



MSC in Chemistry

1st Semester

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSCH 101	Inorganic chemistry	40	60	100
MSCH 102	Organic chemistry	40	60	100
MSCH 103	Physical chemistry	40	60	100
MSCH 104	Chemistry Practical	40	60	100
Total		180	220	400

2nd Semester

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSCH 201	Group Theory and Spectroscopy	40	60	100
MSCH 202	Mathematics for Chemists/Biology chemists	40	60	100
MSCH 203	Computer for chemist	40	60	100
MSCH 204	Chemistry Practical	60	40	100
Total		180	220	400

3rd Semester

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSCH 301	Application of Spectroscopy Photochemistry Solid State Chemistry	40	60	100
MSCH 302	Bioinorganic Chemistry	40	60	100
MSCH 303	Environmental Chemistry	40	60	100
MSCH 304	Organic Synthesis—I	40	60	100
MSCH 305	Chemistry Practical	60	40	100
Total		220	280	500

4th Semester

PAPERS CODE	PAPERS NAME	INTERNAL	EXTERNAL	TOTAL
MSCH 401	Organic Synthesis—II	40	60	100
MSCH 402	Heterocyclic Chemistry	40	60	100
MSCH 403	Chemistry for Natural Products	40	60	100

MSCH 404	Chemistry Practical	60	40	100
Total		180	220	400

1MSCH01: Inorganic Chemistry

Objectives:

On completion of this course, the prospective teacher shall:

- Predict bond order & shapes of covalent compounds using MO & VB theories.
- Classify coordination compounds & predict isomerism, coordination number, shapes and spectral term symbol for coordination compounds.
- Understand and apply CFT for splitting of d-orbitals in octahedral, tetrahedral and square planar complexes.
- Determine symmetry elements and their point groups of molecules by point group theory
- Recognize bonding, synthesis and application of organometallic complexes.

Detailed Course Content:

Unit-I: Stereochemistry and Bonding in compounds

Valence bond theory, Types of overlapping, Molecular orbital theory, Bond order, Factor affecting on Bond length (Bond strength), Homonuclear diatomic molecules, Heteronuclear diatomic molecules, Shapes of covalent compounds, VSEPR, Hybridization.

Unit-II: Transition Elements & Coordination Compounds

Classification of Coordination compounds, Werner's theory, Nomenclature, Isomerism, Coordination number, structures and shapes, electronic spectra (spectroscopic terms, term symbols, calculation of spectroscopic terms).

Unit-III: Crystal Field Theory

Concept of crystal field theory, Crystal Field Splitting of d-orbitals (Octahedral, tetrahedral and square planar complexes with CFSE concept), Factors affecting the value of Δ , High spin and Low spin complexes, T_d distortion, Jahn-Teller effect, splitting of d and f ground terms and its Orgel diagram, Example based on CFSE, Pairing energy and magnetic momentum.

Unit-IV: Symmetry and Point Group Theory

Symmetry elements and Operations, Point groups and their symmetry elements, Properties and representation of Groups (Matrices, Representation of point groups, character table). Examples and application of symmetry.

Unit-V: Organometallic Complexes

Introduction, Structure & Classification, 18 electron rule, hapticity, ligands in organometallic chemistry, Metal-Carbonyl and clusters, organometallic catalysis: Hydroformylation, Monsanto acetic acid process, Wacker (Smidt) process, Wilkinson's catalyst, Mond process.

Suggested Readings:

1. Agarwala S. K.; Lal K. (2009), Advanced Inorganic Chemistry, Meerut (ISBN: 978-81- 8398-773-8).
2. Miessler, G. L; Fischer, P. J.; Tarr, D. A. (2014, sixth edition) Inorganic Chemistry. Library of Congress Cataloging-in-Publication Data (ISBN: 978-0-321-81105-9).
3. Prasad, R. K. (2004, Second edition) Quantum Chemistry. New Delhi: New Age

International (P) Ltd. (ISBN: 81-224-1264-5).

4. Chandra, A. K. (2008, Fourth edition) Introductory Quantum Chemistry, New Delhi: Tata McGraw-Hill. (ISBN: 0-07-462054-1).

5. Singh, A.; Singh, R. (2005) Textbook of Inorganic Chemistry Vol. I & II. New Delhi: Campus Books International (ISBN: 8180300714).

6. Mehrotra, R. C. and Singh, A. (2004, Second edition) Organometallic Chemistry A Unified Approach, New Delhi: New Age International (P) Ltd. (ISBN: 81-224-1258-05).

