West Bengal University of Technology
BF-142, Salt Lake, Sector-1, Kolkata-700064
<u>MARINE ENGINEERING</u>

<u>SYLLABUS FOR 1ST YEAR I SEMESTER</u>

	Paper Code		Subject	Contact Hours Per Week L+T+P	Total	Credit
1.	Hu	101	English Language & Communication	3+1+0	4	4
2.	Ph	101	Engineering Physics	3+1+0	4	4
3.	M	101	Mathematics	3+1+0	4	4
4.	ME	101	Mechanical Sciences	3+1+0	4	4
5.	EE	101	Basic Electrical Engineering	3+1+0	4	4
6.	Ch	101	Environment & Ecology	3+0+0	3	3
					23	23

LABORATORY

	Paper Code		Subject	Contact Hours Per Week L+T+P	Total	Credit
7.	Ph	191	Engineering Physics Lab	0+0+3	3	2
8.	EE	191	Electrical Engineering Lab	0+0+3	3	2
9.	ME	191	Engineering Graphics	0+0+3	3	2
10.	ME	192	Workshop Practical	0+0+3	3	2
					12	8
				18+5+12=	35 Hours per week	31

L= LECTURE HOURS PER WEEK
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MARINE ENGINEERING
MARINE ENGINEERING
SYLLABUS FOR 1ST YEAR II SEMESTER

	Paper Code		Subject	Contact Hours Per Week L+T+P	Total	Credit
1.	Ph	201	Engineering Physics	3+0+0	3	3
2.	M	201	Mathematics	3+1+0	4	4
3.	ME	201	Mechanical Sciences	3+0+0	3	3
4.	CS	201	Introduction to Computing	2+1+0	3	3
5.	EC	201	Basic Electronics Engg.	3+1+0	4	4
6.	Ch	202	Engineering Chemistry	3+0+0	3	3
					20	20

LABORATORY

	Paper Code		Subject		Total	Credit
7.	Ph	291	Engineering Physics Lab	0+0+2	2	1
8.	Ch	291	Engineering Chemistry Lab	0+0+2	2	1
9.	CS	291	Computer Lab	0+0+3	3	2
10.	EC	291	Electronics Engineering Lab	0+0+3	3	2
11.	ME	291	Engineering Graphics	0+0+3	3	2
12	ME	292	Workshop practical	0+0+3	3	2
					16	10
				17+3+ 16 =	36 Hrs. per week	30

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West Bengal University of Technology
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MARINE ENGINEERING
MARINE ENGINEERING
SYLLABUS FOR 2nd YEAR III SEMESTER

	Paper	Code	Subject	Contact Hours Per Week L+T+P	Total	Credit
1.	ME	301	Workshop Technology	3+0+0	3	3
2.	MM	302	Mathematics III	3+1+0	4	4
3.	MECG	303	Economics & Commercial Geography	3+0+0	3	3
4.	MAT	305	Applied Thermodynamics I	3+1+0	4	4
5.	MMS	306	Material Science I	3+0+0	3	3
6.	MEL	307	Electrical Machines I	2+0+0	2	2
7.	MMM	308	Mechanics of Materials I	3+1+0	4	4
					23	23

LABORATORY

	Paper	Code	Subject	Contact Hours Per Week L+T+P	Total	Credit
	*MWP	309	Workshop Practicals	0+0+3	3	3
	MEP	310	Computer Practicals	0+0+2	2	1
	MMSP	312	Applied Mechanics Lab	0+0+2	2	1
	MED	304	Machine Drawing	0+0+3	3	3
					10	7
				20+3+11=	33 Hrs. per week	30

* to be assessed throughout the semester.

