B. E. COMMON TO ALL PROGRAMMES
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES

Course Code	**18MAT31**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	**03**	Exam Hours	03

Course Learning Objectives:

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

Module-1

Laplace Transforms: Definition and Laplace transform of elementary functions. Laplace transforms of Periodic functions and unit-step function – problems.
Inverse Laplace Transforms: Inverse Laplace transform - problems, Convolution theorem to find the inverse Laplace transform (without proof) and problems, solution of linear differential equations using Laplace transform.

Module-2

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis, examples from engineering field.

Module-3

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Simple problems.
Difference Equations and Z-Transforms: Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform. Simple problems.

Module-4

Numerical Solutions of Ordinary Differential Equations (ODE's): Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Range - Kutta method of fourth order, Milne's and Adam-Bashforth predictor and corrector method (No derivations of formulae), Problems.

Module-5

Numerical Solution of Second Order ODE's: Runge -Kutta method and Milne's predictor and corrector method.(No derivations of formulae).
Calculus of Variations: Variation of function and functional, variational problems, Euler's equation, Geodesics, hanging chain, problems.

Course Outcomes: At the end of the course the student will be able to:

- CO1: Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
- CO2: Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- CO3: Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- CO4: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- CO5:Determine the extremals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Question paper pattern:

1. The question paper will have ten full questions carrying equal marks.
2. Each full question will be for 20 marks.

- There will be two full questions (with a maximum of four sub- questions) from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2016
2	Higher Engineering	B. S. Grewal	Khanna Publishers	44th Edition, 2017

	Mathematics			
3	Engineering Mathematics	Srimanta Pal et al	Oxford University Press	3rd Edition, 2016
Reference Books				
1	Advanced Engineering Mathematics	C. Ray Wylie, Louis C. Barrett	McGraw-Hill Book Co	6th Edition, 1995
2	Introductory Methods of Numerical Analysis	S. S. Sastry	Prentice Hall of India	4th Edition 2010
3	Higher Engineering Mathematics	B.V. Ramana	McGraw-Hill	11th Edition,2010
4	A Text Book of Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publications	2014
5	Advanced Engineering Mathematics	Chandrika Prasad and Reena Garg	Khanna Publishing,	2018

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20

MATERIAL SCIENCE
B.E, III Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MR32**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

- The foundation for understanding the structure and various modes of failure in materials common in mechanical engineering.
- Topics are designed to explore the mechanical properties of metals and their alloys and composites.
- The means of modifying such properties, as well as the processing and failure of materials.
- Concepts of use of materials for various applications are highlighted.

Module - 1

Basics, Mechanical Behavior

Introduction to Crystal Structure – Coordination number, atomic packing factor, Simple Cubic, BCC, FCC and HCP Structures, simple problems, Crystal imperfections – point, line, surface and volume imperfections, Atomic Diffusion: Phenomenon, Fick's laws of diffusion; Factors affecting diffusion.

Mechanical Behavior:
Stress-strain diagram for ductile and brittle materials, mechanical properties in plastic range, yield strength offset yield strength, ductility, ultimate tensile strength, toughness.

Module - 2

Plastic deformation: of single crystal by slip and twinning.
Fracture: Type I, Type II and Type III,

Fatigue: Types of fatigue loading with examples, Mechanism of fatigue, Fatigue properties, S-N diagram, Fatigue testing. **Creep:** Description of the phenomenon with examples, three stages of creep, creep properties, Stress relaxation.

Module - 3

Solidification
Mechanism of solidification, Homogenous and Heterogeneous nucleation, crystal growth, cast metal structures.
Phase Diagram I: Solid solutions Hume Rothary rule substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase rule.
Phase Diagram II
Construction of equilibrium diagrams involving complete and partial solubility, lever rule, simple problems. Different types invariant reactions.

Module - 4

Iron carbon equilibrium diagram
Description of phases, solidification of steels and cast irons, invariant reactions.
Heat treating of metals
TTT curves, continuous cooling curves, description of the following heat treatment processes with industrial applications: annealing and its types. normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nitriding, flame hardening and induction hardening, age hardening of aluminum-copper alloys.

Module - 5

Ferrous and non ferrous materials
Properties, Composition and uses of Grey cast iron, malleable iron, SG iron and steel Copper alloys-brasses and bronzes. Aluminum alloys-Al-Cu, Al-Si,Al-Zn alloys. Titanium alloys
Composite Materials
Definition, classification, types of matrix materials & reinforcements, fundamentals of production of FRP's and MMC's advantages and application of composites.

Course Outcomes:

- Describe the mechanical properties of metals, their alloys and various modes of failure.
- Understand the microstructures of ferrous and non-ferrous materials to mechanical properties.
- Explain the processes of heat treatment of various alloys.
- Understand the properties and potentialities of various materials available and material selection procedures.
- Know about composite materials and their processing as well as applications.

TEXT BOOKS:

1. Smith, Foundations of Materials Science and Engineering, 4th Edition, McGraw Hill, 2009.
2. William D. Callister, Material science and Engineering and Introduction, Wiley, 2006.

REFERENCE BOOKS

1. V.Raghavan, Materials Science and Engineering, ,PHI, 2002
2. Donald R. Askland and Pradeep.P. Phule, The Science and Engineering of Materials, Cengage Learning, 4lh Ed., 2003.
3. George Ellwood Dieter, Mechanical Metallurgy, McGraw-Hill.
4. ASM Handbooks, American Society of Metals.

BASIC THERMODYNAMICS
B.E, III Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MR33**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

- Learn about thermodynamic systems and boundaries
- Study the basic laws of thermodynamics including, conservation of mass, conservation of energy or first law , second law and Zeroth law.
- Understand various forms of energy including heat transfer and work
- Identify various types of properties (e.g., extensive and intensive properties)
- Use tables, equations, and charts, in evaluation of thermodynamic properties
- Apply conservation of mass, first law, and second law in thermodynamic analysis of systems (e.g., turbines, pumps, compressors, heat exchangers, etc.)
- Enhance their problem solving skills in thermal engineering

Module - 1

Fundamental Concepts & Definitions: Thermodynamics- definition and scope, Microscopic and Macroscopic approaches. Some practical applications of engineering thermodynamic Systems, Characteristics of system boundary and control surface, examples. Thermodynamic properties; definition and units, intensive , extensive properties, specific properties, pressure, specific volume Thermodynamic state, state point, state diagram, path and process, quasi-static process, cyclic and non-cyclic; processes; Thermodynamic equilibrium; definition, mechanical equilibrium; diathermic wall, thermal equilibrium, chemical equilibrium, Zeroth law of thermodynamics, Temperature; concepts, scales, international fixed points and measurement of temperature. Constant volume gas thermometer, constant pressure gas thermometer, mercury in glass thermometer, problems

Work and Heat: Mechanics definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work; as a part of a system boundary, as a whole of a system boundary, expressions for displacement work in various processes through p-v diagrams. Shaft work; Electrical work. Other types of work. Heat; definition, units and sign convention. Problems.

Module - 2

First Law of Thermodynamics: Joules experiments, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, energy, energy as a property, modes of energy, Extension of the First law to control volume; steady flow energy equation(SFEE), important applications.

Second Law of Thermodynamics: limitations of first law of thermodynamics Devices converting heat to work; (a) in a thermodynamic cycle, (b) in a mechanical cycle. Thermal reservoir, Direct heat engine; schematic representation and efficiency. Devices converting work to heat in a thermodynamic cycle; reversed heat engine, schematic representation, coefficients of performance. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Carnot cycle, Carnot principles. Problems.

Module - 3

Entropy: Clausius inequality; Statement, proof, application to areversible cycle. Entropy; definition, a property, change of entropy, principle of increase in entropy, entropy as aquantitative test for irreversibility, calculation of entropy using Tds relations, entropy as a coordinate, numericalproblems. Available and unavailable energy. Reversiblework and irreversibility, (no numerical problems)

Pure Substances

P-T and P-V diagrams, triple point and critical points.Subcooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of pure substance with water as example.Enthalpy of change of phase (Latent heat). Dryness fraction(quality),T-S and H-S diagrams, representation of variousprocesses on these diagrams. Steam tables and its use.Throttling calorimeter, separating and throttling calorimeter, problems.

Module - 4

Thermodynamic relations

Helmholtz and Gibbs functions, .Maxwell relation, Clausius Clayperon's equation.

Idealgas; equation of state, internal energy and enthalpy as functions of temperature only, universal and particular gas constants, specific heats, perfect and semi-perfect gases. Evaluation of heat, work, change in internal energy

.enthalpy and entropy in various quasi-static processes.

Module - 5

Ideal gas mixture

Ideal gas mixture; Dalton's laws of partial pressures, Amagat's law of additive volumes, evaluation of properties, Analysis of various processes.

RealGases: Introduction. Van-der Waal's Equation of state, Van-der Waal's constants in terms of critical properties, Law of corresponding states, compressibility factor; compressibility chart, Redllich Kwong equation ,Beattie-bridgeman equation, problems.

Course Outcomes:

- Explain thermodynamic systems, properties, Zeroth law of thermodynamics, temperature scales and energy interactions.
- Determine heat, work, internal energy, enthalpy for flow &non flow process using First and Second Law of Thermodynamics.
- Interpret behavior of pure substances and its applications to practical problems.
- Determine change in internal energy, change in enthalpy and change in entropy using TD relations for ideal gases.
- Calculate Thermodynamics properties of real gases at all ranges of pressure, temperatures using modified equation of state including Vander Waals equation, Redlich Kwong equation and Beattie-bridgeman equation

TEXT BOOKS:

1. Basic Engineering Thermodynamics, A.Venkatesh, Universities Press, 2008
2. Basic and Applied Thermodynamics, P.K.Nag, 2nd Ed., Tata McGraw Hill Pub. 2002

REFERENCE BOOKS

1. Thermodynamics, An Engineering Approach, YunusA.Cenegal and Michael A.Boles, Tata McGraw Hill publications, 2002
2. Engineering Thermodynamics, J.B.Jones and G.A.Hawkins, John Wiley and Sons..
3. Fundamentals of Classical Thermodynamics, G.J.VanWylen and R.E.Sonntag, Wiley Eastern.
4. An Introduction to Thermodynamcis, Y.V.C.Rao, Wiley Eastern, 1993,
5. Basic Thermodynamics, B.K Venkanna, Swati B. Wadavadagi,PHI, New Delhi, 2010

MECHANICS OF MATERIALS
B.E, III Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MR34**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

- Classify the stresses into various categories and define elastic properties of materials and compute stress and strain intensities caused by applied loads in simple and compound sections and temperature changes.
- Derive the equations for principal stress and maximum in-plane shear stress and calculate their magnitude and direction. Draw Mohr circle for plane stress system and interpret this circle.
- Determine the shear force, bending moment and draw shear force and bending moment diagrams, describe behavior of beams under lateral loads.
- Explain the structural behavior of members subjected to torque, Calculate twist and stress induced in shafts subjected to bending and torsion.
- Understand the concept of stability and derive crippling loads for columns.
- Understand the concept of strain energy and compute strain energy for applied loads.

Module - 1

Stress and Strain: Introduction, Hooke's law, Calculation of stresses in straight, Stepped and tapered sections Composite sections, Stresses due to temperature change, Shear stress and strain, Lateral strain and Poisson's ratio, Generalized Hooke's law, Bulk modulus, Relationship between elastic constants

Module - 2

Analysis of Stress and Strain: Plane stress, Stresses on inclined planes, Principal stresses and maximum shear stress, Principal angles, Shear stresses on principal planes, Maximum shear tress, Mohr circle for plane stress conditions. Cylinders: **Thin cylinder**: Hoop's stress, maximum shear stress, circumferential and longitudinal strains, **Thick cylinders**: Lames equations.

Module - 3

Shear Forces and Bending Moments: Type of beams, Loads and reactions, Relationship between loads, shear forces and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads and uniformly distributed constant / varying loads.

Module - 4

Stress in Beams: Pure bending, Curvature of a beam, Longitudinal strains in beams, Normal stresses in Beams with rectangular, circular, 'I' and 'T' cross sections, Flexure Formula, Bending Stresses, Governing differential equation and its solution deflection of beams: Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple, Macaulay's method, Numerical examples.

Module - 5

Torsion: Circular solid and hallow shafts, Torsional moment of resistance, Power transmission of straight and stepped shafts, Twist in shaft sections, Thin tubular sections, Thin walled sections**Columns:** Buckling and stability, Critical load, Columns with pinned ends, Columns with other support conditions, Effective length of columns, Secant formula for columns

Course Outcomes:

- Understand simple, compound, thermal stresses and strains their relations, Poisson's ratio, Hooke's law, mechanical properties including elastic constants and their relations.
- Determine stresses, strains and deformations in bars with varying circular and rectangular cross-sections subjected to normal and temperature loads
- Determine plane stress, principal stress, maximum shear stress and their orientations using analytical method and Mohr's circle
- Determine the dimensions of structural members including beams, bars and rods using Energy methods and also stress distribution in thick and thin cylinders
- Draw SFD and BMD for different beams including cantilever beams, simply supported beams and overhanging beams subjected to UDL, UVL, Point loads and couples
- Determine dimensions, bending stress, shear stress and its distribution in beams of circular, rectangular, symmetrical I and T sections subjected to point loads and UDL

- Determine the dimensions of shafts based on torsional strength, rigidity and flexibility and also elastic stability of columns using Rankin's and Euler's theory

TEXT BOOKS:

1. James M Gere, Barry J Goodno, Strength of Materials, Indian Edition, Cengage Learning, 2009.
2. R Subramanian, Strength of Materials, Oxford, 2005.

REFERENCE BOOKS

1. S S Rattan, Strength of Materials, Second Edition, McGraw Hill, 2011.
2. Ferdinand Beer and Russell Johston, Mechanics of materials, Tata McGraw Hill, 2003.

B. E. MARINE ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

ELEMENTARY NAVIGATION, SEAMANSHIP AND SURVIVAL AT SEA

Course Code	**18MR35**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

- To provide detailed information of general ship knowledge
- To provide knowledge of various Navigation skills.
- To impart knowledge of various Survival at sea.
- To provide adequate knowledge of Life boats and life rafts.

Module - 1

Seaman & their Duties:
General ship knowledge: Ship's Department-Engine and deck, Commonly used nautical terms like Poop-Deck, Forecastle, and Bridge etc. Navigational lights and Signals Port and Starboard, Forward and aft mast lights, colors and Location. Flags used on ships, flag etiquette, Morse code and semaphore signaling, sound signals
Survival at Sea: Look out, precautions and bad weather, Survival difficulties and factors, LSA equipment available, duties of crew members during emergencies. . Immersion suit, Thermal Protective Aid , Donning of Life Jacket, initial action on boarding, maintaining the craft survival .

Module - 2

Rope Knots and Moorings:
Types of Knots, Practice of knot formation, Knots, bends, hitches, Ropes splice. Materials of ropes, strength care and maintenance, use of mooring line, heaving line, Rat guards, canvas and its use. Anchors: How they work ,Their use, dropping and weighing anchors, cable stopper.

Module - 3

Navigation:
General knowledge of principal stars, sextant, Navigation compasses, Echo Sounder, Log and uses, barometer and weather classification, classification of clouds G.M.T. and zonal time, wireless Navigational Instruments, Radar Satellite- Navigation. Bridge layout .Latest advancements in navigation technology.

Module - 4

Life Boats ,Rescue boats and Life Rafts:
Construction, Equipment carried Carrying capacity. Davits: Types and their operation, Launching of Life Rafts (Inflatable type).
Embarkation into Lifeboat and Life Raft. Survival Pack, Stowage and securing arrangement. Life boat drills, Lowering & hoisting of Life boats.
Abandon Ship:
Manning of Lifeboat and Life raft. Muster list, Radio & Alarm signals, Distress signal (S.O.S.), Distress Calls time and Radio frequency, Pyro-techniques.

Module - 5

Conventions and Regulations: Introduction to IMO, The need for conventions. Introduction of MARPOL convention and its annexes, Regulatory control towards environmental pollution at sea. Familiarization with SOLAS, STOW conventions, ISPS code and other maritime codes & conventions.

Course Outcomes:

- Students will be able to acquire the fundamentals of lifeboat and life raft launching Operations and use of various equipments present in it.
- Students will able to understand the general duties of seamanship.
- Students will be able to interpret the basic survival methods in case of emergencies.
- Final study provides the necessary knowledge regarding seamanship and duties related to every seaman onboard the vessel.
- Students will be able to understand the detailed information of navigation system and the purpose of various equipment present in bridge.

TEXT BOOKS:

1. Graham Danton, **"The theory and practice of seamanship"**, 11th Edition, Routledge, New york,

USA and Canada, 1996.
2. Capt. J. Dinger, **"Seamanship Primer",** 7th Edition, Bhandarkar Publications, Mumbai 1998.
3. Kemp & Young, **"Seamanship Notes",** Stanford Maritime limited, 1997

REFERENCE BOOKS

1. A.N. Cockcroft, **"Seamenship and Nautical knowledge",** 27th Edition, Brown son & Ferguson Ltd., Glasgow 1997.
2. Richards, **" Principles of Modern Radar ",**YesdeePublishings Pvt. Ltd., Indian Reprint 2012
3. Capt.P.M.Sarma , **"Theory of Marine Gyro Compass""**1st Ed. , Bhandarkar Publications ,2002

MECHANICAL MEASUREMENTS AND METROLOGY
B.E, III Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MR36**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

- Understand metrology, its advancements & measuring instruments.
- Acquire knowledge on different standards of length, calibration of End Bars, linear and angular measurements, Screw thread and gear measurement & comparators.
- Equip with knowledge of limits, fits, tolerances and gauging.
- Acquire knowledge of measurement systems and methods with emphasis on different transducers, intermediate modifying and terminating devices.
- Understand the measurement of Force, Torque, Pressure, Temperature and Strain

Module - 1

Introduction to Metrology: Definition, objectives and concept of metrology, Need of inspection, Principles, process, methods of measurement, Classification and selection of measuring instruments and systems. Accuracy, precision and errors in measurement.

Standards of length – International Prototype meter, Imperial standard Yard, Wavelength Standards, Subdivision of standards, Line and End standards, Classification of standards and Traceability, calibration of End bars(Numerical problems), standardization.

Linear Measurement and angular measurements:

Slip gauges- Indian standards on slip gauge, method of selection of slip gauge, stack of slip gauge, wringing of slip gauge, care of slip gauge, slip gauge accessories, problems on building of slip gauges (M87, M112). Measurement of angles- sine bar, sine center, angle gauges, Auto collimator- principle, applications.

Module – 2

System of Limits, Fits, Tolerance and Gauging:

Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly, limits of size, Indian standards, concept of limits of size and tolerances, definition of fits, hole basis system, shaft basis system, types of fits and their designation (IS 919-1963), geometric tolerance, position-tolerances.

Classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials.

Comparators:

Functional requirements, classification, mechanical- Johnson Mikrokator, sigma comparators, dial indicator, electrical-principles, LVDT, Pneumatic- back pressure gauges, solex comparators and optical comparators-Zeiss ultra-optimeter.

Module – 3

Measurement of screw thread and gear:

Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3- wire methods, best size wire. Screw thread gauges, Tool maker's microscope.

Types of Gears, Gear tooth terminology, tooth thickness measurement using gear tooth Vernier method, constant chord method and base tangent method. Gear roll tester for composite error.

Module – 4

Measurement systems and basic concepts of measurement methods:

Definition, significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-time delay. Errors in measurement, classification of errors. Transducers, transfer efficiency, primary and secondary transducers, electrical, mechanical transducers.

Intermediate modifying and terminating devices: Mechanical systems, inherent problems, electrical intermediate modifying devices, input circuitry, ballast circuit, electronic amplifiers. Terminating devices, Cathode ray oscilloscope, Oscillographs.

Module – 5

Force, Torque and Pressure Measurement:

Direct methods and indirect method, force measuring inst. Torque measuring inst., Types of dynamometers, Absorption dynamometer, Prony brake and rope brake dynamometer, and power measuring instruments. Pressure measurement, principle, use of elastic members, Bridgeman gauge, McLeod gauge, Pirani gauge.

Measurement of strain and temperature:

Theory of strain gauges, types, electrical resistance strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement. Temperature Compensation, Wheatstone bridge circuit, orientation of strain gauges for force and torque, Strain gauge based load cells and torque sensors.Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, pyrometer, optical pyrometer.

Course Outcomes:

- Understand the objectives of metrology, methods of measurement, selection of measuring instruments, standards of measurement and calibration of end bars.
- Describe slip gauges, wringing of slip gauges and building of slip gauges, angle measurement using sine bar, sine center, angle gauges, Autocollimator.
- Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design
- Understand the principle of Johnson Mikrokator, sigma comparator, dial indicator, LVDT, back pressure gauges, Solex comparators and Zeiss Ultra Optimeter.
- Describe measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2 – wire, 3 – wire methods, screw thread gauges and tool maker's microscope.
- Explain measurement of tooth thickness using gear tooth verniermethod, constant chord method, composite error using gear roll tester.
- Understand laser interferometers and Coordinate measuring machines.
- Explain measurement systems, transducers, intermediate modifying devices and terminating devices.
- Describe functioning of force, torque, pressure, strain and Temperature measuring devices.

TEXT BOOKS:

1. **Mechanical Measurements,** Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.

2. **Engineering Metrology,** R.K. Jain, Khanna Publishers, Delhi, 2009.

REFERENCE BOOKS

1. **Engineering Metrology and Measurements,** Bentley, Pearson Education.
2. **Theory and Design for Mechanical Measurements, III edition,** Richard S Figliola, Donald E Beasley, WILEY India Publishers.
3. **Engineering Metrology,** Gupta I.C., DhanpatRai Publications.
4. **Deoblin's Measurement system**, Ernest Deoblin, Dhaneshmanick, McGraw –Hill.
5. **Engineering Metrology and Measurements,** N.V. Raghavendra and L.Krishnamurthy, Oxford University Press.

MATERIAL TESTING LAB
B.E, III Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MRL37**	CIE Marks	40
Number of Lecture Hours/Week	03 (1Hour instruction + 2 hours Laboratory)	SEE Marks	60
RBT Levels	L1, L2, L3	Exam Hours	03

Credits – 02

Course Learning Objectives:

1. To learn the concept of the preparation of samples to perform characterization such as microstructure, volume fraction of phases and grain size.
2. To understand mechanical behavior of various engineering materials by conducting standard tests.
3. To learn material failure modes and the different loads causing failure.
4. To learn the concepts of improving the mechanical properties of materials by different methods like heat treatment, surface treatment etc.

PART A

1. Preparation of specimen for Metallographic examination of different engineering materials.

   To report microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & composites.
2. Heat treatment: Annealing, normalizing, hardening and tempering of steel.

   Metallographic specimens of heat treated components to be supplied and students should report microstructures of furnace cooled, water cooled, air cooled, tempered steel.

   Students should be able to distinguish the phase changes in a heat treated specimen compared to untreated specimen.

3. Brinell, Rockwell and Vickers's Hardness tests on untreated and heat treated specimens.

4. To study the defects of Cast and Welded components using Non-destructive tests like:

   a) Ultrasonic flaw detection

   b) Magnetic crack detection

   c) Dye penetration testing.

PART B

1. Tensile, shear and compression tests of steel, aluminum and cast iron specimens using Universal Testing Machine
2. Torsion Test on steel bar.
3. Bending Test on steel and wood specimens.
4. Izod and Charpy Tests on Mild steel and C.I Specimen.
5. To study the wear characteristics of ferrous and non-ferrous materials under different parameters.
6. Fatigue Test (demonstration only).

