

THE NATIONAL COUNCIL OF EXAMINERS FOR ENGINEERING AND SURVEYING
PRINCIPLES AND PRACTICE OF ENGINEERING EXAMINATION

Naval Architecture/Marine

Effective April 2008

	Approximate Percentage of Examination
I. Engineering Fundamentals	25%
A. Mechanics	6%
1. Rigid bodies (static, dynamic, equilibrium)	
2. Deformable bodies (static, dynamic, equilibrium, elastic, inelastic)	
B. Loads	8%
1. Axial, lateral, flexural, torsional, and shear (e.g., tension, compression, bearing), thermal, fatigue	
2. Fluid loads (static and dynamic, pressure induced, hydrostatic, hydroelastic)	
3. Specialized marine loads, including cargo, seaway induced (e.g., slamming and impact), collision, grounding, drydocking, launching, and moorings	
C. Welds/Connections and Structure	7%
1. Connectors and fasteners (e.g., rivets, bolts, adhesives) and bimetallic joints (e.g., explosion bonding)	
2. Welding design and procedures (stresses, symbols, filler materials, methods, inspection, testing)	
3. Structural elements, including frames, beams, girders, trusses, plates, columns, pillars, stanchions, clips, brackets, knees, gussets, and flexible strength members (e.g., stays and shrouds)	
4. Structural applications and considerations, including hull girder, midship section, buckling, stress concentration, fatigue, corrosion, foundations, stiffened elements (e.g., shell, bulkhead, deck), finite element models (FEM) (boundary conditions, element selection), and appendages	
D. Vibration	4%
1. Local vibration, including vortex induced, flow induced, machinery induced (e.g., propulsor), and shafting (torsional, axial, whirling)	
2. Global vibration, including hull girder and seaway induced (e.g., whipping, springing, slamming)	
II. Naval Architecture	30%
A. Stability, Flotation, Dynamic Stability, and Vessel Response	11%
1. Stability principles (static and dynamic), intact and damaged, stability criteria, righting arm, free-surface effect, stability aground, cargo shift, submerged and transitional stability, stability while towing or lifting	
2. Stability methods and procedures, including computation and curves (e.g., displacement curves, Bonjean curves, cross curves), integration methods (e.g., Simpson's rule, trapezoidal rule), and tests (inclining, sallying)	
3. Dynamic stability in waves, including forces and motions caused by wind and waves, response amplitude operators, towing, parametric roll, porpoising, broaching, chine walking, flow effects (e.g., squat, bank suction, channel effect, passing)	

	Approximate Percentage of Examination
B. Hydrodynamics	8%
1. Hydrodynamic/aerodynamic resistance and propulsion, including cavitation	
2. Propulsor and appendage design	
3. Maneuvering and directional stability, including dynamic positioning and steering, rudders, and control surfaces	
4. Seakeeping and added mass	
5. Hull modes, including displacement, planing, and semidisplacement and foil borne	
6. Computational fluid dynamics and application of analytical design tools (e.g., strip or diffraction theories)	
C. Wind and Waves	5%
1. Wave spectra	
2. Currents	
3. Tides	
4. Wind scale	
5. Sea state	
D. Hull Forms	6%
1. Conventional displacement monohulls, including barges	
2. Special hull forms, including sailboats, semidisplacement, planing, surface-effect ships, air-cushion vehicles, hydrofoils, submersible (e.g., submarine), semisubmersible, and SWATH	
3. Multihulls (e.g., catamarans, trimarans, cathedral hulls, pontoons)	
4. Sailboats	
III. Marine Engineering	26%
A. Thermodynamics	4%
1. Fundamentals of thermodynamics [e.g., conservation of mass and energy; heat balance, including power cycles; fluid properties (enthalpy, entropy); combustion]	
2. Heat transfer and heat exchangers	
B. Internal Fluid Flow	5%
1. Piping system components (e.g., valves and control devices, strainers, filters, sea chests, sea cocks)	
2. System requirements, layout, and calculations (e.g., pipe flow, resistance, pressure drop, viscosity, limiting flow speeds, and flow effects, including noise, cavitation, and pipe hammer)	
3. Hydraulics	
4. Pumps (including NPSH) and compressors	
C. Propulsion and Power Generation	6%
1. Power systems, including steam plants, internal combustion engines, nuclear plants, fuel cells, solar power, wind power, and electric drive	
2. Fuels (properties, handling systems, effects on equipment)	
D. Machine Design	4%
1. Gearing, shafting, and bearings	
2. Lubrication (lubricants, properties, systems)	
E. HVAC/Refrigeration	2%
1. HVAC systems, including cargo dehumidification, chilled water systems, ventilation systems, vessel lay-up, combining elements from refrigeration (e.g., psychrometrics, entropy)	

