B.Sc. SYLLABUS

Main Courses
Engineering Drawing I
1. Drawing Instruments and Accessories 2. Orthographic Projections 3. Isometric Projection 4. Sections of Solids

Statics

1. Scalars and vectors, Newton's laws and gravitation, Dimensions and units
2. Two and three-dimensional force systems, Moment and couple, Resultants
3. Equilibrium in two and three dimensions, Free-body diagram, Equilibrium equations
4. Statically determinate and indeterminate systems, Completely and incompletely fixed systems
5. Structures, Trusses, Method of joints, Method of sections, Frames and machines
6. Center of Mass, Centroids of lines areas and volumes, Distributed loads
7. Beams, External loadings, Shear force diagram, Bending moment diagram
8. Flexible Cables, Frictional phenomena
9. Area moments of inertia, Radius of gyration, Products of inertia, Rotation of axes

Dynamics

1. Motion and dynamics, System of units, Gravity and effects of altitude and earth rotation, dimensions.
2. Kinematics of particles, Selection of coordinates, Rectangular coordinates, Normal and tangential coordinates, Polar coordinates.
3. Three-dimensional curvilinear motion, Rectangular coordinates, Cylindrical coordinates, Spherical coordinates, Relative motion.
4. Kinetics of particles, Newton's second law, Constrained and non-constrained motion, Free body diagram.
5. Methods of analytical dynamics, Principles of work and energy, Gravitational elastic energy, Elastic potential energy, Conservative forces.
6. Impulse and momentum, Principle of impulse and linear momentum, Principle of impulse and angular momentum, Principles of conservation of momentum.
7. Direct central impact, Coefficient of restitution, Impact energy loss, Oblique central impact.
8. Kinetics of System of Particles, Generalized Newton's second law, Work and energy, Conservation of linear and angular momentum.
9. Plane Kinematics of Rigid Bodies, Translation and Rotation of a Rigid Body, Absolute and relative motion, Instantaneous center of velocity.
10. Relative Acceleration, Motion relative to rotating axes, Time derivatives of unit vectors, Coriolis Acceleration.
11. Plane kinetics of rigid bodies, Equations of planar motion, Momentum equations, System of connected bodies, General Plane Motion.
12. Methods of analytical dynamics for rigid bodies, Work-energy relations, Potential energy and work-energy equation.

Strength of Materials

1. Introduction to strength of materials and its role in Engineering Mechanics.
2. Definition of force systems, External and Internal force.
3. Definition of stress and strain, components of strain and stress, relation between stress and strain, Hook's law, Young's modulus, Poisson's ratio, shear modulus, bulk modulus, isotropic materials.
4. Stress and deformation analysis of structure under axial force (Determinate, Indeterminate, Thermal stress, Limit loads (Elastic limit, Plastic limit), unloading, strain energy)
5. Stress and deformation analysis of structure under Torque (Circular shafts Determinate, Circular shafts Indeterminate, Limit loads (Elastic limit Torque, Plastic limit Torque), unloading, strain energy in torsion), Torsion of closed thin-walled shafts, Torsion of thin-walled open sections
6. Review of shear force and bending moment diagram in beams
7. Stress and deformation analysis of structure under Bending (Pure bending, Limit loads (Elastic limit bending moment, Plastic limit bending moment), composite beams)
8. Shear stress analysis in beams (Transverse shear stress), solid section, thin-walled open section, shear center

Strength of Materials 2

Unsymmetrical Bending, Beams with asymmetric sections, Neutral axis in asymmetric bending

1. Compound stress, Combination of axial force and bending moment, out-of-center, Core of column, combination of torsion and shear force, Shear force out of shear center
2. Stress and strain transformation, Principal stress and strain, Mohr's circle, Maximum shear stress
3. Energy method, Strain energy in different loading conditions, Deformation by energy method, Impact factor
4. Failure criteria, Tresca criterion, von-Mises criterion
5. Thin-walled pressure vessels
6. Stability and instability of structures, buckling load, Euler critical load

Thermodynamics 1

1. Basic Concepts: Continuum, macroscopic approach, thermodynamic system (closed and open or control volume); thermodynamic properties and equilibrium; state of a system, state diagram, path and process; Zeroth law of thermodynamics; concept of temperature; heat.
2. Properties of Pure Substances: Thermodynamic properties of pure substances in solid, liquid and vapor phases, P-V-T behavior of simple compressible substances, phase rule, thermodynamic property tables and charts, ideal and real gases, equations of state, compressibility chart.
3. Work and Heat: definition of work, different modes of work, comparison of work and heat
4. First Law of Thermodynamics: Energy, enthalpy, specific heats, first law applied to systems and control volumes, steady and unsteady flow analysis.
5. Second Law of Thermodynamics: Kelvin-Planck and Clausius statements, reversible and irreversible processes, Carnot theorems, thermodynamic temperature scale
6. Entroy: Clausius inequality and concept of entropy, principle of increase of entropy; availability and irreversibility.
7. Irreversibility and exergy: reversible work, irreversibility, and exergy.

