenyl hydrazine from chloro benzene. (Electrophilic and nucleophilic substitution reactions on aromatic ring).
6. Synthesis of triphenylcarbinol from bromobenzene. (Grignard reaction) Book 2, page220.

B: Quantitative Analysis of Organic Compounds:

1. Estimation of phenol/aniline using bromate-bromide solution.
   (The application to find the purity of the sample and to determine the amount in given solution).
2. Determine the number of hydroxyl and amino groups in the given sample by the acetylation method.
3. Determine the mol. wt. of the given ketone by using 2,4-DNP method.
4. Estimation of reducing sugar by Fehling solutionmethod.
5. To determine the saponification value of the given fat or oilsample.
6. To determine the iodine number of the given fat or oilsample.

Books Recommended:

1. An Introduction to Modern Experimental Organic Chemistry, R. M. Roberts, J. C. Gilbert, L.B.Rodewald and A. S. Wingrove Holt, Ranehart and Winston Inc. NewYork.
2. Introduction to Organic Laboratory Techniques – A Contemporary Approach. D. L.Pavia, G. M. Lampmana and G. S. Kriz, W. B. Saunders Company, 1976.
3. Laboratory Experiments in Organic Chemistry, R. Adams, J. R. Johnson and C. F. Wilcox. The Macmillan Limited,London.
4. Text Book of Practical Organic Chemistry, A. I.Vogel.

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHP-2088
COURSE TITLE: Physical Chemistry (Practical)

Course outcomes:

Students will be able to

CO1: know about the safety requirements and lab skills required to perform physico-chemical experiments

CO2: know the principle and mechanism of Conductometric and pH metric titrations experiments

CO3: study distribution of benzoic acid in organic and aqueous solvent

CO4: determine specific and molar refraction using Abbe's refractometer.

Master of Science (Chemistry)
(Semester-II)
Session: 2024-25
COURSE CODE: MCHP-2088
COURSE TITLE: Physical Chemistry (Practical)

Time: 6Hrs **Max. Marks: 100**
Credit (L-T-P): 0-0-3 **(P: 70, CA: 30)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office,Kanya Maha Vidyalaya,Jalandhar.

1) To determine the strength of given acid by Ph metrically.
2) To determine dissociation constant of given acid pH metrically
3) Titration of weak acid conductometrically
4) Titration of strong acidconductometrically
5) To determine dissociation constant of given acid conductometrically
6) Determine the dissociation constant of acetic acid in DMSO, DMF, dioxane by titrating it with KOH.
7) Determine the activity coefficient of an electrolyte at different molalities by e.m.f. measurements.
8) Compare the cleansing powers of samples of two detergents from surface tension measurements.
9) Determine the specific refraction, molar refraction and atomic parachor with the helpofAbbe'srefractometer.
10) To study the distribution of benzoic acid between benzene and water.
11) Determine the equilibrium constant of reaction KI $+I_2$ à KI_3 by distribution law and hence find the value of go of the abovereaction.
12) Compare the relative strength of CH_3COOH and $ClCH_2COOH$ from conductance measurements.
13) Determine the solubility (g/litre) of sparingly soluble lead sulphate fromconductance measurements.
14) Titrate a given mixture of HCl and CH_3COOH against NaOH solution conductometrically.
15) Compare the relative strengthof:

i) HCl and ii) H_2SO_4 by following the kinetics of inversion of cane sugarPolarimetrically.

Books Recommended:

1.Yadav, J. B (2005): *Advanced Practical Physical Chemistry*, 22nd edition, Goel publishing House, Krishna Prakashan Media Ltd.

2. Venkatesan, V,Veeraswamy, R and Kulandaivelu, A.R (1997): *Basic Principles of Practical Chemistry*", 2nd edition, Sultan Chand and Sons Publication, New Delhi.

FACULTY OF SCIENCES

SYLLABUS

of

Master of Science (Chemistry)

(Semester: III)

(Under Credit Based Continuous Evaluation Grading System)

Session: 2024-25

The Heritage Institution

KANYA MAHA VIDYALAYA JALANDHAR

(Autonomous)

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)

SCHEME AND CURRICULUM OF EXAMINATION OF TWO YEAR DEGREE PROGRAMME

Master of Science (Chemistry)

Credit Based Continuous Evaluation Grading System (CBCEGS)

(Session: 2024-25)

Semester III

Master of Science (Chemistry) Semester III										
Course Code	**Course Title**	**Course Type**	**Hours Per Week** **L-T-P**	**Credits** **L-T-P**	**Total Credits**	**Marks**				**Examination time** **(in Hours)**
						Total	**Th**	**P**	**CA**	
MCHL-3081	Inorganic Chemistry-II	C	4-0-0	4-0-0	4	100	80	-	20	3
MCHL-3082	Organic Synthesis	C	4-0-0	4-0-0	4	100	80	-	20	3
MCHL-3083	Surface and Polymer Chemistry	C	4-0-0	4-0-0	4	100	80	-	20	3
MCHL-3084	Photochemistry and Pericyclic reactions	C	4-0-0	4-0-0	4	100	80	-	20	3
MCHP-3085	Inorganic Chemistry Practical (Preparations)	C	0-0-6	0-0-3	3	75	-	60	15	3*2
MCHP-3086	Physical Chemistry Practical	C	0-0-6	0-0-3	3	75	-	60	15	3*2
Student can opt any one of the following Interdisciplinary compulsory courses. The ID course opted in Sem-I cannot be opted in Sem-III		IDE			4					
Total					**26**	**550**				

IDEC-3101*	Communication Skills		4-0-0			100	80	-	20	3
IDEM-3362*	Basics of Music (Vocal)		2-1-1			100	40	40	20	
IDEH-3313*	Human Rights and Constitutional Duties		4-0-0			100	80	-	20	
IDEI-3124*	Basics of Computer Applications		2-0-4			100	50	30	20	3+3
IDEW-3275*	Indian Heritage: Contribution to the world		4-0-0			100	80	-	20	3
(*Credits of these ID courses will not be added to SGPA)										

C- Compulsory Course

IDE- Inter Disciplinary Elective Course

IDC-Inter Disciplinary Compulsory Course

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHL-3081
COURSE TITLE: Inorganic Chemistry-II

Course outcomes:

Students will be able to

CO1: study about the different oxygen carriers present in the body with their structure and stereochemistry

CO2: study the bioenergetics of various biological processes in living/non living organisms and role of bio-enzymes and their functioning.

