

# Naval Architecture & Ship Construction - II

T.E. Sem. VI [MARINE]

## EVALUATION SYSTEM

	Time	Marks
<b>Theory Exam</b>	3 Hrs.	100
<b>Practical Exam</b>	–	–
<b>Oral Exam</b>	–	–
<b>Term Work</b>	–	25

## SYLLABUS

### 1. Ship Form Calculations and Hydrostatics

Lines plan. Numerical integration – Trapezoidal, Simpson's and Tehebycheff's rules and their application to the calculation of areas, volumes and first and second moments. Hydrostatic particulars. Wetted surface. Deadweight-displacement scale. Bale and grain capacities. Tank capacity. Sounding and ullage. Capacity plan.

### 2. Ship Stability

**Equilibrium :** Conditions of equilibrium – weight and buoyancy, centres of gravity and buoyancy. Effect of adding, removing and moving weights. Tones per cm immersion. Flooding of a compartment amidships.

**Intact Stability :** Concept of stability – positive, negative and neutral stability. Conditions for initial stability. Transverse and longitudinal metacentres. Rolling period and metacentric height. List and its correction. Effect of suspended weights and free surfaces on stability. Inclining experiment. Transverse stability at large heel angles. Righting lever. Cross curves of stability. Dynamical stability. Angle of loll. Intact stability criteria. Moment to change trim 1 cm. Trimming moments due to adding, removing and moving weights. Effect of change in density of water on draught and trim. Effect of grounding and docking on stability.

### 3. Damage Stability

Effects of damage. Subdivision. Floodable length and permissible length. Damage stability. Damage stability requirements for different types of ships. Probabilistic approach to damage stability requirements.

### 4. Load Line

Freeboard and reserve buoyancy. Type A and Type B ships. Calculation of freeboard. Reduced freeboard for Type B ships. Conditions of assignment. List of closing appliances. Load line marking and load line survey. Timber load lines.

### 5. Tonnage

Tonnage regulations. Gross tonnage and net tonnage. Calculation of tonnage.

### 6. Statutory and Classification Society Surveys of Ships

Introduction to IMO and flag survey rules. Functioning of classification societies. Surveys during construction. Periodical surveys as per statutory rules and class rules. Statutory certificates and their validity. Enhanced survey requirements.

**Reference:**

1. An Introduction to Naval Architecture (*E.C. Tupper*)
2. Basic Ship Theory (*K.J. Rawson and E.C. Tupper*)
3. Ships and Naval Architecture (*R.Munro – Smith*)
4. Principles of Naval Architecture (*E.V.Lewis (Editor)*), Society of Naval Architects and Marine Engineers, Jersey City, U.S.A.



# Mechanics of Fluids - II

T.E. Sem. VI [MARINE]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	25

## SYLLABUS

### 1. Dimensional Analysis and Dynamical Similarity

Use of Dimensions for finding conversion factors; Dimensions of Common quantities; Dimensional equations; Method of finding dimensionless groups; Geometrical and dynamical similarity, General principle; Dynamical similarity problems.

Non-dimensional performance characteristics of roto dynamic machinery. Detailing of characteristics.

### 2. Turbines

Definition of hydro turbines. Application of momentum equation to stationary and vanes moving with linear velocity. Series of moving vanes. Application of angular momentum principle to turbine rotor. Euler's velocity. Expression for work done.

### 3. Pelton Turbines

Parts of turbine, salient features, power developed. Hydraulic, Volumetric, Mechanical and Overall efficiencies.

### 4. Characteristics of turbines, Cavitation

Mechanism of cavitation, types of cavitation. Thoma cavitation parameter. Governing of turbines : methods employed in Pelton, Francis and Kaplan turbines. Pumped Storage Plants : Tubular turbines and Deriaz turbines.

### 5. Classification of Pumps

Positive displacement and non positive displacement, priming of pumps.

Positive displacement pumps; types and application, general features of rotary pumps; like, gear pumps, screw pumps, vane pumps; general features of reciprocating pumps, various types, single and double acting, single and multi cylinder, definition of head, coefficient of discharge, work done and efficiency, theoretical indicator diagrams, effects of acceleration and friction, use of air vessel.

### 6. Centrifugal Pumps

Application, components of the pump, correction factors for the head losses and efficiency, velocity diagrams at inlet and exit, calculation for power input, torque on shafts, cavitations in centrifugal pumps. NPSH, series and parallel operation of pumps, radial thrust and axial thrust, methods used to balance them, seals used in centrifugal pumps, trouble shooting in centrifugal pumps, self priming pumps, pump characteristics and basic principle of selection of a pump.

