Confirmatory Exam Program Requirements
Computer Engineering

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

The following restrictions apply:

If you choose 17-Comp-A1, **do not** choose 17-Comp-B2

If you choose 17-Comp-A3, **do not** choose 17-Comp-B1

If you choose 17-Comp-A4, **do not** choose 17-Comp-B3

Computer Engineering Technical Exams			
Group A		**Group B**	
17-Comp-A1	Electronics	17-Comp-B1	Advanced Computer Architecture
17-Comp-A2	Digital Systems Design	17-Comp-B2	Principles of VLSI
17-Comp-A3	Computer Architecture	17-Comp-B3	Data Bases and File Systems
17-Comp-A4	Program Design and Data Structures	17-Comp-B4	Computer Graphics
		17-Comp-B5	Computer Communications
17-Comp-A5	Operating Systems	17-Comp-B6	Computer Control and Robotics
17-Comp-A6	Software Engineering	17-Comp-B7	Digital Signal Processing
		17-Comp-B8	Computer Integrated Manufacturing
		17-Comp-B9	Artificial Intelligence and Expert Systems
		17-Comp-B10	Distributed Systems
		17-Comp-B11	Advanced Software Design
		17-Comp-B12	Computer Security
		17-Comp-B13	Mechatronic Design

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

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

Professional Engineers
Ontario

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 , through the website 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 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.

Professional Engineers
Ontario

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

COMPUTER ENGINEERING EXAMINATIONS

INTRODUCTION

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Computer Engineering examinations consists of eighteen, 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 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 examinations 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-5   Advanced Mathematics
Series Solutions of Differential Equations: Series solutions of ordinary differential equations, boundary value problems and orthogonal functions, Fourier series. Numerical Methods: Use of computers for numerical solution of engineering problems, including techniques involving library subroutines and spreadsheets. Approximations and errors, interpolation, systems of linear and non-linear algebraic equations, curve fitting, numerical integration and differentiation, and ordinary differential equations.

04-BS-6   Mechanics of Materials
Definitions of normal stress, shearing stress, normal strain, shearing strain; shear force and bending moment diagrams; members subjected to axial loading; members subjected to torsional loading; compound stresses, Mohr's circle; deformation of flexural and torsional members; failure theories; elastic and inelastic strength criteria; columns.

04-BS-7   Mechanics of Fluids
Fluid characteristics, dimensions and units, flow properties, and fluid properties; the fundamentals of fluid statics, engineering applications of fluid statics; the one-dimensional equations of continuity, momentum, and energy; laminar and turbulent flow, flow separation, drag and lift on immersed objects; wall friction and minor losses in closed conduit flow; flow of incompressible and compressible fluids in pipes; dimensional analysis and similitude; flow measurement methods.

04-BS-8   Digital Logic Circuits
Boolean algebra, encoders, decoders, shift registers, and asynchronous and synchronous counters together with timing considerations. Design of asynchronous circuits, synchronous sequential circuits, and finite state machines. Karnaugh mapping techniques, and state tables and diagrams. Introduction to programmable logic.

04-BS-9   Basic Electromagnetics
Introduction to the basic electromagnetic principles upon which electrical engineering is based (laws in both integral and differential form). Classical development of electrostatics and magnetostatics leading to Maxwell's equations. Application of electromagnetic theory to calculation of d-c circuit parameters, study of plane wave transmission in various media.

04-BS-10   Thermodynamics
Thermodynamic states of simple systems; the laws of thermodynamics; equilibrium, PVT and other thermodynamic diagrams; equation of state; compressibility charts and steam tables; calculation of property changes; enthalpy; applications of thermodynamics, cycles, reversibility; thermodynamics of phase changes, Gibbs phase rule, gas-vapour mixtures.

04-BS-11   Properties of Materials
Properties of materials for mechanical, thermal and electrical applications. Atomic bonding, solid solutions, crystallisation. Equilibrium phase diagrams, applications to steel and aluminium alloys, heat treatments. Structure and special properties of polymers and ceramic materials. General characteristics of metallic composites, polymeric composites and concrete. Introduction to materials in hostile environments: corrosion, creep at high temperature, refractory materials, subnormal temperature brittle fracture.

