ARYAVART INTERNATIONAL UNIVERSITY

Tilthai, Dharmanagar, North Tripura-799250

Syllabus for M. Sc. (Chemistry)

Semester 1

Theory									
Course Code	Topic	L	T	P	Credit	Theory Marks	Internal Marks	Practical Marks	Total Marks
24CH101	Inorganic Chemistry- I	4	0	0	4	70	30	0	100
24CH102	Organic Chemistry- I	4	0	0	4	70	30	0	100
24CH103	Physical Chemistry- I	4	0	0	4	70	30	0	100
Skill Enhancement Course (SEC-1) Choose any one									
24CH111	Mathematics for Chemists	2	0	0	2	70	30	0	100
24CH112	Biology for Chemists	2	0	0	2	70	30	0	100
24CH113	Computer for Chemists	2	0	0	2	70	30	0	100
Practical									
24CH191	Inorganic Chemistry Lab	0	0	4	4	0	30	70	100
24CH192	Organic Chemistry Lab	0	0	4	4	0	30	70	100
24CH193	Physical Chemistry Lab	0	0	4	4	0	30	70	100
Total					**26**	**280**	**210**	**210**	**700**

ARYAVART INTERNATIONAL UNIVERSITY
Tilthai, Dharmanagar, North Tripura

Detailed Syllabus

INORGANIC CHEMISTRY-I

Code: 24CH101

Max Marks: 70

UNIT I (15 Hrs.)

Stereochemistry And Bonding In Main Group Compounds

VSEPR, Walsh diagrams (tri and tetra-molecules), d π-p π bonds, Bent rule and energetics of hybridization, some simple reactions of covalently bonded molecules.

UNIT II (15 Hrs.)

Metal-Ligand Bonding

Limitations of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, π bonding and molecular orbital theory.

UNIT III (15 Hrs.)

Metal-Ligand Equilibria In Solution

Stepwise and overall formation constant and their interaction, trends in stepwise constants, factors affecting the stability of metal complexes with reference to the nature of metal ion and ligand, chelate effect and its thermodynamic origin, determination of binary formation constants by pH spectrophotometry.

Reaction Mechanism of Transition Metal Complexes- I

Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valance bond and crystal field theories, kinetics of octahedral substitution.

UNIT IV (15 Hrs.)

Reaction Mechanism of Transition Metal Complexes –II

Acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, reactions without metal-ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of substitution reaction, Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus Hush Theory, inner sphere type reactions.

Text Book:

1. Cotton, F.A.; Wilkinson Advanced Inorganic Chemistry, 6th Sons, 1999. edition, John Wiley& Sons, 1999
2. Huheey, James E. Inorganic Chemistry: Principles of Structure and Reactivity, 4th edition, Harper Collins College Publishers, 1993.
3. Greenwood, N.N. and Earnshaw, A. Chemistry of the Elements, 2nd edition, Butterworth-Heinemann, A division of Read Educational & Professional Publishing Ltd., 2001
4. Lever, A.B.P. Inorganic Electronic Spectroscopy, 2nd edition, Elsevier Science Publishers B.V., 1984.
5. Carlin, Richard L. and Duyneveldt, A. J. Van Magnetic Properties of Transition Metal Compounds, Inorganic Chemistry Concepts 2, Springer-verlag New York Inc., 1977.

Reference Books:

1. Shriver, D.F.; Atkins, P.W. Inorganic Chemistry, 1st edition, Oxford University Press, 2006.
2. Earnshaw, A. Introduction to Magnetochemistry, Academic Press, 1968.
3. Dutta, R. L.; Syanal, A. Elements of Magneto chemistry, 2nd edition, Affiliated East West Press, 1993.
4. Drago, Russell S. Physical Methods for Chemists, 2nd edition, Saunders College Publishing, 1992.

ARYAVART INTERNATIONAL UNIVERSITY
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ORGANIC CHEMISTRY-I

Code: 24CH102
Max Marks: 70

UNIT I (15 Hrs.)

Nature of Bonding in Organic Molecule

Delocalized chemical bonding, conjugation, Cross conjugation, resonance hyper conjugation, Bonding in fullerenes, Tautomerism, Aromaticity in benzenoid and non-benzenoid compd. Alternant and non-alternant hydrocarbons, Huckel's rule. Energy level of π M.O., Annulenes, anti-aromaticity, aromaticity, Homo aromaticity, PMO approach.

Bonds weaker than covalent, addition compound, crown ether complexes and cryptands, Inclusion compound, cyclodextrins, Catenanes & rotaxanes.

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

UNIT II (15 Hrs.)

Stereochemistry

Conformational analysis of cyclo alkanes, decalins, effect of confirmation on reactivity. Confirmation of sugars, Steric strain due to undesirable crowding of resolution, entatiotropic and diasterotropic atoms. Stereo specific and stereo selective synthesis, chirality due to helical shape. Stereochemistry of compounds containing N,S,P.