	Approximate Percentage of Examination
F. Electrical Systems	5%
<ol style="list-style-type: none"> 1. Electrical equipment, including energy conversion devices (e.g., motors, generators, transformers), batteries, cables, circuit breakers, lighting, rectifiers, electronic devices, VFD and SCR systems, emergency power supply (e.g., UPS), clean power systems 2. Electrical systems, including system analysis and design, distribution and power circuits, power factors, voltage loss, short-circuit analysis, breaker coordination, degaussing systems, and determination of the optimal number of power sources and voltages 	
IV. Common	19%
A. Materials, Corrosion, and Corrosion Control	3%
<ol style="list-style-type: none"> 1. Structural materials and properties (e.g., strength, elongation, fatigue strength), ferrous and nonferrous metals, plastics and composite materials, wood, concrete 2. Other materials and considerations, including composite construction processes (e.g., compatibility, laminating, resin infusion, vacuum-bagging, closed molding), ballast materials, sail materials (e.g., Dacron, cotton, carbon fiber, aramid), ropes, and cables 3. Elements of corrosion, including galvanic series, general wastage, pitting, crevice and stress corrosion, fretting, and stray currents 4. Corrosion-control applications, including impressed current systems, sacrificial anodes, bonding and grounding, and coating selection and procedures 	
B. Navigation and Vessel Control	1%
<ol style="list-style-type: none"> 1. Bridge layout 2. Visibility 3. Understanding of integrated bridge systems 	
C. Hull Outfitting	3%
<ol style="list-style-type: none"> 1. Steering gear; winches and mooring equipment, including ground tackle, fenders, deck fittings (e.g., bollards and bits, chocks); cranes and cargo gear (e.g., closed loading/unloading systems, cargo pumps, vapor recovery); hull closure devices (e.g., doors, sideports, hatch covers); pin systems (Articulate Tug- Barges); ramps; ladders (e.g., pilot ladders); gangways; conveyors; tank gauging; tank-washing systems; inert gas systems; and mission-specific equipment 2. Accommodation outfit, including insulation (e.g., structural fire protection, acoustic, thermal), ladders, joiner work, furnishings, galley equipment, and deck covering 	
D. Weight Engineering	2%
<ol style="list-style-type: none"> 1. Weights and centers 2. Weight controls, including margins, allowances, and statistics 	
E. Shipbuilding and Repair	3%
<ol style="list-style-type: none"> 1. Shipbuilding and repair, launching, drydocking, surface preparation and coatings, shaft alignment, ship breaking and disposal, maintainability, rigging, and material handling 2. Quality assurance, including deflection and distortion controls, inspection, surveys, testing, trials, and commissioning 	

	Approximate Percentage of Examination
F. Economics	2%
1. Engineering and ship economics, including life-cycle costs, disposal costs, depreciation, cost-benefit analysis (e.g., net present value), multiple cost savings (e.g., learning curve), project cost-estimating (e.g., acquisition, operation)	
2. Trade and market analysis, financing, and subsidies	
G. Rules and Regulations, Human Factors, Safety Systems, Procedures and Manuals, and Pollution Prevention	5%
1. Statutory requirements, including regulatory agency requirements (e.g., U.S. Coast Guard, OSHA, EPA, ADA), admeasurement and international conventions and agreements (e.g., IMO, STCW, MARPOL, SOLAS)	
2. Construction, design, and inspection standards, including classification societies (e.g., ABS, Alternate Compliance Programs), ABYC, ASTM, NFPA, MCA, IEEE, AWS, Panama Canal Regulations	
3. Safety issues, including emergency egress and fatigue	
4. Firefighting systems and equipment (e.g., fire main, foam, CO ₂ , firefighter outfits, alarms, fire prevention)	
5. Lifesaving equipment, including lifeboats, life rafts, davits, rescue boats, inflatable buoyant apparatus (IBA), personal flotation devices, survival suits	
6. Cargo loading, trim and stability booklet, loading computers	
7. Emergency plans and procedures, including damage control, Fire Control Plan, International Safety Management, ISPS, periodic safety test procedures, spill response (OPA 90)	
8. Prevention and treatment of air, liquid, and solid pollution, including biological contaminants [e.g., OWS equipment, sewage systems, incinerators, exhaust emissions, volatile organic compound (VOC) control, antifouling coating constituent release], and HAZMAT control	
Total	100%

Notes

1. The examination is developed with questions that require a variety of approaches and methodologies, including design, analysis, and application. Some questions may require knowledge of engineering economics.
2. The knowledge areas specified under 1, 2, 3, etc., are examples of kinds of knowledge, but they are not exclusive or exhaustive categories.
3. This examination contains 80 multiple-choice questions. Examinee works all questions.