SYLLABUS

FOR

4 YEAR B.TECH (MARINE ENGINEERING) PROGRAMME

INDIAN MARITIME UNIVERSITY

(A Central University, Govt. of India)

2017

The Curriculum for the Four Year ***"B.Tech (Marine Engineering)"*** *includes the requirements of STCW Convention, as amended, of IMO and that of the Directorate General of Shipping, Government of India for competencies required for "Officer Incharge of an Engineering watch".*

CONSTITUTION OF THE COMMITTEE

1.	Shri J.K.Dhar, Director, IMU-Mumbai Campus & Dean (School of Marine Engineering & Technology)	Chairman
2.	Dr. Prasanna Gandhi, Professor, Department of Mechanical Engg., IIT, Mumbai	Member
3.	Shri B.R.Sekhar, Chief Surveyor, Directorate General of Shipping	Member
4.	Shri Rajeeva Prakash, Director, IMU-Cochin Campus	Member
5.	Shri Krishnendu Das, Associate Professor, IMU-Kolkata Campus	Member
6.	Shri Shirish Kumar, Dean, Samundra Institute of Maritime Studies	Member
7.	Shri Francis Akkara, Anglo Eastern	Member
8.	Shri A.Sukumaran, Principal Officer i/c, MMD	Member
9.	Prof. R.P.Gokarn, Ex-Professor & HoD, IIT, Mumbai & Member of the Institution of Naval Architects	Member
10.	Shri Sanjeev Vakil, Chief Executive Officer, Hindustan Institute of Maritime Studies (HIMT)	Member
11.	Shri S.Bharat, Ex-Indian Register of Shipping	Member

Special Invitees:

1.	Shri Muhammed Shaji E, Associate Professor, IMU-Mumbai Campus
2.	Dr.K.Sivasami, Associate Professor, IMU-Mumbai Campus
3.	Shri A.N.S.Neti, Engineer Officer, IMU-Mumbai Campus
4.	Shri Iqbal Khatib, Engineer Officer, IMU-Mumbai Campus
5.	Dr. S.M.Puranik, Lecturer, IMU-Mumbai Campus
6.	Shri T.Seshatalpa Sai, Faculty, IMU-Mumbai Campus
7.	Smt. Aparna Erande, Academic Officer, IMU-Mumbai Campus
8.	Smt. Darshana Pashte, Academic Officer, IMU-Mumbai Campus
9.	Cdr. K. Chandra, Visiting Faculty, IMU-Mumbai Campus
10.	Shri V.V.Marathe, Visiting Faculty, IMU-Mumbai Campus
11.	Shri Mohd. Junaiduddin, Visiting Faculty, IMU-Mumbai Campus
12.	Dr. Reeta S. Dubey, Faculty, IMU-Mumbai Campus

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INDIAN MARITIME UNIVERSITY

Course Curriculum for 4 Year Bachelor of Technology (Marine Engineering)

SEMESTER – I

Code	Subjects	Internal Assessment	Semester Examination	Total Marks	Lecture Per Week	Tutorial /library Per Week	Practical Per Week	Total Contact Hours Per Week / Semester	Credit Point
UG11T3101	English	30	70	100	03	00		03 / 54	3
UG11T3102	Mathematics – I	30	70	100	03	01		04 / 72	4
UG11T3103	Basic Thermodynamics	30	70	100	03	00		03 / 54	3
UG11T3104	Basic Electrical and Electronics Engineering	30	70	100	03	01		04 / 72	4
UG11T3105	Engineering Mechanics – I	30	70	100	03	00		03 / 54	4
UG11T3106	Workshop Technology	30	70	100	03	00		03 / 54	3
UG11T3107	Geometrical Drawing	30	70	100	01	03		04 / 72	2
	Practicals								
UG11P3101	Basic Electrical and Electronics Laboratory	30	70	100			03	03 / 54	2
UG11P3102	Workshop Practicals - I	30	70	100			06	06 / 108	3
UG11P3103	Communicative English Laboratory	30	70	100			02	02 / 36	1
				1000				**35 / 630**	

SEMESTER –II

Code	Subjects	Internal Assessment	Semester Examination	Total Marks	Lecture Per Week	Tutorial /library Per Week	Practical Per Week	Total Contact Class/ Hours Per Week	Credit Point
UG11T3201	Seamanship, Elementary Navigation and Survival at sea	30	70	100	02	01		03 / 54	3
UG11T3202	Mathematics – II	30	70	100	03	00		03 / 54	3
UG11T3203	Applied Thermodynamics – I	30	70	100	03	01		04 / 72	4
UG11T3204	Strength of Materials – I	30	70	100	03	01		04 / 72	4
UG11T3205	Computer Science	30	70	100	03	00		03 / 54	3
UG11T3206	Engineering Mechanics – II	30	70	100	03	00		03 / 54	3
UG11T3207	Engineering and Machine Drawing	30	70	100	01	03		04 / 72	2
	Practicals								
UG11P3201	Applied Mechanics Laboratory	30	70	100			03	03 / 54	2
UG11P3202	Workshop Practicals - II	30	70	100			06	06 / 108	3
UG11P3203	Computer Laboratory - I	30	70	100			02	02 / 36	2
				1000				**35 / 630**	

SEMESTER -III

Code	Subjects	Internal Assessment	Semester Examination	Total Marks	Lecture Per Week	Tutorial /library Per Week	Practical Per Week	Total Contact Class/ Hours Per Week	Credit Point
UG11T3301	Computational Mathematics	30	70	100	03	00		03 / 54	3
UG11T3302	Analog electronics and Communication	30	70	100	04	00		03 / 54	3
UG11T3303	Applied Thermodynamics – II	30	70	100	03	01		04 / 72	4
UG11T3304	Strength of Materials – II	30	70	100	03	01		04 / 72	4
UG11T3305	Mechanics of Machines – I	30	70	100	02	01		03 / 54	3
UG11T3306	Electrical Machines – I	30	70	100	03	01		04 / 72	4
UG11T3307	Marine Engineering Drawing	30	70	100	01	03		04 / 72	2
	Practicals								
UG11P3301	Electronics Laboratory	30	70	100			03	03 / 54	2
UG11P3302	Heat and Chemical Laboratory	30	70	100			03	03 / 54	2
UG11P3303	Workshop Practicals – III	30	70	100			03	03 / 54	2
				1000				**34 / 612**	

SEMESTER - IV

Code	Subjects	Internal Assessment	Semester Examination	Total Marks	Lecture Per Week	Tutorial /library Per Week	Practical Per Week	Total Contact Class/ Hours Per Week	Credit Point
UG11T3401	Marine Boilers	30	70	100	04	00		03 / 54	3
UG11T3402	Digital Electronics and PLC	30	70	100	04	00		03 / 54	3
UG11T3403	Mechanics of Machines – II	30	70	100	03	01		04 / 72	4
UG11T3404	Electrical Machines – II	30	70	100	03	01		04 / 72	4
UG11T3405	Fluid Mechanics	30	70	100	03	01		04 / 72	4
UG11T3406	Marine Heat Engine and Air Conditioning	30	70	100	03	01		04 / 72	4
UG11T3407	Applied Marine Control and Automation	30	70	100	02	00		03/ 54	3
	Practicals								
UG11P3401	Computer Microprocessor and PLC Laboratory	30	70	100			04	04 / 72	2
UG11P3402	Workshop Practicals – IV	30	70	100			03	03 / 54	2
UG11P3403	Control Engineering Laboratory	30	70	100			02	02 / 36	2
				1000				**34 / 612**	

SEMESTER –V

Code	Subjects	Internal Assessment	Semester Examination	Total Marks	Lecture Per Week	Tutorial /library Per Week	Practical Per Week	Total Contact Hours Per Week/ Sem	Credit Point
UG11T3501	Material Science	30	70	100	04	00		04 / 72	4
UG11T3502	Ship Structure and Construction	30	70	100	04	00		04 / 72	4
UG11T3503	Marine Internal Combustion Engines – I	30	70	100	03	01		04 / 72	4
UG11T3504	Fluid Machines	30	70	100	02	01		03 / 54	3
UG11T3505	Marine Auxiliary Machinery – I	30	70	100	03	01		04 / 72	4
UG11T3506	Naval Architecture – I	30	70	100	03	01		04 / 72	4
UG11T3507	Elementary Design and Drawing	30	70	100	03	--		03 / 54	2
	Practicals								
UG11P3501	Material Science Laboratory	30	70	100			03	03 / 54	2
UG11P3502	Vibration Laboratory and Fluid Mechanics Laboratory	30	70	100			03	03 / 54	2
UG11P3503	Marine Power Plant Operation – I	30	70	100			03	03 / 54	2
				1000				**35 / 630**	

SEMESTER –VI

Code	Subjects	Internal Assessment	Semester Examination	Total Marks	Lecture Per Week	Tutorial /library Per Week	Practical Per Week	Total Contact Hours Per Week/Sem	Credit Point
UG11T3601	Ship Fire Prevention and Control	30	70	100	04	01		03 / 54	3
UG11T3602	Marine Internal Combustion Engines-II	30	70	100	04	00		04 / 72	4
UG11T3603	Marine Electrical Technology	30	70	100	03	01		04 / 72	4
UG11T3604	Marine Auxiliary Machinery – II	30	70	100	04	00		04 / 72	4
UG11T3605	Naval Architecture – II	30	70	100	03	01		04 / 72	4
UG11T3606	Management Science and Economics	30	70	100	04	01		04 / 72	4
UG11T3607	Marine Steam Engineering	30	70	100	04	01		03 / 54	3
	Practicals								
UG11P3601	Fire Control and Life Saving Appliances Laboratory	30	70	100			03	03 / 54	2
UG11P3602	Marine Power Plant Operation – II	30	70	100			03	03 / 54	2
UG11P3603	Electrical Machines Laboratory	30	70	100			03	03 / 54	2
				1000				**35 / 630**	

SEMESTER –VII

Code	Subjects	Internal Assessment	Semester Examination	Total Marks	Lecture Per Week	Tutorial /library Per Week	Practical Per Week	Total Contact Hours Per Week/Sem	Credit Point
UG11T3701	Ship Operation and Management	30	70	100	04	00		04 / 72	4
UG11T3702	Advanced Marine Control Engineering and Automation	30	70	100	04	00		04 / 72	4
UG11T3703	IMO - Maritime Conventions and Classification Societies	30	70	100	03	00		03 / 54	3
UG11T3704	Advanced Marine Technology	30	70	100	03	01		04 / 72	4
UG11T3705	Engine Room Management	30	70	100	03	01		04 / 72	4
UG11E3701- 3704	**Elective**	30	70	100	03	01		04 / 72	4
UG11T3706	Marine Machinery and System Design	30	70	100	02	03		05 / 90	3
	Practicals								
UG11P3701	Simulator and Simulation Laboratory	30	70	100			03	03 / 54	2
UG11P3702	Technical Paper and Project	50	50	100			04	04 / 72	2
				900				**35 / 630**	

SEMESTER -VIII

Code	Subjects	Internal Assessment	Semester Examination	Total Marks	Lecture Per Week	Tutorial /library Per Week	Practical Per Week	Total Contact Hours Per Week/ Sem	Credit Point
UG11P3801	On board Training and Assessment	100		100				6 Months	14
UG11P3802	Voyage / Training Report	100		100					10
UG11P3803	Project on Environment and its Protection	50	50	100					2
UG11P3804	Viva – Voce	100		100					
	Total			**400**					

SEMESTER – I

UG 11T3101	ENGLISH	54 HRS

OBJECTIVE: *To build proficiency in writing, reading and speaking in English language.*

Unit - I: Prose 10 Hrs

1. Google Guys (Extract) – Richard L Brandt
2. Happiness 101 – Geeta Padmanabhan
3. Structured Procrastination – John Perry
4. The Refugee – K.A. Abbas
5. The Lion and the Lamb – Leonard Clarke

Unit - II: Poetry 10 Hrs

1. The Blind Pedlar – Osbert Sitwell
2. An Old Woman – Arun Kolatkar
3. No Sentence – Anjum Hassan
4. The Solitary Reaper – William Wordsworth
5. Gift – Alice Walker

Unit - III: Short Stories 10 Hrs

1. A Garden So Rich – Christie Craig
2. The Umbrella Man – Roald Dahl
3. The Bird – Amar Jalil
4. The Fortune Teller – Karel Capek
5. The Postmaster – Rabindranath Tagore

Unit - IV: Drama 12 Hrs

1. A Boy Who Stopped Smiling – Ramu Ramanathan
2. While the Auto Waits – O' Henry
3. The Cell phone Epidemic – Claudia I. Haas

4. The Death Trap – 'Saki' (H.H. Munro)
5. The Dear Departed: A Comedy in One-Act – Stanley Houghton

Unit - V: Communicative Grammar 12 Hrs

1. Seeking and Giving Information
2. Being Informal
3. Expressing Ability, Possibility Etc.

TEXT BOOKS:

1. CHANDRALEKHA RAO et al., (2016), *Spring Part One*, Emerald Publishers, Chennai.
2. USHA SAIKUMAR et al., (2017), *Panorama*, Emerald Publishers, Chennai.

REFERENCE BOOKS:

1. BHASKARAN NAIR et al., (2016), *Reflections*, Cambridge University, New Delhi.

Websites

1. http://www.learnenglish.de/

SEMESTER – I

UG11T3102	MATHEMATICS-1	72 HRS

OBJECTIVE: *The course is aimed at developing basic mathematical skills that are imperative for effective understanding of Engineering subjects. The topics introduced will serve as a basic tool for specialised studies in Engineering fields.*

Applications of derivatives - Curvature, Asymptotes. 4 Hrs

Successive Differentiation-Higher order derivates, n^{th} order derivatives, Standard results, n^{th} order derivates of rational functions and partial fractions, n^{th} order derivative of the product of powers of sines and cosines. Leibnitz' Theorem, Maclaurin's Theorem and std. Expansions. 8 Hrs

Functions of Several Variables-Limit, Continuity, Partial derivatives and their geometrical significance, Higher order partial derivatives, Homogeneous functions, Euler's theorem, Maxima, Minima and Saddle points, Constrained maxima or minima, Lagrange multipliers, exact differentials. Curve tracing of cartesian and polar curves. 12 Hrs

Calculus of Variations-The Brachistochrome problem, Euler-Lagrange development, applications of Euler's equation, Several dependent variables, Applications to discrete mechanics, Isoperimetric problem. 8 Hrs

Properties of Definite Integrals, Fundamental theorem of integral calculus, applications of integrals to lengths of plane curve, volume and surface of revolution, Centre of gravity, Moment of inertia, Integration as limit of a sum, Beta function and gamma function, Multiple integrals, Differentiation under integral sign. Work done by variable forces mean values, RMS value of sin nx 1 cos nx, Pappus and Guldinus theorem and its applications. Applications - Area volume, mass, centre of gravity of wire, lamina and solid. 10 Hrs

Vector algebra, Scalar and vector products, Orthonormal triad, Scalar triple products, Linear dependence of vectors, Other repeated products, Identity of Lagrange, Reciprocal systems. 6 Hrs

Vector calculus, Vector functions of one variable and their derivatives, curves, arc length, tangent, curvature and torsion, Gradient of a scalar field, Divergence of a vector field, Curl of a vector field, Directional derivatives. 8 Hrs

Matrices and Determinants, Matrix algebra, Sub matrices, Rank of a matrix, Systems of n linear equations in n unknowns, Inverse of a matrix, Hermitian and Skew-Hermitian matrices, Unitary, Orthogonal and normal matrices, Eigen values and Eigen vectors, Eigen values of Hermitian, Skew-Hermitian and Unitary matrices, Bilinear, Quadric, Hermitian and Skew-Hermitian forms, Real life applications. 6 Hrs

Review of pre requisites of complex numbers, De-Moivre's theorem, Complex variables, Limit, derivative, Analytic functions, Cauchy Rieman equations, Cauchy's integral theorem, Cauchy's integral formula, Derivatives of an analytic functions.

4 Hrs

Linear Programming: Graphical Method, General Linear programming problems, Canonical and standard form of LPP, simplex method, Two phase method. Duality concept, dual simplex method, transportation problems, Assignment problems.

6 Hrs

REFERENCE BOOKS:

1. GREWAL, B. S. Higher Engineering Mathematics, Khanna Publishers, Delhi
2. Bali, N.P. and Narayana Iyengar, N.CH.S., Engineering Mathematics, Laxmi Publications Pvt. Ltd, New Delhi
3. Venkataraman M.K., Engineering Mathematics, Vol-I & II, The National Publishing Company, Chennai
4. K.A. Stroud, Engineering Mathematics.

SEMESTER - I

UG11T3103	BASIC THERMODYNAMICS	54 HRS

OBJECTIVE: *To impart Basic Thermodynamics knowledge to the students. At the end of the course, the student should be able to understand and further study of Applied Thermodynamics effectively.*

Thermodynamics Definitions : Thermodynamics and Energy, Application Areas of Thermodynamics; State and Equilibrium, Properties of State – Extensive, Intensive; Forms of Energy – Internal Energy, Heat, Work, Mechanical Energy, Point Function, Path Function ; Systems - Boundary, control volume, control mass, isolated systems; First Law of Thermodynamics and its application to various Processes, Energy Balance, Energy Change of a System, Mechanisms of Energy Transfer; Steady-Flow Energy Equation; Non-Flow Energy Equation; Basic Problems. Various thermodynamic processes P-V Diagram for Work Transfer in Reversible Processes; Steady Flow Process and Non-flow Process; Energy Conversion Efficiencies

8 Hrs

Properties of Pure Substances and Gases: Pure Substance, Phase-Change Processes of Pure Substances, Property Diagrams for Phase-Change Processes, Property Tables – Enthalpy, Saturated, Superheated and Sub cooled (Compressed Liquid); Use of Steam Tables and Steam Charts, Characteristic Equation of State for a Perfect Gas; Equation of State for Real Gas; Compressibility Factor, Real gas equations. Related problems

[Gibbs Phase Rule, Joules Law, Vanderwaal's equation, Virial equation, Adiabatic mixing]

12 Hrs

Energy Analysis of Systems: Energy Analysis of Closed Systems, Energy Balance for Closed Systems, Specific Heats, Internal Energy, Enthalpy, and Specific Heats of Ideal Gases, Internal Energy, Enthalpy, and Specific Heat of Solids and Liquids; Mass and Energy Analysis of Control Volumes, Conservation of Mass, Flow Work and the Energy of a Flowing Fluid, Energy Analysis of Steady-Flow Systems and Energy Analysis of Unsteady-Flow Processes.

12 Hrs

The Second Law of Thermodynamics : Introduction to the Second Law of Thermodynamics, Thermal Energy Reservoirs, Heat Engines, Refrigerators and Heat Pumps, Perpetual-Motion Machines, Reversible and Irreversible Processes, The Carnot Cycle and principles, The Thermodynamic Temperature Scale, The Carnot Heat Engine, Refrigerator and Heat pump; Entropy - The Increase of Entropy Principle, Entropy Change of Pure Substances, Isentropic Processes, Property Diagrams Involving Entropy, Entropy Change of Liquids and Solids, Entropy Change of Ideal Gases, Reversible Steady-Flow Work, Entropy Balance

12 Hrs

Exergy : A Measure of Work Potential, Reversible Work and Irreversibility, Second-Law Efficiency, Exergy Change of a System, Exergy Transfer by Heat, Work and Mass, The Decrease of Exergy Principle and Exergy Destruction, Exergy Balance: Closed Systems, Exergy Balance: Control Volumes

10 Hrs

REFERENCE BOOKS:

1. Applied Thermodynamics for Engineering Technologists - T.D.Eastop & A.McConkey
2. Basic Engineering Thermodynamics – Joel Rayner
3. Thermodynamics : An Engineering Approach – Yunus A Cengel and M A Boles
4. Fundamentals of Engineering Thermodynamics – MJ Moran, HN Shapiro, DD Boettner & MB Bailey
5. Heat and Thermodynamics – M W Zemansky and R H Dittman
6. Fundamentals of Thermodynamics – Claus Borgnakke and Richard E. Sonntag
7. Engineering Thermodynamics – PK Nag
8. Thermodynamics for Engineers (Schaum Series) – M Potter and C W Somerton

UG11T3104	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	72 HRS

OBJECTIVE: *The course is aimed at developing the basic electrical and electronics engineering knowledge that are imperative for effective understanding of electrical machines and electronics.*

ELECTRIC CIRCUITS:

Circuit Concepts: Electrical Quantities, Lumped-Circuit Elements, Ohm's Law, Kirchhoff's Laws, Voltage and Current sources, Voltage and Current divider principles, Analogy between Electrical and Other Non-electric Physical Systems, Effect of temperature on resistance. 3 Hrs

Circuit Analysis Techniques: Thévenin and Norton Equivalent Circuits, Node-Voltage and Mesh-Current Analyses, Superposition and Linearity, Maximum power transfer theorem. Star–Delta (Y-D) Transformation. 4 Hrs

Electrostatics and DC Transients Analysis: Transients and steady state response of series and parallel R-L, R-C, R-L-C circuits. Coulomb's law of electrostatics, Electric field and potential, Energy stored in inductor and capacitor, Charging and discharging characteristics of capacitor. Practical Application: Battery (Lead acid) construction and it's working. Maintenance, charging and sulphasion in cells. Generation of static electricity, arrangement for continuous discharge of static charges to avoid explosion on tankers. 10 Hrs

Single-Phase AC Circuits: Generation of Sinusoidal (AC) Voltage Waveform, Average value, Root Mean Square (RMS) value, Form factor, Peak factor, Representation of sinusoidal signal by a phasor and solution of current (phasor concept) in series and parallels R-L, R-C, R-L-C circuits. Power consumed and Power factor, Complex Power, Volt-Amperes (VA) and Reactive Power. 8 Hrs

Resonance in AC Circuits: Resonance in series and parallel (R-L, R-C, R-L-C) circuits. 2 Hrs

Three-Phase AC Circuits: Three-phase voltages and phase sequence for Star and Delta Connections, Relation between the Phase and Line voltages and currents for Star and Delta Connections, Balanced and unbalanced three-phase loads (Star & Delta), Measurement of Power by wattmeter. 5 Hrs

Magnetic Circuits: Different laws for calculating magnetic field i.e. Biot-Savart law, Ampere's circuital law, Reluctance & Permeance, Leakage flux and fringing, B-H Characteristics, Different zones of B-H characteristic, Analysis of Series magnetic circuit, Analysis of Series-parallel magnetic circuit, Eddy Current & Hysteresis Losses, Faraday's laws of electromagnetic Induction, Self inductance, mutual inductance and coefficient of coupling. Energy stored in a magnetic field. 10 Hrs

Electrical Instruments and Measurements: Basic requirements of a measuring instrument-deflection, control and damping devices, moving coil, moving iron, dynamometer and thermocouple type of ammeter, voltmeter and wattmeter-their construction and other details, extension of scales of a meter. Energy meter, Frequency meter, Megger, Potentiometer, Galvanometer, Multimeter. 8 Hrs

A.C Bridge: Measurement of resistance, inductance and capacitance by Bridge Method (Maxwell-Wien Bridge, Schering Bridge and Kelvin Double Bridge). Application of localization of cable faults. 4 Hrs

Fundamentals of Electrical Installation: Distribution of electrical energy, system of wiring and installation, Earthing of installation, testing of electrical installation. 2 Hrs

ELECTRONICS:

Semi Conductors: Types of Semi Conductors, Electrical characteristics, Diffusion and Drift, Mobility, Varistors, Thermistors and Non Linear Resistors. 4 Hrs

Semi Conductor Diodes: Characteristics of diodes, Diode as a rectifier, Diode clamper and voltage doubler, Zener diodes, tunnel Diodes, Rectifiers & Filters, LEDs, seven-segment display. 4 Hrs

Transistors: The junction transistor and its characteristics, transistor as a switch, Transistor as an amplifier, stabilized biased circuits, self biased and potentiometer biased. 6Hrs

Regulated Power Supplies: series regulators and shunt regulators 2 Hrs

REFERENCE BOOKS:

1. Electrical Engineering by Edward Huges
2. Basic Electrical Engineering by Mittal and Mittal.
3. Electrical Engineering & Electronics by J. B. Gupta.
4. Basic Electrical & Electronics Engineering by S. K. Bhattacharya.
5. A text Book of Electro technology, volume 1, Basic Electrical Engineering, by B. L. Theraja and A. K. Theraja.
6. A text Book of Electro technology, volume 4, Electronic Devices and Circuits, by B. L. Theraja and A. K. Theraja
7. Basic Electronics, Volume 1 – 7, Harry Mileaf.