UNIT III (15 Hrs.)

Aliphatic Nucleophilic Substitution

The SN2, SN1, mixed SN1 and SN2 and SET mechanisms. The neighbouring group mechanism, neighbouring group participation by π and σ bonds, Classical and non-classical carbocations, norbornyl system. common carbocation rearrangements. The SNi mechanism. Nucleophilic substitution at an allylic, aliphatic, trigonal and a vinylic carbon.

Reactivity effects of substrate structure, attacking nucleophile, leaving group and reaction medium, phase transfer catalysis, ambident nucleophile, regioselectivity.

Aliphatic Electrophilic Substitution

Biomolecular mechanisms-SE2 and SEi. The SE1 mechanism, electrophilic substitution accompanied by double bond shifts. Effect of substrates, leaving group and the solvent polarity on the reactivity.

UNIT IV (15 Hrs.)

Aromatic Electrophilic Substitution

The arenium ion mechanism, orientation and reactivity, energy profile diagrams. The ortho/para ratio, ipso attack, orientation in other ring systems. Quantitative treatment of reactivity in substrates and electrophiles. Diazonium coupling, Vilsmeyer reaction, Gattermann-Koch reaction.

Aromatic Nucleophilic Substitution

The SNAr, SN1, benzyne and SRN1 mechanisms, Reactivity-effect of substrate structure, leaving group and attacking nucleophile. The Von Richter, Sommelet-Hauser and smiles rearrangements.

Text Books:

1. March, Jerry Advanced Organic Chemistry: Reactions, Mechanism and Structure, 6th edition, John Wiley, 2007.
2. Carry, F. A.; Sundberg, R.J. Advanced Organic Chemistry, 3rd edition, Plenum, 1990.
3. Sykes, Peter A Guide Book to mechanism in Organic Chemistry, 6th edition, Longman, 1989.
4. Morrison, R. T.; Boyd, R. N. Organic Chemistry, 6th edition, Prentice Hall, 1992.
5. Kalsi, P. S. Organic Reactions and their Mechanisms, 2nd edition, New Age International Publishers, 2000.

Reference Books:

1. Mukherji, S.M.; Singh, S.P. Reactions Mechanism in Chemistry, Vol. I, II, III, Macmillan, 1985.
2. Nasipuri, D. Stereochemistry of Organic Compounds, 2nd edition New Age International Publishers, 1994.
3. Kalsi, P.S. Stereochemistry of Organic Compounds, 2nd edition, New Age International, 1993.
4. Kalsi, P.S. Stereochemistry: Conformation and Mechanism, 2nd edition, Wiley Eastern Limited, 1993.

ARYAVART INTERNATIONAL UNIVERSITY
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PHYSICAL CHEMISTRY-I

Code: 24CH103
Max Marks: 70

UNIT I (15 Hrs.)

Quantum Chemistry

Application of Schrodinger wave equation to particle in three dimensional box, simple harmonic oscillator and rigid rotator. Approximate Methods: The variation theorem, Linear variation Principle, perturbation theory (first order, second order and Non-degenerate), Applications of variation method and perturbation theory to the Helium atom. Self-Consistent-Field theory.

UNIT II (15 Hrs.)

Angular Momentum

Ordinary ang. momentum, generalized angular momentum, eigen functions for angular momentum, eigcu values of angular momentum, operator using ladder operators, addition of angular-momenta, spin, anti-symmetry and Pauli exclusion principle.

Molecular Orbital Theory : Huckel theory of conjugated systems, bond order and charge density calculations, application to ethylene, allyl, butadiene, cyclopropenyl system, cylobutadiene etc.

UNIT III (15 Hrs.)

Thermodynamics

Classical Thermodynamics: Partial molal properties, partial molal free energy, volume & heat content and their significance, Determination of these quantities, concept of fugacity and determination of fugacity. Non ideal systems, excess functions for non-ideal solutions, Activity, Activity coeff, Debye huckel theory for activity coeff. electrolyte solutions, determination of activity & activity coeff, ionic strength. Application of phase rule to 3-component system, second order phase transitions. Statistical Thermodynamics: Concept of distribution, thermodynamic probability & most probable distribution, ensemble averaging, postulates of ensemble averaging, canonical, grand canonical & micro canonical ensembles.

UNIT IV (15 Hrs.)

Statistical Thermodynamics

Corresponding distribution laws (using Lagrange's method of undetermined multipliers) Partition functions: Translational, Rotational, Vibrational, Electronic partitions functions. Calculation of Thermodynamic properties in terms of partition functions. Heat capacity, behaviour of solids chemical equilibria and equilibrium constant in terms of partition function, F.D. statistics, distribution law and application to metals. Bose Einsteins statistics. Distribution law & application to Helium.