Thermodynamics 2

1. Thermodynamic analysis of cycle components (Turbine, boiler, heat exchangers, diffusers and nozzles, throttling device, pumps, …)
2. Vapor Power Cycles Concepts of vapor power cycles and their applications: Rankine cycle for vapor power plants, Reheat Rankine cycle, Superheating, Regenerative Rankine cycles.
3. Gas Power Cycles Concepts of gas power cycles and their applications: Otto cycle, Diesel cycle, and Brayton cycle.
4. Refrigeration Cycles Concepts of refrigeration cycles and their applications: Refrigerators and heat pumps, Vapor-compression refrigeration cycle. Selection of the right refrigerant. Heat pump systems. Gas refrigeration cycles.
5. Gas Mixtures Composition of a gas mixture. P-v-T behavior of gas mixtures. Thermodynamic properties of gas mixtures. Gas-vapor Mixtures and Air-conditioning Dry and atmospheric air. Specific and relative humidity of air. Dew-point and wet-bulb temperatures. The psychrometric chart. Air-conditioning processes. Wet cooling towers.
6. Combustion: Chemical Reactions of Fuels and combustion, and their applications. Theoretical and actual combustion processes. Enthalpy of formation and enthalpy of combustion. Steady-flow and closed reacting systems. First law analysis of reacting systems. Adiabatic flame temperature. Second-law analysis of reacting systems.

Fluid Mechanics 1

1. Introduction:
   - The concept of a fluid:
   - The fluid as a continuum;
   - Dimensions and units;
   - Properties of the velocity field;
   - Thermodynamic properties of a fluid;
   - Viscosity and other secondary properties;
   - Basic flow-analysis techniques; and
   - Flow patterns: streamlines, streaklines, and pathlines.
2. Pressure distribution in fluid:
   - Pressure and pressure gradient;
   - Equilibrium of a fluid element;
   - Hydrostatic pressure distributions
   - Application to manometry;
   - Hydrostatic forces on plane surfaces
   - Hydrostatic forces on curved surfaces
   - Hydrostatic forces in layered fluids
   - Buoyancy and stability
   - Pressure distribution in rigid-body motion; and
   - Pressure measurement.
3. Integral relations for a control volume:
   - Basic physical laws of fluid mechanics;
   - The Reynolds transport theorem;
   - Conservation of mass;
   - The linear momentum equation;
   - The angular-momentum theorem;
   - The energy equation; and
   - Frictionless flow: The Bernoulli equation.
4. Differential Relations for Fluid flow:
   - The acceleration field of a fluid;
   - The differential equation of mass conservation;
   - The differential equation of linear Momentum;
   - The differential equation of angular Momentum;
   - The differential equation of energy;
   - Boundary conditions for the basic equations;
   - The Stream function;
   - Vorticity and irrotationality;
   - Frictionless irrotational flows; and
   - Some illustrative incompressible viscous flows.
5. Dimensional analysis and similarity:

- Introduction;
- The principle of dimensional homogeneity;
- The Pi theorem;
- Non-dimensionalization of the basic equations; and
- Modeling and its pitfalls.

6. Viscous flow in ducts:
   - Reynolds-number regimes
   - Internal versus external viscous flows;
   - Semi-empirical turbulent shear correlations;
   - Flow in a circular pipe;
   - Three types of pipe-flow problems;
   - Minor losses in pipe systems; and
   - Fluid meters.

