2025 SYLLABUS

Naval architectural engineering examinations

Group A - Compulsory examinations (Seven required)

25- Nav-A1 Fundamentals of Naval Architecture

Hull form definition: principal dimensions, ships' lines, coefficients of form. Hull form characteristics including integration methods, Bonjean curves, wetted surface, and 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 surface effect. Subdivision and damage stability calculations. Stability criteria for damaged stability. Load line regulations, tonnage regulations. Use of numerical methods in ship's calculations.

Textbooks (most recent edition is recommended):

Primary Text:

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

Secondary Text:

- Barnaby, Kenneth C., Basic Naval Architecture, latest edition. Hutchinson's Scientific and Technical Publications.
- Van Lammeren, W.P.A. ed., Buoyancy and Stability of Ships. The Technical Publications H. Stam.
- Attwood, Edward L. et al., Theoretical Naval Architecture. Longmans, Green and Co.
- de Heere, R.F. Scheltema, Buoyancy and Stability of Ships. Technical Publications H. Stam.

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

Review of fluid dynamic concepts, dimensional analysis, frictional resistance, wave-making resistance, and other components of resistance. Use of models, presenting model resistance data. The 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).. Ship standardization trials.

Textbooks (most recent edition is recommended):

- Lewis, Edward V. ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapters 5, 6, Volume II.
- Molland, Anthony F., The Maritime Engineering Reference Book, 2008

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

REWRITTEN

Applications of the linearized equations of motion to ocean vehicle problems with single and multiple degrees of freedom in waves; Dynamics of marine vehicles: regular and irregular waves; motions in waves; hydrodynamic effects such as added mass, radiation and viscous damping; experimental and numerical methods (strip theory and panel method) for measurement and prediction of wave-induced motions..

Textbooks (most recent edition is recommended):

Primary Text:

- Lewis, Edward V. ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapter 8, Volume III.
- Dynamics of Marine Vehicles, R. Bhattacharyya, John Wiley & Sons, New York, 1978.

Secondary Text:

- Saunders, Harold E. ed., Hydrodynamics in Ship Design. The Society of Naval Architects and Marine Engineers, Volumes I, II and III.
- Vossers, G., Behaviour of Ships on Waves. The Technical Publishing Company H. Stam.

25-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 and buckling of flat plates and stiffened panels. Shear lag and stress diffusion. Load carrying capability and structural performance criteria. Reliability of structures, ultimate strength. Analytical optimization of structures.

Textbooks (most recent edition is recommended):

- Taggart ed., Ship Design and Construction. The Society of Naval Architects and Marine Engineers.
- Edward V. Lewis. ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapter 4, Volume I.
- Hughes, O.F., 1983, Ship Structural Design, Wiley-Interscience, Published by the Society of Naval Architects and Marine Engineers, New York (1988).
- Hughes, O.F. and Paik J.K., 2010. Ship Structural Analysis and Design, Published by the Society of Naval Architects and Marine Engineers, New Jersey.D.W. Chalmers, Design of Ships' Structures, HMSO

25-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. Statement of requirements for ships. Environmental design considerations. Weight and cost estimation, power requirements estimation, and selection of principal design characteristics. Global bending strength requirements, seakeeping implications on ship designs. Economic and operational evaluation of alternative solutions. Optimization and design trade-offs. ADD

Textbooks (most recent edition is recommended):

Primary Text:

- Taggart ed., Ship Design and Construction. The Society of Naval Architects and Marine Engineers.

- Watson, D.G.M., Practical Ship Design, 1998

Secondary Text:

- Schokker, J.C., Arkenbout et al., The Design of Merchant Ships. The Technical Publishing Company H. Stam.
- Saunders, Harold E. ed., Hydrodynamics in Ship Design. The Society of Naval Architects and Marine Engineers, Volume I.