Text Books:

1. Atkins, P.W. Physical Chemistry, 3rd edition, ELBS, 1987.
2. Chandra, A.K Introductions to Quantum Chemistry, 4th edition, Tata McGraw Hill, 1994.
3. Young, R-J; Lovell, P.A. Introduction to Polymers, 2nd edition, Replika Press Pvt. Ltd., 1991.
4. Flory, P.J. Principles of Polymer Chemistry, 1st edition, Asian Book Private Ltd., 2006.
5. Crow, D.R. Principles and Applications of Electrochemistry, 4th edition, Chapman and Hall, London, 1994.

Reference Books:

1. Levine, Ira N. Quantum Chemistry, 5th edition, Prentice-Hall International, Inc., 2000.
2. McWeeny, R. Coulson's Valence, 3rd edition, ELBS, Oxford University Press, 1979.
3. Moore, J.W.; Pearson, R.G. Kinetics and Mechanism, 2nd edition, John Wiley and Sons, 1981.
4. Y. Moroi Micelles: Theoretical and Applied Aspects, 1st edition, Plenum Press, 1992.
5. Bockris, John O'M; Reddy, Amulya K.N. Modern Electro-Chemistry, 2nd edition, Plenum Press, New York, 1998.

6. Adamson, Arthur W. Physical Chemistry of Surfaces, 4th edition, A Wiley-Interscience Publication, 1982.

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MATHMATICS FOR CHEMISTS

Code: 24CH111
Max Marks: 70

UNIT I (15 Hrs.)

Vectors

Vector, dot, cross and triple products etc. The gradient, divergence and curl. Vector calculus.

Matrix Algebra

Addition and multiplication; inverse, adjoint and transpose of matrices, special matrices (Symmetric, skew-symmetric, Hermitian, unit, diagonal, unitary, etc.) and their properties. Matrix equation: Homogeneous, non-homogenous linear and conditions for the solution, linear dependence and independence. Introduction to vector spaces, matrix eigen values and eigen vectors, diagonalization, determinants (examples from Huckel theory).

Elementary Differential Equations

Variables-separable and exact, first-order differential equations, homogenous, exact and linear equations. Applications to chemical kinetics, secular equilibria, quantum chemistry, etc. Solutions of differential equations by the power series method, second order differential equations and their solutions.

UNIT II (15 Hrs.)

Differential Calculus

Functions, continuity and differentiability, rules for differentiation, applications of differential calculus including maxima and minima (examples related to maximally populated rotational energy levels, Bohr's radius and most probable velocity from Maxwell's distribution etc), exact and inexact differentials with their applications to thermodynamic properties. Integral calculus, basic rules for integration, integration by parts, partial fraction and substitution. Reduction formulae, applications of integral calculus. Functions of several variables, partial differentiation, co-ordinate transformations (e.g. Cartesian to spherical polar), curve sketching.

Permutation and Probability: Permutations and combinations, probability and probability theorems, probability curves, average, root mean square and most probable errors, examples from the kinetic theory of gases etc., curve fitting (including least squares fit etc.) with a general polynomial fit.

Text Books:

1. 1st Steiner, E. The Chemistry Mathematics, 1st edition, Oxford University Press.
2. 1st Doggett; Sucliffe Mathematics for Chemistry, 1st edition, Longman, 2003.
3. Daniels, F. Mathematical Preparation for Physical Chemistry, McGraw Hill.
4. Hirst, D.M. Chemical Mathematics, Longman.
5. Barrante, J. R. Applied Mathematics for Physical Chemistry, 3rd 2004. edition, Prentice Hall, 2004.
6. Tebbutt Basic Mathematics for Chemists, 1st edition, John Wiley, 1994.

BIOLOGY FOR CHEMISTS

Code: 24CH112
Max Marks: 70

UNIT I (15 Hrs.)

Cell Structure and Functions

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

Carbohydrates:

Conformation of monosaccharides, structure and functions of important derivatives of monosaccharides like glycosides, deoxy sugars, myoinositol, amino sugars. N-acetylmuramic acid, sialilic acid, disaccharides and polysaccharides. Structure and biological functions of glucosaminoglycans or muco-polysaccharides. Carbohydrates of glycoproteins and glycolipids. Role of sugars in biological recognition. Blood group substances. Ascorbic acid. Carbohydrate metabolism- kreb's cycle, glycolsis, glycognesis and glycogenolysis, gluconeogenenis, pentose phosphate pathway.

UNIT II (15 Hrs.)

Lipids

Fatty acids, essential fatty acids, structure and function of triacylglycerols, glyerophosphplipids, cholesterol, bile acids, prostaglandins, lipoproteins-composition and function, role in atherosclerosis. Properties of lipid aggregates micelles, bilayers, liposomes and their possible biological functions. Biological membranes. Fluid mosaic model of membrane structure. Lipid metabolism - beta oxidation of fatty acid.

