DEVI AHILYA VISHWAVIDYALAYA, INDORE

School of Chemical Sciences

1.1.1
Syllabus of all programs

Scheme and Syllabus
of
M.Sc. Chemistry

I and III Semesters
Effective from Academic Year 2018-19 onwards

Devi Ahilya Vishwavidyalaya,
Indore (M.P.), 452001

SCHOOL OF CHEMICAL SCIENCES
DEVI AHILYA VISHWAVIDYALAYA, INDORE

COURSE STRUCTURE

M.Sc. Chemistry

(Four Semester Course Based on Choice Based Credit System)
w.e.f. July 2018

SEMESTER I

Code	Type of Course	Name of the Course	Credits
MCH-101	Core Course	Inorganic Chemistry - I	3
MCH-102	Core Course	Organic Chemistry - I	3
MCH-103	Core Course	Physical Chemistry - I	3
MCH-104	Core Course	Symmetry,Group Theory and Spectroscopy	3
MCH-105 MCH-106	Elective Course –Generic* (Any One)	Concepts of Mathematics General Biology	3 3
MCH-107	Laboratory Course I	Practical	5
		Comprehensive Viva-Voce	4
Total Credits			**24**

SEMESTER II

Code	Type of Course	Name of the Course	Credits
MCH-201	Core Course	Inorganic Chemistry - II	3
MCH-202	Core Course	Organic Chemistry - II	3
MCH-203	Core Course	Physical Chemistry-II	3
MCH-204	Elective Course-Discipline Centric	Chemistry of Drugs	3
MCH-205 MCH-206	Elective Course –Generic* (Any One)	Computer Applications in Chemistry Computer Programming	3 3
MCH 207	Laboratory Course II	Practical	5
		Comprehensive Viva-Voce	4
Total Credits			**24**

SEMESTER III

Code	Type of Course	Name of the Course	Credits
MCH-301	Core Course	Molecular Spectroscopy	3
MCH-302	Elective Course-Discipline Centric	Organic Photochemistry	3
MCH-303	Elective Course-Discipline Centric	Bio-inorganic Chemistry	3
MCH-304	Elective Course-Discipline Centric	Diffraction Methods and Spectroscopy	3
MCH-305	Elective Course –Generic* (Any One)	Advanced Medicinal Chemistry	3
MCH-306		Chemistry of Polymers	3
MCH-307		Organic Synthesis	3
MCH-308	Laboratory Course III	Practical & Spectral Interpretation / Seminar	5
		Comprehensive Viva-Voce	4
Total Credits			**24**

SEMESTER IV

Code	Type of Course	Name of the Course	Credits
MCH-401	Core Course	Advances in Analytical Chemistry	4
MCH-402	Elective Course-Discipline Centric	Environmental Chemistry	4
MCH-403	Elective Course-Discipline Centric	Solid State Chemistry and Nanoscience	4
MCH-404	Elective Course-Discipline Centric	Bio-organic Chemistry	4
MCH-405	(Any One)	Organometallic Chemistry	4
MCH-406		Chemistry of Natural Products	4
MCH-407		Heterocyclic Chemistry	4
MCH-408	Project	Dissertation/ Project	4
		Comprehensive Viva-Voce	4
Total Credits			**24**

***Note:**

1. The students can choose this course or any other P.G. level Generic Course of 3 Credits being run at other School/ Institute.
2. Credit earned through Choice Based Course from other department will be counted in calculating CGPA for the award of the Degree in which admission is taken.
3. Teaching and examination of Choice Based Course will be conducted by School of Studies / Institute where this course is being offered.

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M.Sc. Chemistry

SEMESTER I
MCH-101: INORGANIC CHEMISTRY-I

Credits 3

Unit I	**Stereochemistry and Bonding in Main Group Compounds:** Valence shell Electron Pair Repulsion (VSEPR) model, Walsh diagram, Bent's Rule and energetic of hybridization, Vander-Waals's force, Ionic bond, Ion-dipole forces, Dipole-dipole interaction, Induced –dipole interactions and instantaneous diploe –diploe interactions
Unit II	**Metal-Ligand Equilibrium in Solution** Stepwise and overall formation constants and their interaction, trends in stepwise constant, 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 potentiometry and spectrophotometry.
Unit III	**Reaction Mechanism of Transition Metal Complexes** Energy profile of a reaction, reactivity of metal complex, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, acid hydrolysis, factors affecting acid hydrolysis, base hydrolysis, conjugate base mechanism, direct and indirect evidences in favour of conjugate mechanism, anation reactions, reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect, mechanism of the substitution reaction. Redox reaction, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.
Unit IV	**Metal-Ligand bonding** Limitation of crystal field theory, molecular orbital theory, octahedral, tetrahedral and square planar complexes, p-bonding and molecular orbital theory.
	Books Suggested 1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley. 2. Inorganic Chemistry, J.E. Huhey, Harpes & Row. 3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon. 4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier. 5. Magnetiochemistry, R.1. Carlin, Springer Verlag. 6. Comprehensive Coordiantion Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. Mc Cleverty,Pergamon.

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M.Sc. Chemistry

SEMESTER I
MCH-102: ORGANIC CHEMISTRY-I

Credits 3

Unit I	Chirality, Absolute and relative configuration, The terms chiral, achiral, stereogenic center (stereocenter), representations of three dimensional molecules, stereoisomerism resulting from more than one stereogenic unit, Pi-diastereoisomerism and torsional chirality in carbon-carbon double bonds, some stereochemical reactions near a stereocenter (formation of diastereomers) stereoselective and stereospecific reactions, stereoisomerism in compounds without a stereogenic carbon, optical activity due to stereoplane (planar chirality)-paracyclophanes and trans-cyclooctene, optical activity of compounds due to helicity, asymmetric synthesis
Unit II	Aromaticity, NMR spectroscopy and aromaticity, aromatic compounds, antiaromatic compounds, nonaromatic compounds, annulenes, ions, metallocenes Crown ether complexes and cryptates, phase transfer catalysis The Hammett equation- linear free energy relationship, Taft equation, steric effects, strain and Bredt rule.
Unit III	Aliphatic nucleophilic substitution, S_N2 reaction as a stereospecific reaction, S_N1 Mechanism-Ion Pairs and other aspects, S_Ni and SET mechanisms, neighbouring group participation-anchimeric assistance, non-classical carbocations Conformations and stereoisomerism of acyclic and cyclic systems, conformation and chemical reactivity.
Unit IV	Stereochemistry of elimination reactions, E1, E2 and E1cB mechanisms, elimination versus substitution Free radical reactions, Structure, stability and geometry, properties of free radicals
	Books Suggested 1. J. March., Advanced Organic Chemistry: Reactions, Mechanisms and Structure, John Wiley 2. P. S. Kalsi. Stereochemistry, Conformation and Mechanism, New Age International 3. Peter Sykes, A guide book to mechanism in Organic chemistry, Orient-Longmans 4. E. L. Eliel, Stereochemistry of Carbon Compounds, McGraw-Hill 5. S. M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan 6. F. A. Carey and R. J Sundberg, Advanced Organic Chemistry, Part A and B, Plenum 7. P. S. Kalsi., Organic Reactions and their Mechanisms, New Age International