25-Nav-A6 Advanced Strength of Materials (~~25-Mec-A6~~) 22-MEC-A7

Analysis of statically indeterminate structures, including trusses, beams and frames. Moment distribution, slope deflection and energy methods. Stress-Strain Analysis: Stress and strain, transformations, principle stresses, graphical representation by Mohr's circles of biaxial and triaxial cases, generalized Hooke's law including thermal strains, equations of equilibrium and compatibility, plane strain and plane stress problems. Failure theories and limit analysis. Euler critical loads for columns, curved beams, thick-walled cylinders and rotating discs, contact stresses, strain gauges and application, stress concentrations including fracture mechanics.

Energy Methods: Strain energy principles, virtual work, Castigliano's theorem. Applications to cases in axial, bending, and torsional loadings. Applications to statically indeterminate problems.

Textbooks (most recent edition is recommended):

- Ugural, Ansel, & Saul Fenster, Advanced Strength & Applied Elasticity, latest edition. Prentice Hall Englewood Cliffs, New Jersey.
- Budynas, R.G., Advanced Strength & Applied Stress Analysis, latest edition. McGraw-Hill.
- Boresi, A.P., and R.J. Schmidt, Advanced Mechanics of Materials, latest edition. John Wiley & Sons.
- Hibbler, R.C., Mechanics of Materials, 11th edition, Pearson.
- Goodno and Gere, Mechanics of Materials, Enhanced 9th Edition, Cengage Learning.

25-Nav-A7 Hydrodynamics of Ships (III): Ship Manoeuvering NEW

The manoeuverability of ocean vehicles; derivation of linear and nonlinear equations of motion and hydrodynamic coefficients; stability of motion; standard maneuvers such as turning circle, turning spiral, and PMM test; modelling and simulations of the engine, propulsion, rudder and transmission systems during manoeuvring; systems for course keeping, autopilot, motion control and dynamic positioning.

Textbooks (most recent edition is recommended):

Primary Text:

- Edward V. Lewis, ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapter 8, Volume III.

Secondary Text:

- Saunders, Harold E. ed., Hydrodynamics in Ship Design. The Society of Naval Architects and Marine Engineers, Volumes I, IIand III.
- Vossers, G., Behaviour of Ships on Waves. The Technical Publishing Company H. Stam.

Group B - Optional examinations (three required)

25-Nav-B1 Applied Thermodynamics and Heat Transfer (~~25-Mec-A1~~)

22-MEC-A1

Thermodynamics: The fundamental laws of thermodynamics, introductory psychrometry and analysis of the ideal gas compressor cycle, Rankine cycle, Otto cycle, Diesel cycle, Brayton cycle and the vapour compression refrigeration cycle.

Heat Transfer: Application of the principles of steady and transient conduction heat transfer, natural and forced convection heat transfer and radiation heat transfer. Thermal analysis of heat exchangers.

Textbooks (most recent edition is recommended):

- Moran, M.J., H.N. Shapiro, B.R. Munson and D.P. DeWitt, Introduction to Thermal Systems Engineering: Thermodynamics, Fluid Mechanics, and Heat Transfer. John Wiley and Sons.

25-Nav-B2 Marine Engineering and Vibrations

REWRITTEN BUT NO CHANGE IN SCOPE. CONFIRMED WITH 2012 & 2017 EXAMS.

Topics in marine engineering such as, shafting system design; shafting system vibration analysis, study of exciting forces and moments, and balancing of reciprocating and rotating machinery; heat transfer and marine heat exchangers; incompressible fluid flow and piping system design and selection of appropriate pumping devices.

Concepts in mechanical vibration with a focus on the vibration of marine machinery and the dynamic response of marine structures. Topics include: single degree of freedom systems – free vibration, energy methods, response to harmonic excitation, response to arbitrary inputs; multi degree of freedom systems – natural frequencies and mode shapes, response to harmonic excitation; frequency response functions; on-board sources of vibration, vibration measurement techniques and instrumentation.

Textbooks (most recent edition is recommended):

Primary Text:

- Harrington, Roy L. (ed.), Marine Engineering. The Society of Naval Architects and Marine Engineers.
- William S. Vorus (2010), The principles of naval architecture Series: Vibration, Editor: J. Randolph Pauling, The Society of Naval Architects and Marine Engineers.

