Professional Engineers
Ontario

Confirmatory Exam Program Requirements
Marine Engineering

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

Marine Engineering Technical Exams			
Group A		**Group B**	
98-Mar-A1	Applied Thermodynamics and Heat Transfer (16-Mec-A1)	98-Mar-B1	Advanced Machine Design (16-Mec-B1)
98-Mar-A2	Fundamentals of Naval Architecture (16-Nav-A1)	98-Mar-B2	Environmental Control in Ships
98-Mar-A3	Advanced Fluid Mechanics (16-Mec-A6)	98-Mar-B3	System Analysis and Control (16-Mec-A3)
98-Mar-A4	Kinematics and Dynamics of Machines (16-Mec-A2)	98-Mar-B4	Ship Production and Shipyard Management (16-Nav-B5)
98-Mar-A5	Advanced Strength of Materials (16-Mec-A7)	98-Mar-B5	Fluid Machinery (16-Mec-B6)
98-Mar-A6	Design & Manufacture of Machine Elements (16-Mec-A4)	98-Mar-B6	Electrical & Electronics Engineering (16-Mec-A5)
98-Mar-A7	Marine Engineering	98-Mar-B7	Maritime Management

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

Last Revision: May 2019

MARINE ENGINEERING EXAMINATIONS

INTRODUCTION

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Marine 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-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-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-12 Organic Chemistry
Principles of organic chemistry developed around the concepts of structure and functional groups. The main classes of organic compounds. Properties of pure substances. Introduction to molecular structure, bond types, properties, synthesis and reactions, reaction mechanisms, as a means of systematizing organic reactions.

04-BS-13 Biology
Cellular reproduction, growth, and differentiation; metabolism and bioenergetics of living cells; cell structure and function related to the material properties of plant and animal tissues; introductory microbiology — characteristics and classification of microorganisms; interactions of microorganisms with man in the natural world; kinetics and mathematical models of microbial growth; engineered biological systems such as bio-reactors, bio-instrumentation, and waste treatment systems.

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

98-Mar-A1 Applied Thermodynamics and Heat Transfer (16-Mec-AI)
Applied Thermodynamics: Review of fundamental laws and their applications to closed and open systems. Vapour cycles for power and refrigeration; cycle modifications including reheat, regeneration. Gas cycles; spark ignition and compression ignition cycles. Gas turbine cycles, including modifications such as regeneration and intercooling; effects of component efficiency on performance.
Heat Transfer: Conduction in one and two-dimensional systems; steady state and transient regimes. Natural- and forced-convection problems. Radiation heat exchange between black, gray, and real surfaces. Thermal design of heat exchangers.

98-Mar-A2 Fundamentals of Naval Architecture (16-Nav-A1)
Hull form definition: principal dimensions, ships' lines, coefficients of form. Hull form characteristics: integration methods, Bonjean curves, wetted surface, hydrostatic curves. Equilibrium conditions. Initial stability, metacentric height, cross curves of stability, GZ curve, free surface effect, effects of changes in weight on stability, stability criteria, inclining experiment. Dynamical stability. Trim, moment causing trim, effect of added weights on draft, trim and heel. Submerged equilibrium, trim dive. Stability when grounded. Intact stability of unusual ship forms. Free communication effect. Subdivision and damage stability calculations. Stability criteria for damaged stability. Load line regulations, tonnage regulations. Use of computers in ship's calculations.

98-Mar-A3 Advanced Fluid Mechanics (16-Mec-A6)
Review of basic concepts; elementary two-dimensional potential flow, vorticity and circulation, one-dimensional compressible flow of an inviscid perfect gas, isentropic flow through nozzles, shock waves, frictional compressible flow in conduits, equations of viscous flow, laminar and turbulent boundary layers. Bernoulli's equation and Navier-Stokes equations. Dimensional analysis and similitude. Application to pumps, fans, compressors, hydraulic turbines; pump system matching, pump/turbine similarity analysis, and idealized velocity diagrams and head calculations; limitations due to unsteady flow, stalling, and cavitation.

98-Mar-A4 Kinematics and Dynamics of Machines (16-Mec-A2)
Kinematic and Dynamic Analysis: Graphical and analytical methods for kinematic analysis of space mechanisms and elementary body motion in space, static and dynamic force analyses of mechanisms, gyroscopic forces, dynamics of reciprocating and rotating machinery, cam and gear mechanisms and specifications.
Vibration Analysis: Free and forced vibration of underdamped lumped systems with multidegrees of freedom, analytical and numerical techniques of solution, viscous damping, vibrational isolation, vibration measurement, and control.