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M.Sc. Chemistry

SEMESTER I
MCH-103: PHYSICAL CHEMISTRY-I

Credits 3

Unit I	**Quantum Mechanics** The Schrodinger equation and the postulates of quantum mechanics. Discussion of solutions of the Schrodinger equation to some model systems viz., particle in a box, the harmonic oscillator, the rigid rotor, Hydrogen Molecule.
Unit II	**Approximate Methods** Variational and perturbation methods. Applications of variation method and perturbation theory to the Helium atom. Molecular Orbital Theory Huckel theory of conjugated systems bond and charge density calculations. Applications to ethylene, butadiene, cyclopropenyl radical cyclobutadiene.
Unit III	**Classical Thermodynamics** Partial molar Quantities: Partial molar free energy, partial molar volume and partial molar heat content, Chemical Potential and their significance. Determinations of these quantities. Gibbs-Duhem Equation, Variation of Chemical potential with temperature and pressure. Concept of fugacity and determination of fugacity. Non-ideal systems : Excess functions for non-ideal solutions. Variation of fugacity with temperature and pressure. Activity, activity coefficient, Debye Huckel theory for activity coefficient for electrolytic solutions; determination of activity and activity coefficients; ionic strength.
Unit IV	**Statistical Thermodynamics** Partition function (Q), properties of partition function, Translational partition function, calculation of translational energy from translational partition function, translation entropy of monoatomic ideal gas or Sackure- Tetrode equation, Rotational partition function, Vibrational partition function. , Electronic partition function, Partition function and Equilibrium constant.
	Books Suggested 1. J. P. Lowe and K.Peterson, Quantum Chemistry Academic Press. 2. D. A. McQuarrie, Quantum Chemistry Viva Books Pvt. Ltd.: New Delhi. 3. R. G. Mortimer, Mathematics for Physical Chemistry Elsevier. 4. F. L. Pilar, Elementary Quantum Chemistry , Dover Publication Inc.: NewYork. 5. P. W. Atkins and J. de Paula, Atkin's Physical Chemistry , Oxford University Press. 6. I. L. Levine, Quantum Chemistry , Prentice-Hall Inc., New Jersey. 7. T. Engel and P. Reid, Physical Chemistry, Benjamin-Cummings. 8. D. A. McQuarrie and J. D. Simon, Physical Chemistry: A Molecular Approach , Univ. Science Books. 9. R. J. Silbey, R. A. Alberty and M. G. Bawendi, Physical Chemistry , Wiley.

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M.Sc. Chemistry
SEMESTER I

MCH-104: SYMMETRY, GROUP THEORY AND SPECTROSCOPY

Credits 3

Unit I	**Symmetry and Group theory in Chemistry I:** Molecular symmetry and its importance, Symmetry elements and symmetry operations, Symmetry planes, reflections, inversion centre, proper/improper axes and rotations, Associated operations, Products of symmetry operations, Definition of group, subgroup, Conjugacy relation and classes. Point symmetry groups, Schonfilies symbols, representations of groups by matrices (representation for the Cn, C_{nv}, etc), Character of representations
Unit II	**Symmetry and Group theory in Chemistry II:** Matrix representation of symmetry of symmetry operations: Transformation matrices, The great orthogonality theorem (without proof) and its importance, Character tables and their use in spectroscopy. Derivation of character table for C_2v and C_3v point group, Symmetry aspects of molecular vibrations of H_2O molecule, Symmetry of vibrational modes, Infra red and Raman active molecular vibrations of AB_2, AB_3, AB_4, AB_5 and AB_6 molecules
Unit III	**Electron Spin Resonance Spectroscopy:** Basic principles, Hyperfine coupling, Isotropic and anisotropic hyperfine coupling constants, spin polarization for atoms and transition metal ions, spin-orbit coupling and significance of g-tensors, factors affecting the 'g' value. Zero field splitting and Kramer's degeneracy; spin Hamiltonian, spin densities and Mc Connell relationship. Applications of ESR technique
Unit IV	**Mössbauer Spectroscopy:** Basic principles, spectral parameters and spectrum display. Application of the technique to the studies of (1) bonding and structures of Fe+2 and Fe+3 compounds including those of intermediate spin, (2) Sn+2 and Sn+4 compounds, nature of M-L bond, coordination number, structure and (3) detection of oxidation state and inequivalent MB atoms
	Books suggested: 1. Physical Methods in Chemistry, R.S. Drago, Saunders College 2. Chemical Applications of Group Theory, F.A. Cotton 3. Basic Principles of Spectroscopy, R. Chang, Mc Graw Hill 4. Spectrometric Identification of Organic Compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley 5. G. Aruldhas, Molecular Structure and Spectroscopy, Prentice Hal

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SEMESTER I

MCH-105: CONCEPTS OF MATHEMATICS

Credits 3

Unit I	**Vectors:** Scalar or Dot product of two vectors, Vector or Cross product of two vectors, Angle between two vectors, Perpendicular vector, co-linear vector. **Matrices:** Addition, subtraction, multiplication, Transpose of matrix, Properties of transpose, Symmetric and Skew-symmetric matrices, Singular and non- singular matrices, Adjoint of a matrix, inverse of a squire matrix, Determinants.
Unit II	**Differential Calculus** Functions, continuity and differentiability and rules for differentiation. **Integral calculus** Basic rules for integration, integration by parts, partial fractions and substitution. Partial differentiation.
Unit III	**Elementary Differential equations** First-order differential equations, Applications to chemical kinetics, quantum chemistry etc. second order differential equation. Applications of differential calculus including maxima and minima.
Unit IV	**Permutations and Combinations** Factorial notations, Permutations-Theorem and problems on permutation. Combinations and its applications.
	Books Suggested 1. The chemistry Mathematics Book, E.Steiner, Oxford University Press. 2. Mathematics for chemistry, Doggett and Suiclific, Logman. 3. Mathematical for Physical chemistry : F. Daniels, Mc. Graw Hill. 4. Chemical Mathematics D.M. Hirst, Longman. 5. Applied Mathematics for Physical Chemistery, J.R. Barante, Prenice Hall. 6. Basic Mathematics for Chemists, Tebbutt, Wiley.

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SEMESTER I
MCH-106 : GENERAL BIOLOGY

Credits 3

Unit I	Cell structure and functions Structure of prokaryotic and eukaryotic cells, intercellular organelles and their function 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.
Unit II	Carbohydrates Structure and function of important derivatives of monosaccharides like glycosides deoxy sugers, myoinositol, amino sugers. N-acetylmuramic acid. Sialic acid. Structural polysaccharide: Cellulose and chitin, Storage polysaccharide: Starch and glycogen. Structural and biological functions of glucosaminoglycans or mucopolysaccharides. Carbohydrates of glycoprotein and glycolipids. Role of sugars in biological recognition. Carbohydrate metabolism-Kreb's cycle, glycolysis, glycogenesis and glycogenolysis, gluconeogenosis, pentose phosphate pathway.
Unit III	Lipids Fatty acids, essential fatty acids, structure and function of triacylglycerols, glycerophospholipids, sphingolipids, Lippoproteins: Composition and function, role in atherosclerosis. Properties of lipids aggregates-micelles, bilayers, liposomes and their possible biological functions. Lipid metabolism-β -oxidation of fatty acids.
Unit IV	Amino acids, Proteins and nucleic acid Chemical and enzymatic hydrolysis of proteins to peptides, amino acid sequencing. Secondary structure of proteins, α-helix , β-sheets. Super 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/enzymetic/mass spectral, recemization/detection. Chemistry of oxytocin and trytophan releasing hormone (TRH). Chemical and enzymatic hydrolysis of nucleic acids. Structure of ribonucleic acids (RNA) and deoxyribonucleic acids (DNA) double helix model of DNA and forces responsible for holding it. The chemical basis for heredity, an overview of replication of DNA, transcription, translation and genetic code. Chemical synthesis of mono and trinucleoside.
	Books Suggested 1. Principles of Biochemistry, A.L. Lehninger, Worth Publishers. 2. Biochemistry, L. Stryer, W.H. Freeman. 3. Biochemistry, J.David Rwan, Nell Patterson. 4. Outlines of Biochemistry, E.E. Conn and P.K. Sumpf, John Wiley.