04-BS-15   Engineering Graphics and Design Process

Engineering drawing: Orthographic sketching. Standard orthographic projection. Principal views, selection and positioning of views. Visualization. Conventions and practices. First and second auxiliary views. Basic descriptive geometry. Section views, types, hatching conventions. Basic dimensioning requirements. Tolerance for fits and geometry control. Detail drawings and assembly drawings, other drawings and documents used in an engineering organization. Bill of materials. Fasteners and welds. Design process and methods. Project management & teamwork. Requirements and function analysis in design. Conceptual design and testing. Concept evaluation design factors such as: cost, quality, manufacturability, safety, etc. Systems modelling & design detail.

04-BS-16   Discrete Mathematics

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

GROUP A

17-Comp-A1   Electronics

Devices: circuit models and characteristics. Integrated circuits. Diodes, rectifiers, and wave shaping networks. Field effect and bipolar transistors: small-signal and AC analysis. Single-stage amplifier design. Operational amplifiers and applications. Large-signal analysis, wave shaping and bistable circuits including multivibrators, triggers, and waveform generators. Digital electronics including basic logic gates and memory elements. Hybrid analog/digital devices including A/D and D/A converters.

17-Comp-A2   Digital Systems Design

Boolean algebra. Design of combinatorial and sequential logic. Implementation using simple gates. Programmable logic devices and gate arrays. Characteristics of digital integrated circuit families. Analysis and design for controllers, processors, and memories. Microprocessors, including components, data flow, signals, and timing. Small system design, interconnection of associated devices. Computer interfacing, including parallel and serial I/O, interrupts and DMA. Common bus structures.

17-Comp-A3   Computer Architecture

Architecture, programming and I/O. Computer structure and typical processor architecture. CPU and memory organization, buses.   Characteristics of I/O and storage devices. Processing unit and controller design, hardwired and microprogram control.   Instruction sets and addressing modes; assembly language programming, I/O and interrupt servicing.

17-Comp-A4   Program Design and Data Structures

Programming language syntax and semantics.   Design of structured and modular programs in a high level language (C, C++).   Basics of object-oriented programming: classes.   Non-numerical processing. Design and construction of programs involving structured data: arrays, stacks, queues, lists, trees, and records.

17-Comp-A5   Operating Systems

Operating system principles, components, and programming. Design and implementation of operating systems.   Synchronization of concurrent processes, resource allocation, scheduling, protection, and privacy. Data, task, and job management: loading, linking; I/O control.   Multi-core, multithreading and multiprocessing. Virtualization, hypervisors and containers. Real-time aspects. Basic characteristics of modern operating systems: unix, Windows.

17-Comp-A6   Software Engineering

Software cycles and requirements analysis. Design, implementation, test, verification and validation, documentation, quality assurance, control and life-cycle management of correct, reliable, maintainable, and cost effective software. Current design methodologies, including modularization, graphical design tools, design in high-level languages, and data flow driven designs. Planning and management of software projects.   Software maintenance and configuration management.

GROUP B

17-Comp-B1   Advanced Computer Architecture

Architecture of high speed workstation and personal processors and systems. Instruction set design for pipelined machines.   Caches.   Multiple processor architectures, highly parallel machines, systolic arrays, neural networks, multitasking machines, real-time systems, interconnection of multiple processor systems. Architectures for specialized purposes, array processors, vector processors. Virtual machines.
Embedded systems and control.

17-Comp-B2   Principles of VLSI

Very large scale integrated circuits. Fabrication processes in CMOS and BICMOS. Simplified design rules. Design methodology. Static and dynamic logic, multiphase clocking. Memory elements and memory structures. Gate arrays and standard cell technology; placement and routing. Programmable logic devices. I/O devices. Testing.

17-Comp-B3   Data Bases and File Systems

Concepts and structures for design and implementation of data bases and file systems. Data models, data normalization, data description languages, query facilities, data integrity and reliability, concurrency. Data bases: hierarchical, network and relational databases; data organization. Relational query languages: relational algebra and calculus, SQL. Relational database design. Transaction processing, query processing, reports. Security and integrity; concurrency control. File organization: sequential, indexed and direct access, multiple key, and hashing. File processing: records, files, compaction. Sorting, merging and updating files. Algorithms for inverted lists, multilist, indexed sequential and hierarchical structures. File I/O: control, utility, space allocation, and cataloguing. Index organization.

17-Comp-B4   Computer Graphics

Hardware and software systems for graphics. Input and output devices, display devices. Techniques for describing and generating image. Object modeling and display techniques. Transformations in two and three dimensions: scaling, translation, rotation, clipping and windowing. Visual realism: perspective, visibility, hidden surface elimination, illumination, shading and rendering. Graphic software and data structures, display data structures and procedures, efficient algorithms. Graphic standards such as GKS, PHIGS, TIGA, and X-windows.

