

## **INTRODUCTION**

Nineteen engineering disciplines are included in the Examination Syllabus issued by the Canadian Engineering Qualifications Board of Engineers Canada.

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Forest Engineering examinations consists of nine, 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/Ordre.

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/Ordre.

## **FOREST ENGINEERING EXAMINATIONS**

### **GROUP A**

#### **COMPULSORY EXAMINATIONS (SIX REQUIRED)**

##### **04-For-A1 Forest Engineering Operations**

The identification and characteristics of forest operations functions, systems and machinery and the key environmental, economic and social parameters associated with their use. Design of forest operations at the forest stand, small district, and single contractor level. The analysis, planning and managing of forest operation administrative issues including wages and benefits, occupational health and safety regulations, business organization, contracts and contracting.

##### **04-For-A2 Wood Technology**

Wood anatomy at the molecular and cell level, and the anatomical structure of wood. Identification of common Canadian species based on both gross and minute features. Physical properties of wood – relative density, shrinkage, swelling, and dimensional changes. Mechanical properties of wood – stress-strain response of wood, its orthotropic properties, and the influence of moisture, temperature, cellular structure and growth features on its strength. Tree growth, cellular structure changes, and the major chemical constituents of wood. Biodeterioration of wood. Flow of moisture through wood and wood drying processes. Industrial wood products : types, measurement and basic manufacturing processes.

##### **04-For-A3 Transportation Of Forest Products**

The design and specification of transportation systems required to deliver raw timber from forest logging operations to wood processing facilities, with particular emphasis on the synthesis of systems which integrate truck transportation with unpaved forest roads and paved national/provincial highways. The economic and technical aspects of transportation systems, and the regulations governing the use and safety requirements over national/provincial highways.

Road classification systems and network planning. Geometric design – horizontal/vertical alignment; cross section templates; degrees of curvature; sightline-distances; maximum gradients; cut and fill calculations. Vehicle characteristics – gradeability, power requirements; engine, transmission and axle specification. Vehicle performance predictions.

#### **04-For-A4 Forest Management**

The basis and nature of change in forests, including the effects of harvesting and silviculture. The design of planning processes to manage forest change by orchestrating harvest and silviculture activities. The social, economic and ecological contexts of forest management. The characterization and distinction between trees, stands, and forests. The causative basis for forest dynamic change and the impact of tree harvesting on forest dynamics. Determination of sustained yield and the operability limits on forest harvesting. Patterns of tree development and the influence of interventions on tree growth. Stand regeneration, and the changes in forest dynamics resulting from harvesting and silviculture operations.

#### **04-For-A5 Forest Hydrology**

Hydrologic cycles and processes – precipitation, evaporation, evapo-transpiration, infiltration, subsurface and overland flow, stream flow. Snow hydrology – snowpack accumulation, snow melting, snow fall and its measurement. The hydrograph. Measuring run-off generation, streamflow velocity, base flow separation and time relationships. Hydrometric data analysis. Watershed delineation and management. Riparian and Buffer zone management. The impact of forest operations on stream discharge, stream water quality, soil erosion and aquatic habitat. Provincial and National government regulations covering forest operations and forest management.

#### **04-For-A6 Silviculture**

The design and planning of Stand Interventions and Stand Development operations integrating tree growth biology. The ecological transformation of tree stands from one condition to another to fulfill long-term forest management objectives, while addressing the constraints imposed by biologic and socio-economic conditions, provincial and national natural resource regulations, and international wood quality and forest land-use standards. The silvics of major Canadian species, silviculture tools and methodologies, stand dynamics and intervention relationships, stand production rates and inventory determination, and the costing and economic evaluation of stand interventions.

## GROUP B

### ELECTIVE EXAMINATIONS (THREE REQUIRED)

#### **04-For-B1 Structural Analysis And Design**

Structural analysis and design, including their underlying principles, as applied to beams, cantilevers, compression members and trusses. Limit analysis of plane frames, arches, walls and foundations. Behaviour of structures. The application of linear elastic concepts to predict forces and deflections and the application of plastic analysis to predict the collapse of statically determinate and indeterminate systems (beams, arches, trusses and frames). The design of buildings and bridge structures used in forest engineering operations.

