

Integral University, Lucknow
Department of Chemistry
M.Sc. (Industrial Chemistry), 1st Year/ 1st Semester
Subject Name: Physical Chemistry, Subject Code: CH-401
SYLLABUS REVISED-2015
w.e.f. July-2015

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Unit-I

08

Thermodynamics: Combined form of the First and Second laws of Thermodynamics; Concept of free energy, Free energy functions and their discussion; Thermodynamic equilibrium and free energy functions; Free energy of the system and entropy of the universe; Chemical Potential, Gibbs-Duhem equation; Chemical potential and thermodynamic functions; Chemical potential of a pure substance; Chemical potential of ideal gas mixture; Fugacity and its determination; thermodynamic criteria for non equilibrium states, Entropy production and entropy flow.

Unit-II

08

Statistical Thermodynamics: Common terms; Thermodynamical probability; Probability of entropy; The Boltzmann Distribution law; The partition function, Thermodynamic properties in terms of partition function; Partition function of polyatomic molecules; Translational, Rotational and Vibrational partition functions; Equilibrium constant and partition function.

Unit-III

08

Chemical Kinetics: Theory of reaction rates; Collision theory of reaction rates; Steric factor and activated complex theory; Arrhenius equation and activated complex theory; Dynamics of unimolecular reaction (Lindemann-Hinshelwood and Rice-Ramsperger Kessel); Marcus theories of unimolecular reaction; Kinetics of enzyme reactions.

Unit-IV

08

Electrochemistry: Electrochemistry of solutions; Electro catalysis, Nernst-Planck Equation; Concept of Activity and activity coefficient; Debye-Huckel Theory of strong electrolytes. Debye-Huckel limiting law equation for mean activity coefficient of strong electrolytes. Determination of activity coefficient by solubility and emf methods; Ionic strength.

Unit-V

08

Photochemistry: Laws of Photochemistry (Grothus-Draper law and Stark-Einstein law of Photochemical Equivalence), Lambert-Beer Law. Quantum Efficiency and its determination; Photochemical reactions and their kinetics (Hydrogen-Bromine, Hydrogen-Chlorine, Decomposition of Hydrogen Iodide and kinetics of Dimerization of Anthracene).

Books recommended:

1. Physical Chemistry, P.W. Atkins, ELBS
2. Quantum Chemistry, Ira N. Levine, Prentice Hall
3. Thermodynamics – J. Rajaram and J.C. Kuriacose – Educational Publishers.
4. Physical Chemistry of Surfaces – A.W. Adamson – John Wiley Sons.
5. Quantum Chemistry – Eyring, Walter, Kinball
6. Statistical Physics (Part I) (Course of Theoretical Physics Vol. 5) – L.D. London. & E.M. Lefshitz Pergamon Press, London.
7. Chemical Thermodynamics by R.P. Rastogi et al
8. Principles of Physical Chemistry by Puri, Sharma and Pathan.

Integral University, Lucknow
Department of Chemistry
M.Sc. (Industrial Chemistry), 1st Year/ 1st Semester
Subject Name: Inorganic Chemistry, Subject Code: CH-402
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w.e.f. July-2015

L T P 3 1 0

Unit-1

08

Coordination compounds: General characteristic properties of transition elements, Werner's theory, Effective atomic number, Shapes of d orbitals. Bonding in transition metal complexes; Valence bond theory, Crystal field theory; Octahedral complexes, effects of crystal field splitting, tetrahedral distortion of octahedral complexes (Jahn-Teller Distortion), Square planar arrangements, tetrahedral complexes, chelates, magnetism, Molecular orbital theory.

Unit-II

08

Nomenclature and isomerism in coordination compounds: Nomenclature of co-ordination compounds, isomerism in coordination compounds; Polymerization, Ionization, Hydrate, Linkage, Coordination, Coordination position isomerism. Stereoisomerism; Geometrical and optical isomerism. Metal carbonyls, metal clusters and sandwich compounds.

Unit-III

08

Organometallic Chemistry of Transition Elements: Ligand hapticity, electron count for different types of organometallic compounds, 18 and 16 electron rule exceptions, synthesis, structure and bonding, organometallic reagents in organic synthesis and in homogeneous catalytic reactions (Hydrogenation, hydroformylation, isomerisation and polymerisation).

Unit-IV

08

Bioinorganic Chemistry: Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.

Unit- V

08

Characterization of inorganic compounds: Characterization of inorganic compounds by IR, Raman, NMR, EPR, Mossbauer, UV-Vis, NQR, MS, electron spectroscopy and microscopic techniques.