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<u>MARINE ENGINEERING</u>
<u>MARINE ENGINEERING</u>
<u>SYLLABUS FOR 2nd YEAR 2nd SEMESTER</u>

	Paper	Code	Subject	Contact Hours Per Week L+T+P	Total	Credit	
1.	MCH	401	Social Studies	3+0+0	3	3	
2.	MBSS	402	Basic Ship Structure	3+0+0	3	3	
3.	MMA	403	Marine Auxiliary Machines I	3+0+0	3	3	
4.	MAT	405	Applied Thermodynamics II	3+1+0	4	4	
5.	MSMS	406	Seamanship	2+0+1	3	3	
6.	MEL	407	Electrical Machines II	3+0+0	3	3	
7.	MMM	408	Mechanics of Materials II	3+1+0	4	4	
					23	23	

LABORATORY

	Paper	Code	Subject	L+T+P	Total	Credit	
	MWP	409	Workshop Practicals	0+0+5	5	4	
	MED	404	Marine Engineering Drawing	0+1+4	5	4	
					10	8	
				20+3+10=	33 Hrs. per week	31	

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MARINE ENGINEERING
MARINE ENGINEERING
SYLLABUS FOR 3rd YEAR 1st SEMESTER

	Paper	Code	Subject	Contact Hours Per Week L+T+P	Total	Credit
1.	MBSS	502	Ship Construction	2+0+0	2	2
2.	MMA	503	Marine Auxiliary Machines II	3+0+0	3	3
3.	MED	504	Elementary Design	1+0+4	5	5
4.	MMOM	505	Mechanics of Machines I	4+1+0	5	5
5.	MMF	506	Mechanics of Fluids	3+1+0	4	4
6.	MEL	507	Electrical Machines III	3+0+0	3	3
7.	MMM	508	Mechanics of Materials III	3+0+0	3	3
					25	25
LABORATORY						
	MWP	509	Workshop Practical(Marine)	0+0+6	6	5
	MEL	510	Electric Machine Labs	0+0+2	2	1
					8	6
				18+3+11=	33 Hrs. per week	30

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Note: 9 weeks of Marine oriented workshop practical in lieu of external workshop training at 40 hours per week has been considered

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MARINE ENGINEERING
SYLLABUS FOR 3rd YEAR 2nd SEMESTER

	Paper	Code	Subject	Contact Hours Per Week L+T+P	Total	Credit
1.	MMNG	601	Management Science	4+0+0	4	4
2.	MMB	602	Marine Boiler	3+0+0	3	3
3.	MMA	603	Marine Auxiliary Machines III	4+1+0	5	5
4.	MICE	604	Marine Internal Combustion Engine I	3+0+0	3	3
5.	MMOM	605	Mechanics of Machine II	3+1+0	4	4
6.	MMF	606	Fluid Mechanics & Dimensional Analysis	2+1+0	3	3
7.	MEL	607	Marine Electrical Technology I	2+0+0	2	2
8.	MSE	608	Marine Steam Engineering I	4+0+0	4	4
					28	28

LABORATORY

	Paper	Code	Subject	Contact Hours Per Week L+T+P	Total	Credit
	MWP	609	Workshop Practical(Marine)	0+0+6	6	5
	MMBL	610	Boiler Chemical Lab & Fuel oil & L. oil testing Lab	0+0+2	2	1
					8	6
				25+3+8=	36 Hrs. per week	34

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MARINE ENGINEERING

MARINE ENGINEERING
SYLLABUS FOR 4th YEAR 1st SEMESTER

	Paper	Code	Subject	Contact Hours Per Week L+T+P	Total	Credit
1.	MNAR	702	Naval Architecture I	3+0+0	3	3
2.	MED	703	Marine Machinery System Design	0+0+6	6	6
3.	MICE	704	Marine Internal Combustion Engine II	4+0+0	4	4
4.	MSSEP	705	SSEP & Safe Watch keeping I	4+0+0	4	4
5.	MHE	706	Marine Heat Engines & Air Conditioning	3+1+0	4	4
6.	MEL	707	Marine Electrical Technology I & Electrical Measurements	4+0+0	4	4
7.	MSE	708	Marine Steam Engineering II	1+0+0	1	1
					26	26

LABORATORY

	Paper	Code	Subject	L+T+P	Total	Credit
	MMEL	709	Mechanical Lab	0+0+2	2	1
	MFEL	710	Fire Control Lab	0+0+3	3	2
	MEL	711	Electrical Measurement Lab	0+0+1	1	1
	MMSP	712	Material Testing Lab	0+0+2	2	1
					8	4
				19+1+14=	34 Hrs. per week	30