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SEMESTER III
MCH-301: MOLECULAR SPECTROSCOPY

Credits 3

Unit I	Ultraviolet and Visible spectroscopy: Fundamentals, effect of solvent and extending conjugation on electronic transitions, ultraviolet bands for carbonyl compounds, unsaturated carbonyl compounds, dienes, conjugated polyenes, Fieser Woodward rules for conjugated dienes and carbonyl compounds, ultraviolet spectra of aromatic compounds. Steric effect in biphenyls
Unit II	Nuclear Magnetic Resonance Spectroscopy-: Nuclear spin, nuclear resonance, saturation, shielding of magnetic nuclei, chemical shift and its measurements, factors influencing chemical shift, deshielding, spin-spin interactions, factors influencing coupling constant 'J' Classification of spin systems,(AXB, AMX, ABC, A2B2 etc.). First-order and Second-order spectra Basic idea about instrument, FT NMR, chemical shift values and correlation for protons bonded to carbon (aliphatic, olefinic, aldehydic and aromatic) and other nuclei (alcohols, phenols, enols, carboxylic acids, amines, amides & mercapto), spin decoupling(double resonance), chemical exchange, effect of deuteration, stereochemistry, hindered rotation, NMR shift reagents, Solvent effect, Nuclear Overhauser effect (NOE).
Unit III	Carbon-13 NMR Spectroscopy: General considerations, chemical shift (aliphatic olefinic , alkyne, aromatic, heteroaromatic and carboynl carbon), NMR studies of nuclei other than proton and carbon-^{19}F and ^{31}P. Two dimensional NMR spectroscopy: COSY, HETCOR, NOESY, DEPT,HMBC and HMQC techniques
Unit IV	Mass Spectrometry : Introduction, ion production EI, CI, FD, ESI and FAB, ion analysis, ion abundance, Mass spectral fragmentation of organic compounds, common functional groups, molecular ion peak, metastable ion peak, Mc Lafferty rearrangement , Nitrogen rule, High resolution mass spectrometry. Combined problems based on UV, IR, NMR and Mass spectral techniques
	Books Suggested 1. R.M. Silverstein, G.C. Bassler and T.C. Morrill, Spectrometric Identification of Organic Compounds, John Wiley 2. R.J. Abraham, J. Fisher and P. Loftus, Introduction to NMR spectroscopy, Wiley 3. J.R. Dyer, Application of Spectroscopy of Organic Compounds, Prentice Hall 4. D.H. Williams, I. Fleming, Spectroscopic Methods in Organic Chemistry, Tata McGraw-Hill 5. Banwell, Fundamentals of Molecular Spectroscopy, Tata McGraw Hill 6. G. Aruldhas, Molecular Structure and Spectroscopy, Prentice Hall

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SEMESTER III

MCH-302: ORGANIC PHOTOCHEMISTRY

Credits 3

Unit I	**Basic principles of photochemistry:** Absorption of light by organic molecules, Jablonski diagram, properties of excited states, types of excitations, mechanism of excited state processes, fate of excited molecule, transfer of excitation energy, quantum yield, actinometry
Unit II	**Determination of Reaction Mechanism:** Classification, rate constants and life times of reactive energy state determination of rate constants of reactions. Effect of light intensity on the rate of photochemical reactions, Types of photochemical reactions-photo dissociation, gas-phase photolysis.
Unit III	**Photochemistry of Alkene:** Photochemical isomerization of cis and trans alkenes, Photochemical cyclization of reaction, di-pi methane rearrangement and cope rearrangement. **Photochemistry of Aromatic Compounds**: Isomerisations, Additions and Substitutions.
Unit IV	**Photochemistry of Carbonyl Compounds** Photoreduction, Norrish type I and Norrish type II reactions Paterno–Buchi reaction, Photochemistry of enones, Hydrogen abstraction rearrangement of unsaturated ketones and cyclohexadienones **Miscellaneous Photochemical Reactions** Photo-Fries reactions of anilides, Photo-Fries rearrangement. Barton reaction. Singlet molecular oxygen reaction. Photochemical formation of smog. Photodegration of polymers. Photochemistry of vision
	Books Suggested 1. K.K. Rothagi-Mukheriji, Fundamentals of photochemistry, Wiley-Eastern. 2. A Gilbert and J. Baggott, Essentials of Molecular Photochemistry, Blackwell Scientific Publication. 3. N.J. Turro, Molecular Photochemistry, Benjamin. 4. A. Cox and T. Camp, Introductory Photochemistry, McGraw Hill. 5. R.P. Kundall and A. Gilbert, Photochemistry, Thomson Nelson. 6. J. Coxon and B.Holtom, Organic Photochemistry, Cambridge University Press. 7. C H Dupuoy and O L Chapman Molecular Reactions and Photochemistry, Prentice Hall 8. J Kagan, Organic Photochemistry, Academic Press.

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SEMESTER III
MCH-303: BIO-INORGANIC CHEMISTRY

Credits 3

Unit I	Electron Transfer in Biology Structure and function of metal of proteins in electron transport processes cytochrome's and ion-sulphure proteins, synthetic models. Biological nitrogen fixation, and its mechanism, nitrogenase, Chemical nitrogen fixation.
Unit II	Metalloporphyrins Structure and optical spectra; heme proteins: magnetic susceptibility, epr and electronic spectra; hemoglobin and myoglobin: molecular structures, thermodynamics and kinetics of oxygenation, electronic and spatial structures, synthetic oxygen carriers, model systems; iron enzymes, peroxidase, catalase and cytochrome P-450
Unit III	Metalloenzymes Copper enzymes, superoxide dismutase, cytochrome oxidase and ceruloplasmin; Coenzymes; Molybdenum enzyme: xanthine oxidase; Zinc enzymes: carbonic anhydrase, carboxy peptidase and interchangeability of zinc and cobalt in enzymes; Vitamin B12 and B12 coenzymes; Iron storage, transport, biomineralization and siderophores, ferritin and transferrins. Hemocyanin and Hemerithrin.
Unit IV	Metal Ions in Biological Systems Bulk and trace metals with special reference to Na, K, Mg, Ca, Fe, Cu, Zn, Co, and K+/Na+ pump.
	Books Suggested 1. S. J. Lippard & J. M. Berg. Principles of Bioorganic Chemistry, Panima Publ. Corpn. 2. E.-I. Ochiai. Bioinorganic Chemistry – An Introduction, Allyn and Bacon Inc. 3. M. N. Hughes. The Inorganic Chemistry of Biological Processes, Wiley . 4. R.P. Hanzlik. Inorganic Aspects of Biological and Organic Chemistry, Academic Press. 5. H. Kraatz & N. Metzler-Nolte (Eds.). Concepts and Models in Bioinorganic Chemistry, Wiley. 6. 2. I. Bertini, H. B. Gray, S. J. Dippard & J. S. Valentine, Bioinorganic Chemistry, Viva Books Pvt. Ltd. 7. 3. A.W. Addison, W.R. Cullen, D. Dolphin & B.R. James (eds.). Biological Aspects of Inorganic Chemistry, John Wiley .

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SEMESTER III
MCH-304: DIFFRACTION METHODS & SPECTROSCOPY

Credits 3

Unit I	**X-ray Diffraction** Bragg condition, Miller indices, X-Ray emission, Moseley Law, Duane Hunt Law, Laue Method and Debye Scherrer method of X-ray structural analysis of crystals, Crystel density, Structure of simple lattices and X-ray intensities, structure factor and its relation to intensity and electron density, phase problem. Description of the procedure for an X-ray structure analysis, absolute configuration of molecules.
Unit II	**Electron Diffraction** Electron diffraction vs X-Ray diffraction, Resolution and operating voltage of electron microscope, Measurement techniques: SEM and TEM , Sample preparation and elucidation of structure . **Neutron Diffraction** Difference between Neutron Diffraction and X-Ray Diffraction, Neutron Spectrometer : Instrumentation and Applications, Elucidation of structure of Ferro- and Antiferro- magnetic structures .
Unit III	**Photoelectron Spectroscopy** Basic principles; photo-electric effect, ionization process, X-Ray Photoelectron Spectroscopy (XPS) : Features, Advantages, Limitations and Applications. Photoelectron spectra of simple molecules. ESCA: Chemical information from ESCA.
Unit IV	**Infrared-Spectroscopy:** Electromagnetic Radiation, basic principle of IR spectroscopy, Review of linear harmonic oscillator, Selection rules, force constant and bond strengths, normal modes of vibration, group frequencies, overtones, combination bands and Fermi resonance, factors affecting the band positions and intensities, Far IR region, metal ligand vibrations Characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ethers, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, amides, acids, anhydrides, lactones, lactams and conjugated carbonyl compounds). Effect of hydrogen bonding and solvent effect on vibrational frequencies.
	Books Suggested 1. L.V. Azaroff, Elements of X-Ray Crystalography, McGraw-Hill/ Wiley, New York. 2. S. K. Chatterjee, X-Ray Diffraction,: Itys Theory and Applications, PHI Learning Pvt. Ltd. New Delhi. 3. R.M. Silverstein, G.C. Bassler and T.C. Morrill, Spectrometric Identification of Organic Compounds, John Wiley 4. Paulvan der Heide, X-ray Photoelectron Spectroscopy: An introduction to Principles and Practices , Wiley. 5. John F. Watts, John Wolstenholme, An Introduction to Surface Analysis by XPS and AES, Wiley. 6. P.K. Ghosh, Introduction of Photoelectron Spectroscopy.

