M.M. UNIVERSITY, SADOPUR
CHEMISTRY DEPARTMENT
M.Sc. Chemistry IIIrd Semester
Organic Chemistry – Elective I
Photochemistry and Pericyclic Reactions
(July 2018 onwards)

MCH-525

L	T	P	Cr
5	0	0	5

Total Marks: 100
Theory: 60
Sessional: 40
Time: 3 Hours

Note: Eight questions will be set, two questions from each unit I, II, III & IV The candidates are required to attempt five questions in all selecting at least one question from each unit. All questions carry equal marks.

UNIT-I

Photochemistry: Excitation and excited states, Franck-Condon Principle, Jablonski diagram, energy transfer photosensitization, quenching, quantum efficiency and quantum yield, actinometery.

Photochemistry of Alkenes: Intramolecular reactions of the olefinic bond- geometrical isomerism, cyclization reaction of conjugated olefins, rearrangements of 1,4- & 1,5-dienes. Enone and dienone rearrangements.

UNIT-II

Photochemistry of Carbonyl Compounds: Norish type I and type II changes. Intramolecular reactions of carbonyl compounds- saturated, cyclic and acyclic, α, β-unsaturated and β, γ-unsaturated compounds Photochemistry of cyclic ketones: Paterno-Buchi reaction and Photoreduction

Miscellaneous Photochemical reactions: Photochemistry of Aromatic compounds (substitution, isomerisation, cyclisation and cycloaddition reactions). Photo-fries reactions of anilides, photolysis of nitriles and esters. Barton reaction. Elementary idea of Photochemistry of Vision.

UNIT-III

Pericyclic Reactions: Molecular orbital symmetry, frontier orbitals of ethylene, 1, 3-butadiene, 1, 3, 5-hexatriene and allyl system. Classification of pericyclic reactions, Woodward-Hoffmann correlation diagram. FMO and PMO approach, Electrocyclic reaction – conrotatory and disrotatory motions. 4n, 4n+2, allyl systems, ring opening of cyclopropyl halides and tosylates, cycloadditions-antarafacial and suprafacial additions, 4n and 4n+2 systems, 2+2 additions of ketenes, 1,3-dipolar cycloadditions and cheleotropic reactions.

UNIT-IV

Sigmatropic rearrangements: suprafacial and antarafacial shifts of H, sigmatropic shift of H, sigmatropic shifts involving carbon moieties, retention and inversion of configuration, [3,3] and [5,5] sigmatropic rearrangements, detailed treatment of Sommelet-Houser, Claisen and Cope rearrangements, introduction to ene reactions. Simple problems on pericyclic reactions, Group transfers and eliminations.

Books Recommended:

1. K.K Rohtagi-Mukherji, *Fundamentals of Photochemistry*, Wiley Eastern
2. R.P.Kundall and A.Gilbert, *Photochemistry*, Thomson Nelson.
3. J.Coxon and B.Halton, *Organic Photochemistry*, Cambridge University Press.
4. A.Cox and T.Camp, *Introductory Photochemistry,* McGraw Hill.
5. S.M. Mukherji, *Pericyclic Reactions*, Macmillan, India.
6. J.Singh and L.D.S Yadav, *Advance Organic Chemistry*, Pragati Prakashan, Meerut.
7. H. O. House, *Modern Organic Reactions. 2nd Edition (1972)*, Benjamin/Cummings Publishing Company, California

M.M. UNIVERSITY, SADOPUR
CHEMISTRY DEPARTMENT
M. Sc. Chemistry III Semester
Analytical Techniques
(July 2018 onwards)

MCH 521

L	T	P	Cr
4	0	0	4

Total Marks: 100
Theory: 60
Sessional: 40
Time of Examination: 3Hours

Note: Eight questions will be set, two questions from each unit I, II, III & IV The candidates are required to attempt five questions in all selecting at least one question from each unit. All questions carry equal marks.

UNIT-I

Introduction: Role of analytical chemistry, classification of analytical methods -- classical and instrumental. Types of instrumental analysis. Precision – standard deviation, relative standard deviation. Accuracy – absolute error, relative error. Types of error, sources of errors and the effects upon the analytical results. Methods for reporting analytical data.

Atomic Spectroscopy: Sample preparation for atomic spectroscopy, the theory of Atomic Absorption Spectroscopy (AAS) and a detailed description of the techniques of flame AAS (ETAAS and GFAAS) and their associated instrumentation. An introduction to mercury cold vapour and hydride generation techniques. The theory of Atomic Emission Spectroscopy (AES) and a detailed description of the techniques of flame photometry and inductively coupled plasma AES (ICP-AES) and their associated instrumentation. Chemical and spectral interferences encountered in both techniques and how to overcome them.