L= LECTURE HOURS PER WEEK
T= TUTORIAL HOURS PER WEEK
P= PRACTICAL HOURS PER WEEK

MARINE ENGINEERING
SYLLABUS FOR 4th YEAR 2nd SEMESTER

Paper	Code	Subject	Contact Hours Per Week L+T+P	Total	Credit
1.	METR 801	Marine Control And Automation	4+0+0	4	4
2.	MNAR 802	Naval Architecture II	3+1+0	4	4
3.	MOPT 803	Elective	4+0+0	4	4
4.	MTP 804	Technical Paper, Project & Model Making	0+2+3	5	4
5.	MSSEP 805	SSEP & Safe Watch keeping II	3+0+0	3	3
6.	MSOM 806	Ship Operation & Management	3+0+0	3	3
				23	22

LABORATORY

	Code	Subject	L+T+P	Total	Credit
	MPPO 807	Power Plant Operation	0+0+5	5	4
	MCTR 808	Control & Simulator Lab	0+0+3	3	2
				8	6
			17+3+11=	31 Hrs. per week	28

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SEMESTER - I

ENGLISH LANGUAGE & COMMUNICATION   (HU – 101)   (56 HRS)

DETAILED SYLLABUS	HRS
Grammar - Structure of sentences - Active / Passive Voice - Direct / Indirect Narration	13
Essay - Descriptive - Comparative - Argumentative - Thesis statement- Structure of opening / concluding paragraphs - Body of the essay	7
Reading Comprehension - Global- Contextual- Inferential- Select passages from recommended text	8
Business Correspondence - Letter Writing - Formal. Drafting. Biodata-Resume'/Curriculum Vitae	7
Report Writing - Structure, Types of report - Practice Writing	8
Communication / Public Speaking skills, Features of effective speech, verbal-nonverbal	7
Group discussion - principle - practice	6

ENGINEERING PHYSICS   (PH – 101)   (60 HRS)

DETAILED SYLLABUS	HRS
Theory of Relativity Inertial frame of reference, Non inertial frames and fictitious forces, Outline of Relativity, Michelson-Morley experiment, Lorentz transformation of space and time, length contraction , variation of mass with velocity, equivalence of mass and energy.	8
Geometrical Optics Combination of thin lenses, cardinal points of coaxial system of thin lenses, thick lenses, location and properties of cardinal points. Matrix method in paraxial rays - introduction, effect of translation and refraction. Imaging by a spherical Refracting surface, Imaging by a co-axial optical system (thick lens & lens formulae), unit planes, Nodal planes	8

Physical Optics Interference - analytical treatment of interference, intensity distribution of fringe system, coherent and non-coherent sources, fundamental conditions of interference ,Fresnefs biprism , displacement of fringes, wedge shaped films, Newton's rings Diffraction single slit and double slit diffraction, diffraction grating, Limit of resolution, resolving power of grating and image forming systems. Polarisation Brewster's law, double refraction, geometry of calcite crystal, optic axis, nicol prism, circularly and elliptically polarized light, retardation plates, production and analysis of planes, polarimeter. Basic principle of laser, components of a laser device. Optical resonator by laser. Basic principle of holography, optical fibres.	21
Acoustics Simple Harmonic motion, Damped Harmonic motion, Forced vibration Amplitude resonance, velocity resonance and energy intake. Transverse vibrations and longitudinal vibrations, wave equation, sound absorption and reverberation Sabine's formula. Production and applications of Ultrasonics, Acoustics of buildings.	8
Dynamics of Fluids Continuity equation, Bernoulli's theorem and its applications, Torcelli's theorem, Viscosity, flow of liquid through a capillary tube, capillaries in series and parallel, Poiseullie's formula, Stoke's formula, rotation viscometer.	15

SEMESTER I

MATHEMATICS   (M – 101)   (60 HRS)