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SEMESTER III

MCH-305: ADVANCED MEDICINAL CHEMISTRY

Credits 3

Unit I	**Antineoplastic agents** Introduction, cancer chemotherapy, role of alkylating agents and antimetabolite in treatment of cancer, carcinolytic antibiotics, and mitotic inhibitors, Synthesis of mechlorethamine, cyclophosphamide, melphalan, uracil, mustards and 6-mercaptopurine, recent development in cancer chemotherapy.
Unit II	**Psychoactive drugs-The chemotherapy of mind** Introduction, neurotransmitters, CNS depressants, general anesthetics, mode of action of hypnotics, sedatives, anti-anxiety drugs, benzodiazipines, buspirone, neurochemistry of mental diseases, Anti psychotic drugs the neuroleptics, anti-depressants, butyro phenones, stereo chemical aspects of psychotropic drugs. Synthesis of diazepam, oxazepam, chlorazepam, alprazolam, phenytoin, ethosuximide, trimethadione, barbiturates, thiopental sodium, gluthemide.
Unit III	**Tranquilizers:-** Phenothiazine derivatives - structure- activity relationship, metabolism and mode of action; other tranquilizers. Synthesis of chlorpromazine. **Sulpha Drugs:** Classification, structure-activity-relationship, Mode of action. Synthesis: Sulphadiazine, Sulphaisoxazole, Sulphadimethoxine.
Unit IV	**Diuretics (Drugs acting on renal system):** Classification, structure-activity relationships and mode of action of organomercurials, phenoxy acetic acids, purines carbonic anhydrase inhibitors, benzothiadiazines , ulphamoyl benzoic acid derivatives, endocrine antagonists.
	Books Suggested 1. Robert F.dorge Wilson and Gisvod. Textbook of organic Medicinal and Pharmaceu-tical Chemistry. 2. Ed. M.E. Wolff, John wiley. Berger's Medicinal Chemistry and drug discovery, Vol-I. 3. J.Faprhop and G.Penzillin. Organic synthesis-concept, method and starting material. 4. Eds.Korolkovas and Burkhattar J.H. John Wiley & sons. Essentials of medicinal Chemistry. 5. Graham & Patrick, Introduction to Medicinal Chemistry OUP 6. Goodman and Gilman's Pharmacological Basis of Therapeutics, McGraw-Hill. 7. Wilson and Gisvold's Text Book of Organic Medicinal and Pharmaceutical Chemistry, Ed Robert F. Dorge.

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SEMESTER III

MCH-306: CHEMISTRY OF POLYMERS

Credits 3

Unit I	[A]Introduction to polymers: Important terminologies and definitions used in polymer chemistry such as monomers, repeat units, degree of polymerization, molecular weight, size, glass transition temperature and morphology. Nomenclature of polymers and their classification, Types of polymers- linear, branched, crosslinked, ladder, thermoplastic, thermosetting, fibres, elastomers, natural polymers, addition and condensation polymers. Stereoregular polymers- atactic, syndiotactic and isotactic. [B]Polymerization mechanism**:** condensation, addition, radical chain, ionic and co-ordination and co-polymerization and their mechanisms. Methods of polymerisation in homogeneous and heterogeneous systems
Unit II	[A] Polydispersion-average molecular weight concept: Number, weight and viscosity average molecular weights. Polydispersity and molecular weight distribution. The practical significance of molecular weight. Measurement of molecular-weights. End-group, viscosity, light scattering, osmotic and ultracentrifugation methods. [B] Polymerization conditions and polymer reactions.. Analysis and testing of polymers: Chemical analysis of polymers, spectroscopic methods, X-ray diffraction study, Microscopy. Thermal analysis and physical testing-tensile strength. Fatigue, impact, Tear esistance, Hardness and abrasion resistance.
Unit III	Polymer Processing Plastics, elastomers, fibers. Compounding. Processing techniques. Clendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermoforming, foaming, reinforcing and fire spining
Unit IV	Structure, Properties and Application of Polymers: [A] Functional polymers: Fire retarding polymers and Electrically conducting polymers. [B] Biomedical polymers: Contact lens, dental polymers, artificial heart and kidney, [C] Polymers based on boron-borazines, boranes , carboranes, [D] Polymers based on Silicon, silicone's polymetalloxanes and polymetallosiloxanes, [E] Polymers based on Phosphorous-Phosphazenes, Polyphosphates
	Books Suggested 1. Polymer Science, V. R. Gowariker, N. V. Viswanathan and J. Sreedhar, Wiley-Eastern. 2. Textbook of Polymers Science, F.W. Billmeyer Jr., Wiley. 3. Contemporary Polymer Chemistry, H.R. Al cock and F.W. Lambe, Prentice Hall. 4. Developments in Inorganic polymer Chemistry, M.F. Lappert and G.J. Leigh. 5. Inorganic polymers- N.H. Ray. 6. Inorganic polymers, Graham and Stone. 7. Inorganic polymers, J. E. Mark, H. R. Allcok and R. West

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SEMESTER III
MCH-307: ORGANIC SYNTHESIS

Credits 3

Unit I	**Disconnection approach (Retrosynthetic analysis):** Guidelines to choose disconnection, Synthons and synthetic equivalents, Functional group interconversion, the order of events and its guidelines, One-group C-X disconnections, Two-group C-X disconnections, Chemoselectivity, reversal of polarity, cyclization reactions and summary of strategy. Amine synthesis, Stereoselectivity, stereoselective reactions, stereospecific reactions
Unit II	**One group C-C disconnections:** Alcohols, carbonyl compounds, regioselectivity. Use of acetylenes **Two-group C-C disconnections:** Diels-Alder reactions (stereospecificity, stereoselectivity, endo-selectivity, regioselectivity), 1,3-Difunctionalised and , unsaturated carbonyl compounds, 1,5-Difunctionalised compounds, Michael addition and Robinson Annelation.
Unit III	**Oxidation Processes** Introduction, Different oxidative processes. Mn(VII) oxidants:Oxidation of alcohols,alkenes,alkynes,aldehydes,ketones,aromatic side chains and rings,amines Cr (VI) oxidants:Oxidation of alcohols /phenols(Jones reagent,Collins reagent,PCC,PDC), alkanes,alkenes,aromatic side chain and aromatic nucleus. Oxidation with peracids: oxidation of alkenes ,ketones. Other oxidants: Oxidation with ruthenium tetraoxide, lead tetra acetate, thallium. (III) nitrate,potassium periodate,aluminium tri-isopropoxide and aluminium tri-t-butoxide, hydrogen peroxide, t-Butyl hydroperoxide
Unit IV	**Reduction Processes** Introduction, Different reductive processes. Catalytic hydrogenation: Heterogeneous hydrogenation, Homogeneous hydrogenation. Metal hydride reduction :Scope, Mechanism, stereochemical aspects of metal hydride reduction using lithium aluminium hydride,Sodium borohydride, Diboranes Reduction by dissolving metals: Scope and basic mechanism, Clemensen reduction, Birch reduction Reduction by other reducing agents: Hydrazines, Diimid
	Books Suggested 1. S. Warren, Designing Organic Synthesis, Wiley. 2. W.Carruthers,S ome Modren Methods of Organic Synthesis, Cambrige Univ. Press. 3. H.O. House, Modern Synthetic Reactions, W.A. Benjamin 4. V.K.Ahluwalia ,Organic Reaction Mechanisms, Narosa Publishing House 5. S.M.Mukherji and S.P.Singh,Reaction Mechanism in Organic Chemistry, Macmilan 6. J. March, Advanced Organic Synthesis: Reaction, Mechanisms and Structure, Wiley