SEMESTER - I

UG11T3105	ENGINEERING MECHANICS-I	54 HRS

OBJECTIVE: *To impart a sound knowledge on the principles of Engineering Mechanics.*

Vector Statics: Scalars and Vectors. Moments and couples, Couple moment – couple moment as a free vector, addition & subtraction of couple, Equilibrium and resultant of co-planar, concurrent and non-concurrent forces (analytical & graphical method), Lamis Theorem, Frame-works. Free body diagrams. Trusses, Method of section, joint to joint method and Bow's notations.

6 Hrs

Non-Coplanar Forces : Three rectangular components of vectors. Equilibrium and resultant of vectors in space. 4 Hrs

Virtual Work and Machines : Principle of virtual work. Ideal machines. Law of machines. Reversibility and irreversibility of lifting machines and its application to different types of lifting machines.

6 Hrs

Centroids: Centroids of lines, Centroids of areas, Centroids of volumes, Centroids of masses, Centre of gravity, Composite figures, Pappus Theorem 6 Hrs

Moment of Inertia : Moment of inertia of area. Transfer formula. Product of inertia and its transfer formula. Maximum and minimum moment of inertia. Mass moment of inertia and its transfer formula. Radius of gyration.

10 Hrs

Rectilinear Motion : Differential equation. Constant force, Force as function of time and displacement. D' Alambert's principle of dynamic equilibrium. Linear momentum.

8 Hrs

Curvilinear Motion : Differential equation. Normal and tangential acceleration. Projectile, D'Alembert's principle. Angular momentum.

6 Hrs

Motion of Rigid Bodies : Rotation about fixed axis. Rotation under constant moment. Periodic motion, Work, power and energy.

8 Hrs

REFERENCE BOOKS:

1. Rajasekaran, S. Sankara Subramanian. G. "Fundamentals of Engineering Mechanics", Vikas Publishing House Pvt. Ltd
2. Irving-H. Shames, "Engineering Mechanics – Statics and Dynamics" Pearson Education Asia Pvt. Ltd.
3. Hibbler R.C. "Engineering Mechanics", Vol-I Statics, Vol-II, Dynamics, Pearson Education Asia Pvt. Ltd
4. Elementary Mechanics of Machines – J. Hannah & R.C. Stephens

SEMESTER - I

UG11T3106	WORKSHOP TECHNOLOGY	54 HRS

***OBJECTIVE** : To impart knowledge to the students about, Common Workshop Tools, Measuring Techniques, Machining & Fusion Processes & Overhauling of various types of valves.*

Common Workshop Tools : Description and usage of different types of Callipers, Straight edges, Try squares, Vices, Hammers, Chisels, Scrapers, Files, Drills, Reamers, Taps, V-Blocks, Face plate, Marking blocks, Carpentry tools, Pattern maker's tools, Smithy tools and Moulding tools. Application of hand tools such as chisel, file and saw. 6 Hrs

Metal Cutting Machines: Operation and inspection of the important types of metal cutting machines including Centre lathes, Capstan & Turret lathes, Automatic lathes, Drilling and Boring machines, Shaping, Slotting & Planing machines & Milling machine.

8 Hrs

Machine Process and Machine Tools: The geometry of cutting processes, Chip formation, Cutting forces, Stresses and power, Friction of chip on tool. Generation and dissipation of heat in cutting. Standard nomenclature for cutting tools. Cutting speeds and feeds, estimation of machining time. The fundamental cutting process, geometrical control of the cutting edge. Turning, screw cutting and taper turning processes on Centre lathe. Shears and punches. Principles of jigs and fixtures . I S Standards. 7 Hrs

Abrasive Process: Grinding, honing and lapping by hand and machines. 4 Hrs

Measuring Instruments and Inspection : Description and use of steel rule, Vernier's scale, Micro-meter (Inside & Outside), Dial gauge, Depth gauge, Thread gauge, Feeler gauge, Telescopic Feeler gauge, Bridge gauge, Wire gauge, Trammel gauge, Poker gauge, Taper gauge, Snap gauge, Plug gauge, Surface roughness analyzer, Optical methods of measurement (Auto-collimator).

7 Hrs

Welding : Welding Equipment & Applications, Electric welding (A.C & D.C.) spot welding. Gas welding. Different welding method (carbon arc, metal arc, GMA, TIG, Plasma, Submerged arc etc) & Electrodes, Welded joint edge preparation, Soldering & Brazing process and fluxes used. Defects in welding and steps taken. Welding inspection, Safety measures in welding.
Safe working practices – Personal protection equipment.

10 Hrs

Fitting and Overhauling : Types of packing and jointing materials and their uses, Construction details of various types of valves and cocks, Globe valves (return / non return), Gate valves, Butterfly valves, Reducing valves for steam and air. Bedding of bearings,

Marking of engine parts for fitting, machining operations fitting of keys, cotters, Pipe work. 8 Hrs

Safety Measures : Risk Assessment, Safe working practice, Sources of danger and methods of protection. Types of guards and safety devices. Personal Protection Equipment, Factory Act Regulation. 4 Hrs

REFERENCE BOOKS :

1. Workshop Technology I & II – Hazra Choudhury.
2. Workshop Technology – R.S.Khurmi.
3. Workshop Technology – W.A.J. Chapman (Vol I & II)
4. H.M.T Production Technology – TATA McGraw Hill

SEMESTER - I

UG11T3107	GEOMETRICAL DRAWING	72 HRS

OBJECTIVE: *To impart the knowledge to the students about good draughtsmanship curves used in engineering practise, and projection of solids.*

Introduction to Technical Drawing:
Draughtsman ship, lettering, dimensioning, types of lines and correct use of drawing instruments, Construction of geometrical figures specially showing joining of straight lines and curves. 18 Hrs

Curves used in Engineering Practice:
Conic sections construction of ellipse, parabola and hyperbola by various methods. Drawing of spirals, involutes, cycloids, epi and hypocycloids, helixes. Detailed drawings of helical springs of round and rectangular sections Square thread formation in proper helical form.
18 Hrs

Development of Surfaces and Curves of Intersections:
Developing the surface of prisms. Pyramids and cones and drawing the curves of intersection of cylinders to cylinders, cylinders to cones, and other solids.
18 Hrs

Projection of Points and Lines

Ortho Graphic Projections of Solids:
Axis perpendicular to a plane, axis parallel to both planes, axis parallel to one plane and inclined to the other, axis inclined to both planes.
18 Hrs

REFERENCE BOOKS:

1. M. B. Shah and B.C. Rana, " Engineering Drawing ", Pearson Education
2. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House

SEMESTER - I

UG11P3101	BASIC ELECTRICAL AND ELECTRONICS LABORATORY	54 HRS

ELECTRICAL LABORATORY 27 Hrs

1. Determination of equivalent resistance of the resistors when they are connected in Series, Parallel and Series-parallel combinations.
2. Characteristics of Fluorescent lamps.
3. Characteristics of Tungsten filament lamps.
4. Verification of Thevenin's theorem.
5. Verification of Norton's theorems.
6. Verification of Maximum power transfer theorem.
7. Verification of Superposition theorem.
8. Study of R-L-C Series circuit.
9. Study of R-L-C parallel circuit.
10. Measurement of power in a three phase circuit by two wattmeter method.
11. Measurement of energy (single and 3 phase) using suitable energy meter.
12. Measurement of the insulation resistance of an electrical machine and continuity test by the Megger.
13. Measurement of various parameters with multimeter, Tong-tester, Tachometer.
14. Use of Line tester and test lamp.

ELECTRONICS LABORATORY 27 Hrs

1. To understand the operation & measurement with the help of voltmeter, Ammeter, CRO, Multimeter, Clamp meter.
2. Determination of V-I characteristics of a p-n junction diode.
3. Determination of V-I characteristics of a Zener diode.
4. Determination of V-I characteristics of LED.
5. To study charging & discharging action of a Capacitor.
6. To study full wave & half wave rectification circuit with L, C, Pie filter, L-C filter & without filter.
7. To determine band gap of a semiconductor using hot water bath.
8. Determination of V-I characteristics of a high current p-n junction diode.
9. Realisation of Basic & Universal Logic gates.
10. To determine the characteristics of a thermistor.
11. To determine of input /output characteristics of a Transistor CE amplifier.
12. To study the clipping & clamping circuit using diode.

SEMESTER – I

UG11P3102	WORKSHOP PRACTICALS – I	108 HRS

Awareness of Safety Equipments in working

Familiarization:

1. Personal Safety and safe working practices.
2. Common hand tools.
3. Measuring tools, precision tools.

Fitting Shop: Bench Work

1. To make a square block from a round bar.
   (OR)
   To make a hexagon block from a round bar.
2. To make a Male-Female square fitting from 10 millimeter, thick plate.
3. To make a V-fitting from a 10 millimeter, thick plate.

Black Smithy Shop:

1. Drawing down from round rod and bending to 90^0.
2. To make a square head on a round rod (square head pin).
3. Bending 90^0 from a round rod.
4. To make a flat chisel of Hexagonal stem from a round rod.
5. Tempering process of tools.

Machine Shop:

1. Familiarization of Lathe, Lathe machine tools.
2. Familiarization of Drilling machine and relevant tools.

Carpentry Shop:

1. Make a wooden box with dovetail joint.
2. Make a wooden plug for condenser tube.
3. Make a cement box for a leaking water pipe.

Miscellaneous:

Two jobs that a student may be given as a project. Jobs to relate to onboard systems within the above mentioned fields.

SEMESTER - I

UG11P3103	COMMUNICATIVE ENGLISH LABORATORY	36 HRS

Development of Skills in Oral Communication:

- Phonology: Pronunciation, Word Stress, Intonation, Sentence Stress
- Presentation Skills: Content Structuring, Preparation & Planning, Welcome Note, Vote of Thanks.
- Facing Interview: Attitude, Etiquette, Body Language and Diction.
- Sea speak : External Communication & Internal Communication on Board Ship
- Group Discussions & Extempore Speeches

Maritime Correspondence:

- Sentence structure, process of writing i.e. to identify, organize and list the points/ideas related to a given topic in a proper logical sequence and writes a rough draft and final draft.
- Letter Writing: Types, Parts, Styles.
- Maritime Correspondence: Repatriation Letter, Requisition Letter, Promotion Letter, Letter of Indemnity, Grievance Letter
- Email Writing
- Notice, Agenda and Minutes

Report Writing (Maritime Correspondence):

- Precis Writing
- Structure of a technical report, description of factual details as observed.
- Maritime Correspondence: Damage Report, Incident Report
- Accident Report.

Standard Marine Communication Phrases:

- Importance of Standard Marine Communication Phrases: Procedure, Spelling, Message Markers, Responses, Distress/Urgency/ Safety Signals, Corrections, Readiness, Repetition, Numbers, Positions, Bearings, Courses, Distances, Speed, Times, Geographical Names, Ambiguous Words, Omission of "may", "might", "should" and "could. Use and understand the IMO Standard Marine Communication Phrases (SMCP)

Selected tests to be conducted to test skill in comprehension and speech.

REFERENCE BOOKS:

1. IMO Standard Marine Communication Phrases (SMCP) London : International Maritime Organisation
2. Sea speak Training Manual, Essential English for International Maritime Use: Pergamon Press UK
3. Blakey, T.N. English for Maritime Studies, Prentice - Hall International, London
4. English Grammar and Composition : Wren & Martin

SEMESTER-II

UG11T3201	SEAMANSHIP, ELEMENTARY NAVIGATION AND SURVIVAL AT SEA	54 HRS

***OBJECTIVE**: To make the students familiar with the duties of a seaman, various types of ropes and knots, knowledge of Bridge equipments and about Life Saving Appliances.*

Seamen and their Duties: Ship's Departments, General ship knowledge, lay out and nautical terms like Poop-Deck, Forecastle, Bridge, Monkey island etc, Bridge equipment arrangement. 4 Hrs

Navigational Lights and Signals: Navigation lights, Colours, Location and visibility. Look out, Precautions in Bad weather, Flags used on ships, Flag etiquette, Morse and Semaphore signalling, Sound signals. 5 Hrs

Rope Knots and Moorings: Types of knots. Practice of knot formation, Materials of ropes, Strength, Care and maintenance, use of mooring line, heaving line, Rat guards, Canvas and its use. 4 Hrs

Anchors: Different type of anchor. Their use, Dropping and Weighing anchor, Cable stopper. 3 Hrs

Navigation: General knowledge of principal Stars. Sextant, Navigation Compasses, Echo Sounder, Log and uses, barometer and weather classification, G.M.T. and Zonal time, wireless Navigational Instruments, radar satellite-Navigation. 6 Hrs

Life Boats and Life Rafts: Construction, equipment carried, carrying capacity. Davits and their operation, Launching of Life rafts (Inflatable type). Embarkation into lifeboat and Life raft. Survival pack, Stowage and securing arrangement. Rescue boat, immersion suit, Thermal Protective Aid. 8 Hrs

Abandon Ship: Manning of lifeboat and life raft. Muster list, Radio and Alarm signals, Distress signal (S.O.S.). Distress Calls time and Radio frequency. Pyro-techniques. 3 Hrs

Survival at Sea: Survival difficulties and factors, equipment available, Duties of crew members, Initial action on boarding, Maintaining the craft. 3 Hrs

Introduction of MARPOL: Convention and its annexes, Regulatory Control towards environmental pollution at sea. Familiarisation with SOLAS, STCW convention, ISPS code and other maritime codes & conventions. Ill effects of cargo on human and environment.

8 Hrs

Practical: Knots, bends and hitches, Ropes splice, Donning of Life jackets, Life boat drills. Lowering & hoisting of Life boats (model). 8 Hrs

Rescue: Method of Helicopter rescue, evacuation 2 Hrs

REFERENCE BOOKS:

1. Seamanship : J. Dinger
2. Survival in Life Boat : : Capt Puri
3. SOLAS : IMO
4. MARPOL : IMO
5. International light, shape & sound signals : W. Moore
6. Electronic navigation aids : G. Sonnenberg
7. Search and Rescue Manual : I.M.O. Publication
8. Mariner's Hand Book : H.M.S.O.

SEMESTER-II

UG11T3202	MATHEMATICS II	54 HRS

OBJECTIVE: *The course is aimed to understand higher mathematics useful in solving engineering problems*

Fourier Series and Integrals, Periodic Functions, Fourier Series and Euler's Formulae, Fourier Series for Even & Odd Functions and Functions having arbitrary period; Half-range Expansions. Applications of Fourier Series-Rectangular Pulse; Half-wave Rectifier. Fourier Integral, Orthogonal Functions, Gibbs Phenomenon. 10 Hrs

Ordinary Differential Equations of First Order, Basic Concepts, Geometrical Considerations; Isoclines, Formation of Differential Equations, Separable Equation; Equations Reducible to Separable Forms; Exact Differential Equations; Integrating Factors; Linear First Order Differential Equations; Variation of Parameters; Picard's Iteration Method; Families of Curves; Orthogonal Trajectories; Applications to Electrical Circuits. Cauchy's Homogeneous Linear Differential Equation and Legendre's Equation Applications to deflection of beams, struts and columns. 10 Hrs

Ordinary Differential Equation of n^{th} order; Solution of Homogeneous and Non-homogeneous Equations, Method of Undetermined Co-efficient. System of Ordinary Differential Equations, Phase Plane, Critical Points, Stability. Differential Equation with Variable Co-efficient. 4 Hrs

Laplace Transform, Inverse Transform, Linearity, Laplace Transforms of Derivatives & Integrals; Transformation of Ordinary Differential Equation. Applications, shifting on the 's' and 't' axes; Convolutions, Partial Fractions 10 Hrs

Probability and Statistics; Concept of Probability; Random Experiments, Sample Space, Events; Axioms of Probability; Some important Theorems on Probability; Mutually exclusive events; Conditional Probability; Theorems on Conditional Probability; Independent Events; Bayes' Theorem; Problems and Application on Combinatorial Analysis; Probability using Combinatorial Analysis.

8 Hrs

Random Variables and Probability Distributions; Discrete and Continuous Probability Distributions; Joint Probability Distributions; Independent Random Variables; Conditional Distributions.

4 Hrs

Mathematical Expectations; Theorems on Mathematical Expectations; Variance and Standard Deviation; Standardized Random Variable; Moment Generating Functions; Characteristic Functions; Variance for Joint Distributions, Co-variance; Correlation Co-efficient; Conditional Expectation; Variance & Moment; Chebyshev's Inequality; Law of large numbers; Percentiles; Special Probability Distributions-Binomial, Poisson; Normal and their Properties; Multinomial Distribution;

8 Hrs

REFERENCE BOOKS:

1. GREWAL, B. S. Higher Engineering Mathematics, Khanna Publishers, Delhi
2. Bali, N.P. and Narayana Iyengar, N.CH.S., Engineering Mathematics, Laxmi Publications Pvt. Ltd, New Delhi
3. Venkataraman M.K., Engineering Mathematics, Vol-I & II, The National Publishing Company, Chennai
4. K. A. Stroud, Engineering Mathematics

SEMESTER – II

UG11T3203	APPLIED THERMODYNAMICS - I	72 HRS

OBJECTIVE: *To impart Applied Thermodynamics knowledge to the students. At the end of the course, the student should get complete knowledge of Gas and Vapour power cycles.*

Ideal Gas Cycles : Gas power cycles – basic considerations, Carnot cycle and its importance, air standard assumptions. Constant Volume cycle, constant pressure cycle, Diesel cycle, Dual combustion cycle, Otto cycle. Reciprocating engines overview – 2 Stroke and 4 Stroke cycle, criteria of performance, compression ratio and thermal efficiency; Indicator diagrams, indicated power, brake power, Friction power, Mechanical Efficiency, Specific Fuel Consumption and applied problems

12 Hrs

Vapour Power Cycles : The Carnot Vapour Cycle, Rankine Cycle, Deviation of Actual Vapor Power Cycles from Idealized Ones, Increasing efficiency of a Rankine cycle, Ideal Reheat Rankine Cycle, Ideal Regenerative Rankine Cycle for open and closed feed systems, Cogeneration, Combined Gas–Vapour Power Cycles and Binary vapour cycle.

16 Hrs

Gas Mixtures : Composition of a Gas Mixture, P-V-T Behaviour of Gas Mixtures: Ideal and Real Gases, Properties of Gas Mixtures: Ideal and Real Gases, Ideal Gas Mixtures and Ideal Solutions, Reversible Mixing Processes, problems on adiabatic mixing.
Dalton's law of partial pressure

16 Hrs

Reciprocating Compressors : Ideal cycle for compressors, Work transfer in single stage compressor, Mass and Volume flow, free air delivery, effect of clearance and volumetric efficiency in single stage compressors, multi-stage compression with clearance and without clearance. Conditions for minimum work input, effect of inter cooling. Types of compressors – Tandem, Inline reciprocating, Rotary positive displacement types, compressed air motors and applied problems.

18 Hrs

Axial Flow Compressors: Principle of Centrifugal Compression and pressure rise in centrifugal compressor, change in angular momentum, pre-whirl and pre-whirl vanes, Mach number at inlet to a centrifugal compressor, slip and slip factor, multi-stage centrifugal compressor.

10 Hrs

REFERENCE BOOKS:

1. Applied Thermodynamics for Engineering Technologists – T.D.Eastop & A.McConkey
2. Applied Thermodynamics – Joel Rayner
3. Thermodynamics – An Engineering Approach – by Yunus A Cengel and M A Boles
4. Fundamentals of Engineering Thermodynamics – by MJ Moran, HN Shapiro, DD Boettner & MB Bailey
5. Heat and Thermodynamics – by M W Zemansky and R H Dittman
6. Fundamentals of Thermodynamics – by Claus Borgnakke and Richard E. Sonntag
7. Engineering Thermodynamics – by PK Nag
8. Thermodynamics for Engineers (Schaum Series) – by M Potter and C W Somerton

SEMESTER-II

UG11T3204	STRENGTH OF MATERIALS-I	72 HRS

OBJECTIVE: *To impart knowledge about stress and strain, Shearing Force and Bending Moment, Thin Walled Shells deflection of Beams design of shafts and thick cylinder in the field of strength of materials.*

Simple Stresses and Strains: Concept of Stress and Strain and their relationship in deformable solids. Normal, shear and hydrostatic stresses and the corresponding strains. Poisson's Ratio and complementary shear stress. Relationship between three elastic constants. Uni-axial loading and deformations; Thermal Stress; Axial Stresses in composite materials.

10 Hrs

Strain Energy in Simple Stresses: Concept of Strain Energy; Strain Energy due to normal and Shear Stresses; Strain Energy due to impact loads; Resilience. 8 Hrs

Shearing Force and Bending Moment: Sign Convention, Relation between Intensity of Loading, Shearing Force and Bending Moment. Graphical construction of Bending Moment & Shear Force diagrams.

10 Hrs

Thin Walled Shells: Stresses and Strains in thin Walled Shells subjected to internal pressure; Stresses and Strains in submersibles. Strengthening of Thin Walled Shells by wire or tape winding. Effect of temperature; Volumetric strain on capacity. 10 Hrs

Welded Joints: Strength of Welded Joints. Torsion effect on welded joint. 6 Hrs

Bending Stress : Pure Bending, Second moment of area, Stresses due to bending. Position of Neutral axis, Radius of Curvature, Combined bending and direct stress. Short Column with eccentric loading. Composite beams. Bending beyond the limit of proportionality.

10 Hrs

Shear and Torsion : Shear Stress and Shear Strain. Twisting of solid and hollow shafts, Stiffness and Strength. Power and Torque relation. Shafts with linear and compound shafts, Partial hollow shafts, Calculation for Coupling bolts, Torsion applied to closed coil springs, springs with axial load, Calculations for mean diameter Of springs, wire diameter & number of coils. Strain Energy in torsion. Plastic yielding of materials in Torsion.

18 Hrs

REFERENC BOOKS :

1. Strength of Materials — G. H. Ryder
2. Strength of Materials — Stephen Timoshenko
3. Strength of Materials — R. K. Rajput
4. Strength of Materials — R. C. Stephens

SEMESTER - II

UG11T3205	COMPUTER SCIENCE	54 HRS

OBJECTIVE: *To provide an awareness to Computing and Programming*

Introduction to Computers
Basic computer organization and architecture, Number systems.

4 Hrs

Computer Software
Computer Software: Types of Software, Software Development Steps, Basic Internet Technology, Computer networking 11 Hrs

Problem Solving and Office Automation
Planning the Computer Program: Purpose, Algorithm, Flow Charts, Pseudo code

8 Hrs

Introduction to ANSI C
Overview of ANSI C, Constants, Variables and Data Types, Operators and Expressions, Managing Input and Output operators, Decision Making: Branching and Looping.