Amino-acids, Peptides and Proteins:

Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins forces responsible for holding of secondary structures. Alpha helix, Beta sheets, secondary structure, triple helix structure of collagen. Tertiary structure of protein-folding and domain structure. Quaternary structure. Amino acid metabolism- degradation and biosynthesis of amino acids, sequence determination chemical enzymatic mass spectral, racemization detection. Chemistry of oxytocin and tryptophan releasing hormone.

Nucleic Acids:

Purines and pyrimidines bases of nucleic acids, base pairing via H-bonding. Structure of ribonucleic acids RNA and deoxyribonucleic acids DNA, double helix model of DNA and forces responsible for holding it. Chemical and enzymatic hydrolysis of nucleic acids. The chemical basis for hereditary, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.

Text Books:

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

ARYAVART INTERNATIONAL UNIVERSITY
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COMPUTER FOR CHEMISTS

Code: 24CH113
Max Marks: 70

UNIT I **(15 hrs)**

Introduction to Computers And Computing:

Basic structure and functioning of computers with a PC as an illustrative examples. Memory I/O devices secondary storage. Computer languages. operating system with DOS as an example. Introduction to UNIX and WINDOWS. Data processing, principles of programming, Algorithms and flow charts.

Use of Computer to Programmes: The students will learn how to operate a PC and how to run standard programmes and packages. Execution of linear regression, X-Y plot, numerical integration and differentiation as well as differential equation solution programmes. Programmes with data preferably from Physical laboratory. Word processing Software such as WORDSTAR/MS-WORD / EXCEL.

UNIT II **(15 hrs)**

Programming in Chemistry:

Development of small computer codes involving simple formulae in chemistry, such as Vander Waals equation, pH titration, kinetics, radioactive decay evaluation of lattice energy and ionic radii from experimental data. Linear simultaneous equations to solve secular equations within the Huckel theory elementary structural features such as bond lengths, bond angles, dihedral angles etc. of molecules extracted from a data base such as Cambridge data base.

Computer Programming in FORTRAN/C/BASIC

Elements of the computer language. Constants and variables operators and variable symbols expressions. Arithmetic assignment statement. Statement Input and output. Format statements Termination statements. Branching statement such as IF or go to statement. Logical variable Double precision variables. Subscripted variables and DIMENSION. DO statement. Function and SUBROUTINE. COMMON and DATA statements.

Suggested Readings:

1. Hunt, R.; Shelley, J. Computers and Common Sense, Prentice Hall.
2. stNorris, A.C. Computational Chemistry, 1 edition, John Wiley & Sons, 1981.
3. Killingbeck, J.P.; Hilger, Adam Microcomputer Quantum Mechanics.
4. Rajaraman, V. Computer Programming in FORTRAN IV, 4 edition, Prentice Hall India Pvt. Ltd., 1997.
5. Rajaraman, V.; RadhaKrishnan, V. An Introduction to Digital Computer Design, Prentice Hall.

ARYAVART INTERNATIONAL UNIVERSITY
Tilthai, Dharmanagar, North Tripura

INORGANIC CHEMISTRY LAB

Code: 24CH191
Max Marks: 70
Contents:

1. Cent per cent quantitative Analysis of Cement.
2. Estimation of the following:
   (a) Magnesium by E.D.T.A. Methods (Volumetrically)
   (b) Zinc by potassium ferrocyanide (Volumetrically)
   (c) Nickel by Dimethylglyoxime (Gravimetrically)
   (d) Manganese in steel by sodium bismuthate method.
3. A. Separation and determination of two metal ions Cu-Ni, Ni-Zn, Cu-Fe etc. involving volumetric and gravimetric methods.
   B. Separation of cations and anions by a) Paper chromatography b) Column Chromatography.
4. Preparation of inorganic compounds:
   (i) $[Cu(NH_3)_4]SO_4.H_2O$
   (ii) $K_3[Fe(C_2O_4)_3]$
   (iii) Prussian Blue, Turnbull's Blue
   (iv) $[Ni(NH_3)_6]Cl_2$
   (v) $[Ni(dmg)_2]$

ORGANIC CHEMISTRY LAB

Code: 24CH192
Max Marks: 70
Contents:

1. Organic Qualitative Identification of organic compounds containing one functional group using Chemical & Spectral Analysis
2. Separation, purification and identification of binary mixture (one liquid and one solid) involving TLC and Column Chromatography. Chemical tests and Functional group identification.
3. Preparation of organic compounds using methods not involving more than two steps. Some of the experiments listed below:
   (i) Preparation of methyl Orange
   (ii) Preparation of Martius yellow
   (iii) Preparation of p-nitro aniline from acetanilide
   (iv) Preparation of Cinnamic acid from Benzaldehyde
4. Estimation of Glucose

ARYAVART INTERNATIONAL UNIVERSITY
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PHYSICAL CHEMISTRY LAB

Code: 24CH193
Max Marks: 70

Contents:

1. **Viscosity:**
   (i) Determination of percentage composition of a liquid mixture by viscosity measurement.
   (ii) Determination of molecular weight of a high polymer (say polystyrene) by viscosity measurement.
2. **Surface Tension:**
   (i) Determination of Parachor value of $>CH_2$ group.
   (ii) To measure interfacial tension and to test the validity of Antonoff's rule.
   (iii) To compare cleansing power of two detergents.
   (iv) To determine the critical micelle concentration of a soap by surface tension method.
3. **Solubility:**
   (i) Determination of solubility of an inorganic salt in water at different temperatures and hence to draw the solubility curve.
   (ii) To study the effect of addition of an electrolyte on the solubility of an organic acid.
   (iii) To study the variation of solubility of $Ca(OH)_2$ in NaOH solution and hence determine the solubility product.
4. **Colloidal State:**
   (i) To compare the precipitation power of Na^{+}, Ba^{+2}& $A1^{+3}$ ions for As_2S_3 sol.
   (ii) To study interaction between arsenious sulphide and ferric hydroxide sol.
5. **Density:** Determine the partial molar volume of ethanol in dil. aqueous solution at room temperature

Theory Paper

Total: 100 Marks
External: 70 Marks
Internal:30 Marks

External: 70 Marks
10 Question (MCQ): 1 mark each (1x10 = 10)
Answer any 6 out of 8 (Very Short 20-30 Words): 2 marks each (2x6 = 12)
Answer any 6 out of 8 (Short 50-70 Words): 3 marks each (3x6 = 18)
Answer any 6 out of 8 (Long 100-120 Words): 5 marks each (5x6 = 30)

Internal: 30 Marks
Two Internal Assessment Examinations will be conducted, each carrying 50 marks. The higher of the two scores will be considered for the final assessment.

Lab

Practical: 100 Marks
External: 70 Marks
Internal: 30 Marks

External (Two programs): 70 Marks
Program Writing: 10 + 10 Marks
Algorithm& Flowchart: 5 + 5 Marks
Program Execution: 15 + 15 Marks
Viva: 10 Marks

Internal Assessment (30 Marks)
Internal Assessment Examinations will be conducted, carrying 50 marks
Record: 5 Marks
Attendance: 5 Marks
Program Writing: 15 Marks
Program Execution: 15 Marks
Viva: 10 Marks

ARYAVART INTERNATIONAL UNIVERSITY

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Syllabus for M. Sc. (Chemistry)

Semester 2

Theory									
Course Code	Topic	L	T	P	Credit	Theory Marks	Internal Marks	Practical Marks	Total Marks
24CH201	Inorganic Chemistry-II	4	0	0	4	70	30	0	100
24CH202	Organic Chemistry-II	4	0	0	4	70	30	0	100
24CH203	Physical Chemistry-II	4	0	0	4	70	30	0	100
24CH204	Group Theory, Spectroscopy And Diffraction Methods	4	0	0	4	70	30	0	100
Practical									
24CH291	Inorganic Chemistry Lab	0	0	4	4	0	30	70	100
24CH292	Organic Chemistry Lab	0	0	4	4	0	30	70	100
24CH293	Physical Chemistry Lab	0	0	4	4	0	30	70	100
Total					**28**	**280**	**210**	**210**	**700**

ARYAVART INTERNATIONAL UNIVERSITY
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Detailed Syllabus

INORGANIC CHEMISTRY-II

Code: 24CH201
Max. Marks: 70

UNIT I **(15 hrs)**

Electronic Spectra and Magnetic Properties Of Transition Metal Complexes- I

Spectroscopic ground states, correlation, Orgel and Tanabe-Sugano diagrams for transition metal complexes (d1 - 9 states), calculations of Dq, B and β parameters, charge transfer spectra and Heteropoly Acids and Salts.

UNIT II **(15 hrs)**

Electronic Spectra and Magnetic Properties of Transition Metal Complexes- II

Spectroscopic method of assignment of absolute configuration in optically active metal chelates and their stereo chemical information, anomalous magnetic moments, magnetic exchange coupling and spin crossover.

UNIT III **(15 hrs)**

Metal II- Complexes

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

UNIT IV **(15 hrs)**

Metal Cluster

Higher boranes, carboranes, metallobranes and metallocarboranes, metal carbonyl and halide clusters, compounds with metal-metal multiple bonds

Suggested Readings:

1. Cotton, F.A.; Wilkinson Advanced Inorganic Chemistry, 6th edition, John Wiley & Sons, 1999.
2. Huheey, James E. Inorganic Chemistry: Principles of Structure and Reactivity, 4th edition, Harper Collins College Publishers, 1993.
3. Greenwood, N.N. and Earnshaw, A. Chemistry of the Elements, 2nd edition, Butterworth Heinemann, A division of Read Educational & Professional Publishing Ltd., 2001.
4. Lever, A. B. P. Inorganic Electronic Spectroscopy, 2nd edition, Elsevier Science Publishers B.V., 1984.
5. Carlin, Richard L. and Duyneveldt, A. J. Van Magnetic Properties of Transition Metal Compounds, Inorganic Chemistry Concepts 2, Springer-verlag New York Inc., 1977.

