Department of Chemistry

Syllabus Distribution – SEM 2

Chemistry Course Structure Four-year Chemistry Major Course Structure (Theory)

PAPER: CHEM-H-CC2-2-Th (DSCC-2) (Credit: Theory -03, Practical – 01) Fundamentals of Chemistry - II Theory: (45 Lectures)

Module	Detailed syllabus	Will be covered by	No. of lectures
I	**Kinetic Theory and Gaseous state** Concept of pressure and temperature from kinetic theory of gas.Nature of distribution of velocities, Maxwell's distribution of speeds in one, two and three dimensions; Kinetic energy distribution in one, two and three dimensions, calculations of average, root mean square and most probable values in each case; Collision of gas molecules; Collision diameter; Collision number and mean free path; Frequency of binary collisions (similar and different molecules); Wall collision and rate of effusion Calculation of number of molecules having energy $\geq \varepsilon$, Principle of equipartition of energy and its application to calculate the classical limit of molar heat capacity of gases	Dr.Mumu Chakraborty	8 Lectures
	Real gas and Virial equation Deviation of gases from ideal behavior; Compressibility factor; Boyle temperature; Andrew's and Amagat's plots; van der Waals equation and its features; its derivation and application in explaining real gas behavior ; Existence of critical state, Critical constants in terms of van der Waals constants; Law of corresponding states; Virial equation of state; van der Waals equation expressed in the Virial form and significance of second virial coefficient; Intermolecular forces (Debye, Keesom and London interactions; Lennard-Jones potential - elementary idea.	Dr.Bhaswati Bhattacharya	7 Lectures
II	**Chemical Bonding – I** i) Ionic bond: General characteristics, types of ions, size effects, radius ratio rule and its application and limitations. Packing of ions in crystals. Born-Lande equation with derivation and importance of Kapustinskii expression for lattice energy. Madelung constant, Born-Haber cycle and its application, Solvation energy. Defects in solids (elementary idea). Solubility energeticsof	Dr.Mumu Chakraborty	5 Lectures

	dissolution process. ii) ii) Covalent bond: Polarizing power and polarizabilty, ionic potential, Fajan's rules, Lewis structures, formal charge, Valence Bond Theory, the hydrogen molecule (Heitler – London approach), directional character of covalent bonds, hybridizations, equivalent and non-equivalent hybrid orbitals, Bent's rules, dipole moments, VSEPR theory, shapes of molecules and ions containing lone pairs (examples from main group chemistry) and multiple bonding (σ and π bond approach).	Dr.Bhaswati Bhattacharya	5 Lectures
II	**Theoretical principles of inorganic qualitative analysis** Basic principles involved in analysis of cations and anions and solubility products, common ion effect. Principle involved in separation of cations into groups and choice of group reagents. Interfering anions (fluoride, borate, oxalate and phosphate) and need to remove them after Group II	Dr.Bhaswati Bhattacharya (Basic radicals)	3 Lectures
		Dr.Mumu Chakraborty (Acid radicals)	2 Lectures
III	**Stereochemistry – II** Chirotopicityand its relationship with stereogenicity; concept of pseudoasymmetry forABA type systems. Relative and absolute configuration: R/S descriptors; erythro/threo and meso nomenclature of compounds; E/Z descriptors for C=C, combination of R/S- and E/Zisomerisms. Optical activity of chiral compounds: optical rotation, and specific rotation; racemic compounds, racemisation (through cationic, anionic intermediates); resolution of acids and bases via diastereomeric salt formation; optical purity and enantiomeric excess.	Dr.Mumu Chakraborty	8 Lectures
	General Treatment of Reaction Mechanism–I Reactive intermediates Carbocations (carbenium and carbonium ions), non-classical carbocations, carbanions, carbon radicals: generation and stability, structure and electrophilic / nucleophilic behaviour of reactive intermediates (elementary idea). 18 Reaction thermodynamics Free energy and equilibrium, enthalpy and entropy factor, calculation of enthalpy change via BDE, intermolecular & intramolecular reactions. Reaction kinetics Rate constant and free energy of activation; free energy profiles for one-step, and two-step reactions; catalyzed reactions, principle of microscopic reversibility; Hammond's postulate. Substitution Reaction Free-radical substitution reaction: halogenation of alkanes, mechanism (with evidence) and stereochemical features; reactivity-selectivity principle in the light of Hammond's postulate.	Dr.Bhaswati Bhattacharya	7 Lectures

Practical :(30 Lectures) PAPER: CHEM-H-CC2-2-P (DSCC-2) Qualitative semimicro analysis of mixtures containing three radicals. Emphasis should be given to the understanding of the chemistry of different reactions (only water /acid soluble salts):

Syllabus	Will be covered by	No. of lectures
Cation Radicals Na+ , K+ , Ca2+, Sr2+, Ba2+, Al3+, Cr3+, Fe3+, Mn2+/Mn4+, Co2+/Co3+, Ni2+, Cu2+, Zn2+, Pb2+, NH4 +, Sn2+/Sn4+	Dr.Bhaswati Bhattacharya	15
Anion Radicals F- , Cl- , Br- , I - , S2O3 2- , S2- , SO4 2- , NO3 - , NO2 - , PO4 3- , BO3 3- , CrO4 2- / Cr2O7 2 , SCN- , [Fe(CN)6] 3- , [Fe(CN)6] 4- , AsO4 3- , BrO3 - , IO3 -	Dr.Mumu Chakraborty	15

SKILL ENHANCEMENT COURSE CHEMISTRY Paper:CHEM-H-SEC2-2-Th (SEC-2) (Credit: Theory -04) AI for Everyone Theory: (45 Lectures)

Module	Detailed syllabus	Will be covered by	No. of lectures
I	**Introduction to Artificial Intelligence, Subfields and Technologies:** • Definition and scope of AI • Historical overview and key milestones • Differentiating AI from human intelligence • Machine learning: Supervised, unsupervised, and reinforcement learning • Deep learning and neural networks • Natural language processing (NLP) and computer vision	Dr.Bhaswati Bhattacharya	15
II	**Applications of AI and Ethical and Social Implications of AI:** • AI in healthcare: Diagnosis, treatment, and medical imaging • AI in finance: Fraud detection, algorithmic trading, and risk assessment • AI in transportation: Autonomous vehicles and traffic optimization • AI in customer service and chatbots • AI in education: Personalized learning and intelligent tutoring systems • Bias and fairness in AI systems • Privacy and data protection concerns • Impact of AI on employment and the workforce • AI and social inequality	Dr.Mumu Chakraborty	15

III	**Other Important Issues:** • Ethical guidelines and responsible AI practices • AI and Innovation	Dr.Mumu Chakraborty	7
	• Emerging trends and future directions in AI • AI and creativity: Generative models and artistic applications	Dr.Bhaswati Bhattacharya	8