Fluid Mechanics 2

1. General Viscous fluid flows
   - Mass conservation, momentum, and energy equations in differential form for continua;
   - Navier-Stokes equation for viscous flows.
2. Flow past immersed bodies
   - Boundary layers theory
   - Flat plate boundary layer, Laminar and Turbulent, Skin friction
   - Boundary layer with pressure gradient, Separation
   - Drag on immersed bodies
     - Frictional and pressure Drag (Form Drag)
     - Creeping Flow
   - Lift
3. Potential flow
   - Circulation;
   - Velocity Potential;
   - Stream Function;
   - Basic Equation of incompressible irrotational flow:
     - Laplace's Equation
     - Bernoulli's equation
   - Simple flows, Uniform flows, Sources and Sinks, Simple Vortex, Doublet;
   - Superposition of simple flows;
   - Added or Virtual mass.
4. Free surface Flow, Movement of oceans and rivers and also in open channel:
   - Uniform flow in channel;
   - The Gravity waves;
   - Hydraulic jump; and
   - Varied flow.
5. Turbo-machinery:
   - Classification of Turbo Machines;
   - Transit power from a shaft to the fluid:
     - Pumps, compressors, blowers, fans;
     - Displacement pumps;
     - Radial, axial and mixed pumps;
     - Dimensionless parameters;
     - Specific speed;
     - Pump efficiency;
     - Pump selection;
     - Homolog pumps, Pump characteristic curves;

- System characteristic curves;
- Operating point;
- Cavitation in pumps, Net positive suction head;
- Pumps in series and parallel.

➢ Transit power from a fluid to the shaft, Turbines:

- Types of Turbine;
- Axial, radial and combined flows.

Mechanical Engineering Design I

1. Definition of design in solid mechanics, Uncertainty and Safety factor
2. Stress analysis for various loadings, Stress and strain components and transformations
3. Stress analysis for thick-walled cylindrical pressure vessels, Thermal stresses and strains
4. Stress-strain behavior of ductile and brittle materials under quasi static loading
5. Failure theories for ductile materials
6. Failure theories for brittle materials
7. Stress concentration and related curves, Introduction to fracture mechanics
8. Fatigue failure theories, Standard fatigue test, Stress-life method
9. Design of shafts and shaft components, Shaft deflection, Critical speed
10. Design of permanent joints, Welding, Butt and fillet welds
11. Stresses in welded joints in torsion and bending, Strength of Welded Joints, Static and Fatigue loading

Heat Transfer

1. Basics and Laws: Definition of Heat Transfer, Reversible and irreversible processes, Modes of heat flow, Combined heat transfer system and law of energy conservation.
2. Steady State Heat Conduction: Introduction, I-D heat conduction through a plane wall, long hollow cylinder, hollow sphere, Conduction equation in Cartesian, polar and spherical co-ordinate systems, Conduction with Heat Generation: Introduction, 1-D heat conduction with heat sources, Extended surfaces (fins), Fin effectiveness 2-D heat conduction.
3. Steady State Conduction in two dimensions with and without heat sources; analytical and numerical methods.
4. Transient Heat Conduction: Systems with negligible internal resistance, Transient heat conduction in plane walls, cylinders, spheres with convective boundary conditions, Chart solution, Relaxation Method, Numericals.
5. Heat Exchangers: Classification, Performance variables, Analysis of a parallel/counter flow heat exchanger, Heat exchanger effectiveness.

Engineering Mathematics

1. Fourier series, integral and Fourier transform: Definition of Fourier series, Even and odd functions, sine, cosine, and full Fourier expansions, Parseval's theorem, Gibbs phenomenon, Fourier integral, Fourier transform.
2. Partial differential equations (PDE): First order PDE and their solution methods, Second order PDE (hyperbolic, parabolic, elliptic), Laplace equation, Wave equation, Diffusion equation, Separation of variables method, introduction of different boundary conditions, application of Laplace and Fourier transform in solving PDEs.
3. Complex analysis: Complex functions (Exponential, Trigonometric, Hyperbolic, Logarithmic, Inverse trigonometry, Total power), Polar form of complex numbers, Limit and continuity, Analytical functions, Derivative of analytical functions, Curves and regions on the complex plane, conformal mappings of $w = z + b$, $w = \frac{ac+b}{cz+d}$, $w = e^{-z}$, Cauchy formula, Taylor and Laurent expansions, Poles, Residue integration, Residue theorem, evaluation of some real integrals in complex analysis.