CO3: learn biochemistry of iron and detailed mechanism of nitrogen fixation reactions

CO4: learn about the different enzymes participating in the chemical reactions inside the body and their functions and role of metal ions in medicines

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHL-3081
COURSE TITLE: Inorganic Chemistry-II

Time: 3Hrs **Max. Marks: 100**

Credit (LTP): 4-0-0 **(Theory: 80, CA: 20)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (16 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Metal Ions in Biological Systems-Essential and trace elements, periodic survey of essential and trace elements, biological importance and relative abundance, Na^+/ K^+ ion pump.
Transport and Storage of Dioxygen- Oxygen carriers-Hb and Mb: Structure and mechanism of their function, co-operativity, inhibition and poisoning by ligands and metal ions, hemocyanins and hemerythrin, model complexes of iron, cobalt and copper.
.

UNIT-II

Bioenergetics and ATP Cycle- Process concept to phosphate hydrolysis, Nucleotide transfer-DNA polymerase, phosphate transfer pyruvate kinase, phosphoglucomutase, created kinase, ATPase **Photosynthesis and respiration** – chlorophyll : structure, function and its synthetic model.
Bioredox Agents and Mechanism- Enzymes and their functioning, Vitamin B_{12} coenzyme, its function and application in organic syntheses, intake of alcohol and its remedy.

UNIT-III

Biochemistry of Iron- Availability of iron, competition for iron, iron toxicity and nutrition.

Electron Transfer in Biology- Cytochromes-structure and function, CN^- and CO poisoning, Ferredoxin and rubredoxim. **Nitrogenase**- Biological N_2 fixation, molybdenum nitrogenase, spectroscopic and other evidence, other nitrogenases modelsystems.
Metal Storage, Transport- Ferritin, transferrin and siderophores.

UNIT-IV

Metalloenzymes- Zinc enzymes-carboxypeptidase and carbonic anhydrase, Copper enzymes-superoxide dismutase.
Calcium in Biology- Calcium in living cell, transport and regulation, molecular aspects of intramolecular processes,
Metals in Medicine- Metal deficiency and disease, toxic effects of antibiotics and related compounds, chelate therapy

Books Recommended:

1. Principles of Bioinorganic Chemistry, S. J. Lippard and Berg, University ScienceBooks.
2. Inorganic Biochemistry, Vol I and II. Ed. G. L. Eichhorn,Elsevier.
3. J.E. Huheey: Inorganic Chemistry III and IV Ed. Pearson Education Asia –(2002).
4. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, 5^{th}Edition.
5. Progress in Inorganic Chemistry, Vols 18 and 38 Ed. J. J. Lippard,Wiley
6. Bioinorganic Chemistry by D.Banergia

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHL-3082
COURSE TITLE: Organic Synthesis

Course outcomes:

Students will be able to

CO1: understand general mechanistic consideration of organic rearrangements and to understand synthesis and reactions of macroring compounds and fused polynuclear hydrocarbons

CO2: study the synthesis and reactions of three, four, six, seven and large membered Heterocycles

CO3: know about the use of various reagents in organic synthesis and functional group transformations

CO4: understand the basic concepts of supramolecular chemistry

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHL-3082
COURSE TITLE: Organic Synthesis

Time: 3 Hrs **Max. Marks: 100**

Credit (LTP): LTP: 4-0-0 **(Theory: 80, CA: 20)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (16 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Rearrangements: General mechanistic considerations – nature of migration, migratory aptitude, memory effects. A detailed study of the following rearrangements: Pinacol-pinacolone, Wagner-Merwein, Demjanov, Benzil-Benzilic acid, Favorskii, Arndt-Eistert synthesis, Neber, Beckmann, Hofmann, Curtius, Schmidt, Baeyer-Villiger, Shapiroreaction.

Polynuclear Compounds and Macro-Ring Compounds
Introduction, comparative study of aromatic character of Linear and non-Linear-ortho-fused polynuclear hydrocarbons, ortho-and peri-fused polynuclear hydrocarbons.General method of preparation and reactions of indene, fluorene anthracene and phenanthrene.

UNIT-II

Heterocyclic Synthesis
Principles of heterocyclic synthesis involving cyclization reactions and cycloaddition reaction.

Small Ring Heterocycles
Synthesis of aziridines, oxiranes, thiiranes and their ring opening and rearrangement reactions.

Five-Membered Heterocycles with one Heteroatom
Synthesis of Furan, Pyrrole, Thiophene and their electrophilic, nucleophilic, metallation reactions.

Six-Membered Heterocycles with one Heteroatom
Pyridine synthesis (from dicarbonyl compounds, *Hantzsch Synthesis,* through *cycloaddition reactions),* reactions of pyridine (electrophilic, nucleophilic, metallation), synthesis of pyrylium salts, pyrones, benzopyrylium salts, benzopyrones (coumarins, chromones) and their electrophilic, nucleophilic and addition reactions.

Seven-and Large-Membered Heterocycles
Synthesis and reactions of azepines, oxepines, thiepines, thiazepines.

UNIT-III

Reagents in Organic Synthesis

Use of the following reagents in organic synthesis and functional group transformations; Complex metal hydrides, Gilman's reagent, lithium dimethylcuprate, lithium disopropylamide (LDA) dicyclohexylcarbodimide. 1,3-Dithiane (reactivity umpolung), trimethylsilyl iodide, tri-n-butyltinhybride, Woodward and prevost hydroxylation, osmium tetroxide, DDQ, selenium dioxide, phase transfer catalysts, crown ethers and Merrifield resin, Peterson's synthesis, Wilkinson's catalyst, Bakeryeast.

