Eligibility for appearing in CRET-Materials Science

For admission to the D. Phil. programme of the Centre of Material Sciences, candidate should be M.Sc. /M.Tech. in Materials Science/ Physics/Chemistry/Electronics or any other allied subject of the Materials Science. Candidate appearing for CRET may have choice of questions out of syllabi for the CRET covering major components of Physics and Chemistry related with the Materials Science. Other rules and regulations for the admission to the D. Phil. programme will be same as for the university in general.

CRET Entrance Syllabus (Materials Science)

Postulates of quantum mechanics, Particle in a Box, Harmonic Oscillator, Hydrogen atom, Operators, Angular momentum.

Helmholtz and Gibbs free energies, Maxwell's relations and applications, Micro-canonical, Canonical and Grand Canonical ensembles, Maxwell, Boltzmann, Bose- Einstein and Fermi-Dirac statistics, First and second order phase transformations.

Symmetry operations and symmetry elements, Reciprocal lattice, Atomic scattering factor, Point group symmetry, Space group, Miller indices of planes and directions, Generation and properties of X-ray.

Types of bonding, Lattice energy, Vibration of crystal with mono-atomic and diatomic lattices, Phonon momentum, Energy level in one dimension, Electrical conductivity and Ohms law, Motion of electron in magnetic field, Hall effect. Nearly free electron model, Bloch function, Kronig Penny model, Formation of energy bands and gaps, Brillouin zones and boundaries, Number of orbital in a band, Insulators, Conductors, Semiconductors and Semimetals.

Dielectric constant and polarizability, Clausius-Mossatti equation, Ferro-electricity, Types and models of ferro-electric transition, Piezo-electric and Pyro-electric materials.

Mechanical tests, Stress and strain, Tensile, Shear, Hardness, Reflection, refraction, Absorption and transmission of electromagnetic radiation in solids, Luminescence, Photoconductivity.

Dia, Para, Ferro, Anti-ferro and Ferri-magnetism, Langevin and Weiss theories, Quantum theory of diamagnetism, Para-magnetism, Hund's rule, Magnetic anisotropy, Magnetic order, Hysteresis, Hard and soft magnetic materials, Superconductivity, Meissner effect, Type I and Type II superconductors, Cooper pairs and BCS theory.

Option

Electronic, Rotational and Vibrational spectra, Raman Spectra, Selection Rules, Basic Principles of Nuclear magnetic resonance.

Main group elements and their compounds: General characteristics, allotropes, structure and properties.

Transition elements and coordination compounds: Structure, isomerism, spectral and magnetic properties, valence bon, MO and Crystal field theories.

Inner Transition elements: General, spectral and magnetic properties.

Intermediates and Organic Reaction Mechanisms: Carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes; Addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species.

Stereochemistry: D-L and R-S Nomenclature, Stereoisomers, Stereochemistry of C, N, S and Phosphorous compounds.

Organic Synthesis and reactions: Alkanes, alkenes, alkynes, arenes, alcohols, phenols, aldehydes, ketones, carboxylic acids and their derivatives, halides, nitro compounds and amines, Important name reactions, Rearrangements.
Laws of photochemistry, photochemical reactions, Photo physical phenomenon, photo-oxidation, photo-reduction and photosynthesis.
Spectroscopic Techniques and its applications: UV- visible, IR, NMR, Raman, ESR, Mossbauer, electro-analytical techniques.
Electrochemistry: Electrolysis Debye-Huckel theory, Nernst equation, determination of E.M.F. of cell, electrochemical cells, concentration cells, acid and base concept.
Nernst equation, redox systems, electrochemical cells, Debye-Huckel theory, electrolytic conductance, ionic equilibria, conductometric and potentiometric titrations.