Course Outcomes:

- Acquire experimentation skills in the field of material testing.
- Develop theoretical understanding of the mechanical properties of materials by performing experiments.
- Apply the knowledge to analyze a material failure and determine the failure inducing agent/s.
- Apply the knowledge of testing methods in related areas.
- Know how to improve structure/behavior of materials for various industrial applications.

Students should make observations on nature of failure and manifestations of failure in each of the experiments apart from reporting values of mechanical properties determined after conducting the tests.

Scheme of Examination:

ONE question from part -A:	**30 Marks**
ONE question from part -B:	**50 Marks**
Viva -Voice:	**20 Marks**
Total :	**100 Marks**

MECHANICAL MEASUREMENTS AND METROLOGY LAB
B.E, III Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MRL38**	CIE Marks	40
Number of Lecture Hours/Week	03 (1 Hour Instruction + 2 Hours Laboratory)	SEE Marks	60
RBT Levels	L1, L2, L3	Exam Hours	03

Credits – 02

Course Learning Objectives:

- To illustrate the theoretical concepts taught in Mechanical Measurements & Metrology through experiments.
- To illustrate the use of various measuring tools measuring techniques.
- To understand calibration techniques of various measuring devices.

PART – A

MECHANICAL MEASUREMENTS

1. Calibration of Pressure Gauge
2. Calibration of Thermocouple
3. Calibration of LVDT
4. Calibration of Load cell
5. Determination of modulus of elasticity of a mild steel specimen using strain gauges

PART B

METROLOGY

1. Measurements using Optical Projector / Toolmaker Microscope.
2. Measurement of angle using Sine Center / Sine bar / bevel protractor
3. Measurement of alignment using Autocollimator / Roller set
4. Measurement of cutting tool forces using
   a) Lathe tool Dynamometer OR
   b) Drill tool Dynamometer.
5. Measurements of Screw thread Parameters using two wire or Three-wire methods.
6. Measurements of Surface roughness, Using Tally Surf/Mechanical Comparator
7. Measurement of gear tooth profile using gear tooth Vernier /Gear tooth micrometer
8. Calibration of Micrometer using slip gauges

9. Measurement using Optical Flats

Course Outcomes:

- To calibrate pressure gauge, thermocouple, LVDT, load cell, micrometer.
- To measure angle using Sine Center/ Sine Bar/ Bevel Protractor, alignment using Autocollimator/ Roller set.
- To demonstrate measurements using Optical Projector/Tool maker microscope, Optical flats.
- To measure cutting tool forces using Lathe/Drill tool dynamometer.
- To measure Screw thread parameters using 2-Wire or 3-Wire method, gear tooth profile using gear tooth vernier/Gear tooth micrometer.
- To measure surface roughness using Tally Surf/ Mechanical Comparator.

Scheme of Examination:

ONE question from part -A:	**30 Marks**
ONE question from part -B:	**50 Marks**
Viva -Voice:	**20 Marks**
Total :	**100 Marks**

B. E. Common to all Programmes
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

ADDITIONAL MATHEMATICS – I
(Mandatory Learning Course: Common to All Programmes)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech. programmes)

Course Code	**18MATDIP31**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:1:0)	SEE Marks	60
Credits	0	Exam Hours	03

Course Learning Objectives:

- To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.
- To provide an insight into vector differentiation and first order ODE's.

Module-1

Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).
Vector Algebra: Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.

Module-2

Differential Calculus: Review of elementary differential calculus. Polar curves –angle between the radius vector and the tangent pedal equation- Problems. Maclaurin's series expansions, problems.
Partial Differentiation: Euler's theorem for homogeneous functions of two variables. Total derivatives - differentiation of composite function. Application to Jacobians of order two.

Module-3

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl and Laplacian (Definitions only). Solenoidal and irrotational vector fields-Problems.

Module-4

Integral Calculus: Review of elementary integral calculus. Statement of reduction formulae for $\sin^n x, \cos^n x, and\ \sin^m x \times \cos^n x$and evaluation of these with standard limits-Examples. Double and triple integrals, problems.

Module-5

Ordinary differential equations (ODE's): Introduction-solutions of first order and first degree differential equations: Variable Separable methods, exact and linear differential equations of order one. Application to Newton's law of cooling.

Course Outcomes: At the end of the course the student will be able to:

- CO1: Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
- CO2: Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
- CO3: Analyze position, velocity and acceleration in two and three dimensions of vector valued functions. CO4: Learn techniques of integration including the evaluation of double and triple integrals.
- CO5: Identify and solve first order ordinary differential equations.

Question paper pattern:

3. The question paper will have ten full questions carrying equal marks.
4. Each full question will be for 20 marks.

- There will be two full questions (with a maximum of four sub- questions) from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	43rd Edition, 2015
Reference Books				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2015
2	Engineering Mathematics Vol. I	Rohit Khurana	Cengage Learning	2015

THEORY OF MACHINES
B.E, IV Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	18MR42	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

- **To identify and enumerate different link based mechanisms with basic understanding of motion**
- **To interpret and analyse various velocity and acceleration diagrams for various mechanisms**
- **To understand and illustrate various power transmission mechanisms using suitable method**
- **To design and evaluate the performance of different cams and followers.**

Module - 1

Links and Mechanisms:
Introduction: Definitions: Link, kinematic pairs, kinematic chain, mechanism, structure,degrees of freedom, Classification links, Classification of pairs based on type of relative motion, Grubler's criterion, mobility of mechanism, Groshoff's criteria.Mechanisms: Quick return motion mechanisms-Drag link mechanism, Whitworth mechanismand Crank and slotted lever Mechanism. Oldham's coupling, Straight line motion mechanisms Peaucellier's mechanism and Robert's mechanism. Intermittent Motion mechanisms: Geneva wheel mechanism, Ratchet and Pawl mechanism, toggle mechanism, pantograph, condition forcorrect steering, Ackerman steering gear mechanism.

Module – 2

Force principle:
Alembert's principle, Inertia force, inertia torque.**Friction and Belt Drives:** Definitions: Types of friction: laws of friction, Friction in pivot bearings. Belt drives: Flat belt drives, ratio of belt tensions, centrifugal tension, and power transmitted, Numerical Problems.

Module – 3

Balancing of Rotating Masses:
Static and dynamic balancing, balancing of single rotating mass by balancing masses in same plane and in different planes. Balancing of several rotating masses by balancing masses in same plane and in different planes.
Balancing of Reciprocating Masses: Inertia effect of crank and connecting rod, Single cylinder engine, balancing in multi cylinder-inline engine (primary and secondary forces), numerical problems.

Module – 4

Governors: Types of governors; force analysis of Porter and Hartnell governors. Controlling force, stability, sensitiveness, isochronism, effort and power.
Gyroscope: Gyroscopic couple. Effect of gyroscopic couple on plane disc, Aeroplane, Ship, stability of two wheelers and four wheelers (Without numerical problems)

Module – 5

Cams: Types of cams, types of followers. Displacement, velocity and acceleration curves foruniform velocity, Simple Harmonic Motion, Uniform Acceleration and Retardation, Cycloidalmotion. Cam profiles: disc cam with reciprocating / oscillating follower having knife-edge, rollerand flat-face follower inline and offset (Without derivations).

Course Outcomes:

- **To identify and enumerate different link based mechanisms with basic understanding of motion**
- **To understand and illustrate various power transmission mechanisms using suitable**

methods

- **To understand and illustrate various Governer mechanisms using suitable methods**
- **To design and evaluate the performance of different cams and followers.**

TEXT BOOKS:

1**Theory of Machines**", Rattan S.S, Tata McGraw-Hill Publishing Company Ltd., New Delhi, and 3rd Ed-2009

2. "**Theory of Machines**", Sadhu Singh, Pearson Education (Singapore) Pvt. Ltd, Indian Branch New Delhi, 2nd Ed 2006

REFERENCE BOOKS

1. "Theory of Machines & Mechanisms", J.J. Uicker, , G.R. Pennock, J.E. Shigley, OXFORD 3rd Ed. 2009.
2. "Theory of Machines"by Thomas Bevan, CBS Publication 1984.
3. "Design of Machinery" by Robert L. Norton, McGraw Hill, 2001.
4. "Mechanisms and Dynamics"of Machinery by J. Srinivas, Scitech Publications,Chennai,2002.
5. "Dynamics of machinery" by J. B. K. Das & P. L. S. Murthy.

APPLIED THERMODYNAMICS
B.E, IV Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	18MR43	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 04

Course Learning Objectives:

- **Apply the basic knowledge of thermodynamics to Gas power cycles, Gas Turbines, Vapour power cycles, Refrigeration and hence find the performance parameters of the devices which work on these cycles.**
- **Understand combustion thermodynamics, stoichiometric and actual air/fuel ratios and analyze fuel and flue gas.**
- **Find the performance parameters of I.C engines and draw the heat balance sheet.**

Module - 1

Gas power cycles
Air standard cycles; Carnot, Otto, Diesel, Dual and Stirling cycles, p-v and T -s diagrams, description, efficiencies and mean effective pressures. Comparison of Otto and Diesel cycles.
Gas turbine (Brayton) cycle; description and analysis. Regenerative gas turbine cycle. Inter-cooling and reheating in gas turbine cycles. Jet propulsion and rocket propulsion

Module - 2

Vapour power cycles
Carnot vapour power cycle, drawbacks as a reference cycle. Simple Rankine cycle; description, T-s diagram, analysis for performance. Comparison of Carnot and Rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles. Ideal and practical regenerative Rankine cycles, open and closed feed water heaters. Reheat Rankine cycle. Characteristics of an Ideal working fluid in Vapour power cycles, Binary Vapour cycles

Module - 3

Combustion thermodynamics: Theoretical air and excess air for combustion of fuels. Mass balance actual combustion. Exhaust gas analysis. A/F ratio energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, combustion efficiency, and adiabatic flow temperature. Dissociation and equilibrium, emissions

Module – 4

I.C Engines: Classification of IC engines, Combustion of SI engine and CI engine, Detonation and factors affecting detonation, IC Engine fuels, Ratings and Alternate Fuels. Testing of two stroke and four stroke SI and CI engines for performance related numerical problems, heat balance, Motoring Method, Willan's line method, swinging field dynamometer, Morse test

Module - 5

Refrigeration: Vapor compression refrigeration system, description, analysis, refrigerating effect, capacity, power required, units of refrigeration, COP, refrigerants and their desirable properties. Air cycle refrigeration: Reversed Brayton cycle, Vapor absorption refrigeration system, steam jet refrigeration.
Psychrometry: atmospheric air and psychrometric properties, Dry bulb temperature, wet bulb temperature, dew point temperature, partial pressures, specific and relative humidities and the relation between the two, enthalpy and adiabatic saturation temperature. Construction and use of psychometric chart. Analysis of various processes: heating, cooling, dehumidifying and humidifying. Adiabatic mixing of moist air. Summer and Winter air conditioning.

Course Outcomes:.

- **Understand the theoretical working cycle of I.C engines, Gas Turbines, Thermal power plantsand refrigeration.**

- **Analyze the combustion process, calculate the stoichiometric and actual A/F ratio, analyze the fuel and flue gases**
- **Calculate the performance parameters and draw the heat balance sheet for I. C. Engines.**
- **Refrigeration system and apply theory to solve numerical on working of these devices.**
- **Understand the properties of air and design air conditioning system for the requirement given.**

TEXT BOOKS:

1. **Basic and Applied thermodynamics:** P.K. Nag, 2nd Ed., Tata McGraw Hill Pub.Co, 2002.
2. **Applied Thermodynamics:** Rajput, Laxmi publication.

REFERENCE BOOKS:

1. An Introduction to Thermo Dynamics by Y.V.C.Rao, Wiley Eastern Ltd, 2003.
2. I.C Engines by Ganeshan.V. Tata McGraw Hill, 4rth Edi. 2012

SHIP STRUCTURE AND CONSTRUCTION
B.E, IV Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MR44**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**

Credits – 03

Course Learning Objectives:

- **Conceptual understanding of ship terms, section and materials use.**
- **Understanding of bottom and side framing and for-end and after- end arrangements.**
- **Basic knowledge of shell and decks.**
- **Understanding of load line and tonnage**
- **Understanding Ship Types and miscellaneous ship out fittings**

Module - 1

Ships Terms: General Classification of Ships.Various terms used in ship Construction with reference to Ship's parameter e.g. L.B.P., LOA, Moulded Depth, Moulded draught, and other similar terms.
Stresses in ship's structure: Bending, Shear, Hogging, Sagging, Racking, Pounding, Painting, etc., and Strength members to counteract the same.
Sections and materials use : Type of section like Angles, Bulb Plates, Flanged beams used in ship construction. Basic types of welding. Testing of welds.

Module - 2

Bottom & Side Framing : Double bottoms, Water tight floors, Solid and bracket floors, Longitudinal framing keels, side framing like Tankside brackets, Beam Knee, Web frame, etc,
Fore-End Arrangements: Stem construction, arrangements to resist panting, panting stringers, Forepeak — Collision bulk heads, Bulbous bows. Anchor and cable arrangements.
After-End-Arrangements: Types of Sterns, Stem frame and rudder. Types of rudder. Supporting of rudder, Shaft tunnel, Tunnel bearings.

Module - 3

Shell & Decks: Plating systems for shells, Deck plating & Deck girders, discontinuities like hatches and other openings, supporting & closing arrangements, mid-ship Section of ships.
Bulk heads & Deep Tanks: Water tight bulkheads, Arrangements of plating and stiffeners. Water tight sliding doors, Water tight openin[g]s through bulkheads for electric cables pipes and shafting. Deep tank for oil fuel or oil cargo corrugated bulk heads.

Module - 4

Loadline and Tonnage
Plimsol / Load line Mark, Tonnage regulations .Definition of freeboard and various assigning conditions, calculation as per latest convention. Shipyard Practice: Layout of a Shipyard, fabrication of assembly, subassembly and units in construction.Role of Surveyors in construction of Ship; Keel laying, Launching, Sea trial. Use of computers in ship design with cost implication.

Module - 5

Ship Types and miscellaneous outfits
Constructional details of Tankers, bulk carriers, container ships, car carriers, LNG, LPG and chemical carriers, Lash ships; Passenger ships, Dredger, Tugs, and offshore platforms.
Ship insulation, corrosion control and antifouling system, surface preparation and painting.

Course Outcomes:

- **Understand ship terms, section and materials use.**
- **Describe those parts of the ship's structure that facilitate the stowage and handling of cargo operations.**
- **Develop basic knowledge of Shell and decks.**
- **Define ship design terminology to facilitate comprehension of construction principles.**
- **Have a basic knowledge of shipyard practice.**

TEXT BOOKS:

1. **Ship Construction** – REEDS Vol – 5
2. D. J. Eyres "**Ship Construction**", 4' Edition, Butter Worth – Heinemann, Oxford, 1994.

REFERENCE BOOKS

1. **Ship Construction** – Munro & Smith
2. **Merchant Ship Construction** – H.J. Pursey

MARINE HEAT ENGINE AND AIR CONDITIONING
B.E, IV Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MR45**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03**	**SEE Marks**	**60**
Total Number of Lecture Hours	**40(8 Hours per Module)**	**Exam Hours**	**03**

Credits – 03

Course Learning Objectives:

- To provide a knowledge of reciprocating compressors.
- To provide a knowledge of refrigeration cycles.
- To provide a knowledge of air conditioning systems.
- To provide a knowledge of heat exchangers.

Module - 1

RECIPROCATING COMPRESSORS: Ideal cycles for compressors, work transfer in a single stage compressors-mass flow-volume flow-free air delivery-effect of clearance and volumetric efficiency in single stage compressors. Multi stage compression neglecting clearance volume. Condition for minimum work input and perfect inter cooling. Tandem in line arrangements in compressors. Air motors.

Module - 2

BASIC REFRIGERATION AND AIR CONDITIONING : Reversed Carnot cycle-vapour compression cycle-refrigerating effect-co-efficient of performance-cooling capacity-refrigerants used in marine practice and their justification-rating of refrigeration plant-methods for improving C.O.P – use of vapour tables-applied problems.

Module - 3

MARINE REFRIGERATING PLANTS: Typical marine refrigerating plants with multiple compression and evaporator system, refrigerated cargo T.E.V: H.P cutout, L.P cutout, shaft seal, lubrication and maintenance of refrigerant plant, transfer and storage of refrigerant, refrigerant charging, Troubleshooting in refrigeration systemrefrigeration in liquefied gas carries reefer vessels

Module - 4

MARINE AIR CONDITIONING: Principle of air conditioning-Psychrometric properties of air comfort conditions-control of humidity-air flow and air conditioning capacity-cylinder and loading mechanism-air circulation system- container cooling system-air cooler fans-air conditioning system in cargo ship-types of air conditioning system-air flow and air conditioning capacity -trouble shooting and maintenance.

Module - 5

BASIC DESIGN OF HEAT EXCHANGERS: Introduction-types-LMTD and NTU method-double pipe, shell and tube type, condenser and evaporator, air distribution and duct insulation, detail of ship side and deck insulation, cooling and heating load and maintenance –applied problems

Course Outcomes:

- **To calculate the performance reciprocating compressors.**
- **Have a very clear idea of theoretical aspects of marine refrigeration and air conditioning.**
- **Will be able to do an economical and efficient design of heat exchangers for air conditioning and refrigeration plants.**

TEXT BOOKS:

4. Arora C P "**refrigeration and Air conditioning**" 1st edition, srieswar enterprises Chennai
5. Kuppanthulukkanam, heat **exchanger design hand book** 1st edition CRC Press 2000

REFERENCE BOOKS

4. **D A Taylor introduction to marine engineering 2nd edition Butter Worth London 1993**

FLUID MECHANICS
B.E, IV Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	18MR46	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

- **Conceptual understanding of fluid properties and fluid statistics.**
- **Understanding of fluid kinematics and fluid dynamics.**
- **Basic knowledge of dimensional analysis and similitude.**
- **Understanding of laminar and turbulent flows in closed conduits**
- **Understanding flow measurement.**

Module - 1

Properties of Fluids:
Introduction, Types of fluid, Properties of fluids, viscosity, thermodynamic properties, surface tension, capillarity, vapour pressure and cavitation.
Fluid Statistics:
Fluid pressure at a point, Pascal's law, pressure variation in a static fluid, absolute, gauge, atmospheric and vacuum pressures, simple manometers and differential manometers. Total pressure and center of pressure on submerged plane surfaces; horizontal, vertical and inclined plane surfaces, curved surface submerged in liquid.

Module - 2

Buoyancy and Fluid Kinematics:
Buoyancy, center of buoyancy, metacenter and metacentric height, conditions of equilibrium of floating and submerged bodies, determination of Metacentric height theoretically.
Kinematics: Types of fluid flow, continuity equation in 2D and 3D (Cartesian Co-ordinates only),, velocity potential function and stream function.
Fluid Dynamics
Introduction to equation of motion, Introduction to Navier- Stokes equation of motion, Euler's equation of motion, Bernoulli's equation from first principles and also from Euler's equation, limitations of Bernoulli's equation.

Module - 3

Fluid Flow Measurements
Venturimeter, orifice meter, pitot-tube, vertical orifice, V-Notch and rectangular notches
Dimensional Analysis Scheme of Examination:
Introduction, derived quantities, dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham Pi-theorem, dimensionless numbers, similitude, types of similitudes.

Module - 4

Flow through pipes
Minor losses through pipes. Darcey's and Chezy's equation for loss of head due to friction in pipes. HGL and TEL.
Laminar flow and viscous effects
Reyonold's number, critical Reynold's number, laminar flow through circular pipe-Hagen Poiseille's equation, laminar flow between parallel and stationary plates.

Module - 5

Flow past immersed bodies: Drag, Lift, expression for lift and drag, boundary layer concept, displacement, momentum and energy thickness. Introduction to compressible flow: Velocity of sound in a fluid, Mach number, Mach cone, propagation of pressure waves in a compressible fluid.

Course Outcomes:

- **Understand properties of fluids and hydrostatics.**
- **Formulate and solve equations of the control volume for fluid flow systems.**
- **Develop basic knowledge of dimensional analysis and similitude and flow**

measurement devices.

- **Calculate resistance to flow of incompressible fluids through closed conduits.**
- **Solve field problems in fast immersed bodies.**

TEXT BOOKS:

1. Fluid Mechanics (SI Units), Yunus A. Cengel John M.Oimbala, 2nd Ed., Tata McGraw Hill, 2006
2. Fluid Mechanics, Dr. Bansal, R.K. Lakshmi Publications, 2004.

REFERENCE BOOKS

1. Fluid Mechanics, Oijush.K.Kundu, IRAM COCHEN, ELSEVIER, 3rd Ed. 2005.
2. Fluid Mechanics and hydraulics, Dr.Jagadishlal: Metropolitan Book Co-Ltd., 1997.
3. Fluid Mechanics, John F.Douglas, Janul and M.Gasiosek and john A.Swaffield, Pearson Education Asia, 5th ed., 2006
4. Fluid Mechanics and Fluid Power Engineering, Kumar.D.S, Kataria and Sons, 2004
5. Fluid Mechanics -. Merle C. Potter, Elaine P.Scott. Cengage learning

MACHINE SHOP AND FOUNDRY LAB
B.E, IV Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	18MRL47	CIE Marks	40
Number of Lecture Hours/Week	03 (1 Hour Instruction + 2 Hours Laboratory)	SEE Marks	60
RBT Levels	L1, L2, L3	Exam Hours	03
Credits – 02			

Course Learning Objectives:

- **To provide an insight into different sand preparation and foundry equipment's.**
- **To provide an insight to different machine tools, accessories and attachments**
- **To train students into machining operations to enrich their practical skills**
- **To develop team qualities and ethical principles**.

PART – A

1. **Machine shop**
   Preparation of three models on lathe involving

   Plain turning, Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and eccentric turning.

PART B

2. **Foundry Practice**

   1. Use of foundry tools and other equipment's.
   2. Preparation of molding sand mixture.
   3. Preparation of green sand molds using two molding boxes kept ready for pouring.
      - Using patterns (Single piece pattern and Split pattern)
      - Without patterns.
      - Incorporating core in the mold. (Core boxes).
      - Preparation of one casting (Aluminum or cast iron-Demonstration only)

Course Outcomes:

- **Demonstrate various skills of sand preparation, molding.**
- **Demonstrate various skills of machining operations.**
- **Work as a team keeping up ethical principles.**

Scheme of Examination:

ONE question from part -A: 30 Marks

ONE question from part -B:	**50 Marks**
Viva -Voice:	**20 Marks**
Total :	**100 Marks**

COMPUTER AIDED MARINE ENGINEERING DRAWING
B.E, IV Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MRL48**	CIE Marks	40
Number of Lecture Hours/Week	03 (1Hour instruction + 4 hours Practice)	SEE Marks	60
Total Number of Lecture Hours	40	Exam Hours	03

Credits – 03

Course Learning Objectives:

- To acquire the knowledge of CAD software and its features.
- To inculcate understanding of the theory of projection and make drawings using orthographic projections and sectional views
- To familiarize the students with Indian Standards on drawing practices.
- To impart knowledge of thread forms, fasteners, keys, joints and couplings.
- To make the students understand and interpret drawings of machine components so as to prepare assembly drawings either manually and using CAD packages.
- To acquire the knowledge of limits fits and tolerance pertaining to machine drawings.