UNIT-IV

Supramolecular Chemistry

Definition and development of supramolecularchemistry, Classification of supramolecular Host-Guest compounds, Historical concepts such as receptors, coordination, lock and key analogy, Chelate and Macrocyclic effects, Preorganization and Complementarity, Thermodynamics and Kinetic selectivity, Overview of intermolecular forces such as Hydrogen bonding, Hydrophobic effects, Cation-π interactions, Ion-ion, Ion-dipole, Dipole-dipole interactions, π-π stacking, van der Waals forces, Synthesis and structure of supramolecular hosts for Recognition of cations: Crown ethers, Cryptands, Spherands, Siderophores;for Recognition of anions:Guanidinium- based receptors; for Recognition of neutral molecules: Cyclotriveratrylene (CTV).

Book Recommended:

1. Supramolecular Chemistry, Jonathan W. Steed, Jerry L. Atwood, John Wiley and Sons
2. Principles of Modern Hetrocyclic Chemistry by L.A. Paquette
3. Hetrocyclic Chemistry by J.A. Joule and K. Mills
4. Heterocyclic Chemistry by Gilrchirst

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHL-3083
COURSE TITLE: Surface and Polymer Chemistry

Course outcomes:

Students will be able to

CO1: study concept of adsorption and activity of catalysis at surfaces, solve numerical on BET equation

CO2: understand the concept of micelle formation, learn about CMC and thermodynamics of micellization

CO3: learn about the type and classification of polymers

CO4: know about the structure, properties and utilization of polymers, study in detail about the glass transition temperature

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHL-3083
COURSE TITLE: Surface and Polymer Chemistry

Time: 3 Hrs **Max. Marks: 100**

Credit (LTP): 4-0-0 **(Theory: 80, CA: 20)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (16 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Adsorption

Surface tension, capillary action, pressure difference across curved surface (Laplace equations), vapour pressure of droplets (Kelvin equation), Gibbs adsorption isotherm, estimation of surface area (BET equation), surface films on liquids (Electro-kinetic phenomena), and catalytic activity at surfaces.

UNIT-II

Micelles

Surface active agents, classification of surface active agents, micellization, hydrophobic interactions, critical micellar concentration (CMC), factors affecting CMC of surfactants, counter ion binding to micelles, thermodynamics of micellization – phase separation and mass action models, solubilization, micro emulsion, reverse micelles.

UNIT-III

Macromolecules

Polymer – definition, types of polymers, electrically conducting, fire resistant, liquids crystal polymers, kinetics of polymerization, thermodynamics ofpolymerization.
Molecular mass, number and mass average molecular mass, molecular mass determination (osmometry, viscometry, diffusion and light scattering methods), sedimentation, chain configuration of macromolecules, calculations of average dimensions of various chain structures. Importance of polymers, Basic concepts: monomers, repeat units, degree of polymerization. Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and copolymerization. Polymerization conditions and polymer reactions.Polymerization in homogenous and heterogeneous systems. Number, weight and viscosity average weights.

UNIT IV

Structure and Properties:

Polymer structure and properties-crystalline melting point T_m-melting point of homogenous series, effect of chain flexibility and steric factors, entropy and heat of fusion. The glass transition temperature, T_g-Relationship between $T_m$and T_g, effects of molecular weight, diluents, chemical structure, chain topology, branching and chain linking. Property requirements and polymerutilization.

Books Recommended:

1. Physical Chemistry, P. W.Atkins.
2. Textbook of polymer science, F. W. Billmeyer Jr.Wiley.
3. Polymer science, V. R. Gowariker, N. V. Viswanathan and J. Sreedhar,Wiley-Eastern
4. Polymer Chemistry, Melcolm P. Stevens, Oxford University Press
5. Physical Chemistry of Polymers , A.Tager, Mir Publishers, Moscow

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHL-3084
COURSE TITLE: Photochemistry and Pericyclic reactions

Course outcomes:

Students will be able to

CO1: classify the pericyclic reactions and explain them under thermal and photochemical conditions.

CO2: interpret the product of Pericyclic reactions (Cyclo addition, Electocyclic and sigmatropic Reactions)

CO3: know the basic concepts of photochemical reactions and determine their reaction mechanisms

CO4: apply the knowledge of photochemical reactions of Alkenes, carbonyl compounds, aromatic compounds and to study named photochemical reactions, photochemistry of smog, polymers and vision

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHL-3084
COURSE TITLE: Photochemistry and Pericyclic reactions

Time: 3 Hrs **Max. Marks: 100**

Credit (LTP): 4-0-0 **(Theory: 80, CA: 20)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (16 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-1

Pericyclic Reactions (A)
Molecular orbital symmetry, Frontier orbitals of ethylene, 1,3-butadiene, 1,3,5-hexatriene, allyl system, classification of pericyclic reactions FMO approach. Woodward-Hoffmann correlation diagrams method and Perturbation of molecular orbital (PMC) approach for he explanation of pericyclic reactions under thermal and photo-chemical conditions. Electrocyclic reactions – controtatory and disrotatory motions, 4n, 4n+2, allylsystems secondary effects. Cycloadditions – antrafacial and suprafacial additions, notation of cylcoadditions (4n) and (4n+2) systems with a greater emphasis on (2+2) and (4+2)

UNIT-II

Pericyclic Reactions (B)
cycloaddition-stereochemical effects and effects of substituents on the rates of cycloadditions, 1,3-dipolar cyclo-additions and cheleotropicreactions.Sigmatropic Rearrangements-suprafacial and antrafacial shifts [1,2]- sigmatropic shifts involving carbon moieties retention and invertion of configuration, (3,3) and (5,5)sigma-tropic rearrangements, detailed treatment of Claisen and Cope rearrangements, fluxional tautomerism, aza-cope rearrangements, introductions to Ene reactions, simple problems on pericyclic reactions. Elecrocyclic rearrangement of cyclobutenes and 1,3cyclohexadienes.

UNIT-III

Photochemistry
Interaction of electromagnetic radiation with matter, types of excitations, fate of excited molecule, quantum yield, transfer of excitation energy, actinometry.

Determination of Reaction Mechanism
Classification, rate constants and life times of reactive energy states –determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions.Types of photochemical reactions – photodissociation, gas-phasephotolysis.

