MRE 501 DYNAMICS OF MACHINERY (70 hrs)

MODULE I


Dynamics of reciprocating engines: Gear force, equivalent masses, inertia force in the single engine, bearing loads in the single cylinder engine, -4 hrs

MODULE II

Flywheels: Inertia torque-turning moment diagrams for multi cylinder engines, coefficient of fluctuation of speed and energy, fly wheel mass calculation, effect of centrifugal tension on fly wheel. -8 hrs

Gyroscopes: Motion of rigid body in 3 Dimension, Euler’s equation of motion, gyrodynamics, gyroscope and gyroscopic couples, gyroscopic stabilization of ships and aeroplanes, gyroscopic effects on automobiles. -8 hrs

MODULE III

Balancing: Static and dynamic balancing, balancing of several masses in a plane, balancing of masses rotating in several planes, conditions for complete balancing of an engine, reciprocating and rotating parts. Locomotive balancing- hammer blow, variation of tractive effort, swaying couple, locomotive balancing of opposed piston engines. Multicylinder in-line engines – radial engines and V engines. Balancing machines and their principles of working. -12 hrs

MODULE IV


Vibrations of single degree of freedom systems: Natural vibration, equation of motion, natural frequency, equilibrium method, energy method, viscous damping, logarithmic decrement, coulomb damping, forced vibration, harmonic excitation with and without damping, non dimensional expression for amplitude and phase, rotating unbalance, critical speed for shafts, support excited motion, vibration isolation.

Vibration measuring instruments: Seismometer, accelerometer, vibration exciters. -15 hrs

MODULE V

Free vibration of two degree and multi degree freedom systems: Solution for free vibration, normal modes, vibration absorber, coupled vibration, general solution, matrix method of formulation, numerical evaluation of natural frequencies and natural mode.

Approximate numerical methods: Rayleigh’s method – Dunkerly method.

Torsional vibration in multi – rocker systems, geared system. -15 hrs

Reference:
3. Singeresu S.Rao : Mechanical Vibrations, Addison wesely

CUSAT B.Tech Degree Syllabus for Marine Engineering- Sem V
MRE 502 MARINE BOILER & STEAM ENGINEERING (85 hrs)

MODULE I
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. -5 hrs

Smoke Tube Boilers: Various types in marine use, Principal dimensions and staying of flat surface of multi tubular cylindrical Boilers. Vertical Auxiliary Boilers. -5 hrs

Water Tube Boilers: General description with sketches of principal types of boilers in marine use. -5 hrs

MODULE II

Boiler Mountings: Safety Valves – Improved High Lift, Full lift and Full Bore type : Gauge Glass – Ordinary plate type and remote Indicator; automatic feed regulator, three element High & Low water level alarms, Main Steam Stop Valves, Retractable type Soot Blower etc. -4 hrs

Accessories: Superheater, Economizer, Air pre-heater & Steam pre-heater; Circulation and use of Unheated Down comers in highly rated boilers; Superheat temperature control, Attemperators and De-superheaters. -4 hrs

MODULE III
Operation, Care & Maintenance: Pre-commissioning 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 renewals, etc. Maintenance, inspection and survey of boilers. -6 hrs

Refractory: Purposes of refractory, types of refractory and reasons for failure. -2 hrs

Oil burning: Procedure of Liquid fuel burning in open furnace, Various types of atomizer, Furnace arrangement for oil burning, Boiler Control System i.e. master control, fuel control, air control and viscosity control. -4 hrs

MODULE IV
Reciprocating/Steam Engines: History of multiple expansion marine reciprocating engines & steam turbines. -5 hrs

Layout of Plant: General layout of plant & description of a modern geared steam turbine installation including auxiliaries in modern use. -4 hrs

Selection of Materials: Materials used in various components like blades, rotors, castings, sealing glands, gears etc. & their justification. -2 hrs

