

MINIMUM CORE SUBJECT AREAS: MARINE & NAVAL ARCHITECTURE ENGINEERING

AREA	SUBJECTS / DESCRIPTION	RECOMMENDED CONTACT HOURS
All areas below are considered core for Marine Engineering with recommended hours specified.		
1. Marine Engineering	<ul style="list-style-type: none"> - selected topics on marine propulsion engines, main and auxiliary machinery arrangements, combustion equations, stoichiometric air/fuel ratio calculation, gas exchange process and pressure charging, components of two and four stroke engines - selected topics on marine engine supporting systems, such as fuel system, lubricating oil system (including Cylinder oil lubrication), cooling systems and air starting system, steam requirements, boilers types, other boiler arrangements, boiler mountings, purity of boiler feed water, and boiler water treatment etc. 	45
2. Applied thermodynamics / thermodynamics	<ul style="list-style-type: none"> - selected topics on system, control volume, control mass, energy; properties of pure substance, phases and phase change; first law of thermodynamics for open and closed systems; second law of thermodynamics; Entropy and energy; internal combustion engines and gas turbines; steam cycle and refrigeration; heat transfer 	45
3. Materials Technology / Material Engineering	<ul style="list-style-type: none"> - selected topics on fundamentals of materials, bonding in solids including atomic structure and interatomic bonding, crystalline structures and defects, mechanical properties, concepts of stress, strain and ductility and the shapes of stress-strain curves for different materials, tensile properties, hardness and toughness and appropriate testing methods, microstructure and microstructural control in metal, manufacturing processes, manufacturing with metals and composites and the effects of processing on properties - selected topics on materials in marine engineering, overview of metals, polymers and composites used in the marine environment, defects and plastic deformation in the crystalline state; mechanical properties of materials; fatigue failure and fatigue testing with case studies, mechanisms for controlling or preventing failure in marine structures, heat treatment of steel; classification of polymers; and mechanical properties of plastics 	45
4. Strength of Material	<ul style="list-style-type: none"> - selected topics on stress and strain; bending & deflection of beams; torsion of shaft; thin-walled pressure vessels; two-dimensional theory of elasticity; thermal stress, disks and cylinders; columns – stability, buckling; failure & yielding criteria; energy methods; bending of plates; finite element analysis of plane truss framework 	45
5. Dynamics of mechanical systems	<ul style="list-style-type: none"> - selected topics on Newton's second law for linear and rotating marine systems; compatibility equations; moment of inertia and radius of gyration, parallel axes and perpendicular axes theorems; vibration of marine systems; the kinematics and dynamics of marine gear drives, elementary kinematic analysis of linkages by means of velocity diagrams and acceleration diagrams 	45

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6. Electrical and electronic engineering	<ul style="list-style-type: none"> - selected topics on DC circuit theory; electromagnetism, magnetic circuits; electromagnetic Induction; electrostatics; transient response; AC circuit theory; DC machines-basic theory; application and types; AC circuit theory-phasor diagrams, power, power factor; transformers-theory; equivalent circuits, construction, applications; introduction to power conditioning - selected topics on marine power system; analogue/digital circuits; digital signal processing; integrated power electronics; power/energy storage, distribution and conversion; embedded systems; marine power system analysis and control; engineering electromagnetism; digital & analogue control systems - selected topics on automation such as controllers, actuators, sensors and transducers; interfacing and signal conditioning; design, fabrication, installation and programming of automatic systems; robotics; artificial intelligence etc. 	45
7. Naval Architecture	<ul style="list-style-type: none"> - selected topics on Naval architectural principles and concepts; Methods of numerical integration and quadrature; Calculation of hydrostatics based on areas, volumes and centroids; Metacentric theory and ship stability; The concepts of initial and static stability; The presentation of stability information; The evaluation of stability; The physical properties of fluids and how they are modelled; The principles of hydrostatic and fluid dynamics; Potential flow models and Newtonian fluids, the implications for very large angle stability, solutions of general arrangement and accommodation design for different types of vessels, basic fluid mechanics and relevant theory of ship resistance, the numerical and experimental techniques used to estimate hull resistance, physical model testing, full-scale trials and empirical methods used in relation to ship resistance, estimating the resistance in the preliminary design stage 	45
All areas below are considered core for Naval Architecture with recommended hours specified.		
1. Fluid mechanics and thermodynamics	<ul style="list-style-type: none"> - selected topics on concepts on fluids; fluid statics; fluids in motions (streamline, Bernoulli equation); kinematics of fluid motion (velocity and acceleration fields, Reynolds transport theorem); flow analysis using control volume approach (continuity, linear momentum, and energy equations) potential and viscous flows; dimensional analysis; pipe flows (laminar and turbulent flows); fluid machineries - selected topics on system, control volume, control mass, energy; properties of pure substance, phases and phase change; first law of thermodynamics for open and closed systems; second law of thermodynamics; Entropy and energy; Internal combustion engines and gas turbines; steam cycle and refrigeration; heat transfer 	45