### Reference:

1. Hydraulic Machinery (*Jagdish Lal*)
2. Fluid Mechanics and Hydraulic Machines (*R.K.Bansal*) Lakshmi Publications.
3. Fluid Mechanics (*R.K.Rajput*)
4. Hydraulic Machines (*Vasandani*)
5. Fluid Flow Machines (*N.S.Govinda Rao,*) Tata Mc.Graw Hill Publishing Corpan, Ltd.
3. Fluid Mechanics (*Douglas*) Et.Al.



## Marine IC Engines - II

T.E. Sem. VI [MARINE]

### EVALUATION SYSTEM

	Time	Marks
<b>Theory Exam</b>	3 Hrs.	100
<b>Practical Exam</b>	–	–
<b>Oral Exam</b>	–	–
<b>Term Work</b>	–	25

### SYLLABUS

#### 1. Fuel Injection Equipments and Metering Devices

Unit injection and common rail systems; fuel injection systems, basic principles of fuel injection pumps, helical groove and spill valve type fuel pumps; systems for burning heavy oil in slow and medium speed Marine engines, V.I.T. and electronics injection systems, characteristics of fuel cam, drive for camshaft, fuel injection valve, fuel pump setting, measuring equipments and its working principle, effects of viscosity on liquid fuel combustion, emission control.

#### 2. Starting and Reversing

Starting and Reversing systems of different Marine Diesel Engines with safety provisions.

#### Indicator Diagrams and Power Calculations

Construction details of indicator instruments, Indicator power and draw diagrams, power calculations, fault detection, Light spring indicator diagrams, power balancing, performance characteristic curves; Test bed and sea trials of diesel engines.

#### 3. Lubrication Systems

lubrication arrangement in diesel engines including coolers and filters, cylinder lubrication, Liner wear and preventive measures, contamination of lubricating oil – its effect and preventive measures, treatment of oil, lubricating oil properties, Test analysis of used oils for effectiveness and for monitoring engine performance, additives in lubricating oils. Microbial Degradation of. Lubricating Oils.

#### 4. Medium Speed Engines

Construction details and principal components of medium speed diesel engines, including V types, used for main propulsion, coupling and reduction gearing. Construction details of medium speed diesel engine used for electric power generation.

#### 5. Governors

Governors and their basic function, constant speed and overspeed governors, constructional details and hunting of governor, general concept of hydraulic governors, general concept of hydraulic governors, general concept of electronic governors.

#### 6. Automation in Modern Diesel Engine Plants

Remote Operation, alarm and fail safe systems; computerized monitoring and diagnostic application in propulsion engines, the intelligent engine concept, NOx control of diesel engines, improvement in design for increased TBO (Time Between Overhauls).

#### Maintenance of Diesel Engines

Inspection, Repair / Replacement of various component / members such as piston, piston ring, piston rod stuffing box, cylinder head, liner, bearings, driving chains/gears, cross head, gudgeon pin, piston and connecting rods, crankshaft, cam shaft, crankshaft deflection and alignment, Engine holding down arrangement, tie rods. Hot and Cold Corrosion, Crankshaft web – slip, X-head bearing problem.

### **Modern Trends and Development in Diesel Engine**

Current developments in SULZER, MAN-B&W, SEMT PILLSTICH, WARTSILA; Intelligent Engine (Cam less concept), improvement in design for increase in TBO, UMS operation in diesel plant Emulsified fuel injection.

#### **Reference:**

1. Marine Diesel Engines (*Pounder, Elsevier*)
2. Marine Diesel Engines (*Synyal*)
3. Marine Diesel Engines (*Lamb*)
4. Motor Engineering Knowledge, Vol-12, Reed's Thomas Reed Publication, London
5. Marine Engineering Practice Series, 20 parts in 3 volumes Institute of Marine Engineering, London
6. The Running and Maintenance of Marine Machinery (*Cowley*) Institute of Marine Engineers, London
7. Marine Engineering (*D.A. Taylor Elsevier*)
8. Marine Engineering (*Harrington*) SNAME.