UNIT-IV

Photochemistry of Alkenes

Intramolecular reactions of the olefinic bond – geometrical isomerism, cyclisation reactions, rearrangement of 1,4- and 1, -dinenes.

Photochemistry of Carbonyl Compounds

Intramolecular reactions of carbonyl compounds – saturated, cyclic and acyclic, β, γ- unsaturated and α,β-unsaturated compounds, Cyclohexadienones. Intermolecular cycloaddition reactions – dimerisations and oxetane formation.

Photochemistry of Aromatic Compounds

Isomerisations, additions and substitutions.

Miscellaneous Photochemical Reactions

Photo-Fries reactions of anilides.Photo-Fries rearrangement.Barton reaction.Singlet molecular oxygen reactions.Photochemical formation of smog.Photodegradation of polymers.Photochemistry of vision.

Books Recommended:

1. Organic Photochemistry – Chapman andDepuy.
2. Organic Photochemistry – W.H.Horsepool.
3. Photochemistry of Excited States –J.D.Goyle.
4. Pericyclic Reactions: A Mechanistic study by S.M. Mukherji
5. The conservation of orbital Symmetry by R. B. Woodward and R. Hoffman
6. Fundamentals of Photochemistry by K.K.Rohtagi Mukherji

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHP-3085
COURSE TITLE: Inorganic Chemistry Practical (Preparations)

Course outcomes:

Students will be able to

CO1:plan and conduct experiments for synthesizing and analysing the inorganic compounds

CO2:do measurements of magnetic moments of synthesized complexes.

CO3:estimate metal ions in the synthesized complex through various analytical techniques

CO4:interpret and characterise the metal complexes through various spectrpscopic and analytical techniques

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHP-3085
COURSE TITLE: Inorganic Chemistry Practical (Preparations)

Time: 6 Hrs **Max. Marks: 75**
Credit (LTP): 0-0-3 **(P: 60, CA: 15)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

1. Preparation of $Co(acac)_3$, its characterization using NMR, IR, UV-Vis and analysis of Cobalt. (ref. J. Chem. Edu., 1980, 57, 7,525)
2. Preparation of $Co(acac\text{-}NO_2)_3$, its characterization using NMR, IR, UV-Vis andanalysis of Cobalt. (ref. J. Chem. Edu., 1980, 57, 7,525)
3. Preparation of $[Fe(H_2O)_6][Fe(N\text{-salicyldeneglycinato})_2]_2.3H_2O$, its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Iron.(ref. InorganicaChimicaActa, 1977, 23,35).
4. Preparation of $[Ni(NH_3)_6]Cl_2$ its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Nickel and NH_3. (ref. Marr and Rockett,1972).
5. Preparation of $[Ni(ethylenediamine)_3]Cl_2$ its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Nickel. (ref. Marr and Rockett, 1972, page270).
6. Preparation of $[Fe(NO)(S_2CN(Et)_2)_2]$ its characterization using IR, UV-Vis, magnetic susceptibility and analysis of Fe(II). (ref. Marr and Rockett, 1972, page 262, J. Chem. Soc. 1962, 84,3404).
7. Preparation of octahedral and tetrahedral complexes of dichlorodipyridylcobalt(II), differentiate them using IR, UV and magnetic properties. Estimate Co(II) from one of them. (ref. Marr and Rockett, 1972, page 375, Inorganic Chemistry, 1966, 5,615).
8. Preparation of $VO(acac)_2$ and its piperidine complex, characterize using IR, UV and magnetic moment. Estimate for V(IV). (ref. Marr and Rockett, 1972,243).
9. Preparation of diaquotetraacetataocopper(II), magnetic susceptibility IR and UV-Vis, analysis ofCopper(II).
10. Preparation of cis- and trans- potassium dioxalatodiaquochromate(III). Interpretation of IR, UV and magnetic properties. Estimation of Chromium. (ref. Marr and Rockett, 1972, page386).
11. Preparation of $HgCo(NCS)_4$, its IR and measure its magnetic moment. (ref. Marr andRockett, 1972, page365).

12. Preparation of sodium tetrathionate, interpretation of its IR and analysis using potassium iodate. (ref. Marr and Rockett, 1972, page214).
13. Preparation of Potassium dithionate, interpretation of its IR and analysis using potassium iodate. (ref. Marr and Rockett, 1972, page214).
14. Preparation of bis(acetylacetonato)copper(II), UV-Vis, and IR, magnetic studies, Demonstration of Jahn Teller effect by solution spectral studies. (ref. Bull. Chem. Soc. Japan, 1965, 29,852).
15. Preparation of salicylamide complexes of Copper(II). IR, UV, magnetic data and analysis of Cu(II). (ref. Indian J. of Chem., 1977, 15A, No. 5, 459; ibid, 1971, 9,1396).
16. To prepare a macrocyclic ligand 5,7,7,12,14,14-hexamethyl-1,4,8,11-tetraazacyclo tetradeca-4,11-dienedi(hydrogeniodide) and its complex with Ni(II). Study IR, NMR and UV-Vis of ligand and complex and magnetic properties of complex. To analyze for Ni and I. (J. Chem. Edu. 1977, 79,581).
17. Preparation and resolution of tris (ethylenediamine) cobalt (III). UV-Vis, NMR, IR, optical rotation of the resolved complexes. ((ref. Marr and Rockett, 1972, page386).

