

MODULE I

Introduction: Mechanism and machines; plane mechanisms; kinematic chains and their classification, kinematic inversion; equivalent linkages. -4 hrs

Kinematic analysis of plane mechanisms: introduction; general case of plane motion; velocity acceleration; Coriolis's component; velocity and acceleration images; Arnold Kennedy's theorem of three centers; velocity analysis using instantaneous centers (graphical method only). Analytical treatment of four bar mechanism and slider-crank mechanism. -11 hrs

MODULE II

Path generator: Pantograph, exact straight line mechanism- Paucellier mechanism & Thompson indicator mechanism -3 hrs

Cams: Classification of cams and followers; geometry of radial cam; displacement diagram; uniform, simple harmonic, parabolic and cycloidal motions; graphical layout of cam profiles; basic follower motions; displacement, velocity, acceleration and jerk relations; comparison of follower motions; pressure angle, comparison of follower curvature; analysis of tangent cam, convex and concave sided cams with roller follower and with flat footed follower, polynomial cam design. -12 hrs

MODULE III

Governors: Function of a Governor, comparison between a Governor and a fly wheel, Various types of Governors centrifugal and inertia types of Governors, Sensitiveness, Stability, Hunting of Governors, Governor effort and power, consideration of friction in Governors. -25 hrs

MODULE IV

Spur gears: Gear terminology; conjugate motion; involute arc of action; contact ratio; generation of gear tooth profiles; interference; cycloidal properties; comparison of characteristics of involute and cycloidal profiles; interchangeable gears; standard and non-standard gear tooth properties; description of different types of gears such as helical, bevel, and worm gears. -10 hrs

Gear trains: Introduction; example of gear trains; simple and compound gear trains calculation of gear ratios, epicyclic gear train, solution of epicyclic gear train problems. -5 hrs

MODULE V

Belt and Rope Drives: Ratio of belt tensions, power transmitted, centrifugal tension, and initial tension, flat belts, v-belts and ropes. -8 hrs

Clutches: Analysis of single plate, multi-plate and cone clutches. -4 hrs

Brakes: Analysis of different types of brakes-block brake, band brake, internal expanding shoe brake, condition for self locking, power transmitted and heat generated. -6 hrs

Dynamometers: rope brake dynamometer, belt transmission dynamometer. -2 hrs

Reference:

1. J.E.Shigley & J.J.Uicker : Theory of machines and mechanisms, McGraw Hill
2. J.E.Shigley : Kinematic analysis of mechanisms.
3. Thomas Beven : Theory of machines
4. Zimmerman : Elementary kinematics of mechanism, John Wiley Pub
5. Rattan : Theory of machines, Tata McGraw Hill

MODULE I

Common workshop tools: description and uses of different types of calipers. Straight edges, try squared, vices, hammers, chisels, scrapers, files, drills, reamers, tapes, v-blocks, face plates, marking blocks, carpentry tools, pattern markers tools, Smithy tools and Moulding tools.

-6 hrs

Machine process: The geometry of cutting process, mechanics of cutting, chip formation, cutting forces, stresses and power friction of chip on tool. Generation and dissipation of heat in cutting. Standard nomenclature for cutting tools. Cutting speeds and feeds, estimation of machining time. The fundamental of cutting process, application in hand tools as chisel, file and saw geometrical control of cutting edge.

-9 hrs

MODULE II

Machine tools: Kinematic analysis, specification, operation and inspection of important types of metal cutting machine tool including center lathes, capstan and turret lathes, automatic lathes, drilling and boring machines. Shaping slotting and planning machines, milling and broaching machines. Turning, screw cutting and taper turning process on center lathe, Abrasive process, Grinding, honing and lapping by and machines. Shears and punches, wood working machines, Principles of jigs and fixtures standardization.

-15 hrs

MODULE III

Measuring instruments and inspection. Description and use of steel rule venires scale, micrometer, dial guage, depth gauge, feeler gauge, wire guage, pattern markers scale, taper guage, snap guage, optical methods of measurement, principles of interchangeability, limit system, use of limit gauss.