Materials Science
1. Identification of materials and its properties 2. Atoms, molecules and chemical bonds 3. Structure and organization of solids 4. Crystal network defects 5. Mechanical and physical, chemical properties, Heat and magnetic properties 6. Plastic deformation of metals and alloys 7. Structure and properties of single phase metals 8. Structure and properties of metal multiphase materials 9. Steel and non-ferrous alloy materials in marine industry 10. Steel and cast iron and iron and carbon phase diagrams 11. Alloy steels in marine industries and metallography 12. Corrosion in marine environments 13. Ceramic materials and their properties 14. Application of ferrous and non-ferrous materials in marine industry 15. Smart materials in marine industries and introduction to nanotechnology and new materials

Structural Analysis

1. Determinacy and stability
2. Internal force, shear force and bending moment diagrams
3. Trusses, Definition of trusses, analysis of trusses
4. Influence line, Definition, Influence line for reaction forces, Influence line for shear force and bending moment, Moller-Bersla method for drawing influence line, Influence line for Girders, Influence line for trusses
5. Deformation of structures, Moment-Area Theorem, Elastic load, Conjugated beam
6. Energy method and its applications, Virtual work method, Casigiliano's theorem, Betty-Maxwell Theorem
7. Indeterminate structures
8. Influence line for indeterminate structures

Ship Introduction

1. Definitions and Terms Related to Ships and Their Topology
2. General Principles Governing the Design and Construction of Ships
3. Types of Merchant Ships
4. Propulsion Systems in Ships
5. Dimensional, Weight, Volume and Geometric Characteristics of Ships
6. Materials Used In Shipbuilding
7. Construction of Hull
8. Building of Hulls
9. Shipbuilding and Ship Repair Yards
10. Legislative Maritime Organizations

Basic Electrical Engineering Lab.

1. Introduction to Measuring Equipment
2. Principles of Testing and Types of Errors
3. Laws of Ohm, Kirchhoff, KVL, KCL, Superposition
4. Thevenin Theorem
5. Filters
6. Sinusoidal and Transient Response
7. Diode
8. Zener Diode
9. Rectification
10. Clippers
11. Function Generator Impedance

Strength of Material Laboratory

1. Tensile test
2. Symmetrical bending apparatus tests (Including: 1- Determination of reaction forces, 2- Effects of load, thickness and material on beam deflection, 3- Pure bending and 4- Superposition principle)
3. Un-symmetrical bending apparatus tests (Including: 1- Shear center and 2- Deflection of un-symmetrical beams)
4. Elastic torsion test
5. Buckling apparatus tests (Including: 1- Determination of critical buckling force and 2- Effects of slenderness ratio of beams on critical buckling force)
6. Strain gauge familiarization (Using thin and thick cylinders)
7. Impact test

Specialized Courses

Hydrostatics and Stability of Ships

1. Introduction: The problem of ship hydrostatics and stability and its application in naval architecture.
2. Ship Hydrostatics: Introduction, Ship's Lines and Lines drawing, relationship between weight and buoyancy, geometry coefficients, numerical integration rules, calculation of ship hydrostatic curves, bonjean's curve, wetted surface, capacities and load lines.
3. Intact Stability: Principles of ship stability, weight and its center calculation, metacentric height, static stability curves, free surface and suspended weight effects, evaluation of ship stability, trim, inclining test, ship stability in grounded condition, Submerged vessel's equilibrium.
4. A review on damaged ship stability, introduction of deterministic and stochastic methods of damaged ship stability calculation, the added weight and lost buoyancy methods, floodable length.

Ship Hydrodynamics

1.Ship Resistance

1-1- Introduction (The Navier-Stokes equations for incompressible flow, The Euler equations, The Bernoulli equation) 1-2- Resistance Based on Fluid Mechanics 1-3- Flow and Resistance of a Fully-Immersed Body1-4- Boundary Layer 1-5- Friction Resistance 1-6- Pressure Resistance 1-7- Wave Making Resistance 1-8- Percentage of Resistance Components 1-9- Marine Lab and Law of Similitude 1-10- Principles of Resistance Model Testing 1-11- Water Depth Effect on Ship Resistance 1-12- Resistance Calculation by Empirical Methods 1-13- Parametric Study of Ship Resistance 1-14 An introduction to numerical computation of ship resistance 1-15 Resistance

2.Ship propeller

2.1Introduction 2.2 Ship geometry 2.3Propeller theories 2.4Propeller hydrodynamic characteristics in open water conditions 2.5Wake fraction and propeller behind hull, 2.6 Model test and the law of similitude 2.7Propeller ad propulsion system efficiency 2.8Cavitation

