

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Department of Chemistry

The Syllabus of the Chemistry for the admission tests to be conducted for admission to the PhD programme for ODD SEM 2021-2022.

Part A (Compulsory area):

1. Chemical and Statistical Thermodynamics

Second law and thermodynamic relations; third law of classical thermodynamics and their applications; Thermodynamics of ideal and non ideal binary solutions; Gibbs-Duhem equation, Duhem- Margules equation, equilibrium constant, temperature dependent equilibrium constant; Thermodynamic excess functions. Experimental determination of activity coefficient of electrolytes and non electrolytes; Statistical Thermodynamics

2. Chemical Kinetics and Catalysis

Rate process approach towards complex reactions including Opposing reaction, parallel reaction, consecutive reactions chain reactions; Pseudo first order reactions; Determination of order of a reaction by half-life and differential method; temperature dependence of rate constant; Lindemann theory of unimolecular reaction and collision theory; transition State theory; effect of ionic strength (primary and secondary salt effect), dielectric constant and pressure on rate; Catalysis: rate expressions for homogeneous and heterogeneous catalytic reactions including acid-base and enzyme catalyzed reactions

3. Coordination Chemistry

Bloomstrand-Jorgensen's chain theory; Warner's theory; perfect and imperfect complexes, detection and evidence of complex formation in solution; classification of ligands; inner-metallic complex; Poly nuclear or bridged complexes; Nomenclature of coordination compounds; Electronic spectra of transition metal complexes; Electronic spectra of lanthanide and actinide complexes; Spectroscopic term symbols, Orgel diagram, Tanabe Sano diagram,

4. Acid-base

Theories, general trends, hard and soft acid and bases, superacids, factor influencing acidity and basicity, the Lux concept

5. Organic Synthesis

Planning Organic Syntheses (Strategy and Control); Making Carbon-carbon single and double bonds; Functional group interconversions and Retrosynthetic analysis; Asymmetric synthesis

6. *Organic Spectroscopy*

Mass Spectroscopy :Generation of ions and detection; EI, CI, FD, FAB, plasma desorption; fragmentation pattern in EI, GC-MS, MS-MS, LC-MS. Application of UV, IR, NMR and MS in structure elucidation

NMR Spectroscopy:

PMR spectroscopy: Long-range spin-spin interaction. Interpretation of non-first order NMR; double resonance, Lanthanide shift reagent, spin-tickling, INDOR, NOE, effect of solvents (aliphatic and aromatic), preliminary idea on ^{19}F , ^{31}P , ^{14}N , ^{15}N , ^{17}O . NMR of solids, NMR imaging; ^{13}C NMR Spectroscopy

Part B (Optional area):

1. *Electrochemistry*

Concepts on conductance, EMF of cells, laws of electrolysis, Ion-solvent interaction, effect of nonelectrolyte on ion-solvent interaction, Debye-Huckel-Onsagar theory of inter-ionic interaction, thickness of ionic atmosphere, rate process approach towards ionic

2. *Chemical bonding*

Molecular shape, Valence Bond Theory, VSEPR theory, Molecular Orbital Theory and their applications

3. *Stereochemistry*

Configuration and conformations, relative and absolute stereochemistry, optical rotation, symmetry elements, dynamic stereochemistry, effect of stereoelectronic factors on reaction rates, Horeaus rule, Prelog's rule, Cram's rule; Optical rotation and optical rotatory dispersion: circular birefringence; and circular; Cotton effect; ORD of ketones and Octant rule.


(HOD, Chemistry) 18.07.21