1MSCH02: Organic Chemistry

Detailed Course Content:

Unit-I: Electronic effects:

Introduction, Temporary effect: Electromeric (Mesomeric) effect, Permanent Effects: Inductive effect, Resonance effect, Hyperconjugation effect and its applications (Stability, Acidity, Basicity, Nucleophilicity, Aromatic character).

Unit-II: Reactive Intermediates-I:

Homolytic and Heterolytic fission, Different types of arrow notation, concept and examples of Electrophiles and Nucleophiles. Hybridization, structure, generation, stability, reactivity & applications of Carbocation and Carbanion.

Unit-III: Reactive Intermediates-II:

Hybridization, structure, generation, stability, reactivity & applications of Free radicals, Carbenes, Nitrenes, Ylides, Benzyne and Enamines.

Unit-IV: Aromaticity:

Introduction, criteria of aromaticity, Hückel's rule, examples of aromatic, anti-aromatic and non-aromatic compounds. Aromatic character for annulenes, azulenes & heterocycles.

Unit-V: Organic reagents:

Structure, properties, synthesis and applications of:

(1) DDO, (2) Dicyclohexylcarbodiimide (DCC), (3) Lithium diisopropylamide (LDA), (4) LiAlH₄ (LAH), (5) m-Chloroperbenzoic acid (MCPBA) (6) N-Bromosuccinimide (NBS), (7) TBAB (Quaternary Ammonium salt), (8) Woodward & Prevost Hydroxylation.

Suggested Readings:

1. Ahluwalia, V. K. (2011, Fourth edition) Organic Reaction Mechanism. New Delhi: Narosa (ISBN: 978-81-8487-115-9).

2. Morrison & Boyd (2009, Sixth edition) Organic Chemistry. New Jersey: Pearson Education (ISBN: 978-81-7758-169-0). McMurry, John E. (2011, Eight edition) Organic Chemistry. Boston: Cengage Learning (ISBN: 0840054440).

3. Smith, Michael B.; March, Jerry (2013, Seventh edition) Organic Chemistry: Reactions, Mechanisms and Structure. Hoboken: Wiley-Blackwell (ISBN: 978-0-470-46259-1).

4. Bansal, Raj K. (2009, Fifth) A Textbook of Organic Chemistry) . New Delhi: New Age International (ISBN: 978-51-224-2025-8).

T. W. Graham Solomons (2011, 10th edition) Organic Chemistry. Hoboken: John Wiley & Sons (ISBN: 978-0-470-55659-7).

1MSCH03 : Physical Chemistry

Detailed Course Content:

Unit-I : Chemical kinetics:

Introduction of Chemical kinetics, Types of reaction: reversible reaction, opposite reaction, successive reaction, consecutive reaction, simultaneous reaction, parallel reaction, order of reaction, zero order, First order reaction in solution, Pseudo unimolecular reaction, Second order reaction, Pseudo Bimolecular reaction, Third order reaction, nth order, molecularity with example, Effect of temperature on rate of reaction, Temperature coefficient, Arrhenius equation, the temperature dependence reaction rates, Interpretation of Arrhenius parameters, Activation energy, Collision theory.

Unit-II: The Properties of Solutions:

Ideal solutions: Properties, the Duhem-Margules equation, vapour pressure curves.

Composition of liquid and vapour in equilibrium influence of temperature on gas solubility and solid-liquid equilibria.

Non ideal solutions: Deviation from ideal behavior, vapour pressure curves, liquid and vapour compositions. General equations for liquid mixtures, partially miscible liquids

Dilute solutions: Henry's law. Determination of molecular weights from freezing and boiling points. Problems.

Unit-III: Free Energy and Chemical Reactions

Chemical equilibrium and the equilibrium constant: Equilibrium in homogeneous gaseous systems. Homogeneous reactions in liquid solutions. Homogeneous reactions in dilute solutions. Chemical equilibria in heterogeneous systems. Free energy change in chemical reactions: The reaction isotherm, standard free energy of reaction, the direction of chemical variation of equilibrium constant with pressure and temperature. Influence of temperature on heterogeneous reactions. Integration of the Van't Hoff equation.

Variation of standard free energy with temperature. Simultaneous equilibria. Formation of standard free energies and entropy changes and their applications, problems.

Unit-IV: Homogeneous & Heterogeneous Catalysis

Introduction, types of catalysis (Homogeneous & heterogeneous) & their characteristics.

Theory of catalysis, autocatalysis, promoters or activators, types of acid base catalysis.

Mechanism of acid-base catalysis & catalytic coefficients, Enzyme catalysis.

Unit-V : Polymer Chemistry

Introduction & classification of polymers, synthesis of some general polymers, identification of polymer: chemical analysis, spectroscopic methods, X-ray diffraction and, thermal analysis.

