



## **Confirmatory Exam Program Requirements Building Engineering**

**Building Engineering Technical Exams.** You must choose three of your four exams from the Building Engineering Technical Exam list. Two of these exams must be from Group A and one from Group B listed below.

<b>Building Engineering Technical Exams</b>			
<b>Group A</b>		<b>Group B</b>	
07-Bld-A1	Elementary Structural Analysis	07-Bld-B1	Computer Programming
07-Bld-A2	Elementary Structural Design	07-Bld-B2	Advanced Structural Analysis
07-Bld-A3	Construction Engineering	07-Bld-B3	Advanced Structural Design
07-Bld-A4	Building Engineering Systems	07-Bld-B4	Modern Building Materials
07-Bld-A5	Building Science	07-Bld-B5	Fire and Smoke Control in Buildings
07-Bld-A6	Geotechnical Materials and Analysis	07-Bld-B6	Building Energy Conservation Technologies
07-Bld-A7	Building Envelope Design	07-Bld-B7	Indoor Air Quality
		07-Bld-B8	Control Systems in Building
		07-Bld-B9	Building Services

**Complementary Studies.** You must also choose one exam from the Complementary Studies below.

<b>Complementary Studies</b>	
11-CS-1	Engineering Economics
11-CS-2	Engineering in Society – Health & Safety
11-CS-3	Sustainability, Engineering and the Environment
11-CS-4	Engineering Management





## PEO'S TECHNICAL EXAMINATION PROGRAMS

### WHY A TECHNICAL EXAM PROGRAM?

The academic requirement for licensing as a professional engineer in Ontario is a bachelor's degree in engineering from an accredited program at a Canadian university or its equivalent.

The Canadian Engineering Accreditation Board (CEAB) accredits undergraduate engineering degree programs on behalf of the provincial/territorial engineering associations/order, including PEO.

Applicants who do not hold a bachelor's degree in engineering from a CEAB-accredited program may be required to pursue either PEO's *Confirmatory* or *Specific* exam program to demonstrate that they possess the equivalent academic background for licensing purposes.

**PEO's TECHNICAL EXAM PROGRAMS *Confirmatory Exam Program (CEP)*.** Applicants whose undergraduate Bachelor's engineering degree was obtained via a program that appears to be similar to the respective CEAB-accredited program are usually assigned a Confirmatory Exam Program, which consists of four exams. The intent is to give the applicant an opportunity to demonstrate that s/he has an academic preparation that is deemed to be equivalent to that of a graduate of a CEAB-accredited program.

***Specific Exam Program (SEP)*.** If PEO's assessment reveals that an applicant's academic qualifications are below the established Canadian standard, s/he will be assigned a Specific Exam Program aimed to remedy identified deficiencies for licensing purposes. A Specific Exam Program may consist of Basic Studies exams, discipline-specific exams, Complementary Studies exams and a thesis.

Basic Studies exams are a prerequisite and must be addressed first; PEO will re-evaluate the applicant's file following the successful completion of all Basic Studies exams and may modify the original exam program, and advise the applicant of the options available to address any outstanding exams.

### TIME LIMITS FOR WRITING EXAMS

PEO's technical exams are offered twice annually (in May and December).

Applicants must write at least one exam within two academic years following the date of receipt of their exam program notification. Once the exam program is commenced, the applicant must write at least one exam each academic year or the file will be closed. All exam programs must be successfully completed within eight academic years of the date that the applicant was notified of his/her exam program. ("Academic Year" means the period starting September 1 in a year and ending August 31 in the following year.)

### HAVING THE FILE CLOSED

An application file will be closed if any one of the following conditions applies:

- not completing all exam requirements within the specified time limit;
- not writing at least one exam in each academic year after writing the first exam;
- failing the same exam on three attempts;
- failing a total of five exams;
- failing two Basic Studies exams; or
- failing to write a failed exam within one academic year for CEP.

### PERFORMANCE STANDARDS

The pass mark for all PEO exams is 50%.

***Confirmatory Exam Program.*** An applicant will be considered to have successfully completed the CEP if the average of the technical exam marks is at least 55% and a pass mark (at least 50%) was received on the Complementary Studies exam.

If an applicant fails two exams or fails the same exam twice in a CEP, s/he may be assigned a Failed-to-Confirm exam program, which may consist of additional exams in the Basic Studies, discipline-specific and Complementary Studies categories.

