

## INTRODUCTION

The Canadian Engineering Qualifications Board of Engineers Canada issues the Examination Syllabus that includes a continually increasing number of engineering disciplines.

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Engineering Physics examinations consists of ten, three-hour examination papers. Candidates will be assigned examinations based on an assessment of their academic background. Examinations from discipline syllabi other than those specific to the candidates' discipline may be assigned at the discretion of the constituent association.

Before writing the discipline examinations, candidates must have passed, or have been exempted from, the Basic Studies Examinations.

Information on examination scheduling, textbooks, materials provided or required, and whether the examinations are open or closed book, will be supplied by the constituent association.

## ENGINEERING PHYSICS EXAMINATIONS

### GROUP A

#### COMPULSORY EXAMINATIONS (SEVEN REQUIRED)

##### **17-Phys-A1 Classical Mechanics**

Review of fundamental principles; Lagrangian Mechanics; non-conservative and non-holonomic systems; central force problem; motion of a rigid body; variational principles, and an introduction to Hamilton's equations.

##### **17-Phys-A2 Statistical Physics**

Kinetic theory of gases; Quantum states, temperature, entropy, chemical potential, Boltzmann factor, fermions and bosons. Fermi-Dirac distributions and electrons in metals. Bose-Einstein distributions and photons, Black-body radiation, Debye theory of phonons.

##### **17-Phys-A3 Electromagnetics (16-Elec-A7)**

Field concepts. Maxwell's equations. Free space and guided wave propagation, transmission lines. Characteristic impedance. Impedance matching and transformation. Fields of moving charges, electromagnetic induction, radiation, and antennae.

##### **17-Phys-A4 Quantum Mechanics**

Breakdown of classical mechanics. Schrodinger equation and elementary systems; one dimensional problems. Postulates and interpretation of quantum mechanics. Algebraic solution of the Schrodinger equation for the harmonic oscillator. Angular momentum and spin. Central force problems; the hydrogenic atom. Concepts and applications of tunneling. Perturbation theory.

**17-Phys-A5-A Electronic Materials and Devices**

Semiconductor physics; band theory, drift and diffusion. Semiconductor devices; diodes, bipolar and MOS devices, sensors and transducers. Other electronics related materials; dielectrics, piezoelectrics, and magnetic materials and their application to modern sensors and transducers.

**17-Phys-A5-B Analog and Digital Electronic Circuits**

Time and frequency domain analysis of linear and nonlinear circuits. Biasing and small signal analysis of transistor amplifiers. Operational amplifiers. Feedback and stability of amplifiers. Oscillators and active filters. Digital circuits and logic families; D/A and A/D conversion; instrumentation.

**17-Phys-A6 Solid State Physics**

Lattice structure and bonding. Lattice vibrations and phonons. Electrons in solids, band structure of metals, semiconductors and insulators, the Fermi surface. The effects of reduced size/dimensionality, i.e., nanostructures. Semiconductors and junctions. Paramagnetism and diamagnetism. Introduction to lattice defects.

**17-Phys-A7 Optics**

Gaussian optics, optical instruments, matrix analysis of lens systems, aberrations, polarization: Double and multiple-beam interference. Fraunhofer and Fresnel diffraction, optical waveguides, fibre optics, contemporary optics design.

**GROUP B****ELECTIVE EXAMINATIONS (THREE REQUIRED)****17-Phys-B1 Radiation Physics**

Atomic and nuclear structure, isotopes, radioactivity, X-rays, attenuation and absorption in matter, detection of radiation, radiation instrumentation, dosimetry, radiation protection, radiation safety and standards, non-ionizing radiation.

**17-Phys-B2 Electro-Optical Engineering (16-Elec-B10)**

Optical transmission: waveguide modes, fiber optics, fibre optic propagation characteristics. Optoelectronics: optical resonators, lasers, sources and detectors, couplers, modulators, guided wave devices. Applications.

**17-Phys-B3 Digital Systems and Computers (16-Elec-A4)**

Combinatorial and sequential switching circuits. Register level design of digital systems. Computer memories. Computer architecture, assembly language programming, interrupts, and interfacing.

**17-Phys-B4 Signals and Communications (16-Elec-A3)**

Amplitude and frequency modulation systems: signals, spectra, implementation. Sampling of continuous signals and the Nyquist sampling theorem. Fourier series and transforms, spectral concepts. Discrete signals and systems: the sampling theorem, time and frequency response, the Z-transform. PCM and simple baseband pulse code modulation systems. Digital modulation techniques, e.g., ASK, PSK, QAM.

**17-Phys-B5 Systems and Control (16-Elec-A2)**

Models, transfer functions, and system response. Root locus analysis and design. Feedback and stability: Bode diagrams. Nyquist criterion, frequency domain design. State variable representation. Simple PID control systems.

**17-Phys-B6 Applied Thermodynamics and Heat Transfer (16-Mec-A1)**

Applied Thermodynamics: Review of fundamental laws and their applications to closed and open systems. Vapour cycles for power and refrigeration; cycle modifications including reheat, regeneration. Gas cycles; spark ignition and compression ignition cycles. Gas turbine cycles, including modifications such as regeneration and intercooling; effects of component efficiency on performance. Heat Transfer: Conduction in one and two-dimensional systems; steady state and transient regimes. Natural – and forced-convection problems. Radiation heat exchange between black, gray, and real surfaces. Thermal design of heat exchangers.

**17-Phys-B7 Structure of Materials (10-Met-A4)**

Atomic and molecular structure. Metallic, ionic, covalent and Van der Waals's, Crystal structure, space lattices and Miller indices. Crystalline and non-crystalline (amorphous). Solidification (crystallisation) and associated microstructures of cast metals and phenomena of grain boundaries. Observations of material

structure (X-ray techniques, metallography, optical and electron microscopy). Defects in solids, dislocation and slip, vacancies and diffusion. Basic mechanisms of deformation processes of materials. Phase diagrams (solid solution systems, eutectic and eutectoid systems, peritectic reaction, intermetallic compounds). Application of lever rule to phase proportions in common single - and binary-phase systems.