Prime Movers

1. Prime movers: energy extractors machines, natural resources of energy, measurement units, ideal cycles, limit cycle and actual cycle, fuel efficiency, internal efficiency, mechanical efficiency, overall efficiency.
2. Steam Turbines: Properties of Steam and use of Steam Tables- T-S and H-S Diagrams. Analysis of Various Thermodynamic Processes under gone by Steam. Vapor Power Cycles: Carnot Cycle-Rankine Cycle- Thermodynamic Variables Effecting Efficiency and output of Rankine Cycle-. Analysis of simple Rankine Cycle and Re-heat cycle Steam Turbines: Schematic layout of steam power plant Classification of Steam Turbines- Impulse Turbine and Reaction Turbine- Compounding in Turbines- blade efficiency, Velocity Diagrams for simple Impulse and Reaction Turbines- Work done & efficiency
3. Condensers: Different types of condensers, applications, auxiliary appendages. Computational elements.
4. Gas Turbines: Simple gas turbine plant-ideal cycle, closed cycle -open cycle-. Efficiency, Work ratio and optimum pressure ratio for simple gas turbine cycle. Actual cycle, analysis of simple cycles & cycles with inter cooling, reheating and Regeneration
5. I.C Engines – Otto and Diesel engines: two-stroke and four-stroke engines under controlled and exploding pressure, ideal cycle and its efficiency, classification, working principles – valve and port timing diagrams – air standard cycles – Engine systems line fuel injection, carburetion, ignition, cooling and lubrication – Engine performance evaluation.
6. Fuel Cells Engines: Structures, description, operational mechanism, application in marine industries.
7. Advanced engines: Stirling and Ericson engines, introduction of other advanced engines, their application in marine industries.

Marine Engineering

1. Introduction:
   - Definition and the scope of the marine engineering;
   - The mechanical and electrical systems of ships;
   - The main propulsion system and its elements: and
     - Hull;
     - Propulsor: and
     - Engine.
2. Design procedure of the ship power plant and main propulsion system;
3. Diesel Engines: Selection procedure for ships, Their equipment; and systems;
4. Gas turbines and their application for ships;
5. The combined systems; and
6. The shafting system.

Welding Technology

1. Introduction
2. Welding processes
3. Engineering materials
4. Heat transfer in welds
5. Weld metallurgy
6. Weld defects
7. Selected subjects

Vibrations

1. Vibrational motions, Harmonic and periodic motion, Degrees of freedom of a vibrational system.
2. Free vibration of one-degree-of-freedom systems, Newtonian and energy formulation for equation of motion, Natural frequency, Effective mass of a spring.
3. Free vibration of viscously damped systems, Virtual work principle for a one-degree-of-freedom system, Coulomb dry damped Systems.
4. Harmonically excited forced vibration and resonance, Rotating unbalanced mass excitation, Support harmonic motion excitation, Isolation of a system vibration.
5. Whirling of rotating shafts, Critical speed, Unbalance in rotor and propeller of ship, Static and dynamic balance of propeller.
6. Energy loss in a forced vibration, Equivalent viscous damping, Structural damping.
7. Transient vibration under Impulse excitation force, Arbitrary excitation force, Laplace transformation.
8. Vibration of multi-degree-of-freedom systems, Modal analysis, Initial conditions, Modes of vibration and natural frequencies.
9. Generalized coordinates, Coordinate transformations, Orthogonality of Modes of Vibration, Forced vibration of multi-degree-of-freedom systems.
10. Methods of analytical dynamics in vibration, Work and energy and generalized coordinates, Lagrange's equations of motion.
11. Vibration of continuous systems, Lateral vibration of strings, Torsional vibration of shafts, Longitudinal vibration of bars, Bending vibration of Euler beam.
12. Ship propeller cavitation and vibration in stern, Engine and machine vibration, Foundation and vibration reduction
13. Noise in ship, Noise measurement, Sound equations and mathematical analysis, Noise reduction and muffling, Sound speed in the sea, Noise and cavitation relation.

Ship Construction I

1. Evolution of the Ships
2. Materials used in Shipbuilding (Past and Present)
3. Material Experiments
4. Forces acting on the Ships and Response of the Ships to them
5. Importance of Studying Ship Construction
6. Bottom Structure
7. Side Shell Structure
8. Deck Structure
9. Structure of the Bulkheads
10. Structure of the Pillars
11. Fore End Structure
12. Aft End Structure
13. Structure of the Superstructure
14. Ship Failures
15. Introduction to the Methods for Design and Analysis of Ship Structure
16. Longitudinal Strength of Ship Hull Girder (Determination of Curves of Weight and Buoyancy Distributions, Drawing the Shear Force and Bending Moment Diagrams, Calculation of Moment of Inertia of Ship Hull Girder Cross-Section)