### GOOD-PERFORMANCE REVIEW POLICY

***Confirmatory Exam Program.*** To meet the "good-performance" review criterion, an applicant must have written two technical exams at the first sitting and achieved a minimum average of 65% with no mark below 60%.

After a second exam sitting, if an applicant has passed three technical exams with no mark below 60%, s/he may receive consideration for exemption from writing the Complementary Studies exam. If an applicant attempted two exams in the first sitting but failed one, s/he may still qualify for a "good-performance" review if s/he passes the failed exam with a mark of 70% or higher and achieves 60% or higher on the previously unwritten technical exam attempted at the second sitting.

**Important:** If an applicant has been assigned a **Directed Confirmatory Exam Program**, the good performance criteria are different; to be eligible, in addition to meeting the above criteria, all the directed exams must be addressed as well. Applicants are advised to contact the Exam Centre to discuss further.

#### Note:

- Good-Performance reviews are not applicable to Specific Exam Program and Failed-to-Confirm exam program applicants.

### WHEN AND WHERE PEO EXAMS ARE OFFERED

PEO technical exams are held in May and December at 14 centres in Ontario. Exams are usually offered over a five-day period.

Registration packages to write are mailed in January for the May sitting and in July for the December sitting.

If the technical exam package is not received by the times indicated above, applicants should call the Exam Centre.

### PROCUREMENT OF TEXTS AND OTHER MATERIALS FOR AN EXAM

To help in the procurement of all the suggested technical text books Contact customer service of Login Brothers at [orders@lb.ca](mailto:orders@lb.ca), through the website [www.lb.ca](http://www.lb.ca) or 1-800-665-1148 to assist you. It is recommended to always purchase the latest edition of any suggested textbook.

If an applicant does not have the current text listing or the text(s) is out of print, the applicant is advised to contact the Exam Centre (see below).

Recent written exams (i.e., reprints) are available on-line at PEO's website at [www.peo.on.ca](http://www.peo.on.ca) for free download. These past exams are available to provide the applicant with knowledge of the exam format, etc. The answers/solutions of past exams are not available at PEO.



## PEO'S TECHNICAL EXAMINATION PROGRAMS

### EXAM FEES

All Exam Fees are non-refundable.

First Exam Fee	\$700
Each Subsequent Exam Fee	\$200
Submission of an Engineering Thesis	\$360

### COURSES-IN-LIEU

For all course(s)-in-lieu of PEO exam(s), applicants must get prior approval from PEO. A request must be in writing and should include a description of the proposed university calendar course and should be submitted at least two months in advance of the course's registration deadline.

Applicants must arrange for the official grade report(s) to be forwarded to the Licensing and Registration Department upon the completion of the course(s).

**NOTE:** *Courses-in-lieu are not acceptable for:*

- *Basic Exams,*
- *Confirmatory Exams,*
- *Directed Confirmatory Exams,*
- *Failed exams*

### EXAM CENTRES

Exams are offered annually in May and December at the following centres in Ontario:

Belleville	London	Sudbury
Chalk River	Ottawa	Thunder Bay
Hamilton	Peterborough	Toronto
Kingston	Sarnia	Windsor
Kirkland Lake	St. Catharines	

The timetable information and exact location of exams are posted on PEO's website early in April to applicants writing exams in May, and early in November for those writing in December.

Applicants living inside Ontario must write at an Ontario centre. One of the centres listed may be selected. Applicants living outside Ontario may make special arrangements to write outside Ontario or Canada. Call the Exam Centre for further instructions if special arrangements are required.

### ADDITIONAL INFORMATION

**Order of exams.** Basic Studies exams are a prerequisite and must be written first. Following the successful completion of all Basic Studies exams, applicants may write the remaining exams in any order. However, it is recommended that exams in less-advanced subjects be written first. Passing an exam in an advanced subject does not merit credit for a less-advanced subject.

**English Language Skills.** An acceptable level of English—both written and spoken—is required to practise engineering and to successfully complete PEO exams. If an applicant needs to improve English language skills, s/he should contact one of the many English as a Second Language Programs run by schools and community organizations throughout Ontario.

**Penalties.** Using notes or other aids in an exam where these are not allowed is strictly forbidden. Applicants caught doing so will have their paper confiscated and risk having their licence application withdrawn.