# Dynamics of Machines - II

T.E. Sem. VI [MARINE]

## EVALUATION SYSTEM

	Time	Marks
<b>Theory Exam</b>	3 Hrs.	100
<b>Practical Exam</b>	–	–
<b>Oral Exam</b>	–	–
<b>Term Work</b>	–	25

## SYLLABUS

### 1. Vibrations

#### Basic concepts of vibration

Vibrational oscillation, causes effects of vibrations, Vibration parameters-spring, mass, damper, Damper models, Motion-periodic, non-periodic, harmonic, non-harmonic, Degree of freedom, static equilibrium position, Vibration classification, Steps involved in vibration analysis.

#### Free undamped single degree of freedom vibration system

Longitudinal, transverse, tensioned system, Methods for formation of differential equations by Newton, Energy, Lagrangian (Rayleigh's method), Effect of springs mass and shaft inertia on natural frequency, Effect of flexible bearings on natural frequency.

#### Free Damped single degree of freedom vibration system

Viscous damped system-under damped, critically damped, over damped. Logarithmic decrement, Coulomb's damping, Combined viscous and Coulomb's damping.

### 2. Equivalent single degree of freedom vibration system

Conversion of multi-springs, multi masses, multi-dampers into a single spring, mass and damper with linear or rotational co-ordinate system.

#### Free Undamped Multi degree of freedom Vibration systems

Eigen values and Eigen vectors for liner system and torsional two degree of freedom, Holzer method for liner and torsional unbranched system, Two rotors, three rotors and geared system, Dunkerley and Rayleigh method for transverse vibratory system.

### 3. Forced single degree of freedom vibratory system

Analysis of linear and torsional systems subjected to harmonic force excitation and harmonic motion excitation (excluding elastic damper)

### 4. Vibration measuring instruments

principle of seismic instruments, vibrometer, accelerometer-underdamped, damped.

#### Vibration Isolation

Force isolation, motion isolation, isolators

### 5. Rotor Dynamics

Critical speed of single rotor, undamped and damped

#### Cam Dynamics

Cam Kinematics and Dynamics: Mathematical Model, Differential equation, Response, Follower Jump phenomenon

### 6. Static and dynamic balancing of multi rotor system

**Balancing of reciprocating masses :** In-line engines, V-engines (excluding radial engines).

**Reference:**

1. Mechanical Vibrations (*G.K.Grover*)
2. Mechanical Vibrations (*V.P.Singh*) Dhanpat Rai & Sons
3. Mechanical Vibrations (*S.S.Rao*) Addison Wesley Publishing
4. Fundamental of Mechanical Vibration (*Graham Kelly*) Tata McGraw Hill.
5. Mechanical Vibration Analysis (*P. Srineevasan*) Tata McGraw Hill
6. Mechanical Vibrations –Schaum’s Outline series, McGraw Hill
7. Theory & Practice of Mechanical Vibrations (*J.S.Rao, K.G.Gupta*) New Age International Publications
8. Theory of Vibrations with applications (*W.T.Thomson*) Prentice Hall of India
9. Mechanical Vibrations (*Den, Chambil, Hinckle*)



# Marine Auxiliary Machinery - II

T.E. Sem. VI [MARINE]

## EVALUATION SYSTEM

	Time	Marks
<b>Theory Exam</b>	3 Hrs.	100
<b>Practical Exam</b>	–	–
<b>Oral Exam</b>	–	25
<b>Term Work</b>	–	25

## SYLLABUS

### 1. Steering Gears Main and Auxiliary Steering Systems

Operation, Constructional details, care and maintenance of : Various types of steering machinery and Steering Systems, Telemotor systems, transmitters and receivers, Variable delivery pumps used in steering gears, axial and radial displacement types.

Hunting action of steering gear, Emergency Steering arrangement. Safe-matic (single failure criteria) steering gear as per SOLAS 74.

### 2. Shafting

Methods of shaft alignment, constructional details and working of Thrust blocks. Intermediate shaft bearing and stern tube bearing. Oil, water, lubricated stern tubes. Sealing glands, stresses in Tail End, Intermediate and Thrust Shafts, R.P.M. meter, Measurement of Brake Horse power.

#### Dry Docking

Methods of dry docking of ships. Inspection and routine overhauling of underwater fittings. Hull external inspection, repair / renewal of Hull plates. Measurement of clearances and drops. Removal, repair and fitting of propellers (with and without key), rudder, Statutory Requirements.

### 3. Pollution Prevention and Environment Protection and Equipments

Incinerators, Sewage treatment plant, Engine room crane, Chain blocks, tackles, Anchor chain, its testing and survey requirements.