Scheme and Syllabus
of
M.Sc. Chemistry

II and IV Semesters
Effective from Academic Year 2018-19 onwards

Devi Ahilya Vishwavidyalaya,
Indore (M.P.), 452001

SCHOOL OF CHEMICAL SCIENCES
DEVI AHILYA VISHWAVIDYALAYA, INDORE

COURSE STRUCTURE

M.Sc. Chemistry
(Four Semester Course Based on Choice Based Credit System)
w.e.f. Jan. 2018

SEMESTER I

Code	Type of Course	Name of the Course	Credits
MCH-101	Core Course	Inorganic Chemistry - I	3
MCH-102	Core Course	Organic Chemistry - I	3
MCH-103	Core Course	Physical Chemistry - I	3
MCH-104	Core Course	Symmetry, Group Theory and Spectroscopy	3
MCH-105 MCH-106	Elective Course –Generic* (Any One)	Concept of Mathematics General Biology	3
MCH-107	Laboratory Course I	Practical	5
		Comprehensive Viva-Voce	4
Total Credits			**24**

SEMESTER II

Code	Type of Course	Name of the Course	Credits
MCH-201	Core Course	Inorganic Chemistry - II	3
MCH-202	Core Course	Organic Chemistry - II	3
MCH-203	Core Course	Physical Chemistry-II	3
MCH-204	Elective Course-Discipline Centric	Chemistry of Drugs	3
MCH-205 MCH-206	Elective Course –Generic* (Any One)	Computer Applications in Chemistry Computer Programming	3 3
MCH 207	Laboratory Course II	Practical	5
		Comprehensive Viva-Voce	4
Total Credits			**24**

SEMESTER III

Code	Type of Course	Name of the Course	Credits
MCH-301	Core Course	Molecular Spectroscopy	3
MCH-302	Elective Course-Discipline Centric	Organic Photochemistry	3
MCH-303	Elective Course-Discipline Centric	Bio-inorganic Chemistry	3
MCH-304	Elective Course-Discipline Centric	Diffraction Methods and Spectroscopy	3
MCH-305	Elective Course –Generic* (Any One)	Advanced Medicinal Chemistry	3
MCH-306		Chemistry of Polymers	3
MCH-307		Organic Synthesis	3
MCH-308	Laboratory Course III	Practical & Spectral Interpretation / Seminar	5
		Comprehensive Viva-Voce	4
Total Credits			**24**

SEMESTER IV

Code	Type of Course	Name of the Course	Credits
MCH-401	Core Course	Advances in Analytical Chemistry	4
MCH-402	Elective Course-Discipline Centric	Environmental Chemistry	4
MCH-403	Elective Course-Discipline Centric	Solid State Chemistry and Nanoscience	4
MCH-404	Elective Course-Discipline Centric (Any One)	Bio-organic Chemistry	4
MCH-405		Organometallic Chemistry	4
MCH-406		Chemistry of Natural Products	4
MCH-407		Heterocyclic Chemistry	4
MCH-408	Project	Dissertation/ Project	4
		Comprehensive Viva-Voce	4
Total Credits			**24**

***Note:**

4. The students can choose this course or any other P.G. level Generic Course of 3 Credits being run at other School/ Institute.
5. Credit earned through Choice Based Course from other department will be counted in calculating CGPA for the award of the Degree in which admission is taken.
6. Teaching and examination of Choice Based Course will be conducted by School of Studies / Institute where this course is being offered.

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SEMESTER II

MCH-201: INORGANIC CHEMISTRY-II

Credits 3

Unit – I	**Electronic Spectra and Magnetic Properties of Transition Metal Complexes :** Spectroscopic ground states, correlation. Orgel and Tanabe-Sugano diagrams for transition metal complexes (d^1-d^9 states), calculations of 10Dq, B and β parameters, charge transfer spectra, anomalous magnetic moments, Orbital contribution to magnetic moment, magnetic exchange coupling and spin crossover.
Unit – II	**Metal π-Complexes** Metal carbonyl, structure and bonding, vibrational spectra of metal carbonyls for bonding and structural elucidation, important reactions of metal carbonyls; preparation, bonding structure and important reaction of transition metal nitrosyl, dinitrogen and dioxgen complexes; tertiary phosphine as ligand.
Unit – III	**Boranes** Classification, preparation, reactivity, bonding and topology of Boranes, carboranes, metalloboranes and metallocarbonaes.
Unit – IV	**Metal Clusters, Chains and Fullerenes** Compounds with metal-metal multiple bonds. Isopoly and heteropoly acids and their salts. Fullerenes
	Books Suggested : 1. Advanced Inorganic Chemistry, F.A. Cotton and Wilkinson, John Wiley. 2. Inorganic Chemistry, J.E. Huheey, Harpes & Row. 3. Chemistry of the Elements. N.N. Greenwood and A. Earnshow, Pergamon. 4. Inorganic Electronic Spectroscopy, A.B.P. Lever, Elsevier. 5. Magnetiochemistry, R.1. Carlin, Springer Verlag. 6. Comprehensive Coordiantion Chemistry eds., G. Wilkinson, R.D. Gillars and J.A. Mc Cleverty, Pergamon.

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SEMESTER II
MCH-202: ORGANIC CHEMISTRY-II

Credits 3

Unit – I	Common organic reactions and their mechanisms, base catalysed reactions, Stork Enamine reaction, acid catalysed reactions, reactions of carboxylic acids and their derivatives Reagents in organic synthesis and relevant name reactions, organotransition metal reagents, some transition metal organometallic reactions, phosphorus containing reagents, organosulphur compounds, silicon reagents, boron containing reagents
Unit – II	Eletrophilic aromatic substitution- the arenium ion mechanism, orientation and reactivity, Ipso substitution, aromatic rearrangements Aromatic nucleophilic substitution-S_NAr mechanism, S_N1 mechanism, benzyne mechanism
Unit – III	Stereochemistry and mechanism of addition to carbon-carbon multiple bonds, addition reactions of alkenes and alkynes involving electrophiles, Birch reduction, epoxidation of alkenes Addition to carbon-hetero multiple bonds, addition to carbonyl compounds, metal hydride reduction, Meerwein-Ponndorf-Verley reduction, Wittig reaction
Unit – IV	Pericyclic reactions, conservation of molecular orbital symmetry, electrocyclic reactions, cycloaddition, sigmatropic rearrangements, the ene reaction, Mobius – Huckel analysis (PMO approach), correlation diagram method
	Books Suggested 1. J. March., Advanced Organic Chemistry: Reactions, Mechanisms and Structure, John Wiley 2. P. S. Kalsi. Stereochemistry, Conformation and Mechanism, New Age International 3. Peter Sykes, A guide book to mechanism in Organic chemistry, Orient-Longmans 4. S. M. Mukherji and S. P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan 5. F. A. Carey and R. J Sundberg, Advanced Organic Chemistry, Part A and B, Plenum 6. P. S. Kalsi., Organic Reactions and their Mechanisms, New Age International

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SEMESTER II
MCH-203: PHYSICAL CHEMISTRY-II