**Exam Results.** Exam results are normally mailed within 45 working days following writing of the exam. No results will be given over the telephone or in person at PEO office. Exam papers will not be returned to applicants and answers are not available. Failed exams are automatically re-read. However, applicants may request a formal re-read

of an exam paper. A non-refundable fee of \$330 is charged in the event a formal re-read is requested by an applicant. Requests for a re-read must be received within 30 days after an applicant has been notified of the exam mark.

**Reapplying After A File Has Been Closed.** If a file has been closed, an applicant may reapply with the understanding that the regulations and policies in effect at the time of the new application will be enforced.

An application for licence fee and all other associated fees will be required.

If a file was closed for poor academic performance, the applicant may be required to show that s/he has taken course(s) in the subject(s) covered by any failed exam(s).

All recorded failed exams from a previous application must be successfully addressed before an applicant will be allowed to pursue the new program.

### WORKING IN ENGINEERING BEFORE LICENSURE

Applicants may work in engineering provided a licensed professional engineer takes responsibility for the work. It is illegal to use the title "professional engineer" or any variation thereof (project engineer, systems engineer, etc.) as an occupational or business title that might lead to the belief that a person is a licensed professional engineer.

### NEED MORE INFORMATION?

For more information about licensing/registration requirements, please contact:

Licensing and Registration Department  
Professional Engineers Ontario  
40 Sheppard Avenue West, Suite 101  
Toronto, ON M2N 6K9  
Tel: (416) 224-1100 / 1-800-339-3716  
Fax: (416) 224-8168 / 1-800-268-0496  
<http://www.peo.on.ca>

# PEO'S CONFIRMATORY EXAMINATION PROGRAM

## Confirmatory Exam Program (CEP)

PEO's *Confirmatory Exam Program* (CEP) consists of three technical exams in the applicant's engineering discipline and a *Complementary Studies* exam.

- This program must be completed within eight academic years following the date of receipt of the exam program notification. ("Academic Year" means the period starting September 1 in a year and ending August 31 in the following year.)
- Applicants will have successfully completed the *Confirmatory Exam Program* if the average of their three technical exams is at least 55% with no mark below 50% and they achieve a pass (50%) on the *Complementary Studies* exam.
- To qualify for the good performance review, applicants must address all the directed exams, if the applicant is assigned a *Directed Confirmatory Exam Program*

**Good-Performance review** for CEP applicants may be warranted as follows:

- Applicants who pass any two technical exams at their first sitting, with a minimum average of 65% and with no mark below 60%, may be exempted from completing the remaining exams in the *Confirmatory Exam Program*.
- Applicants who complete three technical exams in two sittings with no mark below 60% may be exempted from the *Complementary Studies* exam.
- Applicants who fail one technical exam and achieve a mark of 70% or higher on the failed exam on their second attempt, and 60% or higher on a previously unwritten technical exam attempted at the same sitting, may be exempted from completing the remaining exams in their *Confirmatory Exam Program*.

A **Failed-to-Confirm** Exam Program for CEP applicants, consisting of additional exam(s), will be assigned to applicants who do not confirm their engineering knowledge via their *Confirmatory Exam Program*. At least one of the following will apply:

- Applicants who do not achieve an average mark of at least 55% on the three technical exams will be assigned a *Failed-to-Confirm* Exam Program and one additional technical exam will be assigned.
- Applicants, who failed the same exam twice or failed two different exams will be assigned a *Failed-to-Confirm* Exam Program where an additional exam will be assigned for each exam failure. They must also pass the failed exams.

**Please note:** For applicants who are assigned a **Failed-to-Confirm** Exam Program, their engineering experience does not begin until after the academic requirements for licencing are met, and they will be required to demonstrate 48 months of engineering experience from that time.

A **file will be closed** under the following circumstances:

- If there is loss of contact (no active mailing address), the applicant's file will be closed.
- Applicants who do not attempt any exams within two academic years after notification of their exam program will have their file closed.
- Once an exam program commences, applicants must write at least one exam each academic year or their file will be closed even if the applicant has successfully passed exams in the past.
- Applicants who fail a technical/Complementary Studies exam on their first sitting must pass the failed exam within one academic year or their file will be closed.