#### **04-For-B2 Machine Design**

The design of machine elements commonly found in mechanical devices and systems. Analysis and design of mechanical power transmissions (v-belts, roller-chain drives, wire rope systems). Analysis and design of fluid power transmissions (hydraulic actuators, motors and pumps, their flow, torque, hp requirements and efficiency. Hydraulic Actuators - types, force, velocity and power relationships. Valves in hydraulic systems - pressure control, directional, and control valves. Hydraulic circuits - open-loop; closed-loop. The design process, including general guidelines, codes, standards, and sources of information. Analysis of combined stresses and application of Mohr's Circle. Designing for different types of loadings – static; repeated; fluctuating. Analysis and prediction of failure.

#### **04-For-B3 Soils Engineering**

Soils Engineering applications to forest engineering operations and natural resource extraction industries. Exploration methods and soil characteristics. Mechanical and physical properties of soils. Stresses imposed by static and dynamic loads on soil structures. The effective stress principle. Road structure design – resource access roads; primary and secondary resource extraction roads. Methods to strengthen subgrades: shear strength; bearing capacity; soil seepage; frost action. Retaining structures, slope stability, and geosynthetics. Aggregate testing and specification.

#### **04-For-B4 Forest Operations Research**

The application of mathematical methods to solve resource - constrained planning problems in forest engineering operations management - stands to be harvested; timber volume cut; bucking patterns to match product demand; selection of harvesting machines. The use of regression analysis and cost-trade off modeling to create production functions and optimal machine travel distances. The theory, methodology and application of Linear Programming, Integer Programming, Network Models and Stochastic Simulation to create and solve models, and determine optimal solutions to forest engineering operational problems.

#### **04-For-B5 Wood Properties**

Macroscopic investigation of wood to identify and determine their physical and mechanical properties. The calculation of equilibrium moisture content and moisture diffusion through wood. Differential shrinkage and the causes of lumber warping. The calculation of specific gravity and its

conversion from one basis to another. Electrical and thermal properties – thermal conductivity and insulation value, heat value of wood, electrical conductivity and its application in measuring wood properties. Mechanical properties: the influence of cellular structure and environmental factors. Rheological properties – creep and duration of load effect. Properties of wood composites and laminates. Silviculture: genetic improvement and its effects on wood quality. Agents and processes to control wood deterioration. Wood selection for specific exposure categories.

#### **04-For-B6 Forest Operations Planning**

Forest-level planning of large-scale industrial forest operations (harvesting, wood transportation, roads, silviculture, forest resource management, support functions) over tactical, operational and annual planning horizons in the context of integrated, hierarchical forest management. Development of plans for compatibility with relevant corporate and societal objectives and constraints, and vertically consistent through planning levels, horizontally across functional divisions, and longitudinally over relevant time frames. Planning frameworks to determine the kinds of decisions that need to be made, the information required to make those decisions, and the models and data required to produce the information.

#### **04-For-B7 Forest Soils**

The geological, topographical, climatological and historical origin of soils. Processes of soil formation. Soil profiles, texture, structure, volume, weight, moisture and movement. The physical, chemical and biological nature of soils, and the interaction of their properties with vegetation types and growth. Cation exchange reaction and capacity. Soil reaction (pH) and the chemistry of plant nutrients. Macrofauna, mesofauna and microorganisms and sulphur transformation. Organic and inorganic matter, plant and animal residues ; decomposition and humus formation. The distribution, classification and variability of soils, with special emphasis on forested sites.

#### **04-For-B8 Geomorphology**

Origins, history and composition of the earth. Internal structures – geophysics; plate tectonics; convergent and divergent margins. Plate interiors. The rock cycle – sedimentary, igneous and metamorphic. Sediment transport and deposition. Identification of quaternary landforms and geological hazards. Mineral, fossil fuel and water resources. Forest terrain analysis and interpretation by remote sensing, and processing for use as GIS layers.

#### **04-For-B9 Wood Products**

Life cycle analysis and summary statistics of the wood products industry in Canada. Wood adhesives: types and their selection for specific end applications. The hot-pressing process for wood composites and its influence on product quality. The manufacturing processes for creating softwood and hardwood dimension lumber. Machinery and processes to manufacture finger-joined lumber; plywood; oriented strand board; fiberboard; particleboard; glued-laminated timber; structural composite lumber; wood I-joists; and wood - plastic composite lumber.