DETAILED SYLLABUS	HRS
Calculus of Functions of One Variable Successive <lifferentiation, Libnitz's theorem (without proof) , Rolle's theorem, mean value theorems and Taylor's theorem. Newton's method for approximate solution.Fundamental theorems of integral calculus, elementary reduction formulae for integrals. Applications to length, area, volume, surface area of revolution, moments and centers of gravity.	15
Infinite Series: Convergence, divergence, comparison test, ratio test, Cauchy's root test, Cauchy's integral test (statements only), alternating series, Leibnitz's theorem, absolute and conditional convergence. Expansions of functions into Taylor and Maclaurin series.	10
Calculus of Functions of Several Variables Partial derivatives, chain rule, gradient and directional derivative. Differentiation of implicit functions, exact <lifferentials. Tangent planes and normals. Maxima, minima and saddle points. Simple problems in extrema of functions with constraints-method of Lagrange multipliers. Multiple integrals-double and triple integrals. Jacobians transformations of coordinates. Applications to areas, volumes, etc.	20
Vector Calculus Scalar and vector fields. Lines and surface integrals. Gradient, divergence and curl. Line integrals independent of path. Green's theorem, divergence theorem and Stoke's theorem (without proofs) and their simple applications.	15

SEMESTER - I

MECHANICAL SCIENCES (ME - 101) (60 HRS)

DETAILED SYLLABUS	HRS
Fundamentals of Mechanics - Basic Concepts Force systems & Equilibrium: Types of forces- concurrent, coplanar, distributed, spatial, resultant of a force about an axis, concept of equilibrium. Moment and couple, Principles of Transmissibility. Lamis and Varignon's theorem, resultant of a coplanar force system into a single force and a couple. Computation of centroids, centre of gravity and moment of inertia of areas and masses Equilibrium of a rigid body, concepts of friction. Laws of coulomb friction. Problems- applications to wedges- square threaded screws and bolts. Analysis of Simple Structures- Analysis of plane pin joints, trusses and frames- Methods of joints, sections and members. Virtual works- Principle of virtual work, simple applications to machines, mechanical efficiency, potential energy and equilibrium.	20
Mechanics of Materials Concepts of stress and strains- Internal and external forces, Stress-normal, shearing and bearing, deformations, Strain-normal, shearing and bearing, stress-strain diagram, elastic and plastic behaviour, elastic constants and their mutual relations. St.Venaut's principle, thermal stresses, shearing force and bending moments, Shear and Bending moment diagrams and their applications, deflections of beams. Principal stresses, graphical representation by Mohr's circle. Computations of stress and strain in simple structure and thin walled pressure vessels, Principle of strain energy.	20
Plane Trusses The structural model, simple trusses, analysis of simple trusses, method of joints, methods of sections, graphical method.	3

Kinematics and Kinetics Rectilinear and curvilinear motion of particles, Translations and rotation of rigid bodies, general planes, equations of motions in non-inertial frames of references, inertia force, D'Al__"1wt's principle, simp1e systems of rigid bodies. Principle of work and energy, application to plane motion of particles and rigid bodies, conservation of energy, power, efficiency. Principle of impulses and momentum, application to plane motion of particles and rigid bodies. Mechanical vibrations: Introduction to free forced and damped vibrations.	17

SEMESTER I

BASIC ELECTRICAL ENGINEERING (EE – 101) (60HRS)