If you have any questions concerning the above listed, please contact the Exam Centre  
416-840-1097, 1057, 1096, 1095 or 1(800) 339-3716 1097, 1057, 1096, 1095  
e-mail: [exams@peo.on.ca](mailto:exams@peo.on.ca)

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## **BUILDING ENGINEERING EXAMINATIONS**

### **INTRODUCTION**

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Building Engineering examinations consists of eighteen, three-hour examination papers and an engineering report. 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 PEO's Academic Requirement Committee.

Information on examination scheduling, textbooks, materials provided or required, and whether the examinations are open or closed book, will be provided by PEO's Examination Centre.

### **BASIC STUDIES**

#### **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.

#### **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-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-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-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.

**GROUP A**

**07-Bld-A1      Elementary Structural Analysis**

**Structural Analysis I:** Analysis of statically determinate structures: deflections, strain energy concepts, virtual work principles. Mueller Breslau principle, influence lines.

Approximate methods for statically indeterminate structures. Collapse load analysis.

**Structural Analysis II:** Analysis of statically indeterminate structures: the methods of consistent deformations, slope deflection, and moment distribution. Application of virtual work principles. Introduction to matrix methods.

### **07-Bld-A2 Elementary Structural Design**

**Structural Design I:** Basis for limit states design. Code requirements. Structural steel design: tension and compression members, beams and beam-columns. Connections. Introduction to the design of timber members.

**Structural Design II:** Reinforced concrete behaviour in flexure, compression, shear, and bond. Ultimate strength design of reinforced concrete beams, columns, walls, and footings. Introduction to prestressed concrete and masonry

### **07-Bld-A3 Construction Engineering**

**Construction Engineering:** The nature of construction and the environment in which the industry works; organizational structures for project delivery; construction contracts and documents; introduction to construction processes: excavation and site works, foundation layout, concrete form design, concrete, steel, timber, and masonry construction; project planning, scheduling, and control; construction safety.

**Project Management for Construction:** Introduction to project management techniques in construction, including project delivery methods, construction contracts, cost estimating and bidding planning and scheduling, cash flow analysis, project tracking and control.

**Labour and Industrial Relations in Construction:** The study of labour legislation with special emphasis on the construction industry, union organization, the theory and practice of negotiations, mediation, contract administration, and arbitration. Review of actual contracts.

**Construction Processes:** A study of current construction methods and techniques. The subjects include site preparation and earthwork, wood framing, masonry, concrete forming, slip forming, precast construction, industrialized building, deep excavation shoring and underpinning. Design, erection, and removal of temporary construction work. Current field practice and safety considerations.

### **07-Bld-A4 Building Engineering Systems**

**Building Engineering Systems:** Introduction to systematic solution of building engineering problems. Techniques treated include linear programming, network analysis, nonlinear programming. Introduction to decision analysis and simulation. Application of optimization methods for solution of design problems in building science, building environment, building structures, and construction management.

**HVAC System Design:** Principles of HVAC system design and analysis; component and system selection criteria including room air distribution, fans and air circulation, humidifying and dehumidifying processes, piping and ducting design. Air quality standards. Control systems and techniques; operational economics.

**Thermal Analysis of Buildings:** Two- and three-dimensional steady-state and transient conductive heat transfer together with convection and radiation as applied to building materials and geometries. Heating and cooling load analysis, including building shapes, construction type, solar radiation, infiltration, occupancy effects, and daily load variations. Applications for thermal load analysis. Introduction to heat exchangers.

**Building Acoustics:** Noise control criteria and regulations, instrumentation, noise sources, room acoustics, walls, barriers and enclosures, acoustical materials and structures, vibration and noise control systems for buildings.

**Building Illumination:** Production, measurement and control of light, design of lighting systems. Design in respect to daylighting. Integration of lighting systems with mechanical systems.

**07-Bld-A5 Building Science**

**Building Science:** General introduction to the thermal environment. Topics include heat, temperature, one-dimensional steady-state processes. Convection: natural and forced. Radiation. Combined radiative and convective surface transfer. Psychrometrics. Thermal comfort. Air quality. Condensation: surface and interstitial. Introduction to compressible viscous flow, friction, and flow in pipes; boundary layer and wind effects.

