

Applied Mathematics – IV

S.E. Sem. IV [MARINE]

EVALUATION SYSTEM

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

SYLLABUS

1. Fourier Series

- Orthogonal and orthonormal functions, Expression for a function in a series of Orthogonal functions.
- Sine and cosine functions and their orthogonality properties.
- Fourier series of periodic functions with period 2π and $2L$. Dirichlets theorem (only statement).
- Even and odd functions.
- Half range sine and cosine series.
- Parsevalls relations (only statement).
- Complex form of Fourier series.
- Fourier integrals even and odd functions.

2. Partial Differential Equations

- Partial differential equation governing transverse vibrations of an elastic string, its formulation and solution using Fourier series.
- Heat equation, steady-state configuration for heat flow.
- Two and Three dimensional Laplace equation.

3. Random Variables

Discrete and continuous random variables, probability mass function and density function. Probability distribution for random variables. Expected value, Variance.

4. Probability Distributions

Binomial, Poisson and normal Distributions.

5. Sampling theory

- Sampling distribution, Test of Hypothesis, Level of significance, critical region. One tailed and two tailed tests. Interval estimation of population parameters. Large and small samples.
- Test of significance for large samples : Test for significance of the difference between sample mean and population means. Test for significance of the difference between the means of two samples.
- Student's t-distribution and its properties. Test of significance of small samples : Test for significance of the difference between sample mean and population means, Test for significance of the difference between the means of two samples, Chi-square distribution and its properties. Test of the Goodness of fit.

6. Fitting of curves

- Least square method : Fitting the straight line and parabolic curve. Bivariate Frequency Distributions, Correlation. Co-variance, Karl Pearson coefficient and Spearman's Rank Co-relation Coefficient (non-repeated and repeated ranks, without proof) Regression Coefficient and lines of regression.

Reference:

1. A Text Book of Applied Mathematics (*P.N. & J.N. Wartikar*)
2. Mathematical Statistics (*J.N. Kapoor & H.C. Saxena*)
3. Higher Engineering Mathematics (*Dr. B.S. Grewal*)
4. Probability, Statistics and Random Processes (*T. Veerarajan*)
5. Advance Engineering Mathematics (*E. Kreyszig*)



Strength of Materials – II

S.E. Sem. IV [MARINE]

EVALUATION SYSTEM

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

SYLLABUS

1. Deflection of Beams

Deflection of cantilevers, simply supported and overhanging beams using double integration and Macaulay's method for different types of loading, moment area methods of deflection coefficients, deflection by graphical method. Castigliano's theorem and its application for computing deflections in beams.

2. Fixed and continuous beams

Moment area method, built-in beam with central concentrated load, built-in beam with uniformly distributed load, with load not at center, Macaulay's method continuous beam, Claperyron's three moment theorem. Applied problems.

3. Bending of Curved bars

Flexural stresses in beams with initial curvature. Application to crane hooks, chain links and rings, Castigliano's theorem and its application to curved bars. Applied Problems.

4. Thick Cylinders

Thick Cylinders, Lamé's theory, compound cylinders, solid shaft subjected to radial pressure, shrinkage allowance. Applied Problems.

5. Struts

Euler's theory and Euler's bucking load, struts with both ends pin joined, both ends fixed, one end fixed and one end free, one end hinged, Pin joined strut with eccentric load, Rankine-Gorden Formulae. Applied problems.

6. Strain energy

Strain energy due to axial force and bending moment stresses in axial members and simple beam due to impact loading, strain rosette and its use on ship's hull, Strain energy due to twisting, strain energy due to impact loads, Resilience Applied Problems.

Springs

Open Coiled helical spring, spiral and leaf spring with Applied Problems.

Reference :

1. Strength of Materials (*S. Ramamrutham*) – Dhanpat Rai Publication
2. Strength of Materials (*R.K. Rajput*) – S. Chand Publication
3. Strength of Materials (*R.S. Khurmi*) – S. Chand Publication
4. Engineering Mechanics (*Timoshenko & Young*) – Tata McGraw Hill
5. Strength of Materials (*Arthur Morely*)
6. Mechanics of Materials (*E.P. Popov Prentice Hall*)
7. Mechanics of Materials (*Ferdinand P. Beer, E. Russell Johnston, Jr. John T. Dewolf*) – McGraw Hill International



Applied Thermodynamics – II

S.E. Sem. IV [MARINE]

EVALUATION SYSTEM

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

SYLLABUS

1. Ideal Gas Cycles

Otto Diesel, Dual Cycles, Brayton Ericsson, Stirling cycle. Air standard efficiency and mean effective pressure. Representation on P-V and T-S diagrams. Comparison of various cycles. 4 stroke and 2 stroke Cycle; Compression Ratio and thermal Efficiency, Indicator Diagrams, Indicated Power; Brake Power; friction power, Mechanical Efficiency, Specific Fuel consumption. Energy Balance, Applied Problems.