-8 hrs

MODULE IV

Fitting and overhauling: Types of packing and jointing materials and their uses, design considerations and construction of various types of valves and cocks, reducing valves for steam and air. Bedding of bearings, marking of engine parts for fitting, machining operations fittings of keys, cotters, etc.

-8 hrs

Safety measures: sources of danger and methods of protection. Types of guards and safety devices, factory act regulations.

-4 hrs

MODULE V

Welding: Welding equipment and applications, electric welding A.C. and D.C. spot welding, gas welding. Soldering and brazing, Different welding electrodes, solders and brazing fluxes.

-10 hrs

References:

1. Boothroyd –Fundamentals of Metal Matching and Machine Tools –McGraw Hill.
2. Sen and Bhattacharya -Metal Cutting Theory and Practice-New Central Book Agency Calcutta
3. H.M.T production Technology
4. Black -Theory of Metal Cutting [McGraw Hill]
5. M.C.Shaw -Metal cutting
6. Yankee -Manufacturing Process[Prentice Hall]
7. Sharma -Text book of Production Engineering[S.Chand and Co.]
8. Delela Publication –Manufacturing Science and Technology Vol. II [Ummesh Publication]
9. Pandy and Shah-Modern Machining Processes[Tata McGraw Hill]
10. Koeingberg -Matching science and their application[Pergamon Press]

Module I

Crystallography : crystal structure, space lattice, crystal systems, miller indices of crystal planes and directions, atomic density of crystallographic planes and lines, atomic packing factor, co-ordination number, inter planar spacing. -8 hrs

Crystal imperfections : point defect, line defect, edge dislocation, screw dislocation, interaction between dislocation, planar defects, stacking faults, grain boundary, twist and twin boundaries, volume defects. -8 hrs

Solidification of metals : homogenous and heterogeneous nucleation, crystal growth, grains and grain boundaries, equi-axed and columnar grains, dendritic pattern, polymorphism. -4 hrs

Module II

Solid Solutions: Equilibrium between phases, Gibb's phase rule, solid solution, interstitial, substitutional, ordered and disordered types, Hume – Rothery rules, equilibrium phase diagrams of binary alloys-complete solid solubility, partial solid solubility, no solid solubility,: eutectic, peritectic and eutectoid reactions, intermetallic compound. -12 hrs

Allotropy of iron: Iron-carbon Equilibrium diagrams. Equilibrium diagrams of Cu- Ni, Cd-Bi, Pb-Sn, and Ag-Pt systems as examples. -6 hrs

Module III

Heat treatment of steel: Definition and aims of heat treatment, T T T diagram, isothermal and continuous cooling, annealing, normalizing, hardening, tempering, austempering, martempering, hardenability of steels, jomini test, surface treatments –case hardening, carburising, cyaniding, nitriding, flame hardening, induction hardening, metal coating- hot dipping, electro plating, metal cladding, impregnation, metal spraying. -12 hrs

Metals and Alloys: Cast Irons : classification- gray, white, malleable, and spheroidal graphite cast irons, composition, properties and uses. Steels : Classification of steels, function of alloying elements of steels, composition and properties of common commercially important alloy steels. Non-ferrous alloys : composition, properties and use of common commercial alloys of Cu, Al, Mg, bearing metals. -8 hrs

Module IV

Deformation of metals : Elastic, anelastic and visco elastic behaviour, plastic deformation, mechanism of slip, slip planes and slip directions, mechanism of twinning, strengthening mechanisms, work hardening, grain boundary hardening, precipitation hardening, cold working, hot working, recovery, recrystallisation and grain growth. -8 hrs

Failure of metals : creep, mechanism of creep, creep curves, creep resistant materials, fracture, brittle fracture, Griffith's theory, ductile fracture, ductile-brittle transition, protection against fracture, fatigue, mechanism of fatigue, S-N Curve. -8 hrs

Module V

Testing of Materials: Destructive tests – Tensile test, compression test, hardness test, bend test, torsion test, and impact test. Non-destructive tests – Magnetic dust test, Fluorescent test, Ultrasonic test Radiographic test. -6 hrs

Uses of Materials in Shipboard Application: Chromium, Ceramic, Titanium, PTFE in shipboard systems. Characteristics of the above materials. -2 hrs