20 Hrs

Functions and Pointers
Handling of Character Strings, User defined Functions, Definitions, Declarations, Call by reference, Call by value, Structures and Unions, Pointers, Arrays, Preprocessor.

11 Hrs

REFERENCE BOOKS:

1 Yashwant Kanetkar, "Let Us C"
2 E. Balagurusamy, "Computing Fundamentals and C Programming", Tata McGraw-Hill Publishing Company Limited.
3 Ashok. N. Kamthane, "Computer Programming", Pearson Education (India)
4 Behrouz A. Forouzan and Richard F. Gilberg, "A Structured Programming Approach Using C", Brooks – Cole Thomson Learning Publications.

5 Pradip Dey, Manas Ghoush, "Programming in C", Oxford University Press.
6 Byron Gottfried, "Programming with C", TMH Publications.
7 Stephen G. Kochan, "Programming in C", Pearson Education India.
8 Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Pearson Education Inc.
9 S. Thamarai Selvi and R. Murugan, "C for All", Anuradha Publishers.

SEMESTER - II

UG11T3206	ENGINEERING MECHANICS-II	54 HRS

***OBJECTIVE**: To enable the student to correlate the principles of friction, dynamics of rotation with application oriented studies.*

Friction: Static and Kinetic Friction - Laws of Friction; Effort required to pull a body up or down an inclined plane. Friction in Square and V-threaded screws, friction in pivots and collars; Conical bearings and thrust bearings plates. Cone clutches and Centrifugal clutches.

8 Hrs

Dynamics of Rotation : Dynamics of rotating particle and rotating bodies, velocity and acceleration in terms of path variables, cylindrical co-ordinates forces acting on a body having known motion; Torque equation; Work done by application of torque; Kinetic energy of rotation. Total Kinetic energy of a rolling wheel.

8 Hrs

Periodic Motion : Simple Harmonic motion; Application of S.H.M. to masses and springs. Simple Pendulum and Compound Pendulum. Centrifugal Force and its application to conical pendulum, Unloaded Governor, Curved tracks and machine parts, stress in thin rim due to centrifugal action.

10 Hrs

Drives and Brake: Belt and Rope drives; Open and Cross Belt drive; Belt dimensions; Ratio of belt tension; Modification for V-groove pulleys; Power of Belt drives and maximum power transmitted. Effect of Centrifugal tension; Creep in Belts; Different types of band brakes and block brakes. Dynamometers and their working principles; Absorption Dynamometer Band & Rope Brake Dynamometer, Hydraulic Dynamometer. 18 Hrs

Governors: Function of Governor; Comparison between a Governor and a fly wheel; Various types of Governors; Centrifugal and Inertia types of Governors, Sensitiveness; Stability and Hunting of Governors; Governor effort and Power, Consideration of friction in Governors. 10 Hrs

REFERENCE BOOKS:

1. Applied Mechanics — J. Hannah & M.J. Hillier
2. A text book of Engineering Mechanics — R.S. Khurmi
3. Engineering Mechanics — H. L. Langhaar & A. P. Boresi
4. Applied Mechanics — I B Prasad

SEMESTER-II

UG11T3207	ENGINEERING AND MACHINE DRAWING	72 HRS

OBJECTIVE: *To impart training to students regarding how to draw and to read drawings of various machine components.*

Orthographic Projections: Orthographic Projection in 1st & 3rd angle projections of simple machine components from given isometric drawings; Drawing of third view from the given two views in Orthographic projections. Details of sectioning: Sectioning of components at the central axis; Part sectioning, Off-centre sectioning and Off-set sectioning; Simple assembly drawings with sectional views. 20 Hrs

Pictorial Projections: Isometric and oblique projections. Use of isometric scale. Isometric drawing of simple solids like prisms, Pyramids, cylinders and cones. Sectional views of simple machine components in isometric. 12 Hrs

Projection of Ports: Projection of Port and Openings in hollow cylinders. Parallel cut & radial cut ports; Rectangular & tapered ports in right cylinders; Tapered ports in tapered cylinders; Example of diesel cylinder liners; Steam piston valve liner and blow down cock. 20 Hrs

Thread Formation, Nuts, Bolts and Studs: V-threads and square thread details; Metric & BSP threads; General conventions for drawing of threads in engineering drawings; Standard bolts, studs, nuts & tapped holes; Special bolts & screws e.g. tapped bolts, collar bolts and studs, pinching screws, cheese headed and round headed screws; Various types of locking arrangements of nuts. 20 Hrs

REFERENCE BOOKS:

1. M. B. Shah and B.C. Rana, "Engineering Drawing ", Pearson Education.
2. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House.
3. H. G. Beck, "Reed's, Engineering Drawing for Marine Engineers – Volume II".
4. H. Barr & J.G. Holburn "MacGIBBON'S Pictorial Drawing Book for Marine Engineers"

SEMESTER-II

UG11P3201	APPLIED MECHANICS LABORATORY	54 HRS

1. To determine the magnitude and nature of forces acting on the different members of (a) Wall Crank (b) Shear Leg Apparatus (c) Derrick Crane.

2. To determine the reactions of a Loaded Beam.
   (a) Bell crank lever (b) Simply supported beam

3.
   (i) To determine the co-efficient of friction between leather and metal in an inclined plane.
   (ii) To prove in a frictionless simple machine that Mechanical Advantage is the same as the Velocity Ratio.

4. To find out the Mechanical Advantage, Velocity Ratio, Theoretical Effort, Efficiency, Friction, the Equation giving the relation between Load and Actual Efforts, and draw graphs with load as base for
   (i) Efficiency,
   (ii) Actual Effort,
   (iii) Mechanical Advantage
   (iv) Friction for the following machines:
   (a) Screw Jack;
   (b) Worm and Worm Wheel;
   (c) Compound Wheel and Axle;
   (d) Single Purchase Crab
   (e) Double Purchase Crab.

5. To verify that the efficiency of a square thread is greater than that of V-thread.

6. To verify that-$E_1 \times E_2 = E_3$

   Where-
   E_1 = Efficiency of Simple Screw Jack;
   E_2 = Efficiency of Worm Wheel; and
   E_3 = Efficiency of Combined Screw Jack and Worm Wheel.

7. To determine the Moment of Inertia and Radius of Gyration of a Fly Wheel.

8. To find the co-efficient of friction both for flat belt and V-Belt with Belt friction apparatus and hence find the slip.

9. Centrifugal clutch to demonstrate the process of Power parameters of the Hartnell Governor.
   (i) Rotating masses
   (ii) Spring Rate
   (iii) Initial Spring Compression.

Note the effects of varying the mass of the centre sleeve of the Porter Governor and Compare the same with that of Proell Governor.

10. To determine the characteristic curves of sleeve position against speed of rotation in case of :
    (i) Hartnell Governor
    (ii) Porter Governor and
    (iii) Proell Governor

11. To determine the moment of inertia of different bodies by the Trifilar suspension by experiment and by calculation.

SEMESTER-II

UG11P3202	WORKSHOP PRACTICALS – II	108 HRS

Machine Shop (Lathe Work):

Prepare a Job piece which consists of following operations:

1. Straight Turning.
2. A Step Pulley.
3. Straight turning, under-cut with taper & threads.
4. Stepping down with knurling operation.
5. Taper turning and inside boring.
6. Making of hexagonal end with under-cut taper turning and thread cutting.

Welding Shop:

1. Welding edge preparation.
2. Practice for welding run.
3. Lap Welding.
4. Single and Double V Butt welding.
5. T-welding (both sides).
6. Vertical welding.

General Overhauling Work:

1. Dismantling, refitting and studying of various valves including return-type and non-return-type valves.
2. Overhauling of a Globe Valve.
3. Overhauling of a Butterfly valve.
4. Dismantling, refitting and studying the operation of a Sluice Valve.
5. Cutting of joints and packing for various uses.
6. Use of stud extractor and bearing puller.
7. Use of hand power tools (portables).

Miscellaneous Work:

Two projects related to modern onboard systems under above mentioned workshops.

SEMESTER – II

UG11P3203	COMPUTER LABORATORY	36 HRS

a) Word Processing

1. Document creation, Text manipulation with Scientific notations.
2. Table Creation, Table formatting and Conversion.
3. Mail merge and Letter preparation.
4. Drawing – Flow chart

b) Preparation of Spread Sheet

1. Chart – Line, XY, Bar and Pie.
2. Formula – Formula editor.
3. Spread sheet – inclusion of object, Picture and graphics, protecting the document and sheet.
4. Sorting and Import/Export Features

c) Simple C - Programming

1. Data Types, Expression Evaluation, Condition Statements.
2. Arrays
3. Structures and Unions
4. Functions, Pointer.

SEMESTER III

UG11T3301	COMPUTATIONAL MATHEMATICS	54 HRS

OBJECTIVE: *To impart the knowledge to the students, on various computational methods.*

Sampling Theory:
Population and Sample, Sampling with and without replacement, Random Samples, Population Parameters, Sample Statistics, Sample Mean, Sampling distribution of means, Sample variance, mean, variance and moments for grouped data.

6 Hrs

Curve Fitting, Regression and Correlation:
Curve fitting, Method of least squares, The least squares line, Least square line in terms of sample variance and covariance, Regression lines, Regression coefficients, The least square parabola, Multiple regression, Standard error of estimate, Linear correlation coefficient, Probabilistic interpretations of regression and correlation

12 Hrs

Digital Mathematics:
Binary codes: Weighted and Non weighted Binary codes, Error detecting codes, Error correcting codes, Alphanumeric codes. Basic logic gates: AND, OR, NOT gates, combining logic gates, NAND, NOR, Exclusive-OR, Exclusive-NOR gates, converting gates with inverters.

2 Hrs

Logic Circuits:
Sum-of-Products Boolean expressions, Product-of-Sums Boolean expressions, use of De Morgan's Theorems, use of NAND logic, USE OF NOR logic Numerical Analysis.

4 Hrs

The Calculus of Finite Differences:
Differences of a function, Fundamental operators of the calculus of Finite Differences, Algebra of Finite Difference operators, Fundamental equations satisfied by Finite Difference operators, Difference tables, Derivative of a tabulated function, Integral of a tabulated function, Summation formula, Difference equation with constant coefficients, Applications to oscillations of a chain of particles connected by strings and an electrical line with discontinuous leaks, Interpolation formulae, Newton's divided difference formula, Lagrange Interpolation formula, Forward and backward Gregory-Newton interpolation formulae, Stirling interpolation formula. Numerical integration by various methods (Trapezoidal Rule, Simpson's Rule etc.), Linear difference equation with constant coefficients. 14 Hrs

Numerical Solution of First Order Differential Equation:
Taylor's method, Picard's method, Ranga-Kutta method, Newton-Raphson method and Regula Falsi method

6 Hrs

Computing:
Design of efficient algorithms for problems like-factorial of a positive integer, Fibonacci Sequence generation, sin x, cos x, e^x series summation Linear search problem, Bubble sort Problem, Merging Problem, Calculation of computational complexity. 10 Hrs

REFERENCE BOOKS:

1. Numerical Methods for Engineering & Scientific Computation – by Jain , M. K. Iyanger, S. R. K. Jain
2. Numerical Methods for Engineers – By Chapra S. C., Canale R. P.
3. GREWAL, B. S. Higher Engineering Mathematics, Khanna Publishers, Delhi.
4. Engineering Mathematics – N P Bali and Narayan Iyengar, N.C.H.S., Laxmi Publications Pvt. Ltd, New Delhi

SEMESTER III

UG11T3302	ANALOG ELECTRONICS AND COMMUNICATION	54 HRS

OBJECTIVE: *The course is designed for the basic understanding of Analog Electronics and Communication*

Transistors: Low and high frequency Response, Response of Transistor Amplifiers, Effect of negative & positive feedback in transistor amplifier, JFET & MOSFETS, UJT (its basic characteristics and biasing), CMOS devices and applications

8 Hrs.

Transistor Power Amplifier: Design theory, Basic Complementary symmetry. Practical complementary push-pull amplifier, Phase inverter Relation between Maximum Output power and load resistance and Transistor dissipation.

5 Hrs

Signal Generators (operating principles, applications) and Oscillators: Requirements for Oscillations, phase shift Oscillator, Wien Bridge Oscillator, Crystal Oscillators, Decoupling Filters, signal generators.

6 Hrs.

Wave Shaping and Switching: Clipping, Clamping, time base or Sweep Generator, Multivibrators & Schmitt Triggers. 4 Hrs.

Operational Amplifier and 555 Timer: Concept of Differential Amplifiers. Its use in OP-AMPS. Linear OP-amp circuits, IC555 and its application (Multivibrator).

13 Hrs.

Industrial Electronics: Power rectification, Silicon Control Rectifier (power control), Insulated Gate Bipolar Transistor (IGBT), Photo-Electric Devices, Invertors.

4 Hrs.

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

14 Hrs.

REFERENCE BOOKS:

1. Electronic Devices & Circuit Theory – Robert L.Boylestad, Louis Nachelsky
2. Integrated Electronics – Millman, Halkias
3. Hand Book of Electronics - Kumar V, S I Gupta
4. Electronic Communication – Dennis Roddy, John Coolen
5. Communication Systems – Simon Haykin.

SEMESTER III

UG11T3303	APPLIED THERMODYNAMICS - II	72HRS

OBJECTIVE: *To impart Applied Thermodynamics knowledge to the students. At the end of the course, the student should get complete knowledge on Heat Transfer and its Applications.*

Fuels, Combustion and Dissociation: Definition of fuel, combustion. Combustion equation, analysis of the products of combustion, stoichiometric combustion, actual combustion, excess air, mixture strength, dissociation. Theoretical and Actual Combustion Processes, Effect of dissociation on IC Engines, Enthalpy of Formation and Enthalpy of Combustion, First law analysis, adiabatic flame temperature, entropy change. 14 Hrs

Compressible Flow: One dimensional steady flow of compressible fluids, Stagnation properties, Speed of sound and Mach number, Isentropic flow, Effect of friction, Flow through nozzles and diffusers. Flow of Steam through nozzles and Diffusers. 16 Hrs

Heat Transfer: Basic concepts and review of thermodynamics of heat transfer, Heat transfer mechanisms, Conduction, Convection and Radiation. Simultaneous Heat transfer mechanisms. Steady, Transient Heat transfer, Heat generation, Multidimensional heat transfer, One dimensional heat conduction equation in large plane wall, long cylinder and sphere. Combined one dimensional heat conduction equation. Steady heat conduction in plane walls including multi-layered walls, Insulation. Fundamentals of convection, Fundamentals of Thermal radiation. 16 Hrs

Convection and Radiation: Physical mechanisms of convection, Boundary layer, Classification of fluid flows – Laminar and Turbulent flows. Forced convection and Natural convection. Importance and use of non-dimensional groups in heat transfer applications – Prandtl number, Nusselt Number, Reynolds Number, Stanton Number, Grashof Number, Graetz Number. Thermal radiation, Black body radiation, Radiation intensity, Radiative properties. 14 Hrs

Heat Exchangers: Types of heat exchangers, Application of heat transfer in Marine Heat Exchangers like Coolers, Condensers, Heaters and Evaporators. The Overall heat transfer coefficient, Analysis of Heat Exchangers, LMTD Method, Sizing and Selection of Heat Exchangers 12 Hrs

REFERENCE BOOKS:

1. Heat and Mass Transfer : Fundamentals & Applications, Yunus A Cengel and Afshin J Ghajar
2. A Heat Transfer Textbook, J H Leinhard IV / J H Leinhard V
3. Fundamentals of Engineering Thermodynamics, MJ Moran, HN Shapiro, DD Boettner & MB Bailey
4. ASHRAE Hand Book, HVAC Fundamentals SI Units
5. Applied Thermodynamics for Engineering Technologists, T D Eastop and A McConkey
6. Basic and Applied Thermodynamics, P K Nag
7. Steam : Its generation and use, Babcock & Wilcox Company

SEMESTER III

UG11T3304	STRENGTH OF MATERIALS-II	72 HRS

OBJECTIVE: *To impart knowledge about principal stress, deflection of Beams design of shafts and thick cylinder in the field of strength of materials.*

Compound Stress and Strain: Stresses on an Oblique section, General two dimensional stress system, Materials subjected to Direct & Shear Stresses, Principal plane & Principal Stresses. Strain on an oblique section. Determination of principal strains. Principal strains in 3-dimensions. Principal Stresses determined from Principal Strains. Mohr's Diagrams for Stress, Strain and Strain Rosette. Combined bending and Twisting, Equivalent bending moment and Torsion, shear, bending and torsion, Theories of failure. 12 Hrs

Deflection of Beams: Strain energy due to bending. Application of impact. Deflection by integration, Macaulay's Method. Moment area Methods of deflection co-efficients. Deflection due to shear, Deflection by graphical method. Applied problems. 15 Hrs

Built-in and Continuous Beams: Moment-area method, built-in beam with central concentrated load, built-in beam with uniformly distributed load, with load not at center, Macaulay's method, Continuous beam, Claperyrons three moment theorem. Applied problems. 15 Hrs

Thin Curved Bar: Strain energy due to bending Castigliano's theorem, and its application to curved bars, strain energy due to twisting. Applied problems. 10 Hrs

Thick Cylinders: Thick cylinders, Lame's theory, compound cylinders, solid shaft subjected to radial pressure, shrinkage allowance. Applied problems. 10 Hrs

Struts: Euler's theory and Euler's buckling load. Struts with both ends pin joined, both ends fixed, one end fixed and one end free, one end hinged. Pin joined strut with eccentric load, Rankine-Gordon Formula. Applied problems. 10 Hrs

REFERENCE BOOKS:

1. Strength of Materials — G. H. Ryder
2. Strength of Materials — Stephen Timoshenko
3. Strength of Materials — R. K. Rajput

SEMESTER III

UG11T3305	MECHANICS OF MACHINES-I	54 HRS

OBJECTIVE: *To impart the knowledge of velocity and acceleration of various kinematic linkages, cam profiles for different cam followers, various parameters of gears and gear trains.*

Turning Moment and Flywheel: Function of a Flywheel. Crank effort diagrams. Fluctuation of speed and energy. Effect of centrifugal tension on flywheel, Inertia torque and its effects on Crank Effort diagrams. 7 Hrs

Kinematics and Link-Mechanisms: Relative motion between bodies moving in different planes. Instantaneous center method; Rubbing velocities at pin joints. Graphical construction for relative velocity and acceleration in different link and sliding mechanisms. Analytical determination of velocity and acceleration. Forces in Crank and connecting rods. Inertia force on linked connecting rods, Effect of friction. 7 Hrs

Cams: Types of cams and followers. Specified motion of followers. Uniform acceleration and deceleration, S.H.M. and uniform velocity, Graphical construction of Cam-profile. Analytical design procedure for cams with Straight flank, Curved flank, Circular flank with various types of followers Spring force and Reaction Torque. In-line cams and off center cams. 13 Hrs

Spur Gearing: Various definition e.g. p.c.d., profile of gear teeth, module, path of contact, velocity of sliding, Interference, Gear ratio and center distance of simple and compound gear trains. 8 Hrs

Toothed Gearing: Types of gears, Transmission of power by gear trains on parallel shafts; Rack and pinion, Bevel gears, Worm and Worm wheel, Spur gear, Helical gears, Spiral gears; Double helical gears, cross-axis helical gears. Different types of gear train, Epicyclic gear trains, Torque on gear trains, acceleration of gear trains.
Conditions for constant velocity ratio; methods of avoiding interference. 12 Hrs

Gyroscope : Gyroscopic couple, Vector representation of torque and angular momentum, steady rectangular precession, vector treatment; Steady conical precession; Motion involving steady precession; Application to Ship's stabilization, reaction on gearbox bearings & other bearings . 7 Hrs

REFERENCE BOOKS:

1. Advanced Mechanics of Machines J. Hannah & R.C. Stephens
2. Theory of Machines – P. L. Ballaney
3. Engineering Mechanics – S. Timoshenko & D. H. Young

SEMESTER – III

UG11T3306	ELECTRICAL MACHINES -I	72 HRS

OBJECTIVE: *To expose the students to the concepts of electrical D.C. machines, transformers and distribution system.*

Fundamentals of DC Machines: Electromechanical Energy Conversion Principle, DC machines-Principle of working, construction, winding, EMF and Torque equation, Armature reaction, commutation, brush shift, compensating winding, Circuit model of DC Machines. 8 Hrs

DC Generators: Characteristics of DC Generators, Performance equations, Methods of Excitations, Parallel Operation, Equalizer Bus-bar. 8 Hrs

DC Motors: Classification and Characteristics of DC Motors, Starting and Reversing, Speed-Torque equations, Starters, Speed control including electronic method of control. Braking of D.C. Motor.

8 Hrs

Testing of DC Machines: Testing of DC Machines for finding out losses and efficiency. 4 Hrs

Distribution Systems: D.C. and A.C. transmission and distribution - Two wire and Three wire DC system, Use of balancer, AC transmission single phase and three phase, Three wire and Four wire distribution, comparison of DC and AC transmission, effect of voltage drop, Copper loss reduction under different systems, single and double fed distributors, Fuses, DC air circuit breaker, AC air and oil circuit breakers. HV & LV switchgears. 10 Hrs

TRANSFORMERS:

Construction of Transformers: Core Material, Transformer windings, Insulations, Leads & Terminals, Bushings, Tap Changers, Transformer Tank, Transformer oil. 6 Hrs

Principles of Transformer Operation: Principle of Transformer operation, Ideal two-winding transformer, Concept of Phasor, Phasor diagram of a transformer (no load & on load), Rating of transformers, Equivalent circuit of a transformer, Determination of parameters by tests (Open circuit & Short circuit), Voltage regulation, Per-Unit calculation, Transformer losses & Efficiency, All-day efficiency and Cooling methods of transformer.

16 Hrs

Transformer Connections and Operation: Transformer Polarity, Sumpner's test, Auto Transformers, Parallel Operation of Transformers, Load sharing, Current and Potential Transformers, Tap Changers on Transformers. 8 Hrs

Three-Phase Transformer: Construction, Different types of Connections, Phase conversion.

4Hrs

REFERENCE BOOKS:

1. Hughes Electrical & Electronic Technology – Revised by I McKenzie Smith
2. "Electricity applied to Marine Engineering" – W.Laws
3. Dr. P. S. Bimbhra: "Electrical Machinery", Khanna Publishers.
4. D. P. Kothari & I. J. Nagrath: "Electric Machines", Tata McGraw Hill.
5. Smarajit Ghosh, "Electrical Machines", Person Publications.
6. P. K. Mukherjee & S. Chakraborty: "Electrical Machines", Dhanpat Rai Publications
7. B. L. Theraja & A. K. Theraja: "Electrical Technology", S Chand.
8. S. K. Sen: "Electrical Machines", Khanna Publishers.
9. Parker Smith: "Problems in Electrical Engineering", CBS Publishers & Distributors.
10. V. K. Mehta & Rohit Mehta: "Principles of Power System", S. Chand.
11. Dr. S. L. Uppal: "Electrical Power", Khanna Publishers.

SEMESTER III

UG11T3307	MARINE ENGINEERING DRAWING	72 HRS

OBJECTIVE: *To impart training to students how to draw assembly drawing of various marine machinery components.*

Machinery Components Drawing : Drawing of complete machine components in assembly (Orthographic to Orthographic and isometric to Orthographic) with details like couplings, Glands, Return and non-return valves, cocks & plugs, interpretation of machinery drawings and handbooks marine engineering drawing and design. The interpretation of piping, hydraulic and pneumatic diagrams.