Credits 3

Unit – I	**Chemical Dynamics** Chemical kinetics: Empirical rate laws, Arrhenius equation, theories of reaction rates, determination of reaction mechanisms. Kinetics of inorganic mechanisms : Hydrogen- Bromine reaction, Hydrogen- Chlorine Reaction. Decomposition of nitrogen pentaoxide, Decomposition of Ozone. Kinetics of organic Decompositions : Pyrolysis of acetaldehyde, decomposition of ethane.
Unit – II	**Surface Chemistry and Catalysis** Adsorption : Gibbs adsorption isotherm, BET equation and estimation of surface area . Micelles:Surface active agents, classification of surface active agents, micellization, critical micellar concentration (CMC), factors affecting the CMC of surfactants, thermodynamics of micellization Concepts of catalysis: Kinetics of homogenous catalysis, kinetics of enzyme reactions,
Unit – III	**Complex and Fast Reaction** Complex Reactions: Opposing reactions, Complex reactions, Parallel reactions , kinetics of free radical polymerization Fast reactions: Experimental techniques for fast reactions viz., flow method, relaxation method, flash photolysis
Unit – IV	**Electrochemical Methods** Voltammetric Techniques: Nernst equation, Voltammetry, Current voltage relationship, characteristics of DME, half-wave potential, Types of currents, Qualitative and Quantities applications, Numerical problems. Amperometric titrations: amperometric titration curves, apparatus and technique of amperometric titration , applications of amperometric titrations. Cyclic voltammetry; Principle, Instrumental aspects and applications. Linear-scan voltammetry. Corrosion: Classification of corrosion, Wet corrosion, Dry corrosion, Electrochemical principle of corrosion, factors affecting corrosion rate, Corrosion prevention methods, corrosion inhibitors, Corrosion protection of the metals by surface treatment.
	Books Suggested 1. P.W. Atkins , Physical Chemistry, ELBS. 2. A.K. Chandra, Introduction to Quantum Chemistyry, Tata Mc Graw Hill. 3. Ira N. Levine, Quantum Chemistry, Prentice Hall. 4. K.J. Laidler, Chemical Kinetics. McGraw-Hill. 5. V. Moraoi, Micelles, Theoretical and Applied Aspects, Plenum. 6. A. J. Bard and L. R. Faulkner, Electrochemical Methods: Fundamentals and Applications, John Wiley & Sons: New York.

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SEMESTER II

MCH-205: COMPUTER APPLICATIONS IN CHEMISTRY

Credits 3

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

Unit – I	**Use of standard Programs and Packages** Power Point preparation and Presentation of research work MS EXCEL
Unit – II	**Use of Computer Softwares** ACD Lab Origin Programs related to pi-chart, Bar diagram
Unit – III	**Fundamental concepts of Programming** Fundamental s of BASIC programming, Flow Charts for problems related to chemistry and mathematics, Basic concepts of FORTON, BASIC and C- Language.
Unit – IV	**Programming in Chemistry** Developing of small computer programs involving simple formulae in Chemistry such as Van der Waals equation. Chemical Kinetics (Determination of Rate constant), Radioactive decay (Half Life and Average Life), Determination Normality, Molarity and Molality of solutions, Evaluation of Electronegativity of atom and Lattice Energy.
	Books Suggested : 1. Fundamentals of Computer: V. Rajaraman (Prentice Hall Advanced Organic Chemistry, F.A. Carey and R.J. Sunderg, Plenum. 2. Computers in Chemistry : K.V. Raman (Tata Mc Graw Hill) 3. Computer Programming in FORTRAN IV-V Rajaraman (Prentice Hall)

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SEMESTER II
MCH-206: COMPUTER PROGRAMMING

Credits 3

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

Unit – I	**Introduction to computers and Computing** Basic structure and functioning of computer with a PC as illustrative example. Operating systems with DOS as an example Introduction to UNIX and WINDOWS.
Unit – II	**Computer Programming in FORTRAN/C/BASIC/ C** (The language features are listed here with reference to FORTRAN. The instructor may choose another language such as BASIC or C the features may be replaced appropriately). Constants and variables. Operations and symbols Expressions. Arithmetic assignment statement. Input and output Format statement. Termination statements. Branching statements as IF or GO TO statement. LOGICAL variables. Double precession variables. Subscripted variables and DIMENSION. DO statement FUNCTION AND SUBROUTINE. COMMON and DATA statement
Unit – III	**Programming in Chemistry** Developing of small computer codes (FORTRAN/C/BASIC/C) involving simple formulae in Chemistry, such as Van der Waals equation. Chemical kinetics (determination of Rate constant) Radioactive decay (Half Life and Average Life). Determination Normality, Molarity nd Molality of solutions. Evaluation Electronegativity of atom and Lattice Energy from experimental determination of molecular weight and percentage of element organic compounds using data from experimental metal representation of molecules in terms of elementary structural features such as bond lengths, bodn angles, dihedral angles, etc.
Unit – IV	**Use of Computer programmes** Operation of PC. Data Processing. Running of standard Programs and Packages such as MS WORD, MS EXCEL special emphasis on calculations and chart formations. X-Y plot. Use of Programs Chemcraft, Molden and PovRey.
	Books Suggested : 1. Fundamentals of Computer: V. Rajaraman (Prentice Hall Advanced Organic Chemistry, F.A. Carey and R.J. Sunderg, Plenum. 2. Computers in Chemistry : K.V. Raman (Tata Mc Graw Hill) 3. Computer Programming in FORTRAN IV-V Rajaraman (Prentice Hall)

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SEMESTER IV

MCH-401: ADVANCES IN ANALYTICAL CHEMISTRY

Credits 4

Unit – I	**Statistical tests and Error Analysis:** Accuracy, precision, classification of errors, significant figures and computation, mean deviation and standard deviation, Least square methods, regression coefficient , F-test, t-test and Chi-test.
Unit – II	**Spectrochemical and Thermal Methods :** Spectrophotometry: Quantities principles of absorption, instrumentation, single beam, double beam, determination of pKa value of an indicator, detectors, applications. Atomic spectroscopy: Principles of emissions, atomic emission spectroscopy and flame emission spectroscopy, monochromator, detector, types of interferences, Thermal methods of analysis: Principles and instrumentation of TG and DTA. Complementary nature of TG and DTA. Differential scanning calorimeter (DSC). Applications of thermal methods in analytical chemistry .
Unit – III	**Advanced Electrochemistry:** Coulometric Analysis: Constant current coulometric analysis, controlled potential coulometric analysis, characterization of coulometric analysis, constant current coulometric titrations, cells for coulometric titrations, apparatus and methods, external generation of reagents, application of coulometric titrations- neutralization titrations, precipitation and complex formation titrations.
Unit – IV	**Separation Techniques:** **Ion Exchange chromatography:** Basic principles, ion exchange equilibria, types of ion exchange resins (strongly acidic, strongly basic, weakly acidic, weakly basic), ion exchange capacity. **Gas Chromatography** Introduction, instrumentation, types of column (packed, open tubular etc.), types of detector (TCD, ID, FID, ECD, element selective detectors), programme temperature gas chromatography, applications of GC for quantitative analysis. Internal standard method and standard addition method. **High performance liquid chromatography** Introduction, Types of liquid chromatography, high performance liquid chromatography and instrumentation, derivatization, quantitative analysis. **Liquid –liquid extraction** Distribution coefficient, distribution ratio, solvent extraction of metals, analytical separations, multiple batch extractions, countercurrent distribution., multiple extractions.
	Books Suggested 1. Gary D.Christian, Analytical Chemistry, John-Wiley 2. H.A.Willard, L.L.Merrit, and J.A.Dean, Instrumental Methods of Analysis, Van Nostrand, New York, 1986. 3. D.A.Skoog & D.M.West Principles of Instrumental Analysis. Holt Rinahart Winston, New York, 1988. 4. K A Robinsons Chemical Analysis, Harper Collins Publishers, NewYork. **5.** A.J. Bard and L. R. Faulkner, Electrochemical Methods: Fundamentals and Applications, John Wiley & Sons: New York.