UNIT-II

Separation Techniques: The basis of chromatographic separations. Typical stationary and mobile phases. Dead time, retention time, capacity factor, selectivity, resolution, and efficiency. Band spreading in chromatography – the Van Deemter equation. Instrumentation of TLC, GC, HPLC. Isocratic HPLC and solvent programming in HPLC. Qualitative and quantitative analysis by TLC, GC and HPLC. Column chromatography. Ion chromatography. Size exclusion chromatography. The flame ionization detector (for gas chromatography) and the UV/Vis absorption detector (for HPLC).

UNIT-III

Electro-Analytical Methods: The Nernst equation and the theory of pH measurement. pH electrodes, their construction and operation. Potentiometric titerations and their advantages. Ion-selective electrodes and their applications. Interferences encountered in potentiometric measurement. Voltametry, DC polarography, half-wave potentials, polarographic analysis of mixtures. Anodic stripping voltammetry.

UNIT-IV

Thermal Techniques: Theory, instrumental requirement, methodology applications of thermogravimetric analysis (TGA), differential thermal analysis (DTA) and differential scanning calorimetry (DSC). Applications of DSC for the determination of drug purity.

Electron Microscopy: Basic theory and principle of electron microscopy, detailed description and applications of Scanning Electron Microscope (SEM), Transmission Electron Microscope (TEM) and Atomic Force Microscope (AFM).

Essential Readings

1. D. A. Skoog, F. J. Holler, and T. E. Nieman, *Principles of Instrumental Analysis*, 5th Edition, Saunders College Pub, 1998.
2. Instrumental methods of Chemical Analysis by B. K. Sharma (21st Ed), 2002; Goel Publishing House, Meerut .
3. F. Rouessac, A. Rouessac, and M. Bertrand, *Chemical Analysis: Modern Instrumentation Methods and Techniques*, John Wiley, 2000.

Suggested Readings

1. J. Mendham, R. C. Denney, J. D. Barnes, R. C. Denney, *Vogel's Quantitative Chemical Analysis*, 6th Edition, Prentice Hall, 2000.
2. D. A. Skoog, D. M. West, and F. J. Holler, *Fundamentals of Analytical Chemistry*, 7th Edition, Saunders College Pub, 1996.
3. J. Churacek and M. Masson, *Advanced Instrumental Methods of Chemical Analysis*, Ellis Horwood, 1994.
4. Basic Concepts of Analytical Chemistry By S M Khopkar (3rd Ed), 2008 New Age International (P) Limited, New Delhi.

M.M. UNIVERSITY, SADOPUR
CHEMISTRY DEPARTMENT
M.Sc. Chemistry IIIrd Semester
Organic Chemistry – Elective II
Natural Products and Heterocyclic Chemistry
(July 2018 onwards)

MCH-535

L	T	P	Cr
5	0	0	5

Total Marks: 100
Theory: 60
Sessional: 40
Time: 3 Hours

Note: Eight questions will be set, two questions from each unit I, II, III & IV The candidates are required to attempt five questions in all selecting at least one question from each unit. All questions carry equal marks.

UNIT- I

Natural Products

Terpenoids:
Nomenclature, general methods of structure determination. Structure and synthesis of citral, geraniol, α-terpineol, α-pinene, camphor, and carotene. Biogenetic isoprene rule.

Steroids:
Nomenclature, basic skeleton, Diels hydrocarbon, stereochemistry, isolation, structure elucidation and synthesis of: Cholesterol, Andosterone, Testosterone, Progesterone and Cortison.

UNIT-II

Alkaloids:
Nomenclature, general methods of structure elucidation. Structure, synthesis, stereochemistry of morphine, reserpine, (+)conin, nicotine, flavons and isoflavons.

UNIT-III

Heterocyclic Chemistry

Aromatic Heterocycles: General chemical behavior of aromatic heterocycles, nomenclature (structural type), criteria of aromaticity, bond length, ring current and chemical shifts in ^{1}H NMR spectra, empirical resonance energy, **Non-aromatic Heterocycles**: Strained bond angle and torsional strain and their consequences in small ring heterocycles. Conformation of six membered heterocycles with references to molecular geometry, barrier to ring inversion, pyramidal inversion and 1, 3- diaxial interaction. Attractive interactions – hydrogen bonding

UNIT-IV

UNIT-IV

Heterocyclic Synthesis (three, four and benzofused five membered): Three membered rings- synthesis and reactions of aziridines, oxiranes, and thiiranes. Synthesis and reactions of indoles, oxazoles, pyrazoles and thiazoles.

Six membered Heterocycles with one, two or more heteroatoms: Synthesis and reactions of pyrylium salts and pyrones. Synthesis of pyrimidines and purines.