Selection of materials in shipbuilding & Marine Engineering : Boilers, Steam and Gas turbines, Purifiers and Diesel engine components, Pumping Machinery, Components and piping system, Engine seating, Propellers and Rudders. Composition, strength value and other requirements for materials used. -8 hrs

REFERENCES

1. L.W. Van Vlack : Elements of material science – Addison – Wesley.
2. Reed Hill : Physical metallurgy principles – Affiliated east-west press N.Delhi.
3. Clark & Varney : Physical metallurgy for engineers – Van Nostrand
4. V.Raghavan : Material science and engineering, Prentice Hall of India
5. Dieter : Mechanical metallurgy, McGraw Hill
6. Avner : Mechanical metallurgy, McGraw Hill
7. Narula : Material Science, Tata McGraw Hill
8. B.K.Agarwal : Introduction to engineering materials, Tata McGraw Hill
9. Manas Chanda : Science to Engg. Materials Vol I, II and III, Macmillan Co. of India.

MODULE I

Transistor Power Amplifiers : Class A, B & C amplifiers, efficiency, distribution, Design theory, Symmetry, practical complimentary, Push –Pull amplifier, Phase inverter, maximum output power & load resistance and transistor dissipation, Heat sink design.

-9 hrs

Operational Amplifier Theory: Concept of differential Amplifiers, Linear OP-amp circuits.

-8 hrs

MODULE II

Digital Circuits: Logic systems and Gates, Binary and BCD codes, Boolean Algebra, Simplifications, Flip-flops, Counters, Registers and Multiplexers.

-10 hrs

Converters (A-D and D-A) : Analog to Digital and Digital to Analog converters and their uses in Data Loggers.

-10 hrs

MODULE III

TTL & CMOS GATES : Digital Integrated circuits, Semi conductor Memories- ROM, RAM, and PROM.

-8 hrs

Industrial Electronics: Power Rectification, Silicon Controlled Rectifiers power control, Photo-electric devices, Inverters.

-6 hrs

MODULE IV

Communication: Modulation, Demodulation, AM/FM/PM Wireless, Radio Transmitters and Receivers, T-V Radar, Pulse communication.

-8 hrs

MODULE V

Electronic Instruments: cathode Ray Oscilloscope, digital Voltmeters and frequency-meters, Multi-meter, Voltmeter and signal Generators, Q-meters.

-6 hrs

References:

1. Electronic Devices and Circuits : Milman & Halkias (McGraw Hill)
2. Integrated Electronics : Millman & Halkias (McGraw Hill)
3. Basic Electronics : Bhargava
4. Power Electronics : NED Mohan

MRE 405 MARINE AUXILIARY MACHINERY-1 (60 hrs)

MODULE I

Engine Room Layout: Lay out of main and auxiliary machinery in engine rooms in different ships. -4 hrs

Layout of Pipe lines: Pipe material, Piping arrangement for steam, bilge, ballast and oil fuel systems, Lub oil and Cooling system lines with various fittings. Domestic fresh water and sea water and sea water hydrophore system. Colour code and safety fittings of bunkering procedure and in the pipelines etc. -8 hrs

Bunkering procedure, precautions taken, Line diagram for H.F.O & D.O -4 hrs

MODULE II

Blowers and Compressors: Operational and constructional details of blowers and compressors used on board ships, Uses of compressed air. -4 hrs

Evaporators: Construction and Operation of different types of evaporators, Fresh Water generators and distillers. Conditioning arrangement of distilled water for drinking purpose. Use & Care Maintenance of pumps of various types. -5 hrs

MODULE III

Filters: strainers and filters, types of marine filters, auto cleaner and Duplex filters, Static filters, Priming and core maintenance of filters. -5 hrs

Pollution Prevention: Use of coalescers, baffles, girds. STOKES Law; Static and turbo separators, Oily bilge separators their construction and operation, prevention of oil pollution and various International requirements. MARPOL Convention, OLM & OCM, Introduction of IMO Conventions, regulation, rules & arrangements. -8 hrs

MODULE IV

Deck Machinery: Various types of deck machinery used in ships e.g. Winches and Wind lass and their requirements. Operation and maintenance Deck Cranes, Hydraulic deck machinery; hydraulic motors, line filters and systems. -8 hrs