36 Hrs

Marine Machinery Components and Assembly Drawings : Assembly Drawings of marine components in Orthographic projection from Isometric views e,g, Bilge Suction Strainer Boxes, Ship's Side Discharge Valve Chest, Cylinder Relief Valve, Control Valve, Oil Fuel Strainer, Parallel Slide Stop Valve, Ballast Chest for Water, Feed Check Valve, Gear Pump, Control Valves, Boiler Blow-down valves, Diesel Engines' Rocker arms, cylinder liner, connecting rod with bearings, Boiler Full bore safety valve, Hydraulic Exhaust Valve with air spring, Air Inlet Valve, Automatic Valve. (Minimum of 9 drawings to be completed in the class. Remaining drawings to be given as home assignment).

36 Hrs

(Sample list drawings para 17 DGS Annex-II).

REFERENCE BOOKS:

1. MacGIBBON'S Pictorial Drawing Book for Marine Engineers - H. Barr & J.G. Holburn

2. Reeds Engineering Drawing for Marine Engineers - Volume II - H. G. Beck

SEMESTER - III

UG11P3301	ELECTRONICS LABORATORY	54 HRS

1. To study the frequency response of a RC coupled amplifier.
2. To study Transistor bias stability.
3. To study Transistor feedback amplifier.
4. Constructing a voltage regulator at given circuit parameter & study its response at no load & loaded condition.
5. To study integrated circuit OP-AMP. (Adder, Sub tractor, integrating, differentiating , inverting, non-inverting)
6. To study 555 timer circuit application (Multivibrator and signal generator)
7. To study 1^{st} order and 2^{nd} order filter using OP-AMP.
8. Determination of V-I characteristics of a JFET.
9. To study V-I characteristics of SCR.
10. To study speed control of a DC Motor Using SCR.
11. To Study Amplitude Modulation of a given modulating & modulated signal specification. Also determine Modulation Index.
12. To Study Frequency Modulation of a given modulating & modulated signal specification. Also determine Modulation Index
13. To study wave nature of pulse code modulation.

SEMESTER – III

UG11P3302	HEAT AND CHEMICAL LABORATORY	54 HRS

BOILER CHEMISTRY:

1. To determine hardness content of the sample of boiler water in P.P.M. in terms of $CaCO_3$
2. To determine Chloride Content of the sample of water in P.P.M. in terms of $CaCO_3$
3. To determine Alkalinity due to Phenolphthaline, total Alkalinity and Caustic Alkalinity of the sample of water (in P.P.M)
4. To determine Phosphate Content of the sample of water
5. To determine dissolved Oxygen content of the sample of water.
6. To determine sulphate content of given sample of water
7. To determine Ph-value of the given sample of water.
8. To determine total-dissolved solids, turbidity of a sample of water.
9. To determine Hydrazine content of boiler water.
10. Boiler water tests using kits as found in latest types of ships.
11. Study sludges & scale deposit – silica, volatile & non-volatile suspended matter.

FUEL AND LUBRICANT CHEMISTRY:

1. To determine Absolute Viscosity and Kinematic Viscosity of Heavy oil, Diesel oil, Fresh Lubricating Oil & Used Lubricating oil by Red Wood Viscometer.
2. To determine the Flash Point of a given sample of Fuel & Lubricating oil.
3. To determine water content of used Lubricating oil.
4. Conduct spot test for L.O and analyse result.
5. To determine the percentage of CO2, CO and Oxygen in the flue gases.
6. To determine the Calorific value of the fuel with the help of a Bomb Calorimeter.

HEAT TRANSFER EXPERIMENTS:

1. To determine the Thermal Conductivity of good conductors.
2. To determine the Thermal Conductivity of Insulating materials.
3. Heat transfer Through Fins or extended surface.
4. Heat Transfer through Forced Convection.

SEMESTER III

UG11P3303	WORKSHOP PRACTICALS – III	54 HRS

1. Study of Workshop layout.
2. Steam & Exhaust Line Tracing.
3. Feed & condensate Line Tracing for the Steam Engine Plant.
4. Tracing of Cooling Water, Fuel oil, Lube oil and Air Starting lines for Auxiliary Engine.
5. Smoke tube Boiler Familiarization.
6. Globe valve overhauling
7. Sluice valve overhauling
8. Quick Closing Valve Overhaul.
9. Reducing Valve Overhaul.
10. 2 Way / 3 Way Cock Overhaul.
11. Shaft Key Making.
12. Thread cutting by Taps & Die.
13. Thread cutting by Lathe machine
14. Other important "Jobs" that may be introduced as per current trend, to keep student abreast with latest technology.

SEMESTER IV

UG11T3401	MARINE BOILERS	54 HRS

OBJECTIVE: *To develop knowledge of cadets on (construction & operation) of various types of boilers.*

Smoke Tube Boilers/ Aux Boiler: General consideration governing the design of boilers , comparison of smoke tube and water tube boilers; Vertical auxiliary boilers- Cochran spheroid, Aalborg, Sunrod, Thimble tube & Spanner Boilers - general description with sketches.

8 Hrs

Water Tube Boilers : general description with sketches of principal types of boilers in marine use, -Foster Wheeler ESD-I,II,III,IV, ESRD Boilers , Babcock MR Boilers and Kawasaki UFE Boilers. Dual Fired (Oil & LNG) Boilers. Double Evaporation Boiler. Superheater, Economizer, Air & Steam pre-heater; Water walls, circulation and use of unheated down comers in highly rated boilers; superheat temperature control, Attemperators and De-superheaters.

10 Hrs

Waste Heat Boilers: waste heat recovery calculation, economizer, exhaust gas boiler, Cochran exhaust gas composite boiler, Aalborg sun rod exhaust gas and composite boiler. Forced water circulation boiler.

6 Hrs

Boiler Mountings: List of Mountings for water tube and Smoke tube Boilers. Safety valves - improved high lift, full bore type and consolidated safety valves. Gauge glasses - tubular type & plate types and remote Water Level Indicator . Automatic feed regulator of Single, Two and Three element types, and retractable type soot blowers.

8 Hrs

Feed System: Open Feed System, Closed Feed System, Feed pump, 3 Stage Air Ejector, De-aerator etc. Boiler water testing.

4 Hrs

Operation, Care and Maintenance : pre- commissioning procedures, steam raising and operating procedures, action in the event of shortage of water & contamination by oil. Blowing down of boiler, laying up a boiler; general maintenance, external and internal tube cleaning. Tube renewals and tube plugging. Inspection and survey of boilers.

6 Hrs

Refractory: purpose of refractory , types of refractory , installation & fixing of refractory & fire bricks. Refractory failure – causes & prevention.

3 Hrs

Oil Burning Process: procedure of liquid fuel burning in open furnace, Various types of atomizer, Furnace arrangement for oil burning, combustion control system i.e. master control, fuel control, air control and viscosity control.

6 Hrs

Tests on Boiler: Destructive and non destructive tests on boiler plates, welded seams, Classification Societies requirements for boilers construction, hydraulic tests.

3 Hrs

REFERENCE BOOKS:

1. Marine steam boilers -J.H.Milton
2. Marine boilers - G.T.H. Flanagan
3. Running & Maintenance of Marine Machinery - Cowley, I.M.E Publication
4. Boiler Control System - David Lindsley
5. Steam Engineering Knowledge for Marine Engineers - Reeds Volume:9
6. Steam – Its generation and Use - Babcock Engineering
7. Boiler Plant Instrumentation - Kent Gunn

SEMESTER IV

UG11T3402	DIGITAL ELECTRONICS AND PLC	54 HRS

OBJECTIVE: *The course is designed for the basic understanding of Digital Electronics and PLC.*

Digital Circuits : Logic systems and Gates. Boolean Algebra, Simplifications, Binary and BCD codes, Flip-flops; Counters; Registers and Multiplexers. 14 Hrs

Converters (A-D and D-A) : Analog to Digital and Digital to Analog Convertors and their use in Data-Loggers. 2 Hrs

TTL & CMOS GATES: Digital Integrated Circuits, Semi-conductor Memories-ROM, RAM and PROM. 4 Hrs

Programmable Logic Controller 14 Hrs

Concept of a generalized PLC configuration

CPU, Power Supply, Rack, I/O Modules- DI, DO, AI, AO, specialty modules, PLC Rack Power Supply, Addressing, Serial communication Network, Remote Input Output Terminals (RTU), PLC Programming, Programmable Logic Controller (PLC) Overview, PLC and Control System Components, Number Systems and Codes, Creating Relay Logic Diagrams,

PLC Programming

Programming Logic Gate Functions in PLCs, PLC Timer Functions, PLC Counter Functions, PLC Math Functions, PLC Logic Functions, PLC Compare, Jump, and MCR (Master Control Reset) Functions, PLC Subroutine Functions, Sequencer Functions, PLC Networks in Manufacturing, Troubleshooting and Servicing the PLC System

Case Studies

Motor Drive Logic, Fault Annunciation Logic, Flap Gate Operation Logic, Sequence Operation Logic

SCADA

Overview, Traditional Control, Distributed Control, What do SCADA Provide? , Generic Software, Architecture and SCADA functions

Microprocessor 8085 14 Hrs

Architecture, Memory , Instruction Set, Interfacing Assembly Language programming

Electronic Instruments and Measuring Devices : Cathode Ray Oscilloscope, Digital Voltmeters and frequency-meters, Multimeters; signal Generators, Signal generator as used on-board ship (like measuring and controlling various variables)

Transducers and its application in the measurement of rpm, pressure, flow, temperature, strain etc. Q-meters, IC tester, LCD.

6 Hrs.

REFERENCE BOOKS:

1. Microprocessor Architecture, Programming & Application-R. Gaonkar, Wiley
2. Advanced Microprocessor & Peripherals-Ray & Bhurchandi, MH
3. Microcontroller, Deshmukh, MH
4. Programmable Logic Controllers, by W. Bolton,
5. Microprocessor & interfacing, Hall, MH
6. Fundamental of microprocessor, Uday Kumar, Pearson
7. Digital Design by Morris Mano

SEMESTER IV

UG11T3403	MECHANICS OF MACHINES-II	72 HRS

OBJECTIVE: *To impart the knowledge to the student on Balancing, Vibrations : Torsional, forced and transverse.*

Balancing : Balancing of masses rotating in different planes, dynamic forces at bearings; Primary and secondary balance of multi-cylinder in-line Engines and Configurations. Primary and secondary balance of multi-cylinder V - type Engines and Configurations. 15 Hrs

Vibration :Free Harmonic Vibrations, Linear motion of an elastic system, Angular motion of an elastic system. Differential equation of motion. Free Vibration of springs in series and parallel. Simple and Compound pendulums. Single and two degrees of freedom. 10 Hrs

Torsional vibrations : Single rotor system, rotor at end and rotor in the middle. Effect of inertia of Shaft, Two rotor system, rotors at both ends and rotors at one end. Three rotor and multirotor system. Torsionally equivalent shafts, Geared system. 7 Hrs

Forced Vibrations : Forced Linear and angular Vibrations, Periodic force transmitted to support, Periodic movement of the support. 7 Hrs

Transverse Vibrations of Beams : Single Concentrated load, effect of the mass of the beam, Energy method-several concentrated Loads uniformly distributed load, Dunkerley's empirical method for several Concentrated loads. 8 Hrs

Whirling of Shafts-Whirling of shafts, critical speed, effect of slope of the disc, effect of end thrust. 7 Hrs

Damped Vibrations : Idea of Viscous and Coulomb damping, Linear and angular vibrations with Viscous damping, Forced damped linear and angular Vibrations, Periodic movement of support. 8 Hrs

Forced Damped Vibration : To write differential equation of motion and find amplitude, frequency. 10 Hrs

REFERENCE BOOKS :

1. Advanced Mechanics of Machines - J. Hannah & R.C. Stephens
2. Theory of Machines – P. L. Ballaney
3. Engineering Mechanics – S. Timoshenko & D. H. Young

SEMESTER - IV

UG11T3404	ELECTRICAL MACHINES -II	72 HRS

OBJECTIVE: *To expose the students to the concepts on AC Motors, Alternators and principles of operation of synchronous motors*

Three phase Induction Motor:

Construction, Theory and Operation of Poly Phase Induction Motors: Construction, Principle of Operation, Equivalent Circuit and Performance, No-Load and Blocked – Rotor test, circle Diagram, losses and Efficiency, Operating Characteristics and Influence of machine Parameters on the Performance of the Motor, induction Generator.

12 Hrs

Starting, Speed Control and Braking of Poly-Phase Induction Motors: Starting of Squirrel Cage Motors, Starting of Wound Rotor Motors, Speed Control of Three Phase Induction Motor, Electrical Braking of Poly-Phase Induction Motors.

10 Hrs

The Single-Phase Induction Motor: Theories of Operation, Double Revolving Field Theory, Voltage Equations and Equivalent Circuit, Determination of Parameters by Tests, Split-Phase starting, Shaded-Pole Starting, Repulsion Motor Starting, Capacitor Motor, A.C Tachometers, Two-Phase Control Motor, Cross Field theory.

10 Hrs

Special Induction Machines: Induction voltage Regulator, Synchronous induction Motor, Power Synchros, Position Synchros, Linear Motor.

4 Hrs

Synchronous Machines:

Alternators or Three Phase Synchronous Generators:

Basic Principle, Construction and EMF Equations of Alternators: Introductions, constructional features of cylindrical and salient pole rotor, armature winding, Chording of windings, Pitch factor, Distribution or breadth factor, EMF equations, Shape of the emf wave.

8 Hrs

Steady State Operation of Alternators: Phasor diagram, Voltage regulation, Determination of Voltage Regulation by EMF, MMF and Potier method of three phase synchronous generator.

4 Hrs

Parallel Operation and Stability of Alternators: Losses and Efficiency, Parallel operation of alternators, Synchronizing current, Synchronizing power and torque, Connected to infinite bus-bars,

Effect of unequal voltages, Load sharing between alternators, Hunting of alternators, Time period of oscillation, Maximum power output.

8 Hrs

Synchronous Motors:

Construction, Starting and Excitation of Synchronous Motors: Introduction, Characteristics features, Construction, Principle of operation, Method of starting, Equivalent circuit, Effect of load, Torque developed, Power developed, Effect of excitation on armature current and power factor (V-curves) 8 Hrs

Performance of Synchronous Motors: Synchronous condensers, Motor ratings, Hunting of synchronous motor, Applications, Advantages and disadvantages, Comparison between synchronous and induction motors. 4 Hrs

Special Electromechanical Devices: Switched reluctance motor, Permanent magnet machines, Brushless D.C machines, Stepper motor, Tacho generators, Synchros & resolvers. AC servo motors. Inductors Generators (only elementary aspects of the above types are expected). 4 Hrs

REFERENCE BOOKS:

1. Hughes Electrical & Electronic Technology – Revised by I McKenzie Smith
2. Electric Motor drives – Berde
3. Electricity applied to Marine Engineering – W.Law
4. Dr. P. S. Bimbhra: "Electrical Machinery", Khanna Publishers.
5. M. G. Say: Performances & Design of A.C. Machines; CBS Publishers & Distributors.
6. D. P. Kothari & I. J. Nagrath: "Electric Machines", Tata McGraw Hill.
7. P. K. Mukherjee & S. Chakraborty: "Electrical Machines", Dhanpat Rai Publications.
8. Smarajit Ghosh, "Electrical Machines", Person Publications.
9. S. K. Sen: "Electrical Machines", Khanna Publishers.
10. Parker Smith: "Problems in Electrical Engineering", CBS Publishers & Distributors.
11. B. L. Theraja & A. K. Theraja: "Electrical Technology", S Chand.

SEMESTER IV

UG11T3405	FLUID MECHANICS	72 HRS

OBJECTIVE: *To impart the knowledge of Fluid properties and effect of various forces acting on different places and surfaces, the inviscid flow and real viscous flow*

Fluid Properties, Pressure and its Measurement:
Definition of Fluid. Different properties, i.e. Capillarity, Surface tension, viscosity. Pressure and its Measurement-Various type of pressure, Measurement of pressure, Manometer and Mechanical gauges, Different type of simple manometers, Different type of differential manometers, Different type of mechanical gauges. Applied problems. 10 Hrs

Hydrostatics Forces and Buoyancy:
Total pressure and centre of pressure on immersed plane surface in different positions and Curved surfaces. Total force and center of pressure on immersed surfaces such as Tanks, Bulkheads, Lock Gates, Centre of buoyancy, Meta-centre, Condition of equilibrium of a floating and submerged bodies. Experimental and theoretical methods to find GM value. Applied problems. 12 Hrs

Fundamental of Fluid Flow and Equation of Motion : Types of fluid flow, Description of flow pattern, Energy of flowing fluid, pressure energy, potential energy, kinetic energy, total energy; Euler's Equation of motion, Bernoulli's Equation for steady motion and its application, Kinetic Energy correction factor, Pressure velocity relationship, Pitot Tube, Orifice-meter, Measurement of flow rate by Venturimeter, Flow through an Orifice, Hydraulic Coefficients, Time of emptying a tank through an Orifice. Applied problems.
10 Hrs

Impact of Jets and Jet Propulsion:
Impulse Momentum Principle, Force exerted by jet on stationary flat plate, Force exerted by jet on inclined stationary flat plate, Force exerted by jet on stationary curved plate at centre, Force exerted by jet striking tangentially on stationary curved plate. Force on vertical flat plate moving in the direction of jet. Force on inclined flat plate moving in the direction of jet. Jet propulsion, Jet propulsion of ships. Applied problems.
10 Hrs

Flow and Losses in Pipes and Fittings : Losses of energy in pipe lines; Losses due to sudden increase in pipe diameter, Losses due to sudden contraction in diameter, Friction losses, Shock losses, derivation of Darcey's and Chezy's formula; Hydraulic Grade Line and Energy Line, Pipes in series and in parallel. Equivalent pipe. Transmission of power by pipe line; Condition for maximum power transmission. Time of emptying a reservoir through pipe. Surge pressure.
10 Hrs

Viscous Flow: Flow of viscous fluid through circular pipe and between parallel planes Kinetic energy correction and momentum correction factors, Boundary layer, resistance co-efficient, variation of resistance co-efficient with Reynold's number, Viscous resistance and Power absorbed in viscous flow for Journal Bearing, Foot-step Bearing and Collar Bearing. Loss of head due to friction in viscous flow-Hagen Poiseuille Equation. Method of determination of co-efficient of viscosity. Applied problems.
10 Hrs

Vortex Motion and Radial Flow: Free Vortex flow, Forced Vortex Flow, Equation of motion of forced vortex flow. Vortex flow for open cylinder. Vortex Force exerted on top of closed cylinder. Radial flow. Spiral free Vortex Motion, Spiral forced vortex Motion. Applied problems.

10 Hrs

REFERENCE BOOKS:

1. Hydraulics and fluid mechanics - P.N. Modi, S.M. Seth
2. Fluid Mechanics & Hydraulic Machines - R.K. Rajputh
3. Fluid Mechanics (Part – I & Part – II) - J. F. Douglas
4. Fluid Mechanics & Hydraulic Machines - R. K. Bansal
5. Mechanics of fluids - Bernard Massey & John Ward-Smith
6. Fundamentals of Fluid Mechanics - G.S. Sawhney

SEMESTER IV

UG11T3406	MARINE HEAT ENGINES AND AIR CONDITIONING	72 HRS

OBJECTIVE: *To impact the knowledge of Marine Steam Turbine, Gas Turbine and Marine Refrigeration and Air-conditioning plants with accessories and its performances.*

Marine Steam Turbines : Compounding of steam turbine – pressure compounding, velocity compounding and pressure-velocity compounding, types of turbines, impulse, reaction concepts, Velocity diagrams for simple impulse and impulse – reaction turbine, forces on blades, work done by blades, axial thrust, effect of friction on blades, maximum energy transfer conditions. Problems associated with steam turbines – diagram work output, diagram efficiency, degree of reaction, stage efficiency, overall efficiency, re-heat factor and condition curve.

18 Hrs

Boilers and Evaporators : Boiler calculations, boiler thermal efficiency and equivalent evaporation of a boiler, basic calculations on the effect of condenser leakage and impure feed, dissolved solids and scale in boilers; density of water and its control in boilers and evaporators. Basic calculations on the performance of single – effect, multi-effect and flash type evaporators; applied problems

10 Hrs

Marine Gas Turbines: Constant volume or explosion cycle gas turbine plant, constant pressure cycle or Joule – Brayton cycle Gas turbine plant. Deviation of Actual Gas-Turbine Cycles from Idealized Ones. Methods of gas turbine cycle efficiency - Brayton cycle with regeneration, Brayton cycle with intercooling, reheating and regeneration. Combined gas - vapor cycles, topping and bottoming cycles concepts.

General constructional of design features for marine plants, material of construction. Heat exchangers & Reheater arrangements, comparison of free piston engine, gasifiers of conventional air steam combustion chambers.

16 Hrs

Marine Refrigeration : Refrigeration cycles, refrigerators and heat pumps, reversed Carnot cycle, Vapor compression cycles – Ideal and Real cycles, Refrigerating effect, COP, capacity rating of a refrigerating plant, methods of improving COP, use of vapor tables and applied problems. Types of marine refrigerating plants with multiple compression and Evaporator system, heat pump systems, Selecting refrigerant, gas refrigeration cycles, absorption refrigeration systems, refrigeration in liquefied gas carriers, Reefer ships and containers.

16 Hrs

Air Conditioning : Principles of Air conditioning, dry air and atmospheric air (water vapor mixture), Adiabatic saturation and wet bulb temperatures, specific humidity, relative humidity, dew point, unsaturated and saturated air, study of Psychrometric chart and numericals based on air conditioning. Human comfort and air conditioning, Air conditioning processes – Heating, Cooling, Humidification, De-humidification, evaporative mixtures, adiabatic mixing, ventilation, recirculation. Thermal load assessment of accommodation, compartments. 12 Hrs

REFERENCE BOOKS:

1. Marine Engineering- Robert Taggart (Editor), SNAME
2. Principles of Naval Engineering, NAVPERS 10788B- Bureau of Naval Personnel
3. Turbine Main Engines- John B Main, F R Harris and C W Herbert
4. Marine Steam Engines and Turbines- S C McBirnie
5. ASHRAE Hand Book, HVAC Fundamentals SI Units
6. Steam : Its generation and use – by Babcock & Wilcox Company
7. Heat and Mass Transfer : Fundamentals & Applications - Yunus A Cengel and Afshin J Ghajar
8. A Heat Transfer Textbook, J H Leinhard IV / J H Leinhard V
9. Fundamentals of Engineering Thermodynamics- MJ Moran, HN Shapiro, DD Boettner & MB Bailey
10. Applied Thermodynamics for Engineering Technologists- T D Eastop and A McConkey
11. Basic and Applied Thermodynamics - P K Nag

SEMESTER – IV

UG11T3407	APPLIED MARINE CONTROL AND AUTOMATION	54 HRS

OBJECTIVE: *To enable the students to the concepts of Basic Automatic control system and its application to ship board automation.*

Introduction to Control System: Concept of feedback and Automatic Control, Effects of feedback, Objectives of control systems. Definition of linear and nonlinear systems. Elementary concepts of sensitivity and robustness. Types of control systems.

4 Hrs

Mathematical Modeling of Dynamic Systems: Electrical analogy of Mechanical systems, Mechanical couplings, Transfer Function concepts, Block diagram representation of Control Systems. Signal Flow Graph.
Time domain analysis and frequency domain analysis and Stability of linear second order control systems. 6 Hrs

Correcting Units: Detailed study of Diaphragm actuators, Valve-positioners, Piston actuators, Electro-hydraulic actuators & Electric actuator control valves.