PART A

Introduction to Computer Aided , Sketching Review of graphic interface of the software. Review of basic sketching commands and navigational commands Sections of Solids: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on, axis inclinations, spheres and hollow solids), True shape of section. Orthographic views: Conversion of pictorial views into orthographic projections of simple machine parts with or without section. (Bureau of Indian Standards conventions are to be followed for the drawings), Hidden line conventions, Precedence of lines**. 5Hours**

Thread forms: Thread terminology, sectional views of threads. ISO Metric (Internal & External), BSW (Internal and External), square, Acme and Sellers thread, American Standard thread. Fasteners: Hexagonal headed bolt and nut with washer (assembly), square headed bolt and nut with washer (assembly) simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw. **5 Hours**

PART B

Keys and Joints: Parallel, Taper, Feather Key, Gib head key and Woodruff key Riveted joints: Single and double riveted lap joints, Butt joints with single/double cover straps (Chain and zigzag using snap head riveters).
Joints: Cotter joint (socket and spigot), Knuckle joint (pin joint) for two rods. Couplings: Splitmuff coupling, protected type flange coupling, Pin (bush) type flexible coupling. **5Hours**

PART C

Limits, Fits and Tolerances: Introduction, Fundamental tolerances, Deviations, Methods of placing limit dimensions, Types of fits with symbols and applications, Geometrical tolerances on drawings, Standards followed in industry. **2 Hours**

Assembly Drawings: (Part drawings shall be given)

1. Plummer block (Pedestal Bearing)

2. Cylinder relief valve
3. I.C. Engine connecting rod
4. Screw jack (Bottle type)
5. Boiler blow down valve **23 Hours**

Course Outcomes:

- Improve their visualization skills.
- Understand the theory of projection.
- Make component drawings.
- Produce the assembly drawings using part drawings.
- Engage in life long learning using sketching and drawing as communication tool.

TEXT BOOKS:

1. 'A Primer on Computer Aided Machine Drawing-2007', Published by VTU, Belgaum.
2. 'Machine Drawing', N.D.Bhat&V.M.Panchal, Published by Charotar Publishing House, 1999.
3. 'Machine Drawing', N.Siddeshwar, P.Kannaih, V.V.S. Sastri, published by Tata Mc.Grawhill, 2006.

REFERENCE BOOKS

1. "A Text Book of Computer Aided Machine Drawing", S. Trymbakaa Murthy, CBS Publishers, New Delhi, 2007.
2. 'Machine Drawing', K.R. Gopala Krishna, Subhash publication.

Internal Assessment: 40 Marks

Sketches shall be in sketch books and drawing shall through use of software on A3/A4 sheets. Sketch book and all the drawing printouts shall be submitted.

Scheme of Evaluation for Internal Assessment (40 Marks)

(a) Class work (Sketching and Computer Aided Machine drawing printouts in A4/A3 size sheets): 24 Marks.

(b) Internal Assessment test in the same pattern as that of the main examination (Better of the two Tests): 16 marks.

Scheme of Examination:

Two questions to be set from each Part A, part B and Part C.

Student has to answer one question each from Part A , Part B for 20 marks each and one question from Part C for 60 marks.

Part A 1 x 20	**= 20 Marks**
Part B 1 x 20	**= 20 Marks**
Part C 1 x 60	**= 60 Marks**
	= 100
Total	**Marks**

INSTRUCTION FOR COMPUTER AIDED MACHINE DRAWING (18MRL48) EXAMINATION

1. No restriction of timing for sketching/ computerization of solutions. The total duration is 3 hours.
2. It is desirable to do sketching of all the solutions before computerization.
3. Drawing instruments may be used for sketching.
4. For Part A and Part B 2D drafting environment should be used.
5. For Part C 3D part environment should be used for parts assembly drawing and extract 2D views.

B. E. Common to all Programmes
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - IV

ADDITIONAL MATHEMATICS – II
(Mandatory Learning Course: Common to All Programmes)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech. programmes)

Course Code	**18MATDIP41**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:1:0)	SEE Marks	60
Credits	**0**	Exam Hours	03

Course Learning Objectives:

- To provide essential concepts of linear algebra, second & higher order differential equations along with methods to solve them.
- To provide an insight into elementary probability theory and numerical methods.

Module-1

Linear Algebra: Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of a square matrix. Problems.

Module-2

Numerical Methods: Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)- Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems.

Module-3

Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators.*[Particular Integral restricted to R(x)=* $e^{ax}, \sin ax$ */*$\cos ax$ *for* $f(D)y = R(x)$.]

Module-4

Partial Differential Equations (PDE's):- Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.

Module-5

Probability: Introduction. Samplespace and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes's theorem, problems.

Course Outcomes: At the end of the course the student will be able to:
CO1: Solve systems of linear equations using matrix algebra.
CO2: Apply the knowledge of numerical methods in modelling and solving engineering problems.
CO3: Make use of analytical methods to solve higher order differential equations.
CO4: Classify partial differential equations and solve them by exact methods.
CO5: Apply elementary probability theory and solve related problems.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	43rd Edition, 2015
Reference Books				

1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2015
2	Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publishers	7th Edition, 2007
3	Engineering Mathematics Vol. I	Rohit Khurana	Cengage Learning	1st Edition, 2015

B. E. MARINE ENGINEERING
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - V

MANAGEMENT AND ECONOMICS

Course Code	**18MR51**	CIE Marks	40
Teaching Hours/Week (L:T:P)	2:2:0	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To help the students to understand the fundamental concepts and principles of management; the basic roles, skills, functions of management, various organizational structures and basic knowledge of marketing.
- To impart knowledge, with respect to concepts, principles and practical applications of Economics, which govern the functioning of a firm/organization under different market conditions.

Module-1

Management: Introduction - Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought- early management approaches – Modern management approaches. Planning: Nature, importance and purpose of planning process Objectives - Types of plans (Meaning Only) - Decision making Importance of planning - steps in planning & planning premises - Hierarchy of plans.

Module-2

Organizing and Staffing: Nature and purpose of organization Principles of organization - Types of organization - Departmentation Committees Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning Only) Nature and importance of staffing--Process of Selection & Recruitment (in brief). Directing & Controlling: Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief).

Module-3

Introduction: Engineering and economics, Problem solving and decision making, Laws of demand and supply, Difference between Microeconomics & Macroeconomics, equilibrium between demand & supply, elasticity of demand, price elasticity, income elasticity. Law of Returns, Interest and interest factors, simple and compound interest, Cash flow diagrams, personal loans and EMI payment calculation with flexible interest rates, Discussion and problems.

Module-4

Present, future and annual worth and rate of returns: Basic present worth comparisons, Present worth-equivalence, Assets with unequal lives and infinites lives, future worth comparisons, payback comparisons, Equivalent annual worth comparisons, situations for annual worth comparisons. Asset life, Rate of return, minimum acceptable rate of return, IRR anomalies and misconceptions, Cost of capital, comparisons of all present future and annual worth with IRR, product costing, Discussions and problems.

Module-5

Costing and depreciation: Components of costs, estimation of selling price, marginal cost, first cost, all kinds of overheads, indirect cost estimation with depreciation, mensuration and estimation of material cost, cost estimation of mechanical process, idling time. Product costing (approaches to product costing), causes of depreciation, methods of computing depreciation charges, straight line method, declining balance method, sum of years method, sinking fund method, service output methods, taxation concepts, personal income taxes and corporate taxes, Discussions and problems.

Course Outcomes: At the end of the course, the student will be able to:

CO1: Understand needs, functions, roles, scope and evolution of Management
CO2: Understand importance, purpose of Planning and hierarchy of planning and also34nalyse its types.
CO3: Discuss Decision making, Organizing, Staffing, Directing and Controlling.
CO4: Select the best economic model from various available alternatives.
CO5: Understand various interest rate methods and implement the suitable one.
CO6: Estimate various depreciation values of commodities.
CO7: Prepare the project reports effectively.

Question paper pattern:

5. The question paper will have ten full questions carrying equal marks.
6. Each full question will be for 20 marks.

- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl. No.	Title of the Book	Name of the Author/s	Name of the	Edition and
Textbook/s				
1	Mechanical estimation	T.R. Banga& S.C. Sharma	Khanna Publishers	17th edition 2015
2	Engineering Economy	Riggs J.L	McGraw Hill	4th edition
3	Engineering Economy	Thuesen H.G	PHI	2002
4	Principles of Management	Tripathy and Reddy	Tata McGraw Hill	3rd edition 2006
Textbook/s				
1	Mechanical estimation	T.R. Banga& S.C. Sharma	Khanna Publishers	17th edition 2015
2	Engineering Economy	Riggs J.L	McGraw Hill	4th edition
3	Engineering Economy	Thuesen H.G	PHI	2002
4	Principles of Management	Tripathy and Reddy	Tata McGraw Hill	3rd edition 2006

B.E, V Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

NAVAL ARCHITECTURE

Course Code	**18 MR52**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 04

Course Learning Objectives:

- an ability to apply knowledge of mathematics, science, and engineering within naval architecture and marine engineering;
- Basic hydrostatics, Geometry of ship;
- Calculations of ship forms and various co-efficients: Calculating the area of wetted surface, volume etc.
- an understanding of the various types of Propellers and Rudders;
- an understanding of and experience in marine system conceptual and preliminary design using industrial capability.

Module - 1

Geometry of Ship &**Hydrostatic Calculations :** Ships lines, Displacement Calculation, pressure exerted by a liquid, load on immersed plane ,centre of pressure, load diagram shearing force on bulkhead stiffener, Simpson's first rule, application to volumes, use of intermediate ordinates application to first and second moments of area. , Familiarisation with hydrostatic curves of ship, problems.

Module - 2

T.P.C, Co-efficient of forms: Concept of DWT, GT and NT, Tonnes per Cm. Immersion, Co-efficient of forms, wetted surface area, Similar figures, shearing force and bending moment

Centre of gravity: effect of addition and removal of masses, Effect of movement of mass, Effect of suspended mass calculations.

Module - 3

Stability of ships: Statical stability at small angles of heel. Calculation on BM, metacentric diagram inclining experiment, free surface effect, stability at large angle of heel, stability of wall sided vessel. Problems.

Resistance: Frictional, residuary and total resistance, Admiralty co-efficient fuel co-efficient and consumption, problems.

Module - 4

TRIM: Change in draughts due to added masses, change in mean draught and end draught due to density change in mean draught and end draught due to bilging MCTI, 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, Change in draft due to change in density. Problems.

Module - 5

PROPELLER AND RUDDER THEORY: Geometry of screw propeller, types of propeller, Blade element theory Apparent and real slip, wake, thrust, relation between powers, built and solid propellers, measurement of pitch, cavitation.

Force on rudder, types of rudders, model experiments and turning trails, torque on stock, angle of heel due to force on rudder, angle of heel when turning, problems.

Course Outcomes: At the end of the course the students would have acquired the knowledge of:

1. An ability to apply knowledge of mathematics, science, and engineering within naval architecture and marine engineering.
2. Basic hydrostatics, Geometry of ship.
3. Calculations of ship forms and various co-efficients: Calculating the area of wetted surface, volume etc.
4. An understanding of the various types of Propellers and Rudders;
5. An understanding of and experience in marine system conceptual and preliminary design using industrial capability.

TEXT BOOKS:

1.Ship and Naval Architecture, R. Munro-Smith
2. Naval Architecture for Engineers, Reeds' Vol — 6

REFERENCE BOOKS

1. K. J. Rawson and E. C. Tupper, basic ship theory (vol II), 5TH edition,butterheinmann London 2001
2. E A Stokoe "Naval Architecture for Marine Engineers" vol 4, reeds publications, 2000
3. G.N. Hatdh, "creative naval architecture" 1st Edition, Thomas reed publications, London 1971

B.E, V Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

MARINE INTERNAL COMBUSTION ENGINE- I

Course Code	**18 MR53**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(10 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: The students should be able to have:

- A theoretical Knowledge of the marine diesel engines.
- A knowledge of the structural elements of a marine diesel engines
- Knowledge of the scavenging systems.
- Analyze of fuel and lubricating systems.
- Knowledge of selection of lubricants.

Module - 1

PERFORMANCE CHARACTERISTICS OF I.C. ENGINE

4-Stroke and 2-Stroke cycles; Deviation from ideal condition in actual engines; Limitation in parameters, Timing Diagrams of 2-Stroke and 4-Stroke engines. Comparative study of slow speed, medium speed and high-speed diesel engines – suitability and requirements for various purposes. Mean Piston speed, M.C.R. & C.S.R. ratings. Practical heat balance diagrams and thermal efficiency.

Module - 2

GENERAL DESCRIPTION OF MARINE DIESEL ENGINE:

Constructional Details of I.C. engines and marine diesel engines: components: jackets and liners, cylinder heads and fittings, pistons, cross heads, connecting rods, crank shaft, bearings, bed plates, Aframes, welded construction for bedplates & frames and tie rods etc.

COOLING OF I.C. ENGINES: Various cooling media, their merits and demerits, cooling of pistons, cylinder jackets & cylinder heads, bore cooling, coolant conveying Line diagram , maintenance of coolant and cooling system, cooling water: testing and treatment.

Module - 3

SCAVENGING SYSTEM:

Scavenging arrangements in 2-stroke engines; air charging and exhausting in 4-stroke engines; various types of scavenging in 2-stroke engines; uniflow, loop and cross flow scavenging, their merits and demerits, scavenge pumps for normally aspirated engines, under piston scavenging, scavenge manifolds.

TURBOCHARGING ARRANGEMENTS:

Pulse and constant pressure type; merits and demerits in highly rated marine propulsion engines. air movements inside the cylinders. Turbocharger Faults/Problems.

Module - 4

ENGINE SAFETY AND FUEL:

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, shore side and shipboard sampling and testing. Treatment of fuel for contaminants including microbiological infection. Fuel injectors - function and requirements ,injector types, fuel injector faults, High pressure pipe safety, Compression pressure ratio and its effect on engines.

Module - 5

MARINE LUBRICATING OIL:

Lubrication principles: introduction – friction – functions of lubricants – basic requirements – types of lubricants – hydrodynamic or full fluid film lubrication – lubrication of slider bearings – hydrostatic lubrication – boundary lubrication – hydrodynamic lubrication, lube oil properties ,

SELECTION OF LUBRICANTS: Introduction – field of application –Cylinder lubrication requirements, cylinder oil Lubricating systems for various engines – monitoring engines through lubricating oil analysis reports onboard lube oil test and shore testing **.** Treatment of Lube oil for contaminants including microbiological infection.

Course Outcomes: At the end of this course, student will be able to:

- Have an understanding of various types of Marine Diesel Engines.
- Have knowledge of various systems used in Marine Diesel Engine plants.
- Have knowledge of the theoretical aspect of Scavenging and super charging system.
- Have knowledge of the theoretical aspect of engine emergencies and steps taken.
- Have knowledge of the theoretical aspect of fuel and lubricating systems.

TEXT BOOKS:

1.D.A. Taylor, “Introduction to Marine Engineering”, 2nd Edition, Butter worth – Heinemann, London, 1999
2. Wood yard, Doug, “Pounders Marine Diesel Engines”, 7th Edition, Butter Worth Heinemann Publishing, London, 2001.
3. Leslie Jackson, Thomos D Morton, Paul A Russell, “Motor Engineering Knowledge For Marine Engineers”, 3rd Ed. Reeds Vol 12, Adlard Coles Nautical, London
.

REFERENCE BOOKS

1. M.E.P., “Low Speed Diesel Engines New”, Marine Engineering Practice, Vol-2 Part-17,,IMarEST, London
2. S. H. Henshall, “Medium and High Speed Diesel Engines for Marine Use”, 1st Edition, Institute of Marine Engineers, Mumbai, 1996.
3. D.K. Sanyal, “Principle & Practice of Marine Diesel Engines”, 2nd Edition, Bhandarkar Publication, Mumbai, 1998.
4. Mathur, M.L., Sharma, R.P., “ Internal Combustion Engines”, 7th Ed. Dhanpat rai Publications, REPRINT 2002

MARINE AUXILLARY MACHINES
B.E, V Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MR53**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 04

Course Learning Objectives: The students should be able to have:

- A theoretical Knowledge of the auxiliary equipments on ships and the engine room layout.
- A knowledge of engine room pipeline systems and the fittings.
- A knowledge of pumps and pumping systems.
- Knowledge of the heat exchanger systems.
- Understanding of steering systems

Module - 1

Engine Room Layout , Piping Systems And Fittings :
Layout of main and auxiliary machinery in Engine Rooms in different ships. Steam and condensate system, water hammering in pipes, Expansion joints in pipelines, Bilge – ballast, fuel oil bunkering and transfer system, bunkering procedure, precautions taken, fuel oil service system to main and auxiliary engines, lubricating oil and Engine cooling system to main and auxiliary engines, central cooling systems, control and service air system, domestic fresh water and sea water (Hydrophore) service system, drinking water system, fire main system.

Module - 2

Valves, Cocks , Packing, Joints, Filters And Strainers :
Straight way cocks, right angled cock, T-cock, spherical cock, Boiler gauge glass cock (cylindrical cock). Globe valves, SDNR valve, swing check valve (storm valve), gate valves, butterfly valves, relief valves, quick closing valves, pressure reducing valves, control valves, change over valve chests, fuel oil transfer chest, valve actuators, steam traps. Packings, Insulation of materials, Types,- Various applications. Seals – purpose of bearing seal, description and application of non rubbing seals and rubbing seals, simple felt seal, seals suitable for various peripheral speeds, V-ring seals, Lip seals. Filtration, filter elements basket strainers, duplex strainers, edge type strainers, auto-kleen strainers, back flushing strainers, magnetic filter, rotary filters, fine filters.

Module - 3

Pumps :
Types of pumps for various requirements – their characteristics, performance and application in ships – centrifugal pumps – gear pumps – screw pumps and reciprocating pumps – care and maintenance of pumps, operation of all pumping systems on board such as bilge, ballast and cargo pumping operations.

Module - 4

HEAT EXCHANGERS, EVAPORATORS AND DISTILLERS
Principle of surface heat transfer – description, contact heat transfer, construction of shell and tube type – flat plate type, single and double pass – lubricating oil coolers, fuel oil heaters, fresh water coolers, compressed air coolers, Main Engine charge air cooler, Fresh water heaters, steam condensers, evaporators and condensers in refrigeration system – materials used in all the above heat exchangers, expansion allowance – temperature controls effect of air in the system – maintenance. Distillation of water, distilling equipment, problem of scale formation and method of controlling, methods of distillation, single effect and double effect shell type evaporator, low pressure vacuum type evaporator, flash evaporators, multiple effect evaporators-construction and operation salt water leaks and detection, reverse osmosis desalination plant, membranes, drinking water and treatment.

Module - 5

STEERING SYSTEM
Hydraulic Telemotor system (Transmitter and receiver), Bypass valve – charging system, – hydraulic power unit – hunting gear heleshaw pump principle, construction and operation – pawl and ratchet mechanism, 2-ram and 4-ram steering gear – electric steering gear, principle and operation – Hunting gear and emergency steering gear. Electro-hydraulic steering gear, Rotary vane steering gear – principle – construction – operation – safety features, relief, isolating and bypass valves, steering system regulations and testing – trouble shooting – rectification maintenance.

Course Outcomes:

- Have an understanding of the engine room layout and systems
- Have an understanding of the various ancillaries in the system and its function.
- Have a knowledge of ships pumping systems.
- Have a knowledge of the heat exchangers and distillation systems
- Have a understanding of the steering systems.

TEXT BOOKS:

1. D.W. Smith, “Marine Auxillary Machinery”, 6th Edition, Butter worths, London, 1987.
2. H.D. McGeorge, “Marine Auxillary Machinery”, 7th Edition, Butter worth, London,2001.

REFERENCE BOOKS

1. H.D. McGeorge, “General Engineering Knowledge”, 3rd edition, Butter worth – Heineman, London, 1991.

TURBOMACHINES
B.E, V Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MR55**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 04

Course Learning Objectives:

1. To provide Students with a comprehensive classification of compressible fluid machines (positive displacement machines and turbo machines)
2. To enable students to design mechanical components of turbines (such as blades) and understand the velocity triangles for such type of turbo-machines.
3. To give an integrated view of various types of compressors (such as axial & centrifugal compressors) and explain the performance as well as the design considerations for these types of compressors.
4. To clearly understand water turbine characteristics, performance principles, design aspects and the performance analysis of multi-stage turbines.
5. To explain centrifugal pumps (performance, impeller design) and flow problems; particularly losses, cavitations

Module – 1

Introduction: Definition of turbomachine, parts of turbomachines, Comparison with positive displacement machines, Classification, Dimensionless parameters and their significance, Effect of Reynold's number, Unit and specific quantities, model studies. Problems.

Thermodynamics of fluid flow: Application of thermodynamic laws, Static and Stagnation states-Incompressible fluids and perfect gases, overall isentropic efficiency, stage efficiency (their comparison) and polytropic efficiency for both compression and expansion processes. Reheat factor for expansion process problems.

Module – 2

Energy exchange in Turbomachines: Euler's turbine equation, Alternate form of Euler's turbine equation, Velocity triangles for different values of degree of reaction, Components of energy transfer, Degree of Reaction, utilization factor, Relation between degree of reaction and Utilization factor, Problems.

General Analysis of Turbomachines: Radial flow compressors and pumps – general analysis, Expression for degree of reaction, velocity triangles, Theoretical head – capacity relationship, General analysis of axial flow pumps and compressors, degree of reaction, velocity triangles, Problems.

Module – 3

Steam Turbines: Classification, Single stage impulse turbine, condition for maximum blade efficiency, stage efficiency, Need and methods of compounding, Multi-stage impulse turbine, expression for maximum utilization factor, Problems (Graphical/Analytical)

Module - 4

Hydraulic Turbines: Classification, Different efficiencies, Pelton turbine – velocity triangles, design parameters, Maximum efficiency. Francis turbine - velocity triangles, design parameters, runner shapes for different blade speeds. Draft tubes- Types and functions. Kaplan and Propeller turbines - velocity triangles, design parameters.Problems..

Module - 5

Centrifugal Pumps: Classification and parts of centrifugal pump, different heads and efficiencies of centrifugal pump, Minimum speed for starting the flow, Maximum suction lift, Net positive suction head, Cavitation, Need for priming, Pumps in series and parallel. Problems.

Course Outcomes: The student shall be able to

1. Identify and differentiate positive displacement machine and turbo machines.
2. Explain the working principles of turbo machines and apply it to various types of machines.
3. Analyze energy transfer through graphical and analytical methods in turbo machines.
4. Determine the velocity triangles for different turbo machinery and able to Apply the affinity laws to pumps and turbines.
5. Design different kinds of turbo machines.

TEXT BOOKS:

1. An Introduction to Energy Conversion, Volume III, Turbo machinery, V. Kadambi and Manohar Prasad, New Age International Publishers, reprint 2008.
2. Turbines, Compressors & Fans, S. M. Yahya, Tata McGraw Hill Co. Ltd., 2nd edition, 2002

REFERENCE BOOKS

1. Principals of Turbomachines, D. G. Shepherd, The Macmillan Company (1964).
2. Fluid Mechanics & Thermodynamics of Turbomachines, S. L. Dixon, Elsevier (2005).
3. Text Book of Turbomachines, M. S. Govindgouda and A. M. Nagaraj, M. M. Publications, 4Th Ed, 2008.
4. Turbomachine, B.K.Venkanna PHI, New Delhi 2009.

