

## 2.1 INTRODUCTION

The Basic Studies Examinations are part of the Examination Syllabus issued by the Canadian Engineering Qualifications Board of Engineers Canada.

The Basic Studies Examinations have been structured to ensure that applicants have an adequate foundation in advanced mathematics, basic sciences, and engineering sciences. A full set of Basic Studies Examinations consists of eight, three-hour examination papers.

Candidates will be assigned examinations based on an assessment of their academic background. Prior to assignment of basic studies examinations, candidates are required to have the necessary basic calculus, computer, physics, and chemistry courses equivalent to a first year engineering university program or, in Québec, a second year Pure and Applied Sciences CEGEP program. All candidates must have a knowledge of the material in mathematics 04-BS-1, and probability and statistics 04-BS-2. In addition, the candidate must have knowledge of the material in six of the following subjects — statics and dynamics (04-BS-3), electric circuits and power (04-BS-4), advanced mathematics (04-BS-5), mechanics of materials (04-BS-6), mechanics of fluids (04-BS-7), digital logic circuits (04-BS-8), basic electromagnetics (04-BS-9), thermodynamics (04-BS-10), properties of materials (04-BS-11), organic chemistry (04-BS-12), biology (04-BS-13), geology (04-BS-14), engineering graphics and design process (04-BS-15), and discrete mathematics (04-BS-16). The particular selection of subjects will depend on the candidate's engineering discipline.

The level expected in these examinations is that of textbooks currently used in first and second year courses in programs accredited by the Canadian Engineering Accreditation Board of Engineers Canada.

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/Ordre. Not all examinations are offered by all constituent Associations/Ordre.

## 2.2 BASIC STUDIES EXAMINATIONS

### COMPULSORY EXAMINATIONS

#### 04-BS-1 Mathematics

Calculus, Vector, and Linear Algebra: Applications involving matrix algebra, determinants, eigenvalues; first and second order linear ordinary differential equations, Laplace transforms. Vector algebra; vector functions and operations; orthogonal curvilinear coordinates; applications of partial derivatives, Lagrange multipliers, multiple integrals, line and surface integrals; integral theorems (Gauss, Green, Stokes). Power series.

#### 04-BS-2 Probability and Statistics

Concepts of probability, events and populations, probability theorems, concept of a random variable, continuous and discrete random variables, probability distributions, distributions of functions of a random variable, sampling and statistical estimation theory, hypothesis testing, simple regression analysis.

## OPTIONAL EXAMINATIONS (CHOOSE SIX)

### **04-BS-3 Statics and Dynamics**

Force vectors in two- and three-dimensions, equilibrium of a particle in two- and three-dimensions; moments and couples; equilibrium of rigid bodies in two- and three-dimensions; centroids, centres of gravity; second moment of area, moment of inertia; truss, frame and cable static analysis; friction. Planar kinematics of particles and rigid bodies; planar kinetics of particles and rigid bodies; work and energy, impulse, and momentum of particles and rigid bodies.

### **04-BS-4 Electric Circuits and Power**

Basic laws, current, voltage, power; DC circuits, network theorems, network analysis; simple transients, AC circuits. Impedance concept, resonance; use and application of phasors and complex algebra in steady-state response; simple magnetic circuits; basic concepts and performance characteristics of transformers; an introduction to diodes and transistors; rectification and filtering; simple logic circuits.

### **04-BS-5 Advanced Mathematics**

Series Solutions of Differential Equations: Series solutions of ordinary differential equations, boundary value problems and orthogonal functions, Fourier series.

Numerical Methods: Use of computers for numerical solution of engineering problems, including techniques involving library subroutines and spreadsheets. Approximations and errors, interpolation, systems of linear and non-linear algebraic equations, curve fitting, numerical integration and differentiation, and ordinary differential equations.

### **04-BS-6 Mechanics of Materials**

Definitions of normal stress, shearing stress, normal strain, shearing strain; shear force and bending moment diagrams; members subjected to axial loading; members subjected to torsional loading; compound stresses, Mohr's circle; deformation of flexural and torsional members; failure theories; elastic and inelastic strength criteria; columns.