Suggested Readings:

1. Glasstone, Samuel.(2007) Thermodynamics for Chemists: Narahari Press (ISBN:1406773220).
2. Peter Atkins, Julio de Paula (2015) Physical chemistry: Thomson Press (ISBN: 019872872- 7).
3. Gurdeep Raj (2014, Third edition) Thernlod ynarnics. Meerut: GOEL publishing House (ISBN: 81872248 S6).
4. Gurtu, J. N. Gurtu, A. (2014, Twelfth edition) A dvanced Physical Chemistry. Meerut: Pragati Prakashan (ISBN: 9350060191).
5. Barrow, Gordon II. (1996. Sixth edition) Physical Chemistry. New York: McGraw -Hill International. (ISBN: 0070051119).
6. V R Gowariker. (2012) Polymer Chemistry. New age International P limited. (ISBN:

978-0- 8.5226-307-5).

1MSCH04: Group Theory and Spectroscopy

Detailed Course Content:

Unit-I. Introduction to Spectroscopic Techniques:

Types of Analytical techniques, Introduction of Instrumental methods and its classification, Overview of spectroscopic methods based on wave length regions of Electromagnetic radiation, Properties of Electromagnetic radiation.

UV-Visible Spectroscopy: Introduction to UV and Visible, Principle & Theory of UV spectrometry, Instrumentation, Interpretation of UV spectra, Applications UV spectroscopy.

Unit-II. Infrared Spectroscopy

Introduction to IR and FTIR, Principle & Theory of Infrared absorption spectrometry, Infrared sources and transducers, Sample handling, Instrumentation, Interpretation of IR spectra, Applications and limitations of IR spectroscopy.

Unit-III. Mass Spectroscopy:

Introduction, Principle, Theory and components of mass spectrometers, Different ionization and detection techniques, recording and resolution of mass spectrometer, Types of ions produced in mass spectrometer, Interpretation of Mass spectra of selected organic compounds / API, Applications of Mass spectrometry.

Unit-IV. Nuclear Magnetic Resonance Spectroscopy-I:

Introduction, NMR active nuclei, Basic Theory, NMR Spectrometer, internal Standard & solvent; ¹H NMR (PMR): Principle, Number of PMR Signals: Equivalent and

Nonequivalent Protons, Shielding, Deshielding and Chemical shift, Magnetic anisotropy, Factors affecting on chemical shift, Peak area and Proton counting, spin-spin coupling (multiplicity), coupling constant (J), Nomenclature of Spin Systems, applications & problems of Nuclear magnetic resonance spectroscopy.

Unit-V. Nuclear Magnetic Resonance Spectroscopy-II:

¹³C NMR: Introduction, Principle, Chemical shift, Application and Problems of ¹³C NMR Spectroscopy, DEPT; 2D NMR: Introduction of Homonuclear Correlation Spectroscopy (COSY, TOCSY, NOESY and INADEQUATE), Heteronuclear Correlation Spectroscopy (HSQC, HMQC and HMBC).

Suggested Readings:

1. Savant, M. M, Khistariya, A. V. (2017, First edition) Spectroscopy. Bharat Publishing House, Rajkot (ISBN: 978-93-5236-290-5).
2. Yadav, L. D. S. (2005) Organic spectroscopy. Springer-Science + Business Media, B.V. (ISBN 978-94-017-2508-8).
3. Field, L. D., Li, H. L., Magill, A. M. (2015, First edition) Organic Structures from 2D NMR Spectra. John Wiley & Sons Ltd, (ISBN: 9781118868942).
4. Jacobsen, N. E. (2017) NMR Data Interpretation Explained. John Wiley & Sons Ltd, (ISBN: 9781118370223).
5. Pavia, Donald L., Lampman, Gary M., Kriz, George S. Vyvyan, James A. (2015, Fifth edition) Introduction to Spectroscopy, Cengage Learning, USA. (ISBN: 9781285460123).
6. Silverstein, Robert M., Webster, Francis X., Kiemle, David J., Bryce, David L. (2014, Eighth edition) Spectrometric identification of Organic Compounds. John Wiley

& Sons Ltd. (ISBN: 978-0-470-91401-4).

7. Williams, D. H., Fleming, I. (2007, Sixth edition) Spectroscopic Methods in Organic Chemistry. New Delhi: Tata McGraw-Hill. (ISBN: 0077118 I 2X).

Kalsi, P. S. (2006, Sixth edition) Spectroscopy of Organic Compounds. New Delhi: New Age International Pvt. Ltd. (ISBN: 8122415431).