B.E, V Semester, Marine Engineering
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(Effective from the academic year 2018-19)

MARINE BOILERS

Course Code	**18MR56**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

1. To provide knowledge to the students about Marine Boilers and its ancillaries.
2. Basic knowledge of boiler mountings and its uses.
3. To know the boiler water chemistry and its treatment.
4. To know the operation of the boiler.
5. To know the maintenance routines of the boiler.

Module – 1

Boilers and Ancillaries:
Smoke tube boiler, water tube boiler, composite boiler, Scotch boiler, d-type boiler, dual pressure boiler steam to steam generator, forced circulation, circumferential and Longitudinal stress, Economizers, attemperators and desuperheater, superheaters, air heater, Selection of material, tests on selected material compensation for holes, man hole door, use of refractory material.

Module – 2

Boiler mountings and its maintenance:
Safety valves-types materials, adjustment(full lift safety valve, improved high lift safety valve; full bore safety valve), overhauling procedure of safety valves, pressure setting of safety valve, Gauge glass – Ordinary plate type and remote Indicator, automatic feed regulator, main steam stop valve, feed check valves, soot blowers.

Module – 3

Boiler Water Treatment and tests
Boiler corrosion, causes of corrosion, galvanic action, caustic embrittlement. Effects of salt and gases in feed water requirement of water treatment lime and soda treatment, caustic soda treatment coagulants, condensate line treatment. Salinometer, litmus papers, alkalinity test chloride test sulphate test, phosphate test hardness test, total dissolved solids hydrazine test sampling troubles associated with water treatment Action in the event of shortage of water**.**

Module - 4

OPERATION OF BOILERS and Feed system
Combustion of residual fuel in boiler pressure: types of burner pressure jet type, rotating cup type, steam blast jet type: air registers, pre-commissioning procedures, boiler combustion control system, lighting up curve, furnace blow back general precautions to be followed by a watch keeper, problems associated with operation of marine boiler.
Feed system:-open, closed, auxiliary feed system. Types of condenser, air ejector, De-aerator. Water level control system.

Module - 5

Maintenance of boiler
Procedure for opening up and closing the boiler, procedure for hydraulic test regulations concerning hydraulic test, basic survey procedure, cleaning of boiler, procedure for soot blowing operations, weekly checks, maintenance of easing gear, emergency operation. Blowing down of boiler Laying up a boiler; general maintenance, External and internal tube cleaning. Tube renewals.

Course Outcomes:

1. A basic knowledge of Waste heat boilers and boiler mountings.
2. Operation and Maintenance of boilers.
3. A basic knowledge of the marine auxiliary boiler combustion and feed water systems.
4. A overview of the auxiliary boiler maintenance routines.

TEXT BOOKS:

1. J.H. Milton & R.M. Leach, “Marine Steam Boilers”, 4th Edition, Butter worth, London, 1980
2. 2. C. McBirnie, “Marine Steam Engines and Turbines”, 4th Edition, Butter worth, London 1980.
3. 3. Thomas D. Morton, “Steam Engineering Knowledge for Marine Engineers”, 3rd Edition, Thomas Reed Publications, London 1979.

REFERENCE BOOKS

1. GTH. Flanagan, “Marine Boilers” 3rd Edition, Butter worth, London, 2001.
2. K.M.B. Donald, “Marine Steam Turbines”, 1st Edition, Institute of Marine Engineers, London, 1977.
3. L.Jackson & T.D. Morton, “General Engineering Knowledge for Marine Engineers”, 4th Edition, Thomas Reeds Publication, United Kingdom, 1986.
4. M.E.P., “Operation Of Machinery In Ships Steam Turbines, Boilers”, Marine Engineering Practice, Vol 2,Part 15, IMarEST, London

MARINE ENGINE LAB
B.E, V Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	**18MRL57**	**CIE Marks**	**40**
Number of Lecture Hours/Week	**03 (1 Hour Instruction+ 2 Hours Laboratory)**	**SEE Marks**	**60**
RBT Levels	**L1, L2, L3**	**Exam Hours**	**03**
Credits – 02			

Course Learning Objectives:
To impart skills to students to demonstrate the ability to carry out the different tests to understand the performance characteristics of Diesel engines.

PART A

1. Determination of Flash point and Fire point of lubricating oil using Abel Pensky and Marten's (closed) / Cleavland's (Open Cup) Apparatus.
2. Determination of Calorific value of solid, liquid and gaseous fuels.
3. Determination of Viscosity of lubricating oil using Redwoods, Saybolt and Torsion Viscometers.
4. Valve Timing/port opening diagram of an I.C. engine (4 stroke/2 strokes).
5. Use of planimeter

PART B

1. Performance Tests on I.C. Engines, Calculations of IP, BP, Thermal efficiencies, Volumetric efficiency, Mechanical efficiency, SFC, FP, A:F Ratio heat balance sheet for
   (a) Four stroke Diesel Engine
   (b) Four stroke Petrol Engine
   (c) Multi Cylinder Diesel/Petrol Engine, (Morse test)
   (d) Two stroke Petrol Engine
   (e) Variable Compression Ratio I.C. Engine.

Course Outcomes: Students will be able to
1. To perform various tests on the heat engines
2. To analyse the results to understand the performance characteristics of engines
3. To choose the best fuels and lubricants based on the test results.

Scheme of Examination:
ONE question from part –A - 30 Marks
ONE question from part –B - 50 Marks
Viva Voce - 20 Marks
Total - 100

FLUID MECHANICS AND MACHINES LAB
B.E, V Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Course Code	18MRL58	CIE Marks	40
Number of Lecture Hours/Week	03 (1 Hour Instruction+ 2 Hours Laboratory)	SEE Marks	60
RBT Levels	L1, L2, L3	Exam Hours	03

Credits – 02

Course Learning Objectives: Students are expected

- To compare the results of analytical models introduced in lecture to the actual behavior of real fluid flows
- To discuss and practice standard measurement techniques of fluid mechanics and their applications
- To learn and practice writing technical reports
- To work on small design projects.

PART A

1. Determination of coefficient of friction of flow in a pipe.
2. Determination of minor losses in flow through pipes.
3. Determination of force developed by impact of jets on vanes.
4. Calibration of flow measuring devices
    a. Orifice Plate meter
    b. Nozzle
    c. Venturimeter
    d. V-notch

PART B

1. Performance testing of Turbines
    a. Pelton wheel
    b. Francis Turbine
    c. Kaplan Turbines
2. Performance testing of Pumps
    a. Single stage / Multi stage centrifugal pumps
    b. Reciprocating pump
3. Performance test of a two stage Reciprocating Air Compressor
4. Performance test on an Air Blower

Course Outcomes: At the end of the course, the students will be able to:

- Students can able to understand to analyze practical problems in all power plants and chemical industries
- Conduct experiments (in teams) in pipe flows and open-channel flows and interpreting data from model studies to prototype cases, as well as documenting them in engineering reports
- Analyze a variety of practical fluid-flow devices and utilize fluid mechanics principles in design
- Given the required flow rate and pressure rise, select the proper pump to optimize the pumping efficiency

Scheme of Examination:
ONE question from part –A - 30 Marks
ONE question from part –B - 50 Marks
Viva Voce - 20 Marks
Total - 100

B. E. COMMON TO ALL PROGRAMMES
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER – V

ENVIRONMENTAL STUDIES

Course Code	18CIV59	CIE Marks	40
Teaching Hours / Week (L:T:P)	(1:0:0)	SEE Marks	60
Credits	01	Exam Hours	02

Module - 1

Ecosystems (Structure and Function): Forest, Desert, Wetlands, Riverine, Oceanic and Lake.
Biodiversity: Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

Module - 2

Advances in Energy Systems (Merits, Demerits, Global Status and Applications)**:** Hydrogen, Solar, OTEC, Tidal and Wind.
Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Module - 3

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies)**:** Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.
Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module - 4

Global Environmental Concerns (Concept, policies and case-studies):Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module - 5

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs.
Field work: Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.

Course Outcomes: At the end of the course, students will be able to:

- CO1: Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
- CO2: Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
- CO3: Demonstrate ecology knowledge of a complex relationship between biotic and a biotic components.
- CO4: Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Question paper pattern:

- The Question paper will have 100 objective questions.
- Each question will be for 01 marks
- Student will have to answer all the questions in an OMR Sheet.
- The Duration of Exam will be 2 hours.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Environmental Studies	Benny Joseph	Tata Mc Graw – Hill.	2nd Edition, 2012
2.	Environmental Studies	S M Prakash	Pristine Publishing House, Mangalore	3rd Edition, 2018
3	Environmental Studies – From Crisis to Cure	R Rajagopalan	Oxford Publisher	2005
Reference Books				

1	Principals of Environmental Science and Engineering	Raman Sivakumar	Cengage learning, Singapur.	2nd Edition, 2005
2	Environmental Science – working with the Earth	G.Tyler Miller Jr.	Thomson Brooks /Cole,	11th Edition, 2006
3	Text Book of Environmental and Ecology	Pratiba Sing, AnoopSingh& PiyushMalaviya	Acme Learning Pvt. Ltd. New Delhi.	1st Edition

B.E, VI Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
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HEAT TRANSFER

Course Code	**18MR61**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 04

Course Learning Objectives: To enable the students to

1. Study the modes of heat transfer.
2. Learn how to formulate and solve 1-D steady and unsteady heat conduction problems.
3. Apply empirical correlations for fully-developed laminar, turbulent internal flows and external boundary layer convective flow problems.
4. Study the basic principles of heat exchanger analysis and thermal design.
5. Understand the principles of radiation heat transfer.

Module – 1

Introductory Concepts And Definitions: Modes of heat transfer: Basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity; convective heat transfer coefficient; radiation heat transfer; Combined heat transfer mechanism.
Conduction: Boundary conditions of 1^{st} , 2^{nd} and 3^{rd} kind, Derivation of general three dimensional conduction equation in Cartesian coordinate, special cases, discussion on 3-D conduction in cylindrical and spherical coordinate systems (No derivation). One dimensional conduction equations in slab, cylindrical and spherical coordinates for plane and composite walls. Overall heat transfer coefficient. Thermal contact resistance. Critical thickness of insulation-cylinder and sphere.

Module – 2

Finned surfaces: Heat transfer in extended surfaces of uniform cross-section without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and effectiveness. Numerical problems. Variable Thermal Conductivity-Derivation for heat flow and temperature distribution in plane wall.
One dimensional Transient(unsteady) conduction and use of temperature charts: Lumped system analysis, mixed Boundary condition, Use of Transient temperature charts (Heisler's charts) for transient conduction in slab, long cylinder and sphere; use of transient temperature charts for transient conduction in semi-infinite solids. Numerical Problems.

Module - 3

Convection Concepts And Basic Relations In Boundary Layers: Flow over a body velocity boundary layer; critical Reynolds number; drag coefficient and drag force; thermal boundary layer; local heat transfer coefficient; Average heat transfer coefficient; Nusselt number. Flow inside a duct.Forced Convections:. Physical significance of Reynolds, Prandtl, Nusselt and Stanton numbers. Use of various correlations for hydro dynamically and thermally developed flows inside a duct, use of correlations for flow over a flat plate, over a cylinder and sphere. Numerical problems.
Free convection:- physical significance of Grashoff number, Laminar and Turbulent flows, Vertical Plates, Vertical Tubes and Horizontal Tubes, Numerical Problems

Module - 4

Heat Exchangers: Classification of heat exchangers; overall heat transfer coefficient, fouling and fouling factor; LMTD, Effectiveness-NTU methods of analysis of heat exchangers. Numerical problems.
Condensation And Boiling: Types of condensation (discussion only) Nusselt's theory for laminar condensation on a vertical flat surface; use of correlations for condensation on vertical flat surfaces, horizontal tube and horizontal tube banks; Reynolds number for condensate flow; regimes of pool boiling, pool boiling correlations. Numerical problems.

Module - 5

Radiation Heat Transfer: Thermal radiation; definitions of various terms used in radiation heat transfer; Stefan-Boltzman law, Kirchoff's law, Planck's law and Wein's displacement law. Radiation heat exchange between two parallel infinite black surfaces, between two parallel infinite gray surfaces; effect of radiation shield; intensity of radiation and solid angle; Lambert's law; radiation heat exchange between two finite surfaces configuration factor or view factor. Numerical problems.

Course Outcomes: The student shall be able to

1. Understand the basic laws of heat transfer and consequence of heat transfer in thermal analyses of engineering

systems

2. Analyze problems involving steady state heat conduction and unsteady heat conduction.
3. Understand the fundamentals of convective heat transfer and evaluate heat transfer coefficients for natural and forced convection.
4. Analyze heat exchanger performance by using the method of log mean temperature difference and method of heat exchanger effectiveness.
5. Calculate radiation heat transfer between black body surfaces and gray body surfaces.

TEXT BOOKS:

1. Heat transfer-A basic approach, Ozisik, Tata McGraw Hill 2002
2. Heat & Mass transfer, Tirumaleshwar, Pearson education 2006
3. Fundamentals of heat and mass transfer, Frenk P. Incropera and David P. Dewitt, John Wiley and son's

REFERENCE BOOKS

1. Heat transfer, P.K. Nag, Tata McGraw Hill 2002.
2. Heat transfer, a practical approach, Yunus A- Cengel Tata McGraw Hill
3. Principles of heat transfer, Kreith Thomas Learning 2001

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MARINE INTERNAL COMBUSTION ENGINE-II

Course Code	**18MR62**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 04

Course Learning Objectives: The students should be able to have:

- A theoretical Knowledge of the Manoeuvring Systems.
- A knowledge of the automation in diesel engine plants
- A knowledge of the Trouble shooting in Diesel Engines.
- A knowledge of fuel and lubricating systems.

Module - 1

Forces and stresses: Stresses acting on main engines bed plate, crankshaft, piston and piston rod, connecting rod, Torque Variations within a cycle, Static and Dynamic balancing, Different type of vibration & its effects, methods of vibration damping.

Fuel pumps and Metering Devices: Requirements, Fuel Injection Methods, Fuel Pumps: Suction Valve Controlled Pump, Suction and spill Valve Controlled Pump, Port Controlled – Helix Jerk Pump. System for burning heavy fuel oil in slow and medium speed marine engine, V.I.T &Electronic injection system

Module - 2

Manoeuvring Systems: Starting and reversing system of different Marine Diesel Engines with safety provisions and Actions in Emergency situation.

Indicator diagrams and power calculations: Construction details of indicator instrument. Study of different types of indicator cards, Significance of diagram power calculation, fault detection, simple draw cards and out of phase diagram Power balancing, Performance Characteristic Curves, Test bed and Sea trials of diesel engines

Module - 3

Lubrication systems: Lubrication arrangement in diesel engines including Coolers and Filters, Cylinder Lubrication, Liner wear and protective measures, Combinations of lubricating oil its effect and preventive measures.

Gas Turbines: Principle of working, Different Arrangements of Gas Turbines, General Construction and design features for marine plants, Materials of construction, Heat Exchangers and Reheat arrangements, Comparison of Free piston engine and conventional air-steam combustion chambers

Module - 4

Automation in Modern Diesel Engine Plants: Remote operation, Alarm and fail safe system; Governors: Definitions, mechanical, hydraulic, electronic governors. Concept of intelligent engine: U.M.S Operation of ships, minimum requirement of automation for UMS operation

Maintenance of Diesel Engines: Inspection and replacement of various Component members such as Piston, Piston ring-head bearings, Cylinder Head, Liner, Bearings, Driving chain and gears etc. Crankshaft deflection and alignment, Engine holding down arrangements, Tightening of Tie bolts

Module - 5

Trouble shooting in Diesel Engines: Hot and Cold corrosion, Crankshaft web slip-head bearing problems, microbial degradation in fuel & lube oil.

Modern trends in Development: Current Engines (Sulzer, B&W CMC & SMC, SEMI Pill stick), Intelligent Engine (Camels concept), Improvement in design for increased TBO, Nox-Control of Marine Diesel Engines. All latest Technology incorporated in a modern propulsion machinery ships.

Course Outcomes: At the end of this course, student will be able to:

- Have an understanding of various types of forces and stresses acting on Marine Diesel Engines.
- Have knowledge of Manoeuvring Systems used in Marine Diesel Engine plants.
- Have knowledge of the lubricating system and Trouble shooting in Diesel Engines.

TEXT BOOKS:

1. Wood yard, Goug,"Pounder's Marine Diesel Engines" (8th edition), Batter worth Heinemann Publishing, London, 2001

2. S H Henshell,"Medium and High speed Diesel Engines for Marine Use" (1st edition), Institute of Marine Engineers, Mumbai, 1996

REFERENCE BOOKS

3.”Slow speed Diesel Engine”, Institute of Marine Engineer
4. D K Sanyal,”Principal & Practice of Marine Diesel Engines”, 2nd edition
5.”Marine Low Speed Diesel Engine”, Denis Griffiths.
6.”Lamb’s Question and Answer Marine Diesel Engine”
7.”Diesel Engine”,A.J.Wharton

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MARINE ELECTRICAL TECHNOLOGY

Course Code	**18MR 63**	IA Marks	40
Number of Lecture Hours/Week	03	Exam Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: The students should be able to have:

- Theoretical and practical knowledge of the Electrical systems on Board ships.
- Grasp of the troubleshooting aspects of marine electrical systems.

Module - 1

Power Distribution and Regulations:

The marine environment – effects of inclination – Generators – Power supply commonly available – main switchboard Do"s and Don"ts – Electric shock – first aid – conditions of shock risk. Requirements & Regulations – safe electrical equipments for hazardous areas –tanker, Systems of AC distribution – general concept – single, two and three phase systems with 2,3 and 4 wires – power distribution – general Distribution scheme – specific systems for ship's service – tankers schemes – primary power bus – need for emergency power supply – method of supply – passenger and cargo vessels requirements – shore supply –precautions to be taken while consuming shore supply –arrangement to ensure proper phase supply .

Module - 2

Instrumentation and Switch gear:

Insulated & Earthed neutral systems – introduction – circuit faults – causes –prevention – earth fault indicators – detection and clearance – alternators. AVR: excitation systems ,effect of kW and Kvar Loading.

Paralleling of Alternators: Manual and auto synchronizing – lamps – parallel operation –load sharing – kW, kVAR.

Switchboards & Switchgear: Main and sub switchboard-Rating and Characteristics of Main switchboards and circuit breakers, different types of circuit breakers.

Fault protection devices – introduction – over-voltage-surge- – DC generator protection –alternator and system protection – protection through fuses – protection Discrimination Motor Protection.

Module - 3

Cables and Lighting Systems:

Electrical Cables: Cables- conductors – Wire Sizes-Current Rating Insulation – protection and temperature ratings – insulation classes – A, B, E, F,H Insulation for High temperatures – Insulating Materials – Cable insulation & Sheath– Cable gland – Degrees of Protection – Temperature Ratings – Temperature Rise.

Lighting Systems: Introduction – Incandescent Lamps – Discharge lamps – HCLPMF lamps – High pressure Mercury Fluorescent lamps – High and Low pressure sodium vapour lamps .

Navigation & signal lights – Signals for a power driven ship under way (At night) – Emergency lighting.

High voltage systems on board ship- brief introduction and requirements.

Module - 4

Propulsion and Steering Systems:

Propulsion Systems: Auxiliary propulsion systems – Layout and Optimizing storage space – Electrical Propulsion – Advantages & Disadvantages DC constant current systems – DC motor supplied from alternators – Turbo – electric propulsion – AC single speed and Induction motor drives – Fixed speed alternators – Cyclo converter device-Diesel Electric propulsion – Thruster and Water jet propulsion. Electro hydraulic Steering system.

Motors and Motor starting systems.

Module - 5

Auxillaries and Batteries:

Batteries & Battery charging: Battery supplies – Lead-acid batteries – Electrical Characteristics – Nickel – Cadmium batteries – Sealed Ni-Cd batteries – Battery charging – Charging from AC and DC mains – Standby Emergency batteries – Voltage Regulators – Battery insulation & safety measures – First Aid treatment –Gas analysers - Combustible gas indicator – Portable oxygen analyzer – CO2 Analysis – Tank scope – Fixed oxygen Analyser. Cathodic protection system.

Course Outcomes: At the end of this course, student will be able to:

- Have a knowledge of Different Types of Electrical distribution Systems
- Have knowledge of Regulations observed onboard ships regarding electrical equipments.
- Have knowledge of Different types of electrical Instruments and Switch Gear used on board Ship.
- Have knowledge of using electrical instruments, to find out and rectify various kinds of faults

onboard ships.

- Have a knowledge of maintenance of electrical equipments, instruments, system components etc

TEXT BOOKS:

1. BOWIC C.T., Marine Electrical Practice, 5th Edition, "Butter Worth", London, 1981.
2. LAW S.W., "Electricity applied to Marine Engineering", 4th Edition, "The Institute of Marine Engineers", London, 1998.

REFERENCE BOOKS

1. Elstan.A. Fernandez., "Marine Electrical Technology", 1st Edition, "Sterling Book House", Mumbai, 2002.
2. Elstan.A. Fernandez., "Marine Electrical Technology", 4th Edition, "Shroff Publishers & Distributors Pvt. Ltd.,Mumbai, 2007.
3. Surinder Pal Bali," Electrical Technology Machines and Measurements", Vol II, 1st Ed. Pearson, 2013
4. Surinder Pal Bali," Electrical Technology Machines and Measurements", Vol.I, 1st Ed. Pearson, 2013

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Professional Elective-I
ADVANCED MARINE TECHNOLOGY

Course Code	**18MR641**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

Course Learning Objective:

- To give the students a knowledge of Oil Tankers and their construction.
- To make the student aware of Gas Tankers and their systems.
- To gain knowledge of operations on board Tankers.
- To have a knowledge of dangerous cargo and the precautions to be taken.
- To have a knowledge of the operation of special duty vessels.

Module - 1

Oil Tankers: Origin of double hull ships, their usefulness and superiority over conventional single skin ships, IMO requirements, schedule for phasing out single hull tank vessels of different sizes. Types and classification, construction, COW system, IG system , cargo pumps and Pipeline systems – Ring main – Direct Line – Combined – Free flow system – Stripping lines. Safety devices associated with loading and discharging.

Module - 2

Gas Tankers:
Principles Of Gas Carrier Design: Design standards and ship types, Cargo containment systems, materials of construction and insulation, Gas carrier types.
The Ship — Equipment And Instrumentation: Cargo pipelines and valves,cargo pumps, cargo heaters, cargo vaporizers, reliquification plants and boil off control,cargo compressors and associated equipment, IG and nitrogen gas systems, electrical equipment in gas Dangerous spaces.

Module - 3

Oil tanker , cargo and routine operations:
Lining up pipe lines and cargo operations – loading more than one grade – discharging –ballasting – precautions – ship / shore check list safety goods – sources of ignition on – static electricity – precautions to prevent ignition due to static electricity cargo operations when not secured alongside – procedure if oil spill occurs – oil record books. Uses of inert gas during tanker operating cycle. Tank washing: Procedure – portable and fixed machines – tank washing with water –washing atmospheres – crude oil washing (COW) – advantages and disadvantages of COW – operating and safety procedures – gas freeing – pressure vacuum values – "Load on Top" system (LOT) regulations and operation – Segregated Ballast Tanks (SBT).

Module - 4

Intrinsically Dangerous Cargos : Dangerous goods – loaded in bulk – packaging – IMDG code – emergency procedures – „MS & M" notices – general fire precautions, during loading / discharging, - fire fighting and detection system. Liquefied gas cargoes – regulations types of cargo and carriers – LPG and LNG – cargo handling equipments tank monitors and controls – operational procedures loading and discharging of LPG/LNG cargoes – chemical cargoes regulations, operations – bulk chemical carriers – tank material and coatings – tank washing – cargo record book – equipment items precautions to be observed during cargo operations in port – fire protection – personnel protection.