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SEMESTER IV
MCH-402: ENVIRONMENTAL CHEMISTRY

Credits 4

Unit-I	**Environment** Introduction. Composition of atmosphere, vertical temperature, temperature inversion, heat budget of the earth, atmospheric system, vertical stability atmosphere, Biochemical cycles of C, N, P, S and O. Biodistribution of elements. **Hydrosphere** Chemical composition of water bodies-lakes, streams, rivers and wet lands etc. Hydrological cycle Aquatic pollution – Inorganic,organic, pesticide, agriculture, industrial and sewage, detergents, oil spills and oil pollutants. Water quality parameters – dissolved oxygen, biochemical oxygen demand, solids, metals, content of chloride, sulphate, phosphate, nitrate and microorganisms. Water quality standards. Analytical methods of measuring BOD, DO, COD, F, Oils, metals (As, Cd, Cr, Hg, Pb, Se etc.),residual chloride and chlorine demand. Purification and treatment of water.
Unit-II	**Soils** Composition, micro and macro nutrients, pollution – fertilizers, pesticides, plastics and metals. Waste treatment. **Atmosphere** Chemical composition of atmosphere – particles, ions and radicals and their formation. Chemical and photochemical reactions in atmosphere, smog formation, oxides of N, C, S, O and their effect, pollution by chemicals, petroleum, minerals, chlorofluorohydrocarbons. Green house effect, acid rain, air pollution controls and their chemistry. Analytical methods for measuring air pollutants. Continuous monitoring instruments. Urban Air Pollution Exhaust emissions, damaging effects of carbon monoxide. Monitoring of CO. Control strategies.
Unit-III	**Industrial Pollution** Cement, sugar, distillery, drug, paper and pulp, thermal power plants, nuclear power plants, metallurgy. Polymers, drugs etc. Environmental disasters – Cherbonyl, Three mile island, Seveso and minamata disasters, Japan tsunami
Unit-IV	**Environmental Toxicology** Toxic heavy metals **:** Mercury, lead, arsenic and cadmium. Causes of toxicity. Bioaccumulation, sources of heavy metals. Chemical speciation of Hg, Pb, As, and Cd. Biochemical and damaging effects. Toxic Organic Compound **:** Pesticides, classification, properties and uses of organochlorine and ionospheres pesticides detection and damaging effects.

	Books Suggested 1. Environmental Chemistry, S.E. Mahan, Lewis Publishers. 2. Environmental Chemistry, Sharma & Kaur, Krishna Publishers. 3. Environmental Chemistry, A.K. De, Wiley Eastern 4. Environmental Pollution Analysis, S.M. Khopkar, Wiley Eastern 5. Standard Method of Chemical Analysis, F.J. Welcher Vol. III, Van Nostrand Reinhold Co. 6. Environmental Toxicology, Ed. S. Landsberger and M. Creatchman, Gordon and Breach Science Publication. 7. Enviromental Chemistry, C. Baird, W.H. Freeman.

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SEMESTER IV

MCH-403: SOLID STATE CHEMISTRY & NANOSCIENCE

Credits 4

Unit- I	**Solid State Reactions** General Principles,Experimental procedure, Coprecipitation as a procedure to solid state reactions, Crystallization of solutions and gels (zeolite synthesis),melts,and glasses, Vapor phase transport methods, Modification of existing structures by intercalation and Ion exchange reactions, preparation of thin films - electrochemical methods, chemical vapour deposition; Growth of single Crystals – Czochralski method, Bridgman & Stokbarger methods, zone melting.
Unit -II	**Crystal defects and Non- stoichiometry** Stoichiometric Defects: Perfect and imperfect crystals, Types of defects, Point defects Schottky defect , Frenkel defects ,The concentration of defects: Law of Mass action and statistical thermodynamic approaches, Numericals Non-Stoichiometric Defects: Origin of non-stoichiometry, Colour centers: F-centre,H-centre,V-centre.
Unit- III	**Superconductors** Superconductivity: occurrence of superconductivity, destruction of superconductivity by magnetic fields (Meissner effect), BCS theory of superconductivity, **Organic Superconductors**: Brief introduction, Types , Examples and their Applications **Optical properties**: Luminescence and phosphors; Configurational coordinate model, Antistoke phosphors, Lasers — ruby and neodymium
Unit- IV	**Nanotechnology & Nanomaterials** Basic concepts of Nanoscience -nanotechnology and their role in various fields, Synthesis of nanoparticles (Top-down -Nanolithography, CVD; Bottom-up -Sol-get processing, chemical synthesis) , Chemistry involved in the synthesis of inorganic (metal oxides, metals, quantum-dots) nanostructured materials, and their characterization techniques, Properties of nanostructured materials: optical, magnetic and chemical properties. Applications in the multiple domains of nanotechnology (environment, energy, medical, optics, lab-on-chip) Nanometerials: Introduction, Carbon-based materials-Fullerenes, Carbon nanotubes, Quantum well, Quantum wires, Quantum dots, Dendrimers

	Books Suggested 1. Solid state chemistry and its applications, A.R. West. Plenum 2. Principles of the Solid State, H.V. Keer, Wiley Eastern 3. Solid State Chemistry, N.B. Hannay 4. Solid State Chemistry, D.K. Chakrabarty, New Wiley Eastern. 5. Introduction to nanotechnology: Charles P.Poole, Jr. Frank, J. Owens: Wiley India 6. Chemistry of Advanced Materials: An overview, L.V. Interrate, M.J. Hampden-Smith Wiley-VCH 7. Nanomaterials : A.K. Bandyopadhyay; New Age International Publishers 8. Nanotechnology by Mark Ratner and Daniel Ratner, Pearson Education .

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SEMESTER IV
MCH-404: BIOORGANIC CHEMISTRY

Credits 4

Unit-I	**Introduction :** Basic Consideration, Proximity effects and molecular adoption. **Enzymes**: Introduction, Chemical and Biological catalysis, remarkable properties of enzymes, Nomenclature and classification, concept and identification of active site by use of inhibitors, reversible & irreversible inhibition.
Unit-II	**Kinds of Reactions Catalyzed by Enzymes:** B-cleavage and consideration, some isomerization and rearrangement reactions. Enzyme catalyzed carboxylation and decarboxylation. **Mechanism of Enzyme action:** Transition state theory, Orientation and steric effect, acid-base catalysis, covalent catalysis. **Co-Enzyme Chemistry:** Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes, Structure and biological functions of coenzyme A.
Unit-III	**Enzyme Models :** Host guest chemistry, Chiral recognition and catalysis, molecular recognition, molecular asymmetry and prochirality, Biomimetic chemistry, crown ethers, cryptates, cyclodextrins, cyclodextrin based enzyme models, Calixarenes, ionophores, micelles synthetic enzyme or synzymes.
Unit-IV	**Biotechnological Application of enzymes:** Large scale production and purification of enzymes, techniques and methods of immobilization of enzyme activity, application of immobilized enzymes, effect of immobilization on Enzyme activity, application of immobilized enzymes. Clinical uses of enzymes, enzyme therapy, enzymes and recombinant DNA technology.
	Books Suggested 1. Bioorganic chemistry:A Chemical Approch to Enzyme action,Hermann Dugas and C.Penny, Springer-Verag. 2. Understanding Enzymes, Trevor Palmer, Prentice Hall 3. Enzyme Chemistry: Impact and applications, Ed Collin J Suckling, Chapman and Hall 4. Enzyme mechanism a Ed. M.I.Page and A. Williams, Royal society of chemistry 5. Fundamentals of Enzymology, N.C. Price and L. Stevens, Oxford University Press. 6. Enzymattic Reaction Mechanism C. Walsh,W.H. Freeman. 7. Enzyme Structure and Mechanism A Fersht, W.H.Freeman. 8. Biochemistry : The Chemical reaction of leaving cells, D.E.Metzler, Academic Press. 9. Biochemistry(4^{th} edn.) Stryer, L.W.; H.Freeman & Co.(1995) 10. Understanding Enzymes Palmer, T.; Prantice Hall (1995).