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ORGANIC CHEMISTRY-II

Code: 24CH202
Max Marks: 70

UNIT I

Reaction Mechanism, Structure and Reactivity **(8 hrs)**

Types of mechanism, types of reactions, thermodynamics and kinetic requirement. Kinetic and thermodynamics control, Hammond's postulate, Curtin-Hammett Principle, Potential energy diagrams, transition states and intermediates, method of determining mechanisms, isotope effects.

Addition to Carbon-Carbon Multiple Bonds **(7 hrs)**

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

UNIT II **(15 hrs)**

Addition to Carbon-Heteroatom Multiple Bonds

Mechanism of metal hydride reduction of saturated and unsaturated carbonyl compounds acids, esters and nitriles. Addition of grignard reagents, organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Wittig reaction. Mechanism of condensation reactions involving enolates-Aldol, Knoevenagel, Claisen, Mannich, Benzoin, Perkin and Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

UNIT III

Free Radical Reactions **(8 hrs)**

Type of free radical reactions, free radical substitution mechanism at an aromatic substrate, neighbouring group assistance. Reactivity for aliphatic and aromatic substrates at a bridgehead. Reactivity in the attacking radicals. The effect of solvents on reactivity. Allylic halogenation (NBS), oxidation of aldehydes to carboxylic acids, auto-oxidation. Coupling of alkynes and arylation of aromatic compounds by diazonium salts. Sandmeyer reaction. Free Radical Rearrangement. Hunsdiecker reaction.

Elimination Reaction **(7 hrs)**

The E2, E1 and E1cB mechanisms and their spectrum, Orientation of the double bond. Reactivity effects of substrate structure, attacking base, the leaving group and the medium. Mechanism and orientation in pyrolytic elimination.

UNIT IV **(15 hrs)**

Pericyclic Reactions

Molecular orbital symmetry, frontier orbitals of ethylene, 1,3-butadiene, 1, 3, 5-hexatriene and allyl system. Classification of pericyclic reactions. Woodward-Hoffmann correlation diagrams. FMO and PMO approach. Electrocyclic reactions conrotatory and disrotatory motions 4n, 4n +2 and allyl system. Cycloadditions-antarafacial suprafacial additions, 4n and 4n+2 systems, 2+2 addition of ketenes, 1, 3-dipolar cycloadditions and cheleotropic reactions. Sigmatropic rearrangements-Suprafacial and antarafacial shifts of H. Sigmatropic shifts involving carbon moieties, [3, 3]-and [5, 5]- sigmatropic rearrangements. Claisen, Cope and aza-Cope rearrangement. Fluxional tautomerism. Ene reaction.

Suggested Readings:

1. March, Jerry Advanced Organic Chemistry: Reactions, Mechanism and Structure, 6th edition, John Wiley, 2007.
2. Carry, F. A.; Sundberg, R.J. Advanced Organic Chemistry, 3rd edition, Plenum, 1990.
3. Sykes, Peter A Guide Book to mechanism in Organic Chemistry, 6th Longman, 1989.
4. Morrison, R. T.; Boyd, R. N. Organic Chemistry, 6th edition, Prentice Hall, 1992.
5. Kalsi, P. S. Organic Reactions and their Mechanisms, 2nd edition, New Age International Publishers, 2000.

ARYAVART INTERNATIONAL UNIVERSITY
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PHYSICAL CHEMISTRY-II

Code: 24CH203
Max Marks: 70

UNIT I **(15 hrs)**

Chemical Dynamics: Methods of determining rate laws, ionic reactions*, kinetic salt effects, steady state kinetics, kinetic & thermodynamic control of reactions, treatments of unimolecular reactions, Dynamic chain (pyrolysis of acetaldehyde composition of ethane), photochemical (H2-cl2) reactions & oscillatory reactions (Belousov-Zhabotinsky reaction), homogeneous catalysis, kinetics of enzyme reactions, general features of fast reactions, study of fast reactions by flow method, relaxation method, flash photolysis, and NMR method, dynamics of molecular motion, probing the transition state, dynamics of barrierless chemical reactions in solution, dynamics of unimolecular reaction (Lindemann-Hinshelwood and Rice-Ramsperger-Kassel-Marcus Theories of unimolecular reactions).

UNIT II **(15 Hrs.)**

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.), transformation of generalized fluxes and forces, non-equilibrium stationary states, phenomenological equators, microscopic reversibility and onsager's reciprocity relations, electro kinetic phenomenon, diffusion, electrical conduction, irreversible thermodynamics for biological system, coupled reactions.

Macromolecules: Electrically conducting, fire resistant, liquid crystal polymers, Kinetics of polymerization, mechanism of polymerization, mol. mass determination (osmometry, viscometry, diffusion & light scattering methods), sedimentation, chain config. of macromolecules, calculation of average dimensions.