#### Ship Stabilizer and associated topics

Different types of ship stabilizer, Bow Thrusters, hull protection arrangements.

### 4. Refrigeration

Uses of refrigeration at sea, cryogenic technology-definition, temperature range, insulation Effect on environment, Montreal and Kyoto protocols requirements and their enforcement through Annex VI of MARPOL 73 / 78.

Construction of various components of refrigeration plants, i.e., compressor, condenser, evaporator, expansion valves, control and safety equipments for domestic, refrigerated cargo spaces and refrigerated containers.

Operation and maintenance of refrigeration plants, control of temperature in different chambers, charging of refrigerant / oil, purging of air, defrosting methods, trouble shooting.

Refrigeration of cargo holds, brine system and its operation and maintenance, methods of air circulation in holds, insulating materials, insulation, micro-organism, dead and live cargo, factors affecting refrigerated cargo, container ship refrigeration, preparation for loading cargo, survey of refrigeration equipments.

### 5. Air Conditioning

Necessity on board ships, different systems, control of room air temperature, humidity, noise, dust and purity, construction of duct and diffuser, fans, ventilation of accommodation, fire safety balancing of system. Heating of accommodation in cold regions incorporated in same or separating unit. Humidity control while in heating mode. Bacteria in Ventilation Duct.

**Ventilation**

Ventilation of engine room, pump room, CO<sub>2</sub> and battery rooms, air change requirements, design consideration, maintenance.

**6. Noise Pollution and Vibration**

Elements of aerodynamics and hydrodynamics sound, Noise sources on ships and noise suppression techniques. Noise level measurement in accommodation, passenger spaces and in E.R., permitted decibels. Ear protection aids.

Various modes of vibration in a ship (i.e. free, forced, transverse, axial, torsional their sources and effects), Resonance and critical speed, structure borne, and air borne vibration. Anti vibration mountings of machineries, De-tuners, Dampers with reference to torsional vibrations dampers, use of torsigraphs.

**Reference:**

1. Marine Auxilliary Machinery (*D.W.Smith*) Newnes – Butterworth
2. General Engineering Knowledge (*H.D.McGeorge*) Butterworth Heinemann
3. General Eng. Knowledge for Marine Engineers – Reed Practical Mathematics Series Vol. 8
4. Refrigeration and Airconditioning (*C.P.Arora*) Tata McGraw Hill
5. Marine Engineering Practice Booklets – 1 to 20 in 3 volumes Institute of Marine Engineers Publications
6. Introduction to Marine Engineering (*D.A. Taylor*) Butterworth – Heinemann
7. Notes on Instrumentation & Control (*G.J.Roy*) Stanford Maritime, London



# Applied Thermodynamics (Marine) III

T.E. Sem. VI [MARINE]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	25

## SYLLABUS

### 1. Fuels, Combustion and Dissociation

Definition of Fuel, Combustion. Combustion Equation. Analysis of the products of Combustion, Stoichiometric Combustion, Actual Combustion, Excess Air, Mixture Strength, Dissociation, Effect of Dissociation on I.C. Engines.

### 2. Gas Dynamics

One Dimensional steady flow of compressible fluids, Isentropic flow, Effect of Friction, Flow through Nozzles and diffusers, Critical conditions, Mach number, Subsonic and Supersonic Flow. Flow of steam through Nozzles and Diffusers.

### 3. Steam Turbines

Supersaturated Flow of Steam; Applied problems.

General Principles of Impulse and Reaction Turbines.

Velocity Diagrams for Simple Impulse and Impulse-Reaction Turbine. Compounding of Impulse Turbine – Pressure and Velocity Compounding. Force on blades. Work done by blades, Axial thrust, Blade or Diagram Efficiency. Effect of Friction on blades, Applied problems.

### 4. Refrigeration

Reversed Carnot Cycle, Vapour Compression Cycles, Refrigerating effect, Co-efficient of performance, Cooling capacity, rating of a Refrigerating plant, Methods of improving C.O.P. Use of vapour Tables, Applied problems.

Typical marine Refrigerating Plants with Multiple Compression and Evaporator System. Refrigeration in liquefied gas carriers and refrigerated container.

### 5. Transmission of Heat

Fourier's Law of Heat Conduction: Thermal conductivity of insulating materials. Conduction through flat and cylindrical, spherical surfaces in series. Heat transfer from fluids to fluids through walls. Application of Heat Transfer in Marine Heat Exchangers, like Coolers, Heaters, Condensers. Prediction of convection Heat Transfer rates. Use of Non-Dimensional Groups.