**07-Bld-A6 Geotechnical Materials and Analysis**

**Soil Mechanics:** Index properties and classification of soils. Weight-volume relationships. Soil structures. Moisture-density relationships. Permeability, deformation, and strength of soils. Principle of total and effective stresses. Steady state seepage through isotropic soil media. Stress distribution due to external loads and analysis of total settlements. Outline of theory of consolidation. Fundamentals of stability of earth retaining walls, slopes, and footings

**07-Bld-A7 Building Envelope Design**

**Building Envelope Design:** Technical influences in the design of building envelope, including the control of heat flow, air and moisture penetration, building movements, and deterioration. Application of air/vapour barrier and rain-screen systems. Performance assessment and building codes through case studies and design projects. Design of walls, roofs, joints and assemblies. Cause of deterioration and preventive measures; on-site investigation. Relevant building codes and standards.

**GROUP B**

**07-Bld-B1 Computer Programming**

**Construction Information Systems:** Information technology and information management in construction. Resolution of technical problems by means of software (spreadsheets, data bases, etc.). Programming with Visual Basic. AutoCAD. 3D Modelling.

**07-Bld-B2 Advanced Structural Analysis**

**Introduction to Structural Dynamics:** Theory of vibration. Dynamic response of simple structural systems. Effects of blast, wind, traffic, and machinery vibrations. Basic concepts in earthquake resistant design. Computer applications. Lectures: three hours per week.

**Matrix Analysis of Structures:** Classical and matrix methods of structural analysis; influence coefficients, transformation matrices. Matrix formulation of the force and of the displacement methods of analysis. Direct stiffness approach; substructure technique. Introduction to finite-element method. Computer applications.

**07-Bld-B3      Advanced Structural Design**

**Foundation Design:** Loads, bearing capacity, and settlement. Lateral pressures. Foundation drainage and water-proofing. Spread footings. Strip footings. Pile foundations. Caissons. Retaining walls. Sheet-piling walls. Braced cofferdams. Cellular cofferdams. Anchors.

**Design of Reinforced Concrete Structures:** Design of long columns, columns subjected to biaxial bending, two-way slabs, flat plates, girders, and shells. Design of frames, shear-walls, and prefabricated structures. Prestressed concrete: losses, short- and long-term deflections; design requirements for shear, flexure, bond, and anchorage

**Design of Steel Structures:** Trends and developments in structural-steel design. Framing systems. Floor systems; composite construction; plate girders. Design of braced frames, moment-resisting frames. Connections. P-Delta effects. Introduction to steel-bridge design.

**07-Bld-B4      Modern Building Materials**

**Modern Building Materials** Engineering properties of building materials such as: plastics, synthetic fibres, adhesives, sealants, caulking compounds, foams, sandwich panels, composites, polymer concrete systems, fibre-reinforced concretes, plastic mortars, polymers for flooring, roofing, synthetic wall papers. Moisture properties of modern building materials. Their structural, thermal, and acoustical properties. Consideration of corrosion, bio- and thermal-degradation, stability to ultraviolet and solar radiation.

**07-Bld-B5      Fire and Smoke Control in Buildings**

**Fire and Smoke Control in Buildings:** Topics treated include fire and smoke control; failure mechanisms of building enclosure illustrated by case studies; code requirements for enclosure systems; systems approach for fire safety.

**07-Bld-B6      Building Energy Conservation Technologies**

**Building Energy Conservation Technologies:** Standards of energy efficiency in buildings. Trends in energy consumption. Energy audit: evaluation of energy performance of existing buildings, weather normalization methods, measurements, disaggregation of total energy consumption, use of computer models, impact of people behaviour. Energy efficiency measures in buildings: approaches, materials and equipments, operating strategies, evaluation methods of energy savings. Renewable energy sources: passive or active solar systems, geothermal systems, free-cooling. Optimum selection of energy sources. Air-to-air energy recovery.

**07-Bld-B7      Indoor Air Quality**

**Indoor Air Quality:** Elements of indoor air quality, physical/ chemical characteristics of contaminants, health effects, standard requirements. Estimation of the levels of indoor air contaminants in buildings. Design of ventilation systems for pollutant control. Air pollution due to outdoor air supply through ventilation systems. Effect of outdoor air pollution on indoor air quality.

