INTRODUCTION

Seventeen engineering disciplines are included in the Examination Syllabus issued by the Canadian Engineering Qualifications Board of Engineers Canada.

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of Naval Architectural Engineering examinations consists of nine, three-hour examination papers. Candidates will be assigned examinations based on an assessment of their academic background. Examinations from discipline syllabi other than those specific to the candidates' discipline may be assigned at the discretion of the constituent Association/Ordre.

Before writing the discipline examinations, candidates must have passed, or have been exempted from, the Basic Studies Examinations.

Information on examination scheduling, textbooks, materials provided or required, and whether the examinations are open or closed book, will be supplied by the constituent Association/Ordre.

NAVAL ARCHITECTURAL ENGINEERING EXAMINATIONS

GROUP A

COMPULSORY EXAMINATIONS (SIX REQUIRED)

98-Nav-Al Fundamentals of Naval Architecture

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-Nav-A2 Hydrodynamics of Ships (I): Resistance and Propulsion

Review of fluid dynamic concepts, dimensional analysis, frictional resistance, wave-making resistance, other components of resistance. Use of models, presenting model resistance data. Functional relationship between resistance and hull form. Algorithms for resistance calculations. Advanced marine vehicles. Powering of ships, theory of propeller action. Law of similitude for propellers, interaction between hull and propellers. Model self-propulsion tests. Geometry of screw propellers. Cavitation. Propeller selection and design. Other propulsion devices such as: jet propulsion, air propulsion (sail, air propellers), paddle wheels, vertical-axis propellers (Kirsten, Voith-Schneider) etc. Ship standardization trials.

98-Nav-A3 Hydrodynamics of Ships (II): Ship Motion

Ocean waves, wave spectral density. Rigid body dynamics of marine vehicles and structures, ship responses to regular and irregular waves. Introduction to hydroelastic analysis methods of ships and ocean structures. Manoeuvring and control of ship motions, assessing ship's performance in a seaway. Directional stability. Design aspects.

98-Nav-A4 Ship Structure and Strength of Ships

Ship types, framing systems, longitudinal strength requirements, classification rules. Structural components, hull materials, methods of joining structural parts. Hull outfit and fittings with special emphasis on construction process, hull preservation and maintenance. Deckhouses and superstructures. Ship structural loads, analysis of hull girders (stress and deflection), vertical shear force, bending moment, torsion, midship section and bulkhead configurations. Thermal effects on primary stresses and deflections. Bending of flat plates, shear lag and stress diffusion. Load carrying capability and structural performance criteria. Reliability of structures, ultimate strength. Analytical optimization of structures.

98-Nav-A5 Ship Design

Preliminary design methods for the design of marine platforms and vehicles from mission statement to the selection of one or more acceptable solutions. Weight and cost estimation, power requirements estimation, and selection of principal design characteristics. Economic and operational evaluation of alternative solutions. Optimization. Use of computers in ship design.

98-Nav-A6 Advanced Strength of Materials (98-Mec-A4)

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.

GROUP B

ELECTIVE EXAMINATIONS (THREE REQUIRED)

98-Nav-B1 Applied Thermodynamics and Heat Transfer (98-Mec-Al)

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-Nav-B2 Marine Engineering (98-Mar-A7)

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.

98-Nav-B3 Small Commercial Ships

Types of small commercial ships. Specific design criteria for each type. Scantling, powering, propulsion and stability requirements. Type specific systems. Various construction materials and their construction techniques. Regulations applicable to small commercial ships. Classification society rules.

98-Nav-B4 Advanced Structural Analysis

Analysis of statically indeterminate structures, including trusses, beams and frames. Moment distribution, slope deflection and energy methods. Force and deformation methods applied to

matrix formulation. Bending and buckling of plates. (Prerequisite examinations: 98-Nav-A4 and 98-Mec-A4).

98-Nav-B5 Ship Production and Shipyard Management

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-Nav-B6 Design and Manufacture of Machine Elements (98-Mec-A5)

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-Nav-B7 Environmental Control in Ships (98-Mar-B2)

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, and shipboard waste treatment.