6 Hrs

Signal Transmitting Devices: Flapper Nozzle system, Electro pneumatic signal converter, Pneumatic types of Controllers; Hydraulic, electric and electronic process flow logic, Variable inductance and capacitance transducer, Force balance transducer, Synchros. 8 Hrs

Control System Performance Measures: PI, PD and PID controllers. Two Step (On – Off) Control, Modulating Control, Off Set or Droop, Desired Value, Set Value, Action Controllers, Stacked type controllers, Controller adjustments, Split Range control, Ratio control and Cascade Control, System Response, Distance Velocity, Measurement and Transfer Lags. 10 Hrs

Measuring Sensors: Pressure, Temperature, Level and Flow measuring devices. Miscellaneous Instruments; Tachometers (Electric and Mechanical), Salinity Indicator (Dionic Gauge), Oil in Water Monitor, Photo Electric Cells, Photo Conductive Cells, Photo Voltaic Cells, Viscosity Sensors, Oil Mist Detector, Flaw detector – Ultrasonic and Magnetic. 8 Hrs

Application of Controls on Ships: Marine Boiler – Automatic Combustion control, Air – Fuel ratio control, Boiler water level control- single and two element, Steam pressure control, Fuel oil viscosity control, Lubricating oil temperature control, Jacket/piston cooling temperature control, Instruments for UMS classification.
Proportional controller for Boiler Feed water control 8 Hrs

Manipulator Element: Principles, Operation & Application, Electrical Servomotor, Hydraulic servomotor. 4 Hrs

REFERENCE BOOKS:

1. D. A. Taylor, "Marine Control Practice", Butterworth & Co (Publishers) Ltd.
2. Ogata, K, "Modern Control Engineering", Pearson Education
3. Roy Choudhury, D., "Control System Engineering", PHI.
4. Kuo, B.C., "Automatic Control System", PHI.
5. Reeds Volume:10,Instrumentation and Control Systems

SEMESTER IV

UG11P3401	COMPUTER MICRO PROCESSORS AND PLC LABORATORY	72 HRS

A) To study the Logic Training Board

B) Programmable Logic controller

1. System Hardware Identification
2. PLC system configurations, installations
3. PLC to I/O Device interface
4. PLC programming
5. Speed control of mini DC motor using DAC
6. Study of SCADA system (architecture) and demonstration of P,PI, PD, PID Controls

C) Microprocessor 8085

Programming using kit/simulator for

1. Table look up
2. Copying a block of memory
3. Shifting a block of memory
4. Packing and unpacking of BCD numbers
5. Addition of BCD numbers
6. Binary to ASCII conversion
7. Speed control of mini DC motor using DAC

D) Study of 8051 Micro controller kit and writing programs for the following tasks using the kit

1) Table look up
2) Basic arithmetic and logical operations
3) Interfacing of Keyboard and stepper motor

SEMESTER IV

UG11P3402	WORKSHOP PRACTICALS – IV	54 HRS

1. Study of Workshop layout.
2. Rectangular block making by Shaping Machine.
3. Key Way making by Milling Machine.
4. Reciprocating Pump Overhauling.
5. Centrifugal Pump Overhauling.
6. Air Compressor Overhauling.
7. Water tube Boiler Familiarisation.
8. Machine Shop Job: Making a specimen for tensile test.
9. Double-V Weld.
10. T-Weld (inner & outer).
11. Pipe repair & Fabrication.
12. Diesel Engine Familiarisation & Overhauling.
13. Familiarisation with CNC & VMC machines.
14. Additional practicals to be included to help in understanding of modern day ship systems.

SEMESTER – IV

UG11P3403	CONTROL ENGINEERING LABORATORY	36 HRS

Study of Operation of Control Equipments:

1. Operation and utility of a 3 Term (P + I + D) Pneumatic controller for Temperature, Pressure, Flow and Level on SCADA unit.
2. Operation of Automatic Viscosity Controller
3. Operation of boiler automatic controller (Level, Pressure and Temperature)
4. Study hydraulic trainer unit to be familiar with, hydraulic equipments.
5. Study pneumatic equipments on pneumatic trainer unit.
6. To study the functioning of a Mist Detector.
7. Calibration of Pressure Gauge.
8. Operation of an Automatic flow controller and measuring the flow from a given pipe.
9. Microprocessor controlled DC & AC machines.

MAT LAB

1. Generation of periodic, exponential, sinusoidal , damped sinusoidal, step and impulse .
2. Ramp signal using MATLAB in both discrete and analog form .
3. Evaluation of convolution integral, Discrete Fourier transform for periodic and non periodic.
4. Signals and simulation of difference equations using MATLAB.
5. Cascade connection of second order system using MATLAB.
6. 20 Determination of Laplace Transform and inverse Laplace transform using MATLAB.
7. Programs to implement structure union and function.

SEMESTER V

UG11T3501	MATERIAL SCIENCE	72 HRS

OBJECTIVE: *To impart knowledge on metal, its behaviour, interactions with environment & suitability of usage.*

Atom and Crystal Structure:
Atomic packing - directionally and non directionally bonded atoms, crystal structure, space lattice. Ionic and molecular crystals; interfacing in crystals, Non-crystalline solids; elastomer; long chain and molecular compounds.

6 Hrs

Solid Solution:
Properties of solid solutions and alloys. Types of Binary alloys, Thermal Equilibrium Diagrams, Cooling curves, Eutectic, Eutectoid and Peritectic reaction, Eutectic & Peritectic alloys, Inter metallic compounds.

8 Hrs

Phases of Iron :

Allotropy of Iron, Explanation about Different phases of iron carbon such as delta iron, austenite, cementite etc. Iron-carbon Equilibrium diagrams. Equilibrium Diagrams for Ferrous and Non-ferrous metals and alloys.

6 Hrs

Heat Treatment: Heat treatment principles and processes and purposes for Ferrous and non-ferrous metals and alloys. Effect on structures and properties. Deformation and Fracture of materials in services.

8 Hrs

Fatigue and Creep : Fatigue loading, Mechanisms of fatigue, fatigue curve, Fatigue tests. Design criteria in fatigue. Stress concentration. Creep phenomena and creep-resisting alloys. Creep curve. Short time and long time creep tests. Development of creep resisting alloys.

12 Hrs

Corrosion Control and prevention:
Corrosion Principles, Factors influencing corrosion, electrochemical aspects of corrosion, environmental & metallurgical effects on corrosion, mechanism of corrosion-galvanic or two metal corrosion. Types of corrosion – crevice corrosion, atmospheric corrosion, pitting & inter granular corrosion, selective leaching, erosion corrosion, stress corrosion, hydrogen damage and fatigue corrosion. Corrosion due to biofouling, microbial corrosion. Corrosion rate expressions, corrosion rate measurements. 4 Hrs

Corrosion Prevention: Materials selection-alteration of environments - comparison of cathodic and anodic protection .protective coating - metallic coating and other inorganic coat inorganic coating-.protection by means of paints-antifouling paints-corrosion protection system of hull structure- bio-fouling control. corrosion inhibitors-anodic inhibitor-marine coating -corrosion resistant materials for propellers, pumps, system, heat exchangers, hulls. 4 Hrs

Uses of Materials in Shipboard Application: Chromium, Ceramic, Titanium, PTFE in Shipboard Systems. Characteristics of above materials. 4 Hrs

Selection of Materials in Shipbuilding and Marine Engineering : Boilers, Steam and Gas turbine, Purifiers and Diesel engine components, Pumping Machinery, Components and Piping System, Engine seating. Propellers and Rudders. Composition, Strength value and other requirement for materials used. 6 Hrs

Metals and Alloys : Different types of iron and steel; properties and uses in Industry. Alloys of iron and steel, Non ferrous metals and alloys, Effects of various elements on steel and cast iron. Shipbuilding steels.

8 Hrs

Miscellaneous Engineering Materials: Insulating Materials, Plastics & Rubber, PVC, Resins, Adhesives and bonding plastics, paints. Properties and selection for various engineering applications. Polyurethane foam.

6 Hrs

REFERENCE BOOKS:

1. Metallurgy for Engineers - E.C.Rollason
2. Material Science & Engineering - William Smith, Ravi Prakash
3. Material Science - Hazra Choudhary
4. Material Science - V K Manchanda
5. Material Science - R S Khurmi

SEMESTER – V

UG11T3502	SHIP STRUCTURE AND CONSTRUCTION	72 HRS

OBJECTIVE: *To impart knowledge on ship's terms, ship structure and its construction.*

Ship Types / General Classification of Ships:
Tankers, Bulk Carriers, General Cargo Ships, Container Ships, Car Carriers, LNG, LPG and Chemical Carriers, LASH ships, Passenger ships, Reefer Ships, Dredgers & Tugs.OBO, Cattle Carrier, Vessels for Offshore Industry such as OSV, MSV, DSV, PSV, GTV, TIV, Pipe laying ship and Cable laying ship. 2 Hrs

Ship's Terms:
Various terms used in ship construction. Main dimensions. Freeboard, rise of floor, flare, sheer, camber, rake and similar terms

4 Hrs

Stresses in Ship's Structure:
Stresses due to bending, Shear, racking, pounding and panting. Strength members to counter act these stresses.

4 Hrs

Materials and Sections Used:
Different materials used in shipbuilding. Various grades of steel used in ship construction Type of section like plates, flat bars, T-Bars, angles, bulb plates, Flanged plates etc.

6 Hrs

Welding:
Welding techniques and machines in ship building process. Defects in welds, testing of welds. Fabricated components.

4 Hrs

Bottom and Side Framing:
Double bottoms, Water tight floors, solid and bracket floors, Transverse framing, Longitudinal framing, Tank side brackets, Beam Knees, Web frames. 6 Hrs

Shell & Decks:
Plating systems for shell plating including keel, bilge strake, sheer strake. Deck plating & deck girders. Discontinuities, such as hatches and other openings. Supporting & closing arrangements, midship section.

7 Hrs

Bulkheads & Deep Tanks:
Watertight bulkheads, Arrangement of plating and stiffeners. Watertight sliding doors. Watertight openings through bulkheads for electric cables, pipes and shafting. Deep tanks for oil fuel or oil cargo. Corrugated bulkheads. Slosh bulkheads.

7 Hrs

Fore-End Arrangements:
Stem construction. Arrangements to resist panting. Forepeak – Collision bulk head, Bulbous bows. Anchor and cable arrangements, Chain locker

6 Hrs

Aft-End Arrangements:
Types of sterns, Stern frame and rudder. Types of rudder. Rudder support. Rudder carrier bearing, shaft tunnel, shaft bearings. Aft peak tank. 6 Hrs

Load Line and Tonnage:
Definition of freeboard conditions for assignment, List of closing appliances,
Load line Surveys. Details of markings permanently carved. Tonnage regulations. 4 Hrs

Shipyard Practice:
Shipyard layout. Hull construction processes and assembly stages. Outfitting and machinery installation. Tests and trials. Role of surveyors in ship construction. Use of computers.

5 Hrs

Offshore Technology:
Drilling ships and platforms, Supply/support vessels, Dynamic positioning. Cable laying vessels.

3 Hrs

Ship Surveys:
Survey rules, Functioning of ship classification societies. Surveys during construction.
Periodical surveys as per statutory regulations. Constructional features and rule guidelines for merchant vessels as per. Various IMO conventions and codes.

4Hrs

Ship Systems:
Ventilation, bilge piping, HP air, LP air, fuel system, sea water system, pumps and piping system.

4 Hrs

REFERENCE BOOKS:

1. Ship Construction – Reeds Volume:5
2. "Ship Construction", D. J. Eyres, Butter worth – Heinemann, Oxford.
3. Merchant Ship Construction – H.J. Pursey
4. Merchant Ship Construction – D.A. Taylor
5. Principles of Naval Architecture Vol I (Editor Lewis) SNAME Publication
6. Ship Construction – Gilmor Bruce

SEMESTER-V

UG11T3503	MARINE INTERNAL COMBUSTION ENGINES - I	72 HRS

OBJECTIVE: *To develop knowledge in marine diesel engines construction, fundamentals and latest developments.*

Performance Characteristics of I.C. Engines: 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 Practical heat balance diagrams and thermal efficiency.

10 Hrs

General Description of I.C. Engines: Marine Diesel Engine of M.A.N- B&W., Sulzer-make, Constructional Details of I.C. Engines: Principal Components: Jackets and Liners, Cylinder heads. Pistons, Cross heads, Connecting rods, Bed Plates, A-frames, Welded construction for Bed plates & frames. Tie rods, hydraulic exhaust valves. Crank-shafts, Cam-shafts,

13 Hrs

Starting Systems: Starting system of various types of 4 stroke diesel engines.

3Hrs

Scavenging and Supercharging System : Scavenging arrangements in 2-stroke engines; Air charging and exhausting in 4-stroke engines; Various types of Scavenging in 2-stroke engines; Uni-flow, loop, cross loop and reverse loop scavenging, their merits and demerits, Scavenge pumps for normally aspirated engines; under piston scavenging, Scavenge manifolds.

5 Hrs

Supercharging Arrangements: Pulse and constant pressure type; Their relative merits and demerits in highly rated marine propulsion engines. Air movements inside the cylinders. Turbocharger and its details. Two stage turbocharging. Turbocharger surging

7 Hrs

Combustion of Fuels in I.C. Engines: Fuels, Combustion Process – fundamentals, Grades of suitable fuels. Preparation of fuels for efficient combustion. Fuel atomization, Ignition quality, Fuel injectors, and its details. Ignition delay, after burning. Basic definitions Flash point. Fire point. Ignition point. Compression pressure ratio and its effect on engines. Reasons for variation in compression pressure and peak pressure. Design aspects of combustion chamber.

13 Hrs

Cooling of I.C. Engines: Various Cooling media used; their merits and demerits, cooling of Pistons, cylinder jackets & cylinder heads, Bore cooling, maintenance of coolant and cooling system. 5 Hrs

Safety and Prevention of Mishaps in I.C. Engines: Causes and prevention of crank-case explosions, and Scavenge fires. Detection of same and safety fittings provided to prevent damage. Uptake fires, starting air line explosion and other engine safeties.

12 Hrs

Special Features of I.C. Engines: Development of long-stroke Engines, Implication of stroke-bore ratio

4 Hrs

REFERENCE BOOKS:

1. Wood yard, Goug, "Pounder's Marine Diesel Engines". Butter Worth Heinemann Publishing, London.
2. "Slow Speed Diesel Engines" Institute of Marine Engineers
3. S H Henshall, "Medium and High Speed Diesel Engines for Marine Use". Institute of Marine Engineers, Mumbai.
4. D K Sanyal, "Principle & Practice of Marine Diesel Engines". Bhandarkar Publication, Mumbai.
5. "Marine Low Speed Diesel Engine", Denis Griffiths.
6. "Lamb's Question and Answer on Marine diesel Engine".
7. "Diesel Engines", A.J. Wharton.

SEMESTER-V

UG11T3504	FLUID MACHINES	54 HRS

***OBJECTIVE**: To impart and develop knowledge about centrifugal pumps, reciprocating pumps and turbines and dimensional analysis.*

Centrifugal Pumps: Introduction of Pumps, Types of Centrifugal pump. Priming of pump. Calculations of various heads; Losses and Efficiency, Work done per unit weight, Velocity Diagrams at inlet and exit; Calculation of power, Torque on shafts. Performance of pumps & Characteristic Curves, Cavitation in Centrifugal pumps. Net Positive Suction Head, Minimum speed and Specific speed of pump. Applied problems.

12 Hrs

Reciprocating Pumps: Introduction and comparison with other pumps. Various types, single and double acting, single and multi cylinder, Co-efficient of discharge; Negative slip of pump Theoretical indicator Diagrams; Effect of acceleration and friction head on indicator diagram; Cavitation and separation, Maximum speed without cavitation & separation. Use of air vessel. Applied problems.

12 Hrs

Impulse and Reaction Turbines: Introduction of Turbines, Various Types of turbines, velocity triangles and work done and efficiency of various turbines. Impulse Turbine -Pelton wheels. Inward Radial flow Reaction turbine- Francis Turbine; Degree of reactions, Axial flow reaction turbine- Kaplan Turbine, Draft Tube, Specific Speed, Unit Quantities etc. and Applied problems.

15 Hrs

Physical Similarity, Dimensional and Model Analysis: : Introduction of dimensions, Types of variables, Types of forces acting in moving fluid, Ratios of Forces and Dimensionless groups, Dimensional Homogeneity. Type of Physical similarity. Methods of Dimensional Analysis. Model Laws, Model Testing. Application of Dynamic similarity and Model Analysis for Roto Dynamic Machines i.e. pumps and Turbines. Applied problems.

15 Hrs

REFERENCE BOOKS:

1. Hydraulics and Fluid mechanics - P.N. Modi, S.M. Seth
2. Fluid Mechanics & Hydraulic Machines - R.K. Rajputh
3. Fluid Mechanics (Part – I & Part – II) - J. F. Douglas
4. Fluid Mechanics & Hydraulic Machines - R. K. Bansal
5. Mechanics of Fluids - Bernard Massey & John Ward-Smith
6. Fundamentals of Fluid Mechanics - G.S. Sawhney

SEMESTER V

UG11T3505	MARINE AUXILIARY MACHINERY – I	72 HRS

***OBJECTIVE** : To impart knowledge of Ship's engine room layout, piping systems and fittings and working principle, construction and operation problem of ships Auxiliary Machinery.*

Engine Room Layout: Layout of main and auxiliary machinery in engine rooms in different ships.

2 Hrs

Engine Room Piping Layout: Layout and arrangement of important Pipe lines in Engine Room with fittings and its materials of construction. These include systems like - Steam, Bilge, Ballast and Oil fuel systems, Lube oil system lines, Sea water system, Fresh water system and Fire Fighting systems etc. Fresh water / Sea water Hydrophore systems, Feed water, Distilled water, Drinking water systems and their filling lines. Colour codes and other symbols used to identify pipelines

9 Hrs

Bunker and Oil Transfer: Standard practice followed for Bunkering fuels including sampling and spill containment systems; sludge discharge to shore reception and other oil transfer procedures.

3 Hrs

Filters: strainers and filters, types of marine filters, different types of filter materials, auto-clean and Duplex filters, static filter, magnetic filter, micro filters. Priming and core maintenance of filters.

5 Hrs

Pumps: Types of pumps for various requirements, their characteristics and application in ships. Centrifugal Pumps, Gear Pumps, Screw Pumps and Reciprocating pumps. Care and Maintenance of pumps. Hydraulic pumps & motors, hydraulic line filters and systems. Automation and control of pumps & pumping systems.

8 Hrs

Air Compressors and Blowers: Operational and constructional details of compressors used on board ships. Uses of compressed air. Air Bottles, Construction, mountings, compressor safeties & associated systems.

6 Hrs

Evaporators: Construction and Operation of different types of evaporators and maintenance. Fresh Water generators distillers. Reverse Osmosis process, Conditioning arrangements of distilled water for drinking purpose.

4 Hrs

Heat Exchangers: Tubular and plate type, reasons of corrosion, tube removal, plugging, materials used and maintenance.

3 Hrs

Pollution Prevention: STOKES Law; Static and turbo separators, Oily bilge Separators their construction and operation, Use of coalescers, prevention of oil pollution and various International requirements. MARPOL Convention, Shipboard Oil Pollution Emergency Plan (SOPEP), Shipboard Marine Pollution Emergency Plan (SMPEP) & Oil Discharge monitoring and control system (ODMCS).

6 Hrs

Oil Purification: Theory of oil purifications, various methods of oil purifications, Use of settling / service tanks & precautions taken before entering / cleaning tanks. Principles of operation and construction of different Centrifuges for heavy fuel and lubricating oil such as self de-sludging & ALCAP system.

7 Hrs

Steering Gear: Operation and Constructional details of various types of steering machinery – Ram type and Rotary vane type. Telemotor systems, Variable Delivery Pumps used in steering gears - axial and radial displacement types. Hunting action of Steering gear. Emergency Steering arrangement. Safematic Steering Gear with redundancy concept as per SOLAS. Care and Maintenance of Steering Gear Plants.

5 Hrs

Propulsion Shafting System: Methods of shaft alignment, constructional details and working of Thrust blocks. Intermediate Shaft bearing and Stern tube bearing. Oil / water lubricated Stern Tubes. Shaft Sealing arrangement. Stresses in Tail End, Intermediate and Thrust Shafts. Propeller drop. Muff Coupling.

5 Hrs

Dry Docking: Methods of dry docking of ships, Inspection and routine overhauling of underwater fittings and hull; Measurement of propeller drop, removal and fittings of propeller (with and without key).

3 Hrs

Other Ship Board Equipments: Incinerators & MARPOL Annex- VI, Sewage Treatment Plant (MARPOL Annex – IV), Shore discharge / reception facilities, Different types of ship stabilizer. Bow Thrusters, Hull protection arrangements & Marine Growth Protection System.

6 Hrs

REFERENCE BOOKS:

1. Marine Auxiliary machinery - D.W. Smith
2. Marine Auxiliary machinery - H.D. McGeorge
3. Basic Marine Engineering - J.K. Dhar
4. Marine Engineering Practice - IMEI Publication
5. General Engineering Knowledge for Marine Engineers - Reeds Volume:8
6. Marine Machineries- Operation & Maintenance – T.B. Srinivasan, IMEI Publication.
7. The Running & Maintenance of Marine Machinery – J. Cowley by IMEI Publication.

SEMESTER V

UG11T3506	NAVAL ARCHITECTURE – I	72 HRS

***OBJECTIVE**: To impart basic knowledge of ship hydrostatics, stability and strength.*

Geometry of Ship and Definitions: Ship geometry, Definition of hull surface – coordinate systems, graphic description – Lines plan of ships, coefficients of form, Ship forms. Displacements, deadweight, gross tonnage and net tonnage.

5 Hrs

Numerical Integration in Naval Architecture: Simpson's rules, Trapezoidal rule, mean and mid-ordinate rules, Tchebycheff's rules and their applications to calculation of areas, volumes and centroids, first and second moment of areas, displacement. 5 Hrs

Basic Ship Hydrostatics: Density, relative density, Pressure exerted by a liquid. Archimedes principle, Meaning of buoyancy, reserve buoyancy and permeability. tonne per centimetre immersion (TPCI). Effect of change in density of water, center of pressure, First and second moments of area. Conditions of equilibrium of floating bodies. Definition of stability, initial stability, meta-centric height, calculation of BM, GM, Addition and removal of masses. Effect of suspended mass, free surface effect. Inclining experiment.

20 Hrs

Hydrostatic Curves: The calculation of hydrostatic data – waterline properties, volume properties, Wetted surface area of a ship, Hydrostatic curves, Bonjean curves and their use.

4 Hrs

Statical Stability at Large Angles of Heel: Definition of large angles of heel, Righting arm, Cross curves of stability, Curve of Statical stability. Angle of loll. Dynamical stability. Influence of trim and waves on stability. Influence of ship forms on stability. Pure loss of stability, IMO code of intact stability.