Ship Manufacturing

1- History of Shipyards and Familiarity with the Process of Fundamental Changes in Their Organization from its Inception Until Now
2. Changes in Location of Shipyards to use Technology Development
3. Locating the Construction Site of Shipyards taking into account the Changes Made in Global Competitions
4- General Study of Design in Construction Planning and Use of Software and Hardware Systems Developed in Construction Planning
5. Application of Computer in Shipbuilding Industry
6. Necessary Facilities and Equipment in Shipyards
7. Mould Loftingand Marking
8. Workshops for Construction and Installation of Ship Parts
9. Planning Process of Shipyards
10. Systematic Work Process (Work Cycle)
11. Planning and Executive Process of Ship Construction
12. History of Shipbuilding Terms
13. Preparing and Leveling Plates and Profiles
14. Cutting Process and its Types
15. Forming Plates and Parts
16. Welding and Welding Process in Shipyards
17. Assembly and Installation of Parts
18. Launching
19. Equipping The Ship after Launching
20. Visiting the Shipyard and Getting Acquainted With the Construction Processes in Practice

Ship Design
Introduction including definitions, introduction of ship types, introduction of some of IMO conventions etc. 1. Owner study 2. Principles of ship design 3. Determination of ship main particulars and their effects on ship performances 4. General arrangement 5. Hull-form design 6. Calculation of ship weight and weight center 7. An introduction to computer aided ship geometry design 8. A review on optimization of ship design

Renewable Energy

1. Introduction: Pollution of fossil fuels and increasing energy consumption and the desire for clean and renewable energy sources
2. Energy sources: Electrical, Mechanical, Thermal, Nuclear, Chemical Radiation, Primary, secondary and final Energy, Performance, Efficiency and accessibility of energy sources
3. Types of renewable energy by land and sea
4. Solar energy: Extraction methods in solar thermal power plants, Types of thermal power plants
5. Wind energy: Wind speed distribution, Types of wind turbines on land. Vertical axis turbines, Horizontal axis turbines, Capacity coefficient, Integration coefficient, Turbine potential power, Wind power parts.
6. Water energy and its extraction methods on land
7. Geothermal energy and its extraction methods
8. Biomass energy
9. Marine renewable energy, Opportunities and Challenges
10. Offshore wind energy: Difference between offshore and onshore winds, Fixed base and floating offshore turbines
11. Tidal energies: Tidal mechanism and its types, Tidal components, Tidal power estimation,
12. Types of absorbable tidal energy: Tidal potential energy (tidal lagoons, tidal dams), Tidal kinetic energy (turbines and hydrofoils), Tidal dynamic power, Tidal dams: One-basin arrangement (one-sided, two-sided), two-basin arrangement, Combined basins arrangement, Storage pump power plant,
13. Wave energy: Estimation of wave power, Types of wave absorbers: Shore line, Near shore and offshore
14. Environmental impacts of renewable marine energy absorption devices
15. Planning for the construction of offshore energy farms
16. Iran's ability to exploit marine renewable energy

Mechanical Engineering Design II

1. Design of screws and bolted joints, Standards of screws, Power screws, Bolted joints
2. Stiffness of screw and joining elements, Bolted joint under static and fatigue tension
3. Design of helical springs for static and fatigue loading, Stresses in and deflection of springs
4. Design of rolling contact bearings, Types of bearings, Reliability of life and load of bearing
5. Radial and thrust loading, Design and selection of ball, roller and tapered roller bearings
6. Gears and transmission, Types of gears, Conjugate action of teeth, Involute profile
7. Kinematics of gears and gear chains, Load analysis of spur and helical gears
8. Design of spur and helical gears, Bending of gear tooth, Strength equations

Engineering Drawing II

English for Marine Student

Study of manuscripts covering different aspects of marine engineering fields.

A) General Topics (From design phase to decommissioning of the ship)

1. Ship design
2. Ship construction (Including: familiarization with shipyard equipment)
3. Ship machinery (Including: E/R and deck machinery, bridge and navigational equipment and safety equipment)
4. Ship management
5. Ship maintenance and repair
6. Ship recycling

B) Technical Topics

1. Ship structure
2. Hydrodynamics
3. Hydrostatics
4. Ship vibration (including hull vibrations and shaft and propeller vibrations)

C) Rules and regulations

1. Regulatory bodies (Including introducing of international organizations and classification societies, conventions, resolutions, etc.)
2. Maritime law
3. Ship Inspection

D) Other topics (optional)

1. Introduction to offshore structures (offshore platforms, marine cable and pipelines)
2. Submarines
3. High speed crafts
4. Marine environment
5. Ports and harbors