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SEMESTER IV
MCH-405: ORGANOMETALLIC CHEMISTRY

Credits 4

Unit-I	**Main Group Organometallics** Synthesis and reactions of organolithium compounds; Synthesis and reactions of organomagnesium compounds; Organometallics of zinc and mercury: preparation, structure, bonding and reactions of aluminum organyls; Thallium(I) organyls (synthesis of TlCp); Organyls of sodium, synthesis of NaCp; Silicon and tin organyls of coordination number 4.
Unit-II	**Transition Metal–Carbon Bond** Transition Metal–Carbon σ-Bond: Brief review of metal alkyl compounds; transition metalcarbene and transition metal-carbyne compounds; transition metal vinylidene and transition metal allenylidene compounds. Cyclopropenyl cation ($C_3R_3^+$) as a ligand; C_4R_4 as a ligand (R = H, Me, Ph)
Unit-III	**Syntheses of Cyclopentadienyl and Arene Metal Analogues** Synthesis and reactions of cyclopentadienyl metal carbonyls, cyclopentadienyl metal hydrides, cyclopentadienyl metal halides, arene metal carbonyls, η6-arene-chromium tricarbonyl in organic synthesis.
Unit-IV	**Applications to Organic Synthesis and Homogeneous Catalysis** (a) In Organic Synthesis: Hydrozirconation of alkenes and alkynes; reagent; η4-diene iron-tricarbonyls in organic synthesis (b) In Catalysis: Asymmetric hydrogenation; synthesis of acetic acid and glycol (Monsanto acetic acid process); Arylation/vinylation of olefins (Heck reaction); Wacker process (olefin oxidation); Asymmetric epoxidation.
	Books Suggested 1. C. Elschenbroich. *Organometallics* (3rd edn.), Wiley-VCH Publication (2006). 2. C. Elschenbroich & A. Salzer. *Organometallics – A Concise Introduction* (2nd edn.),VCH Publication (1992). 3. F. Mathey & A. Sevin. *Molecular Chemistry of the Transition Elements*, John Wiley (1996). 4. F. A. Cotton & G. Wilkinson. *Advanced Inorganic Chemistry* (5th edn.), John Wiley (1988). 5. R. C. Mehrotra & A. Singh. *Organometallic Chemistry: A Unified Approach* (2nd

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SEMESTER IV
MCH-406: CHEMISTRY OF NATURAL PRODUCTS

Credits 4

Unit-I	**Terpenoids** Structure determination, stereochemistry, biosynthesis and synthesis of some common terpenopids Citral, α-Terpeneol, Farnesol, Zingiberence, Santonin, Phytol and Abietic acid.
Unit-II	**Alkaloids** Structure, stereochemistry, synthesis and biosynthesis of some common alkaloids Ephedrine, Nicotine, Atropine, (+) Conin ,Quinine and Morphine.
Unit-III	**[a] Steroids:** Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of: Cholesterol, Bile acids. Harmons: Androsterone, Testosterone, Ostrone, Progesterone, Aldosterone, Biosynthesis of Steroids. **[B] Prostaglandis** Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2a.
Unit-IV	**[A] Plant Pigments** Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin Quercetin, Myrcetin, Vitexin, Diadzein, Aureusin, Cyanidin, Hirsutidin, Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway. Prophyrins: Structure and synthesis of Haemoglobin and Chlorophyll. **[B] Pyrethroids and Rotenones** Synthesis and reactions of Pyrethroids and Rotenones. (For structure elucidation, emphasis is to be placed on the use of spectral parameters wherever possible).
	Books Suggested 1. Organic Chemistry : Vol. 1 and 2, I. L. Finar, ELBS 2. Organic Chemistry of Natural Products Vol. I and Vol. II, Gurdeep R. Chatwal, Himalaya Publishing House 3. Stereoselective Synthesis: A Practical Approach, M. Norgradi, VCH. 4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier. Introduction to Flavonoids, B.A. Bohm. Harwood Academic Publishers. 5. New Trends in Natural Product chemistry, Ataaur Rahman and M.L. Choudhary, Harwood Academic Publishers. 6. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers. A. R. Katritzky and C. W. Rees: Comprehensive Heterocyclic Chemistry, Pergamon

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SEMESTER IV
MCH-407: HETEROCYCLIC CHEMISTRY

Credits 4

Unit-I	**Nomenclature of Heterocycles** Replacement and systematic nomenclature (Hantzsch-Widman system) for monocyclic, fused , bridged and spiro heterocycles **Aromatic Heterocycles** General chemical behaviour of aromatic heterocycles,classification,criteria of aromaticity(bond lengths,ring current and chemical shifts in ^{1}HNMR,empirical resonance energy,delocalization energy,and Dewar resonance energy,Diamagnetic susceptibility exaltations)
Unit-II	**Non- Aromatic Heterocycles** Strain-Bond angle and Torsional strains and their consequences in small ring heterocycles Conformation of six membered heterocycles with reference to molecular geometry, barrier to ring inversion, pyramidal inversion and 1,3-diaxial interaction **Heterocyclic Synthesis** Principles of heterocyclic synthesis involving cyclization and cycloaddition reactions
Unit-III	**Small Ring Heterocycles** Three- membered and four- membered Heterocycles- synthesis and reactions of aziridines, oxiranes, thiranes, azetidines, and oxetanes **Benzo Fused Five- membered Heterocycles** Synthesis and reactions of benzopyrroles, benzofurans and benzothiophenes
Unit-IV	**Meso-ionic Heterocycles** General classification, chemistry of some important meso-ionic heterocycles of type-A and B and their applications. **Six- membered Heterocycles with one Heteroatom** Synthesis and reactions of coumarins, chromones **Six- membered Heterocycles with two or more Heteroatoms** Synthesis and reactions of diazines and triazines **Seven- membered Heterocycles** Synthesis and reactions of azepines, oxepines, thiepines.and diazepines
	Books Suggested 1. R. M. Acheson : An Introduction to Chemistry of Heterocyclic Compounds (Interscience) 2. R. K. Bansal: Heterocyclic Chemistry (Wiley E). 3. L. A. Paquitte: Principles of Modern Heterocyclic Chemistry. 4. A. R. Katritzky: Advances in Heterocyclic Chemistry (A.P.). 5. R. R. Gupta, M. Kumar and V. Gupta: Heterocyclic Chemistry, Vol-1-3, Springer Verlag. 6. T. Eicher and S. Hauptmann: The Chemistry of Heterocycles, Thieme 7. J. A. Joule, K. Mills and G. F. Smith: Heterocyclic Chemistry, Chapman and Hall

School of Chemical Sciences
Devi Ahilya Vishwavidyalaya, Indore

M.Sc. Chemistry

SEMESTER IV
MCH-406: CHEMISTRY OF NATURAL PRODUCTS

Credits 4

Unit-I	**Terpenoids** Structure determination, stereochemistry, biosynthesis and synthesis of some common terpenopids Citral, α-Terpeneol, Farnesol, Zingiberence, Santonin, Phytol and Abietic acid.
Unit-II	**Alkaloids** Structure, stereochemistry, synthesis and biosynthesis of some common alkaloids Ephedrine, Nicotine, Atropine, (+) Conin ,Quinine and Morphine.
Unit-III	**[a] Steroids:** Occurrence, nomenclature, basic skeleton, Diel's hydrocarbon and stereochemistry, Isolation, Structure determination and synthesis of: Cholesterol, Bile acids. Harmons: Androsterone, Testosterone, Ostrone, Progesterone, Aldosterone, Biosynthesis of Steroids. **[B] Prostaglandis** Occurrence, nomenclature, classification, biogenesis and physiological effects. Synthesis of PGE2 and PGF2a.
Unit-IV	**[A] Plant Pigments** Occurrence, nomenclature and general methods of structure determination. Isolation and synthesis of Apigenin, Luteolin Quercetin, Myrcetin, Vitexin, Diadzein, Aureusin, Cyanidin, Hirsutidin, Biosynthesis of flavonoids: Acetate pathway and Shikimic acid pathway. Prophyrins: Structure and synthesis of Haemoglobin and Chlorophyll. **[B] Pyrethroids and Rotenones** Synthesis and reactions of Pyrethroids and Rotenones. (For structure elucidation, emphasis is to be placed on the use of spectral parameters wherever possible).
	Books Suggested 1. Organic Chemistry : Vol. 1 and 2, I. L. Finar, ELBS 2. Organic Chemistry of Natural Products Vol. I and Vol. II, Gurdeep R. Chatwal, Himalaya Publishing House 3. Stereoselective Synthesis: A Practical Approach, M. Norgradi, VCH. 4. Rodd's Chemistry of Carbon Compounds, Ed. S. Coffey, Elsevier. Introduction to Flavonoids, B.A. Bohm. Harwood Academic Publishers. 5. New Trends in Natural Product chemistry, Ataaur Rahman and M.L. Choudhary, Harwood Academic Publishers. 6. Insecticides of Natural Origin, Sukh Dev, Harwood Academic Publishers