Books Recommended:

1. B.N. Figgis, Introduction to Ligand Field, WileyEastern.
2. A.B.P. Lever, Inorganic Electronic Spectroscopy,Elsevier.
3. A.Earnshaw, Introduction to Magnetochemistry, AcademicPress.
4. J.E. Huheey, Inorganic Chemistry Principles of Structure and Reactivity, Harper Interscience.
5. R.S. Drago, Physical Medhod in Chemistry, W.B.SaundersCompany.
6. F.A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry, WileyInterscience.
7. F.A. Cotton, Chemical Application of Group Theory, WileyEaster

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHP-3086
COURSE TITLE: Physical Chemistry Practical

Course outcomes

Students will be able to

CO1: apply the principle and mechanism of Conductometric and potentiometric titrations

CO2: determine the partial molar volumeof compounds using Dilatometer

CO3: determine specific and molar refractivity using Abbes refractometer

CO4: study complex formation and the kinetics of hydrolysis Spectrophotometrically

Master of Science (Chemistry)
(Semester-III)
Session: 2024-25
COURSE CODE: MCHP-3086
COURSE TITLE: Physical Chemistry Practical

Time: 6 hrs. **Max. Marks: 75**
Credit (LTP): 0-0-3 **(P: 60, CA: 15)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

1. To determine the partial molar volume of
   (a) Glycine (b) Urea using dilatometer
2. To determine the partial molar volume of
   (a) methanol (b) n-propanol using dilatometer
3. To determine the surface tension (double capillary) of mixture of solid and water by deferential method and hence find out parachor of the mixture.
4. To determine the specific and molar refractivity of n-propanol, butanol, hexane and carbon tetrachloride and calculate refraction equivalents of C, H andCl.
5. To determine the molar refractivity of water, DMF, Dioxane and mixtures of water-DMF, water-Dioxane and verify the refractivity rule. Predict about the interactions between components of mixture by plotting graph between refractive index and mole fraction.
6. To determine the equivalent conductance of weak electrolyte (acetic acid) at infinite dilution using Kohlrausch law.
7. Determine equivalent conductance of strong electrolyte at several concentrations and hence verify Onsagerequation.
8. Determine equivalent conductance of weak electrolyte, say acetic acid at different concentrations and hence test validity of Ostwald's dilution law. Also determine dissociation constant of the electrolyte.
9. To determine dissociation constant of a dibasic acid potentiometrically.
10. To study complex formation between Fe (III) and salicylic acid and find out the formula of the complex spectrophotometrically.
11. To determine the formula of the complex ion formed between Fe (III) and thiocyanate ion by Job's method.
12. To study the kinetics of hydrolysis of crystal violetspectrophotometrically.
13. To determine the pH of various mixtures of sodium acetate and acetic acid in aqueous solution and hence determine the dissociation constant of theacid.
14. Titrate potentiometrically Zn(II) by $K_4Fe(CN)_6$ and verify the composition of the complex $K_2Zn_3[Fe(CN)_6]_2$
15. Determination of nitrite in water spectrophotometrically.
16. Determination of molecular weight of polymers by Viscometry.
17. Determine the molar refraction of a solid substance by dissolving it in a solvent and its refractive index.

Books Recommended:

1. Yadav, J. B (2005): *Advanced Practical Physical Chemistry*, 22nd edition, Goel publishing House, Krishna Prakashan Media Ltd.

2. Venkatesan, V., Veeraswamy, R. and Kulandaivelu, A.R (1997): *Basic Principles of Practical Chemistry*", 2nd edition, Sultan Chand and Sons Publication, New Delhi.

FACULTY OF SCIENCES

SYLLABUS

of

Master of Science (Chemistry)

(Semester: IV)

(Under Credit Based Continuous Evaluation Grading System)

Session: 2024-25

The Heritage Institution

KANYA MAHA VIDYALAYA JALANDHAR

(Autonomous)

KANYA MAHA VIDYALAYA JALANDHAR (AUTONOMOUS)

SCHEME AND CURRICULUM OF EXAMINATION OF TWO YEAR DEGREE PROGRAMME

Master of Science (Chemistry)
Credit Based Continuous Evaluation Grading System (CBCEGS)
(Session: 2024-25)
Semester IV

Master of Science (Chemistry) Semester IV										
Course Code	**Course Title**	**Course Type**	**Hours Per Week L-T-P**	**Credits L-T-P**	**Total Credits**	**Marks**				**Examination time (in Hours)**
						Total	**Th**	**P**	**CA**	
MCHL-4081	Advanced Inorganic Chemistry	C	4-0-0	4-0-0	4	100	80	-	20	3
MCHL-4082	Chemistry of Natural Products	C	4-0-0	4-0-0	4	100	80	-	20	3
MCHL-4083	Electrochemistry and Chemical Dynamics	C	4-0-0	4-0-0	4	100	80	-	20	3
MCHP-4084	Advanced Practical-Organic Synthesis	C	0-0-6	0-0-3	3	75	-	60	15	3*2
MCHP-4085	Advanced Practical-Inorganic Synthesis	C	0-0-6	0-0-3	3	75	-	60	15	3*2
MCHP-4086	Advanced Practical-Physical Chemistry	C	0-0-6	0-0-3	3	75	-	60	15	3*2
Total					**21**	**525**				

C- Compulsory Course

IDE- Inter Disciplinary Elective Course

IDC-Inter Disciplinary Compulsory Course

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHL-4081
COURSE TITLE: Advanced Inorganic Chemistry

Course outcome:

Students will be able to

CO1:understand Photo substitution reactions,photoredox reactions, photolysis of water

CO2:understand oxidative addition and reductive elimination, migration (Insertion) reaction and cyclometallation reactions,

CO3:characterise the compound by synthetic methods and know the chemical behaviour and synthetic applications of hydride compounds

CO4:understand hydroformylation, Carbonylation Reaction, decarbonylation reactions, hydrocyanation Polymerization, Oligomerisation and metathesis reactions

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHL-4081
COURSE TITLE: Advanced Inorganic Chemistry

Time: 3 Hrs **Max. Marks: 100**

Credit (LTP): 4-0-0 **(Theory: 80, CA: 20)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (16 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Photo Inorganic Chemistry:

Basics of photochemistry- Absorption, excitation, photochemical laws, quantum yield, electronically excited state, energy diddipation by radiative and non-radiative processes, absorption spectra, Franck-Condon principle, photochemical stages-primary and secondary processes, Kashia's rule, Thexi state, Photo substitution reactions, Adamson's rules, Photo substitution reactions of Cr(III)-Polypyridyls, Rh(III) Ammine Complexes, Ru-Polypyridyl complexes, Ligand photo reactions, photoredox reactions, comparison of Fe(II) and Ru(II) complexes, Photo synthesis in plants and Bacterio chlorophyll photosynthesis.