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2. Materials Technology / Material Engineering	<ul style="list-style-type: none"> - selected topics on fundamentals of materials, bonding in solids including atomic structure and interatomic bonding, crystalline structures and defects, mechanical properties, concepts of stress, strain and ductility and the shapes of stress-strain curves for different materials, tensile properties, hardness and toughness and appropriate testing methods, microstructure and microstructural control in metal, manufacturing processes, manufacturing with metals and composites and the effects of processing on properties - selected topics on materials in marine engineering, overview of metals, polymers and composites used in the marine environment, defects and plastic deformation in the crystalline state; mechanical properties of materials; fatigue failure and fatigue testing with case studies, mechanisms for controlling or preventing failure in marine structures, heat treatment of steel; classification of polymers; and mechanical properties of plastics 	45
3. Ship design / Shipbuilding technology	<ul style="list-style-type: none"> - selected topics on the design process as applied to ships; the multi-disciplinary nature of the ship design process; the ship design problem and contemporary influences on ship design; ship design methods for deadweight, capacity linear and rule ships; design considerations related to the type of cargo and operation of the vessel; hull form design and hydrodynamic optimisation for sustainable operation; the synthesis of a ship design solution - selected topics on how marine products are manufactured, repaired and recycled; the types of marine production facilities and their functions and limitations; the main facilities and equipment in typical marine production factories; the main processes involved in marine production and the complications resulting from the use of these processes 	45
4. Ship theory / Principles of Naval Architecture	<ul style="list-style-type: none"> - selected topics on naval architectural principles and concepts; methods of numerical integration and quadrature; calculation of hydrostatics based on areas, volumes and centroids; metacentric theory and ship stability; the concepts of initial and static stability; the presentation of stability information; the evaluation of stability; the physical properties of fluids and how they are modelled; the principles of hydrostatic and fluid dynamics; potential flow models and Newtonian fluids, the implications for very large angle stability, solutions of general arrangement and accommodation design for different types of vessels, basic fluid mechanics and relevant theory of ship resistance, the numerical and experimental techniques used to estimate hull resistance, physical model testing, full-scale trials and empirical methods used in relation to ship resistance, estimating the resistance in the preliminary design stage - selected topics on the global response of ship as a beam in still water and poised on a wave; the resulting forces, moments and stresses; the calculation and development of midship section; the statistical nature of hull bending in waves; response of slender elements in compression; ship structural components and materials in structural design and analysis; ship structural design and analysis 	45

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5. Hydrodynamics	<ul style="list-style-type: none"> - selected topics on physical phenomena and associated hydrodynamic theory relating to advanced hull and propeller flow and hence resulting ship resistance and propulsion; methods which are mainly computational and based on potential flow theory, to model the above mentioned hydrodynamic properties of a ship hull and its propulsion; hydrodynamic design of a conventional ship hullform with specific emphasis on its forebody and afterbody sections; hydrodynamic design of a conventional propeller and its performance analysis; basic principles, design and performance characteristics of unconventional propulsions; ship maneuvering performance and operability 	45
6. Ship Powering and Ship Propulsion	<ul style="list-style-type: none"> - selected topics on marine propulsion engines, main and auxiliary machinery arrangements, combustion equations, Stoichiometric air/fuel ratio calculation, gas exchange process and pressure charging, components of two and four stroke engines - selected topics on marine engine supporting systems: fuel system, lubricating oil system (including cylinder oil lubrication), cooling systems and air starting system, Steam requirements, boilers types, other boiler arrangements, boiler mountings, purity of boiler feed water, and boiler water treatment etc. - selected topics on physical model testing such as full-scale trials and empirical methods used in relation to ship powering problem; The methods adopted for estimating the resistance, performing basic propeller design and prediction the power requirements in the preliminary design stage; concepts of ship maneuvering in calm, deep water including the form of the equations of motion, typical nomenclature and regulatory issues; the experimental methods used for obtaining motion derivatives and the post processing of obtained data including the derivation of semi-empirical methods; linear analysis for preliminary estimations of performance and operability; the concepts of seakeeping including motion of a floating body subject to regular and irregular waves; the concepts of added mass and fluid damping and consider method of obtain the necessary terms using experimental and empirical methods 	45
7. Electrical and Electronic Engineering	<ul style="list-style-type: none"> - selected topics on DC circuit theory; electromagnetism, magnetic circuits; electromagnetic Induction; electrostatics; transient response; AC circuit theory; DC machines-basic theory; application and types; AC circuit theory-phasor diagrams, power, power factor; transformers-theory; equivalent circuits, construction, applications; introduction to power conditioning - selected topics on marine power system; analogue/digital circuits; digital signal processing; integrated power electronics; power/energy storage, distribution and conversion; embedded systems; marine power system analysis and control; engineering electromagnetism; digital & analogue control systems - Selected topics on automation such as controllers, actuators, sensors and transducers; interfacing and signal conditioning; design, fabrication, installation and programming of automatic systems; robotics; artificial intelligence etc. 	45