**07-Bld- B8      Control Systems in Buildings**

**Control Systems in Buildings:** Introduction to automatic control systems. Control issues related to energy conservation, indoor air quality and thermal comfort in buildings, ventilation. Classification of HVAC control systems. Control system hardware: selection and sizing of sensors, actuators and controllers. Practical HVAC control systems; elementary local loop and complete control systems. Designing and tuning of controllers. Building automation systems.

**07-Bld-B9 Building Services**

**Acoustics and Lighting:** General introduction to the aural and visual environment. Psychological impact of environment. Subjective and objective scales of measurement. Introduction to vibration. The hearing mechanism. Transmission of sound, passive control of noise in buildings, transmission loss, absorption and reverberation time. Room acoustic assessment. Active control of the aural environment. Visual perception. Photometry, brightness, luminance, and illumination. Concept of natural lighting in building. Artificial lighting; light sources; luminaries. Calorimetry. Calculation methods for artificial lighting.

**Building Service Systems:** Principles of building service systems, including electrical, gas, communications, service-water supply and distribution; introduction to plans, codes, and standards for utility distribution systems.

**COMPLEMENTARY STUDIES**

**11-CS-1 Engineering Economics**

Basic concepts of engineering economics through understanding of the theoretical and conceptual financial project analysis. Types and applications of engineering economic decisions. Capital, cash flow, and the time value of money concepts. Nominal and effective interest rates when considering loans, mortgages, and bonds. The application of present worth analysis, annual equivalent analysis and rate of return analysis in evaluating independent projects, comparing mutually exclusive projects, analyzing lease vs. buy alternatives and making decisions. After-tax financial analysis requiring an understanding of capital cost allowance (depreciation) and corporate income tax. Understanding methods of financing and capital budgeting. Break-even, sensitivity and risk analyses.

**11-CS-2 Engineering in Society – Health and Safety**

The duties and legal responsibilities for which engineers are accountable; safety laws and regulations; and a basic knowledge of potential hazards and their control: biological hazards – bacteria, viruses; chemical hazards - gases, liquids and dusts; fire and explosion hazards; physical hazards – noise, radiation, temperature extremes; safety hazards – equipment operation; workplace conditions - equity standards, human behaviour, capabilities, and limitations; managing safety and health through risk management, safety analyses, and safety plans and programs; practices and procedures to improve safety. The roles and social responsibilities of an engineer from a professional ethics point of view, as applied in the context of Canadian values. The integration of ethics into engineering practice, and its effect on public safety and trust.

**11-CS-3 Sustainability, Engineering and the Environment**

Basic knowledge of soil, water and air quality engineering: soil and water interaction, water supply issues, human activities and their interaction on soil, air and water resources. Fundamentals of: soil erosion, water quality, atmospheric pollution (carbon and nitrogen cycle), climate change, risk assessment. Basic knowledge of renewable energy sources: solar, photovoltaic, wireless electricity, thermal, wind, geothermal, and biofuels.

**Introduction to** renewable materials engineering; nano materials, new material cycles. Eco-product development, and product life cycle assessment; recycling technologies; reuse of products; design for disassembly, recycling, e-waste, and reverse manufacturing.

Consumption patterns; transportation; environmental communication; consumer awareness. Optimized energy and resources management. Sustainable methods: sustainability indicators; life cycle assessment; regulatory aspects of environmental management, ecological planning.

## **11-CS-4      Engineering Management**

Introduction to management principles and their impact upon social and economic aspects of engineering practice. Engineering management knowledge topics including: market research, assessment and forecasting; strategic planning; risk and change management; product, service and process development; engineering projects and process management; financial resource management; marketing, sales and communications management; leadership and organizational management; professional responsibility. New paradigms and innovative business models, including: sustainable production, products, service systems and consumption; best practices and practical examples of successful implementations of sustainable scientific and engineering solutions.

### **3.2      ENGINEERING REPORT**

Upon passing the examination(s) assigned by PEO's Academic Requirements Committee, a candidate may be required to write an Engineering Report. The report must demonstrate the candidate's ability to present an engineering problem, observation, or idea, and to analyze it logically and accurately using engineering principles, and to draw conclusions or make recommendations. The work must include acceptable technical content involving engineering analysis, design, development, or research. The report must also demonstrate a satisfactory level of writing and graphical skills, thus the quality of the presentation will be a factor in determining the acceptability of the report.