Natural and Forced Convection – use of Prandtl No., Nusselt No., Reynolds No., Stanton No., Grashoff No., Applied problems.

Radiation : basics, Stephen-Boltzman Law, Grey / Black Bodies.

### 6. Mass Transfer

Mechanism of Mass Transfer : Importance of mass transfer in engineering. Introduction of Steady State diffusion of gases and liquids.

**Reference:**

1. Thermal Engineering (Ballaney) Khanna Publishers
2. Thermodynamics (*P.K.Nag*) Tata McGraw Hill. Co.,
3. Applied Thermodynamics for Engineers and Technologies (*Eastop and Mcconky Longman*)
4. Thermodynamics Tables (*Rogers and Mahew*)
5. Thermodynamics Tables and T– $\phi$  diagram.
6. Thermal Engineering (*Kothandraman, Domkundwar, Khajuria*) Arora–Dhanpatri & Sons.
7. Thermal Engineering (*R.K.Rajput*)
8. Steam and gas turbine (*R.Yadav*)
9. Thermodynamics and Heat Engines Vol II (*R. Yadav*) Central Publishing House,
10. Principles of Thermodynamics (*H.A.Sorensen*) A Merinal Publications
11. Thermodynamics (*Rogers and Mahew*)



# Marine Machinery & System Design

T.E. Sem. VI [MARINE]

## EVALUATION SYSTEM

	Time	Marks
Theory Exam	3 Hrs.	100
Practical Exam	–	–
Oral Exam	–	–
Term Work	–	25

## SYLLABUS

### 1. Procedure in Marine Machinery and System Design

Concepts of design, procedure and process, Design Synthesis, Economic Consideration in design, Feasibility, Preliminary. Design Alternative, Final Design Alternative Preliminary and Final Plans and drawings.

Use of standards in design, selection of preferred sizes, Common useful materials and manufacturing consideration in design.

Review of failure criteria in mechanical design, properties of materials, BIS system of designation of steels, I.S. Codes, Basis of good Design, Failure of machine parts, Deformation, wear, Corrosion.

### 2. Strength Consideration for Machines Design

Strength of materials, Reliability, Influence of size, stress concentration, strength under combined stresses, static loads, impact loads, Repeated loads, Completely reversed loads, static plus Alternative loads, cyclic and combined loads, fatigue strength, Dynamic Stresses, selection of materials.

### 3. Design and Drawing – Power Transmission

Shaft and axles, Bearing, Clutches and brakes, Belt drivers, Chain drives, Design and drawing of tooth gearing like spur and Bevel gears, Rack and pinion, worm and worm wheels, helical gears.

### 4. Design and Drawing – power transmitting shafts such as tail-end-shaft.

### 5. Design and Drawing – unfired pressure vessels such as starting air bottle with dished ends.

### 6. System Design and Drawing

Water cooling systems including pumps, filters, Heat exchangers for Diesel and steam engine plants.

Lubricating Oil systems including pumps, purifiers, pressure by-pass valves, heat exchangers.

Electro-hydraulic steering gear system including rudder, rudderstock, Tiller arm, ram and cylinder.

Marine Diesel Engine Fuel injection system including Fuel pumps and fuel injectors.

### Reference:

1. Design of Machine Elements (*V.B.Bhandari*)
2. Machine Design – An Integrated approach (*Robert Norton*) Pearson Education Asia.
3. Machine Design (*Pandya Shah*) Charotar Publishing
4. Machine Engineering Design (*I.E.Shingley*) Tata McGraw Hill.
5. Reed's Engineering Drawing for Marine Engineers (*H.G.Beck*) Thomas Reed Publication.
6. Mac Gibbon's Pictorial Drawing Book for Marine Engineers (*James G. Holburn and John J. Seaton*) James Munro & Company, Limited.
7. Recommended Data Books–PSG (*K. Mahadevan*)
8. Machine Design – (*Reshtov*) Mir Publication
9. Machine Design (*Black Adams*) McGraw Hill
10. Fundamentals of Machine Elements (*Hawrock Jacobson*) McGraw Hill
11. Rules for Surrey and Construction of steel ships (Materials, Machinery, Welding, unfired pressure vessels and Equipment sections)–of any Recognized classification society.