17-Comp-B5   Computer Communications

Data communications, including signals, modulation and reception. Error detecting and correcting codes. Including circuit and packet switching. Multiplexing, including time, frequency and code division multiplexing. Digital networks, including ISDN, frame relay and ATM. Protocols: the ISO/OSI reference model, X.25. Internetworking and router-based networks: the TCP/IP suite of protocols, routing and flow control, Internet addressing and domain names. Local area networks, topologies, access schemes, medium access and logic layers; CSMA/CD and token ring protocols; segmented and hubbed LANs. This syllabus requires knowledge of linear systems as described in 16-Elec-A1.

17-Comp-B6   Computer Control and Robotics

Discrete-time and quantized data control systems. Z-transform and state space methods. Principles of digital control. Digital controllers and components. Controller software. Industrial and robotic systems. Descriptions of 3D space, geometry of robotics manipulators. Transducers and interfacing. This syllabus requires knowledge of linear systems as described in 16-Elec-A1.

17-Comp-B7   Digital Signal Processing

Theory of discrete-time linear systems.   Digital filtering.   Discrete Fourier analysis. Application to voice and image processing, communications, etc.   Hardware for digital signal processing, including digital signal processors. This syllabus requires knowledge of linear systems as described in 16-Elec-A1.

17-Comp-B8   Computer Integrated Manufacturing

The integration of mechanical, electronic and informational components in manufacturing. Hierarchical and distributed computer control, including hardware and software. Collecting, controlling, processing and disseminating data.   Sensors and tool control, station control.   "Factory floor" local area networks and protocols; manufacturing data bases. Process design and operation. CAD/CAM, manufacturing resource planning, and numerical control.

17-Comp-B9   Artificial Intelligence and Expert Systems

Concepts of artificial intelligence.   Overview of knowledge-based and expert systems. Logic programming. Programming languages (LISP and Prolog) for AI and expert system implementation. Knowledge representation. Rule-based and object-based systems.

17-Comp-B10   Distributed Systems

Characteristics of distributed systems. Networked vs. centralized systems. Fundamental concepts and mechanisms. Client-server systems.   Process synchronization and interprocess communications. Principles of fault tolerance.   Transaction processing techniques.   Distributed file systems.   Operating systems for distributed architectures. Security.

17-Comp-B11   Advanced Software Design

The design and programming aspects of the construction of large software systems. Advanced object-oriented design. Language support for modular programming, visual programming systems, GUI design and implementation.

17-Comp-B12   Computer Security

Types of threats, terminology, network basics, internet fraud, theft, cyber stalking, DoS attacks, malware, hacking, industrial espionage, encryption and cryptography, security technology: accvess control, virus scanners, firewalls, IDS, certificates, SSL/TLS, VPN, Wi-fi security; security policies; forensics.

17-Comp-B13   Mechatronic Design

Microprocessors microcontrollers, architectures, programming languages, embedded software and event-driven control, software design, communications and protocols, peripherals: sensors and interface circuits.

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.

NOTE: Please feel free to use the most recent edition of textbooks referenced in this list

17-Comp-A1 Electronics

Sedra & Smith, Microelectronic Circuits, seventh edition

17-Comp-A2 Digital Systems Design

Roth, Fundamentals of Logic Design, 7th edition
Thorne, Computer Organization and Assembler Language Programming for the IBM PC and Compatibles, Addison-Wesley.

17-Comp-A3 Computer Architecture

William Stallings, Computer Organization and Architecture, 10th Edition, Pearson
Hayes, Computer Architecture and Organization, 2nd Edition, McGraw-Hill
Hennessy & Patterson, Computer Architecture: A Quantitative Approach, 2nd Edition

17-Comp-A4 Program Design and Data Structures

Carrano and Henry, Data Abstraction and Problem Solving with C++, seventh edition
Deitel & Deitel, C++: How to Program, tenth edition
Weiss, Data Structures and Algorithm Analysis in C++, fourth ed.
Addison-Wesley Hanley, Essential C++ for Engineers and Scientists
Wiley Wunder & Roberts, Developing Java Software

17-Comp-A5 Operating Systems

Suberschatz & Galvin, Operating System Concepts, 9th Edition
Addison-Wesley Tanenbaum, Modern Operating Systems
Stallings, Operating Systems Internals and Design Principles, 8th ed.