2. Steam Power Cycles

Carnot cycle for steam and ideal Efficiency, Ranking cycle with dry saturated steam and superheated steam. Feed Pump work. Role of Boiler, Condenser and ejector in steam cycle; Rankine Efficiency, cycle Efficiency, Isentropic Efficiency, work Ratio, Reheating and Regenerative Feed Heating and their effect on Thermal Efficiency. Applied Problems.

3. Gas Turbines

Constant Pressure Combustion Turbines. Constant Volume Combustion Turbines, Applied Problems.

4. Reciprocating Compressors

Ideal cycle for compressors, work Transfer in single stage compressor. Mass and volume flow, free Air Delivery. Effect of clearance and volumetric Efficiency in single stage compressors, Multi-stage compression neglecting clearance and with clearance. Condition for Minimum work Input and Perfect Intercooling Tandem and In-line arrangement in compressors. Applied Problems. Air motors, Introduction to rotary compressors.

5. Properties of Mixtures of gases and Gas and Vapours

Dalton's Law of partial pressure, Amagat's Law of partial volume. Volumetric and Gravimetric Analysis of Gas Mixtures, Gibb's-Dalton Law, Mean value of a Gas constant. Equivalent Molecular weight, Density, Specific volume, Specific Heat and Molar Heat capacity of gas mixture. Advanced problems on Adiabatic Mixing.

6. Psychrometry

Air and Water vapour mixture, Specific Humidity, Relative Humidity, dew point, unsaturated and saturated air. Psychrometry Processors.

Reference:

1. Thermal Engineering (*R.Yadav*)
2. Thermal Engineering (*Kothandraman, Domkundwar, Khajuria*) – Arora – Dhanpatrai & Sons.
3. Steam and Gas Turbine (*R.Yadav*)
4. Thermodynamics and Heat Engines Vol II (*R. Yadav*) – Central Publishing House, 1994.
5. Thermal Engineering (*Ballancy*) – Khanna Publishers
6. Thermodynamics an Engineering Approach (*Yonus Cengel*) – Tata McGraw Hill



Material Science

S.E. Sem. IV [MARINE]

EVALUATION SYSTEM

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

SYLLABUS

1. Solid Crystalline Structure

Crystallization of liquid into solid state, Nucleation and growth in metals and alloys Formation of polycrystalline and single crystals.

Classification of crystal structure FCC, BCC and HCP lattice. Lattice structure, unit cell, crystallographic notation-Methods for planes and directions.

2. Strain Hardening

Definition and importance of strain hardening. Dislocation theory of strain hardening, Effects of strain hardening on engineering behaviour of materials. Recrystallization, Annealing, Theory and stages of recovery. Recrystallization and grain growth. Factors affecting recrystallization temperature. Hot and cold working theory. Their advantages, limitations and applications.

Strengthening Mechanisms

Theory and applications of Strain hardening. Age hardening, Precipitation hardening and Dispersion hardening.

3. Fracture

Definition and types of fracture

Brittle fracture. Griffith's theory of fracture. Gowan's modification. Dislocation theory of fracture. Critical stress and crack propagation velocity for brittle fracture, Ductile fracture. Notch effect on fracture. Fracture toughness. Ductility transition. Definition and significance. Conditions of ductility transition and factors affecting it.

4. Fatigue Failure

Definition of fatigue and significance of cyclic stress. Mechanism of fatigue and theories of fatigue failure. Fatigue testing. Test data presentation and statistical evaluation, S. N. Curve and its interpretation. Influence of important factors on fatigue. Notch effect, surface effect. Effect of prestressing, corrosion fatigue. Thermal fatigue.

Creep

Effect of temperature on mechanical behaviour of materials. Definition and signification of creep. Creep testing and data presentation. Mechanism and types of creep. Analysis of classical creep curve. Creep Resistant materials.

5. Theory of Alloys and Alloy Diagrams

Significance of alloying, definition, classification and properties of different types of alloys. Different types of alloy diagrams and their analysis.

Solid solutions : Conditions of their formation and significance, solid solution strengthening.

Importance of Iron as engineering material, Allotropic forms of Iron. Influence of carbon in Iron-Carbon alloying. Iron carbide diagram and its analysis. Classification of steels and Cast Irons.

Graphitisation of Iron

Grey iron, White iron, Mechnite iron, Alloy cast irons, Nodular and Malleable irons, Their microstructures and applications.