1MSCH05

Paper Mathematics for Chemists/Biology for chemists

Unit-I: Statistics- Definition and scope:

- Introduction and scope of statistics.
- Meaning of sample and population.
- Data analysis-classifications and tabulations.
- Graphical representations and its interpretations.

Unit-II: Measures of Central Tendency

- Introduction, need and scope.
- Definition, types and situations.
- Interpretation of data.

Unit-III: Measures of Dispersion

- Meaning and definitions- standard deviation and variance.
- Meaning and types of skewness.
- Analysis and interpretation of data.

Unit-IV: Analgesic and Anti-Inflammatory Drugs

Introduction to diseases, classification of Analgesic and Anti-inflammatory Drugs, synthesis of the following classes of the drugs:

Non-Steroidal Anti-Inflammatory Drugs (NSAIDs):

(1) Heteroarylacetic acid analogues: Indomethacin, Tolmetin sodium.

(2) Arylacetic acid analogues: Ibuprofen, Diclofenac sodium.

(3) Arylpropionic acid analogues: Ketoprofen, Indoprofen.

(4) Naphthalene acetic acid analogues: Naproxen.

(5) Salicylic acid analogues: Aspirin, Benorilate.

(6) Pyrazolones and pyrazolodiones: Phenazone (Antipyrine)

Antipyretic analgesics

(1) Aniline and p-Aminophenol Analogues: Paracetamol, Phenacetin.

(2) Quinoline Derivatives: Cinchophen.

(3) The N-Arylanthranilic Acids: Mefenamic Acid, Flufenainic Acid.

Unit-V : Anesthetics Drugs

Introduction to diseases, classification of Anesthetic drugs, synthesis of the following classes of the drugs:

General Anesthetics:

(1) Inhalation Anesthetics: Halothane, Chloroform.

(2) Intravenous Anesthetics: Ketamine Hydrochloride, Propanidid.

(3) Basal Anesthetics: Tribromoethanol, Paraldehyde.

Local Anaesthetic

(1) The Esters: Benzocaine, Procaine Hydrochloride

(2) Piperidine or Tropane Derivatives: α -Eucaine, Benzamine Hydrochloride.

(3) The Amides: Lignocaine Hydrochloride, Pyrrocaine Hydrochloride,

(4) The Quinoline and Iso-quinoline Analogues: Dibucaine Hydrochloride, Dimethisoquin Hydrochloride.

Miscellaneous Type: Phenacaine Hydrochloride

1MSCH06 : Computer for Chemist

Unit-1

Introduction to Computers and Computing

Basic structure and functioning of computers with a PC as an illustrative example. Memory. VO devices. Secondary storage. Computer languages. Operating systems with DOS as an example. Introduction to UNIX and WINDOWS, principles of programming. Algorithms and flow-charts.

Unit-2

Computer Programming in FORTRAN/C/BASIC

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

UNIT 3

Programming in Chemistry

Developing of small computer codes (FORTRAN/C/BASIC) involving simple formulae in Chemistry, such as Van der Waals equation. Chemical kinetics (determination of rate constants), Radioactive decay (Half Life and Average Life) Determination of Normality. Molarity and Molality of solutions. Evaluation of Electronegativity of atom and Lattice Energy from experimental data. Determination of molecular weight and percentage of elements in organic compounds using data from experimental methods. Representation of molecules in terms of elementary structural features such as bond lengths, bond angles.

Unit-IV

Use of computer Programmes

Operation of PC Data Processing. Running of standard Programs and Packages such as MS WORD, MS

EXCEL special emphasis on calculations and chart formations X-Y plot Simpson's Numerical Integration method.

Unit-V

Programmes with data preferably from physical chemistry Laboratory Introduction of working of any one of the packages such as LOTUS/EXCEL/FOXPRO/MOPAC and Word Processing software such

as WORDSTAR/ MS WORD.

Books Suggested:

Fundamentals of Computers - V. Rajaraman (Prentice Hall)

2 Computers in Chemistry-K V. Raman (Tata McGraw Hill)

31 Computer Programming in FORTRAN IV-V Rajaraman (Prentice Hall)

M. Sc. Final Year (Chemistry)

2MSCH 01 : Application of Spectroscopy, Photochemistry and Solid State chemistry

Detailed Course Content:

Unit-I: Analysis by Fourier Transform Infrared spectroscopy

- Introduction, construction, working and difference between FTIR & Dispersive IR. Advantages of FTIR over dispersive IR.
- Explanation of SOP & Demonstration of working of instrument on the basis of SOP.
- Analysis of solid and liquid sample preparation using KBr pellet method and study of spectrum obtained.
- Few case studies.