98-Mar-A5 Advanced Strength of Materials (16-Mec-A7)
Stress-Strain Analysis: Stress and strain, graphical representation by Mohr's circles of biaxial and triaxial cases, generalized Hooke's law, equations of equilibrium and compatibility, plane strain and plane stress problems. Euler critical loads for columns, shear flow in beams with thin sections, torsion of non-circular members, shear centre, membrane analogy, thick-walled cylinders and rotating discs, curved beams, contact stresses, strain gauges and application, stress concentrations. Failure theories and limit analysis.
Energy Methods: Strain energy principles, virtual work, Castigliano's theorem. Applications to cases in axial, bending, and torsional loadings. Applications to statically indeterminate problems.

98-Mar-A6 Design and Manufacture of Machine Elements (16-Mec-A4)
Stress, strain and material properties. Fundamentals of machining, metal forming, plastic moulding, and powdered metallurgy processes; non-traditional material removal processes: electric discharge machining, laser beam cutting and machining. Load analysis, static body stresses, elastic strain, deflection, and stability. Failure theories, safety factors, and reliability. Fatigue of machine elements, effect of surface treatments, notches, holes, cracks, and other stress raisers. Applications to the design of: threaded fasteners, power screws, bolted connections, welded joints, springs, roller bearings, gears, rotating shafts.

98-Mar-A7 Marine Engineering
Ship system formulations, main propulsion system requirements, main propulsion system trade-off studies, arrangement of machinery, piping diagrams, auxiliary systems.

Characteristics of internal combustion engines, marine uses for such engines. Marine steam generators, selection and design of boilers. Main propulsion steam engines. Main propulsion steam turbines. Main propulsion gas turbines. Electric propulsion drives.

Propeller shafting and shafting system vibration analysis. Pumps, blowers, compressors, ejectors, condensers, heat exchangers, distilling plants. Hull machinery design considerations and machinery installations, machinery foundation designs, hydrostatic power transmission equipment and systems.

Machinery for environmental control and waste treatment. Electric generating plants, switchboards and panels, lighting and power distribution, power equipment, lighting fixtures. Electronics navigation and radio communication. Automation systems. Safety considerations.

Fundamentals of pressurized-water nuclear steam supply systems for use in marine propulsion, reactor design considerations, nuclear fuels, reactor coolants, reactor control, shielding, safety, health physics, economics.

GROUP B

98-Mar-B1 Advanced Machine Design (16-Mec-B1)
Stress analysis and design of machine elements under conditions of: shock, impact, inertial forces, initial and residual stresses, corrosion environments, wear, elevated temperatures (creep), and low temperatures (brittle fracture). Hydrodynamic lubrication. Applications to the design of: journal bearings, clutches, brakes, couplings, and linkages. Introduction to probabilistic methods in mechanical design.

98-Mar-B2 Environmental Control in Ships
Heating, Ventilation and Air Conditioning: Psychometrics, heating load, cooling load, comfort, ventilation and room air distribution. Humidifying and dehumidifying, duct and fan design, piping and pump design. Heating, ventilating and cooling systems and components. Refrigeration.
Noise Control: Sound wave characteristics, measurement instruments. Sources of noise, absorption and transmission. Free field and reverberant conditions. Noise control techniques in ships.
Energy Management Technology: Energy resources and supplies, control systems and instrumentation, lighting, systems operation, engineering/economic analysis principles, energy audit procedures.

Shipboard waste management, collection systems. Environmental pollution and management. Water quality; principles involved in design and operation and physical, chemical and biological treatment processes. Shipboard waste treatment.

98-Mar-B3 System Analysis and Control (16-Mec-A3)
Open-loop and feedback control. Laws governing mechanical, electrical, fluid, and thermal control components. Mathematical models of mechanical, hydraulic, pneumatic, electric and electronic processes, and control devices. Block diagrams, transfer functions, response of servomechanisms to typical input signals (step function, impulse, harmonic), stability analysis, and stability criteria.

98-Mar-B4 Ship Production and Shipyard Management (16-Nav-B5)
General aspects of shipyard organization and management; history and background of modern industry; industrial tendencies; principles of organization; principles of management. Plant location, layout and construction; handling of materials, production engineering and inspection, quality control, procedure control and systems. Control of production, time and motion study. Material control, plant safety. Industrial relations, personnel management, training, human relations and labour organizations. Drydocking and maintenance of ships.

98-Mar-B5 Fluid Machinery (16-Mec-B6)
Review of dimensional analysis and similitude. Performance characteristics. Specific speed and machine selection. System characteristics and operating point and matching. System regulations, momentum and energy transfer, thermodynamic analysis, and efficiency definitions. Two-dimensional cascade analysis and performance. Axial-flow compressors and turbines, impulse and reaction designs, radial-flow machines, secondary flows and losses. Performance limits due to cavitation.