Books Recommended:

1. F. Albert Cotton, Geoffery Wilkinson, Carlos A. Murillo and Manfred Bochmann. Advanced Inorganic chemistry, Sixth edition, Wiley India Pvt. Ltd.
2. J. D. Lee, Concise Inorganic Chemistry, Fifth edition, Wiley India Pvt. Ltd.
3. J H Huheey, Inorganic Chemisry - Principles, structure and reactivity, Harper and Row Publisher, Inc. New York (1972).

Integral University, Lucknow
Department of Chemistry
M.Sc. (Industrial Chemistry), 1st Year/ 1st Semester
Subject Name: Organic Chemistry, Subject Code: CH-403
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w.e.f. July-2015

L T P 3 1 0

Unit I **08**

Reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, nitrenes and benzyne. Organic reaction mechanisms involving addition reactions with electrophilic, nucleophilic or radical species.

Unit II **08**

Reaction mechanisms and Name reactions: Organic reaction mechanisms; involving, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Neighbouring group participation, elimination: E2 vs E1, elimination vs substitution. Aldol condensation, Cannizzaro reaction, Hofmann, Beckmann and Fries rearrangements, Reimer-Tiemann reaction.

Unit III **08**

Name reactions: Reformatsky and Grignard reactions, Michael addition, Friedel-Crafts reaction, Wittig reaction, Oppenauer oxidation, Clemmensen reduction, Wolff-Kishner reduction, Meerwein-Ponndorf Verley reduction and birch reduction, hydroboration-oxidation, oxymercuration and deoxymercuration.

Unit IV **08**

Pericyclic reactions: Introduction, π molecular orbital of ethylene and 1,3-butadiene.

Electrocyclic reactions: Introduction, stereochemistry for the ring opening and ring closing electrocyclic reactions, thermal and photochemical cyclisation of (4n) and (4n+2) system.

Cycloaddition reactions: Introduction, Thermal and photochemical induced (2+2) and (4+2) cycloaddition reactions.

Sigmatropic rearrangements: Introduction, classification, Cope and Claisen rearrangement.

Unit V **08**

Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity and diastereoselectivity.

Books Recommended:

1. Advanced Organic Chemistry (Reactions, Mechanisms and Structure): Michel B. Smith and Jerry March, 4th Edition, Wiley Interscience Publication.
2. A Guidebook to Mechanism in Organic Chemistry by Peter Sykes, Six edition, Pearson publication.
3. Organic Chemistry by Robert Thornton Morrison, Robert Neilson Boyd, and Saibal Kanti Bhattacharjee, Seventh edition, Pearson publication.
4. Organic Chemistry by Jonathan Clayden, Nick Greeves, and Stuart Warren, Second edition, Oxford Publication.
5. Organic Chemistry by T.W.Graham Solomons, and Craig B. Fryhle, Ninth edition, Wiley Publication.
6. Organic Chemistry by I.L. Finar, Volume 1 & 2, Sixth edition, Pearson Publication.

Integral University, Lucknow
Department of Chemistry
M.Sc. (Industrial Chemistry), 1st Year/ 1st Semester
Subject Name: Environmental Chemistry, Subject Code: CH-404
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L T P 3 1 0

Unit-I **08**

Air pollutants: CO, CO₂, ozone, CFC, & NO_x, ozone depletion, global warming, Harmful effects of pollutants on living and non-living species, Analytical methods for monitoring air pollutants, international and national standards.

Unit-II **08**

Physical, chemical and biological water quality parameters; their assessment; Water pollution; water pollutants; toxicity aspects; international and national standards; control; Water sampling techniques; Water treatment processes: aeration, solid purification, nanofiltration, chemical treatments, reverse osmosis, desalination. Waste water treatment processes. Water table maintenance & harvesting methods.

Unit-III **08**

Composition of soil: inorganic and organic components, micro and macronutrients; Soil pollution; Fertilizers, insecticides, pesticides, plastics, toxic metals, dyes, surfactants; toxicity aspects; international and national standards; control.

Unit-IV **08**

Industrial waste; toxic aspects, management and disposal; Radioactive, municipal, agricultural and biomedical waste – toxicity hazards. Bhopal gas tragedy, Chernobyl disaster.

UNIT-V **08**

Heavy metal in the environment; Sources of heavy metals; Poisoning of heavy metals in every bite; Mercury, Copper, Chromium, Cadmium, Cobalt, Lead, Arsenic.

Books recommended:

1. Environmental Chemistry Manahan, Stanley E, 2004, Taylor & Francis Ltd
2. Basic Concepts of Environmental Chemistry, Desley W. Connell, 1 edition, CRC-Press
3. Environmental Chemistry: A Global Perspective, Gary W. Vanloon Stephen J. Duffy , Oxford Univ Pr (Sd)
4. Introduction To Environmental Chemistry, Reid, Brian J. Blackwell Science Ltd
5. Chemistry of the Environment, Thomas G. Spiro, William M. Stigliani, 2nd Edition, Prentice Hall publication.