Maritime Economics

1. Definition of Maritime Economy - An Overview of Maritime Economy of Iran and the World and International Trade
2. Study of maritime transport in Iran and the world - definition of economy and micro and macro economy
3. Assessing the supply and demand for maritime transport services - markets of the maritime transport industry
4. Characteristics of maritime transport in Iran and the world - types of shipping companies
5. Survey of shipping cycles - shipping cost
6. Examining the term incoterms2010 in the transportation of goods at sea - the role of ports in maritime transport - the fleet of commercial vessels
7. Survey of brokerage companies, multi-faceted transport operator, offshore logistics park, freight transportation in warehouse
8. Study of economy and fishing
9. Mines at sea - Shipping lines
10. Marine Insurance and Marine Insurance Companies - The Impact of Shipping, Shipping and Marine Services on the Maritime Economy of Iran and the World
11. Investigation of information technology in sea-based economy - floating safety and offshore platforms and marine economy
12. Economic benefits and losses of shipping goods at sea - energy and maritime economy and trade
13. Trade in the maritime economy in the twentieth century and the globalization of the maritime economy
14. Floating safety and platforms and accident analysis and emphasis on maritime economy factors
15. Maritime tourism

Marine Environment

1- General characteristics of sea waters and seabed

2- Environmental characteristics of the Persian Gulf and the Oman Sea and the Caspian Sea

3- Urban, industrial waste water and polluting sources of the seas

4- Oil pollution and effective factors in oil sectors

5- Cleaning the beaches from pollution

6- Environmental Protection Maritime Organizations (ROPME)

7- Light and heavy industries polluting the sea

8- Oil dispersion model at sea level

9- Oil at sea and regulations on oil pollution

10- Dealing with oil slicks

11- Oil pollution prevention regulations

12- Ship ballast water management

13- MARPOL Ship Pollution Prevention Regulations

14- Regulations for transporting hazardous materials at sea and pollution caused by it

15- Prevention regulations for pollution caused by ship waste

Hydrostatic Lab.

Introduction

1.Inclining test

2. Free surface and suspended weight effects on GM

3. Measurement of the static stability curve, GZ-Φ

4. Test of trim

5. Investigation of the ship stability change due to added light-load

6. Investigation of dynamic stability of ship

Optional Courses

Design of Underwater Vehicles

1. Principles of the underwater vehicle design:
2. Classification of underwater vehicles;
3. Geometrical properties of underwater vehicles;
4. Design algorithm for underwater vehicles;
5. Tonnage and weight groups for underwater vehicles;
6. Hydrostatics, trim, variable weights and buoyancy for underwater vehicles;
7. Design of underwater vehicle's hull;
8. Dimensions and the lines drawing of underwater vehicles;
9. The Hydrodynamic analysis of an underwater vehicles;

Offshore Platforms

1. Introduction: The importance of oil and gas and the role of Offshore platforms in their exploration and extraction.
2. The costs of a platform include initial and operating expenses
3. Familiarity with different types of fixed and floating offshore platforms and their application.
4. Methods of construction, transportation and installation of offshore platforms
5. Familiarity with offshore piping and its various methods,
6. Theory of regular and irregular linear waves and the ways of estimating the design wave from it
7. Wave prediction methods
8. Wind and Wave Roses and their calculations
9. Offshore loading: wind loading, Current loading, wave loading, earthquake loading
10. Familiarity with the rule books for designing fixed offshore platforms
11. Familiarity with fixed platform design software, and modeling in them
12. Design project for Persian Gulf sample platform

High Speed Craft

Ship Hydrodynamics II

1. Ship propulsion:
   - Ship propulsion devices; fixed pitch propeller, controllable pitch propeller, ducted propeller, contra-rotating propeller, water jet and etc.
   - Principles of screw propeller;
   - Screw propeller geometry;
   - Screw propeller drawing;
   - The elementary screw propeller theories;
   - Hydrodynamic characteristics of screw propellers;
   - Hull and propeller interactions;
   - Cavitation;
   - Propulsion efficiency;
   - Propeller design using propeller series;
   - Propulsion characteristics of ship propulsion system; and
   - Application and design of special types of propulsion devices.
2. An introduction to the Ship Maneuverability:
   - Linear ship maneuvering equations;
   - Maneuvering characteristics of ships;
   - The ships maneuvering criteria;
   - The rudder arrangements;
   - Geometrical properties of rudders;
   - Hydrodynamic characteristics of rudders;
   - Systematic design of ship’s rudder.
3. An introduction to the seakeeping of ships:
   - Linearized regular waves; and
   - Uncoupled heave, pitch and roll motions of ships in regular waves.