DETAILED SYLLABUS	HRS
Coulomb's law, Gauss's theorem, capacitance calculation for plates, concentric spheres and co-axial cylinders, dielectrics, stored energy, electrostatic precipitator, electrostatic photocopying (Xerox).	3
Ohm's law, Kirchhoff's laws, mesh current and node voltage methods, Delta-star and starDelta conversion, superposition theorem; Thevenin's and Norton's theorems, Maximum power transfer theorem.	4
Magnetism as a Relativistic effect; Biot-savart law, Ampere's circuital law, magnetic field due to long straight conductors, coils and solenoids; magnetic forces: Lorentz /Ampere force, force production in simple systems. B-H characteristics offerromagnetic materials, Magnetic circuits, Faraday's law, self and mutual inductance, Energy stored in a magnetic field, Hysteresis and Eddy current losses.	6
D.G. Machines: Construction, Characteristics of D.C. generators and D.C. motors (qualitative only), starting and speed control of D.C. machines. D.C. transients in R-L, R-C and R-L-C circuits	6
AC. generation ,waveforms, average and RMS values, peak-factor, R-L, R-C and R-L-C circuits, symbolic notations, j-operator, complex representation of impedances, power factor, active and reactive power, series, parallel and series parallel circuits, series and parallel resonance, Q-factor ; application of circuit theorems.	12
Three phase power supplies, Delta and star connection, line and phase quantities, solution of 3-phase circuits for balanced voltage and balanced loads, phasor diagrams, 3 phase, 4 wire circuits, power measurement by two wattmeter method.	12

General structure of electrical power systems, Power transmission & distribution through overhead lines & underground cables.	
Single phase Transformers: EMF equation, no load and on load operation, open and short circuit tests, equivalent circuit, regulation and efficiency calculations.	5
3 Phase Induction Motors: Production of rotating field, principle of operation ratings. Torque -speed characteristics (qualitative only).Starters for squirrel cage and wound rotor Induction motors. Speed Control.	12

ENVIRONMENT & ECOLOGY   (CH - 101)   (45 HRS)

DETAILED SYLLABUS	HRS
General Introduction, components of the environment, environmental degradation	3
Ecology Elements of Ecology; Ecological balance and consequences of change, principles of environmental impact assessment	5
Air Pollution and Control Atmospheric composition, energy balance, climate, weather, dispersion, sources and effects of pollutants, primary and secondary pollutants, green house effect, depletion of ozone layer, standards and control measures.	12
Water Pollution and Control Hydrosphere, natural water, pollutants: their origin and effects, river / lake / ground water pollution, standards and control.	10
Land Pollution Lithosphere, pollutants (municipal, industrial, commercial, agricultural, hazardous solid wastes) ; their origin and effects, collection and disposal of solid waste, recovery and conversion methods.	10
Noise Pollution Sources, effects, standards and control.	5

ENGINEERING PHYSICS LABORATORY   (PH - 191) (45 HRS)

Suggested List of Experiments

DETAILED SYLLABUS	HRS
1. To determine the coefficient of viscosity of water by capillary flow	
2. To determine the wave length of light by Newton's ring method.	
3. To determine the wave length of light by Fresnefs biprism.	
4. To determine the dispersive coefficient of the given material of the prism.	
5. To determine the focal length of combination of two thin lenses by nodal slide assembly and its verification.	
6. Determination of elm by J.J.Thomson's method.	
7. Use of Carry Foster bridge	
8. Study of electromagnetic induction	45
9. Study of electromagnetic damping and determination of terminal velocity reached by a magnet falling in a metallic tube	
10. Laser Diffraction	
11. Determination of Plank's Constant using photocells.	
12. Determination of Hall Co-efficient of Semiconductors.	
13. Determination of band-gap	
14. Determination of resistance of a ballistic galvanometer and study the variation of logarithmic decrement with resistance.	

<u>BASIC ELECTRICAL ENGINEERING LABORATORY (EE 191) (45 HRS)</u>

Suggested List of Experiments

DETAILED SYLLABUS	HRS
1. To measure the armature and field resistance of a DC machine.	
2. To calibrate a test (moving iron) ammeter and a (dynamometer) wattmeter with respect to standard (DC PMMC) ammeter and voltmeters.	
3. Verification of circuit theorems, Thevenin's and Superposition theorems (with DC sources only).	
4. Voltage-current characteristics of incandescent lamps and fusing time-current characteristics of fuse wire.	
5. Measurement of current, voltages and power in R-L-C series circuit excited by (single phase) AC supply.	
6. Open circuit and short circuit tests on a single phase transformer.	
7. Connection and starting of a three phase induction motor using direct on line (DOL), or star - delta starter.	45
8. Connection and measurement of power consumption of a fluorescent lamp.	
9. Determination of open circuit characteristics (OCC) of a DC machine.	
10. Starting and speed control of a DC shunt motor.	
11. Connection and testing of a single phase energy meter (unity power factor load only)	
12. Two wattmeter method of measuring power in three phase circuit (resistive load only)	
13. Measurement ofthermo emf between different types ofthepnocouples as a function of temperature difference between the junction, measurement of an unknown temperature.	
14. Design and use of potentiometer	
15. Study of LCR circuits with AC current.	

