4.9 INTRODUCTION

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

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.

4.9.1 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 – gradeabilty, 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 (22-MEC-A4)

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.

04-For-A1, Forest Engineering Operations
McDonald, A.J. 1999. Harvesting systems and equipment in British Columbia (FERIC Handbook). ASIN 0772638276. http://www.for.gov.bc.ca/hfd/pubs/docs/sil/sil468.htm

04-For-A3, Forest Soils
Nyle C. Brady, Ray R. Weil, The Nature and Properties of Soils, 14th edition

04-For-A4, Forest Management
Pete Bettinger, Kevin Boston, Jacek Siry, Donald L. Grebner, Forest Management and Planning, Academic Press, October 2008, ISBN-10: 0123743044, ISBN-13: 978-0123743046

Lawrence S Davis, K. Norman Johnson, Pete Bettinger, Theodore Howard, Forest Management, McGraw-Hill, October 2000, ISBN-10: 0070326940, ISBN-13: 978-0070326941

04-For-A6, Silviculture
Ralph Nyland, Silviculture: Concepts and Applications, ISBN 0-07-056999-1, latest edition

04-For-B7, Transportation of Forest Products
Robert A. Douglas, Forest Roads / Resource Access Roads – Delivery - The Transportation of Raw Natural Resource Products from Roadside to Mill, 1999, Fredericton New Brunswick, ISBN 1-55131-009-0

1998 FOREST SYLLABUS PROVIDED FOR HISTORICAL PURPOSES.

APEGBC-Forest Engineering Uniform Syllabus - 1998

GROUP A

COMPULSORY EXAMINATIONS (6 Required)

98-For-A1 Forest Transportation Systems

Access development planning, road design, construction, maintenance, and deactivation (including a road design project; e.g. road design planning project). Planning, analysis, and design of cable systems.

98-For-A2 Bridges on Forest Roads

Theoretical understanding of structural analysis and design of at least one single span bridge design as an application of the acquired knowledge. (eg. A bridge and culvert design project)

98-For-A3 Analysis, Planning and Control of Forest Operations

Economics of logging - phase costing of logging operations, labor and machine rates, machinery selection of road standards, spacing and network patterns, logging development planning, production planning budgeting and analysis, cost control. Harvesting operations methods, techniques, and applications.

Recommended texts:
Riggs, J.L. Engineering Economics McGraw-Hill
Binley, V.W. and Sessions, J. Chain and Board Handbook for Skyline Tension and Deflection Forest Service, 1978
Conway, S. Logging Practices Miller Freeman Publications, 1976

98-For-A4 Tree Physiology, Dendrology and Wood Engineering

Seed structure, dormancy and germination growth-wood formation and tree form, stand development and successions, elementary genetics and breeding, forest regions of Canada, identification of major Canadian tree species, time dependent behaviour or wood, effects of species, density, moisture content, grain orientation and stress-raisers on performance of structural wood members, performance of glues and fasteners, methods for testing of wood properties.

Recommended texts:
Physiology:
Zimmerman and Brown Trees: Structure and Function 1971
Dendrology:

Hosie, R.C. Native Trees of Canada Fitzhenry and Whiteside, 1979
Daniel, T.W., Helms, J.A. and Baker, F.S. Principles of Silviculture (2nd ed.), McGraw-Hill, 1979
Wood Engineering:
Anon Wood Handbook: Wood as an Engineering Material Handbook No. 72 Forest Service, 1974

98-For-A5 Forest Management

Objectives of forest land management, concepts of site, stocking, spacing and forest structure, yield calculations and use of tables, forest growth, determination of allowable cuts, harvest cycles and rotations, land management planning, tenure and administration.

Recommended texts:
Duerr, W.A. et al. Forest Resource Management W.B. Saunders Management, 1979
Smith, J.H.G. Principles of Forest Land Management The Centre of Continuing Education, University of British Columbia, 1982

98-For-A6 Geotechnical Engineering

Introduction to origin of soils, soil identification and classification, site exploration. Permeability and seepage, pore-water pressure and effective stress, compressibility, consolidation, settlement, shearing strength, lateral pressures bearing capacity of footings and piles, compaction, frost action.