Heat Exchangers: tubular and plate type, reasons of corrosion, tube removal, plugging, and materials used. -3 hrs

Job requirement for a watch-keeping Engineer. -3 hrs

MODULE V

Oil Purification: Theory of oil purifications, various methods of oil purifications, Principles of operation and construction of different Centrifuges for heavy fuel and lubricating oil like FOPX system, Self desludging etc. Uses of Homogenizers, Use of setting / service tanks & precautions taken before entering / cleaning tanks. -3 hrs

Pumps: Types of pumps for various requirements, their characteristics and application in ships. Centrifugal Pumps, Gear Pumps, Screw Pumps and Reciprocating Pumps, Care and Maintenance of pumps. -5 hrs

Reference:

1. Smith D.W. - Marine Auxiliary Machinery, Butterworth Publication London.
2. Khetagurov.M. - Marine Auxiliary Machinery and Systems MIR Publishing House, Moscow.
3. I. M. E. - The Running and Maintenance of Marine Machinery

MODULE I

Seamen and their duties: Ship's Department, general ship knowledge and nautical terms like poop-deck, fore-castle, bridge etc. -2 hrs

Deck equipment: winches, derricks, cranes, gypsy, capstan, hatches, and their function. -2 hrs

Navigational lights and signals: Port and Star board, forward and aft mast lights, colors and location. Look out, precautions and bad weather, flags used on ships, flag etiquette, morse and Semaphore signaling, sound signals. -6 hrs

MODULE II

Rope knots and moorings: Types of knots, Practice of knot formation, materials of ropes, strength, care, and maintenance, use of mooring line, heaving line, rat guards, canvas and its use. -2 hrs

Anchors: their use, drooping and weighing anchor, cable stopper. -6 hrs

MODULE III

Navigation: General knowledge of principle stars. Sextant, navigation compasses, echo sounder, log and uses, barometer and weather classification, G.M.T. and zonal time, wireless navigational instruments, radar satellite navigation etc. -6 hrs

MODULE IV

Life boats and life rafts: Construction, equipment carried, carrying capacity. Davits and their operation. Launching of life rafts, inflatable type. Embarkation into life boat and life raft. Survival pack, Stowage and securing arrangement. -6 hrs

Abandon ship: Manning of life boats and life raft. Muster list. Radio and alarm signals, distress signal S.O.S. Distress Calls time and radio frequency. Pyro-techniques. -8 hrs

MODULE V

Survival at sea: survival difficulties and factors, equipment available, duties of crew members, initial action on boarding, maintaining the craft. -4 hrs

Practical: Knots, bends and hitches, Ropes splice, donning of life jackets, Life boat drills, Lowering and hoisting of life boats (model). -8 hrs

MARPOL Convention and its annexes, Regulatory control towards environmental pollution at sea. -4 hrs

Reference:

John R. Annapolis Book of Seamanship Symon and Schirk Publication.

MODULE I

Ships Terms : Various terms used in Ship Construction with reference to Ship's parameter e.g. L.B.P., Moulded Depth, Moulded Draught etc., General Classification of Ships. -5 hrs

Stresses in Ship's Structure : Bending, Shear, Hogging, Sagging, Racking, Pounding, Painting, etc., and Strength members to counteract the same. -6 hrs

Sections and materials use : Type of section like Angles, Bulb Plates, Flanged beams used in ship construction. Rivetting & Welding. Testing of Welds. Fabricated components. -6 hrs

MODULE II

Bottom & Side Framing : Double bottoms, Water tight floors, Solid and bracket floors, Longitudinal framing keels, side framing like Tank side brackets, Beam Knee, Web Frame, etc. -7 hrs

Shell & Decks : Plating systems for shells, Deck plating & Deck girders, discontinuities like hatches and other openings. supporting & closing arrangements, mid-ship Section of ships. -7 hrs

Bulk Heads & Deep Tanks : Water tight bulk heads, Arrangements of plating and stiffeners. Water tight sliding doors, Water tight openings through bulk heads for electric cables pipes and shafting. Deep tank for oil fuel or oil cargo corrugated bulk heads. -7 hrs

