Faculty of Ocean Science and Technology

Subject Code:B1809

Marine Chemistry

Module. 1	**Inorganic Chemistry:** Chemical periodicity 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. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis
Module. 2	**Physical Chemistry:** Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.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.
Module .3	**Chemical kinetics:**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.
Module. 4	**Organic Chemistry:** IUPAC nomenclature of organic molecules including regio- and stereoisomers. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species.Determination of reaction pathways. Common named reactions and rearrangements – applications in organic synthesis. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.

Module. 5	**Analytical Chemistry:** Spectrophotometry: Fundamental laws of photometry, interference and photometric error, instrumentation of photometers. Basic instrumentation for UV-Vis, IR and Fluorescence spectrophotometers.Atomic absorption Spectrophotometry – general principles and instrumentation. Atomic fluorescence spectrometry, Inductively coupled Plasma analysis. Chromatographic Techniques: Classification of chromatographic techniques. Experimental techniques and applications of Ion exchange, Column, Thin Layer and Paper chromatography. HPLC and Gas Chromatography – Principle, Instrumentation and Detectors.Methods and applications. NMR and Mass Spectrometry:NMR – Basic Principles and Instrumentation of Continuous Wave and Pulsed Fourier Transform NMR Spectrophotometers, Mass Spectrometry – Basic Principles and Instrumentation.
Module .6	**Introduction to Marine Environment :**General Introduction: Dimensions of ocean, Physical properties of Seawater, Sea Water Density, Compressibility Effects, T-S Diagrams, Horizontal, Vertical and Seasonal Temperature and Salinity Distributions, tides and tidal currents in shallow seas, estuaries and rivers. Estuaries: Classification and nomenclature; tides in estuaries; estuarine circulation and mixing; sedimentation in estuaries; salinity intrusion in estuaries; coastal pollution. The Ocean floor: General topography of the ocean floor, continental shelves, slopes, submarine canyons, submarine ridges and trenches. Structure and composition of oceanic crust-hydrothermal vents.Ocean margins and their significance, Mineral resources. Sea as a Biological Environment: Classification of the marine environment and marine organisms – plankton, nekton, benthos – marine ecosystems, marine food web, trophic structure - primary and secondary production and factors influencing them. Physico-chemical factors affecting marine life: light, temperature, salinity, pressure, nutrients, dissolved gases; adaptation and biological processes.
Module. 7	**Marine Chemistry**: Ocean as a Chemical System: Origin of seawater, structure of water, ion-water interactions, the polarized water molecule, colligative properties of seawater, comparison of river and sea water. Composition of sea water, salinity and chlorinity concepts, the major and minor constituents, constancy of relative composition, Residence time, geochemical balance of oceans. Dissolved gases in sea water, Factors affecting the concentration of gases in seawater, pH, alkalinity, specific alkalinity, buffer capacity, sea water - carbon dioxide equilibria, precipitation and dissolution of carbonates, global carbon cycle. Biological pump and controls on atmospheric composition - emission of greenhouse gases. Micronutrients: Nitrogen, phosphorus and silicon, their cycles, distribution profiles and their effect on phytoplankton growth, N/P ratio. Organic matter in the sea: Dissolved and particulate Organic matter, Nature, origin and distribution, Photosynthesis and Primary production.