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SEMESTER I

ENGINEERING GRAPHICS   (ME - 191)(45 HRS)

DETAILED SYLLABUS	HRS
1. LINE LETTERING <u>DIMENSIONING. COPYING</u> FIGURE Class sessional work: Different type of lines lettering, Dimensioning, Copying, Different figures Home assignment Rest oflettering both (5:4, 7:4, Mechanical type) Dimensioning (One-aligned system, one-unidrectional system) copying two figures.	4
2. SCALE Class sessional work: Plain scale, Diagonal scale, Comparative scale, Vernier scale Home assignment Plain scale-One PROB. Diagonal scale-Two PROBS. Comparative scale-One PROB. Vernier One PRC	3
3. <u>CURVES</u> CLASS SESSIONAL WORK Parabolla, Hyperbolla, ellipse, Rectangular hyperbolla, Cycloid, Involute, Archemedian spiral, Logerithm spiral, Hellix HOME ASSIGNMENT Hyperbolla, Ellipse-Two methods, Two problems. Involute-One PROBLEM. Hellix -One PROBLEM.	10

4. <u>PROJECTDF POINTS. LINES.</u> SURFACES
Projection of lines including H. T & V. T - Two PROBS. Projection of lines including sideview –
 Two PROBS
 Projection of surfaces
        i)   Pentagon-One PROB.
        ii)   Hexagon-One PROB.
	14

5. PROJECTION OF SOLIDS Class sessional work Cube-One problem involving solid diagonal Pyramid-One PROBLEM Prism-One PROB.	14

SEMESTER I

WORKSHOP PRACTICAL   (ME - 192 AND ME - 292)
(SEMESTER I – 45 HRS;   SEMESTER II – 54 HRS)

DETAILED SYLLABUS	HRS
Carpentry Timber, defmition, Engineering applications, seasoning and preservation, plywood and plyboards	4
Metal Joining Definitions of welding, brazing and soldering processes, and their applications. Oxy-acetylene glass welding process, equipment and techniques, types of flames and their applications. Manual metal arc welding technique and equipment, AC and DC welding, electrodes, constituents and functions of electrode coating. Welding positions. Types of weld joint. Common welding defects such as cracks, undercutting, slag inclusion, porosity.	10
Metal Cutting Introduction to machining and common machining operations. Cutting tool materials. Defmition of machine tools, specification and block diagram oflathe, shaper,milling, drilling machine and grinder. Common lathe operations such as turning, parting, chamfering and facing. Quick return mechanism of shapero Difference between drilling and boring. Filesmaterial and classification.	12
List of jobs to be Made in the Workshop	
Group A T-Lap joint and Bridle joint (Carpentry shop)	8

Group B
   1) a) Gas welding practice by students on mild steel flat
      b) Lap joint by Gas welding
   2) a) MMA welding practice by students
      b) Square butt joint by MMA Welding
   3) a) Lap joint by MMA Welding
      b) Demonstration of brazing
4) Tin smithy for making mechanical joints and soldering of joints
	23

GroupC
   1) Job on lathe with one step tuming and chamfering operations
   2) Job on shaper and milling machine for finishing two sides of a job
   3) a) Drilling two holes of size 5 and 12 mm diameter on job used / to be used for shaping
      b) Grinding a comer of above job on bench grinder
4) Finishing of two sides of a square piece by filing.
	36

MATHEMATICS (M - 201) (72 HRS)