Recommended texts:
Craig, R.F. Soil Mechanics (5th ed. or latest), Van Nostrand Reinhold, 1992
Terzaghi, K. and Peck, R.B. Soil Mechanics in Engineering Practice (2nd ed.), John Wiley and Sons, 1967
Any North American Text on Physical Geology

GROUP B

COMPULSORY EXAMINATIONS (2 Required)

98-For-B1 Machine Design and Forest Mechanization

Fundamentals of metalworking (casting, forging, extrusion, rolling, sheetmetal working), heat treatment of steels and non-ferrous alloys, welding, materials protection and corrosion, design of simple elements such as welded joints, fasteners, bearings, shafts and various types of gears, elements of harvesting, silviculture and road-construction equipment, internal combustion engines, hydraulic systems, traction equipment (tracks and tires), winch systems, machine performance and management.

98-For-B2 Engineering Hydrology

Hydrologic processes - precipitation and snowmelt, evapo-transpiration, watershed response, surface and sub-surface runoff, statistical analysis - frequency and probability with application to floods, draughts and precipitation, hydrological analysis - hydrographs of runoffs, unit hydrographs and convolution, conceptual models of runoff and basics of hydrologic modelling, channel system - reservoir and lake routing, channel routing and flood wave behaviour stochastic methods - basic Markov model and applications to reservoir design.

Recommended Text:
Ward, R.C. Principles of Hydrology (2nd ed.), McGraw-Hill, 1975

Supplementary Text:
Lee, R. Forest Hydrology Columbia University Press, 1980

GROUP B

ELECTIVE EXAMINATIONS (1 Required)

98-For-B3 Forest Protection

Insect attack on B.C. Forests, means of control and minimization of degrade, anatomy and classification of pathogens, seedling, root and foliage diseases, rusts, wilts and mistletoes, damage assessment and disease control procedures, fire prevention, pyrolysis, combustion, ignition and flame spread, weather indices, pre-suppression and control planning and organization, effects of fire on forest environment.

Recommended texts:
Entomology:
Knight, F.B. and Hiekkenen, H.J. Principles of Forest Entomology McGraw-Hill, 1980 (Chapters 17 to 19)
Anon Forest Insect and Disease Survey Pacific Forest Research Centre
Pathology:
Smith, W.H. Tree Pathology - A Short Introduction Academic Press, 1970
Fire:
Brown, A.A. and Davis, K.P. Forest Fire Control and Use McGraw-Hill, 1973
Van Wagner, C.E. Structures of the Canadian Forest Fire Weather Index, Environment Canada, Forest Service, Publ. #1333, Ottawa, 1974

98-For-B4 Mensuration and Photogrammetry

Measures of tree and manufactured product volumes, tree volume table construction, height/diameter curves, methods of forest inventory, sampling methods, cruise design, field procedures, compilation and presentation methodology, tree and stand growth measurement and analysis.

Recommended texts:
Mensuration:
Hausch, B., Miller, C.I. and Bears, P.W. Forest Mensuration (2nd ed.), Ronald Press Co., 1972
Photogrammetry:
Avery, T.E. Interpretation of Aerial Photographs (3rd ed.), Burgess Publishing Co., 1977

98-For-B5 Forest Policy and Administration

Forest policy - formulation, objectives, implementation and assessment, legislative basis for B.C. and Canadian forest policies, forest tenure - history and evolution, cut and yield control, resource planning and taxation in B.C., government administration and organization of the B.C. Forest Service.

Recommended Texts:
McKillop, W. and Mead, W.J. Timber Policy Issues in British Columbia
Pearese, D.H. Timber Rights and Forest Policy in British Columbia (Vol. 1), Report of the Royal Commission on Forest Resources, 1976
Pearse, D.H. Timber Rights and Forest Policy in British Columbia (Vol. 2), Report of the Royal Commission on Forest Resources, 1976
Forest Act, 1978 and Revisions
Ministry of Forests Act, 1978 and Revisions

FOREST ENGINEERING SYLLABUS
EQUIVALENT COURSES - UNIVERSITY OF BRITISH COLUMBIA
FOREST OPERATIONS AND ENGINEERING

Note: These equivalents are those in effect November 2000 and subject to change as UBC Course content changes