MODULE III

Fore-End Arrangements : Stem construction, arrangements to resist panting, panting stringers, Forepeak-Collision bulk heads, Bulbous bows. Anchor and Cable arrangements. -6 hrs

After-End Arrangements : Types of Stems, Stem frame and rudder. Types of rudder. Supporting of rudder, Locking pintle, Bearing pintle, Pallister bearing, Shaft tunnel, Tunnel bearings. -8 hrs

MODULE IV

Loadline and Tonnage: Definition of freeboard and various assigning conditions, List of closing appliances, Loadline Surveys, Tonnage regulations. calculation as per 1969 convention, details of markings permanently carved. -4 hrs

Shipyard Practice : Layout of a Shipyard, Mould loft, Fabrication of assembly, Subassembly, units in construction, role of Surveyors in construction of Ship; Keel laying, Launching, Seatrial. Use of computers in ship design with cost implication. -4 hrs

Reference:

1. Muckle - Naval Architecture for Marine engineers.
2. Tupper E. - Introduction to Naval Architecture
3. Comstock - Principles of Naval Architecture.

MRE 408 ELECTRICAL MACHINES LABORATORY (42 hrs)

1. Calibration of the single phase energy meter by direct loading at various power factors.
2. Measurement of power in the three phase circuit using single, two and three watt meters for balanced/unbalanced load and three and four wire systems.
3. To study an auto- transformer and load it at about 10% (a) higher and (b) lower input voltage.
4. Determination of the efficiency and regulation of the single phase transformer by direct loading.
5. Determination of Equivalent circuit of a transformer by open and short circuit test calculation of efficiency and regulation at various loads and power factors.
6. Parallel operation of two single phase transformer.
7. To study dismantled parts of a d.c. machine.
8. To study dismantled parts of a a.c. machine.
9. Emf induced in a d.c. machine.
10. Parallel operation of two identical dc shunt generators.
11. To study and run a rotary convertor under different conditions to record the generated voltage on d.c. side against variation of load.
12. To perform a load test on a 6-pulse, 2-way bridge rectifier and to obtain the characteristic curves.
13. To study different types of motors, connect A.C. supply, run the motor and obtain its speed load characteristics(The experimental multi motor set).
14. To study the slip-torque characteristics of an induction motor and to find the full load slip.
15. To compute full load input, torque, slip, power factor, efficiency of 3-phase induction motor from circle diagram. Also to compare the results from the circle diagram with actual full load test on the motor.
16. Determination of the regulation of a 3-phase alternator by synchronous impedance method.
17. Synchro transmitter and Repeater.

18. Determination of phase sequence in a 3-phase supply.
19. Study of a single phase controller.
20. Observation of wave form of magnetizing current and hysteresis loop.
21. Study of transformer differential delay.
22. Determination of the regulation of the alternator by emf and mmf methods.
23. Synchronisation of alternator to the A.C. mains and studying the effect of changes in excitation of alternator and power input to their alternator by plotting the V-curve.
24. Starting the cage induction motor using star-delta switch and plotting the performance characteristics.
25. Conducting the no load and blocked rotor tests on slip ring induction motor – determining equivalent circuit and calculating torque-slip characteristics.
26. a) Plotting OCC of a D.C. shunt generator at rated speed – determining the critical resistance.
b) Conducting load test on D.C. shunt generator and plotting external characteristics – deducting internal characteristics.
27. Conducting load test on D.C.L Series motor and plotting the performance characteristics.
28. Study of single phase capacitor start and capacitor run induction motors – plotting speed – voltage relation of single phase fan motor.

Note: Students must present the laboratory records duly certified by the teacher to the Head of the Department before commencement of the semester examinations.

MRE 409 WORKSHOP PRACTICES - III (60 hrs)

Boiler Familiarization

Globe Valve and Sluice Valve Overhauling

Return and Non-Return Valve Overhauling

Cock Overhauling

Shaft Overhauling

Reciprocating Pump Overhauling

Centrifugal Pump Overhauling

Air Compressor Overhauling

Boiler Familiarisation

Double-V Weld

T-Weld [Inner and outer]

Pipe repair and Fabrication.

Diesel Engine familiarisation and Overhauling