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 Environmental 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.

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.

ENVIRONMENTAL ENGINEERING EXAMINATIONS

GROUP A

COMPULSORY EXAMINATIONS (SIX REQUIRED)

18-Env-A1 Principles of Environmental Engineering

Population, economic growth, industrialization, urbanization and energy-use, as causes of environmental pollution. Mass and energy balance for environmental engineering systems under steady state and unsteady state conditions. Physical and transport properties of homogeneous and heterogeneous mixtures. Contaminant partitioning and transport in air, water and solids. Characteristics of particles, chemistry of solutions and gases, material balances, reaction kinetics, microbiology and ecology, as related to the environment. Application of environmental principles (technical and non-technical) to: water resource management, water and wastewater treatment, air pollution control, solid waste management, environmental impact assessment, and environmental ethics. Thermal pollution, noise pollution, greenhouse effect, acid precipitation, ozone depletion, air toxics, and ground-level ozone and fine particulates (photochemical smog). Sustainable development, life cycle analysis, and principles of environmental quality objectives, standards and guidelines. Soils as a treatment system.

18-Env-A2 Hydrology and Municipal Hydraulics Engineering

Components and processes of natural hydrologic systems. Precipitation and snow melt, runoff, infiltration, storm frequency and duration analysis, conceptual models of runoff, stream flow and hydrograph analysis, frequency and probability with application to precipitation, floods and droughts; evaporation and evapotranspiration. Hydraulics of closed pipe systems and open channel flow including flow under uniform and gradually varied conditions, sediment transport. Water distribution systems, storage reservoirs and wastewater collection systems, pipe networks and network design, sanitary sewer and storm water collection system design, basic pumps/prime movers, urban drainage and runoff control. Climate change, its impact on the design of drainage systems and the need for integration of ecological considerations.

18-Env-A3 Geotechnical and Hydrogeological Engineering

Soil composition, properties, identification and classification. Particle size distribution. Seepage and permeability. Concepts of pore water pressure and effective stress. Compressibility. Capillary pressure and hydraulic head. Principles of effective stress, stress-deformation and strength characteristics of soils, consolidation, compaction, slope stability, infiltration, stress distribution with soils and settlements.

Fundamental physics and properties of groundwater flow in porous geologic material; anisotropy, heterogeneity. Introduction to the theory of groundwater flow; groundwater flow equations and patterns, recharge and discharge, flow nets, aquifer pumping, two-phase flow, well hydraulics and non-aqueous phase liquids. Numerical modeling concepts. Aquifer development and management. Wellhead protection. Impact of surface activities and over pumping on aquifer quality.

18-Env-A4 Water and Wastewater Engineering

Characteristics of water: physical, chemical and biological parameters, standard methods of water analyses, impact in streams and treatment of urban and agricultural runoff, population forecasting, prediction of water demand and wastewater generation, water and wastewater quality, water and wastewater treatment plants and systems: physical, chemical and biological systems, primary, secondary and tertiary treatment, sedimentation, coagulation, flocculation, filtration, adsorption, ammonia removal, aeration, anaerobic and aerobic digestion, activated sludge and trickling filter, ion exchange, lagoons, disinfection, natural treatment systems, sludge treatment and disposal, industrial wastewater treatment: characteristics of industrial wastewater, treatment levels and available technologies. Design of isolated wastewater treatment systems. Emphasis on need to consider nutrient and heat recovery as well as impact of emerging contaminants and its implication for wastewater treatment plant design.

18-Env-A5 Air Quality and Pollution Control Engineering

Sources and classification of atmospheric pollutants, indoor and outdoor air pollutants, health and ecological impacts, meteorology: influence of solar radiation and wind fields, lapse rate and stability conditions, characteristics of stack plumes, Dispersion and deposition modeling of atmospheric pollutants: Eddy and Gaussian diffusion models, Puff models, effective stack heights and spatial concentration distributions, Measurement techniques. Characteristics of various air pollutant particulates, health and nuisance/aesthetic considerations (PM2.5 and PM10) and gaseous pollutants (CO, SOx, NOx, etc.), their behaviour in the atmosphere, monitoring. Control of particulates: collection mechanisms and efficiencies. Control of gases and vapours: adsorption, absorption, combustion, incineration. Control of sulphur oxides and oxides of nitrogen, desulphurisation, kinetics of NOx formation. Photochemical reactions, role of nitrogen and hydrocarbons in photochemical reactions, air toxics, mobile sources of air pollutants, noxious pollutants, and odour control. Emissions trading. Olfactometry as a method of measuring odours; its science and application.

18-Env-A6 Solid Waste Engineering and Management

Engineering design and operational aspects of waste generation, collection, storage, transfer, processing, including composting of organic waste, treatment and disposal. Engineering evaluation of: integrated waste management, solid waste characterization and classification, reduction, reuse and recycling, resource recovery and utilization. Life cycle assessment of waste, physical and chemical treatment methods and composting. Landfill design and operation including: site selection, engineered sites, liners and covers, leachate control and treatment, gas recovery and control, including utilization of

recovered gas (energy), and landfill monitoring and reclamation.