UNIT III **(15 Hrs.)**

Surface Chemistry Adsorption: Surface tension, capillary action, pressure difference across curved surface (Laplace eqn), vapour pressure of droplets, (Kelvin eqn), Gibb's adsorption isotherm, estimation of surface area (BET eqn), surface films on liquids (electro kinetic phenomenon), catalytic activity at surfaces.

Micelles: Surface active agents, classification of surface active agents, micellisation, hydrophobic interactions, critical micellar comentration, factors affecting CMC of surfactants, counter ions binding to micelles, thermodynamics of micellization-phase separation & mass action models, solubilization, microemulsion, reverse micelles.

UNIT IV **(15 Hrs.)**

Electrochemistry: Electrochemistry of solutions, Debye-Huckel treatment, and its extension, ion solvent interaction, Debye-Huckel-Jerrum model, Thermodynamics of electrified interface equations, derivation of electrocapillarity, Lippmann equations (surface excess), Methods of determining structures of electrified interfaces, Guoy-Chapman, Stern. Over potentials, exchange current density, derivation of Butler-volmer equation. Tafel plots. Quantum aspects of charge transfer at electrode solution interfaces, quantization of charge transfer, tunnelling Semiconductor interfaces- theory of double layer interfaces, effects of light at semiconductor solution interface.

Electrocatalysis : Influence of various parameters, H-electrode, polarography, theory Ilkoviceqn, (excluding derivation), Half wave potential & its significance, electrocardiography, introduction to corrosion, homogeneous, theory, forms of corrosion, corrosion monitoring.

Suggested Readings:

1. Atkins, P.W. Physical Chemistry, 3rd edition, ELBS, 1987.
2. Chandra, A.K Introductions to Quantum Chemistry, 4th edition, Tata McGraw Hill, 1994.
3. Laidler, Keith J. Chemical Kinetics, 3rd edition, Harper & Row, Publishers, New York.
4. Young, R-J; Lovell, P.A. Introduction to Polymers, 2nd edition, Replika Press Pvt. Ltd., 1991.
5. Flory, P.J. Principles of Polymer Chemistry, 1st 6th edition, Asian Book Private Ltd., 2006.
6. Crow, D.R. Principles and Applications of Electrochemistry, 4th and Hall, London, 1994.

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GROUP THEORY, SPECTROSCOPY AND DIFFRACTION METHODS

Code: 24CH204
Max. Marks: 70

UNIT I **(15 Hrs.)**

Symmetry And Group Theory In Chemistry: Symmetry elements & symmetry operation, definitions of group, subgroup, relation between orders of a finite group & its sub groups. Point group symmetry. Representations of groups by matrices (representation for the Cn, Cnv, Cnn, Dnn etc. group) character of a representation. The great orthogonality theorem and its importance character tables and their use-in spectroscopy.

UNIT II **(15 Hrs.)**

Microwave Spectroscopy: Classification of molecules rigid rotor model, effect of isotopes; non-rigid rotor Stark effect, nuclear and electron spin interaction & effect of external field.

Vibrational Spectroscopy: Infrared Spectroscopy:- Linear Harmonic Oscillator, Vibrational energy of diatomic molecule zero point energy, force constants & bond lengths anharmonicity, morse potential energy diagram. Vibrational rotational spectroscopy, P, Q, R, branches. Selection rules Normal modes of vibration, group frequencies, overtones, hot bands, Raman Vibrational:- Classical & quantum theories of Raman effect pure rotational, vibrational and vibrational. Rotational Raman spectroscopy. Coherent anti stokes Raman spectroscopy.

UNIT III **(15 Hrs.)**

Molecular Spectroscopy: Energy levels, molecular orbital, Frank Condon's Principles, electronic spectra of polyatomic molecules emission spectra; radiative & non-radiative decay. Spectra of transition metal complexes; change transfer spectra.

Basic Principles Photoelectric Effect, Ionization Process: Koopman's theorem, photoelectron spectra of simple molecule. Auger electron spectroscopy.

Diffraction: Bragg's condition, Miller indices. Debye-Scherrer method for structure analysis. Principal and applications of neutron diffraction and electron diffraction

UNIT IV **(15 Hrs.)**

Magnetic Resonance Spectroscopy: Nuclear Magnetic Resonance Spectroscopy:- Nuclear spin, Nuclear resonance, shielding of magnetic nuclei, chemical shifts de-shielding, spin-spin interactions, (ABX, AMX, ABC, A2 B2) spin decoupling. Nuclear Quadrupole Resonance spectroscopy:- Quadrupole Nuclear moments, electric field gradient complex constants applications

Suggested Readings:

1. Windawi, H.; Ho, F.L. Applied Electron Spectroscopy for Chemical Analysis, Wiley Interscience.
2. Parish, R.V. NMR, NQR, EPR and Mossbauer Spectroscopy in Inorganic Chemistry, 1st edition, Ellis Harwood, 1990.
3. Drago, Russell S. Physical Methods for Chemists, 2nd edition, College Publishing, 1992.
4. Cotton, F.A. Chemical Applications of Group Theory, 3rd edition Science Publication, 1971.
5. Wiley Ghosh, P.K. Introduction to Photoelectron Spectroscopy, 1st edition Inter Science, 1982.
6. John Wiley Glusker, J.P. Crystal Structure and Analysis: a Primer, Oxford University Press, 1985.
7. Reddy, K.V. Symmetry and Spectroscopy of Molecules, 1st Age International (P) Ltd., 1998.
8. Banwell, C.N. Fundamentals of Molecular Spectroscopy, 4th edition McGraw-Hill Publishing Company Ltd., 1994.

INORGANIC CHEMISTRY LAB

Code: 24CH291
Max. Marks: 70

Contents:

1. Preparation of hexamminecobalt (III) chloride and determine the percentage of cobalt in the product iodimetrically.
2. Preparation of chloropentaammine cobalt (III) chloride and interpretation of electronic spectrum and magnetic properties.
3. Preparations of nitropentamminecobalt (III) chloride from chloropentaamminecobalt (III) chloride and interpretation of electronic spectrum and magnetic properties.
4. Preparations of nitritopentamminecobalt (III) chloride from chloropentaamminecobalt (III) chloride and interpretation of electronic spectrum and magnetic properties.
5. Preparation of cis-and trans isomers of $[Co(en)_2Cl_2]Cl$ and interpretation of electronic spectra and magnetic properties.
6. Preparations of $Cu_2(CH_3COO)_4\ (H_2O)_2$ from $CuSO_4.5H_2O$ and interpretation of electronic spectrum and magnetic properties.
7. Preparation of cis-and trans isomers of $K[Cr(C_2O_4)(H_2O)_2].2H_2O$ and interpretation of electronic spectra and magnetic properties.
8. Preparation of Tris(thiourea)cuprous (I) sulphate $[Cu(tu)_3]2SO_4.2H_2O$ (Where tu stands for thiourea) and determine the percentage of copper in the product iodimetrically.
9. Preparation of $[Co(acac)_3]$ and interpretation of electronic spectrum and magnetic properties.
10. Preparation of potassium trioxalatoaluminate(III) and tris(acetylacetonato)aluminium(III).

ORGANIC CHEMISTRY LAB

Code: 24CH292
Max. Marks: 70

Contents:

1. Quantitative Analysis Separation and identification of organic tests and preparation of their derivatives.
2. Organic Synthesis via two steps preparation
   a. p-Nitroanilinefromacetanilide.
   b. p-Bromoanilinefromacetanilide
   c. Anthranilic acid from phthalic anhydride.
   d. p-Bromoacetanilidefromaniline.
   e. p-Nitroacetanilidefromaniline.

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PHYSICAL CHEMISTRY LAB

Code: 24CH293

1. **Polarimetry:**
   (i) To study the inversion of cane sugar by optical rotation measurement.
   (ii) To determine the specific and molecular rotations of optically active substances.
2. **Potentiometry:**
   (i) Determination of valence of mercurous ion.
   (ii) Determination of pH value using quinhydrone electrode.
   (iii) Determination of heat of reaction, equilibrium constant and other thermodynamic functions for: (a) Zn + Cu+2 Zn+2+Cu (b) Zn+Pb+2 Zn+2+Pb
   (iv) Determination of hydrolysis constant of aniline hydrochloride / ammonium chloride electrometrically.
3. **Flame Photometry:**
   (i) Determination of Na+ & K+ when present together.
   (ii) Determination of Lithium/Calcium/Barium/Strontium.

Theory Paper

Total: 100 Marks
External: 70 Marks
Internal:30 Marks

External: 70 Marks
10 Question (MCQ): 1 mark each (1x10 = 10)
Answer any 6 out of 8 (Very Short 20-30 Words): 2 marks each (2x6 = 12)
Answer any 6 out of 8 (Short 50-70 Words): 3 marks each (3x6 = 18)
Answer any 6 out of 8 (Long 100-120 Words): 5 marks each (5x6 = 30)

Internal: 30 Marks
Two Internal Assessment Examinations will be conducted, each carrying 50 marks. The higher of the two scores will be considered for the final assessment.

Lab

Practical: 100 Marks
External: 70 Marks
Internal: 30 Marks

External (Two programs): 70 Marks
Program Writing: 10 + 10 Marks
Algorithm& Flowchart: 5 + 5 Marks
Program Execution: 15 + 15 Marks
Viva: 10 Marks

Internal Assessment (30 Marks)
Internal Assessment Examinations will be conducted, carrying 50 marks
Record: 5 Marks
Attendance: 5 Marks
Program Writing: 15 Marks
Program Execution: 15 Marks
Viva: 10 Marks