Effect Alloying Elements in Steels

Limitation of plain carbon steels. Significance of alloying elements. Effects of major and minor constituents. Effect of alloying elements on ferrite, carbide, austenite. Effect of alloying elements on phase transformation, decomposition, hardening and tempering. Classification of tool steels and metallurgy of tool steels and special steels.

Alloy Steels : Effects of alloying elements on the structures, properties and applications of steels. Such as Manganese, Nickel, Chromium, Tungsten, Molybdenum and Silicon Steels.

6. Theory of Heat Treatment

Definition and Significances of heat treatment. Equilibrium and nonequilibrium transformation of Austenite.

Time Temperature Transformation (TTT) diagram, Isothermal Austenite decomposition, Mechanisms of Pearlite Bainite and Martensite transformations.

Heat Treatment Process

Technology of heat treatment, Classification of heat treatment process, Annealing – Principle process, properties and applications of Full annealing, Diffusion annealing, process annealing and Cyclic annealing, Annealing defects and their remedies. Normalizing, hardening, heat treatment, hardening baths, hardening media, Salt baths, Hardenability. Tempering, subzero treatment, Austempering Martempering. Maraging and Ausforming processes.

Surface Hardening

Hardening and surface hardening methods. Their significance and applications. Carbursing, Nitriding, Cyaniding, Carbonitriding, induction hardening and Flame hardening processes.

Reference:

1. Material Science (*Dr. Kodgire*)
2. Physical Metallurgy (*Avner*)
3. Engineering Metallurgy Part I & II (*R.A. Higgins*) – ELBS & Hodder Stoughton, London.
4. Engineering Physical Metallurgy (*Y. Lakhtin*) – Mir Publishers, Moscow.
5. Introduction to Engineering Materials (*B.K. Agrawal*) – Tata McGraw Hill Publishing Co. Ltd.
6. Mechanical Metallurgy (*G.E. Dieter*) – McGraw Hill International, New Delhi.
7. The Structure and properties of Materials Vol.1 : Structure (*M.G. Moffet, GT. W. Pearsall & J. Wuff*)



Marine Equipment Drawing - II

S.E. Sem. IV [MARINE]

EVALUATION SYSTEM

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

SYLLABUS

1. Auxiliary Machine

- Flow regulator
- Hydraulic steering gear
- Quick closing valve

2. Marine Boiler

- Full bore safety valve
- High lift safety valve.

3. Marine Boiler Mounting

Plate type gauge glass

4. Marine Diesel Engine

- Four Stroke piston and rod
- Air inlet valve
- Fuel valve

5. Marine Steam Engine

Turbine flexible coupling.

6. Propulsion Drive :

Stern tube and tail shaft

Reference :

1. Engineering Drawing for Marine Engineers Reeds Vol 11
2. Engineering Drawing (*N.D. Bhatt*)
3. Engineering Drawing (*Kamath & Rao*)
4. Engineering Drawing (*Kannaih & Narayana*)
5. Engineering Drawing (*Dr. M.B. Shah & B.C. Rana*)
6. Machine Drawing (*N.D. Bhatt*)
7. Drawing for Marine Engineers (*Mc Gibbons*)



Marine Auxiliary Machinery I
S.E. Sem. IV [MARINE]

EVALUATION SYSTEM

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

SYLLABUS

1. Engine Room Layout, pipe line systems with filers and associated fittings

Layout of main and auxiliary machinery in engine rooms of different ships. Layout of pipe with fittings, pipe material. Piping arrangement for steam, bilge, ballast, fire, HFO, DFO, LO, seawater, fresh water, compressed air and hydophore systems. Bunkering procedures including safety fittings. Construction, operation, and maintenance of various filters, stainers, auto cleaners. Arrangement of different types of tanks of E R.

Pumps, pumping and control arrangements

Types of pumps for various requirements, their characteristics and applications in ships. Construction and operation of centrifugal pumps, gear pumps, screw pumps and reciprocating pumps and control arrangements for each type, care and maintenance of pumps.

2. Blowers and compressors

Constructional details and operational procedures of blowers and compressors. Engine room force draft and exhaust system. Air bottles, constructions, mountings and associated systems.

Deck Machinery

Various types of deck machinery used in ships, eg. winches and windlass and their construction requirements, operation and maintenance. Deck cranes, hydraulic deck machinery, hydraulic motors, line filers and systems.

3. Evaporators

Construction and operation of different types of vacuum evaporators. Fresh water generators and distillers. Conditioning arrangements of distilled water fro drinking purpose, membrane system.

Heat Exchangers

Construction, operation and maintenance of all types of tubular and plate type heaters and coolers for FO and LO and water Corrosion combat arrangements. Tube removal, plugging and materials used.