Constructional Details: Types of blades, method of fixing, solid built-up & drum rotor for impulse and reaction turbines, castings for HP and LP impulse and reaction turbines, diaphragms, nozzles, glands, carbon glands, labyrinth packing glands, main bearings and thrust bearings. -12 hrs

MODULE V
Condensers: Shapes and types of condensers, constructional details, location & method of securing, working principles, contraction and expansion allowances, leak test. Effect – change of temperature, circulating water quantity, change of main engine power, condenser surface. -5 hrs
Operation and Maintenance: Turbine drain system, turbine gland steam, warming through a turbine plant, control of speed and power of propulsion, throttle valve control and nozzle control, emergency controls, emergency operation of turbines, vibration in marine steam turbine, steam turbine losses. Breakdown and fault finding.  
-13 hrs

Alignment Checking: By bridge gauge and poker gauge, allowances for expansion, sliding foot, thrust bearing static and dynamic balancing  
-3 hrs

References
1. J.H. Milton: Marine Steam Boilers
2. SC Mc Birnie and W J Fox: Marine Steam Engines & Turbines
3. Harrington: Marine Engineering
Kandy Series Vol. IV: Steam Engines
Kandy Series Vol. II: Marine Boilers

CUSAT B.Tech Degree Syllabus for Marine Engineering- Sem V
MRE 503 ECONOMICS & COMMERCIAL GEOGRAPHY (55 hrs)

MODULE I
Importance of economics in Marine Engineering study, Basic economic concepts and terms. Demand analysis, Supply analysis, Elasticity of demand, elasticity of supply. Demand analysis, Supply analysis, Elasticity of demand, elasticity of supply. -8 hrs.

Factors of production, Forms of business organization, Economic system with reference to India. -4 hrs.

MODULE II
Production function, Law of return, Economics of scale, Iso-product and Iso-cost, Cost concepts, Cost-output relationship and cost curves in short period, Long period, Revenue concept, Determination of price under free market and price control by Govt. Types of market, Factors governing extent of market, Pricing under perfect competition, Monopoly, Monopolistic competition and oligopoly. -11 hrs.

MODULE III


MODULE IV

MODULE V

Allocation of market resources in a wealth-maximising manner, Public policy issue in marine transportation, Chartering of ships, Flag of convenience, Policy of Protection and subsidy. -3 hrs.

Reference:
1. Industrial Economics: R. R. Barthwalk
2. Ship Board Operations: H. I. Larvey
3. Practical Ship Handling: Armstrong, Malcom
4. Ship Board Operation Problems: Cyll Hughes
5. Economics: Paul A. Samuelson

CUSAT B.Tech Degree Syllabus for Marine Engineering- Sem V

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MODULE I

General Description of I.C Engines: Marine Diesel Engine of M.A.N., Sulzer, B & W make etc.,


MODULE II
Scavenging: Scavenging arrangements in 2-stroke engine; Air charging and exhausting in 4-stroke engines; Various types of Scavenging, their merits and demerits, Scavenge pumps for normally aspirated engines; under piston scavenging, Scavenge manifolds.

Supercharging Arrangements: Pulse and constant pressure type; Their relative merits and demerits in highly rated marine propulsion engines. Air movements inside the cylinders. Turbocharger and its details. Two stage, un-cooled, radial turbochargers.

MODULE III

Compression pressure ratio and its effect on engines: Reasons for variation in compression pressure and peak pressure. Design aspects of combustion chamber. Control of NOX, SOX in Exhaust emission.

MODULE IV
Cooling of I.C Engines: Various Cooling media used; their merits and demerits, cooling of Pistons, Cylinder jackets & cylinder heads, Bore cooling, coolant conveying mechanism and systems. Maintenance of coolant and cooling system.

Safety and Prevention of Mishaps in I.C Engines: Causes and prevention of crank-case explosions and Scavenger fires. Detection of same and safety fittings provided to prevent damage. Uptake fire, Starting air line explosion. Thermal stresses.