12 Hrs

Flooding and Damage Stability: Definitions as per SOLAS – water tight bulkhead, bulkhead deck, assessment of ship conditions after flooding – Lost Buoyancy or Added mass, change in mean draught due to bilging, change in draughts due to bilging of end compartments, Probabilistic damage stability (MARPOL & SOLAS guidelines for damage stability)

8 Hrs

Longitudinal Stability and Trim: LCB. Centre of Flotation, moment to change Trim Change in draught due to addition of small masses and large masses. Change in draught due to change in density of water. 8 Hrs

Strength of Ships: Longitudinal strength. Curves of buoyancy and weight, Curves of load, shearing force and bending moment, Alternative methods. Standard conditions, still water and wave bending movements and shear forces, Approximation for maximum shearing force and bending moment, Moment of Inertia of section, Section modulus calculation. Stresses in deck and keel. Pressure on bulkhead. 10 Hrs

REFERENCE BOOKS:

1. Buoyancy & Stability of Ships – by IR R F Scheltema De Heere & Bakker (George Haarp & Co. Ltd. London)
2. Ship Hydrostatics and Stability – by Adrian B Biran
3. Principles of Naval Architecture -Vol I – by Edward V Lewis (SNAME)
4. Ship Stability for Masters & Mates – by Derrett & Barrass
5. Naval Architecture for Marine Engineers – Reeds Volume - 4
6. Introduction to Naval Architecture – Eric Tupper
7. Ship and Naval Architecture – R.Munro-Smith
8. Ship Construction – D.J.Eyers
9. Naval Architecture, Principles & Theory – B.Baxter

SEMESTER-V

UG11T3507	ELEMENTARY DESIGN AND DRAWING	54 HRS

OBJECTIVE: *To impart a fair knowledge about Design procedures of Engineering components and train students to draw the various components.*

1. ELEMETARY DESIGN

Procedure in Machine Design : Concepts of design, procedure & processes, Design synthesis, Ergonomic consideration in design, Feasibility, preliminary Design Alternative, Final Design alternative, Preliminary & Final Plans & Drawings.

2 Hrs

Use of Standards in design, selection of preferred sizes, common useful Materials & manufacturing considerations in design. 2 Hrs

Review of failure criteria in mechanical design, properties of materials, heat Treatment processes, BIS system of designation of Steels, Basis of good Design, deformation, wear corrosion.

2 Hrs

Common useful materials & Manufacturing considerations in design. Failure Criteria in Mechanical Design : Basis of good design. Failure of machine parts. Deformation, Wear Corrosion. 2 Hrs

Machine Design: Strength Consideration for Design : Strength of materials, Reliability, Influence of size, Stress concentration, Strength under combined stresses, Static loads, Impact loads, Repeated loads, Completely reversed loads, Static plus Alternating loads, Cyclic & combined loads, Fatigue strength. Dynamic Stresses. Selection of materials. Specifications: - Fit, tolerance, finish-BIS .

5 Hrs

Design and Drawing to Specifications for Parts Subjected to Direct Loads:

Fasteners: Bolts & Screws, Cotter & knuckle joints, keys & couplings, Pipe joints, Riveted & welded joints. Design of Welded machine parts. 2 Hrs

Power Transmission : Shafts & axles, Bearings, clutches & brakes, Belt drives, chain drives, design & drawing of tooth gearing like spur & Bevel gears, Rack & pinion, worm & worm wheels, helical gears.

3 Hrs

2. MARINE ENGINEERING DRAWING

Advanced Marine Machinery Assembly Drawing:

Marine Diesel Pistons 2-stroke & 4 –stroke types, 4- Ram Steering Gear, Diesel Air Starting Valve, Starting Air Pilot Valve, 4 - Stroke Diesel Piston and Rod , Automatic Valve for Starting Air System., Burner Carrier , Quick Closing Sluice Valve, Rudder Carrier Bearing, Reducing Valve ,Upper Piston & Rod , Telemotor Receiver , Turbine Flexible Coupling, Fuel Valve , Stern Tube & Tail Shaft , Michell Thrust Block , Improved High Lift Safety valve Cross head & Guide shoe, Flow regulator, Gauge Glass (Plate type) Pedestal Bearing, Piston type, stop valve, Tunnel bearing ,Valve regulator (Minimum of 9 drawings to be completed in the class. Remaining to be given as home assignment)

36 Hrs

Para 17 Annex II of DGS

REFERENCE BOOKS:

1. Machine Design – "Pandya Shaw"
2. H. G. Beck , "Reeds, Engineering Drawing for Marine Engineers".
3. H. Barr & J.G. Holburn, "Engineers MacGIBBON'S Pictorial Drawing Book for Marine"
4. Design of Machine Elements – V.B. Bhandari by TMH

SEMESTER – V

UG11P3501	MATERIAL SCIENCE LABORATORY	54 HRS

1. To determine the behavior of different materials when subjected to Tension and to obtain the following tensile properties of materials on Universal Testing Machine:
   i) UTS
   ii) Yield Stress
   iii) Young's Modulus
   iv) Breaking Stress
   v) Percentage Elongation
   vi) Percentage reduction in area
   vii) Plotting of Curve of- Stress vs Strain.

2. To conduct IZOD impact test on impact test machine and calculate value of energy absorbed.

3. Calculate hardness of a material on Brinnel's hardness testing machine.

4. Determination of behavior of ductile materials when subjected to torsion and to obtain
   (i) Maximum Torsion Stress,
   (ii) Modulus of Rigidity and
   (iii) Plotting of curve of Angle of Twist vs Torque.

5. To determine the stiffness of springs for
   (a) Round wire and
   (b) Square section wire when subjected to compression.

6. To study grain structure of various ferrous & Non Ferrous material under microscope.

7. To conduct Dye Penetrant Test for detection of crack in material.

8. To conduct Magnetic Particle test for crack detection.

9. To conduct flaw detection test by Ultrasonic Equipment.

10. To study behaviour of a material under fatigue on Fatigue testing machine.

SEMESTER V

UG11P3502	VIBRATION LABORATORY AND FLUID MECHANICS LABORATORY	54 HRS

VIBRATIONS EXPERIMENTS

The following experiments in vibrations are performed with VIBLAB APPARATUS:

1. To verify the relation $T = 2\pi \sqrt{l/g}$ in case of a simple pendulum and to plot the graph T^2 vs L.

2. To verify the relation $T = 2\pi \sqrt{(K^2 + OG^2)} / g.OG.$ in case of a compound pendulum, and find the radius of gyration and equivalent length of compound pendulum.

3. To determine the method of Tortional oscillation, the radius of gyration of a body, about the centre of gravity by using the relation, $T = 2\pi (K/a) \sqrt{L/g}$

4. To verify the relation, $T = 2\pi \sqrt{W/Kg}$ and plot a graph T^2 vs W.

5. Study of undamped natural vibrations of a beam pivoted at one end supported by tension spring at the other end.

6. To find out the natural frequency of a beam with and without load and to verify the Dunkerley's Rule.

7. Study of forced vibrations for various amounts of damping of beam pivoted at one end and supported by tension spring at the other end and to plot a graph of amplitude factor vs frequency ratio. (Longitudinal Vibration).

8. To study the forced vibrations for various amounts of damping and to plot a graph of amplitude factor vs frequency ratio (Lateral Vibration)

9. Experimentally prove the relation $T = 2\pi \sqrt{(I / Kt)}$ and study the relationship between the periodical time and shaft length.

10. To measure circular and linear displacements of cam and follower in case of
    (i) Plate cam-Reciprocating follower
    (ii) Tangent cam-with roller oscillating follower and plot the displacement curves hence differentiate the velocity and accelerating curves

FLUID MECHANICS EXPERIMENTS

1. To determine the meter Constant of the Venturimeter.
2. To determine the efficiency of a Pelton wheel.
3. To determine the friction co-efficient for the flow of water through a pipe.

4. To determine 'GM' (Metacentric Height) of a floating body.
5. Study various types of impellers on board a ship. Impellers of pumps for practical demonstration specially required for Design Work.
6. To study various hydraulic circuits using hydraulic trainer unit.
7. To study the operation of various transparent hydraulic flow control directional valves (3/2, 4/2, 5/2 etc.,).
8. To demonstrate / determine the lube oil pressure distribution at various points on a loaded journal bearing rotating at different speeds and loads.
9. To study the lube oil pressure at different points on a thrust bearing rotating at different speeds.
10. To find the efficiency of a centrifugal pump.
11. To determine the co-efficient of velocity of contraction & co-efficient of discharge of water through the various orifices.

SEMESTER V

UG11P3503	MARINE POWER PLANT OPERATION – I	54 HRS

Study of the following Marine Equipments:

1. Cylinder liner of Marine Diesel Engine and its calibration
2. Piston / Piston ring of Marine Diesel engine and its calibration
3. Cylinder head and mountings
4. Jerk Type Fuel pump
5. Air starting valves
6. Fuel injectors
7. Cylinder relief valves
8. Turbocharger familiarization
9. Purifier demonstration
10. Plate heat exchanger / Shell & tube heat exchanger and its maintenance
11. 4 ram & 2 ram Steering gear
12. Steam Turbine Familiarization
13. Thrust bearing
14. Oily water separator
15. Any other machinery found onboard a modern ship

[Every student / cadet will study equipment and its working as per instruction sheet and draw sketches of the components where required, dismantling & assembling may be part of this practical training. Assessment will be done on student / cadet's understanding of the equipment.]

SEMESTER-VI

UG11T3601	SHIP FIRE PREVENTION AND CONTROL	54 HRS

OBJECTIVE: *To provide sound knowledge of fire prevention and control to the students.*

Fire Hazard Aboard Ships:
Fire triangle, Fire Tetrahedron, Fire-chemistry, Spontaneous Combustion, Limits of inflammability. Advantages of various fire extinguishing agents including vaporizing fluids and their suitability for ship's use. Control of Class A, B, C & class D fires, Combustion products & their effects on life safety.

4 Hrs

Fire Protection Rules in Ship's Construction:
SOLAS convention, requirements in respect of materials of construction and design of ships, (class A , B, C type Bulkheads), fire detection and extinction systems, Fire test, means of escape, fire doors & fire zones, electrical installations in hazardous zones, ventilation system and venting system for tankers. Statutory requirements for fire fighting systems and equipments on different vessels. 6 Hrs

Fire Detection System:
Types of detectors, Selection of fire detectors and alarm systems and their operational limits. Commissioning and periodic testing of sensors and detection system.

8 Hrs

Fire Fighting Equipment and Relevant Rules as per SOLAS:
Fire pumps, hydrants and hoses, Couplings, nozzles and international shore connection. Construction, operation and merits of different types of portable, semi-portable and fixed fire extinguishers installations for ships. Properties of Chemicals used, Water Sprinkler system, Water-mist Fire suppression system. Bulk and bottled Carbon Di-Oxide system. Inert gas systems. Fireman's outfit, its use and care. Maintenance, testing and recharging of appliances. Fire Fighting Appliance Survey. Breathing apparatus types, uses, method of operation. Fixed Fire Fighting installation on LPG & LNG. 18 Hrs

Fire Control:

Fire Control Plan and IMO Symbols, Action required and practical techniques adopted for extinguishing fires in accommodation, machinery spaces, boiler front, Cargo holds, galley, pump room, paint locker. Fire fighting in port and dry dock. Procedure for re-entry after putting off fire, Rescue operations from affected compartments.

First aid, Fire organization on ships, shipboard organization for fire and emergencies. Combustion products and their effects on safety of life. Fire signal and muster. Fire drill. Leadership and duties, Human behaviour, Special precautions for prevention/fighting fire in tankers, chemical carriers and gas carriers, Safe working practice. 18 Hrs

REFERENCE BOOKS:

1. Marine Engineering Practices - IME Publication
2. SOLAS - Bhanderkar Publication
3. FSS / FTP Code - IMO Publication
4. Fire aboard - Frankrush Brook.
5. Fire fighting aboard ships - M . G Stavitsky
6. General Engineering Knowledge for Marine Engineers- Reeds Volume - 8
7. Fire Appliance Rules - DGS/Bhandarkar Publications

SEMESTER VI

UG11T3602	MARINE INTERNAL COMBUSTION ENGINES -II	72 HRS

OBJECTIVE: *To develop knowledge in marine diesel engines construction, fundamentals and latest developments.*

Forces and Stresses: Balancing, overloading, Different types of moments & couples, Different type of vibrations (axial, torsion and radial) & its effects, methods of vibration damping .
4 Hrs

Fuel Pumps and Metering Devices: Jerk and Common rail systems; Fuel injection systems, Helical groove and spill valve type Fuel Pumps. System for burning heavy oil in slow and medium speed marine engine, V.I.T. & Electronic injection system.

-Effects of viscosity on liquid fuel combustion.
-Necessity of variable fuel injection system.
-Necessity for adoption of fuel quality setting system.
-Incorporation of FQSL along with the V.I.T. system on the engine.

10 Hrs

Manoeuvring Systems: Starting and reversing systems of different Marine Diesel engines with safety provisions. Actions on emergency situation. 10 Hrs

Indicator Diagrams and Power Calculations: Construction details of indicator instrument. Study of different types of indicator cards, Significance of diagram. Power Calculations, fault detection, simple draw cards and out of Phase diagrams. Power balancing, Test bed and Sea trials of diesel engines. 6 Hrs

Lubrication Systems : Lubrication arrangement in diesel engines including Coolers & Filters, Cylinder-lubrication, Liner wear and preventive measures, various grades of lubricating oil its effect and preventive measures.

-Improvements in Lubricating oils through use of additives. Types of additives
-Monitoring engines through lubricating oil analysis reports.
- Synthetic Oils & their uses. 10 Hrs

Medium Speed Engines : Different types of medium speed marine diesel engines, couplings, and reduction gears used in conjunction with medium speed Engine, Development in exhaust valve design, V-type engine details.

-Use of poor quality residual fuels and their consequences.
-Improvements in designs for higher power output.

8 Hrs

Automation in Modern Diesel Engine Plants: Remote operation, Alarm and fail safe system, Governors and their basic functions, Constant and variable speed governors. Constructional details and hunting of governor. Electronic governors.

- Computerised monitoring and diagnostic applications in propulsion engines
- Concept of intelligent engine. 6 Hrs

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

6 Hrs

Trouble Shooting in Diesel Engines: Hot & Cold Corrosion, Overloading, high exhaust temperature, misfiring, Crankshaft web slip, X-head bearing problems, starting failure. Microbial degradation of fuel of lub oil

4 Hrs

Modern trends in Development: Current Engines (Sulzer RTA, B&W LMC & SMC, SEMT Pielstick) Intelligent Engine (Cam less concept), improvement in design for increased Time Between Overhaul. NOx – Control of marine Diesel Engines. SOx Control, and IMO regulations in ECA & SECA. MCR & CSR with Propeller curve relationships. All latest Technology incorporated in a modern propulsion machinery ships.

8 Hrs

REFERENCE BOOKS:

1. Wood yard, Goug, "Pounder's Marine Diesel Engines". Butter Worth Heinemann Publishing, London.
2. "Slow speed Diesel Engines", Institute of Marine Engineers,India
3. S H Henshall, "Medium and High Speed Diesel Engines for Marine Use". Institute of Marine Engineers, India.
4. D K Sanyal, "Principle & Practice of Marine Diesel Engines", Bhandarkar Publication, Mumbai.
5. "Marine Low Speed Diesel Engine", Denis Griffiths.
6. "Lamb's Question and Answer on Marine diesel Engines".
7. "Diesel Engines", A.J. Wharton.

SEMESTER VI

UG11T3603	MARINE ELECTRICAL TECHNOLOGY	72 HRS

OBJECTIVE: *To develop skills in marine electrical technology including the knowledge of the regulations observed on board ships regarding electrical equipments.*

Power Generation:
Merits & Demerits of A.C. & D.C. on board; Rules and Regulations governing electrical mac hineries on ships; Different alternator Excitations Systems on board – (indirect, Direct, static excitations, Brushless generator construction & operational diagram. Automatic Voltage Regulator. Effects of loading of generators on rated voltage and RPM of the prime mover 8 Hrs

Alternative Source of Power :
Emergency Generator & Different Starting method including auto start, emergency batteries construction and its different types & duties, Location of emergency power, Different Emergency loads, Rules & Regulation, emergency power, Maintenance of emergency power source on board. Shore Supply – Specifications as per Voltage / frequency, precautions while taking shore supply. Navigation and signalling lights 7 Hrs

Distribution: Different electrical diagrams and their uses. Type of Distribution, Distribution network on board; Main & emergency switch board, construction, different switch gear & protective devices, Grounded and Insulated neutral systems, . Cables & temperature classification. Electrical signals. 5Hrs

Motor and Control Equipments : Types of marine motor, types of enclosures, protective devices on motors, sequential starting (e.g. Refrigerating plants, automatic fired boiler). 3Hrs

Miscellaneous Marine Electrical Equipment Alarm System : Synchros and its working Engine Room Telegraph, Rudder Angle Indicator, R.P.M. & Revolution Counter, Centralised Salinity Indicator,
Watertight door operation, Alarm system (types, supply) on board's oxygen analyzer, High & low level arms, Navigational lights, Emergency Radio Operation, Electrical Deck auxiliaries. 8 Hrs

Maintenance of Electrical Systems, Fault finding and Repair : Type of faults & indication s on Generator, motor & distribution systems, Different Testing equipments & meters (multimeter / megger, clampmeter), Salvaging a motor Detection of faults on electronic

circuits & cards – Indications & corrective arrangements, Necessary Precautions & care while fault finding and Repair, preventive maintenance, periodic surveys, spares requirement. 9 Hrs

Special Electrical Practice : Rules and Regulations & operation of all Electric Steering gear, Electric propulsion, selection of motor for propulsion(DC motor & AC motor).Limitation of power of a dc motor. Working of frequency converters(PWM, Static frequency converter, cyclo converter) Diesel electric and Turbo electric propulsion system, pod / Azipod drive unit, superconductivity applied in propulsion, special electrical practice for oil, gas and chemical Tankers (Tanker classification, Dangerous spaces, Hazardous zones, Temperature class), Flame proof Ex 'd' a nd intrinsic safety Ex 'i', Ex 'e', and Ex 'n' equipments and their applications in zones, Maintenance of Ex-protected apparatus.

18 Hrs

High Voltage: With regard to merchant vessels: Introduction, safety briefing and objectives of the course. High voltage technology and application on board ships, concepts and definitions. Electrical hazards associated with high voltage system e.g. electrical shock, arc flash and arc blast and their precaution. Earthing system (NER). Permits (EPW) and procedures for preventing accidents while carrying out maintenance and repair. High voltage circuit breakers (Vacuum type and sf_6 Type), Personal Protective Device.

8 Hrs

Safe Electrical Practice : Safe watch keeping, points to check on electrical machineries, Switch gears & equipments, microprocessor control and maintenance, electrical fire fighting, precautions against electric shock and related hazards. 6 Hrs

REFERENCE BOOKS:

1. Marine Electrical Technology by Elstan a Fernandez
2. Marine electrical practice by BOWIC
3. Electricity applied to Marine engineering W. LAW
4. Marine Electrical Practice G. O. Watson
5. Practical Marine Electrical Knowledge Dennis T. Hall
6. An Introduction to Electrical Instrumentation B.A. Gregory
7. High voltage Engineering by M. S. Naidu, V. Kamaraju Tata McGraw-Hill Education
8. High voltage Engineering fundamentals by Kuffel

SEMESTER VI

UG11T3604	MARINE AUXILIARY MACHINERY – II	72 HRS

***OBJECTIVE**: To impart sound knowledge about working principle, system components, operation of refrigeration and air conditioning, deck machinery and pollution prevention methods.*

Refrigeration: Principles of refrigeration, overview of refrigeration cycles, different refrigeration systems, classifications of refrigerators, cryogenic technology – definition, temperature range, insulation.
Different refrigerants, chemical formula, desired properties (general, physical, chemical, thermodynamic) comparison, effect on environment , Montreal protocol & latest amendments, new refrigerants.
Design and construction of various components of refrigeration plants, i.e, compressor, condenser, evaporator, expansion v/vs, control & safety equipments.
Operation and maintenance of refrigeration plants, control of temperature in different chambers, charging of refrigerant / oil, purging of air, defrosting methods, trouble shooting.

16 Hrs

Reefer Ships: Refrigeration of cargo holds, brine system and it's operation & maintenance, methods of air circulation in holds, insulating materials, micro-organism control, dead and live cargo, factors affecting refrigerated cargo. Container ship refrigeration, preparation for loading, cargo survey of refrigeration equipment

6 Hrs

Air Conditioning and Air Handling Unit (AHU): Necessity on board ships, different systems, control of room air temperature, humidity, noise, dust and purity. Construction of duct, arrangement of Cooling & dehumidification , heating and humidification. Fans and diffusers – types and selection, ventilation of accommodation, fire safety of the system.

6 Hrs

Ventilation : Ventilation of engine room – principles, volumetric calculations – combustion air requirement etc., fan / blowers types, pressure loss in ducting, noise and power consumption, safety trips testing of flaps / fire dampers. Pump room, CO2 and battery rooms, air change requirements (as per SOLAS), design considerations, maintenance.

6 Hrs

Noise and Vibrations: Elements of aerodynamics and hydrodynamics sound, Noise Sources on Ships and noise suppression techniques, Noise level measurement. Various modes of vibration in a ship (i.e. free, forced, transverse, axial, torsional – Their sources and effects), Resonance and critical speed, Structure borne and air borne vibration, Anti vibration mountings of machineries.
De-tuners, Dampers with reference to torsional vibration, use of torsiographs

9 Hrs

Overhauling of Auxiliary Machinery: Planning for overhaul, stand-by equipment, tools, spares, manpower, Safety procedures - work permit, isolation - lock out / Tag out. Overhauling machinery like - a compressor, pumps – one for each type, purifier, generator engine, oil burning equipment, valves, cleaning filters etc.

8 Hrs

Technical Specification for Ship Stores and Spares: Introduction to types, measurement and identification of industrial supplies – tools, bearings, sealings – O-rings, Gaskets, Gland Packing & other sealants – silicon, forma-gaskets, Valves, Pipes, Steels – bars, bulbs, angles etc.

8 Hrs

Fuels: Study of primary fuels: Coal, Petroleum, Natural Gas, treatment of fuels for combustion in marine ICE and steam plants, Residual Fuels, Emulsified Fuels 4 Hrs

Lubrication: Theory of lubrication; suitability of lubricant for various uses; Additives in oil and their specific use; Loading pattern of various bearings in marine use and lubrication system adopted. 9Hrs

REFERENCE BOOKS:

1. Marine Engineering Practice - IME Publication
2. Refrigeration at Sea - J . R. Stot
3. Marine Airconditioning - S. D. Srivastava
4. Advanced Marine Engineering - J.K. Dhar
5. General Engineering Knowledge - H.D. McGoeorge
6. Marine Auxiliary Machinery - H.D. McGoeorge
7. Engine Stores / Spares Catalouges
8. General Engineering Knowledge for Marine Engineers - Reeds Volume:8
9. Marine Machineries- Operation & Maintenance – T.B. Srinivasan, IMEI Publication.
10. The Running & Maintenance of Marine Machinery – J. Cowley by IMEI Publication.

SEMESTER VI

UG11T3605	NAVAL ARCHITECTURE – II	72 HRS

***OBJECTIVE**: To impart knowledge of ship resistance, propulsion, manoeuvring and sea keeping to students.*

Ship Resistance and Powering: Components of ship resistance; Determination of ship resistance. Model experiments, Froude's Law of comparison, Effective power calculations, Ship correlation factor (SCF), Admiralty coefficient, Fuel coefficient and Fuel consumption. Application of ITTC method.

10 Hrs

Propulsion of Ships and Propellers: Propellers - geometry terminology. Apparent and real slip. Power and efficiencies in ship propulsion system. QPC, Law of similitude and model tests with propellers, Open water characteristics Propeller diagrams. Wake and wake distribution. Thrust deduction fraction, Cavitation – cavitating flows, types of propeller cavitation, detrimental effects of cavitation, criteria for prevention of cavitation. Special types of propeller arrangements – FPP, CPP, Propellers in Nozzles, Paddle wheel, Vertical axis propellers – Voith Schneider, Jet propellers. Ship model correlation, ship trials.