Examination Number	Examination Name	UBC Course Equivalents	Comments
		Basic Studies (All Required)	
98-BS-1	Mathematics	Four Courses: Math 200, 221, 215 and 316	Math 200 = Math 253 Math 221 = Math 152 Math 215 = Math 255 Math 316 = Math 257
98-BS-2	Probability and Statistics	FRST 231	
98-BS-3	Statics and Dynamics	PHYS 170	
98-BS-5	Advanced Mathematics		
98-BS-6	Mechanics of Materials	Two Courses: WOOD 376[1] and <u>one</u> of WOOD 386; or CIVL 230; or MECH 265	[1] WOOD 376 partially covers topics in 98-BS-6 and 92-For-A4
98-BS-7	Mechanics of Fluids	CIVL 215	
98-BS-11	Properties of Materials		
98-BS-14	Geology		
98-BS-19	Geodesy		
		GROUP A (All Required)	
98-For-A1	Forest Transportation Systems		
98-For-A2	Bridges on Forest Roads		
98-For-A3	Analysis, Planning and Control of Forest Operations	Two courses:	[5] FOPR 464 also partially covers [illegible]

	Forest Operations	FOPR 362[2] and 464[5]	covers requirements for 92-For-B1

98-For-A4	Tree Physiology, Dendrology and Wood Engineering	Two courses: FRST 111 and WOOD 376[1]	
98-For-A5	Forest Management	Four Courses: FRST 306[3], 415[4], 421, and 423	[4] FRST 415 also covers 92-For-B5
98-For-A6	Geotechnical Engineering	Two courses: FOPR 363 and 463	
GROUP B (2 Required)			
98-For-B1	Machine Design and Forest Mechanization	Four Courses: Mech 352 and 486; MMAT 380 and FOPR 464[5]	
98-For-B2	Engineering Hydrology	FRST 388 or CIVL 418	
GROUP B (1 Required)			
98-For-B3	Forest Protection	Three Courses: FRST 308; 309 and 327	
98-For-B4	Mensuration and Photogrammetry	Three Courses: FRST 237, 238, and 442	
98-For-B5	Forest Policy and Administration	FRST 415[4]	
COMPLEMENTARY STUDIES (All Required)			
98-CS-1	Engineering Economics	FOPR 260 or FRST 319	
98-CS-2	Health, Safety, and the Environment	Two Courses: APSC 121 and 450	

98-CS-3	Management Concepts for Engineers		

The Association of
PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
of British Columbia

1998 FOREST ENGINEERING SYLLABUS

Checklist for Self-Evaluation

(Not Required for candidates who are assigned confirmatory exams)

Examination Number	Examination Name	Applicant's Self-Evaluation Course Equivalent	For Office Use Only
Basic Studies (All Required)			
98-BS-1	Mathematics		
98-BS-2	Probability and Statistics		
98-BS-3	Statics and Dynamics		
98-BS-5	Advanced Mathematics		
98-BS-6	Mechanics of Materials		
98-BS-7	Mechanics of Fluids		
98-BS-11	Properties of Materials		
98-BS-14	Geology		
98-BS-19	Geodesy		
GROUP A (All Required)			
98-For-A1	Forest Transportation Systems		
98-For-A2	Bridges on Forest Roads		

98-For-A3	Analysis, Planning and Controlling of Forest Operations		
98-For-A4	Tree Physiology, Dendrology, and Wood Engineering		
98-For-A5	Forest Management		
98-For-A6	Geotechnical Engineering		
GROUP B (2 Required)			
98-For-B1	Machine Design and Forest Mechanization		
98-For-B2	Engineering Hydrology		
GROUP B (1 Required)			
98-For-B3	Forest Protection		
98-For-B4	Mensuration and Photogrammetry		
98-For-B5	Forest Policy and Administration		
COMPLEMENTARY STUDIES (All Required)			
98-CS-1	Engineering Economics		
98-CS-2	Health, Safety, and the Environment		
98-CS-3	Management Concepts for Engineers		