UNIT-II

Oxidative-Addition and Migration (Insertion Reactions):

Introduction: Acid base behaviour of metal atoms in complexes, Protonation and Lewis Base behaviour, acceptor properties of Lewis acidity of complexes, oxidative addition and reductive elimination, addition of specific molecules, Hydrogen addition, HX additions, Organic halides addition of some other molecules productive elimination, migration (Insertion) reaction promotion of alkyl migration, insertion of CO into M-H bonds, other aspects of CO insertion reactions, transfer of other molecules, CO_2, SO_2 , NO_2 , RCM, Insertion of alkenes and C-C unsaturated compounds, Cleavage of C-H bonds; alkane activation, Cyclometallation reactions. Reactions of free hydrocarbons.

UNIT-III

Transition Metal Compounds with Bonds to Hydrogen

Characteristics of hydride complexes, synthetic methods, chemical behaviour of hydride compounds, mononuclear polyhydrides, homolepticpolyhydride anions; carbonyl hydrides and onion. Molecular hydrogen compounds; metal hydrogen interaction with C-H bonds; MH interactions; complexes of boron hydride and aluminohydrides, synthetic applications of metal hydrides.

UNIT-IV

Transition Metal Complexes in Catalysis:

Hydroformylation of unsaturated compounds, Reductive carbonylation of alcohols and other compounds; Carbonylation Reaction: Methanol and methyl acetate, Adipic ester. Synthesis and other carbonylation reactions, decarbonylation reactions. Cluster compounds in catalysis, supported homogeneous and phase transfer catalysis, Acrylonitrile synthesis, oxygen transfer from peroxo- and oxo- species, oxygen transfer from NO_2groups.

Books Recommended:

1. Concepts of Inorganic Photochemistry, A. W. Adamson and P. D. Fleischauer,Wiley.
2. W.W. Porterfield, Inorganic Chemistry: A Unified Approach.
3. F.A. Cotton and G. Willkinson, Advanced Inorganic Chemistry, 5^{th}ed, John Wiley and Sons, NewYork.
4. C.ElschenbroichandA.Salzer,Organometalics:AConciseIntroduction,2^{nd}Ed.,VCH 1992.

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHL-4082
COURSE TITLE: Chemistry of Natural Products

Course outcome:

Students will be able to

CO1: study the biosynthetic pathways of natural products, understand the isoprene rule and its role in terpenoids

CO2: classify and understand the synthesis and structure of steroids and alkaloids

CO3: understand the chemistry of Haemin, chlorophyll, prostaglandins and antibiotics

CO4: classify and elucidate the structure of carbohydrates like starch and cellulose, determine the structure conformation and properties of proteins, nucleic acids, DNA and RNA

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHL-4082
COURSE TITLE: Chemistry of Natural Products

Time: 3 Hrs **Max. Marks: 100**

Credit (LTP): 4-0-0 **(Theory: 80, CA: 20)**

Note: The students are allowed to use Non-Programmable Calculator

Instructions for the Paper Setters:

Eight questions of equal marks (16 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-1

Studies on Biosynthetic Pathways of Natural Products
The acetate hypothesis, poly-ketoacids, their aldol type cyclisations and meta orientations of hydroxyl groups in naturally occurring phenols. b) Isoprene rule, mechanism of formation of mevalonic acid from acctyl coenzyme, Biogenetic isoprene rule. Geranyl, Geranyl pyrophosphates and its conversion into thujene. Farnesyl pyrophosphate.

UNIT-II

Terpenoids
General classification, General Methods of structure determination, Chemistry of Camphor, Abietic acid, Santonin biosynthetic studies on tri and tetra terpenoids.
Steroids
General biosynthetic studies on steroids, chemistry of Cholesterol, progesterone, oestrone, transformations in steroid molecules.
Alkaloids
Classification, chemistry of nicotine and morphine.

UNIT-III

Haemin and Chlorophyll
Structure and synthesis of Porphyrins.Chemistry of Haemin and chlorophyll.
Antibiotics
Introduction, types of antibiotics, synthesis and mechanism of action of pencillins.
Prostaglandins
General study, nomenclature, structure of PGE and synthesis of PGE1, PGE2, PGF2x

UNIT-IV

Carbohydrates
Deoxy sugars, sugars, methyl others and acid derivatives of sugars. General methods of structure and ring size determination, structure of maltose, lactose, sucrose, starch and cellulose.

Peptides and Proteins
Sequence determination insulin and oxytocin, Proteins: structure conformation and properties. Enzymes, Kinetics, inhibition mechanism.

Books Recommended

1. Primary Metabolism: A Mechanistic Approach by J.Staunton, Oxford University Press 1978.
2. Secondary Metabolism by J. Mann Oxford University Press. Oxford, 1980.
3. Natural Product Chemistry- A Mechanistic, Biosynthetic and Ecological Approach by Kurt B. G. Torssell, Swadish Pharmaceutical Society, 1997.
4. Fundamentals of BioChemistry by D. Voet, J.G. Voet and C.W.Pratt, John Wiley and Sons Inc., New York, 1999.
5. Principles of Biochemistry by A.L. Lehninger, CBS Publishers, New Delhi

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHL-4083
COURSE TITLE: Electrochemistry and Chemical Dynamics

Course outcomes:

Students will be able to

CO1: Understand the electrochemistry of solutions, method of determination of electrified interfaces, semiconductor electrolyte solution interface, know theory, monitoring and prevention of corrosion

CO2: understand collision theory of reaction rates, Arrhenius theory and activated complex theory, Lindemann-Hinshelwood theory

CO3: understand various Photochemical reactions, Homogeneous catalysis and kinetics of enzyme reactions, general features and methods of studying fast reactions

CO4: interpret polarogram and applications of Voltammetry and Polarography.

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHL-4083
COURSE TITLE: Electrochemistry and Chemical Dynamics

Time: 3 Hrs **Max. Marks: 100**

Credit (LTP): 4-0-0 **(Theory: 80, CA: 20)**

Note: The students are allowed to use Non-Programmable Calculator.