Unit-II: Analysis by Gas chromatography

- Introduction, Explanation, demonstration of each part of GC and it's working setting of parameters on the basis of SOP.
- Actual practice of injection and handling of instrument.
- Sample preparation and calculation.
- Separation of mixture to determine the composition quantitatively by standard method.
- Few case studies.

Unit-III: Analysis by Mass spectrometry

- Principle, Introduction, explanation and demonstration of each part of MS on the basis of SOP.
- Sample preparation and analysis of solid and liquid samples.
- Interpretation of spectra based on fragmentation pattern.

Unit-IV: Analysis by High Performance Liquid Chromatography

- Introduction to liquid chromatography and types of chromatography. Construction and working of the instrument, as per the SOP basis.
- Explanation and preparation of solution, calculation and quantitative determination.
- Preparation of solution, practicing of injecting the sample individually.
- Calculation using graph and formula, conclusion by result.
- Few case studies.

Unit-V: Analysis by Atomic Emission and Absorbance Spectroscopy

- Introduction, explanation and working phenomena of each part of MPAES and AAS basis on SOP.
- Sample and standard solution preparation and calibration.
- Identification of elements present in samples using spectra.
- Few case studies.

Suggested Readings:

1. Pavia, D. L., Lampman, G. M., et al 2015. Introduction to spectroscopy. India: Cengage Learning India Private Limited.
2. Snyder, L. R., Kirkland, J. J. 2010. Practical HPLC Method development 2nd edition. Wiley- Interscience.
3. Moore, G. L. 1988. Introduction to Inductively Coupled Plasma Atomic Emission

Spectrometry. Elsevier Science.

2MSCH02 : Bio inorganic chemistry

Unit-1

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

Boenergetics and ATP Cycle: DNA polymerisation, glucose storage, metal complexes in transmission of energy, chlorophylls, photosystem I and photosystem II in cleavage of water. Transport and Storage of Dioxygen: Haem proteins and oxygen uptake, structure and function of hemoglobin, myoglobin, haemocyanin and hemerythrin, model synthetic complexes of iron, cobalt and copper

Electron Transfer in Biology: Structure and function of metalloproteins in electron transport processes cyochromes and iron-sulphur proteins, synthetic models.

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

Unit-2

Bloorganic Chemistry: Introduction, Basic considerations, Proximity effects and molecular adaptation.

Enzymes Introduction and historical perspective, chemical and biological catalysis, remarkable properties of enzymes like catalytic power, specificity and regulation, Nomenclature and classification. extraction and purification. Fischer's lock and key and Koshland's induced fit hypothesis, concept and

identification of active site by the use of inhibitors, affinity labeling and enzyme modification by site directed mutagenesis. Enzyme kinetics. Michaelis-Menten and Lineweaver- Burk plots, reversible and ineversible inhibition

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

UNIT 3

Types of Reactions Catalysed by Enzymes: Nucleophilic displacement on a phosphorus atom, multiple dis-placement reactions and the coupling of ATP cleavage to endergonic processes. Transfer of sulphate, addition and elimination reactions, enolic intermediates in isomerization reactions. B-Cleavage and condemnation, some isomerization and rearrangement reactions. Enzyme catalyzed earboxylation and decarboxylation.

UNIT 4

Co-enzyme Chemistry: Cofactors as derived from vitamins, coenzymes, prosthetic groups, apoenzymes. Structure and biological functions of coenzyme A, thiamine pyrophosphate, pyridoxal phosphate, NAD

NADP, FMN, FAD, lipoic acid, vitamin B₁ Mechanisms of reactions catalyzed by the above cofactors

Enzyme Models Host-guen chemistry chiral recognition and catalysis, molecular moglie polecalar symmetry and prochirality. Biomimetic chemistry, crown ether, cryptates Cyclodexines cyclodexinn-based enzymne models, calixarenes, ionophores, micelles, synthetic enzymes or syntymer.

Blatechnological Applications of Enzymes: Large-scale production and purification of enzymes, techniques and methods of immobilization of enzymes. effect of immobilization on enzyme activity, application of immobilized enzymes, use of enzymes in food and drink industry-brewing and cheese baking, syrups from corn starch enzymes as targets for drug design. Clinical uses of enzymes, enzyme therapy, cazymes and recombinant DNA technology,

2MSCH03 : Environmental Chemistry

Detailed Course Content

Unit 1: Understanding Environmental Challenges

- Environment : Meaning, importance (man and environment relationship),

components (biotic, abiotic)