15 Hrs

Propeller Design Theories: Simple theories of propeller action, Momentum theory of the propeller, Blade element theory, Circulation theory, Lifting line theory.

7 Hrs

Ship Propeller and Machinery Interaction: Propulsion machinery layout, Ship propeller interaction, influence of condition of the ship, number of propeller blades, propeller area ratio, pitch ratio, service condition, wake and thrust deduction, interaction at extreme loading, specification of speed power and rate of revolution, choice of design point, Engine propeller matching, choice of propeller, ship trials, acceleration and retardation tests.

12 Hrs

Rudder Theory: Basic requirements of rudder. Physics of control surfaces Properties of hydrofoils – lift and drag. Action of the rudder in turning a ship. Rudder nomenclature. Types of rudders. Area and shape of rudder, position of rudder, stern rudders & bow rudders, Forces on rudder. Torque on stock. Angle of heel when turning, Controllability of ships, Directional stability definitions, Measures of manoeuvrability. Model experiments and full scale manoeuvring trials – course keeping, course changing, emergency manoeuvre qualities, turning test, Z-manoeuvre test, modified Z-manoeuvre test, direct spiral test, reversed spiral test, pull-out test, stopping test, stopping inertia test, new course keeping test, man-overboard test, parallel course manoeuvre test, initial turning test, accelerating turning test, acceleration / deceleration test, thruster test, minimum revolution test, crash ahead test. Manoeuvrability activities of IMO

16 Hrs

Motion of Ship on Waves: Theory of waves. Trochoidal waves. Sinusoidal waves. Irregular wave pattern, Wave spectra, Ship motions – Roll pitch yaw surge, sway and yaw. Forces caused by ship motions. Anti- rolling devices.

12 Hrs

REFERENCE BOOKS:

1. Resistance and Propulsion of Ships – Sv AA Harvald
2. Principles of Naval Architecture – Vol II – Edward V Lewis (SNAME)
3. Wind Waves: Their Generation and Propagation on the Ocean Surface – by Blair Kinsman
4. Basic Ship Propulsion – J.P.Ghose & R.P.Gokarn
5. Naval Architecture for Marine Engineers – Reeds Volume:4
6. Marine Propellers and Propulsion – John Carlton
7. Ship resistance and propulsion – F. Mollan
8. Introduction to Naval Architecture – Eric Tupper
9. Ship Structure – IMEI publication

SEMESTER – VI

UG11T3606	MANAGEMENT SCIENCE AND ECONOMICS	72 HRS

OBJECTIVE: *Introduction to Management, Accounting and Finance Management, Production & Operations Management, HRD and Economics.*

MANAGEMENT SCIENCE:

Introduction to Management Principles and Practice:

Definition and objectives of sound management. Need for Sound Management Principles and Practice & Growth of Modern management thought, Management functions, Process Planning, Corporation / Long term & tactical strategy, Policy distribution, SWOT Analyses, Organising – definition / illustrations, Staffing – manpower, planning, Directing - illustration, Controlling, parameters, application & Co-ordination; communication – efficient process model, communication & barriers, inter-personnel communication skill. Developing Organisation Structure. Various types of organizational structures – Line / staff / matrix, centralization vs. decentralization of decision making, distinction between authority / responsibility / accountability, Basic principles of delegation / empowerment of employees; Authority & Responsibility. Boundaries of Authority.

10 Hrs

Accounting and Finance Management:

Methods of Capital formation & Control of Working Capital, How to read balance sheet / Profit / Loss, Budgetary Control & standard costing – Favourable / Adverse variances. Continuous & Discounted Cash Flow & Project Appraisal, Break even Analysis, Cost Benefit Analysis, Methods of Depreciation, Factory Costing, Estimating, Balance Sheet, Financial & Physical Ratios; Project &Budgetary Control.

6 Hrs

Production and Operations Management:

Factors of production, Distinction between products & services, Types of production system viz. Jobbing / Lot / Mass. Functions of Production Planning and Control, Product Development Principles, Standardization, Simplification & Specialization, Plant Layout, Product / Process, Logistics & supply chain / management. Integrated material management – Functions of material planning, inventory control, safety stock / cycle stock, purchase / stores performance, measurement parameters, standardization / codification, waste control. Introduction to Operations Research. Linear Programming, Distribution Methods, Network Technique in Management – Critical Path Method (CPM), Programme Evaluation & Review Technique (PERT). Resources Allocation & Loading smoothing, Operational Sales Forecasting; Works Study, Job Evaluation & Merit Rating, Total Quality Management – Quality Control, ISO 9000 series, Preventive / condition based Maintenance & spare management.

10 Hrs

Human Resource Development (HRD):

The personnel Function, Selection & Recruitment, Role of Psychological Tests in Recruitments, Training of employees, Performance Appraisal & counseling, Reward System, Legal Requirements and Regulation of Working Condition, Employer's Liabilities for Health and Safety, MBO, Leadership / Group Dynamics and Discipline, Motivation theories and Incentives, Maslow's hierarchy of needs theory, X and Y theory, Hertzberg's Hygienic and motivational theory, Elton Mayo's contribution. Problems of Accident – Preventions, Fatigue, Relation with Trade, Union & Workers Participation in Management.

8 Hrs

Ability to apply task & work load management – communication, team building, planning & co-ordination, personal assignments, time & resource constrains. Prioritization. Effective communication onboard & ashore. 2 Hrs

ECONOMICS:

Importance of economics in Marine Engineering study, Basic economic concepts and terms, Demand analysis, Supply analysis, Elasticity of demand, Elasticity of supply. 4 Hrs

Production function, Law of return, Economics of scale, Iso-product and Iso-cost, Cost-concepts, Cost-output relationship and cost curves in short period, Long period, Revenue – concept, Determination of price under free market and price control by Govt. Types of market, Factors governing extent of market, Pricing under perfect competition, Monopoly, Monopolistic competition and oligopoly. 10 Hrs

Money: Types, Functions, Standard. Inflation: Types, Causes. Commercial Banks – Functions, Functions of Central Banks. Features of Money and Capital market. National Income concepts. 4 Hrs

Taxation: Direct and Indirect, Govt. Budgets. Economic development, Growth, features of underdevelopment with reference to India. Globalisation of Indian economics.

4 Hrs

Differences Between Domestic and Foreign Trade. Basis of International Trade:

Trade-theories. Free-Trade Vs Protection. Balance of payments – components, causes of deficit , steps to correct deficit. Exchange-Rates :- Types, determination, Devaluation of currency. Free- convertibility of currency with reference to Indian Rupee. Functions of I.M.F, World Bank, W.T.O.

6 Hrs

Shipping Routes and Ports: Major Shipping Routes & Ports, Types, Problems, factors for good port. Major & Minor ports of India, their location and importance. Deep-sea fishing, Major sea-fishing zones, Off-shore oil producing zones. India's overseas Trade and Economic Importance with reference to Economic zones.

8 Hrs

REFERENCES BOOKS:

1. Economics - Gangopadhyay
2. Modern Office Management - Mills, Standingford, Appleby
3. Thomas Sowell, Basic Economics- A Common Sense Guide to the Economy, Basic Books
4. Prasanna Chandra –Finance Sense – Mc Graw Hill Education.
5. Dressler G & Varkey, Human Resource Management, Pearson Education.

SEMESTER - VI

UG11T3607	MARINE STEAM ENGINEERING	54 HRS

Objective: *To develop knowledge of Cadets on various types of Steam machinery Both construction and operation*

Steam Engines: Rankine Cycle & Modified Rankine Cycle. Comparison between steam Reciprocating Engine and Steam turbine. Reasons why steam Reciprocating Engines could not survive. Basic problems on Rankine Cycle with Superheating & Sub cooling

2 Hrs

Layout of Plant: General layout of plant & description of a modern geared steam turbine installation including auxiliaries in modern steam ships. Details of scoop system & fitting of Astern Turbine

2 Hrs

Types of Steam Turbines: Description of different types of steam turbines. Impulse, Simple, Pressure Compounded, Velocity Compounded, Pressure & Velocity Compounded. Reaction Turbines and Dummy Piston with equalizing pipe. Double flow Turbine, Double Casing Turbine, Reheat Turbine , Single Cylinder Turbine, Single Plane Turbines.

10 Hrs

Constructional Details: Types of blades, method of fixing, End-tightened blades, Taper & twisted Blades, Shrouding & Lacing of Blades. Types of Rotors - solid, built up, drum type & Gashed type Rotors for impulse and reaction turbines. Diaphragms, nozzles, glands, carbon glands, labyrinth packing glands, main bearings, thrust bearing and turbine casing.

12 Hrs

Lubrication of Turbines: Suitable oils and their properties, lubrication of main bearings, thrust bearings and gears. Gravity and pressure lubrication – oil system and emergency lubrication arrangement. Care & Testing of lubricating oil.

3 Hrs

Reduction Gears: Reduction ratio, Hunting tooth arrangement, type of gear teeth, various arrangements of marine gearing. Gear defects, flexible couplings of different types, quill shaft.

5 Hrs

Condensers: Shapes and types of condensers, constructional details, location & method of securing, working principles, contraction and expansion allowances, leak test. Effect of change of temperature, circulating water quantity, change of main engine power, tube leakage & cleanliness. Protection of tubes and tube renewal. Reasons, sources and prevention of air leakage in condensers, material used for condensers.

5 Hrs

Operation and Maintenance: Turbine drain system, turbine gland steam system, warming through procedure of a turbine plant, control of speed and power of propulsion, throttle valve control and nozzle control, emergency operation of turbines, breakdown and fault finding, emergency control devices and complete emergency control systems for main turbine plant. Bridge control of turbine machinery. Vibration in marine steam turbines, reasons & remedies, steam turbine losses & methods to prevent.

10 Hrs

Alignment Checking: Bridge gauge and Poker gauge, allowances for expansion, sliding foot, thrust bearing, static and dynamic balancing.

3Hrs

Selection of Materials : Materials used in various components like blades, Nozzles, Rotors, Casings, Sealing glands, Gears & their justification.

2Hrs

REFERENCE BOOKS:

1. Steam turbine theory & practice - J. Kearton
2. Boiler Control System - David Lindsley
3. Steam Turbine Operation - J. Kearton
4. Marine Steam Engines and turbines - S C. Mcbirnie
5. Steam Turbine - GJ Roy
6. Applied Thermodynamics – T.D.Eastop and A.Mcconkey
7. Thermodynamics – Yunus A Cengel and M.A. Boles – An Engineering approach
8. Basic Engineering Thermodynamics – Joel Rayner
9. Steam Engineering Knowledge for Marine Engineers – Reeds Volume:9

SEMESTER-VI

UG11P3601	FIRE CONTROL AND LIFE SAVING APPLIANCES LABORATORY	54 HRS

1. Testing and Operation of Jet and spray type Nozzles and Fire hoses.
2. Operation of Emergency Fire Pump
3. Operation, Charging and maintenance of Portable Fire Extinguishers
   (a) Water type
   (b) Foam type
   (c) Dry Powder type
   (d) CO_2 type
4. Operation, use and functions of breathing apparatus
   (a) Self contained type
   (b) Bellow Type
5. Use of Fireman's outfit, Immersion suit, TPA, SCBA, EEBD.
6. Study and operate total CO_2 flooding of Engine room and Cargo holds.
7. Operation of different types of Fire detectors.
8. Study of working of life boat and provisions for life boat, Use of life jackets.

   And use of on-board Life Saving Appliances.
9. Construction and operational details of life raft giving importance to manual and hydrostatic release device.
10. Study of high expansion foam applicator system

SEMESTER VI

UG11P3602	MARINE POWER PLANT OPERATION – II	54 HRS

***OBJECTIVE**: To develop skill of operation & maintenance of marine machinery among cadets.*

[Note : The teacher–in-charge of the class will brief the cadets before starting an assignment and de-brief at the end.]

Running of 2 Stroke/4 Stroke Diesel Engine (Coupled to Dynamometer / Alternator): Methods of starting, running under different load conditions.Watch keeping & recording of the temperatures, pressures on Different meters on the diesel engine instrument panel and Switch Board. Looking after the auxiliary machinery viz. Air compressor, Cooling water pump and Lub. Oil pump.

Boiler Operation:
i) Smoke Tube Boiler : Raising steam from cold condition up to its working pressure and maintaining the same while operating the Reciprocating engine and the auxiliary machinery, maintenance schedule for the smoke tube Boiler. Blowing of gauge glasses with precautions involved-Necessity and procedure of cross Blowing. Overhauling of mountings. Dismantling, overhauling and adjustment of High lift Safety Valve, Studying the working of Boiler plant auxiliary machinery.

ii) To study the operation of the water tube boiler Firing from cold condition, raising steam up to its working pressure and to maintain the same while operating the Steam Turbines and the auxiliary machinery, precautions involved during firing of boiler. Operation of steam super heater, water level indicators, high and low level alarms and other boiler mountings, Overhauling and adjusting of safety valves. Recording and controlling of various pressures & temp. on the Instrument panel. Care of Boiler auxiliaries, feed water system and fuel system.

Running of Steam Reciprocating Engine / Steam Turbine Test Rig: Warming up of the engine, Lubrication of moving parts and precautions involved. Starting of the engine, Reversing procedure. Running the engine at full power, performance monitoring.

Operation and Maintenance of Diesel Propulsion Engine: Preparing the engine for operation, Running engine in ahead & astern directions, taking indicator cards, cutting out fuel pumps, Opening up unit for maintenance, checking clearances of bearings.

Electrical Maintenance and Repair: Generator, switch board, electrical motor, starter, distribution system, transformer, distribution cable, DC, electrical system and equipment, battery system, automation control system.

Project Work: Every cadet will be required to make model of any machinery or part found onboard a ship or maritime industry. Working model would be appreciated

SEMESTER – VI

UG11P3603	ELECTRICAL MACHINES LABORATORY	54 HRS

1. Study of the equivalent circuit of a single-phase transformer
2. Parallel operation of single-phase Transformers.
3. Polarity test on single phase transformer and study of the parallel connections of three-phase transformer.
4. To determine the phase-sequence of 3-phase line by using resistance and capacitance in two ways.
5. To study the slip-torque characteristics of an induction motor and to find out the full load slip.
6. To compute full load, input, output, torque, slip, power factor and efficiency of a 3-phase induction motor from circle diagram. Also to compare the results from the circle diagram with actual full load test on the motor.
7. Determination of characteristics 2 or 4 pole single phase Induction Motor.
8. Speed control of 3 phase squirrel cage induction motor by different methods & their comparison (voltage control & frequency control).
9. Different method of starting of 3 phase squirrel cage Induction motor & their comparison (D.O.L, Auto transformer & Star-Delta).
10. Determination of regulation of an Alternator by Synchronous Impedance & Potier reactance method.
11. To determine the direct axis reactance (X_d) & quadrature axis reactance (X_q) of three phase synchronous machine by slip test.
12. Synchronization of 3-phase alternator.
13. To perform different types of Electrical Machines experiments [preferably on Scan Drive System (TERCOSCAN) – Electrical Machine Tutor – Simulator or similar simulator] such as D.C. Machines, Induction Machine, Synchronous Machine and Transformer – mainly Motor Generator characteristics, Control and Transformer tests to be performed – Monitoring & control to be studied with the help of a Personal Computer and different vector quantities seen in the oscilloscope.

SEMESTER-VII

UG11T3701	SHIP OPERATION AND MANAGEMENT	72 HRS

***OBJECTIVE**: To teach the students about management of ships and impart knowledge on statutory regulation.*

Brief History of Shipping: Modern shipping Practice. Marine vehicles and cargo, care of cargo against damage. Development in Shipping and cargo handling. Containerization & Multimodal transportation, Factors affecting universal adoption of Multimodal Transport. Liner and tramp shipping services.

4 Hrs

Conference Systems: Organisation & concerns Shippers Council. Theory of freight rates and fares. Rate fixation machinery and government control. Advantages and Disadvantages of conference vessels.

4Hrs

Chartering and Charter Parties: Different types of Chartering and their differences. Important Clauses of Charter Party, such as Lien; Tanker Chartering and Tanker Charter Party.

6 Hrs

Bill of Lading: Function, Uniqueness and related problems. Carriage of goods by sea act. Cargo Surveys and protests. 6 Hrs

Marine Insurance: Underwriting and loss adjusting principles applied to Marine cargo insurance. Hull / machinery policy, particular average. General average, P & I Clubs – making claims.

10 Hrs

Shipping Companies: Organisational structure, Restructuring on the basis of functional coherence, ship management companies. Turnaround strategy for sick shipping companies. Ownership of vessels, Shipping Company and its administration. 10 Hrs

Capitalization and Finance: Characteristics, cost ratios & allied definition. Sources, Financing package, Lender security, Relation between Insurance & premium, & non-conformity / condition of class. Economics of new and second hand tonnage. Subsidies, procedure & implication of buying & selling new / old vessels.

8 Hrs

Ship Operations : Planning sailing schedules. Influencing factors, Unbalance in sea trade, counter-action, Voyage estimation, Manning of ships, engagement & discharge of crew. Economic factors. 6 Hrs

Commercial Shipping Practice: Freight Rate; Factors affecting Freight rate. Changing Chartering type to take advantage of the market. 4 Hrs

Indian Merchant Shipping Act : Registration of ship, Ship's papers. Port Procedures. Pilotage, Flags of convenience, Flag state and flags of discrimination and their effects on shipping. Action of Master/Seafarer when Vessels are in distress. Shipping causalities penalties under Merchant Shipping Act. Shipping Board; Dock Labour Board Seaman's Welfare. Marine Fraud : Genesis and Prevention. Indian Shipping : Current scenario and few case studies like revival of a company etc. Inland Water Transportation in India.

14 Hrs

REFERENCE BOOKS:

1. Shipping practice - Stevens
2. Managing ships - John M. Downard
3. Advanced shipboard management - Capt. Dara E. Driver
4. Indian Merchant Shipping Act, 1958
5. Ship Operations and Management -Tony Dixon
6. Legal Principles in Shipping Business - Sir David Steel
7. Marine insurance - Chris Adams
8. Inland Vessel act, 1997 and Rules - (Latest Amendment)
9. Ship Operations - Dr. K. V. Hariharan
10. Multi Model Transportation - Dr. K.V. Hariharan

SMESTER - VII

UG11T3702	ADVANCED MARINE CONTROL ENGINEERING AND AUTOMATION	72 HRS

OBJECTIVE: *To Provide Knowledge about Advanced Control Theory of Automation and Control Engineering in ships.*

Introduction to System Analysis:
Formation of Mathematical models for Mechanical, Electrical, Thermal and liquid level system by using Laplace transform, Transfer functions using block diagram and signal flow graph, Mason's gain formula. 6 Hrs

Transient Response Analysis:
Test input signals, Time domain analysis of 1^{st} and 2^{nd} order closed loop system. Steady state errors in terms of close loop transfer functions, Stability of linear system by pole location and Routh-Hurwitz criteria, Root-loci of 2^{nd} order system, effect of adding poles and zeros in system. 8 Hrs

Frequency-Domain Analysis of Linear Systems:
Bode plots, Polar Plots, Concept of resonance frequency of peak magnification. Nyquist criteria, measures of relative stability – phase and gain margins. 8 Hrs

Controllers and Compensation Techniques: Response with P, PI & PID Controllers, PID controller design, Two Step (On – Off) Control, Modulating Control, Ratio and Cascade Control, Improvement of system performance through compensation, Lead, lag and lead-lag compensation, Compensation on Root-locus approach. 8 Hrs

State-Variable Analysis of Control System:
Basic concepts & state model, different state models of state variable approach, controllability and observability. 8 Hrs

Digital Control Systems:
Z-transform, Inverse Z transform, Digital & Discrete time systems and signals, Role of Z transform in linear difference equations, stability of Discrete-time system.

8 Hrs

Non-Linear Systems:
Common Nonlinearities, Phase-plane analysis, Describing function analysis, Stability analysis-Liapunov method.

8 Hrs

Application of Controls on Ships:
Marine Boiler – Automatic parallel cross loop combustion control, Boiler feed water control - two and three-element type, Boiler automatic starting and stopping sequence, Central cooling water system (HT and LT), Steering Gear control system with Auto Pilot, Direct reversing cam less engine control system, Purifier automatic de-sludging control system, Cargo handling crane

operation control system, Electric circuit reading, Instruments for UMS classification. Dual-fuel Boiler Combustion Control System.

18 Hrs

REFERENCE BOOKS:

1. Gopal M, "Digital Control System & State Variable", TMH.
2. Kuo B. C, "Digital Control System", Oxford.
3. Nagrath I J & Gopal M, "Control Systems Engineering", New Age International.
4. D.A. Taylor, "Marine Control Practice", Butter worth & Co (Publishers) Ltd., London.
5. Ogata K, "Modern Control Engineering", PHI.
6. Roy Choudhury, D, "Control System Engineering", PHI.
7. Gibson J E, "Nonlinear Control System", McGraw Hill Book Co
8. Instrumentation & Control Marine – G.T.Roy

SEMESTER-VII

UG11T3703	IMO - MARITIME CONVENTIONS AND CLASSIFICATION SOCIETIES	54 HRS

OBJECTIVE: *To understand the legal structure and framework of the shipping industry and the 'international' aspect and complexity of regulating such a dynamic industry*

1 History of Shipping, Shipping powers (Historical to present day)

2 Ancient and medieval shipping laws, Evolution of modern shipping laws

3 Choice of courts and jurisdiction, Laws of the seas (UNCLOS)

4 International maritime regulatory bodies e.g. IMO, MSC, MEPC, UNCTAD, IACS

5 International conventions e.g. SOLAS, MARPOL, STCW, MLC, Ballast Water Convention, Ratification of conventions and force of law. Understanding of total quality management and ISM. Coastal state and Flag state jurisdictions, casualty investigations and role of coastal and flag state. Merchant Shipping Act and MS Rules.

6 International conventions e.g. Civil liability, Fund convention, wreck convention, Salvage convention, Bunker convention. Why limitation of liability in shipping?

7 Important shipping organizations e.g., Intertanko, Intercargo, ITF, MPA

8 Important shipping organizations e.g., ILO, ICS, ISC, PSC, Flag States: Role of Flag and PSC as per UNCLOS, Regional MOU's, risk based port state inspections, difference between port state detentions and arrest.

9 Role of 'BIMCO', 'The Baltic Exchange', Lloyds of London

10 Description and role of Classification societies and Recognized Organizations and the differences. Types of Class and Statutory Surveys, relation between class and statutory surveys, survey cycles.

REFERENCE BOOKS:

1.Guilf. D, Shipping Interdiction and the Law of the Sea, Cambridge University Press.

2.Bruce Farthing and Mark Brownrigg, Farthing on International Shipping, LLP.

3.G. Pamborides, International Shipping Law: Legislation and Enforcement, Springer.

SEMESTER – VII

UG11T3704	ADVANCED MARINE TECHNOLOGY	72 HRS

OBJECTIVE: *To provide the latest technology and operation incorporated in different types of Tankers Car carrier, Bulk carrier and UMS operation to students*

Bridge Control Systems and UMS Operations: Bridge Control system for propulsion engine and control flow diagram, Bridge indicator panel for engine room machineries, Emergency operation for propulsion engine, UMS requirements & operation.

8 Hrs

Study of LPG and LNG Ships: Various controls of deck equipments including pneumatic and electronic equipments. Study of re-liquefaction plants & its operation, Study of structure of various types of tanks for LNG and LPG vessels, IG and Pure Nitrogen gas systems for gas tankers, Glycol systems, Electric motor room and compressor room safeties. Study of compressors and compressor safety devices and other safety devices in Gas tankers. Cargo pumping system and its operation, cargo operations. Boil-off gas supply system for Boilers and IC Engines.