DETAILED SYLLABUS	HRS
Linear Algebra Vector spaces-linear independence and dependence of vectors, inner products, linear transformations. Matrices and determinants. Systems of linear equations-consistency and inconsistency. Gauss elimination, rank of a matrix, inverse of a matrix. Eigenvalues and eigenvectors of a matrix, diagonalization of a matrix.	21
Ordinary Differential Equations Formation of ODE's, definition of order, degree and solutions. ODE's of first order: separate variables, homogeneous and nonhomogeneous equations, exactness and integrating factors, linear equations and Bernoulli equations. General linear ODE's of nth order: solutions of . homogeneous and nonhomogeneous equations, operator method, methods of undetermined coefficients and of variation of parameters. Solution of simple simultaneous ODE's. Legendre and Bessel functions and their properties.	30
Laplace Transforms Transforms of elementary functions, transforms of derivatives and derivatives of transforms, inverse transforms, transforms of periodic functions, unit step function, shifting theorems, solutions of ODE's using Laplace transforms.	11
Numerical Methods Difference operators- forward, backward, central, shift and average operators and relations between them. Newton's forward and backward interpolation. Lagrange interpolation and the error formula for interpolation. Numerical differentiation and integration-Trapezoidal rule and Simpson's one-third rule including error formulas.	10

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MARINE ENGINEERING

SEMESTER II

ENGINEERING PHYSICS (PH - 201)   (54 HRS)

DETAILED SYLLABUS	HRS
Vector Analysis Scalar and Vector fields, gradient of a scalar field, Divergence and curl of a vector field, Line integral of a vector field, Gauss-divergence theorem, Stoke's theorem	5
Electromagnetism Quantization & Conservation of charge, Coulomb's law (vectorial form) and superposition principle, Concept of electric lines, flux of E-field, Gauss' law, Electric Potential energy and potential, Conductors, capacitors and dielectric materials, Magnetic field, Force on a moving charge in a magnetic field, Force on current element, Torque on current loop, Bio-Savart law, Ampere's law, Electromagnetic induction and Faraday's law, Magnetism in materials, Maxwell's equations in differential and integral form, Electromagnetic Waves.	9
Thermoelectricity Seebeck effect, law of successive temperatures, law of intermediate metals, Peltier effect, Thomson effect, Thermoelectric power.	5
Modern Physics Limitations of classical mechanics and its failure, Blackbody radiation, photo-electric effect, Compton effect (derivation of wavelength shift), X-ray diffraction and Bragg's Law, wave particle duality, Davisson-Germer experiment. Heisenberg's uncertainty relation, Schrodinger's equation (time dependent and time independent), wave function and its normalisation, probability density and expectation values, operators in quantum mechanics (brief introduction), particle in a box (one dimensional, three dimensional also to be discussed). Hydrogen atom problem - Transformation of Schrodinger equation to Spherical polar co-ordinates, discussion of the solution of the equations in polar co-ordinates. Space quantisation, orbital & spin angular momentum, normal Zeeman effect, exclusion principle.	11
Thermal Physics Introduction to statistical physics, Maxwell- Boltzmam distribution, application to ideal gas molecules, distribution of molecular speeds, mean, rms and most probable velocity, Law of equipartition of energy, Fermi-Dirac statistics, calculation of total number of free electrons ill a metal, ev:aluation of Fermi energy and total energy of electrons in a metal at absolute zero temp'erature (short derivation), Bose-Einstin statistics, Planck's radiation law, Wien's displacement law and Stefan -Boltzmann Law.	10
Solid State Physics Crystal class and their symmetries, Bravais lattice, unit cell, fcc, bcc, hcp crystal, Miller indices and applications. Band theory of solids, conductor, semiconductor and insulators, Brillouin zones.	7
Nuclear Physics Nuclear binding energies, nuclear forces and their short range character, balance of mass and energy in nuclear reactions - Q-value of reaction, threshold energy in endothermic reactions, nuclear fission and fusion - fundamentals, nuclear reactors.	7

SEMESTER II

ENGINEERING CHEMISTRY   (CH - 201) (54 HRS)