The report itself need not prove originality of ideas, but the candidate should demonstrate his/her ability to appreciate, present, differentiate between and draw conclusions from observations and ideas. The definition of a "report" is flexible and could also include discussion and judgement of opposed theories or methods, or a description of a novel technique or process and a discussion of the practicality of its application. The key consideration is that the report address a new issue, and not repeat the coverage of the particular subject available in textbooks. It is the current state of the art, the novel or the contentious that is expected to be explored in the report.

While no rigid rules of format are specified, it is recommended that the report be suitably subdivided and include:

- a) A title page and date
- b) A signed declaration of authorship
- c) A table of contents
- d) A summary of the report and its conclusions
- e) Technical content including analysis, design, development or research
- f) Conclusions and/or recommendations
- g) A list of the technical literature cited
- h) A list of acknowledgements, contributors, reviewers and sources of information

The report should be about 5,000 words long, not including tables and graphs. Diagrams, illustrations, etc. should be clearly and properly identified. It is preferable to locate graphs,

diagrams, etc. necessary for the understanding of the text at the place where reference to them is made.

**07-Bld-A1, Elementary Structural Analysis**

Aslam Kassimali, Structural Analysis PWS Publishers Latest Edition ISBN # 0534950469

**07-Bld-A2, Elementary Structural Design**

Handbook of Steel Construction, Current Edition, Canadian Institute of Steel Construction

Concrete Design Handbook, Current Edition, Canadian Portland Cement Association

Wood Design Manual, Current Edition, Canadian Wood Council, Ottawa Tel: 613-247-7077

**07-Bld-A3 , Construction Engineering**

Project Management: A managerial approach (7th Ed.) by Jack R. Meredith and J. Mantel. published by Wiley ISBN -13 978-0471-715375

Managing construction: The contractual viewpoint by K. Collier. published by Delmar Learning. ISBN-10 0-471-71537-9

Managing the Construction Process: Estimating, Scheduling, and Project Control. by Gould, F. E. published by Prentice Hall.

**07-Bld-A4, Building Engineering Systems**

Civil and Environmental Engineering Systems, Charles S. Revelle, E. Earl, Whitlatch and Jeff R. Wright, 2nd edition, 2004, Pearson Prentice Hall.

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**07-Bld-B3, Advanced Structural Design**

G.L. Kulak & M.I. Gilmore, Limit States Design in Structural Steel, 6<sup>th</sup> Edition, Canadian Institute of Steel Construction, 1998

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C.K. Wang et al, Reinforced Concrete Design, 6<sup>th</sup> Edition, Harper and Row, 1998

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**07-Bld-B6 Building Energy Conservation Technologies**

Energy Efficient Buildings with Solar and Geothermal Resources by Ursula Eicker, ISBN: 978-1-118-35224-3.

This book is published by Wiley, and can be found on Amazon: here is the link

[http://www.amazon.com/Energy-Efficient-Buildings-Geothermal-Resources/dp/1118352246/ref=sr\\_1\\_fkmr0\\_l?ie=UTF8&qid=1447355679&sr=8-1-fkmr0&keywords=Energy+Efficient+Buildings+with+Solar+and+Geothermal+Resources+by+Ursula+Eicker%2C+ISBN%3A+978-1-118-35224-3](http://www.amazon.com/Energy-Efficient-Buildings-Geothermal-Resources/dp/1118352246/ref=sr_1_fkmr0_l?ie=UTF8&qid=1447355679&sr=8-1-fkmr0&keywords=Energy+Efficient+Buildings+with+Solar+and+Geothermal+Resources+by+Ursula+Eicker%2C+ISBN%3A+978-1-118-35224-3)

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**11-CS-1      Engineering Economics****Primary Text**

Fraser, Niall; Jewkes, Elizabeth; Bernhardt, Irwin and Tajima, May. Global Engineering Economics: Financial Decision Making for Engineers. Fourth edition, Pearson Education Canada, 2008. ISBN: 978-0132071611.

**Additional Resources**

Sonyi, Andrew; Fenton, Robert and White, John. Principles of Engineering Economics Analysis. Canadian edition, Wall & Emerson Inc., 2000. ISBN: 978-0921332497.

**Web Resources**

Key words: engineering economics, cost engineering, financial analysis

Organizations: International Cost Engineering Council, Association of Cost Engineers, Association for the Advancement of Cost Engineering

**11-CS-2      Engineering in Society – Health & Safety****Primary Text**

Brauer, Roger L. Safety and Health for Engineers. Second edition, John Wiley & Sons Inc., 2006. ISBN: 978-0471286325.