98-Mar-B6 Electrical and Electronics Engineering (16-Mec-A5)
Steady state and transient analysis of electric circuits. Time domain and frequency domain analyses. Single phase and polyphase circuits. Introduction to analogue and digital semiconductor devices. Transistor amplifiers and switches. Power semiconductor devices, rectifiers, dc power supplies and voltage regulation. Operational amplifiers and application circuits. Combinational and sequential digital logic circuits. Protection of electrical apparatus and systems. Electrical safety. Practical approach to electronic instrumentation, measurement systems and transducers. Magnetic circuits and transformers, DC machines: motors and generators. AC machines: induction motors, synchronous motors, and alternators. Power factor correction.

98-Mar-B7 Maritime Management
Overview of management systems and theories including management economics founded on micro and macro economic theories, financial management procedures and marketing processing including the effects of national and international policies on the processes. Examples of management organizational structures and control systems, the planning and decision making techniques with emphasis being placed on a study of basic group dynamics including staff-crew development and labour relations, union affairs and labour laws, motivation, communication, leadership styles, human development, achievement, motivation and personal appraisal techniques. Topics such as family dynamics, alcohol and drugs, stress management, and problems of individuals.

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.

98-Mar- A1 - Applied Thermodynamics and Heat Transfer (16-Mec-A1)

F.P. Incropera & David ". DeWitt, Introduction to Heat Transfer, latest edition, John Wiley & Sons

Y. Cengel & M. Boles Thermodynamics An Engineering Approach, 2nd editiion, McGraw Hill

98-Mar-A2 - Fundamentals of Naval Architecture (16-Nav-A1)

Prime Text:

Edward V. Lewis ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapters 1, 2, 3, Volume 1, 1988.

Supplementary Texts:

Barnaby, Kenneth C., Basic Naval Architecture, 2nd Ed. Hutchinson's Scientific and Technical Publications, 1954.

Van Lammeren, W.P.A. ed., Buoyancy and Stability of Ships. The Technical Publications H. Stam, 1969.

Attwood, Edward L. et al., Theoretical Naval Architecture. Longmans, Green and Co., 1953.

de Heere, R.F. Scheltema, Buoyancy and Stability of Ships. Technical Publications H. Stam, 1969.

98-Mar-A3 - Fluid Mechnanics and Applications (16-Mec-A6)

F.M. White, Fluid Mechanics, 4th edition, McGraw-Hill, 1998

98-Mar-A4 - Kinematics and Dynamics of Machines (16-Mec-A2)

William T. Thomson, Marie Dahleh, Theory of Vibration with Applications, latest edition, Prentice Hall ISBN#0-13-651-068-X

A.G. Erdman & G.N. Sandor, Mechanism Design: Analysis & Synthesis, Volume 1, Prentice Hall, 1997

98-Mar-A5 - Advanced Strength of Materials (16-Mec-A7)

Ansel Ugural & Saul Fenster, Advanced Strength & Applied Elasticity, Prentice Hall Englewood Cliffs New Jersey 07632 latest edition 1995

R.G. Budynas, Advanced Strength & Applied Stress Analysis, McGraw-Hill, 1998, 2nd edition

98-Mar-A6 - Design and Manufacture of Machine Elements (16-Mec-A4)

Kalpakjian, Manufacturing Engineering & Technology, 34d edition, Addison Wesley ISBN# 1-201-53846-6

Shigley & Mischke, Mechanical Engineering Design, McGraw-Hill, 5th edition (Metric/English edition) 1993

98-Mar-A7 - Marine Engineering

Prime Text:

Harrington, Roy L. (ed.), Marine Engineering. The Society of Naval Architects and Marine Engineers, 1971.

Supplementary Text:

Sullivan, James A., Fluid Power Theory and Applications, 3rd edition. Prentice Hall, Inc., 1989. ISBN 0-13-323080-5.

Henke, Russell W., Introduction to Fluid Power Circuits and Systems. Addison-Wesley, 1970, LCC Card No. 0-13-323080-5.

Labbarton, J.M. (ed.), Marine Engineers' Handbook. McGraw-Hill, 1945.

I.R. Cameron, Nuclear Fission Reactors. Plenum Press, 1982. ISBN 0-306-41073-7.

J.R. Lamarsh, Introduction to Nuclear Engineering, 2nd Edition. Addison-Wesley, 1983. ISBN 0-201-142007.