17-Comp-A6 Software Engineering

Sommerville, Software Engineering, 10th Edition
Pressman, Software Engineering: A Practitioners Approach, 8thEdition, McGraw-Hill

17-Comp-B1 Advanced Computer Architecture

Hennessy and Patterson, Computer Architecture: A Quantitative Approach, 5th ed, Morgan Kaufmann

17-Comp-B2 Principles of VLSI

Chen, CMOS Devices and Technology for VLSI
Rabaey & Chandrakasan, Digital Integrated Circuits, 2ED, Pearson
Glasser & Dobberpuhl, The Design and Analysis of VLSI Circuits Jack
& Denyer, Introduction to MOS LSI Design

17-Comp-B3 Data Bases and File Systems

Elmasri & Navathe, Fundamentals of Database Systems, 7th Edition

Connolly and Begg, Database Systems: A Practical Approach to Design, Implementation and Management, 4th edition, Addison-Wesley

Date, An Introduction to Data Base Systems, 6th Edition

17-Comp-B4 Computer Graphics

Foley, van Dam, Feiner & Hughes, Computer Graphics: Principles and Practice, 2nd Edition, Addison-Wesley

17-Comp-B5 Computer Communications

Stallings, W., Data and Computer Communications, 10th Edition, Pearson

Wiley Comer, Internetworking with TCP/IP Volume I: Principles, Protocols, and Architecture

Kurose & Ross, Computer Networking: A Top-Down Approach, 7th ed, Pearson

Saadawi, Amman & El Hakeem, Fundamentals of Telecommunication Networks, Prentice-Hall

17-Comp-B6 Computer Control and Robotics Moudgalya,

Digital Control, Wiley-Interscience

17-Comp-B7 Digital Signal Processing

Blandford and Parr, Introduction to Digital Signal Processing, Pearson

Strum & Kirk, First Principles of Discrete Systems and Digital Signal Processing

17-Comp-B8 Computer Integrated Manufacturing

Rehg & Kraebber, Computer Integrated Manufacturing, 3rd ed, Pearson

17-Comp-B9 Artificial Intelligence and Expert Systems

Winston, Artificial Intelligence

17-Comp-B10 Distributed Systems

Tanenbaum & Van Steen, Distributed Systems: Principles and Paradigms, Pearson

Shuey, R.L., Spooner, D.L., and Frider, O., The Architecture of Distributed Computer Systems, Addison-Wesley

Mullender, S. (Editor), Distributed Systems, 2nd Edition, Addison-Wesley

17-Comp-B11 Advanced Software Design

Dasgupta & Dimitriou, Algorithms, McGraw-Hill

17-Comp-B12 Computer Security

Bishop, Introduction to Computer Security, Addison-Wesley

Easttom, Computer Security Fundamentals, third edition

Anderson, Security Engineering, second ed, https://www.cl.cam.ac.uk/~rja14/book.html **17-Comp-B13 Mechatronic Design**

Carryer et al, Introduction to Mechatronic Design, Pearson

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, 2nd 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 5th edition. Irwin/McGraw-Hill, 2011. ISBN: 978-0073403342

aussi disponible en français :
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

INTRODUCTION

A full set of Computer Engineering examinations consists of the following, 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 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-5	Advanced Mathematics
04-BS-6	Mechanics of Materials
04-BS-7	Mechanics of Fluids
04-BS-8	Digital Logic Circuits
04-BS-9	Basic Electromagnetics
04-BS-10	Thermodynamics
04-BS-11	Properties of Materials
04-BS-15	Engineering Graphics and Design Process
04-BS-16	Discrete Mathematics

PROFESSIONAL EXAMS – SPECIFIC TO COMPUTER ENGINEERING

GROUP A

17-Comp-A1	Electronics
17-Comp-A2	Digital Systems Design
17-Comp-A3	Computer Architecture
17-Comp-A4	Program Design and Data Structures
17-Comp-A5	Operating Systems
17-Comp-A6	Software Engineering

GROUP B

17-Comp-B1	Advanced Computer Architecture
17-Comp-B2	Principles of VLSI
17-Comp-B3	Data Bases and File Systems
17-Comp-B4	Computer Graphics
17-Comp-B5	Computer Communications
17-Comp-B6	Computer Control and Robotics
17-Comp-B7	Digital Signal Processing
17-Comp-B8	Computer Integrated Manufacturing
17-Comp-B9	Artificial Intelligence and Expert Systems
17-Comp-B10	Distributed Systems
17-Comp-B11	Advanced Software Design
17-Comp-B12	Computer Security
17-Comp-B13	Mechatronic Design

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