Instructions for the Paper Setters:

Eight questions of equal marks (16 each) are to be set, two in each of the four Sections (A-D). Questions of Sections A-D should be set from UNITs I-IV of the syllabus respectively. Questions may be subdivided into parts (not exceeding four). Candidates are required to attempt five questions, selecting at least one question from each section. The fifth question may be attempted from any Section.

UNIT-I

Electrochemistry Electrochemistry of solutions, Debye-Huckel-Onsager treatment and its extension, ion-solvent interactions, Debye-Huckel-Bjerrum mode, Thermodynamics of electrified interface equation, Derivation of electro-capillarity, Lipmann equation(surface ecess), method of determination, structure of electrified interfaces, Guoy-Chpmann, Stern models, over potential, exchange current density, derivation of Butler-Volmer equation, Tafel plot.

Semiconductor interface theory of double layer at semiconductor electrolyte solution interface, structure of double layer interfaces, effect of light at semiconductor solution interface.

Introduction to corrosion, homogeneous theory, forms of corrosion, corrosion monitoring and prevention

UNIT-II

Chemical Dynamics (A)

Methods of determining rate laws, collision theory of reaction rates, steric factor, activated complex theory, Arrhenius theory and activated complex theory, ionic reactions, kinetic salt effects,, treatment of unimolecular reactions, Lindemann-

Hinshelwood theory. Dynamic Chain (hydrogen bromine reaction, pyrolysis of acetaldehyde, decomposition of ethane)

UNIT-III

Chemical Dynamics (B)

Photochemical reactions between hydrogen-bromine and hydrogen-chlorine, oscillatory reactions (Belousov-Zhabotinsky reactions), Homogeneous catalysis and kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis.

UNIT-IV

Voltammetry and Polarography

Polarography, polarographic cells, polarogram, interpretation of polarographic waves, equation for the polarographic waves, effect of complex formation on polarographic wave, polarograms for irreversible reactions, dropping mercury electrode, current variations during life time of a drop, merits and demerits of dme, polarographic diffusion currents, Ilkovic equation, capillary characteristics, temperature, polarograms for mixture of reactants, anodic and cathodic waves, factors affecting polarographic currents, applications of polarography, treatment of data, organic and inorganic polarographic analysis, voltammetry at solid electrodes, cyclic voltammetry and interpretation of data, pilot-ion and standard addition method for quantitative analysis

Books Recommended:

1. Chemical Kinetics, K. J. Laddler,McGraw-Hill
2. Modern Electrochemistry Vol.1,2,3, J. Bochris and A.K.N.Reddy
3. Fundamentals of electrochemistry; P.Monk
4. Principles of Instrumental Analysis; Skoog, West; SaundresPublications

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHP-4084
COURSE TITLE: Advanced Practical- Organic Synthesis

Course outcome:

Students will be able to

CO1: plan and implement advance organic synthesis and reactions

CO2: characterize organic molecules by physical and spectroscopic means, including M.P, B.P, and IR

CO3: predict the outcome and mechanism of some simple organic reactions, using a basic understanding of the relative reactivity of functional groups

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHP-4084
COURSE TITLE: Advanced Practical- Organic Synthesis

Time: 6 hrs. **Max. Marks: 75**
Credit (LTP): 0-0-3 **(P: 60, CA: 15)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners.Two copies of the same should be submitted for the record to COE Office,Kanya Maha Vidyalaya,Jalandhar.

1. Synthesis and Reactivity ofbenzalacetophenone
   a. Bromination (Electrophilic additions) andsubsequentdebromination (Elimination)
   b. Epoxidation (Cycloaddition, nucleophilic) and ring opening with hydroxideion.
   c. Michael addition ofaniline.
   d. Conversion of benzalacetophenone to its oxime (nucleophilic addition atC=O)
   e. Conversion of oxime to amide (Beckmann rearrangement) and oxazole (Understand the reactivities at conjugated C=O and C=C) bond.
2. Synthesis of Cyclohexene from cyclohexanol and its conversion to 1, 2- *cis* and 1, 2- *trans* –cyclohexanediols.
   a. Epoxidation with peracid (Cycloaddition) and *anti*- ring opening with sodium hydroxide to *cis*- cyclohexane -1, 2-diol.
   b. Dihydroxylation with$KMnO_4$ (Mechanism of *syn*- and *anti*-cyclohexane-1,2-diol)
3. Preparation and characterization of the Aldol-dehydration products from various combinations of aromatic aldehydes andketone.
   Effect of substituents on aromatic aldehydes on the product distribution.
   a. Aldehyde:benzaldehyde, 4-methylbenzaldehyde.4-methoxybenzaldehyde.
   b. Ketone: acetone, cyclopentanons, cyclohexanone (Book4) 6.

Books Recommended:

1. An Introduction to Modern Experimental Organic Chemistry, R.M. Roberts, J.C. Gilbert, L.B. Rodewald and A.S Wingrove, Holt Rinehart and Winston Inc, New York.1969.
2. Vogel's Text Book of Practical OrganicChemistry.
3. Laboratory Experiments on Organic Chemistry, R. Edemas, J.R. Johnson andC.F. Wilcox, The Macmillan Limited, London, 1970.
4. Modern Projects and Experiments in Organic Chemistry,J.R.Mohrig,C.N. Hammonad, P.F. Schatz and T.C. Morrill, W.H. Freeman and Company, New York 2003.

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHP-4085
COURSE TITLE: Advanced Practical- Inorganic Synthesis

Course outcome:

Students will be able to

CO1: apply key concepts of inorganic chemistry and coordination compounds including those related to synthesis, reaction chemistry, and structure and bonding

CO2:design the basic and advanced laboratory procedures used in inorganic synthesis

CO3:interpret and characterise the metal complexes through various spectrpscopic and analytical techniques

CO4: learn separation of metal cations by chromatographic techniques

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHP-4085
COURSE TITLE: Advanced Practical- Inorganic Synthesis

Time: 6 Hrs **Max. Marks: 75**
Credit (LTP): 0-0-3 **(P: 60, CA: 15)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya,Jalandhar.