**Web Resources**

Key words: health and safety, public safety, engineering ethics

Organizations: Canadian Society of Safety Engineering (CSSE), Canadian Centre for Occupational Health and Safety (CCOHS), Health Canada, National Academy of Engineering Center for Engineering, Ethics and Society

**11-CS-3      Sustainability, Engineering and the Environment**

Mihelcic, J.R. and Zimmerman, J.B. (2014) *Environmental Engineering: Fundamentals, Sustainability, Design, 2<sup>nd</sup> edition*. John Wiley & Sons, Hoboken, NJ.

Berg, L., Hager, M.C., Goodman, L. and Baydack, R. (2010) *Visualizing the Environment* (Canadian Edition). John Wiley & Sons, Hoboken, NJ. (Chapters 10, 11)

Wimmer, W. and Kauffman, Joanne. Handbook of Sustainable Engineering. First edition, Springer Publishing, 2011. ISBN: 978-1-4020-8939-8.

**Additional Resources**

The Report of the Brundtland Commission ("Our Common Future")

1972 Stockholm Report of the United Nations Conference on the Human Environment

1992 United Nations international Earth Summit in Rio de Janeiro

**Web Resources**

Key words: Sustainability; Sustainable engineering; Energy, Engineering and the Environment

Organizations: Environment Canada, Natural Resources Canada, Organisation for Economic Co-operation and Development (OECD) sustainable development

**11-CS-4      Engineering Management****Primary Text**

American Society for Mechanical Engineers. Guide to the Engineering Management Body of Knowledge. American Society for Mechanical Engineers, 2010. ISBN: 978-0791802991

**Additional Resources**

Gray, Clifford F. and Larson, Erik W. Project Management: The Managerial Process. Canadian 5<sup>th</sup> edition. Irwin/McGraw-Hill, 2011. ISBN: 978-0073403342

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Gray, Clifford F. et Larson, Erik W. Management du projet. Chenelière McGraw-Hill, 2006. ISBN: 978-2765104537

**Web Resources**

Key words: engineering management, financial management, strategic management, resource management, operations management

Organizations: American Society for Mechanical Engineers (ASME), Canadian Society for Engineering Management, Project Management Institute, American Society for Engineering Management

*Updated: October 2014*

**TOTAL EXAMINATION PROGRAM**  
**PEO Syllabus of Examinations, 2011 Edition**

**BUILDING ENGINEERING**

**INTRODUCTION**

A full set of Building Engineering examinations consists of the following, three-hour examination papers and an engineering report. 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 PEO's Academic Requirement Committee.

**BASIC STUDIES EXAMINATIONS**

04-BS-1	Mathematics
04-BS-2	Probability and Statistics
04-BS-3	Statics and Dynamics
04-BS-4	Electric Circuits and Power
04-BS-6	Mechanics of Materials
04-BS-7	Mechanics of Fluids
04-BS-10	Thermodynamics
04-BS-11	Properties of Materials
04-BS-15	Engineering Graphics and Design Process

**PROFESSIONAL EXAMS – SPECIFIC TO BUILDING ENGINEERING**

**GROUP A**

07-Bld-A1	Elementary Structural Analysis
07-Bld-A2	Elementary Structural Design
07-Bld-A3	Construction Engineering
07-Bld-A4	Building Engineering Systems
07-Bld-A5	Building Science
07-Bld-A6	Geotechnical Materials and Analysis
07-Bld-A7	Building Envelope Design

**GROUP B**

07-Bld-B1	Computer Programming
07-Bld-B2	Advanced Structural Analysis
07-Bld-B3	Advanced Structural Design
07-Bld-B4	Modern Building Materials
07-Bld-B5	Fire and Smoke Control in Buildings
07-Bld-B6	Building Energy Conservation Technologies
07-Bld-B7	Indoor Air Quality
07-Bld-B8	Control Systems in Buildings
07-Bld-B9	Building Services

**COMPLEMENTARY STUDIES**

11-CS-1	Engineering Economics
11-CS-2	Engineering in Society – Health & Safety
11-CS-3	Sustainability, Engineering and the Environment
11-CS-4	Engineering Management

3.2	Engineering Report
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