- Global Environmental Problems: Major problems (pollution and degradation related) and their types, causes (natural and man-made), effects with reference to developing countries, Climate change, global warming, ozone depletion, acid rain, season change, deforestation, greenhouse effect,
- Types of Environmental Pollution : Air / atmosphere, water / marine, sound, soil; Causes — Physical, natural, industrial, human behavior, population, nuclear, thermal; Prevention and corrective measures
- Types of environmental degradation — soil erosion, land slide; Causes, prevention and corrective measures

Unit 2: Understanding Environmental Education

- Environmental Education: Meaning, importance and scope
- Emerging environmental concerns, their causes and corrective measures needed
- Aims, Objectives and Strategies of Environmental Education with reference to the recommendations of UN Conference on Human Environment, 1972 (Stockholm), International Environmental Education Programme (IEEP), 1975, Conference on Environmental Education (Tbilisi Declaration), 1977

Unit 3: Environmental Education

- Natural resources, natural and man-made environment; Pollution and human health; Natural disasters and their management; Biodiversity and its importance and conservation; Sustainable development economy and environment
- Strategies of Environmental Education: Field work, Project work, Community work, advocacy programmes, Role / Street Play, Nature Club, Nature Walk

Unit 4: Environmental Education and Socio-cultural Values

- Environment and Development: Sustainable development, sustainability of water, food, energy; Developing awareness of sustainable development through education. The millennium development goals
- Role of community in protection of environment, resource conservation and sustainable development; Strategies for developing community awareness on environment management through dialogue, campaign, exhibitions, empowering self- help groups and NGOs. Waste management and recycling
- Environmental ethics : concept and objectives, environmental values — utilitarian, ecological, aesthetic, and moral
- Role of education in environmental management: Approaches and strategies

Unit 5: Environmental Education and ICT

- Impact of Science and Technology on environmental education, Eco-tourism, Eco- development
- Role of mass media and information technology in protection of environment
- Environmental Biotechnology — Need for research and development, environment and human health
- Bioremediation technology for cleaning up of polluted environment
- Technology for sustainable development of ecosystem

Suggested Readings

1. Joy, P., & Neal, P. (1994). be handbook of environmental education. London,

2. Kelu, P. (2000). Environmental education. A conceptual analysis. Calicut:
3. Kumar, A. (2009). A textbook of environmental science. New Delhi: APH Publishing Ltd.,
4. Reddy, P. K., & Reddy, N. D. (2001). Environmental education. Hyderabad: Neelkamal
5. Sharma, B. L., & Maheswari, B. K. (2008). Education for environmental and human value.
6. Sharma, R. A. (2008). Environmental education. Meerut: R.Lall Books Depot.
7. Sharma, R. G. (1986). Environmental education. New Delhi : Metropolitan Book Co., Pvt.
8. Sharma, V. S. (2005). Environmental education. New Delhi: Anmol publication.
9. Singh, Y. K. (2009). Teaching of environmental science. New Delhi: APH Publishing

2MSCH04 : Organic Synthesis: I

Detailed Course Content:

Unit I. A Disconnection Approach:

Introduction to disconnection, concept of synthon, synthetic equivalent, functional group inter-conversion, concept and design of synthesis, criteria of good disconnection

Unit II. One & Two Group Disconnection:

Disconnection and synthesis of alcohols, olefins, simple ketones, acids and its derivatives, Disconnections in 1,3-dioxygenated skeletons, preparation of δ -hydroxy carbonyl compounds, α,β -unsaturated carbonyl compounds, 1,3-dicarbonyls, 1,5-dicarbonyls and use of Mannich Reaction

Unit III. Illogical Two Group Disconnections:

Disconnection and synthesis of 2-hydroxy carbonyl compounds, 1,2-dio1s, 1,4 and 1,6- dicarbonyl compounds.

Unit IV. Disconnection & Synthesis of Acyclic, Cyclic Hetero-Compounds:

Synthesis of ethers, amines, nitrogen and oxygen containing 5 & 6 membered heterocycles.

Unit V. Chemoselectivity & Protecting Groups:

Introduction, three types of control, Chemoselectivity examples and rules, Chemoselectivity by (i) Reactivity (ii) Reagent, Examples of Chemoselectivity in Synthesis. Protection of organic functional groups, protecting reagents and removal of protecting groups.

Tasks and Activities

Each student-teacher is required to submit any two assignments from afore

mentioned units of the syllabus, as per instructions & guidance of the teacher/guide.

Class activity for the course shall be conducted in the form of seminar/ presentation/ poster (chart) presentation/ quiz/ debate/ interview (viva)/ case studies/ field visit cum training or any other suitable method from afore mentioned units of the syllabus, as per instructions & guidance of the teacher/guide.

