DR. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY AURANGABAD

PET - 2016

SYLLABUS IN CHEMISTRY

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PART – A : RESEARCH METHODOLOGY

UNIT-I
Chemical periodicity.

IUPAC nomenclature of organic and inorganic molecules including regio- and stereoisomers.

Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.

Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.

Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.

UNIT-II
Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).

Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.

Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.

UNIT-III
Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.

Aromaticity: Benzenoid and non-benzenoid compounds - generation and reactions.

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

Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution - optical and kinetic.

Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).

UNIT-IV
Basic concepts in analytical chemistry, speration techniques: distillation and solvent and solid phase extraction.
Chromatographic techniques: TLC, Liquid-liquid partition, column, Gel permeation, ion exchange, gas and HPLC.
Hyphenated techniques.
Titrations: conductometric, potentiometric, pH metric, polarometric, ampherometric and high frequency titrimetric and their applications.

UNIT-V
Chemistry in nanoscience and technology.
Catalysis and green chemistry.
Medicinal chemistry.
Supramolecular chemistry.
Environmental chemistry.

PART – B : CORE SUBJECT (CHEMISTRY)

UNIT-I

Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities-selection rules; basic principles of magnetic resonance

Electron spin resonance and Mossbauer spectroscopy.

Structure determination of organic and inorganic compounds by IR, UV-Vis, ^1H and ^{13}C NMR and Mass spectroscopic techniques.

UNIT-II

Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.

Inner transition elements: spectral and magnetic properties, redox reaction, analytical applications.

Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.

Cages and metal clusters.

Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

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

UNIT-III

Common named reactions and rearrangements- applications in organic synthesis.

Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.

Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.

Pericyclic reactions - electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.

Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.

UNIT-IV

Basic principles of quantum mechanics: Postulates; operator algebra; exactly- solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom.

Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.

Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.

Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.

Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.

UNIT-V

Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance-Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.

Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.

Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.

Solid state: Crystal structures; Bragg's law and applications; band structure of solids.

Polymer chemistry: Molar masses; kinetics of polymerization.