Secondary Text:

- Sullivan, James A., Fluid Power Theory and Applications, latest edition. Prentice Hall, Inc.
- Henke, Russell W., Introduction to Fluid Power Circuits and Systems. Addison-Wesley.
- Labbarton, J.M. (ed.), Marine Engineers' Handbook. McGraw-Hill.
- Rao S. (2017), Mechanical Vibrations, Pearson.

25-Nav-B3 Finite Element Analysis for Ship Structures

NEW, LIKELY SAME EXAM AS 22-MEC-B10

Application of the finite element method (FEM) to the design and assessment of ship hull structures. Simulation of static, quasi-static, and impact loads on hull structures. Implicit and explicit finite element (FE) implementations with consideration of nonlinearity, elements, contact, problem type, adequate model geometry, elements/mesh, boundary conditions, loads, assessment of model quality, and benchmarking of results.

Textbooks (most recent edition is recommended):

- Liu, G.R., Quek, S.S., Finite Element Method: A Practical Course, Butterworth-Heinemann, 2003.
- Wu, S.R., Gu, L., Introduction to the Explicit Finite Element Method for Nonlinear Transient Dynamics, Wiley, 2012.

25-Nav-B4 Ship Production and Shipyard Management WAS 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.

Textbooks (most recent edition is recommended):

Primary Text:

- R. L. Storch, et al., Ship Production, Second Edition, SNAME, 2007
- D. J. Eyres and G. J. Bruce, Ship Construction, 7th Edition, Butterworth Heinemann, 2012
- N. R. Mandal, Ship Construction and Welding, Springer, 2017
- Taggart ed., Ship Design and Construction. The Society of Naval Architects and Marine Engineers, Chapter 15.

Secondary Text:

- Chase and Aquilano, Production and Operations Management: A Life Cycle Approach, latest edition. Erwin.
- Halpern, The Assurance Sciences: An Introduction to Quality Control and Reliability. Prentice-Hall.

25-Nav-B5 Marine Control Systems NEW

Considers propulsion and motion control of ships, submersibles and offshore structures, as well as dynamic positioning and power management. The exam will also include fundamental control theory concepts, such as time and frequency domain analysis, spring-mass-damper systems, Laplace transforms, stability of control systems, PID controllers, and modelling of 1 DOF and 2 DOF control systems.

Textbooks (most recent edition is recommended):

- Fossen, TI (1994), Guidance and Control of Ocean Vehicles, Wiley.
- Ogata, K (2021), Modern Control Engineering, Pearson.
- Fossen TI (2011), Handbook of Marine Craft Hydrodynamics and Motion Control, Wiley.

25-Nav-B6 Ocean Engineering and Offshore Structures NEW

Hydrostatics of rigid floating or submerged structures; mooring systems; Environmental loads including wave, current, wind and ice loads; diffraction theory; offshore platform design requirements; safety, hazards and risk management; functional requirements of drilling and production floating structures.

Textbooks (most recent edition is recommended):

- Offshore Structures, D.V. Reddy and M. Arockiasamy, Krieger Publishing. Co., 1991.
- Offshore Structures, G. Clauss, E. Lehman and C. Ostergaard, Vol. 1 and 2, Springer-Varlag, 1992.
- Elements of Ocean Engineering, R.E. Randall, Society of Naval Architect s and Marine Engineers, Jersey City, NJ, 1997.
- Floating Structures: A Guide for Design and Analysis, Barltrop, N.D.P. (ed.), Vol.
- 1 and 2, The Centre for Marine and Petroleum Technology, Oilfield Publication Limited, 1998.
- Hydrodynamics of Offshore Structures, S.K. Chakrabarti, WIT Press, 1987.

INTRODUCTION

The Canadian Engineering Qualifications Board of Engineers Canada issues the Examination Syllabus that includes a continually increasing number of engineering disciplines.

Each discipline examination syllabus is divided into two examination categories: compulsory and elective. A full set of 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.

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.

NAVAL ARCHITECTURAL ENGINEERING EXAMINATIONS

GROUP A

COMPULSORY EXAMINATIONS (SIX REQUIRED)

16- Nav-A1 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.

16-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.

16-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.

16-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.

16-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.