Suggested Readings:

1. Warren, S.; Wyatt, P. (2008, Second edition) Organic Synthesis: The Disconnection Approach. Weinheim: Wiley. (ISBN: 978-0-470-7 1236-8).
 2. Warren, S. (1978) Designing Organic Syntheses: A Programmed Introduction to the Synthron Approach. Weinheim: Wiley. (ISBN: 978-0-471-99612-5).
 3. Carruthers, W.; Coldham, Iain (2004, Fourth Edition) Modern Methods of Organic Synthesis. Cambridge: Cambridge University Press. (ISBN: 9780521778305).
- Fuhrhop, J. -H.; Li, Guangtao; Corey, E. J. (2003, Third completely revised and Enlarged edition) Organic Synthesis: Concepts and Methods. Weinheim: Wiley VCH. (ISBN: 975-3-527-30272-7).

2MSCH05 : Organic Synthesis-II

Detailed Course Content:

Unit-I: Reaction based on Reactive Intermediates-1:

Principal, mechanism and applications:

- Carbocation: Beckmann, Pinacol-pinacolone, Demjanov rearrangement, Benzilic acid rearrangement.
- Carbanion: Aldol condensation, Perkin reaction, Dieckmann condensation, Michael addition, Grignard reaction.
- Free radical: Sandmeyer, Wurtz-Fittig, Hunsdiecker reaction.

Unit-II : Reaction based on Reactive Intermediates-

Principal, mechanism and applications:

- Carbene: Wolf rearrangements, Rieiner-Tiemann reaction.
- Nitrene: Hoffmann, Curtius, Schmidt rearrangement.
- Ylides, Enamines and Dithioketene acetal: Wittig, Stork enamine, Junjappa-Ha reaction.
- Homologation: Arndt-Eistert, Corey-Fuchs alkyne synthesis.

Unit-III : Reaction based on Cyclization:

Principal, mechanism and applications:

- Carbocyclic formation: Robinson annulation, Danishefsky's diene cycloaddition.
- Heterocyclic formation: Fischer indole, Knorr pyrrole, Von Pechman reaction.
- Pericyclic and metathesis: Diels alder cycloaddition, Hetero Diels alder, Aza-Cope rearrangement, Claisen rearrangement, alkene and alkyne (Enyne) metathesis.

Unit-IV : Multicomponent Reactions: ,

Principal, mechanism and applications: Ugi, Biginelli, Hantzsch dihydropyridine, Mannich reaction.

Unit-V : Cross coupling Reactions:

Pd-catalyzed cross coupling reaction: Suzuki, Sonogashira, Heck, Negashi, Kumada, Stille, Buchwald-Hartwig reaction.

Suggested Readings:

1. Ahluwalia, V. K. (2011, Fourth edition) Organic Reaction Mechanism. New Delhi: Narosa (ISBN: 978-81-8487-115-9).
2. Laszlo Kurtip; Barbara Czako (2004, First edition) Strategic Applications of Named Reaction in Organic Synthesis. Philadelphia: Elsevier Publishing company (ISBN: 9780124297852).
3. Organic Chemistry (VI edition) - R.T Morrison- Boyd. Prentice Hall of India (2003)
4. Organic Chemistry- (V edition) - John McMurry), Asian Book Pvt Ltd, New Delhi
5. Advanced organic chemistry (IV edition) - Jerry March
6. A text book of Organic Chemistry, - Raj K. Bansal, New Age International (P) Ltd. 4th Edition 2003.

7. Organic Chemistry, T.W. Graham Solomon, Craig B. Fryble, Low Price 8th Edition, John Wiley & Sons, Inc.

2MSCH06 : Heterocyclic Chemistry

Detailed Course Content:

Unit-I: Nomenclature and Analogues of Cyclopropane and Cyclobutane:

1. Nomenclature of Heterocyclic compounds.

2. Heterocyclic Analogues of Cyclopropane and Cyclobutane:
 - a. Preparation and properties of aziridine, oxirane, thiirane, Azetidine.
 - b. Preparation of 1,2-diazetidene, 1,2-dioxetane, 1,3-dithietane.

Unit-II : Heterocyclic Analogues of Cyclopentane:

- Preparation and properties of pyrrole, furan, thiophene.
- Preparation and properties of indole, benzofuran, benzothiophene.
- Preparation of isoindole, indolizine, isatin.

Unit-III : Heterocyclic Analogues of Benzene:

1. Heterocyclic Analogues of Benzene:
Preparation and properties of pyridine and pyran.
2. Compounds with Two Heteroatoms in a Six Membered Ring:
Preparation of pyridazine, pyrimidine, pyrazine, thiazine, dioxane, morpholine, phthalazine, quinazoline, quinaxoline, phenothiazine.