Fundamentals of Hydroacoustics

1. Hydroacoustics and applications in sea environment: definition of different concepts of sound and hydroacoustics, history of acoustics, application of hydroacoustics in marine engineering.
2. Vibration and hydroacoustics equivalence: One degree of freedom vibration, damping of vibration, forced vibration, mechanical impedance and resonance, transversal vibration, one dimensional wave equation, general solution of wave equation.
3. Sound propagation in sea environment: Reflection and translation of sound, radiation and receiving of sound, sound loss.
4. Hydroacoustics modes and governing equations: Pressure acoustic mode, vorticity acoustic mode and entropy acoustic mode, acoustic equations: Lighthill, Fowcs-Williams-Hawkins, and Kirchhoff, Helmholtz.
5. Analytical, approximate, and numerical method of acoustic modeling: solution of wave and Helmholtz equations, Kirchhoff 's method, Fowcs-Williams-Hawkins approach.
6. Environmental effects in sound propagation in marine engineering: water depth, saltiness, temperature, free surface effects, seabed effect.
7. Recognition of sound source in sea environment: Active and non-active sonar, sonar equations and their analysis, vessel noise, noise generated sources, noise reduction method in vessels.

Corrosion in Marine Environment

1. Introduction to Corrosion electrochemistry (3 sessions)
2. Forms of corrosion (2 sessions)
3. Marine environments
4. Cathodic protection (Cathodic protection through impressed current and sacrificial anodes) (2 sessions)
5. corrosion control through metallic coatings
6. surface preparation before painting
7. Paint coatings
8. The selection of materials for marine environments
9. Design
10. Control and treatment of the environment
11. Offshore structures for oil and gas production

Composite Materials

1. Definitions and terminology for composite materials
2. Classification of composites, Metal and nonmetal composites
3. Constituent materials, Matrix materials, Reinforcement materials, Polymeric matrices
4. Fiber materials, Additives, Manufacturing processes, Standards
5. Stress and strain tensors, Constitutive equations for isotropic materials
6. Micromechanical modeling for combining matrix and fiber properties
7. Macromechanics of unidirectional composites, Orthotropic materials, Symmetry planes
8. Stiffness and compliance matrices, Engineering constants for Orthotropic materials
9. Properties of UD plies out of principal directions, Transformation of stress and strain tensors
10. Transformation of stiffness and compliance matrices, Thermal strains and stresses
11. Strength components for a unidirectional ply, Failure theories for Orthotropic materials
12. Laminates and their symbols, Laminate layup, Classical laminate theory
13. Load-deformation relations for laminates, Laminate stiffness matrices
14. Design and selection of composites, Marine applications

Ship Construction II

1. Construction of Special Ships and their Structural Problems
2. Joints in Ship Construction
3. Loading/Unloading Equipments for Solid Cargo
4. Access Equipments, Handling Equipments and Lashing Equipments for Cargo
5. Hatch Covers
6. Equipments for Mooring Ships in Ports
7. Structural Protection against Fire

Repair and Maintenance of Ships and Offshore Structures

1. Rules and regulations for repair and maintenance of ships and offshore structure
2. Survey of ships and offshore structure
3. Principles of repair and maintenance of ships
4. Introduction to ship repair and maintenance types (daily, periodic, preventive, underwater repair and maintenance and machinery overhaul)
5. Introduction to computerized ship maintenance and repair systems (PMS: Planned Maintenance System, CMMS: Computerized Maintenance Management Systems)
6. Comparison of Construction and repair yards and relevant equipment
7. Docking activities (Entrance, mooring, docking, surface preparation, structural works, repair of electrical, mechanical and piping systems, general works and painting, required tests before and after docking)
8. Man-hour and workload estimation of docking activities in order for cost estimation
9. Management and planning of docking activities
10. Principles of repair and maintenance of offshore structures (offshore platforms, pipelines and marine cables)
11. Equipment used in repair and maintenance of offshore structures

Auxiliary Machinery

1. The auxiliary systems:
   - Ship main engine auxiliary systems;
   - Ship service systems; and
   - Ship operational systems.
2. The auxiliary equipment:
   - Heat exchangers;
   - Pumps;
   - Compressors;
   - Piping, fittings and valves; and
3. Deck machinery;
4. Cargo equipment;
5. Bow and stern thrusters;
6. Auxiliary engines;
7. Steering system;
8. Air conditioning, ventilation and heating systems;
9. Stabilizer and stabilizing systems;
10. Anchoring system;
11. Cargo handling systems; and
12. Sanitary systems.