MODULE V
Forces and Stresses: Balancing, Overloading, Different type of vibrations & its effects, A/F vibration.

CUSAT B.Tech Degree Syllabus for Marine Engineering- Sem V
Fuel pumps and metering devices: Jerk and Common Rail Systems; Fuel injection systems, helical groove and spill valve type Fuel Pumps. System for burning heavy oil in slow and medium speed marine engine, V.I.T & Electronics injection system. -6 hrs

Effects of viscosity on liquid fuel combustion, Measuring equipment and its working principle, Necessity of variable fuel injection system, Procedure of application on a modern slow speed long stroke engine, Necessity for adoption of fuel quality setting system, Incorporation of FQSL along with the V.I.T system on the engine. -6 hrs

References:
1. Harrington: -Marine Engineering
2. A.Kane: -Marine I.C.Engines
4. C.C.Pounder: -Marine Diesel Engines
MRE 505 MARINE AUXILIARY MACHINERY-II (75 hrs)

MODULE I

Steering gears: Operation and Constructional details of various types of steering machinery. 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 Steering Gear with redundancy concept as per SOLAS. Care and Maintenance of Steering Gear Plants. -8 hrs


MODULE II

Dry Docking: Methods of dry docking of ships. Inspection and routine overhauling of underwater fittings and hull. Measurement of clearances and drops. Removal and fitting of propellers (with and without Key). -6 hrs

Other Ship board equipments: Incinerators, Sewage Treatment Plant, Engine room crane, chain blocks, tackles, Anchor chain, its testing and survey requirements. Different types of ship stabilizer, Bow Thrusters, Hull Protection arrangements, Overhauling procedure for various Aux. M/c, Bad weather precaution taken, Maintenance of E.R. Stores etc. Importance of LO/FO testing, Methods of testing etc. Use of oil mist detector. -10 hrs

MODULE III

Noise and Vibrations: Elements of aerodynamics and hydrodynamics sound, Noise Sources on Ships and noise suppression techniques, Noise level measurement. 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 torsion graphs. -15 hrs

MODULE IV

Fuels: Sources of supply, Study of Primary Fuels, Coal, Petroleum, Natural Gas, Classification of Fuels, Treatment of Fuels for combustion in Marine I.C.E. and Steam Plants. Residual fuels, Emulsified Fuels, Merits and demerits of such fuel in marine engines. -12 hrs

MODULE V

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 systems. Loading pattern of various bearings in marine use and Lubrication system adopted. Different types of bearings used for marine machineries. L.O. analysis & monitoring Engine through report. -18 hrs

Reference:
4. Kewel Pujra - Vibrations and Noise control
5. 3. I. M. E. - The Running and Maintenance of Marine Machinery

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Drawing: Advanced Marine Machinery assembly drawings.

Part – I (Auxiliary Machine)
Marine machinery components are assorted stop & sluice valves and auxiliary equipment dismantled; to be conceptualized in assembly and laid out as working & functional parts. Sectional views in elevation & plans executed. Part sectional views depiction.

Part – II (Main machine)
Marine engine components dismantled. Assembled drawings of pistons, thrust blocks, liners, connecting rods, crossheads, injection valves, starting valves, Fuel pumps, Stern tube & Tail shaft, Rudder carrier bearing and all equipment with main machinery. Sectional / Outside and plan views of parts fitted / removed & in functional order.

Reference:
2. N.D. Bhatt : Machine Drawing
MODULE I
Ship Types: Tankers, Bulk Carriers, Container Ships. LNG, LPG and Chemical Carriers, Lash Ships, Passenger Ships, Dredger, Tugs, etc. – Constructional details and requirements. -4 hrs


Ship Surveys: Survey, Rules, Functioning of Ship Classification Societies, Surveys during Construction, Periodical Surveys as per statutory regulations, retention/suspension of class of a ship, constructional features and rule guidelines for a merchant vessel as per Marpol regulations, IBC and IGC codes. Statutory Certificates and their validity, Ships registration formalities, Intact Stability Criteria under damaged conditions (constructional point of view in compliance with statutory regulations), Enhanced Survey requirements, HSSC. -7 hrs