Integral University, Lucknow
Department of Chemistry
M.Sc. (Industrial Chemistry), 1st Year/ 1st Semester
Subject Name: Modern Analytical Techniques, Subject Code: CH-405
SYLLABUS REVISED-2015
w.e.f. July-2015

L T P 3 1 0

Unit-I **08**

UV Spectroscopy: Wave-like propagation of light, absorption of electromagnetic radiation by organic molecules allowed and forbidden transitions, instrumentation, effect of solvents on electronic transitions, formation and designation of absorption bands, conjugated systems and transition energies, unsaturated carbonyl compounds, dienes and conjugated polyenes, Woodward-Fieser rules.

Unit-II **08**

IR Spectroscopy: Introduction, absorption in the infrared region, theory of infrared spectroscopy, instrumentation, molecular vibrations, calculation of vibrational frequencies, factors affecting vibrational frequencies, characteristic absorptions in common classes of compounds, fingerprint region, characteristic vibrational frequencies of alkanes, alkenes, alkynes, aromatic compounds, alcohols, ether, phenols and amines. Detailed study of vibrational frequencies of carbonyl compounds (ketones, aldehydes, esters, acids, anhydrides), applications of infrared spectroscopy.

Unit-III **08**

NMR Spectroscopy: Introduction, theory of NMR spectroscopy, Instrumentation, chemical shift, equivalent and nonequivalent protons, spin-spin splitting, vicinal coupling and stereostructure, proton exchange reactions, nuclear overhauser effect (NOE), shift reagents, principle of C-13 NMR spectroscopy, Relaxation and dynamic processes - Spin lattice relaxation (T₁) and Spin - spin relaxation (T₂) measurements. Interpretation of NMR spectra of some representative compounds.

Unit-IV **08**

Mass Spectrometry: Introduction, basic theory, instrumentation, important useful terms in mass spectrometry, various modes of ionization (EI, CI, FD and FAB) and their applications, fragmentation patterns of various functional groups (alkanes, alkenes, alkynes, alcohols, ether, phenols, amines, ketones, aldehydes, esters, acids and anhydrides), molecular ion peak, metastable peak, McLafferty rearrangements, Nitrogen rule.

Unit-V **08**

Atomic Absorption Spectrophotometry: Introduction, Principle, Instrumentation, Interferences- Spectral, Ionization, Physical and Refractory compound formation, Sample preparation, Internal standard and standard addition calibration and applications of AAS.

Books recommended:

1. Introduction to spectroscopy: Pavia, Lampman & Kriz, 3rd Ed, Books/cole.
2. Spectroscopic methods in organic chemistry: H. Williams and Ian fleminig, V Edition
3. Tata Mc Grawhills
4. Organic spectroscopy: William Kemp, 3rd Edition, Palgrave publications.
5. Fundamentals of Analytical chemistry, Douglas A. Skoog, Donald M. West, F. James Holler, 7th edition, Harcourt college publications.

Integral University, Lucknow
Department of Chemistry
M.Sc. (Industrial Chemistry), 1st Year/ 1st Semester
Subject Name: Industrial Chemistry Practical-1, Subject Code: CH-406
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List of Experiments

1. To determine the percentage composition of the given mixture consisting of two liquids A and B by viscosity method.
2. To determine the relative surface tension of a liquid by Stalagmeter.
3. To determine the molecular weight of non-volatile solute cryscopically using water as solvent.
4. Selective extraction of iron metal cation from mixture of iron and magnesium for determination of their respective concentration.
5. Paper chromatography separation of metal ion.
6. Determination of copper and nickel in the given sample.
7. Separation of amino acid by thin layer chromatography.
8. Separation of mixture of carbohydrate by thin layer chromatography.
9. Separation of plant pigment from green leaves by column chromatography.
10. Separation of mixture of dyes by column chromatography.
11. Oxime and 2, 4 dinitrophenylhydrazone of aldehyde/ketone.
12. Determination of Dissolved Oxygen (D.O.) in the given water sample.
13. Determination of Biological Oxygen Demand (B.O.D.) in the given water sample.
14. Determination of Chemical Oxygen Demand (C.O.D.) in the given water sample.
15. Determination of Conductivity of the water sample.
16. Determination of Total Dissolved Solid (T.D.S.) in the given water sample.
17. Determination of concentration of KMnO_4 by UV-Visible Spectrophotometer.
18. Determination of iron content in the given water sample by UV-Visible Spectrophotometer.