Books Recommended:

1. J .Mann, R.S. Davidson, J.B. Hobbs, D.V. Banthrope and J. B. Harborne, *Natural Products: Chemistry and Biological significance*. Longman, Essex.
2. I.L.Finar, *Organic Chemistry, Vol-II, 5th Edition*, Longman Ltd. New Delhi, 1975.
3. K.C.Nicolaou, *Classics in Total Synthesis of Natural Products, Vol. I & II.*
4. F.A.Carey and R.I.Sundberg, *Advanced Organic Chemistry, Part-B, 3rd Edition*, Plenum Press, 1990.
5. R.K.Bansal, *Heterocyclic Chemistry: Synthesis, Reactions and Mechanism, 3rd Edition*, 1999.
6. T.L.Gilchrist, *Heterocyclic Chemistry, 3rd Edition*, Addison-Wesley Longman Ltd., England, 1997.
7. R.R.Gupta, M. Kumar and V. Gupta, *Heterocyclic Chemistry, Vol. I-3*, Springer Verlag.
8. J.A.Joule, K. Mills and G.F.Smith, *Heterocyclic Chemistry*, Chapman and Hall.
9. A.R.Katritzky and C.W. Rees, *Comprehensive Heterocyclic Chemistry*, eds. Pergamon Press.

M.M. UNIVERSITY, SADOPUR
CHEMISTRY DEPARTMENT
M.Sc. Chemistry IIIrd Semester
Industrial and Environmental Chemistry
(July 2015 onwards)

L	T	P	Cr
4	0	0	4

MCH- 519

Total Marks: 100
Theory: 60
Sessional: 40
Time of Examination: 3Hours

Note: Eight question will be set, two from each of the section A, B, C& D.The candidates are required to attempt five questions in all selecting at least one from each section. All questions carry equal marks.

Industrial Chemistry

Section A

Fundamentals: Chemical reactions-stoichiometry, reaction yields. Reaction evaluation-selection, economic feasibility, thermodynamic feasibility, kinetic feasibility. Chemical plant operation- material balance, energy flow, raw materials, safety, pollution.

Pharmaceutical Industries: Standards for drugs, Pharmaceutical literature(USP, EP, IP), official books and their importance, Use of various analytical techniques for quality control (Only mention of relevant techniques for pharmaceutical industry). The concept of anhydrous bases for assay (potency)

Paper and pulp industries: Manufacturing of pulp and paper - raw materials, mechanical and chemical pulping methods, bleaching, fillers and sizing agents, coloring, paper boards and laminates.

Sugar and starch industries: Manufacturing and refining of cane sugar, milling operation, evaporator, vacuum pan and refining, utilization of by products of sugar industries.

Section B

Water quality requirements for industries: Sources, quality parameters - pH, total dissolved solids, hardness, chloride, sulphate, iron, manganese and silica, permissible limits for various industries, Analysis of water: Alkalinity, Hardness, DO, BOD, COD and Chlorine demand. Water treatment: lime - soda, zeolite, ion exchange and reverse osmosis methods. Rain water harvesting. Water quality standards.

Lubricants: Types of lubricants, mechanism of lubrication, Physical and chemical properties of lubricants (viscosity, viscosity index, flash and fire point, cloud and pour point, aniline point, acid value, saponification value, iodine value), Semi solid lubricants,

Properties: Drop point, Yield value. Solid lubricants, Structure of Graphite, Molybdenum disulphide, Additives for lubricants

Environmental Chemistry

Section C

Environment: Introduction, Biogeochemical cycles of C, N, P, S and O, concept of ecosystem, energy flow in the ecosystem, ecological succession, sustainable development, Disposal of wastes and their management.

Green Chemistry: Introduction, tools and principles of Green Chemistry, Evaluating the effects of Chemistry, feed stocks and starting materials, reaction types. Evaluatuion of methods to design safer chemicals, future trends in Green Chemistry.

Section D

Atmosphere: Chemical composition of atmosphere, chemical and photochemical reactions in atmosphere, smog formation, aerosols, oxides of N, C, S, O and their effect, Acid Rain, chlorofluorohydrocarbons, Ozone Depletion, Green House Effect, Analytical methods for measuring air pollutants.

Hydrosphere: Chemistry of river, lake and pond water. Aquatic pollution- inorganic, organic, pesticide, agricultural, industrial and sewage, detergents, oil spills and oil pollutants. Marine pollution.

Lithosphere: Composition, micro and macro nutrients, Pollution- fertilizers, pesticides, plastics, metals, waste treatment, Soil conservation.

Text Books for Industrial Chemistry

1. H.A. Wittcoff, B.G. Reuben and J.S. Plotkin, *Industrial Organic Chemicals*, 2nd edition, Wiley-Interscience, 2004.
2. N. Austin, Chemical Process Industries.
3 John W. Moore and Elizabeth A. Moore, *Environmental Chemistry*, Academic Press, 1976.
4. B. K. Sharma & H. Kaur, *Environmental Chemistry*, Goel Publishing House, 1994.
5. P.T. Anastas and J. C. Warner, *Green Chemistry; Theory and Practice*, Oxford University Press, USA, 2000.