4. FO and LO treatment (Purification) arrangements

Theory of oil purification, separation and clarification. Various methods of oil treatment, i.e., purification, filtration, separation by gravity, homosiniser. Construction, operation and maintenance of centrifuges for heavy fuel and lubricating oil, automatic desludgers. Treatment of HO of very high density.

Fuels

Sources of supply, study of primary fuels, coal, petroleum, natural gases. Classification of fuels. Treatment of fuels for combustion in marine ICE and steam plants, residual fuels, emulsified fuels, merits and demerits of such fuel in marine engines. Heating process of residual fuel to get correct viscosity at IC engine and boiler.

Lubrication

Theories of lubrication, types of lubricants and their properties. Suitability of lubricants for various uses, solid and fluid lubricants. Additive oils and their specific use. Terminology used in lubrication system. Loading pattern of various bearings in marine use and lubrication system adopted. Different types of bearing used for marine machineries. LO analysis and monitoring of engine through report.

5. Pollution prevention and control arrangements, equipments

Construction, operation and maintenance of conlescercs, baffles, grids. Strokes law. Static and Turbulo separators,15 ppm oily bilge separators and its measuring instruments. Control of leakage of oil in engine room and its disposing through shore connection. MARPOL Convection discharge criteria of quantity of oil from engine room. Cargo pumping arrangement of oil and chemical tankers, garbage treatment.

6. Communication system

Sound power internal telephone, telegraph, voice pipe, ER emergency alarm and other alarm systems.

Reference :

1. Marine Aux Machinery (*D.W. Smith*) – Newnes - Butterworth
2. General Engineering Knowledge (*H.D. McGeorge*) – Butterworth Heinman
3. General Engineering Knowledge for Marine Engineers, reeds Practical Mathematics Series Vol 8
4. Marine Engg. Practice Booklets, Volume 1 to 19 – Inst. Of Marine Engineers Publications .
5. Introduction to Marine Engg. (*D.A. Taylor*) – Butterworth– Heineman
6. Notes on Instrumentation and Control (*G. J. Roy*) – Stanford Maritime, London.
7. Ship Design & Construction , Society of Naval Architects & Marine Engrs (SNAME) , N.Y.N.Y. 10048.



Marine Boilers
S.E. Sem. IV [MARINE]

EVALUATION SYSTEM

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

SYLLABUS

1. General Considerations governing the design of boilers

Types of Marine boilers, comparison of smoke tube and water tube boilers. Destructive and non-destructive tests on plates, rivets, welded seams. Classification societies requirements for boilers construction.

2. Smoke Tube Boilers

Various types on marine use. Principal dimensions and staying of flat surface of multitubular cylindrical Boilers. Fired vertical Auxiliary Boilers, Cochran vertical boiler.

3. Water Tube Boilers

General description with sketches of principal types of boilers in marine use. Double Evaporation Boiler, Superheater, Economiser, Air pre-heater, circulation and use of unheated Down corners in highly rated boilers, superheat temperature control, Attemperators and De-superheaters.

4. Waste heat smoke / water tube boilers and economizers

Waste heat recovery calculation. Lamont Exhaust gas boiler, forced water circulation boiler. Composite boiler of various make including W.T. boiler driving turbo-generator in motor ships.

5. Boiler mountings

Safety valves – Improved High Lift, Full lift and Full Bore type. Gauge Glass - plate type and remote indicator. Automatic feed regulator, three-element control, high and low water level alarms, Main stop valves, Blow down and scum blow down arrangements. Manhole and hand-hole covers. Soot blowers for Air heaters and superheaters including retractable type.

6. Operation, care and maintenance

Precommissioning procedures, Hydraulic tests, steam raising and operating procedures. Action in the event of shortage of water. Blowing down of boiler, laying up a boiler, general maintenance. External and internal tube cleaning. Tube plugging and subsequent renewal Inspection and survey of boilers. Boiler water treatment for feed water, condensate and Boiler, tests, doses, blow down, de-airation, by mechanical and chemical means. PH and Phosphate contents for modern high pressure boiler.

Refractory

Purposes of refractory, types of refractory, reasons for failure, and maintenance, Use of Membrane Water-wall Tubes.

Oil Burning

Procedure of liquid fuel burning in open furnace, Various types of atomizer. Air Register, Furnace arrangement for oil burning, Boiler control system, i.e., master control, fuel control, air control and viscosity control.

Reference:

1. Marine Steam Boilers (*S. H. Milton*) – Newnes– Butterworths.
2. Marine Boilers (*G.T.H.Flanagon*) – Butterworth Heinemann.
3. Steam Engineering Knowledge, Vol. 9 (*Reed's*)
4. The Running and Maintenance of Marine Machinery (*J. Cowley*) IMarEST, London.
5. Rules and Regulations of any classification Society.

