

Syllabus for Energy Engineering and Technology (PGQP45)

Mathematics: Linear algebra, matrices and determinants, systems of linear equations, Eigen values and Eigen vectors, integration and differentiation, area and volume, partial derivatives, maxima and minima, Fourier series, first order and second order differential equations, boundary and initial value problems, heat and wave equations, mean median and standard deviation, Poisson's, normal and binomial distributions, numerical integration with trapezoidal and Simpson's rule, complex numbers.

Physics: System of units – dimensions- Force and motions - conservation laws – moment of inertia – gravity – elasticity – surface tension and viscosity – Heat and thermodynamics – gas laws and specific heat – Law of thermodynamics – Carnot cycle and engines. Simple harmonic motion, oscillation of spring, simple pendulum - forced and damped oscillations - waves motion; Electromagnetic waves - reflection, refraction,, total internal reflection and polarization of light; Atomic structure – Radioactivity - nuclear fission and fusion; Metals – insulators – semiconductors - Semiconductor devices – diodes, transistors, rectifiers - field effect devices – semiconductor device characteristics - Compton Effect - photovoltaic effect.

Chemistry: Chemical bonding, valence bond theory, LCAO-MO theory, hybridization, selection rules for rotational, vibrational, electric and Raman spectroscopy of diatomic and polyatomic molecules, Gibb's-Helmholt's and Maxwell's relations, Van't Hoff's equation, entropy, enthalpy and free energy, chemical potential, ionic mobility and conductivity, standard electrode potential and electrochemical cells, phase rules; Hydrides, halides, oxides, nitrides, sulfides-shapes and reactivity, structure and isomerism, reaction mechanism, kinetic and thermodynamic stability; Crystal systems and lattices, miller planes, crystal packing, crystal defects, Bragg's law, ionic crystals; Bulk properties, transition to nanoscale properties, quantum dots, synthesis of Nano materials - top-down and bottom-up approaches; Chemical Bonding, Solid state, Chemical kinetics; Ionic Equilibrium, Acid Base theory, Nuclear chemistry, Reaction intermediate.

Engineering: Stress and strain, elastic constants, Poissons' ratio, shear forces and bending moment diagram, bending and shear stresses, deflection of beam, torsion of circular shafts, thermal stresses, testing of hardness and impact strength, free and forced vibration of single degree of freedom systems, effect of damping vibration isolation, resonance, critical speed of shafts, design of static and dynamic loading, failure theories, fatigue strength; Electric charges, Coulomb's law, electric field, electric dipole, electric flux, Gauss's law, equipotential surfaces, electric polarization, Electric field and potential – electricity - capacitors – LCR, LR, CR circuits – transformers – batteries – electromagnetism - generators and motors; Electric current, drift velocity, ohm's law, electric resistance, V-I characteristics of ohmic and non-ohmic conductors, electric energy and power, series and parallel combinations of resistors, combination of cells in series and parallel, Kirchoff's law and their applications;

Semiconductor diode, I-V characteristics in forward and reverse bias, diode as a rectifier, Transistors, oscillator circuits, I-V characteristics of LED, photodiode. Optoelectronic devices – LASERs and LEDs – sensors principles and applications.

Power and Energy systems, Energy Science and Technology, Green energy and Environmental Engineering – importance and application.

Biological Science: Structure and function of protein, carbohydrate lipid and Nucleic acid; Photosynthesis and energetics; Central dogma; Transcription, genetic code, translation; Gene expression and regulation- Cell theory and cell as the basic unit of life; Structure of prokaryotic and eukaryotic cell; Plant cell and animal cell; Cell cycle, mitosis, meiosis and their significance. Biological Evolution- Darwin's contribution, Modern Synthetic theory of Evolution; Pathogens; parasites causing common human diseases; Basic concepts of immunology-vaccines; Concept of Biodiversity; Biodiversity conservation; Application of Biotechnology in health and agriculture: Genetically modified organisms - BT crops; Environmental pollution and mitigation; Greenhouse effect and global warming; Ozone depletion; Deforestation.