16-Nav-A6 Advanced Strength of Materials (16-Mec-A7)

Stress-Strain Analysis: Stress and strain, transformations, principle stresses, graphical representation by Mohr’s circles of biaxial and triaxial cases, generalized Hooke’s law including thermal strains, equations of equilibrium and compatibility, plane strain and plane stress problems. Failure theories and limit analysis. Euler critical loads for columns, curved beams, thick-walled cylinders and rotating discs, contact stresses, strain gauges and application, stress concentrations including fracture mechanics.

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)

16-Nav-B1 Applied Thermodynamics and Heat Transfer (16-Mec-A1)

Thermodynamics: Review of the fundamental laws of thermodynamics, introductory psychrometry and analysis of the ideal gas compressor cycle, Rankine cycle, Otto cycle, Diesel cycle, Brayton cycle and the vapour compression refrigeration cycle.

Heat Transfer: Application of the principles of steady and transient conduction heat transfer, natural and forced convection heat transfer and radiation heat transfer. Thermal analysis of heat exchangers.

16-Nav-B2 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.

16-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.

16-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: 16-Nav-A4 and 16-Mec-A4)

16-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.

16-Nav-B6 Design and Manufacture of Machine Elements (16-Mec-A4) UPDATED W/ MEC-A4

Theory and methodology related to conceptual design; review of the methods used in stress analysis; simple design factor approach; variable loads; stress concentrations; bolts and bolted joints; welded joints; springs; shaft and bearing design; clutches, brakes, and braking systems.

The role and characterization of manufacturing technology within the manufacturing enterprise is also examined. Topics include an overview of the deformation process, joining processes, consolidation processes, material removal processes, material alteration processes; composites manufacturing, nano-and-microfabrication technologies rubber processing, glass working, coating processes, mechanical assembly, electronics packaging and assembly, and production lines; and process selection and planning; quality control systems.

16-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.

16-Nav-B8 Ocean Engineering and Offshore Structures NEW

Hydrostatics of rigid floating or submerged structures; mooring systems; wave and ice loads; diffraction theory; offshore platform design requirements; safety and risk management.

NOTE: Please feel free to use the most recent edition of textbooks referenced in this list
NOTA : Utilisez l'édition la plus récente des manuels cités dans cette liste.

16-Nav-A1 Fundamentals of Naval Architecture

Prime Text:

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

Supplementary Texts:

Barnaby, Kenneth C., Basic Naval Architecture, latest edition. Hutchinson's Scientific and Technical Publications.

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

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

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

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

Edward V. Lewis ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapters 5, 6, Volume II.

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

Prime Texts:

Saunders, Harold E. ed., Hydrodynamics in Ship Design. The Society of Naval Architects and Marine Engineers, Volumes I, IIand III.

Vossers, G., Behaviour of Ships on Waves. The Technical Publishing Company H. Stam.

Supplementary Text:

Edward V. Lewis, ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapter 8, Volume III.

16-Nav-A4 Ship Structure and Strength of Ships

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

Edward V. Lewis. ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapter 4, Volume I.

16-Nav-A5 Ship Design

Prime Text:

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

Supplementary Texts:

Schokker, J.C., Arkenbout et al., The Design of Merchant Ships. The Technical Publishing Company H. Stam.

Saunders, Harold E. ed., Hydrodynamics in Ship Design. The Society of Naval Architects and Marine Engineers, Volume I.

16-Nav-A6 Advanced Strength of Materials (16-Mec-A7)

Ugural, Ansel, & Saul Fenster, Advanced Strength & Applied Elasticity, latest edition. Prentice Hall Englewood Cliffs New Jersey.
Budynas, R.G., Advanced Strength & Applied Stress Analysis, latest edition. McGraw-Hill.
Boresi, A.P., and R.J. Schmidt, Advanced Mechanics of Materials, latest edition. John Wiley & Sons.

16-Nav-B1 Applied Thermodynamics and Heat Transfer (16-Mec A1)

Moran, M.J., H.N. Shapiro, B.R. Munson and D.P. DeWitt, Introduction to Thermal Systems Engineering: Thermodynamics, Fluid Mechanics, and Heat Transfer. John Wiley and Sons.