Unit-IV : Heterocyclic Analogues of Naphthalene:

- a. Preparation and properties of quinoline, isoquinoline, acridine.
- b. Preparation of benzopyran, benzopyran-2-one and benzopyran-4-one.

Unit-V : Compounds with two or more than Two Heteroatoms:

2. Compounds with two Heteroatoms in a Five Membered Ring:
 - a. Preparation & properties of pyrazole, oxazole, thiazole
 - b. Preparation of, imidazole, isoxazole, isothiazole.
3. Compounds containing more than Two Heteroatoms:
Preparation of triazole, oxadiazole, thiadiazole, triazenes

Suggested Readings:

1. R. K. Bansal (2017, Fifth edition) Heterocyclic Chemistry. New Age International Private Limited (ISBN: 8122435858).
 2. J. A. Joule, K. Mills (2010, Fifth edition) Heterocyclic chemistry - Wiley-Blackwell (ISBN: 1405133007).
 3. R. M. Acheson An introduction to the chemistry of Heterocyclic compounds. Wiley India Pvt Ltd; (Third edition 2008) (ISBN: 8126516607).
 4. Rakesh Kumar Parashar (First edition 2014) Chemistry of Heterocyclic compounds- (ISBN 9781466517134).
 5. R. R. Gupta, M. Kumar & V. Gupta (2009) Heterocyclic Chemistry-2 volume, Springer (ISBN: 978-3-642-72276-9 & ISBN 978-3-662-07757-3).
 6. T. Eicher & S. Hauptmann (3rd, Completely Revised and Enlarged edition, 2013)/the chemistry of Heterocycles - Wiley-VCH (ISBN 3527327479).
 7. A. R. Katritzky & C. W. Rees (1st edition 1984) Comprehensive Heterocyclic chemistry - (Vols 1 - 8) Pergamon; (ISBN 0080262007).
- T. L. Gilchrist (3 edition 1997) Heterocyclic chemistry - Prentice Hall; (ISBN 0582278430).

2MSCH07 : Chemistry for Natural Products

Detailed Course Content:

Unit-I: Introduction and History of Natural Products

Introduction, classification, source, types of extraction, primary and secondary metabolite, extraction and isolation methods of metabolite.

Unit-II: Alkaloids

Introduction, definition, classification, extraction and phytochemical test Synthesis, structural significance and importance of representative alkaloids: Morphine, Heroin, Codeine, Ricinine, Atropine, Cocaine, Nicotine.

Unit-III: Vitamins

Introduction, History, classification and importance including hyper/hypo diseases. Synthesis, structural significance and importance of representative Vitamins: Vitamin A, B group (folic acid, niacin, pantothenic acid, riboflavin-B₂, pyridoxine-B₆), C and E (α - and β - tocopherols and tocotrienols).

Unit-IV: Steroids

Introduction, History, classification, and extraction of Steroid and sterol.

- Bile acid: Introduction and its function.
- Steroid Hormones: Introduction, type, synthesis, structural significance and importance of representative steroid hormones: Androsterone, Testosterone, Oestrone, Oestradiol, Oestriol, Progesterone.

Unit-V: Natural product derived drugs

Introduction, extract based drugs, Herbal formulation, synthesis & structural significance of some representative molecules: Taxol, (+) Vinblastine, Burshehemin, Carpanone, Griseofulvin, Luotonin.

Suggested Readings:

1. Finar, I.L. (1989, Fifth edition) Organic Chemistry. Vol -2. Stereochemistry and the Chemistry of Natural Products. Harlow : Longman. (ISBN: 0-582-05916-X).

2. Mann, I. Harborne, J.; Davidson R. S. (1994) Natural Products. Their Chemistry and Biological Significance. Harlow: Longman Publishing Group. (ISBN: 0470200022).
3. Hostettmann, Kurt; Gupta, M. P.; Marston A. (1994) Chemistry, Biological & Pharmacological properties of medicinal plants from the Americas. Newark: Harwood Academic Publishers. (ISBN: 9057023970).
4. Norman, R. O. C.; Coxon, I. M. (1993, Third edition) Principles of organic synthesis. New Delhi: CBS Publishers & Distributors. (ISBN: 0748761624).
5. Carey, F. A.; Sundberg, R. J. (2010, Fifth edition) Advanced Organic Chemistry Part B. Reactions and Synthesis. Berlin: Springer. (ISBN: 0387683542).
6. Nogradi, M. (2008, Second revised and updated edition) Stereo selective synthesis. A practical approach. Weinheim: Wiley VCH. (ISBN: 978-3-527-61568-1).

SunRise University