20 Hrs

Chemical Tankers: Classification, Construction, Pumps for chemicals, Tank cleaning procedures, IG systems for Chemical Tankers, Controls and safety devices associated with loading and discharging . Tank gauging systems.

10 Hrs

Oil Tankers: Types & classification, Construction, Cargo & Crude Oil Washing operation, I.G Systems, Pumping arrangements and safety devices associated with loading & discharging. Automatic Unloading System (AUS), Cargo Oil Pump Turbine (COPT) Lube Oil system.

10 Hrs

Car Carrier: Construction, Ventilation, Fire Fighting system, Stability, Strength considerations, RO-RO arrangement.

4 Hrs

Bulk Carrier: Construction, Stress considerations with regard to loading & discharging, Condition assessment system, Enhanced survey, Safety considerations, Stability considerations.

5 Hrs

Latest Engine Technology: Intelligent Engines, Condition monitoring, Common rail fuel injection w.r.t electronic fuel injection, Exhaust emission and control – Technology incorporated, NOx Technical file, EIAPP certificate. SEEMP, EEDI and EEOI.

15 Hrs

REFERENCE BOOKS:

1. Shipboard Operations — H. I. Lavery
2. Marine Diesel Engines — C. C. Pounder
3. Liquefied Gas Handling Principles on Ships and in terminals — McGuire & White
4. Tanker Safety Guide Liquefied Gas: International Chamber of Shipping
5. International Safety Guide for Oil Tankers and Terminals (ISGOTT): International Chamber of Shipping

SEMESTER – VII

UG11T3705	ENGINE ROOM MANAGEMENT	72 HRS

OBJECTIVE: *To enable the student to acquire knowledge for operation and maintenance of marine machinery and take care of engine room environment.*

Engine Room Resource Management:
Effective communication, allocation of resources, planning & co-ordination, workload management, time & resource constraints. Personal relationship onboard ship, working in multi-cultural environment, situational awareness concept. 2 Hrs

Preparation of Engine:
Full knowledge of preparing Main Engine , A.E, Boiler , all auxiliary engines for sailing from port and port operation . First Start Arrangements. Change over procedures of fuel and other systems in engine room machinery main engine, aux. engine and boiler for operation in ECA (Emission Control Areas), EU (European Union) & US. 5 Hrs

Maintenance:
Preparing maintenance schedule for all machineries like Main Engine, Alternator, Compressor, Purifier, Evaporator, steering gear, electrical machinary and all other engine machineries. Overhauling procedure for various Aux. M/c., Maintenance of Continuous running pumps – (FO, LO, FW, SW). PMS Maintenance of Hydraulic Jacks/Tools, including use of Engine Makers specific tools/equipments.
5 Hrs

Breakdown Operations:
Preparation of engines for emergency operation. Emergency repair for engine room machineries. Emergency steering. Propulsion Engine-Unit Cut-out /part load operation, slow speed, super slow speed running precautions. Safety/emergency procedures for change-over from remote/automatic to local control of all systems. 5 Hrs

Spare parts Management: Preparing spares inventory, Sending spares requisition on ship, Maintenance of E.R. Spares, Just –in – Time (JIT) concept, ABC Analysis, Consumable store list requisition- as per IMPA & ISSA Catalogue Code Nos, Monitoring daily consumptions, Bunker estimates. 5 Hrs

Monitoring of Engine Performances:
Taking indicator cards and interpretation of card, trouble shooting from engine parameters like pressure & temperature and behaviour like vibration and noise, crank case inspection, Engine and propeller design curve criteria & analysis for modern propulsion engines use of mist detector and other safety features.
5 Hrs

Management of Engine Room Crew:
Criteria for composing the engine room watch. Operation & Watch requirements. Fitness for duty. Protection for marine environment. Requirement for certification; minimum knowledge requirement for certification-theoretical, practical; Duties & responsibilities concerning safety & protection of environment. Requirements for watch keeping duties. Physical training & experience in watch-keeping routine; Main and aux. Machines, Pumping systems, Generating plant. Safety and emergency procedures. First aid.
5 Hrs

Safe Engineering Watch Keeping:
Routine pumping operations of fuel oil, ballast water, fire pump and cargo pumping system.
Interpretation of functional tests on communication and control system. Maintenance of machinery space ,log book and the significance of readings taken. Safety precautions, observation & immediate action to be taken in event of fire or accident, with particular reference to oil systems 5 Hrs

Engineering Watch (Underway):
General, Taking over watch, Periodic checks of machinery, Engine Room Log, Preventive repair and maintenance; Bridge notification. Navigation in congested water and during restricted visibility, calling the attention of the Chief Engineer Officer, Watch-keeping personnel 5 Hrs

Engineering Watch (Unsheltered anchorage):
Conditions to be ensured. Watch-keeping (in Port-) Watch arrangements; Taking over the watch; Keeping a watch. Oil, Chemical & Gas Tankers-Principles, characteristics of Cargo; Toxicity hazards; Safety equipments; Protection of Personnel. 5 Hrs

Pollution Prevention Methods: Bilge water, garbage and sladges management 5 Hrs

Marine Environment:
Marine Environmental awareness, marine ecology, seas & coastal areas, discharges to sea & their environmental impact, accidental & operational discharges, emissions to air from ships, other pollutants, proactive measures to control pollution & maintain environment. Responsibilities under the relevant requirements of the International Convention for the prevention of Pollution from ships – Annex-I, II, III, IV, V & VI of MARPOL.MARPOL, 73/78 (All Annexes, equipment requirements & their operations, documentation, including necessary record books), Ballast Water Management Convention 2004, Antifouling convention 2001, National Legislations of other countries like Oil Pollution Act 1990.Emission control areas (ECA) . Procedures and arrangement on board for complying with regulatory requirements in these areas Emergency situations, actions to be taken for protecting & safe-guarding environment.
6 Hrs

Deck Machinery:
Various types of deck machinery used in ships e.g. Winches and Windlass and their requirements. Operation and maintenance. Deck Cranes. Hydraulic deck machinery; hydraulic motors, line filters and systems. Hydraulic power packs for operating submersible cargo pumps (Framo type) in Oil & Chemical tankers.
4 Hrs

Dry Docking:
Planning, entering, docking, inspection, maintenance and repairs. Surveys, certification. Undocking and report writing.
5 Hrs

Safety Requirements:
Safety Requirements for working on ship board electrical system including isolation of all electrical plants.
2 Hrs

Safe Working Practices:
Risk Assessment, ISO 31000 - risk management. Risk assessment formats for "specified activity" used on board vessels personal protective equipment, Emergency procedure Entering Enclosed or confined spaces, permit to work systems, Lifting equipments, Hot work, Hazardous substances, Safety measures for safe working environmental and for using hand tools, machine tools, powered hand tools. Materials used for construction, fabrication and repair of system and components 3 Hrs

Use of various types of sealants and packings including oil seals, mechanical seals, labyrinth seals
2 Hrs

REFERENCE BOOKS:

1. Question & Answers of Marine Diesel Engines - John Lamb
2. Marine Electrical Practice - G. O. Watson
3. Marine Auxiliary Machines - D. W. Smith
4. Running & Maintenance of Marine Machinery - IME publication

SEMESTER – VII

UG11E3701 TO UG11E3704	**ELECTIVE**	**72 HRS**

NOTE: Cadet will select any one Elective subject from the following

CODE	SUBJECT
UG11E3701	ADVANCED MARINE HEAT ENGİNES
UG11E3702	ENVIRONMENTAL SCIENCE AND TECHNOLOGY
UG11E3703	ADVANCED MATERIAL SCIENCE AND SURFACE COATING ENGINEERING
UG11E3704	RENEWABLE ENERGY SOURCES AND APPLICATIONS

SEMESTER-VII

UG11T3706	MARINE MACHINERY AND SYSTEM DESIGN	90 HRS

OBJECTIVE: *To impart knowledge as to how understanding of basic engineering subjects such as mechanics, strength of materials, fluid mechanics, etc. Leads to development and design of components and thereby various marine systems on board ships*

Design Considerations: Lecture on Following design considerations: Manufacturing methods, Castings, Forgings, Fabrication & Plastic Moulding: Machining Tolerances, surface Finishes: Available materials, Production methods, Economics, Aesthetic appeal. Initial and Servicing costs, Analysis of force.

5 Hrs

Marine Machinery Component Design: Design of marine machinery components like safety valves, Reducing valves, springs, Journal bearings, Thrust bearings. Design of lifting equipment e.g. Engine room overhead Crane, Crank Shaft, Piston and Connecting Rod & other valves.

15 Hrs

Advanced Design of Marine Systems Design:
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.
Lubricating Oil systems including Pumps, Purifiers.
Electro-hydraulic Steering gear system including Rudder, Rudder stock, Tiller arm , ram & cylinder .
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 pumps and Fuel-injectors.
Design of Steam Turbine Plants.
Design of Gas Turbine Plants.
Life boat and it's launching device.
Refrigeration Plant.
Bulk CO_2 system (High pressure and Low pressure System)
Fire fighting system including emergency fire pump. 60 Hrs

Note :- Latest developments and IMO requirements are to be considered in each design project

Computer Aided Design : Analysis of stress, strain, vibration, thermal stress, deflection through method of Finite Element Analysis by use of various software like AUTO – CAD, Pro-engineer, NX, Solid Edge.

10 Hrs

REFERENCE BOOKS:

1. Machine Design -Pandya & Shah
2. Marine Engineering -Harrington
3. IMO & Classification society Publications
4. Design of Machine Elements – V.B.Bhandari,TMH

SEMESTER-VII

UG11P3701	SIMULATOR AND SIMULATION LABORATORY	54 HRS

Engine Simulator Lab Exercise:

Description of basic engine functions and their simulation introduced in Engine Room Simulator.
Manual engine operation from engine room station, Remote stations-i.e. Control room and Navigation bridge. Safety and interlocks in UMS-ships and effect of malfunction of main engine auxiliaries. Trouble shooting of main engine and other auxiliary systems.

Training on Diesel Engine Operation and Maintenance Software:

Different modes of operation – standard mode, Live run mode and Lesson mode of a four stroke, three cylinder medium speed marine engine.

Using following experiments are to be performed:

1. To start and stop the engine;
2. To change engine's load and speed;
3. To change ambient operating conditions;
4. To simulate engine faults in varying degrees;
5. To mix different simulations;
6. To watch engine operation parameters;
7. To watch functions inside the cylinder;
8. To simulate the engine sound which varies with speed;
9. To carry out maintenance and repairs;
10. To try out different maintenance strategies;
11. To print engine data
12. To use lesson facility.

Diesel Engine Combustion Gas Monitoring Simulator:

1. Familiarising with two stroke diesel engine and its associated auxiliaries with regard to various parameters and systems like fuel oil system, L.O. System, Jacket cooling water system, etc in 19 screens of two monitors (Trainee module).
2. Starting the plant and checking the systems
3. Engaging the turning and turning the Engine on T/G.
4. Giving command from Bridge telegraph and acknowledging the command on E.R. telegraph.
5. Blowing through the engine, significance of blowing through engine.
6. Starting the M/E and running in compliance with the Bridge requirement (communicated by telegraph)
7. Capturing the engine performance in the form of Power card, Draw card, and fuel pump pressure card. Analyzing the cards.
8. Changing the fuel quality (like sulphur etc) and observing its effects on exhaust emission.

9. Study the effect of VIT
10. Starting and running the engine from ECR, BRIDGE AND EMERGENCY STATION.
11. FAULT FINDING WITH THE HELP OF PARAMETERS reading and cards (Power card, Draw card , Fuel pump pressure)

Like: 1) Early injection (2) Late injection (3) Leaky piston ring (4) T/C filter fouled (5) Air cooler Air side/Water side fouled (6) Cylinder liner cracked.

SEMESTER VII

UG11P3702	TECHNICAL PAPER AND PROJECT	72 HRS

Note: The cadets should write a technical paper under guidance of one faculty member of the institute. The paper will be assessed by a committee and the cadets will present the paper to another committee consisting of external assessors for evaluation. Final marks will be calculated from the both external and internal assessment.

SEMESTER – VIII

UG11P3801	ON BOARD TRAINING AND ASSESSMENT	6 MONTHS

Semester VIII will be completed to achieve various competencies as is required by national and international regulations.

There will be total of 20 weeks, 35 hours per week, a total of 700 hours in Semester VIII.

These competencies will have to be completed at any of the combinations of the facilities given below.
Internal workshops / external marine workshops / various engine room systems installed in the institution individually / various engine room systems installed in the institution, collectively (also called ship-in-campus) / watch-keeping on such systems during their running/ advanced marine laboratories / advanced marine simulators. The competencies may also be completed as afloat training onboard ships.

(OR)

Cadets, where permitted by DGS, to undergo onboard training during VIII Semester in accordance with the relevant DGS Circular.

SEMESTER – VIII

UG11P3802	VOYAGE / TRAINING REPORT

Cadet has to submit Voyage / Training report at the end of VIII semester. Voyage / Training report will be evaluated by Internal Examiner.

SEMESTER – VIII

UG11P3803	PROJECT ON ENVIRONMENT AND ITS PROTECTION

Cadet has to prepare a report on pollution prevention measures available on board and present for assessment by the institute.

Cadet has to prepare a report on topics related to marine environment protection or energy management in maritime industry.

Cadet has to submit project report at the end of VIII semester. Project report will be evaluated by internal examiners. A presentation of report has to be done to a panel of Examiners.

SEMESTER – VIII

UG11P3804	VIVA – VOCE

Cadet to attend Viva Voce conducted by Internal / External Examiners covering all his/her academic activities during VIII semester.

SEMESTER-VII

ELECTIVE SUBJECTS

UG11E3701	ADVANCED MARINE HEAT ENGINES	72 HRS

OBJECTIVE: *To develop knowledge of cadets on various marine heat engines and heat exchangers.*

Complex Heat Engine Plants Combined Steam Turbine and Diesel Engine Cycles. Combined steam Turbine and Gas Turbine cycles. Combined Gas Turbine and Diesel Engine cycles/Plants. Different Methods of Improving the Overall Thermal Efficiency of the entire plant. Design of the most optimum condition and combination of complex plants. Cascade Refrigeration plants. Free piston Gas Generators. 30 Hrs

Turbo Blowers and Turbo Compressors: Compressor Characteristics for Axial Flow compressors and Centrifugal compressors. Stalling of compressors. Turbine characteristics. Matching of components like compressor and Turbine. Performance of different units in combination in single shaft arrangement. Minimum work required to run the compressors. 20 Hrs

Combustion and Flame Stabilization: Combustion of liquid Fuels, Atomisation, mixing, combustion curve and different methods of Flame stabilization, Design & combustion chamber. Spray of Fuel. Pre-mixing of Gaseous Fuels for combustion. Stability of the Flame. Adiabatic flame temperature. 15 Hrs

Design of different types of compact Heat Exchangers for different Applications, e.g. Air preheater, Gas and Oil Heaters. 7 Hrs

REFERENCE BOOKS:

1. Marine steam Boilers – J.H. Milton
2. Marine Boilers – G T H Flanagan
3. Steam Turbine Theory and Practice – J. Kearton
4. Heat Engine – P. L. Ballaney
5. Thermodynamics – Applied to heat Engines – E. H. Lewitt
6. Applied Thermodynamics – Joel Rayner
7. Thermal Engineering – R.K. Rajput

SEMESTER-VII

ELECTIVE SUBJECTS

UG11E3702	ENVIRONMENTAL SCIENCE AND TECHNOLOGY	72 HRS

OBJECTIVE: *To impart knowledge, develop awareness of environmental systems and issues. Identification and control of environmental pollution.*

Basics of Environmental Science :
Concept of environment, definition, concept and scope of environmental science, environmental ethics, earth – man –environment, environment-civilisation interface, genesis of global environmentalism. 5 Hrs

Segments and Processes in the Environment:
Evolution of environment, physiochemical and biological factors in environment, Structure & composition of – atmosphere, hydrosphere, lithosphere and biosphere . Hydrological & Geochemical cycle, Geographical classification and zones , climate & weather 7 Hrs

Principles of Ecology:
Tropic structure & energy flow, food-web complexity & patterns, structure and function of forest and agricultural ecosystem, population ecology, community ecology, community structure & dynamics, Landscape ecology, landscape elements, landscape geometry, landscape sustainability, urban-industrial techno-ecosystems. 10 Hrs

Biodiversity and Conservation Biology:
Meaning of biodiversity, levels of biodiversity, factors influencing local & regional biodiversity, hotspots of biodiversity. Global pattern of biodiversity, biodiversity conservation approaches, common aquatic and terrestrial flora & fauna in India and world (Phytoplankton, Zooplankton, Macrophytes). 5 Hrs

Environmental Microbiology:
Fundamentals of microbiology – classification, growth and characteristics. Microbiology of water: Fresh water as a microbial growth supporter, common microorganism, self purification of water , microbial pollution of water and assessment of pollution, D.O, BOD, COD, domestic waste & treatment, beneficial and pathogenic microbes in agriculture and their role in environment. 10 Hrs

Environmental Pollution and its Control:
Air pollution : Natural and anthropogenic sources, primary & secondary pollutants, pollution from emissions of engines & CFC, HCFC , methods of monitoring air pollution, air quality criterion & standard, effects of air pollution, air pollution control- concept, devices and systems.
Water pollution : Sources of pollutants, surface water & ground water pollution, control of water pollution – recycling , industrial waste water control & management. Marine pollution – sources, effect, control.
Pollution from solid wastes, management of solid waste, biomedical waste, e-waste.
20 Hrs

Environmental Audit:

Introduction to Environmental Impact Assessment (EIA), methodologies, official guidelines, techniques for EIA, concept and preparation of environment impact statement (EIS), environment Management Plan (EMP), environmental audit, guidelines and methodologies . Environmental laws and policies. Public liability insurance act 1991. MARPOL 73/78.

15 Hrs

SEMESTER-VII

ELECTIVE SUBJECTS

UG11E3703	ADVANCED MATERIAL SCIENCE AND SURFACE COATING ENGINEERING	72 HRS

OBJECTIVE: *To impart knowledge on materials and coatings to enhance material strength and life.*

Material Structure:
Details of material structure , structure property correlation, materials of construction, Micro and Macro examination of material, behaviour of metals under fatigue, creep, corrosion, low temperature, high temperature, fracture mechanics and fracture toughness, role of residual ductility in corrosion fatigue. 10 Hrs

Material for Ships:
Metals, alloys and material used on ships (piston, cylinder liner & head, D>E valves, propeller, turbine blades, impeller, heat exchangers, chilling plants, LNG tanks, ship's hull,. Special polymeric material like PVC, Teflon, Polypropylene. Super alloys like satellite and other hard facing material for ship's hull and other special application. Amorphous metallic coatings, metal-metalloid coatings Ni-P, Ni-P=B, Ni-P-B-WC-BC-SiC, Al_2O_3. 15 Hrs

Heat Treatment Processes:
Advanced heat treatments processes of steel based on T-T-T curves .advanced steel making processes, Special steel for ship building, advanced heat treatment processes for non-ferrous alloys. 10 Hrs

Metallurgical Aspect of Metal Joining:
Thermo-mechanical treatment and effect on material , soldering and brazing , metallurgical effect of welding ; hot cracking , welding high tensile steel, welding cast iron , welding stainless steel, welding copper and it's alloys, welding brasses, welding bronzes and other alloys. 10 Hrs

Testing of Material:
Advanced study tensile test, hardness test, notched bar test, various methods & machines for tests. Non –destructive tests like penetrant test, magnetic particle test, ultrasonic test, radiographic test, Accoustic emission test (A.E.S), thermal Imaging test for welds. 10 Hrs

Prevention of Corrosion and Cracks:
Non-metallic coatings (paints), anodic & cathodic protection, Impressed Current Cathodic Protection system,
Metallic coatings; thermal spray coating , plasma spray coating, Laser alloying , high energy surfacing processes, Ion-implantation, Ion-plating , plasma enhanced ionic deposition for marine application, Diffusion Coating and Surface modification for improving hull efficiency.
Prevention of static & dynamic stress corrosion cracking (S.C.C), cl. S.C.C. 12 Hrs

Modern Material:
Discussion on recently developed material and study on them. 5 Hrs

REFERENCE BOOKS:

Metallurgy for Engineers - E. C. Rollason English Language Book Society (ELBS)

SEMESTER-VII

ELECTIVE SUBJECTS

UG11E3704	RENEWABLE ENERGY SOURCES AND APPLICATIONS	72 HRS

OBJECTIVE: *To develop knowledge of cadets on the use of renewable / alternatives sources of power and its applications ashore and on ships.*

Principles of Renewable Energy:
Introduction. Fundamentals. Scientific Principles of Renewable Energy. Technical Implications. Social Implications. 10 Hrs

Solar Radiation:
Introduction. Extra terrestrial Solar Radiation. Components of Radiation. Geometry of Earth & Sun. Geometry of the Collector. Solar Beam. Effects of Eastern Atmosphere. Measurement.
Estimation of Solar Radiation. Problems. 5 Hrs

Solar Heating:
Introduction : Heat Balance. Unsheltered & Sheltered Heaters, Systems with Separate storage. Selective Surfaces. Evacuated collectors. Uses of Solar Heat. Air Heater. Space Heating & Cooling. Water desalination. Solar Ponds. Solar Concentrators Electrical Power systems. Problems. 5 Hrs

Photo Voltaic Generation:
Silicon P-N Junction. Photo absorption. Solar Radiation Input. Photo Voltaic Circuit Properties & Loads, Limit to Cell efficiency. Solar Cell Construction. Types & adaptation of Photo voltaic. Other types of Photo voltaics & thermoelectric Generation. Problems. 10 Hrs

Wind Power:
Introduction. Turbine Types & Terms. Linear Momentum & Basic Theory. Dynamic Matching. Stream Tube Theory, Characteristics of the Wind. Power Extraction by a Turbine, Electricity Generation. Mechanical Power. Total systems. Problems. 10 Hrs

Wave Energy / Tidal Power:
Introduction. The cause of Tides. Enhancement of Tides. Tidal Flow Power. Tidal Range Power. World Range Power sites. Problems. 5 Hrs

Ocean Thermal Energy Conversion:
Principles. Heat Exchangers. Pumping Requirements. Other practical considerations. Problems. Hydro Power & Geothermal Energy.
Brief Review & Description 5 Hrs

Energy Storage and Distribution:
Importance of Energy Storage & Distribution. Biological Storage. Chemical Storage. Heat Storage. Electrical Storage. Fuel Cells, Mechanical Storage. Distribution of Energy Problems. 5 Hrs

Bio Mass:
Principles of using Biomass. Availability. Economics. 5 Hrs

Bio Fuels:
Introduction. Biofuel Classification, Thermochemical, Biochemical. Agrochemical.
Biomass Production for energy farming, Energy farming-advantages & disadvantages. Geographical Distribution. Crop yield, Energy analysis. Direct combustion for heat. Domestic cooling & heating, Crop drying. Process heat & electricity.
Pyrolysis. Solid, Liquid, Gases,
Hydrogen Reduction. Acid & enzyme hydrolysis. Conversion of oil (coco) to Ester. Methanol liquid Alcoholic fermentation. Directly from sugar cane sugar Beet. Starch crops. Celluose. Ethanol fuel use. Ethanol production.
Anaerobic Digestion for Biogas-Basic process & energetics Digester sizing. Working Digesters. Agrochemical fuel Extraction-advantages & disadvantages.
12 hrs