16-Nav-B2 Marine Engineering

Prime Text:

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

Supplementary Text:

Sullivan, James A., Fluid Power Theory and Applications, latest edition. Prentice Hall, Inc.

Henke, Russell W., Introduction to Fluid Power Circuits and Systems. Addison-Wesley.

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

I.R. Cameron, Nuclear Fission Reactors. Plenum Press.

J.R. Lamarsh, Introduction to Nuclear Engineering, latest edition. Addison-Wesley.

16-Nav-B3 Small Commercial Ships

Prime Text:

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

Supplementary Texts:

Schokker, J.C., Arkenbout et al., The Design of Merchant Ships. The Technical Publishing Company H. Stam.

Saunders, Harold E. ed., Hydrodynamics in Ship Design. The Society of Naval Architects and Marine Engineers, Volume I.

16-Nav-B4 Advanced Structural Analysis

Timoshenko, S. and Young, D.H., Theory of Structures, latest edition. McGrawHill.

16-Nav-B5 Ship Production and Shipyard Management

Prime Texts:

Buffa , Modern Production Operations Management, latest edition. Wiley.

Juran and Gryna , Quality Planning and Analysis, latest edition. Wiley & Sons.

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

Supplementary Texts:

Chase and Aquilano, Production and Operations Management: A Life Cycle Approach, latest edition. Erwin.

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

Kennedy and Nelville, Basic Statistical Methods for Engineers and Scientists, latest edition. Harper and Row.

Duncan, Quality Control and Industrial Statistics, latest edition. Erwin.

Sule, D.R. (Dileep R.), Manufacturing Facilities. PWS-KENT Publishing Co.

Riggs, James L., Production Systems, latest edition. John Wiley & Sons, Inc.

16-Nav-B6 Design and Manufacture of Machine Elements (16-Mec-A4)

As defined

16-Nav-B7 Environmental Control in Ships

Prime Texts:

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

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

Supplementary Texts:

Jennings, Environmental Engineering. International Text Book Co.

Carrier and Trane Systems Manuals. (ASHRAE Handbooks).

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

16-Nav-B8 Ocean Engineering and Offshore Structures

4.15 INTRODUCTION

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

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.

4.15.1 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.

98-Nav-A1 - Fundamentals of Naval Architecture

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

Edward V. Lewis ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapters 5, 6, Volume II, 1988.

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

Prime Texts:

Saunders, Harold E. ed., Hydrodynamics in Ship Design. The Society of Naval Architects and Marine Engineers, Volumes I and II, 1957, Volume III, 1965.

Vossers, G., Behaviour of Ships on Waves. The Technical Publishing Company H. Stam, 1962.

Supplementary Text:

Edward V. Lewis, ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapter 8, Volume III, 1989.

98-Nav-A4 - Ship Structure and Strength of Ships

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

Edward V. Lewis. ed., Principles of Naval Architecture. The Society of Naval Architects and Marine Engineers, Chapter 4, Volume I, 1988.

98-Nav-A5 - Ship Design

Prime Text:

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

Supplementary Texts:

Schokker, J.C., Arkenbout et al., The Design of Merchant Ships. The Technical Publishing Company H. Stam., 1959.

Saunders, Harold E. ed., Hydrodynamics in Ship Design. The Society of Naval Architects and Marine Engineers, Volume I, 1957.

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

as defined

98Nav-B1 - Applied Thermodynamics and Heat Transfer (98-Mec A1)

as defined

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

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-Nav-B3 - Small Commercial Ships

Prime Text:

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

Supplementary Texts:

Schokker, J.C., Arkenbout et al., The Design of Merchant Ships. The Technical Publishing Company H. Stam., 1959.

Saunders, Harold E. ed., Hydrodynamics in Ship Design. The Society of Naval Architects and Marine Engineers, Volume I, 1957.

98-Nav-B4 - Advanced Structural Analysis

Timoshenko, S. and Young, D.H., Theory of Structures, 2nd edition. McGrawHill, 1965.

98-Nav-B5 - Ship Production and Shipyard Management

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

as defined

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

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.