1. Synthesis of the Linkage Isomers nitrito- and nitropentaamminecobalt(III)chloride
   a) Preparation of chloropentaamminecobalt(III) chloride, $[Co(NH_3)_5Cl]Cl_2$.
   b) Preparation of nitropentaamminecobalt(III) chloride, $[Co(NH_3)_5(NO_2)]Cl_2$.
   c) Preparation of nitritopentaamminecobalt(III) chloride, $[Co(NH_3)_5(ONO)]Cl_2$.
   d) Estimate the chloride in all the complexes using gravimetricanalysis.
   e) Record and interpret the electronic absorption spectra and IR spectra of allcobalt(III) complexes and assign the observed change to distinguish the twoisomers.
2. Synthesis of a coordination compound containing iron and analysis of thiscompound using redoxmethods
   a) Preparation of iron(II)oxalate
   b) Preparation of$K_3[Fe(C_2O_4)_3].3H_2O$
   c) Characterization of Iron(II) and iron(III) complex with IRspectroscopy
   d) Determination of iron and oxalate in $K_3[Fe(C_2O_4)_3].3H_2O$ using volumetricanalysis
3. Synthesis and characterization of the Ni(II) complex of a Schiff-base ligand derivedfrom Salicylaldehyde and ethylenediamine.
   a) Synthesis the Schiff-baseligand.
   b) Interpret the 1H NMR and IR spectra of theligand.
   c) Synthesis the Ni(II) complex of the ligand and compare its IR spectrum with thatoftheligand.
4. Separation of the metal cationsby
   a) Column chromatography with gradient elution Co(II) and Ni(II). Analyze qualitatively the coloured fractions collected for separatedcations.
   b) Paper chromatography [Fe(II), Co(II), Ni(II) and Cu(II). Determine the Rf values for the separate standard cations and use these to identify the cations present in the unknownmixture.

Books Recommended:

1. G. Marr, B. W. Rockett, Practical Inorganic Chemistry(1972).

2. *I. Grenthe, E. Nordin,* Inorganic Chemistry*, 18 (1979)1869–74.*

3. *J.C. Bailar, M. Eldon, Inorg. Synth. 1 (1939)35–38.*

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHP-4086
COURSE TITLE: Advanced Practical- Physical Chemistry

Course outcome:

Students will be able to

CO1:experience the scientific methods employed in basic and applied physical chemistry

CO2: design and perform experiments to determine the rate and order of chemical reactions by varying concentrations and/or temperature

CO3: measure equilibrium concentrations and equilibrium constants for acid-base, solubility, and complexation reactions given initial concentrations of reactant

CO4: develop skills in procedures and instrumental methods like turbidimetry and spectrophotometry.

Master of Science (Chemistry)
(Semester-IV)
Session: 2024-25
COURSE CODE: MCHP-4086
COURSE TITLE: Advanced Practical- Physical Chemistry

Time: 6 Hrs **Max. Marks: 75**
Credit (LTP): 0-0-3 **(P: 60, CA: 15)**

Instruction for practical examiner: Question paper is to be set on the spot jointly by the Internal and External Examiners. Two copies of the same should be submitted for the record to COE Office, Kanya Maha Vidyalaya, Jalandhar.

CHEMICAL EQUILIBRIUM

1. Study the effect of solvent on the conductance of $AgNO_3$/Acetic acid and determine the degree of dissociation and equilibrium constant in different solvents and their mixtures (DMSO, DMF, dioxane, acetone, and water) and test the validity of DEBYE- HUCKEL-ONSAGER'Sequation.
2. To determine acid and base dissociation constant of amino acid pHmetrically.
3. To calculate thermodynamic parameters ,for the reaction
   $Zn + Hg_2SO_4 \longrightarrow 2Hg + Zn\ SO_4$ by emf measurement.

CHEMICAL KINETICS

4. Study the salt effects and the solvent effect on the rate law of alkaline hydrolysis of crystal violet.
5. Determine the degree of hydrolysis and hydrolysis constant of CH_3COONa/NaCl/aniline hydrochloride.
6. Determine the order of reaction by analyzing the kinetic dependence ofindividual reactant (e.g. saponification of ester).
7. Determine the energy of activation for the reaction studied above.

ACTIVITY AND ACTIVITY COEFFICIENTS

8. Determination of mean activity coefficient of given electrolyte by cryoscopy.
9. Determine activity coefficients by EMF method.

PHASE EQUILIBRIUM

10. Draw the phase diagram for any one of the following three componentpartially immiscible liquidsystems.
    i) DMSO/water/benzene ii) water/benzene/acetic acid

SPECTROPHOTOMETRIC METHODS

11. To study the effect of extended conjugation on the wave length of maximum absorption of organic compounds.

TURBIDITYMETRY

12. To determine concentration of sulphate ions with the help of turbidity meter.
13. Determine the CMC by turbidimetric method.
14. Preparation of soap and determination of its CMC.

LEAST SQUARE FITTING

15. To draw calibration curve for the concentration determination of potassium ions by flame photometry and to study the least square fitting of the data.

POLARIMETRY

1. To find the specific rotation and molecular rotation of glucose polarimetrically and also find the concentration of unknown solution. Calculate the intrinsic rotation for glucose.
2. To find out the percentage of two optically active substances such as d-sugar and d-tartaric acid in a given solution polarimetrically.
3. To determine the specific rotation of camphor in benzene or carbon tetrachloride.

Books Recommended:

1.Yadav, J. B (2005): *Advanced Practical Physical Chemistry*, 22nd edition, Goel publishing House, Krishna Prakashan Media Ltd.
2. Venkatesan, V,Veeraswamy, R and Kulandaivelu, A.R (1997): *Basic Principles of Practical Chemistry*", 2nd edition, Sultan Chand and Sons Publication, New Delhi.
3. Findlay's (1985): *Practical Physical Chemistry*, Revised and edited by B.P. Levitt 9 th edition, Longman, London.
4. Chatwal, G.R. and Anand,S.K (2000): *Instrumental Methods of Chemical Analysis*, Himalaya Publishing House, Delhi.