98-Mar-B1 - Advanced Machine Design (16-Mec-B1)

Shigley and Mischke, Mechanical Engineering Design, 5th edition (metric/english edition) McGraw Hill IsbN 0-07-056899-5

98-Mar-B2 - Environmental Control in Ships

Prime Texts:

McQuiston and Parker, Heating Ventilating and Air Conditioning Analysis and Design. Wiley & Sons, 1982.

Irwin and Graf, Industrial Noise and Vibration Control. Prentice-Hall, 1979.

Supplementary Texts:

Jennings, Environmental Engineering. International Text Book Co., 1970.

Carrier and Trane Systems Manuals. (ASHRAE Handbooks).

ASHRAE: Environmental Control Principles: an Educational Supplement to ASHRAE Handbook Fundamentals Volume.

98-Mar-B3 - System Analysis and Control (16-Mec-A3)

J. Van de Vegte, Feedback Control Systems, Prentice-Hall, 1989, latest edition

Dorf, Modem Control Systems, 7th edition, Addison-Wesley, 1980

Raven, Automatic Control Engineering, 4th edition, McGraw-Hill, 1997

98-Mar-B4 - Ship Production and Shipyard Management (16-Nav-B5)

Prime Texts:

Buffa , Modern Production Operations Management, 6th edition. Wiley, 1980.

Juran and Gryna , Quality Planning and Analysis, 2nd edition. Wiley & Sons, 1980.

Taggart ed., Ship Design and Construction. The Society of Naval Architects and Marine Engineers, Chapter 15, 1980.

Supplementary Texts:

Chase and Aquilano, Production and Operations Management: A Life Cycle Approach, 3rd edition. Erwin, 1981.

Halpern, The Assurance Sciences: An Introduction to Quality Control and Reliability. Prentice-Hall, 1978.

Kennedy and Nelville, Basic Statistical Methods for Engineers and Scientists, 2nd edition. Harper and Row, 1979.

Duncan, Quality Control and Industrial Statistics, 4th edition. Erwin, 1974.

Sule, D.R. (Dileep R.), Manufacturing Facilities. PWS-KENT Publishing Co., 1988. ISBN 0-534-91971-5.

Riggs, James L., Production Systems, 3rd edition. John Wiley & Sons, Inc., 1988.

98-Mar-B5 - Fluid Machinery (16-Mec-B6)

R.L. Dougherty, J.B. Franzini, E.J. Finnemore, Fluid Mechanics with Engineering Applications, 8th edition, McGraw-Hill

S.L. Dixon, Fluid Mechanics, Thermodynamics of Turbomachinery, 3rd edition, Pergamon Press

V.L. Streeter, Y.E.B. Wylie, Fluid Mechanics, 8th edition, McGraw-Hill

98-Mar-B6 - Electrical and Electronics Engineering (16-Mec-A5)

R.J. Smith & R.C. Dorf, Circuits, Devices & Systems, 5th edition, John Wiley & Sons Inc. 1992

98-Mar-B7 - Maritime Management

Introduction to Shipping. Fairplay Publications Limited, 1985.

Heurcigel Slocum and Woodman, Organizational Behaviour, 5th edition. West Publishing. ISBN 0-314-47013-1.

Organizational Theory and Design, Draft 5th edition. West Publishing.

ISBN 031404452-3.

Updated: October 2019

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

TOTAL EXAMINATION PROGRAM
PEO Syllabus of Examinations, 2011 Edition

MARINE ENGINEERING

INTRODUCTION

A full set of Marine 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-5	Advanced Mathematics
04-BS-6	Mechanics of Materials
04-BS-7	Mechanics of Fluids
04-BS-9	Basic Electromagnetics
04-BS-10	Thermodynamics
04-BS-11	Properties of Materials
04-BS-12	Organic Chemistry
04-BS-13	Biology
04-BS-15	Engineering Graphics and Design Process

PROFESSIONAL EXAMS – SPECIFIC TO MARINE ENGINEERING

GROUP A

98-Mar-A1	Applied Thermodynamics and Heat Transfer
98-Mar-A2	Fundamentals of Naval Architecture
98-Mar-A3	Advanced Fluid Mechanics
98-Mar-A4	Kinematics and Dynamics of Machines
98-Mar-A5	Advanced Strength of Materials
98-Mar-A6	Design and Manufacture of Machine Elements
98-Mar-A7	Marine Engineering

GROUP B

98-Mar-B1	Advanced Machine Design
98-Mar-B2	Environmental Control in Ships
98-Mar-B3	System Analysis and Control
98-Mar-B4	Ship Production and Shipyard Management
98-Mar-B5	Fluid Machinery
98-Mar-B6	Electrical and Electronics Engineering
98-Mar-B7	Maritime Management

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