GROUP B

ELECTIVE EXAMINATIONS (THREE REQUIRED)

18-Env-B1 Environmental Assessment and Management Systems

Applicable federal and provincial environmental regulations. Analysis of environmental impact using technical and non-technical parameters. Environmental impact assessment legislation and regulatory framework. Environmental impact assessment applied to solid and liquid waste management, effluent control, air pollution control, urban development, and transportation systems. Environmental audits. Introduction to geographical information systems (GIS). Environmental management systems (EMS) ISO 14000/14001 standards, and applications. Principles of sustainable development and implications of finite biosphere and complexities for engineering design and decision-making. Design of controlled environments to enhance health and protection of natural resources for sustainable development. Resource problems and design with ecological, economic, demographic and social dimensions. Techniques to integrate knowledge and define policy. Risk analysis. Life cycle analysis. Risk management. Environmental impact assessment methods.

18-Env-B2 Water Resources

Nature and response of waste inputs to water systems, point and non-point source loading rates. River flow and reservoir analysis. Availability of groundwater resources. Diffusion, dispersion and pollutant transport mechanisms, including two phase flow. Eutrophication reduction in natural water systems. Contaminant decay modeling. Oxygen sag equation and modifications, water quality and contaminant transport in rivers. Functions of watershed models for hydraulic design, environmental assessment and flood warning. Global and national water problems, laws and legislation. Water resources and sustainable development. Technology and impacts of water conservation practices and policies on municipal service infrastructure. Storm water models and management systems. Impact of climate change on water availability.

18-Env-B3 Contaminant Transport

Major types of contaminants in air, surface water and ground water. Physical phenomena governing the transport of contaminants in different environments: advection, dispersion, diffusion, sorption, ion exchange, precipitation, dissolution, volatilization, equilibrium partitioning of contaminants amongst air, water, soil, sediments and biota. Development of governing transport equations, initial and boundary conditions, completely mixed and plug flow systems. Analytical and numerical solutions, model development, calibration, verification, sensitivity analysis, prediction and post audit.

18-Env-B4 Site Assessment and Remediation

Introduction to engineering, regulatory and management aspects of site assessments and restoration. Fundamentals and interactions between soils, groundwater, contaminants, and microorganisms. Site characterization and investigations. Monitoring and sampling strategies and techniques. Remedial action screening. Engineered solutions for site remediation including: physical, chemical, biological and in-situ and ex-situ techniques. Risk assessment. Brownfields. Computer modeling for assessment and remediation.

18-Env-B5 Industrial & Hazardous Waste Management

Definition and characteristics of industrial and hazardous wastes. Industrial and hazardous waste generation rates and prevention. Introduction to I&H waste collection, transportation, treatment, monitoring, and disposal. Applicable international, federal and provincial regulations and initiatives. Municipal services and planning associated with industrial and hazardous waste management. Physical, chemical and biochemical treatment technologies, and disposal methods, including landfilling and incineration. Environmental impact of industrial and hazardous waste management. Radioactive, nuclear and biomedical waste.

18-Env-B6 Agricultural Waste Management

Agricultural sources of pollution (pesticides, mineral fertilizers, on-farm crop and food processing wastes and livestock wastes, wastewaters and waste seepages) and their effect on the total environment. Physical, chemical and biological properties of agricultural waste materials. Design of storage and handling systems for agricultural wastes. Physical, chemical and biological treatment processes of agricultural wastes, their life-cycle analysis, and their potential for nutrient recycling. Various methods of land application of agricultural wastes in relation to pollution problems and fertilizing value. Technologies for utilization of agricultural wastes for biogas production. Air pollution (noise, odour, dust); agriculture as carbon sink. Water quality parameters and management.

18-Env-B7 Environmental Sampling and Analysis

Practical and essential principles of water, soil and air sampling. Basic concepts in quantitative analyses of physical, chemical, and biological parameters. Tolerable levels of contaminants in air, water and soil. Sampling, sample preparation and preservation techniques, and quality assurance and quality control. Development of optimum monitoring strategy, scheduling, and sampling frequency. Database management, data analysis, statistical treatment of data, sources of error, and seasonal effects. Instrumental methods of analysis for organic and inorganic contaminants in air, water, and soil: colorimetry, chromatography, spectroscopy, electrochemical probes, remote sensing and bioassays. Basic concepts of resolution, accuracy, precision, sensitivity, calibration and control of error. Laboratory certification and standardization. Introduction of Genomics potential for Environmental Monitoring.

18-Env-B8 Instrumentation and Process Control

Basic concepts of resolution, accuracy, precision, sensitivity, calibration and control of error. Analysis and interpretation of data. Transducers for the sensing of strain, displacement, velocity, acceleration, pressure, flow, temperature, humidity, moisture content, and electromagnetic radiation. Signal conditioning for noise reduction and control. Operational amplifiers. Systems for data acquisition, telemetry, display, recording and processing. Computer interfacing. Concept of transfer functions. Response of simple chemical processes to step, ramp, and sinusoidal inputs. Transient response of interacting elements in series. Frequency response analysis of simple systems. On-off control, proportional, integral, derivative, and combinations of these control actions. Feed-back and feed-forward control. Controller tuning and algorithms. Simple stability analysis. Dynamics and control of common chemical process units.

18-Env-B9 Environmental Chemistry and Microbiology

Chemistry of organic and inorganic contaminants in the environment. Natural chemical cycles in the biosphere, geosphere, hydrosphere and atmosphere, and consequences of anthropogenic disturbances.

Chemical equilibrium and kinetics. Fundamentals of aquatic, atmospheric and soil chemistry. The fate of hazardous, refractory and heavy metal pollutants in the environment. Introduction to microbial taxonomy, ecology and growth kinetics of microorganisms. The microbes of public health importance in water, soil and air, including their detection, occurrence, transport, and survival in the environment. Introduction to the application of different processes to remove contaminants in natural and engineered systems.