### **04-BS-7 Mechanics of Fluids**

Fluid characteristics, dimensions and units, flow properties, and fluid properties; the fundamentals of fluid statics, engineering applications of fluid statics; the one-dimensional equations of continuity, momentum, and energy; laminar and turbulent flow, flow separation, drag and lift on immersed objects; wall friction and minor losses in closed conduit flow; flow of incompressible and compressible fluids in pipes; dimensional analysis and similitude; flow measurement methods.

### **04-BS-8 Digital Logic Circuits**

Boolean algebra, encoders, decoders, shift registers, and asynchronous and synchronous counters together with timing considerations. Design of asynchronous circuits, synchronous

sequential circuits, and finite state machines. Karnaugh mapping techniques, and state tables and diagrams. Introduction to programmable logic.

#### **04-BS-9 Basic Electromagnetics**

Introduction to the basic electromagnetic principles upon which electrical engineering is based (laws in both integral and differential form). Classical development of electrostatics and magnetostatics leading to Maxwell's equations. Application of electromagnetic theory to calculation of d-c circuit parameters, study of plane wave transmission in various media.

#### **04-BS-10 Thermodynamics**

Thermodynamic states of simple systems; the laws of thermodynamics; equilibrium, PVT and other thermodynamic diagrams; equation of state; compressibility charts and steam tables; calculation of property changes; enthalpy; applications of thermodynamics, cycles, reversibility; thermodynamics of phase changes, Gibbs phase rule, gas-vapour mixtures.

#### **04-BS-11 Properties of Materials**

Properties of materials for mechanical, thermal and electrical applications. Atomic bonding, solid solutions, crystallisation. Equilibrium phase diagrams, applications to steel and aluminium alloys, heat treatments. Structure and special properties of polymers and ceramic materials. General characteristics of metallic composites, polymeric composites and concrete. Introduction to materials in hostile environments: corrosion, creep at high temperature, refractory materials, subnormal temperature brittle fracture.

#### **04-BS-12 Organic Chemistry**

Principles of organic chemistry developed around the concepts of structure and functional groups. The main classes of organic compounds. Properties of pure substances. Introduction to molecular structure, bond types, properties, synthesis and reactions, reaction mechanisms, as a means of systematizing organic reactions.

#### **04-BS-13 Biology**

Cellular reproduction, growth, and differentiation; metabolism and bioenergetics of living cells; cell structure and function related to the material properties of plant and animal tissues; introductory microbiology — characteristics and classification of microorganisms; interactions of microorganisms with man in the natural world; kinetics and mathematical models of microbial growth; engineered biological systems such as bio-reactors, bio-instrumentation, and waste treatment systems.

#### **04-BS-14 Geology**

The structure of the earth, plate tectonics, earthquakes and igneous activity. Minerals and rocks including their formation, identification, basic properties, and classification. Processes of weathering, erosion, transport, and deposition of geological materials and their results of significance to engineering. Occurrence, flow, and quality of groundwater. Introductory aspects of structural geology including faulting, folding, and the overall formation of discontinuities and their effect on the engineering properties of rock masses. Aerial photography and geological maps.

### **04-BS-15      Engineering Graphics and Design Process**

Engineering drawing: Orthographic sketching. Standard orthographic projection. Principal views, selection and positioning of views. Visualization. Conventions and practices. First and second auxiliary views. Basic descriptive geometry. Section views, types, hatching conventions. Basic dimensioning requirements. Tolerance for fits and geometry control. Detail drawings and assembly drawings, other drawings and documents used in an engineering organization. Bill of materials. Fasteners and welds.

Design process and methods. Project management & teamwork. Requirements and function analysis in design. Conceptual design and testing. Concept evaluation design factors such as: cost, quality, manufacturability, safety, etc. Systems modelling & design detail.

### **04-BS-16      Discrete Mathematics**

Logic: propositional equivalences, predicates and quantifiers, sets, set operations, functions, sequences and summations, the growth of functions. Algorithms: complexity of algorithms, the integers and division, matrices. Methods of proof: mathematical induction, recursive definition. Basics of counting: pigeonhole principle, permutations and combinations, discrete probability. Recurrence relations: inclusion-exclusion. Relations and their properties: representing relations, equivalence relations. Introduction to graphs: graph terminology, representing graphs and graph isomorphism, connectivity, Euler and Hamilton paths. Introduction to sorting.