Module - 5

Operation of Special Duty vessels:
Bulk carriers – Bulk Grain and ore etc., - Banana carriers – Coal Carriers – Forest Products carriers – Timber carriers – Container vessels-Ro Ro ships.

Course Outcomes:

1. The student shall be able to understand the Cargo Operations of Oil tankers.
2. The student shall be able to know Inert Gas Systems and Tank Washing Operations of Tankers.
3. The student shall be able to understand Cargo Operations of Chemical tankers, LPG / LNG vessels.
4. The student shall be able to describe the rules of classification societies for Cargo Ships and Tankers.

TEXT BOOKS:

1. Lavery, "Ship board operation", 2nd Edition, Butter Worth- Heinemann, London, 1990.
2. Liquefied Gas Handling Principles On Ships and in Terminals- McGuire and White
3. Cargo Work For Maritime Operations-D.J. House

REFERENCE BOOK

1. D.J. Eyres, "Ship Construction", 4th Edition, Butter worth – Heinemann, Oxford, 1994.

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Professional Elective-I
CONTROL ENGINEERING

Course Code	**18MR642**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: This course provides

1. To Identify the basic elements and structures of feedback control systems
2. To Construct Bode and polar plots for rational transfer functions
3. To recognize the properties of root-locus for feedback control systems with a single variable parameter.
4. To design and evaluate the performance of different Mechanical correction system.

Module - 1

Introduction: Concept of automatic controls, Open loop and closed loop systems, Concepts of feedback, requirements of an ideal control system, Types of controllers- Proportional, Integral Proportional Integral, Proportional Integral Differential controllers.

Mathematical Models: Transfer function models, models of mechanical systems, models of electrical circuits, DC and AC motors in control systems, models of thermal systems, models of hydraulic systems, pneumatic system, Analogous systems: Force voltage, Force current. .

Module - 2

Block Diagrams and Signal Flow Graphs: Transfer Functions definition, function, blocks representation of systems elements, reduction of block diagrams, Signal flow graphs: Mason's gain formula.

Transient and Steady State Response Analysis: Introduction, first order and second order system response to step, ramp and impulse inputs, concepts of time constant and its importance in speed of response. System stability: Routh's-Hurwitz Criterion.

Module - 3

Frequency Response Analysis: Polar plots, NYQUIST stability criterion, Stability analysis, Relative stability concepts, Gain margin and phase margin.

Frequency Response Analysis Using Bode Plots: Bode attenuation diagrams, Stability analysis using Bode plots, Simplified Bode Diagrams.

Module - 4

Root Locus Plots: Definition of root loci, General rules for constructing root loci, Analysis using root locus plots.

Programmable logical controllers: Integrated automation control and monitoring (ICAMS), Computer programmable controller, Relay circuit unit, Digital sequential control devices, Control mechanism of PLC

Module - 5

System Compensation and State Variable Characteristics of Linear Systems: Series and feedback compensation, Introduction to state concepts, state equation of linear continuous data system. Matrix representation of state equations, controllability and observability, Kalman and Gilberts test.

Course Outcome: The student shall be able to

1. To identify and enumerate different Bode and polar plots for rational transfer functions
2. To Verify automation / control systems using good design practice
3. To Understand the purpose, functions, and operations of a PLC
4. To design and evaluate the performance of different Mechanical correction system.

Text Books:

1. Modern Control Engineering, Katsuhiko Ogatta, Pearson Education,2004.
2. Control Systems Principles and Design, M.Gopal, 3rd Ed., TMH,2000.

Reference books:

1. Modern Control Systems, Richard.C.Dorf and Robert.H.Bishop, Addison Wesley,1999
2. System dynamics & control, Eronini-Umez, Thomson Asia pte Ltd. singapore, 2002.
3. Feedback Control System, Schaum's series. 2001.

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Professional Elective-I
MECHANICS OF COMPOSITE MATERIAL

Course Code	**18 MR 643**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:
The Course Learning Objectives are to train students to be able to design composite structures, select composite materials, conduct stress analyses of selected practical applications using laminated plate theories and appropriate strength criteria, and be familiar with the properties and response of composite structures subjected to mechanical loading under static and cyclic conditions.

Module - 1

Introduction to composite materials:
Introduction, What is a composite material, Current and potential advantages of fiber reinforced composites, Applications of composite materials, Military, civil, space, automotive and commercial applications

Module - 2

Macro and micro mechanical behavior of a lamina:
Stress strain relations for anisotropic materials, Restrictions on engineering constants, Strengths of an orthotropic lamina, biaxial strength criteria for orthotropic lamina.

Module - 3

Micro mechanical behavior of lamina and laminates:
Mechanical of material approach to stiffness, Elasticity approach to stiffness, Classification lamination theory, Special cases, strength of laminates

Module - 4

Buckling and Vibration of laminated plates:
Governing equations for bending buckling and vibration of laminated plates, Deflection of simply supported laminated plates, Vibration of simply supported laminated plates.

Module - 5

Design of composite structures:
Introduction, design philosophy, anisotropic analysis, Bending extension coupling, Micromechanics, Non-linear behavior, Interlaminar stresses, transverse shearing, Laminate optimization.

Course Outcomes: The student shall be able to

1. Understand the concept of composite materials.
2. Analyze macro and micro mechanical behavior of lamina.
3. Develop governing equations for bending, buckling and vibrations in laminated plates.
4. Analyze and design composite structures used in aerospace, marine, automobile and other applications
5. Know about composite materials and their processing.

TEXT BOOKS:

1. Composite Science and Engineering, K. K. Chawla Springer Verlag 1998.
2. Mechanics of composite materials, Autar K. Kaw CRC Press New York.
3. Principles of composite material mechanics, Ronald F. Gibson, CRC Press, 2011.
4. Mechanics of Composite Materials, Robert M Jones, Taylor & Francis, 2000

REFERENCE BOOKS

1. Composite materials hand book, MeingSchwaitz," McGraw Hill book company.1984
2. Mechanics of Composite Materials and Structures, MadhujitMukhopadhyay , Universities Press 2009
3. Fiber Reinforced Composites, P. K. Mallick, Marcel Dekker,Inc

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Professional Elective -I
DESIGN OF MACHINE ELEMENTS

Course Code	**18MR644**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: This course provides

- Be able to analyse the stress and strain on mechanical components; and understand, identify and quantify failure modes for mechanical parts.

Module – 1

Introduction: Definitions: normal, shear, biaxial and tri axial stresses, Stress tensor, Principal Stresses. Engineering Materials and their mechanical properties, Stress-Strain diagrams, Design considerations: Codes and Standards

Design For Static & Impact Strength: Static Strength: Static loads and factor of safety, Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Maximum strain theory, Strain energy theory, Distortion energy theory. Failure of brittle and ductile materials, Stress concentration, Determination of Stress concentration factor. Impact Strength: Introduction, Impact stresses due to axial, bending and torsional loads, effect of inertia.

Module – 2

Design For Fatigue Strength: Introduction- S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Modifying factors: size effect, surface effect, Stress concentration effects, Fluctuating stresses, Goodman and Soderberg relationship, stresses due to combined loading, cumulative fatigue damage

Module – 3

Design Of Shafts: Torsion of shafts, design for strength and rigidity with steady loading, ASME codes for power transmission shafting, shafts under fluctuating loads and combined loads.

Cotter And Knuckle Joints: Design of Cotter and Knuckle joints.

Module – 4

IC Engine Parts and Bearings: Design of piston, Design of trunk pistons , buckling of connecting rod, forces in connecting rod, cross section for connecting rod, design procedure for connecting rod, design procedure for crank shaft.center crankshaft at top dead center position and at an angle of maximum torque, side or overhung crankshaft at top dead center position and at an angle of maximum torque.

Bearings: bearing modulus co-effcient of friction minimum oil film thickness heat generated an heat dissipated and bearing materials .examples of journal bearing and thrust bearing.

Module – 5

Spur & Helical Gears: Spur Gears: Definitions, stresses in gear tooth, Lewis equation and form factor, Design for strength, Dynamic load and wear load. Helical Gears: Definitions, formative number of teeth, Design based on strength, dynamic and wear loads.

Course Outcomes: The student shall be able to

1. At the completion of the course the students are expected to have knowledge in,
2. Using Different types of Bearings.
3. Design of IC Engine parts and gears.
4. Design of Marine Machinery systems.

DESIGN DATA HANDBOOK:

1. Design Data Hand Book , K. Lingaiah, McGraw Hill, 2 Ed.
2. Data Hand Book, K. Mahadevan and Balaveera Reddy, CBS Publication
3. Design Data Hand Book, H.G. Patil, I. K. International Publisher, 2010

TEXT BOOKS:

1. Mechanical Engineering Design, Joseph E Shigley and Charles R. Mischke. McGraw Hill International edition, 6th Edition 2003.
2. Design of Machine Elements, V. B Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007

REFERENCE BOOKS

1. Machine Design, Robert L. Norton, Pearson Education Asia, 2001
2. Design of Machine Elements, M. F. Spotts, T. E. Shoup, L. E. Hornberger, S. R. Jayram and C. V. Venkatesh, Pearson Education, 2006.
3. Machine Design, Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008

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Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
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Open Elective-A
AUTOMATION AND INDUSTRIAL ROBOTICS

Course Code	**18MR651**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: This course provides

- To identify potential areas for automation and justify need for automation.
- To select suitable major control components required to automate a process or an activity
- To study the various parts of robots and fields of robotics.
- To study the various kinematics and inverse kinematics of robots.
- To study the control of robots for some specific applications.

Module - 1

Introduction to automation Basic elements of an automated system, advanced automation functions, levels of automation, process industries versus discrete manufacturing industries, continuous versus discrete control, computer process control. Hardware components for automation and process control, sensors, actuators, analog to digital converters, digital to analog converters, input/output devices for discrete data .

Module - 2

Automated production lines Fundamentals of automated production lines, application of automated production lines, analysis of transfer lines, automated assembly systems, fundamentals of automated assembly systems, quantitative analysis of assembly systems, automatic identification methods, barcode technology, radio frequency identification, other AIDC technologies

Module - 3

Industrial Robotics Robotic configuration, robot anatomy and related attributes, robot control systems, end effectors, sensors in robotics, industrial robot applications, robot accuracy and repeatability, different types of robotics, various generations of robots, degrees of freedom – Asimov's laws of robotics dynamic stabilization of robots

Module - 4

Spatial descriptions and transformations Positions, orientations, and frames. Mappings: Changing descriptions from frame to frame. Operators: translations, rotations and transformations, transformation arithmetic transform equations, transformation of free vectors computational considerations, manipulator Kinematics, link description, link-connection description, actuator space joint space and Cartesian space

Module - 5

Robot programming Introduction, levels of robot programming, requirements of robot programming language, problems pertaining to robot programming languages, offline programming systems, central issues in OLP systems, automating subtasks in OLP systems, simple programs on robot applications.

Course Outcomes: The student shall be able to

- To translate and simulate a real time activity using modern tools and discuss the benefits of automation.
- To identify suitable automation hardware for the given application.
- To recommend appropriate modelling and simulation tool for the given manufacturing application.
- To explain the basic principles of Robotic technology, configurations, control and programming of Robots.
- To explain the basic principles of programming and apply it for typical Pick & place, loading & unloading and palletizing applications

TEXT BOOKS:

(1) Automation, Production systems, and computer integrated manufacturing-MikellP.Groover 3rd edition, Pearson 2009
(2) Introduction to robotics mechanics and control- John J.Craig 3rd edition, Pearson 2009

REFERENCE BOOKS:

(1) Robotics for Engineers –YoramKoren, McGraw Hill International, 1st edition, 1985.
(2) Industrial Robotics-Groover, Weiss, Nagel, McGraw Hill International, 2nd edition, 2012.
(3) Robotic Engineering - An Integrated approach, Klafter, Chmielewski and Negin, PHI, 1st edition,

2009.
(4) Computer Based Industrial Control- Krishna Kant, EEE-PHI,2nd edition,2010.
(5) An Introduction to Automated Process Planning Systems- Tiess Chiu Chang & Richard A. Wysk

B.E, VI Semester, Marine Engineering
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
(Effective from the academic year 2018-19)

Open Elective-A
NON TRADITIONAL MACHINING

Course Code	**18 MR652**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: This course provides

1. To identify the basic non-traditional process principles and theory.
2. To understanding of Ultrasonic, water jet and abrasive processes.
3. To recognize the mathematical tools used to analyse laser processes.
4. To design a metal cutting system for optimal performance.

Module - 1

Introduction: History, Classification, comparison between conventional and Non-conventional machining process selection.

Ultrasonic Machining (USM): Introduction, equipment, tool materials &tool size, abrasive slurry, cutting tool system design: - Effect of parameter: Effect of amplitude and frequency and vibration, Effect of abrasive grain diameter, effect of applied static load, effect of slurry, tool & work material, USM process characteristics: Material removal rate, tool wear, Accuracy, surface finish, applications, advantages & Disadvantages of USM.

Module - 2

Abrasive Jet Machining (AJM): Introduction, Equipment, Variables in AJM: Carrier Gas, Type of abrasive, size of abrasive grain, velocity of the abrasive jet, mean number, abrasive particles per unit volume of the carrier gas, work material, standoff distance (SOD), nozzle design, shape of cut. Process Characteristics-Material removal rate, Nozzle wear, Accuracy &surface finish. Applications, advantages & Disadvantages of AJM. Water Jet Machining: Principal, Equipment, Operation, Application, Advantages and limitations of water Jet machinery.

Plasma Arc Machining (Pam): Introduction, equipment, non-thermal generation of plasma, selection of gas, Mechanism of metal removal, PAM parameters, process characteristics. Safety precautions, Applications, Advantages and limitations

Module - 3

Electrochemical Machining (ECM): Introduction, study of ECM machine, elements of ECM process: Cathode tool, Anode work piece, source of DC power, Electrolyte, chemistry of the process, ECM Process characteristics –Material removal rate, Accuracy, surface finish,

ECM Tooling: ECM tooling. technique & example, Tool & insulation materials, Tool size Electrolyte flow arrangement, Handling of slug, Economics of ECM, Applications such as Electrochemical turning, Electrochemical Grinding, Electrochemical Honing, deburring, Advantages, Limitations.

Module - 4

Laser Beam Machining (LBM): Introduction, equipment of LBM mechanism of metal removal, LBM parameters, Process characteristics, Applications, Advantages & limitations.

Electron Beam Machining (EBM): Principles, equipment, operations, applications, advantages and limitation of EBM

Module - 5

Electrical Discharge Machining (EDM): Introduction, mechanism of metal removal, dielectric fluid, spark generator, EDM tools (electrodes) Electrode feed control, Electrode manufacture, Electrode wear, EDM tool design, choice of machining operation, electrode material selection, under sizing and length of electrode, machining time. Flushing; pressure flushing, suction flushing, side flushing, pulsed flushing synchronized with electrode movement, EDM process characteristics: metal removal rate, accuracy, surface finish, Heat Affected Zone. Machine tool selection, Application, EDM accessories / applications, electrical discharge grinding, Traveling wire EDM.

Course Outcomes: The student shall be able to

- Discuss the principle of working of NTM process
- Explain the need for NTM processes
- Describe the various equipment used for NTM processes
- Describe in detail the methods of Laser beam ,plasma arc, electro chemical, ultrasonic, abrasive jet and water jet Machining
- Distinguish between the various NTM processes

- Discuss applications of NTM methods
- Explain the advantages and disadvantages of NTM

TEXT BOOKS:

1.Modern machining process, Pandey and Shan, Tata McGraw Hill2000
2. New Technology, Bhattacharya 2000.

REFERENCE BOOKS:

1 Production Technology, HMT Tata McGraw Hill. 2001
2. Modern Machining Process, Aditya. 2002
3. Non-Conventional Machining, P.K.Mishra, The Institution of Engineers (India) Test book series, Narosa Publishing House –2005.
4. Metals Handbook: Machining Volume 16, Joseph R. Davis(Editor), American Society of Metals (ASM)00

Open Elective -A
ENERGY ENGINEERING
B.E, VI Semester, Marine Engineering
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(Effective from the academic year 2018-19)

Course Code	**18MR653**	IA Marks	40
Number of Lecture Hours/Week	03 Tutorial	EXAM Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: This course provides

1. The foundation for understanding the steam power plant and boilers for marine engineering.
2. Topics are designed to explore the energy conversion techniques
3. Concepts of accessories and problem associated with energy conversion
4. Concepts of use of solar, wind, tidal energy applications are highlighted.

Module – 1

Steam Power Plant: Different Types of Fuels used for steam generation, Equipment for burning coal in lump form, strokers, different types, Oil burners, Advantages and Disadvantages of using pulverized fuel, Equipment for preparation and burning of pulverized coal, unit system and bin system. Pulverized fuel furnaces, cyclone furnace, Coal and ash handling, Generation of steam using forced circulation, high and supercritical pressures.

Module – 2

A Brief Account of Benson, Velox Schmidt Steam Generators.
Chimneys: Natural, forced, induced and balanced draft, Calculations and numerical involving height of chimney to produce a given draft. Cooling towers and Ponds. Accessories for the Steam generators such as super heaters, De super heater, control of super heaters, Economizers, Air pre heaters and re-heaters. Diesel Engine Power Plant: Applications of Diesel Engines in Power field. Method of starting Diesel engines. Auxiliaries like cooling and lubrication system, filters, centrifuges, Oil heaters, intake and exhaust system, Layout of diesel power plant.

Module – 3

Nuclear Power Plant: Principles of release of nuclear energy; Fusion and fission reactions. Nuclear fuels used in the reactors. Multiplication and thermal utilization factors. Elements of the nuclear reactor; moderator, control rod, fuel rods, coolants. Brief description of reactors of the following types-Pressurized water reactor, Boiling water reactor, Sodium graphite reactor, Fast Breeder reactor, Homogeneous graphite reactor and gas cooled reactor, Radiation hazards, Shielding, Radioactive waste disposal.
Hydro-Electric Plants: Hydrographs, flow duration and mass curves, unit hydrograph and numerical. Storage and pondage, pumped storage plants, low, medium and high head plants, Penstock, water hammer, surge tanks, gates and valves. General layout of hydel power plants.

Module - 4

Solar Energy: Solar Extra terrestrial radiation and radiation at the earth surface, radiation-measuring instruments, working principles of solar flat plate collectors, solar pond and photovoltaic conversion (Numerical Examples).
Wind Energy: Properties of wind, availability of wind energy in India, wind velocity and power from wind; major problems associated with wind power, wind machines; Types of wind machines and their characteristics, horizontal and vertical axis wind mills, coefficient of performance of a wind mill rotor (Numerical Examples).

Module – 5

Tidal Power: Tides and waves as energy suppliers and their mechanics; fundamental characteristics of tidal power, harnessing tidal energy, limitations. Ocean Thermal Energy Conversion: Principle of working, Rankine cycle, problems associated with OTEC.
Geothermal Energy Conversion: Principle of working, types of geothermal station with schematic diagram, problems associated with geothermal conversion, scope of geothermal energy. Energy From Bio Mass: Photosynthesis, photosynthetic oxygen production, energy plantation. Bio Chemical Route: Biogas production from organic wastes by anaerobic fermentation, classification of bio gas plants, factors affecting bio gas generation.

Course Outcomes: The student shall be able to

1. Describe the steam power plant and boilers for the power generation application.

2. Understand the concept of steam generator 3. Explain the diesel engines used for power generation. 4. Understand the working of nuclear and hydro power plants. 5. Know about composite solar energy, wind energy , tidal energy and geothermal energy .
TEXT BOOKS: 1. Power Plant Engineering, P. K. Nag Tata McGraw Hill 2nd edn 2001. 2. Power Plant Engineering, Domakundawar, Dhanpath Rai sons. 2003
REFERENCE BOOKS 1. Power Plant Engineering, R. K. Rajput, Laxmi publication, New Delhi. 2. Principles of Energy conversion, A. W. Culp Jr., McGraw Hill. 1996 3. Non conventional Energy sources, G D Rai Khanna Publishers. 4. Non conventional resources, B H Khan TMH - 2007

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Open Elective-A
MICRO AND SMART TECHNOLOGY

Course Code	**18 MR654**	CIE Marks	40
Number of Lecture Hours/Week	3	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: This course provides

- Knowledge of Micro and Smart system Technology is essential for Mechatronic students and the course aims at training students in smart Mechatronic systems, sensors etc.

Module - 1

Introduction to Micro and Smart Systems:
a) What are smart-material systems? Evolution of smart materials, structures and systems. Components of a smart system. Application areas. Commercial products.
b) What are micro systems? Feynman's vision. Micro machined transducers. Evolution of micro-manufacturing. Multi-disciplinary aspects. Applications areas. Commercial products.
Micro And Smart Devices And Systems: Principles And Materials:
a) Definitions and salient features of sensors, actuators, and systems.
b) Sensors: silicon capacitive accelerometer, piezo-resistive pressure sensor, blood analyser, conduct metric gas sensor, fibber-optic gyroscope and surface-acoustic-wave based wireless strain sensor.
c) Actuators: silicon micro-mirror arrays, piezo-electric based inkjet print head, electrostatic comb-drive and micro motor, magnetic micro relay, shape memory-alloy based actuator, electro-thermal actuator
d) Systems: micro gas turbine, portable clinical analyser, active noise control in a helicopter cabin

Module - 2

Micro-Manufacturing and Material Processing:
a) Silicon wafer processing, lithography, thin-film deposition, etching (wet and dry), wafer-bonding, and metallization.
b) Silicon micromachining: surface, bulk, moulding, bonding based process flows.
c) Thick-film processing:
d) Smart material processing:
e) Processing of other materials: ceramics, polymers and metals
f) Emerging trends

Module - 3

Modelling:
a) Scaling issues.
b) Elastic deformation and stress analysis of beams and plates. Residual stresses and stress gradients. Thermal loading. Heat transfer issues. Basic fluids issues.
c) Electrostatics. Coupled electromechanics. Electromagneticactuation. Capillary electro-phoresis. Piezo resistive modelling. Piezoelectric modelling. Magnetostrictive actuators.

Module - 4

Integration and Packaging Of Microelectro Mechanical Systems:
Integration of microelectronics and micro devices at wafer and chip levels. Microelectronic packaging: wire and ball bonding, flip-chip. Low temperature-cofired-ceramic (LTCC) multi-chip-module technology. Microsystem packaging examples.

Module - 5

Electronics, Circuits and Control:
Carrier concentrations, semiconductor diodes, transistors, MOSFET amplifiers, operational amplifiers. Basic Op-Amp circuits. Charge-measuring circuits. Examples from microsystems. Transfer function, state-space modelling, stability, PID controllers, and model order reduction. Examples from smart systems and micro machined accelerometer or a thermal cycler.

Course Outcomes: The student shall be able to

- Students will be able to demonstrate their knowledge in Micro and Smart System Technology in Industrial applications.