MODULE II
Geometry of Ship & Hydrostatic Calculations: Ships lines, Displacement Calculation, First and Second moment of area, Simpson’s rules, application to area and volume, Trapezoidal rule, mean and mid-ordinate rule, Tchebycheff’s rule and their applications, Tones per Cm. Immersion. Co-efficient of forms, Wetted surface area, Similar figures, Centre of gravity, effect of addition and removal of masses, Effect of suspended mass. -22 hrs

MODULE III

Resistance & Powering: Frictional, Residuary & Total resistance, Froude’s Law of comparison, Effective power calculations, Ships co-relation Factor (SCF), Admiralty co-efficient, Fuel Co-efficient and Fuel consumption. Effect of viscosity and application of I TTC formula. -5 hrs

MODULE IV
Longitudinal Stability and Trim: Longitudinal BM. MCT1, change of L.C.B. with change of trim, Change of trim due to adding or deducting weights, change in draft & trim because of filling/flooding several tanks with different densities, alteration of draft due to change in density, Flooding calculations, Floodable length curves, M.O.T. method for determination of floodable lengths, factors of subdivision, Loss of stability due to grounding, Docking stability, Pressure on Chocks. -18 hrs

Reference:
2. Tupper E. - Introduction to Naval Architecture.
4. Lewis - Principles of Naval Architecture.

CUSAT B.Tech Degree Syllabus for Marine Engineering- Sem V
MRE 508 BOILER CHEMISTRY AND HEAT ENGINES LABORATORY (64 hrs)

(A) BOILER CHEMISTRY LABORATORY (24 hrs)

To determine hardness content of the sample of boiler water in P.P.M. – in terms of CaCo3.

To determine Chloride content of the sample of water in P.P.M. in terms of CaCo3.

To determine Alkalinity due to Phenolphthalein, total Alk. And Caustic Alk. Of the sample of water in P.P.M.

To determine Phosphate Content of the sample of water.

To determine dissolved Oxygen Content of the sample of water.

To determine Sulphate content of the given sample of water.

To determine Ph-Value of the given sample.

(B) HEAT ENGINES & HEAT TRANSFER LABORATORY (40hrs)

To determine the absolute Viscosity and Kinematic Viscosity of oils by Red Wood viscometer.

To determine the flash point and fire point of a given sample of oil.

To determine the percentage of CO2, CO and O2 in the flue gases.

To determine the Calorific value of the fuel with the help of Bomb Calorimeter.

To conduct load test on a two stroke single cylinder Petrol engine.

To conduct load test on a two stroke single cylinder Diesel engine.

To conduct load test on a 4 stroke single cylinder Petrol engine.

To conduct load test on a 4 stroke single cylinder Diesel engine.

To conduct load test on a 4 stroke 4 cylinder Petrol engine.

To conduct load test best cooling on a 4 stroke twin cylinder Diesel engine.

To determine the Thermal conductivity of good conductors.

To determine the Thermal Conductivity of Insulating materials.

Heat transfer Through Fins or extended surface.

Heat transfer through Forced Convection.

Heat transfer through Natural Convection.
To study the charging and discharging action of a capacitor

To study the half wave and full wave rectification circuit without and with filter circuit

To study the volt-ampere characteristic of high current semiconductor diode

To study the volt-ampere characteristic of a diode and Zener diode

To study the characteristic of Junction Transistor

To study the volt-ampere characteristic of Field Effect Transistor.

To study the characteristics of Silicon Controlled Rectifier.

To study the Transistor Bias stability

To study the Transistor Feed Back Amplifier

To study the Integrated Circuit operational Amplifier

To study the Integrating, Differentiating Clamping and Clipping Circuit

To study the Logic Training Board

To study the Speed control of a D.C. motor by Thyristor.