TEXT BOOKS:

1. "Micro and Smart Systems" by Dr. A. K. Aatre, Prof. Ananth Suresh, Prof.K.J.Vinoy, Prof. S. Gopalakrishna,, Prof. K.N. Bhat., John Wiley Publications

2. MEMS & Microsystems: Design and Manufacture, Tai-Ran Tsu,Tata Mc-Graw-Hill.

REFERENCE BOOKS:

1. Animations of working principles, process flows and processing techniques, A CD-supplement with Matlab codes, photographs andmovie clips of processing machinery and working devices.
2. Laboratory hardware kits for (i) BEL pressure sensor, (ii) thermal-cycler and (iii) active control of a cantilever beam.
3. Microsystems Design, S. D. Senturia, 2001, Kluwer Academic Publishers, Boston, USA. ISBN 0-7923-7246-8.
4. Analysis and Design Principles of MEMS Devices, Minhang Bao, Elsevier, Amsterdam, The Netherlands, ISBN 0-444-51616-6.
5. Design and Development Methodologies, Smart Material Systems and MEMS: V. Varadan, K. J. Vinoy, S. Gopalakrishnan, Wiley.
6. MEMS- Nitaigour Premch and Mahalik, TMH 2007

HEAT TRANSFER LAB
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Course Code	**18MRL66**	**CIE Marks**	**20**
Number of Lecture Hours/Week	**03 (1 Hour Instruction+ 2 Hours Laboratory)**	**SEE Marks**	**60**
RBT Levels	**L1, L2, L3**	**Exam Hours**	**03**

Credits – 02

Course Learning Objectives: Students are expected-

- To demonstrate the concepts discussed in the Heat & Mass Transfer course.
- To experimentally determine thermal conductivity and heat transfer coefficient through various materials.
- To experimentally measure effectiveness of heat exchangers.
- To conduct performance tests on refrigeration & air conditioning systems.

PART – A

1. Determination of Thermal Conductivity of a Metal Rod.
2. Determination of Overall Heat Transfer Coefficient of a Composite wall.
3. Determination of Effectiveness on a Metallic fin.
4. Determination of Heat Transfer Coefficient in a free Convection on a vertical tube.
5. Determination of Heat Transfer Coefficient in a Forced Convention Flow through a Pipe.
6. Determination of Emissivity of a Surface

PART – B

1. Determination of Steffan Boltzman Constant.
2. Determination of LMDT and Effectiveness in a Parallel Flow and Counter Flow Heat Exchangers
3. Experiments on Boiling of Liquid and Condensation of Vapour
4. Performance Test on a Vapor Compression Refrigeration.
5. Performance Test on a Vapour Compression Air – Conditioner
6. Experiment on Transient Conduction Heat Transfer

Course Outcomes: At the end of the course, the students will be able to:

- To practically relate to concepts discussed in the Heat & Mass Transfer course.
- To conduct various experiments to determine thermal conductivity and heat transfer coefficient in various materials.
- To select appropriate materials & designs for improving effectiveness of heat transfer.
- To conduct performance tests and thereby improve effectiveness of heatexchangers.
- To conduct performance tests and thereby improve effectiveness of refrigeration and air conditioning systems.

REFERENCE BOOKS

1. M. NecatiOzisik, Heat Transfer – A Basic Approach, McGraw Hill, New York, 2005.
2. Incropera, F. P. and De Witt, D. P., Fundamentals of Heat and Mass Transfer, 5th Edition, John Wiley and Sons, New York, 2006.
3. Holman, J. P., Heat Transfer, 9th Edition, Tata McGraw Hill, New York, 2008.

Scheme of Examination:
ONE question from part -A: 40 Marks
ONE question from part -B: 40 Marks
Viva –Voce :20 Marks
Total: 100 Marks

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MARINE ELECTRICAL LAB

Course Code	**18MRL67**	CIE Marks	20
Number of Lecture Hours/Week	03 (1 Hour Instruction+ 2 Hours Laboratory)	SEE Marks	60
RBT Levels	L1, L2, L3	Exam Hours	03

Credits – 02

Course Learning Objectives:

- Information to supplement to the Electric Machines (15MR61) course.
- The ability to conduct testing and experimental procedures on different types of electrical machines
- A chance to practice different types of wiring and devices connections.
- The capability to analyze the operation of electric machines under different loading conditions

PART – A

1. Load characteristics of a D.C. shunt and compound generator. Compound generator
   i) Short shunt-Cumulative and Differential
   (ii) Long shunt-Cumulative and Differential.
2. Load test on a DC motor- determination of speed-torque and HP-efficiency characteristics.
3. Swinburne's Test.
4. Hopkinson's Test.
5. Fields test on series motors.

PART – B

1. Retardation test- electrical braking method.
2. Speed control of DC motor by armature voltage control and flux control.
3. Ward Leonard method of speed control of D.C. motor.
4. Voltage regulation of an alternator by EMF and MMF method

Course Outcomes: Students will be able to

- Understand the concept of efficiency and the short circuit impedance of a three-phase transformer from no-load test, winding resistance, short circuit test, and load test.
- Understand the effect of unbalanced loading on a three-phase transformer with different connections, and the effects and limitations of each connection.
- Study series and parallel connections of three-phase transformers.
- Experimentally obtain the load characteristics of various dc motors and generators.
- Experimentally obtain the load characteristics, starting current and starting torque of a squirrel-cage induction motor and to derive circuit parameters from no-load and blocked-rotor tests.

Scheme of Examination:
ONE question from part -A: 40 Marks
ONE question from part -B: 40 Marks
Viva –Voce :20 Marks
Total: 100 Marks

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MECHANICAL VIBRATION

Course Code	**18MR71**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 04

Course Learning Objectives: This course provides

1. To fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions,
2. To be able to obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF),
3. To be able to write the differential equation of motion of vibratory systems,
4. To be able to make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi degree of freedom linear systems.

Module - 1

Introduction: Types of vibrations, Definitions, Simple Harmonic Motion (S.H.M.), Principle of super position applied to SHM, Beats, Fourier Theorem and problems.

Module - 2

Undamped (Single Degree of Freedom) Free Vibrations: Derivations for spring mass systems, Methods of Analysis, Springs in series and parallel, Natural frequencies of simple systems and Problems.
Damped free vibrations (Single Degree of Freedom): Introduction to Damping, Analysis with viscous damping - Derivations for over, critical and under damped systems, Logarithmic decrement and Problems.

Module - 3

Forced Vibrations (Single Degree of Freedom): Introduction, Analysis of forced vibration with constant harmonic excitation - magnification factor, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, Numerical Problems.
Vibration Measuring Instruments and Whirling of shafts: Seismic Instruments – Vibrometers, Accelerometer, Frequency measuring instruments (Without Numericals). Whirling of shafts with and without damping and Problems.

Module - 4

Numerical Methods for multi degrees of freedom systems: Introduction, Maxwell's reciprocal theorem, Influence coefficients, Rayleigh's method, Dunkley's method, Stodola method, Holzer's method, Orthogonality of principal modes, and Problems.

Module - 5

Modal analysis and Condition Monitoring: Signal analysis, dynamic testing of machines and structures, Experimental modal analysis, Machine condition monitoring techniques and diagnosis,
Acoustics, noise and control: Microphones, sound level meters, sound intensity probes, spectrum analyzers, FFT.

Course Outcomes: The student shall be able to

1. Appreciating the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions
2. Ability to analyse the mathematical model of a linear vibratory system to determine its response
3. Ability to obtain linear mathematical models of real life engineering systems
4. Ability to use Lagrange's equations for linear and nonlinear vibratory systems
5. Ability to determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation.

TEXT BOOKS:

1. Mechanical Vibrations, S. S. Rao, Pearson Education Inc, 4th edition, 2003.
2. Mechanical Vibrations, V. P. Singh, Dhanpat Rai & Company, 3rd edition, 2006.

REFERENCE BOOKS

1. Theory of Vibration with Applications, W. T. Thomson, M. D.Dahleh and C. Padmanabhan, Pearson Education Inc, 5th edition,2008.
2. Mechanical Vibrations: S. Graham Kelly, Schaum's outline Series,Tata McGraw Hill, Special Indian Edition, 2007.
3. Theory and Practice of Mechanical Vibrations: J. S. Rao & K.Gupta, New Age International Publications, New Delhi, 2001.
4. Mechanical Vibrations, G. K.Grover, Nem Chand and Bros, 6th edition, 1996.
5. Noise Control from Concept to Applications, Taylor and Francis, 2005

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ADVANCED MARINE AUXILIARY MACHINES

Course Code	**18MR72**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: The students should be able to have:

- Theoretical Knowledge of the auxiliary equipments on ships.
- Knowledge of oily water separator, sewage, incenerator and MARPOL equipment on ships.
- Knowledge of the refrigeration systems on ships.
- Knowledge of the air compressors and their working
- Knowledge of the maintenance procedures on board ships.

Module – 1

MARPOL EQUIPMENT

Introduction to MARPOL and its ANNEXES, Prevention of oil, garbage, sewage, air pollution and IMO requirement as per MARPOL act. Operation, construction, maintenance of oil water separator both manual and automatic versions. Construction, operation, maintenance of incinerator and the of sewage plant.

Module – 2

THEORY OF OIL PURIFICATION /AIR COMPRESSAOR AND DECK EQUIPMENT: Construction, operation, maintenance of fuel oil and lub oil purifiers, clarifiers together with self de- sludge operation. Theory of air compression and uses of compressed air on board. Construction, operation, maintenance of main air compress and emergency air compressors. Types of bow thrusters, operation, maintenance of the same and Deck machinery, operation, maintenance of cargo winches, windless mooring winches.

Module – 3

Refrigeration and air-conditioning:

Basic principles of refrigeration and refrigeration cycles. Typical marine refrigerating plants with multiple compression and evaporator system, Operation and maintenance of refrigeration plants, control of temperature in different chambers, charging of refrigerant oil, purging of air, defrosting methods, trouble shooting, refrigerants used in marine practice and their justification. Operation, maintenance and Troubleshooting of refrigeration plants. Different air conditioning systems used on board ships. Construction of ducts, fans and ventilation systems in accommodation, engine room, cargo spaces CO_2 and Battery rooms.

Module – 4

Fuels and Lubricants: Source of supply, Study of Primary Fuels, Coal, Petroleum, Natural Gas, Classification of Fuels. Treatment of Fuels for combustion in Marine I.C.E. Residual fuels, Emulsified Fuels, Merits and demerits of such fuel in marine engines. 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.

Module – 5

MAINTAINENCE AND REPAIR

Inspection and routine overhauling of underwater fittings and hull. Measurement of clearances and drops. Engine room crane, chain blocks, tackles, its testing and survey requirements. 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), Planned maintenance, preventive maintenance, condition monitoring, risk assessment, trials and safe working practices.

Course Outcome: At the end of this course, student will be able to:

- Have an understanding of the Construction, operation, maintenance of incinerator and sewage plant.
- Have knowledge of the Construction, operation, maintenance of Oily water Separator and Purifiers.
- Have knowledge of the maintenance operation and maintenance of refrigeration and air conditioning systems.
- Have knowledge of the Maintenance and repair of Equipments, Machinery fitted in ships.

TEXT BOOKS:

1. D.W. Smith, "Marine Auxillary Machinery", 6th Edition, Butter worths, London, 1987.
2. H.D. McGeorge, "Marine Auxillary Machinery", 7th Edition, Butter worth, London,2001**.**

REFERENCE BOOKS

1. D.K. Sanyal, " Principle and practices of Marine Diesel Engine" 2nd Edition, Bhandarkar Publication, Mumbai, 1998
2. MARPOL 73/78, IMO Publications , 2001.
3. Wood Yard , Doug, "Pounder"s Marine Diesel Engine" 7thedition, Butter Worths Heinemann Publications ,London 2001
4. " Pumping and Piping Diagram", IME publication
5. Heinz P. Bloch, Fred K. Geitner, "Machinery Component Maintenance and Repair" 3rd Ed. An imprint of Elsevier, 2010

B.E, VII Semester, Marine Engineering
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Professional Elective-II
SHIP FIRE PREVENTION AND SAFETY

Course Code	**18MR731**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: The students should be able to have:

- Conceptual knowledge of basics of the chemistry of fire.
- Knowledge of rules and regulations governing passive and active fire fighting on board ships.
- Knowledge of fixed and portable firefighting equipment and their operation.
- Understanding of the dangers to human life because of fire.
- Knowledge of emergency procedures for fire fighting on ships.
- Human behavior affecting fire fighting and team management during fire fighting.

Module - 1

Basics of fire fighting.

Chemistry of fire , fire triangle and fire tetrahedron, aspects of combustion-types of combustion including spontaneous combustion, flash point , fire point, limits of flammability, UEL, LEL, classification of fire and the properties of materials in each class of fire, fire fighting mediums and their properties, combustion products and their effect on human life and safety

Module - 2

Fire Protection Built In Ships

SOLAS convention, requirements in respect of materials of construction and design of ships, (class A, B, type BHDS), fire detection and extinction systems, fire test, escape means, electrical installations, ventilation system and venting system for tankers. Statutory requirements for firefighting systems and equipments on different vessels, fire doors & fire zones.

Module - 3

Fire Fighting Equipment and Detection Systems

Types of detectors, selection of fire detectors and alarm systems and their operational limits. Commissioning and periodic testing of sensors and detection system. Fire pumps, hydrants and hoses, couplings, nozzles and international shore connection, construction, operation and merits of different types of portable, non-portable and fixed fire extinguishers installations for ships, water-mist fire suppression system.

Module - 4

Fire Control and Safety Systems on Ships

Action required and practical techniques adopted for extinguishing fires in accommodation, machinery spaces, boiler rooms, cargo holds, galley, etc. Fire fighting in port and dry dock. Procedure for re-entry after putting off fire, fire organization on ships, shipboard organization for fire and emergencies. Fire signal and muster. Fire drill. Fire control plan, Leadership and duties, human behavior.

Module - 5

Safety Measures and First Aid

Special safety measures for preventing, fighting fire in tankers, chemical carriers, oil rigs, supply vessels, and fire fighting ships - Safe working practice with respect to fire on board ships. First aid, Rescue operations from affected compartments.

Course Outcomes:

1. Understand the chemistry and the physics of fire and its propagation.
2. Understand the various fire fighting systems onboard ships.
3. Understand the structural rules governing fire fighting.
4. Understand the working, testing and maintenance of fire fighting systems.
5. Understand the fire fighting procedure and safety systems on board ships.

TEXT BOOKS:

1. Frank Rush Brook, “Fire Aboard”, 3rd Edition, Brown, son & Ferguson Ltd.,
2. Dr James Cowley , “Fire safety at sea”, Marine Engineering Practice, Vol 1, Part 05, IMarEST,
3. Fire safety code book

REFERENCE BOOKS

1. D.G. Shipping, Fire Fighting Appliances Rules (1969/1990), 3rd edition published by Bhandarkar Publications, Mumbai, 1996
2. IMO, SOLAS (Safety of Life at Sea) 3rd Edition, International Maritime Organization, London, UK,

2001.
3. Leslie Jackson, Reed‟s General Engineering Knowledge for Marine Engineers Vol.8, 4th Edition, Thomas Reed publication, Great Britain, 1986.
4. Gupta, R.S.,”A Hand Book of Fire Technology”, 2nd Ed., University Press, 2011

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Professional Elective-II
STABILITY OF SHIPS

Course Code	**18MR732**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

Course Learning Objectives:

- To provide knowledge at an intermediate level on stability for those whose responsibilities include the loading and safe operation of ships.
- To give Maritime students an awareness of problems when dealing with stability and strength, and to suggest methods for solving these problems.
- To provide an intermediate knowledge of transverse and longitudinal stability as applied to real ship situations.
- To provide a knowledge of stability issues during dry docking.
- To help the students solve real case studies of free surface effects and to help them read ships statistical charts.

Module - 1

First principles : Length, mass, force, weight, moment etc., Density and buoyancy, Centre of Buoyancy and Centre of Gravity, Design co-efficients: Cb, Cm, Cw, Cp ,TPC and fresh water allowances, Permeability for tanks and compartments ,Fulcrums and weightless beams.
Simpson's Rules – Quadrature : Calculating areas using 1st, 2nd and 3rd rules, VCGs and LCGs of curved figures, Simpsonising areas for volumes and centroids, Comparison with Morrish's rule, Sub-divided common intervals, Moment of Inertia about amidships and LCF, Moments of Inertia about the centreline

Module - 2

Bending of Beams and Ships: Shear force and bending moment diagrams for beams, Strength diagrams for ships.
Transverse Stability (Part 1) : KB, BM, KM, KG and GM concept of ship stability, Proof of BM = I/V, Metacentric diagrams, Small angle stability – angles of heel up to 15°, Large angle stability – angles of heel up to 90°, Wall-sided format for GZ, Stable, Unstable and Neutral Equilibrium, Moment of weight tables.

Module - 3

Transverse Stability (Part 2) : Suspended weights, Inclining experiment / stability test, Deadweight–moment curve – diagram and use of Natural rolling period TR – 'Stiff' and 'tender' ships, Loss of ukc when static vessel heels, Loss of UKC due to Ship Squat ,Angle of heel whilst a ship turns.
Longitudinal Stability: Trim, TPC and MCT 1 cm, Mean bodily sinkage, Change of Trim and Trim ratio, Estimating new end drafts, True mean draft
Bilging an end compartment, Effect on end drafts caused by change of density

Module - 4

Dry-docking Procedures: Practical considerations of docking a ship, Upthrust 'P' and righting moments, Loss in GM.
Water and Oil Pressure: Centre of Gravity and Centre of Pressure, Thrust and resultant thrust on lockgates and bulkheads, Simpson's rules for calculating centre of pressure.

Module - 5

Free Surface Effects: Loss in GM, or Rise in G effects, Effect of transverse subdivisions, Effect of longitudinal subdivisions.
Stability Data: Load line rules for minimum GM and minimum GZ, Areas enclosed within a statical stability (S/S) curve, Seven parts on an statical stability (S/S) curve, Effects of greater freeboard and greater beam on an S/S curve, Angle of Loll and Angle of List comparisons, KN cross curves of stability
Dynamical stability and moment of statical stability. Information supplied to ships, Typical page from a ship's Trim & Stability book, Hydrostatic Curves – diagram and use of, Concluding remarks.

Course Outcomes:

1. Acquired the knowledge of forces and moments affecting ship stability.
2. Would be able to understand and use the concept of stability for safer ship operations.

TEXT BOOKS:

1. Ship Stability for Masters and Mates	: Captain D.R. Derrett
2. Ship Stability Notes & Examples	: Kemp and young

REFERENCE BOOKS

1. K.J. Rawson and E.C Tupper "Basic ship theory" volume – I & II – 5th edition Butterworth and Heine Mann, London , 2001.
2. John Letcher Edited by J. Randolph Paulling, "Principles of Naval Architecture Series: The Geometry of Ships", 1st Ed. SNAME, 2009
3. Heat Pipes Dunn, P. D. and Reay, D. A., , Fourth Edition, Pergamon Press, 1994

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Professional Elective-II
TRIBOLOGY

Course Code	**18MR733**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

Course Learning Objectives:

- To educate the students on the importance of friction, the related theories/laws of sliding and rolling friction and the effect of viscosity of lubricants.
- To expose the students to the consequences of wear, wear mechanisms, wear theories and analysis of wear problems.
- Tomake the students understand the principles of lubrication, lubrication regimes, theories of hydrodynamic and the advanced lubrication techniques.
- To expose the students to the factors influencing the selection of bearing materials for different sliding applications.
- To introduce the concepts of surface engineering and its importance in tribology.

Module - 1

Introduction to Tribology: Properties of oils and equation of flow: Viscosity, Newton's Law of viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes.
Viscosity measuring apparatus. Lubrication principles, classification of lubricants. Types of lubricants

Module - 2

Hydrodynamic Lubrication: Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, and mechanism of pressure development in an oil film, Reynolds's investigation and Reynolds's equation in 2D.
Idealized Journal Bearing: Introduction to idealized journal bearing, load carrying capacity, condition for equilibrium, Sommerfeld's numbers and significance of it; Partial bearings, end leakages in journal bearing, Numerical problems.

Module - 3

Slider / Pad Bearing with a Fixed and Pivoted Shoe: Pressure distribution, Load carrying capacity, coefficient of friction, frictional resistance in a pivoted shoe bearing, numerical examples.
Oil Flow And Thermal Equilibrium Of Journal Bearing: Oil flow through bearings, self-contained journal bearings, bearings lubricated under pressure, thermal equilibrium of journal bearings.

Module - 4

Hydrostatic Lubrication: Introduction to hydrostatic lubrication, hydrostatic step bearings, load carrying capacity and oil flow through the hydrostatic step bearing.
Bearing Materials: Commonly used bearings materials, properties of typical bearing materials. Advantages and disadvantages of bearing materials.

Module - 5

Behavior of Tribological Components: Selection, friction, Wear of ceramic materials, wear measurements, effects of speed, temperature and pressure. Tribological measures, Material selection, improved design, surface engineering

Course Outcomes:

1. Understand the fundamentals of tribology and associated parameters.
2. Apply concepts of tribology for the performance analysis and design of components experiencing relative motion.
3. Analyse the requirements and design hydrodynamic journal and plane slider bearings for a given application.
4. Select proper bearing materials and lubricants for a given tribological application.
5. Apply the principles of surface engineering for different applications of tribology.

TEXT BOOKS:

1. Fundamentals of Tribology , Basu S K., Sengupta A N., Ahuja B.B., , PHI 2006
2. Introduction to Tribology Bearings, Mujumdar B. C., S. Chand company pvt. Ltd 2008.

REFERENCE BOOKS

1. Theory and Practice of Lubrication for Engineers, Fuller, D., New York company 1998

2. Principles and Applications of Tribology, Moore, Pergamaon press 1998
3. Tribology in Industries, Srivastava S., S Chand and Company limited, Delhi 2002
4. Lubrication of bearings – Theoretical Principles and Design, Redzimovskay E I., Oxford press company 2000

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Professional Elective-II
MARINE CORROSION AND PREVENTION

Course Code	**18MR734**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: This course provides

- To impart knowledge to the students about Corrosion and their influence on Materials and how to prevent corrosion with latest techniques.
- Knowledge of the chemistry of corrosion.
- Knowledge of the corrosion process and the degradation of metals.
- Knowledge of the corrosion in engines.
- Knowledge of the corrosion preventive techniques.

Module - 1

Electrochemistry of corrosion: Corrosion – introduction, definitions and types, Electrochemical cells-definitions and principles, Potential measurements – galvanic cells and concentration cells, EMF and Galvanic series – bimetallic couples, Eh-pH diagrams – fundamental aspects, Construction of Eh – pH diagrams. Fe-H_2O-O_2 diagram, Copper, Aluminum and general corrosion diagrams. Different forms of corrosion - uniform, galvanic, crevice, pitting, intergranular, selective leaching, erosion, stress corrosion cracking - their characteristic features, causes and remedial measures.

Module - 2

Corrosion and Degradation of Metals: Application of the thermodynamics and kinetics of electrochemical reactions to the understanding of corrosion phenomena such as oxidation, passivity, stress corrosion cracking, and weld decay. Some treatment of the environmental degradation of ceramics and polymers. Applications to current materials degradation problems in marine environments, petrochemical and metallurgical industries, and energy conversion systems.

Module - 3

Electrode kinetics and polarization phenomena: Kinetics of diffusion processes, Biological aspects of corrosion, Microbial influenced corrosion (MIC), MIC–Bacterial transport, attachment and affected materials, MIC - Role of aerobic and anaerobic microorganisms, Mechanisms and models for SRB corrosion, MIC and Biofilms, biofilm studies, MIC – Prevention and control.

Module - 4

Corrosion in Marine Diesel Engines: Corrosive wear of cylinder liners – Reasons and remedies. Corrosion In Boiler, Effect of corrosion while boiler not in service – preservation to avoid corrosion,HullPlate Preparation,Plate preparation during building and repair periods -Atmospheric corrosion Mill scale – flame cleaning – Acid Pickling – Blast cleaning – causes of paint failure – shipboard preparations for painting – power wire brushing – power discing – air hammer – high pressure water blasting – sand blasting shot blasting.

Module - 5

Corrosion And Its Prevention: Mechanism of corrosion – Chemical corrosion – Electro chemical corrosion – Anomic & cathodic protection – forms of metallic coatings – anodizing – phosphating, Physical vapour deposition technologies, ion plating, sputter deposition, reactive deposition, magnetron sputtering, general aspects of PVD (production sequence, advantages and disadvantages, microstructure), partial pressure control, summary of applications, duplex treatments.
Corrosion-wear of surface engineered materials, the corrosion-wear synergy. Basic facts of corrosion - cathodic and anodic coatings, coating defects. The passive film and it's breakdown by mechanical action. Type I, Type II &Type III corrosion wear.

Course Outcomes: After the completion of the course the students will have learnt

- Basics of Corrosion.
- Corrosion Mechanisms and factors affecting corrosion.
- Marine Corrosions and the Microbial Corrosions.
- Prevention Factors of Corrosion.

Text Books

1. W.D. Callister, Jr., D.G. Rethwisch, Materials Science and Engineering: An Introduction, John Wiley & Sons , 2009, 978-0-470-41997-7.
2. J.R. Davis, Corrosion: Understanding the Basics, ASM International, 2000, 0-87170-641-5.
3. M.G. Fontana, Corrosion Engineering, McGraw-Hill, 1986, 0-07-021463-8.
4. Lavery, H.I.,"Shipboard operations" Institute of Marine Engineers Publication.
5. Schweitzer, „ Fundamentals of Corrosion",1st Ed. Taylor & Francis, Indian Reprint 20129 (Yesdee Publishing Pvt. Ltd.).
6. M.E.P., "Corrosion For Marine & Offshore Engineers ", Marine Engineering Practice, Vol.02,Part 11, IMarEST, London.

Reference Books:

1. Francis Laurence LaQue , " Marine corrosion: causes and prevention", 1st Ed., Wiley, 1975
2. Claire Hellio, Diego M. Yebra, Pinturas Hempel S.A., "Advances in Marine Antifouling Coatings and Technologies", Woodhead Publishing, 2009

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Professional Elective-III
SHIPPING PRACTICE

Course Code	**18MR741**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8Hours per Module)	Exam Hours	03

Credits –03

Course Learning Objective: This course provides

- An introduction to the business of commercial shipping
- An understanding of liner and tramp shipping
- An understanding of classification societies.
- An understanding of the structure of shipping operations.
- An understanding of the documentation involved in commercial shipping

Module - 1

Introduction to shipping practice:
The ship- an introduction, Classification societies, Types of shipping operations, Shipping conferences, Clearing and forwarding of cargo, Abbrevations.

Module - 2

Basic shipping terminology, specialized vessels, Types of tankers, Ship profile plans , stowage factors , General particulars of a ship.

Module - 3

Business communication in shipping, Port and Liner Agent- roles and functions, other intermediaries in shipping, cargo handling equipment-different types.

Module - 4

Introduction to chartering , Bill of lading, Statutory documents on board, Types of Charter Parties, Unitisation, Containerisation.

Module - 5

Freights and Freight units, Marketing services of liner shipping, Shipping companies, Shipping documents, The ship's crew, Inward and outward clearance of ships, Export and import procedures, procedures for leaving port.

Course Outcomes:

- Understands the basics of the Business of shipping.
- Is able to do business communication.
- Has a knowledge of chartering.
- Has a knowledge of shipping documents.

TEXT BOOKS:

1. Edward Stevens ,"Shipping Practice - With a Consideration of the Law Relating Thereto"
2. Capt. Dara E.Driver, "Advanced Shipboard Management", I Edition, Rumar Publications, Mumbai, 1985.
3. Pinto, "Maritime Law", Bhandarkar Publications, 1998

REFERENCE BOOKS

- Nilima, M.Chanidiramani, "Carriage of goods by Sea and Multimodal Transport", 1st Edition, Saptarang Publication, Mumbai, 1996.
- SOLAS – 1974 - International Maritime Organisation Publications
- MARPOL – 1973/78 - International Maritime Organisation Publications
- STCW -1978/95 - International Maritime Organization Publications.

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Professional Elective-III
HYDRAULICS AND PNEUMATICS

Course Code	**17MR742**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

Course Learning Objective:

1. To Identify the basic fluid power principles and theory
2. To Hydraulic speed and pressure control
3. To recognize the properties and Applications of hydraulic and pneumatic components.
4. To design and evaluate the Connect a pneumatic hose that uses quick-connect fittings.

Module - 1

Introduction to Hydraulic Power: Definition of hydraulic system, advantages, limitations, applications, Pascal's law, structure of hydraulic control system, problems on Pascal's law.
The source of Hydraulic Power: Pumps Classification of pumps, Pumping theory of positive displacement pumps, construction and working of Gear pumps, Vane pumps, Piston pumps, fixed and variable displacement pumps, Pump performance characteristics; pump Selection factors, problems on pumps.

Module - 2

Hydraulic Actuators and Motors: Classification cylinder and hydraulic motors, Linear Hydraulic Actuators [cylinders], single and double acting cylinder, Mechanics of Hydraulic Cylinder Loading, mounting arrangements, Cushioning, special types of cylinders, problems on cylinders,
Construction and working of rotary actuators: such as gear, vane, piston motors, Hydraulic Motor Theoretical Torque, Power and Flow Rate, Hydraulic Motor Performance, problems, symbolic representation of hydraulic actuators (cylinders and motors).

Module - 3

Hydraulic Circuit Design And Analysis: Control of Single and Double - Acting Hydraulic Cylinder, Regenerative circuit, Pump Unloading Circuit, Double Pump Hydraulic System, Counter balance Valve Application, Hydraulic Cylinder Sequencing Circuits, Automatic cylinder reciprocating system, Locked Cylinder using Pilot check Valve, Cylinder synchronizing circuit using different methods, factors affecting synchronization, Hydraulic circuit for force multiplication, Speed Control of Hydraulic Cylinder, Speed Control of Hydraulic Motors, Safety circuit, Accumulators, types, construction and applications with circuits.
Maintenance of Hydraulic System: Hydraulic Oils - Desirable properties, general type of Fluids, Sealing Devices, Reservoir System, Filters and Strainers, wear of Moving Parts due to solid -particle Contamination, temperature control (heat exchangers), Pressure switches, trouble shooting.

Module - 4

Introduction to Pneumatic Control: Definition of pneumatic system, advantages, limitations, applications, Choice of working medium. Characteristic of compressed air. Structure of Pneumatic control System, fluid conditioners and FRL unit. Pneumatic Actuators: Linear cylinder - Types, Conventional type of cylinder-working, End position cushioning, seals, mounting arrangements- Applications. Rod - Less cylinders types, working, advantages, Rotary cylinders- types construction and application, symbols.
Pneumatic Control Valves: DCV such as poppet, spool, suspended seat type slide valve, pressure control valves, flow control valves, types and construction, use of memory valve, Quick exhaust valve, time delay valve, shuttle valve, twin pressure valve, symbols. Simple Pneumatic Control: Direct and indirect actuation pneumatic cylinders, speed control of cylinders- supply air throttling and Exhaust air throttling and Exhaust air throttling.

Module - 5

Multi- Cylinder Application: Coordinated and sequential motion control, Motion and control diagrams. Signal elimination methods, Cascading method- principle, Practical application examples (up to two cylinders) using cascading method (using reversing valves). Electro- Pneumatic Control: Principles - signal input and output, pilot assisted solenoid control of directional control valves, Use of relay and contactors. Control circuitry for simple signal cylinder application. Compressed Air: Production of compressed air- Compressors Preparation of compressed air-Driers, Filters, Regulators, Lubricators, Distribution of compressed air piping layout.

Course Outcomes:

1. Explain the electronics systems used for control of automobiles
2. Select sensors, actuators and control systems used in automobiles
3. Diagnose the faults in the sub systems and systems used automobile

TEXT BOOKS:

1. Fluid Power with Applications, Anthony Esposito, Sixth edition, Pearson Education, Inc, 2000.
2. Pneumatics and Hydraulics, Andrew Parr, Jaico Publishing Co

REFERENCE BOOKS:

1. Oil Hydraulic systems, Principles and Maintenance S. R. Majurr, Tata McGraw Hill Publishing Company Ltd. - 2001
2. Industrial Hydraulics, Pippenger, Hicks" McGraw Hill, New York
3. Hydraulic & Pneumatic Power for Production, Harry L. Stewart
4. Pneumatic Systems, S. R. Majumdar, Tata McGraw Hill Publish 1995
5. Power Hydraulics, Michael J Pinches & John G Ashby, Prentice Hall.

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Professional Elective-III
MARINE MACHINERY AND SYSTEM DESIGN

Course Code	**18MR743**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

Course Learning Objective:

- To understand the basics of Marine Machineries.
- To understand the design consideration while designing marine machinery system, Manufacturing process such as casting, forging, Fabrication, Plastic moulding.
- To understand the design of IC engine components
- To get familiarized with auxiliary machineries used onboard a merchant vessel.

Module - 1

Design Considerations: Following design considerations are to be taken into consideration while designing marine Machinery system : Manufacturing methods, Castings, Forgings, Fabrication and Plastic Moulding: Machinery Tolerances, surface finishes, Application to basic design principles in respect to function, Available materials, Production methods, Economics, Aesthetic appeal. Initial and servicing costs, Analysis of force, Flow through an Assembly and its effect on the design. Design with reference to Repairs and reconditioning specially “at sea” work with its normal restrictions and limitations.

Module - 2

IC Engine parts : Design and drawing of Flywheel, Piston connecting Rod, Safety Valves , Reducing valves, compression and Torsion springs.
Bearings : Journal Bearings, Thrust bearings etc

Module - 3

Advanced Design of Marine Systems Design and Drawing: Power Transmission System including Thrust blocks, Intermediate shaft and Tail End shaft, water cooling systems including pumps, filters, Heat Exchangers for diesel and steam engine plants

Module - 4

Lubrication: Lubricating oil systems including pumps, Purifiers, clarifiers, and pressure by-pass valves, Electro- hydraulic steering gear system including Rudder, Rudder stock, Tiller arm, Ram and Cylinder

Module - 5

Marine diesel engine Air starting systems and exhaust systems: Marine diesel engine Air starting systems including Air Receivers, compressors and Air starting Valves. Marine Diesel engine Scavenge and exhaust system, Marine Diesel engine Fuel Injection system including Fuel injectors. Fuel injector for stroke Diesel Engine and Fuel injector for two stroke Diesel Engine.

Course Outcomes:

- To understand the basics of Marine Machineries.
- To understand the design consideration while designing marine machinery system, Manufacturing process such as casting, forging, Fabrication, Plastic moulding.
- To understand the design of IC engine components
- To get familiarized with auxiliary machineries used onboard a merchant vessel.

TEXT BOOKS:

1. Marine Auxiliary Machinery : D.W Smith.
2. Marine Auxiliary Machinery : H.D George.

REFERENCE BOOKS

1. Marine Engineering Practice : IME Publications
2. Basic Marine Engineering : J.K Dhaar

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Professional Elective-III
SHIP RECYCLING

Course Code	**18MR744**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

- To impart knowledge of ship breaking methods.
- To impart knowledge of safe yard practices.
- To impart knowledge of ship recycling downstream processes.
- To impart knowledge of regulations governing ship recycling.
- To impart knowledge of various ship breaking industries.

Module - 1

SHIP BREAKING METHODS: Introduction on ship breaking, "Afloat method", Dry dock method, type of components to be removed. Towing – Beaching – Preparation of diagram combustible and non-combustible – re-usable materials and components, recovering metals which are mixed with non-metal – metal cutting and scraping.

Module - 2

SHIP BREAKING METHODS: Introduction on ship breaking, "Afloat method", Dry dock method, type of components to be removed. Towing – Beaching – Preparation of diagram combustible and non-combustible – re-usable materials and components, recovering metals which are mixed with non-metal – metal cutting and scraping.

Module - 3

SHIP RECYCLING DOWNSTREAM: Define recyclable –recycled content, recycling plan, pollution prevention procedure for existing ships – Green passport – minimizing reducing waste generation for new ships – minimizing hazardous substance, designing recyclable ships

Module - 4

REGULATION ON RECYCLING: MEPC 53, MEPC 54, MEPC 55, Basel convention, Role of Flag State, Port State recycling state – ILO, London Convention 1972/ 1996 Protocol, Shipping Industry. Ship recycling industry, interested stakeholder, and operational safety hazard conventions, recommended code of practice.

Module - 5

SHIP BREAKING INDUSTRY: Ship breaking industry in India, present scenario, Gujarat Maritime Board, Gujarat Enviro protection and Infrastructure Ltd. Growth of Ship breaking industry – Alang Ship Breaking Yard – Role of pollution control board – Alang –Sosiya Ship breaking yard, Valanar Ship breaking yard. Hazards associated with ship breaking.

Course Outcomes:

- Method of preparation and breaking of the Ships
- Hazards involved in while breaking the ships Method of controlling the same
- Types of Recycling and designing the ships Regulations in force for Recycling
- Ship Breaking Yards in INDIA

TEXT BOOKS:

1. MisraDr.P., Ship Recycling, 1st Edition, Nanosa Publishers 2007.

REFERENCE BOOKS

1. IMO Guidelines on ship recycling

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Open Elective-B
OPERATIONS RESEARCH

Course Code	**18 MR751**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objective: This course provides

1. To introduce the students to linear programming and to make them understand about the scope of OR
2. To make students learn about the simplex method.
3. To learn transportation problems and interpret solutions.
4. To make students learn about sequencing problems.
5. To learn about queuing theory and applications.
6. To learn about critical path and PERT analysis.
7. To learn about game theory and its applications.

Module – 1

Introduction: Evolution of OR, definition of OR, scope of OR, application areas of OR, steps (phases) in OR study, characteristics and limitations of OR, models used in OR, linear programming (LP) problem – formulation and solution by graphical method.

Module – 2

Solution of Linear Programming Problems:
simplex method, canonical and standard form of an LP problem, slack, surplus and artificial variables, big M method and concept of duality, dual simplex method.

Module – 3

Transportation Problem
Finding initial basic feasible solution by north – west corner rule, least cost method and Vogel's approximation method – testing for optimality of balanced transportation problems. (Including assignment and travelling salesman problems) (No degeneracy problems)

Queuing
Queuing Models : Essential features of queuing systems, operating characteristics of queuing system, probability distribution in queuing systems, classification of queuing models, solution of queuing M/M/1 : ∞ /FCFS,M/M/1 : N/FCFS, M/M/C : ∞/FCFS, M/M/C : N/FCFS.

Module – 4

Sequencing
Basic assumptions, sequencing 'n' jobs on single machine using priority rules, sequencing using Johnson's rule- 'n' jobs on 2 machines, 'n' jobs on 3 machines, 'n' jobs on 'm' machines. Sequencing 2 jobs on 'm' machines using graphical method.

GameTheory
Formulation of games, types, solution of games with saddle point, graphical method of solving mixed strategy games, dominance rule for solving mixed strategy games

Module – 5

PERT-CPM Techniques
Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects

Course Outcomes:

1. Formulate real-life problems with Linear Programming.
2. Solve the Linear Programming models using graphical and simplex methods.
3. Formulate real-life transportation, assignment and travelling salesman problems to find the optimum solution using transportation algorithms
4. Analyze the Queuing model for effective customer satisfaction
5. Analyse sequencing and game theory problems
6. Construct precedence diagram for series of activities in a huge project to find out probability of expected

completion time using PERT-CPM networks. Also reduce the duration of project by method of crashing.

TEXT BOOKS:

1. Engineering optimization: Theory and practice"-by S.S.Rao, New Age International (P) Limited.
2. Operations Research: An Introduction" by H A Taha, 5th Edition, Macmillan, New York.
3. Operations Research by NVR Naidu, G Rajendra, T Krishna Rao, I K International Publishing house, New Delhi.

REFERENCE BOOKS

1. Optimization Methods in Operations Research and systems Analysis" – by K.V. Mittal and C. Mohan, New Age, International (P) Limited, Publishers
2. Operations Research – by S.D.Sharma, Kedarnath Ramanath& Co
3. Linear programming, G. Hadley, Narosa Publishing House, New Delhi.
4. Industrial Engineering and Production Management, M. Mahajan, Dhanpat Rai& co

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Open Elective -B
ENERGY AND ENVIRONMENT

Course Code	**18MR752**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objective: This course provides

- To impart knowledge about the importance of keeping the environment ,ecosystems without any kind of pollution and effective use of natural resources

Module – 1

ENVIRONMENT, ECOSYSTEMS AND BIODIVERSITY Definition, scope and importance of Risk and hazards; Chemical hazards, Physical hazards, Biological hazards in the environment – concept of an ecosystem – structure and function of an ecosystem – producers, consumers and decomposers-Oxygen cycle and Nitrogen cycle – energy flow in the ecosystem – ecological succession processes – Introduction, types, characteristic features, structure and function of the (a) forest ecosystem (b) grassland ecosystem (c) desert ecosystem (d) aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries) – Introduction to biodiversity definition: genetic, species and ecosystem diversity – biogeographical classification of India – value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, national and local levels – India as a mega-diversity nation – hot-spots of biodiversity – threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – endangered and endemic species of India – conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

Module – 2

Definition – causes, effects and control measures of: (a) Air pollution (Atmospheric chemistry- Chemical composition of the atmosphere; Chemical and photochemical reactions in the atmosphere - formation of smog, PAN, acid rain, oxygen and ozone chemistry;- Mitigation procedures- Control of particulate and gaseous emission, Control of SO2, NOX, CO and HC) (b) Water pollution : Physical and chemical properties of terrestrial and marine water and their environmental significance; Water quality parameters – physical, chemical and biological; absorption of heavy metals - Water treatment processes. (c) Soil pollution - soil waste management: causes, effects and control measures of municipal solid wastes – (d) Marine pollution (e) Noise pollution (f) Thermal pollution (g) Nuclear hazards–role of an individual in prevention of pollution.

Module - 3

NATURAL RESOURCES Forest resources: Use and over-exploitation, deforestation, case studies- timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and overutilization of surface and ground water, dams-benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Energy Conversion processes – Biogas – production and uses, anaerobic digestion; case studies – Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification – role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles. Introduction to Environmental Biochemistry: Proteins –Biochemical degradation of pollutants, Bioconversion of pollutants.

Module - 4

SOCIAL ISSUES AND THE ENVIRONMENT

From unsustainable to sustainable development – urban problems related to energy – water conservation, rain water harvesting, watershed management – resettlement and rehabilitation of people; its problems and concerns, case studies – role of non-governmental organization- environmental ethics: Issues and possible solutions – 12 Principles of green chemistry- nuclear accidents and holocaust, case studies. – wasteland reclamation – consumerism and waste products – environment production act – Air act – Water act – Wildlife protection act – Forest conservation act –The Biomedical Waste (Management and Handling) Rules; 1998 and amendments- scheme of labelling of environmentally friendly products (Ecomark). enforcement machinery involved in 84 environmental legislation- central and state pollution control boards- disaster management: floods, earthquake, cyclone and landslides. Public awareness.

Module - 5

HUMAN POPULATION AND THE ENVIRONMENT Population growth, variation among nations – population explosion – family welfare programme – environment and human health – human rights – value education – HIV / AIDS – women and child welfare –Environmental impact analysis (EIA)- -GIS-remote

sensing-role of information technology in environment and human health – Case studies.

Course Outcomes: At the end of the course the students would have learnt about,

1. Environment and its eco systems
2. Types of pollution and the method of controlling the pollution
3. Planning and methods of preserving the natural resources
4. .Health and the effect of environment on the health of humans
5. Methods of disposal of different kind of wastes

TEXT BOOKS:

1. Gilbert M.Masters, „Introduction to Environmental Engineering and Science", 2nd edition, Pearson Education (2004).
2. Benny Joseph, „Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2006.

REFERENCE BOOKS

1. R.K. Trivedi, „Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
2. Cunningham, W.P. Cooper, T.H. Gorhani, „Environmental Encyclopedia",Jaico Publ., House, Mumbai, 2001.
3. Dharmendra S. Sengar, „Environmental law", Prentice hall of India PVT LTD,New Delhi,2007.
4. Rajagopalan, R, „Environmental Studies-From Crisis to Cure", Oxford University Press, 2005.
5. Akola Debi, Environmental Science and Engineering, 2nd Ed. University press 2012.

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Open Elective -B
PROJECT MANAGEMENT

Course Code	**18MR753**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objective: This course provides

- Manage the selection and initiation of individual projects and of portfolios of projects in the enterprise.
- Conduct project planning activities that accurately forecast project costs, timelines, and quality. Implement processes for successful resource, communication, and risk and change management.
- Demonstrate effective project execution and control techniques that result in successful projects.
- Conduct project closure activities and obtain formal project acceptance.
- Demonstrate a strong working knowledge of ethics and professional responsibility.
- Demonstrate effective organizational leadership and change skills for managing projects, project teams, and stakeholders.

Module – 1

Introduction: Definition of project, characteristics of projects, understand projects, types of projects, scalability of project tools, project roles

Project Selection and Prioritization – Strategic planning process, Strategic analysis, strategic objectives, portfolio alignment – identifying potential projects, methods of selecting projects, financial mode / scoring models to select projects, prioritizing projects, securing and negotiating projects.

Module – 2

Planning Projects: Introduction, developing the project management plan, understanding stake holders, communication planning, project meeting management, communication needs of global and virtual project teams, communication technologies, Constructing Work Breakdown Structures –scope planning, scope definition, work breakdown structures (WBS), Using Microsoft project for work breakdown structures.

Module - 3

Scheduling Projects: purpose of a project schedule, historical development, how project schedules are limited and created, develop project schedules, uncertainty in project schedules, Gantt Chart, Using Microsoft Project for critical path schedules

Resourcing Projects: Abilities needed when resourcing projects, estimate resource needs, creating staffing management plant, project ream composition issues, assign resource to each activity, resource overloads, critical chain project management (CCPM), compress the project schedule, Using Microsoft Project for resource allocation.

Module - 4

Budgeting Projects: Cost planning, cost estimating, cost budgeting, establishing cost control, using Microsoft Project for Project Budgets,

Project Risk Planning: Risk Management Planning, risk identification, risk analysis, risk response planning, Project Quality Planning and Project Kickoff: Development of quality concepts, project quality management plan, project quality tools, kickoff project, baseline and communicate project management plan, using Microsoft Project for project baselines.

Module - 5

Performing Projects: Project supply chain management: - Plan purchasing and acquisitions, plan contracting, contact types, project partnering and collaborations, project supply chain management, Leading and Managing Project Teams – Acquiring, developing, managing and leading the project team, managing stakeholders, managing project conflicts.

Determining Project Progress and Results: Project Balanced Scorecard Approach, Internal project, customer, financial issues, Using Microsoft Project to monitor and control projects. Finishing the project: Terminate project early, finish projects on time, secure customer feedback and approval, knowledge management, perform administrative and contract closure, celebrate success and reward participant, provide ongoing support.

Course Outcomes: At the end of the course the students would have learnt about,

- Describe a project life cycle, and can skilfully map each stage in the cycle
- Students will identify the resources needed for each stage, including involved stakeholders, tools and supplementary materials
- Students will describe the time needed to successfully complete a project, considering factors such as

task dependencies and task lengths

- Students will be able to provide internal stakeholders with information regarding project costs by considering factors such as estimated cost, variances and profits
- Students will be able to develop a project scope while considering factors such as customer requirements and internal/external goals
- Methods of disposal of different kind of wastes

TEXT BOOKS:

1. **Project Management**, Timothy J Kloppenborg, Cengage Learning, Edition 2009.
2. **Project Management**, A systems approach to planning scheduling and controlling by Harold kerzner, CBS publication.

REFERENCE BOOKS

1. **Project Management Refer,** Pennington Lawrence, Mc Graw hill
2. **Project Management,** A Moder Joseph and Phillips New Yark VanNostrand, Reinhold.
3. **Project Management,** Bhavesh M. Patal, Vikas publishing House

B.E, VII Semester, Marine Engineering
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Open Elective -B
MECHATRONICS

Course Code	**18MR754**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

Course Learning Objective:

1. Understand the evolution and development of Mechatronics as a discipline.
2. Substantiate the need for interdisciplinary study in technology education.
3. Understand the applications of microprocessors in various systems and to know the functions of each element
4. Demonstrate the integration philosophy in view of Mechatronics technology

Module - 1

Introduction: Definition, Multidisciplinary Scenario, Evolution of Mechatronics, Design of Mechatronics system, Objectives, advantages and disadvantages of Mechatronics.

Transducers and sensors: Definition and classification of transducers, Difference between transducer and sensor, Definition and classification of sensors, Principle of working and applications of light sensors, proximity switches and Hall Effect sensors.

Module - 2

Microprocessor & Microcontrollers: Introduction, Microprocessor systems, Basic elements of control systems, Microcontrollers, Difference between Microprocessor and Microcontrollers.

Microprocessor Architecture: Microprocessor architecture and terminology-CPU, memory and address, I/O and Peripheral devices, ALU, Instruction and Program, Assembler, Data, Registers, Program Counter, Flags, Fetchcycle, write cycle, state, bus interrupts. Intel's 8085A Microprocessor.

Module - 3

Programmable logic controller: Introduction to PLC's, basic structure, Principle of operation, Programming and concept of ladder diagram, concept of latching & selection of a PLC.

Integration: Introduction & background, Advanced actuators, Pneumatic actuators, Industrial Robot, different partsof a Robot-Controller, Drive, Arm, End Effectors, Sensor & Functional requirements of robot.

Module - 4

Mechanical actuation systems: Mechanical systems, types of motion, Cams, Gear trains, Ratchet & Pawl, belt and chain drives, mechanical aspects of motor selection.

Electrical actuation systems: Electrical systems, Mechanical switches, Solenoids, Relays, DC/AC Motors, Principle of Stepper Motors & servomotors.

Module - 5

Pneumatic and hydraulic actuation systems: Actuating systems, Pneumatic and hydraulic systems, Classifications of Valves, Pressure relief valves, Pressure regulating/reducing valves, Cylinders and rotary actuators.

DCV & FCV: Principle & construction details, types of sliding spool valve, Symbols of hydraulic elements, components of hydraulic system, functions of various units of hydraulic system. Design of simple hydraulic circuits for various applications.

Course Outcomes: On completion of this subject, students will be able to:

1. Illustrate various components of Mechatronics systems.
2. Assess various control systems used in automation.
3. Develop mechanical, hydraulic, pneumatic and electrical control systems.

TEXT BOOKS:

1. Nitaigour Premchand Mahalik , Mechatronics-Principles, Concepts and Applications, Tata McGraw Hill, 1st Edition, 2003 ISBN.No. 0071239243, 9780071239240.
2. W.Bolton-Pearson Education, Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering, 1st Edition, 2005 ISBN No. 81-7758-284-4.

REFERENCE BOOKS:

1. Mechatronics by HMT Ltd. – Tata McGrawHill, 1st Edition, 2000. ISBN:9780074636435.
2. Anthony Esposito, Fluid Power, Pearson Education, 6th Edition, 2011, ISBN No.9789332518544.

E- Learning- VTU, E- learning

B.E, VII Semester, Marine Engineering
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VIBRATION LAB

Course Code	**18MRL76**	CIE Marks	40
Number of Lecture Hours/Week	03 (1 Hour Instruction+ 2 Hours Laboratory)	SEE Marks	60
RBT Levels	L1, L2, L3	Exam Hours	03

Credits –02

Course Learning Objective:

- Fully understand and appreciate the importance of vibrations in mechanical design of machine parts that operate in vibratory conditions,
- Be able to obtain linear vibratory models of dynamic systems with changing complexities (SDOF, MDOF),
- Be able to write the differential equation of motion of vibratory systems,
- Be able to make free and forced (harmonic, periodic, non-periodic) vibration analysis of single and multi-degree of freedom linear systems.

PART A

1. Determination of natural frequency, logarithmic decrement, damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2. Balancing of rotating masses.
3. Determination of critical speed of a rotating shaft.
4. Determination of equilibrium speed, sensitiveness, power and effort of Porter/Prowel /Hartnel Governor.

PART B

1. Determination of Pressure distribution in Journal bearing.
2. Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
3. Determination of stresses in Curved beam using strain gauge.
4. Experiments on Gyroscope.

Course Outcomes: On completion of this subject, students will be able to:

- Appreciating the need and importance of vibration analysis in mechanical design of machine parts that operate in vibratory conditions.
- Ability to analyze the mathematical model of a linear vibratory system to determine its response
- Ability to obtain linear mathematical models of real life engineering systems
- Ability to use Lagrange's equations for linear and nonlinear vibratory systems
- Ability to determine vibratory responses of SDOF and MDOF systems to harmonic, periodic and non-periodic excitation
- General notion on frequency and time response of vibratory systems

Scheme of Examination:

ONE question from part -A:	**40 Marks**
ONE question from part -B:	**40 Marks**
Viva -Voice:	**20 Marks**
Total :	**100 Marks**

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SIMULATION LAB

Course Code	**18MRL77**	CIE Marks	40
Number of Lecture Hours/Week	03 (1 Hour Instruction+ 2 Hours Laboratory)	SEE Marks	60
RBT Levels	L1, L2, L3	Exam Hours	03

Credits –02

Course Learning Objective:

- To compare the results of analytical models introduced in lecture to the actual behavior of manufacturing
- To discuss and practice standard programming techniques of manufacturing and their applications
- To learn and practice writing programming
- To work on small simulation projects.

PART A

CNC part programming using CAM packages. Simulation of Turning and Milling operations. 2 typical simulations to be carried out using simulation packages like Master- CAM, or any equivalent software.

PART B

1. Falling sphere with viscous drag – Investigate velocity versus time plot; & simulate the fall.
2. Frequency response for a spring-mass system; simulation of the oscillations.
3. Simulation of simple servo-mechanism feedback system in time domain.
4. Simulation of simple servo-mechanism feedback system in `s` domain.

Course Outcomes: At the end of the course, the students will be able to:

- Students can able to understand to analyze practical problems in all manufacturing industries
- Conduct experiments (in team) to simulate the vibration related problems
- Analyze a variety of programming techniques and to utilize in designing new product

Scheme for Examination:

ONE question from part -A:	**40 Marks**
ONE question from part -B:	**40 Marks**
Viva -Voice:	**20 Marks**
Total :	**100 Marks**

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ENGINE ROOM MANAGEMENT

Course Code	**18MR81**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives:

- To impart knowledge to the students in Watch-keeping of Engine Room in various types of ships and to prepare for Class IV MOT Examinations.
- To impart knowledge of safe watch keeping practices.
- To impart knowledge of trouble shooting of auxiliary machinery.
- To impart knowledge of trouble shooting of main engine.
- To impart knowledge of maintenance of engine components.
- To impart knowledge of trouble shooting and maintenance of electrical machinery.

Module - 1

SAFE WATCH KEEPING : Definition of watch, operating principles, requirements of watch keeping, requirements of certification, duties of engineer officers – operation of engine room in general, log book writing – watch keeping under way – watch keeping at port – at unsheltered anchorage, fitness for duty, preparation of Diesel Engines for a long voyage – bad weather precautions, safe working practices – during overhauling at port, and during bad weather, change over from diesel oil to heavy oil and vice versa.
Trouble shooting during watch keeping: Emergency measures taken in case of –flooding of engine room, engine room bilge fire, general fire, In case of any system failure or breakage of pipe lines, etc.

Module - 2

TROUBLE SHOOTING OF AUXILIARY MACHINERIES: Malfunctioning, partial or total failure of auxiliary machineries – such as, auxiliary engines, purifiers, heat exchangers, air compressors, reefer and air conditioning compressors and systems, boilers and accessories, fresh water generators, hydrophore tanks and systems, all pumps & systems. Repairs and maintenance of propeller, rudder, dry-docking methods, dry-docking inspection and repair works.

Module - 3

TROUBLE SHOOTING OF MAIN ENGINE: Trouble shooting related to various types of marine diesel engines and condition monitoring – causes, effects, remedies and prevention of engine not turning on Air and Fuel, knocking at TDC and BDC, black smoke in funnel, poor compression and combustion, early or advanced injection, turbocharger surging, scavenge fire, Air starting line explosion, crank case explosion, exhaust uptake fire, failure of bottom end bolts.

Module - 4

MAINTENANCE OF ENGINE COMPONENTS: Checking of holding down bolts, resin chocking – Tie-rods tensioning, checking and tightening of 2-stroke and 4-stroke bottom end bolts. Inspection and maintenance of crankshaft and cam shaft, dismantle inspection and reassemble of main bearings, cross head bearings & bottom end bearings, connecting rod, piston and piston assembly, stuffing box, cylinder head and all mountings, governor and over speed trip – checking of all clearances, adjustments, effect of improper clearances, prevention and rectification. Cylinder liner and cylinder lubrication, thrust bearing, running gears inspection, engine alignment, chains drive adjustment and tensioning.

Module - 5

TROUBLE SHOOTING AND MAINTENANCE OF ELECTRICAL MACHINERIES: Circuit testing, shore supply arrangement, maintenance of circuit breakers, transformers, electrical motors, navigational lights, batteries, starters, electrical equipment's, maintenance of switchboard. Maintenance of electrical equipment's in oil tankers, LNG / LPG carriers.

Course Outcomes: The students are expected to have learnt,

- STCW standards of training, requirements of officers and ratings.
- Watch-keeping in various ships.
- Prevention, rectification and maintenance with respect to trouble shooting of machineries in the Engine Room.

TEXT BOOKS:

3. Vikram Gokhale & N.Nanda," Marine Engineering Practice and Ship safety and Environmental protection", 3rd Edition, Engee Enterprises Mumbai, 2002.
4. Sulzer brothers, "Sumitomo – Sulzer Diesel Engines", Service Instruction for Sumitomo Sulzer Diesel Engines RND Sumitomo ship building & Machining co., Ltd., Japan.

5. Heinz P. Bloch, Fred K. Geitner, “Machinery Component Maintenance and Repair” 3rd Ed. An imprint of Elsevier, 2010

REFERENCE BOOKS

1. IME Manuals and Ships Marine Manuals.
2. Manual instruction for MAN Diesel Engine and spare parts, 1968.
3. Instruction Manual for Mitsui – B & W Diesel Engine data, Mitsui Engineering & Ship Building co., Mitsui B & W, 1976.
4. Manual De Maintenance & operation MAN type K.270 120E DMR.
5. Daihatsu Diesel Engine instruction book, Operation & maintenance manual for Daihatsu Diesel Engine Model – DV26, Model 6 PKT – TB-16.

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Professional Elective-IV
MARINE ENGINE PRACTICE

Course Code	**18MR821**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: This course provides

1. The understanding of practices in main engine maintenance.
2. The understanding of practices in auxiliary engine maintenance.
3. The understanding of practices in air compressor and purifier maintenance.
4. The understanding of practices in maintenance of propeller and shaft.
5. The understanding of practices in maintenance of ancillary engine room machinery.

Module - 1

Main Engine: Removal and maintenance carried out on various components- cylinder liners, cylinder heads, fuel valves, exhaust valves, starting air valves: The checks to be carried out after removal, liner removal and fitting, defects in liner, fuel valve testing, exhaust valve testing, removal inspection and fitting back of piston and piston rings, overhaul of piston, pressure testing of piston, various bearing clearances(Crosshead, main bearing), Turbocharger maintenance

Module - 2

Auxiliary engine: Maintenance of components such as Fuel valve, cylinder head, pressure testing of fuel valve, pressure testing of cylinder head, removal and checking of piston, piston rings, bottom end bearings, con rod, con rod bolts, removal of main bearing, air cooler cleaning and inspection, lube oil cooler cleaning and inspection, Turbocharger removal and inspection of various components

Module - 3

Air compressor: Construction of tandem type piston, Removal and maintenance of plate type valves, testing of plate type valves, faults in plate type valves, checking of bumping clearance and adjustment of clearance, crankcase inspection and oil condition monitoring, inspection and pressure testing of intercooler, inspection and maintenance of air bottles, requirement of air bottle according to classification society.
Purifiers: Removal and inspection of purifier disc stack, maintenance of frictional brake, factors affecting the performance of purifier. Selection of gravity disc and use of nomogram table.

Module - 4

Propellers and shaft: Propeller Shaft system, shaft checks, coupling bolts- tapered, conventional, pilgrim type coupling bolt, Muff coupling, stern tube sealing arrangement, propeller mounting methods- keyed and keyless, pilgrim nut method, oil injection propeller mounting.

Module - 5

Sewage treatment plant: Requirement according to MARPOL, Biological sewage treatment plant construction working, Plant maintenance and routines, Vacuum type sewage treatment plant working and maintenance.
Incinerator: Requirement according to MARPOL, Construction and maintenance of a shipboard incinerator.
Oily water separator: Requirement according to MARPOL, construction and working of Simplex-turbulo oil/water separator with coalesce, maintenance of OWS, oil content monitoring system.

Course Outcomes:

1. Explain the maintenance procedures for main engines and auxiliary engines.
2. Explain the maintenance procedures for air compressors.
3. Explain the maintenance procedures for other engine room equipment.

TEXT BOOKS:

1. Marine Engineering Practice, IME Publication
2. Marine Auxiliary Machinery, HD McGeorge

REFERENCE BOOKS

1. Reeds General Engineering Knowledge
2. Lamb's Marine Diesel Engine, SG Christensen

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Professional Elective-IV
STEAM ENGINEERING

Course Code	**18MR822**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits – 03

Course Learning Objectives: The students should be able to have

- A theoretical Knowledge of the various vapor cycles.
- A theoretical Knowledge of the working of steam engines.
- A theoretical Knowledge of the steam nozzles and their analysis.
- A theoretical Knowledge of the steam plants and their systems.
- A theoretical Knowledge of the principles of heat transfer as used for steam cycles.

Module- 1

Steam And Vapour Power Cycles: Carnot cycle for steam and ideal efficiency. Rankine cycle with dry, saturated and super heated steam. Modified Rankine, Reheat and Regenerative cycles. Binary vapour power cycles. Feed pump working. Isentropic efficiency, cycle efficiency, work ratio. Reheating and Regenerative feed heating and their effect on thermal efficiency.

Module – 2

Marine steam engine: Modified Rankine cycle for steam engines. Hypothetical indicator diagram. Mean effective pressure and work transfer – diagram factor. Indicated power – specific steam consumption – indicated thermal efficiency – efficiency ratio. Energy balance – compound steam engines.

Module – 3

Steam Nozzles: General flow analysis. velocity at exit. critical pressure ratio and maximum mass flow. convergent and convergent-divergent nozzles – isentropic flow –effect of friction. nozzle area at the throat and exit. problems of steam flow through nozzles.

Module - 4

Marine Stream Turbine Plants: General principle of Impulse and Reaction Turbines. Compounding of steam turbines - Pressure and Velocity compounding, stage efficiency overall efficiency and re-heat factor. Multi-Stage Turbine with regenerative and reheat cycles. Maximum work output condition. Typical steam plant with turbines, condensers and boilers. Thermal efficiency of steam turbine plant.

Module – 5

Basic Principle Of Heat Transfer :
Conduction: Fourier law of Conduction. One dimensional Heat Diffusion equation. Convection: Forced and Free Convection. Radiation: Stefan-Boltzmann's equation. Law of Radiation – Problems.

Course Outcomes:

1. Completed the detailed study of steam cycles, steam engines, steam nozzle and Turbines
2. Have a knowledge to calculate the efficiencies of Steam Turbine plant

TEXT BOOKS:

1. Thomas, D. Morton, "Steam Engineering Knowledge For Marine Engineers", 3rd Ed. Reeds Vol 09, Adlard Coles Nautical, London
2. Coats, "Marine Steam Turbines", Marine Engineering Practice, Vol 1,Part 08, IMarEST, London
3. P.K. Nag, "Basic & Applied Thermodynamics", 1st Edition, Tata McGraw–Hill Publishing Co., Ltd., New Delhi, 2002.
4. T.D. Eastop and McConkey, "Applied Thermodynamics for Engineering Technologist SI units", 2nd Edition, ELBS with DP Publications, London, 1993.

REFERENCE BOOKS

1. Y.V.C. Rao, "Thermodynamics", 2nd Edition, Wiley Eastern Ltd., New Delhi, 1993.
2. E. Ratha Krishnan, "Fundamentals of Engineering Thermodynamics", 1st Edition, Prentice – Hall of India, New Delhi, 2000.
3. Gorden Rogers, Yon Mayhew, " Engineering Thermodynamics Work and Heat Transfer", 4th Ed. Pearson,2011
4. Marine Engineering Series, "Steam Turbines and Gearing", 1st Ed. Stanford Maritime limited, London, 1982
5. Naterer, "Heat Transfer in Single and Multiphase Systems", 1st Ed., Taylor & Francis, Indian reprint 2009,(YesdeePublishings Pvt. Ltd.)

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Professional Elective-IV
SHIPPING TRADE

Course Code	**18MR823**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

Course Learning Objective:

1. A comprehensive understanding of basic concepts maritime trade.
2. An understanding of the principles of maritime trade
3. An understanding of the dynamics of cargo transport.
4. The understanding of the pertinent maritime regulations.
5. The understanding of economics of ship building and ship breaking.

Module - 1

Basic Concepts and the Geography of Maritime Trade:
Basic concepts of seaborne trade, Geography of Maritime Trade, Value added by seaborne transport, Oceans, distances and transit times, Maritime trading network, Europe's sea borne trade-North America's sea borne trade, South America's sea borne trade, Asia's sea borne trade-Africa's sea borne trade, Sea borne trade of the Middle east, Central Asia, Russia, Australia and Oceania.

Module - 2

The Principles of Maritime Trade :
The Principles of Maritime Trade, building blocks of sea trade, countries that trade by sea, Trade theory and drivers of trade, Difference in production costs, Trade due to differences in natural resources, commodity trade cycles, Role of sea transport in trade, Transport of Bulk Cargoes, commercial origins of bulk shipping, the bulk fleetbulk trades, The principles of bulk transport , Liquid bulk transport, crude oil and oil products trade, Major dry bulk trades, minor bulk trades.

Module - 3

Transport of Specialized and General Cargoes:
Transport of specialized and general cargo , Sea transport of chemicals , LPG trade, LNG trade, Transport of refrigerated cargo, Unit load cargo transport, Passenger shipping, Transport of General cargo, origins of the liner service, Economic principles of liner operation, General cargo and liner transport demand, Liner shipping routes, liner companies, liner fleet, principles of liner service economics, Pricing liner services, Liner conferences and co-operative agreements, Container ports and terminals.

Module - 4

The Ship Providing Transport-the Design :
The Ship that provides transport, derived demand for ships, Seven questions that define a design, Ships for general cargo trades, Ships for the dry bulk trades, Ships for liquid bulk cargoes, Gas tankers, Non-cargo ships, Economic criteria for evaluating ship designs.

Module - 5

Economics of Shipbuilding & Ship Breaking:
The role of merchant shipbuilding and scrapping industries, Regional structure of world shipbuilding, Shipbuilding market cycles, economic principles, shipbuilding production process, Shipbuilding costs and competitiveness, ship recycling industry, Regulation of the Maritime Industry, How regulations affect maritime economics.

Course Outcomes:

- Develop basic fundamental understanding of the effects of crack like defects on the performance of aerospace, civil, and mechanical Engineering structures.
- Learn to select appropriate materials for engineering structures to insure damage tolerance.
- Learn to employ modern numerical methods to determine critical crack sizes and fatigue crack propagation rates in engineering structures.
- Gain an appreciation of the status of academic research in field of fracture mechanics.

TEXT BOOK:

1. Stopford, m. (2009) Maritime economics. New York.

REFERENCE BOOKS:

1. 1. Kevin Cullinane (2011) International Handbook of Maritime Economics Edward Elgar publishing.
2. Wayne k. Talley (2012) The Blackwell Companion to Maritime Economics, Wiley-Blackwell: U.K.
3. ICS (2014) Introduction to Shipping.

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Professional Elective-IV
TRANSPORT AND LOGISTICS MANAGEMENT

Course Code	**18MR824**	CIE Marks	40
Number of Lecture Hours/Week	03	SEE Marks	60
Total Number of Lecture Hours	40(8 Hours per Module)	Exam Hours	03

Credits –03

Course Learning Objectives: This course provides

1. The foundation for understanding the concepts of Logistic Management.
2. Topics are designed to explore managerial principles and practices.
3. Concepts of international trade and commerce.
4. To have an understanding of operation research and quantitative techniques.
5. To have an understanding of Port Management.

Module - 1

INTRODUCTION: Introduction to Logistics. Logistics and Competitive Strategy-Competitive advantage-Gaining competitive advantage through logistics-The mission of logistics management. Management principles and practices, Management information system, Human resources management.

Module - 2

MANAGERIAL ECONOMICS.
Managerial economics, Finance accounting, Cost & Management accounting, International financial management. The shipping cycle - Shipping cycle and loan finance decision - Main sources of shipping finance-Issue of shares- types of shares- listing of shares in International stock exchanges.

Module - 3

INTERNATIONAL TRADE AND COMMERCE:
International trade & commerce, International transport system, International transport Law, Transport economics, import-export documentation and procedure, Multimodal transport. Logistic & Operations management.

Module - 4

Quantitative techniques, Operation research, Research Methodology, Strategic management, International marketing

Module - 5

PORT AND TERMINAL MANAGEMENT
Port and Terminal Management, Port Economics, Logistics and Supply Chain Management, Port Pricing and Finance, Port Marketing & Services.
Port ownership structure- Types of port ownership and administration - Organizations concerning ports - Boards governing the ports - Port management development

Course Outcomes:

1. Describe the transport and Logistics strategy, Management principles and practices.
2. Understand the concept of managerial economics.
3. Explain the international trade and commerce, import-export documentation and procedure.
4. Understand the quantitative techniques, operation research, and Research methodology.
5. Know about port management, organizational and administrative structure.
6. To understand Personnel Management, Training and Emergency drills of ships.

TEXT BOOKS:

1. MARTIN, CHRISTOPHER, Logistics and Supply Chain Management. 2 nd edition. Pearson: New Delhi.
2. AGRAWAL, D. K. (2003) Textbook of Logistics and Supply Chain Management. MacMillan: New Delhi.

REFERENCE BOOKS

5. PATRICK M.ALDERTON. 2008, Port Management and Operations. Informa Law Category, U.K.
6. LAMBERT, D.M., STOCK J.R. & LISA M. ELLRAM (1998) Fundamentals of Logistics Management. Irwin-McGraw-Hill: UK