DETAILED SYLLABUS	HRS
Chemical Thermodynamics Concept of thermodynamic system. Introduction of First law of thermodynamics. Internal energy and enthalpy. Cp and Cv, Adiabatic chages. Application of First law of Thermodynamics to chemical processes (Hess's Law and Kirchoff's Law), Joule Thompson and throttling processes. Evaluation of entropy, work functions and free energy in the light of thermodynamics. Condition of spontaneity and equilibrium. Non ideal systems, activity and activity coefficient. Partial molar properties, chemical potential to multicomponent systems. Application of thermodynamics to phase transitions and chemical equilibrium.	9
Atoms and Molecules Particles in a box illustrating energy, quantization, angular momentum, quantization, radial and angular parts of H atom, wave functions / orbitals, probability and charge distribution. Homonuclear and heteronuclear diatomics , covalent bonds, ionic bonds and electronegativity concepts, hybridization and shapes of molecules. Non-covalent interaction (Van der Waals and hydrogen bonding).	3
Solid State Chemistry Brief discussion of stoichiometric deffects <Schottky & Frenkel) and non stoichiometric defects (Metal excess and metal deficiency). Role of Silicon and germanium in the field of semiconductors, transitors, rectifiers and photovoltaic cells. The process for preparing micro. miniaturized semiconductor devices: Integrated circuits.	4
Instrumental Methods of Analysis Experimental methods of structure determination usin'g spectroscopic techniques such as IR, UV-Vis, NMR and Mass Spectrometry.	4
Reaction Dynamics Rate laws, mechanisms and theories of reaction rates (collision and transition state theory). Lasers in Chemistry.	3
Transition and Metal Chemistry Structures of coordination compounds corresponding to coordination numbers up to 6. Types of ligands . Isomerism (geometrical, optical, ionization, linkage and coordination). Theories of bonding in coordination compounds, viz. crystal field theory, valence bond theory. Chelation. Brief application in organic synthesis and medicines etc.	4
Organometallic Chemistry and Catalysis Structure and bonding in organometallic complexes, the sixteen and eighteen electron rules. Homogeneous catalysis, the role of metals in catalytic cycles during some chemical reactions (ego Hydroformylation , hydrogenation etc.) . Role of metals in biology; oxygen carrier, electron transfer.	4
Structure and Reactivity of Organic Molecules Inductive effect; resonance, hyperconjugation, electromeric effete. Carbocation , carbanion and free radicals. Brief study of some addition, elimination and substitution reactions. Conformational analysis (acyclic and cyclic molecules) , geometrical and optical isomerism; E Z, Rand S nomenclature.	3

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ENGINEERING CHEMISTRY(Contd.) (CH - 201) (54 HRS)

Polymerization Basic concepts ,Classifications and industrial application. Polymer, Polymerization processes, kinetic chain length, degree of polymerization, molar mass. Molar weight: number average, weight average and viscosity. Conducting and semi-conducting polymers.	5
Photochemistry Photoexcitation of carbon substrates <Norish type I and type II reactions) , selected examples of the application of photolysis, Photosynthesis (Z-diagram). Chemistry of vision.	3
Industrial Chemistry Fuel, solid, liquid and gaseous fuels. Constituent of coal, coal analysis, proximate and ultimate analysis, classification of coal, petroleum, gasoline, octane number, aviation fuel, natural gas, water gas.	9
Electrochemistry : Conductance of electrolytic solutions, transport numbers and hydration ions, ion conductance and ionic mobility, Basic ideas of inter ionic attractions, Electrochemical cells, cell emf and its thermodynamic significance, single electrode potentials and its applications. Conductometric titrations.	3

MECHANICAL SCIENCES   (ME - 201) (54 HRS)

Thermodynamics First law of Thermodynamics for closed and open systems; flow processes and control volume. Analysis of different non-flow and flow proceses. Limitations of the 1st Law of thermodynamics. Perpetual motion machines (PMM) of the 1st kind, Power producing and power absorbing devices.	6
Second law of thermodynamics, Introduction to Carnot cycle, Practical Thermodynamic cycles. PMM II, corollaries of second law, clausius inequality, reversibility, Entropy and disorder, basic concept of availability.	10
Temperature entropy diagram. Properties of vapour and saturated steam, use of Molier chart and steam tables. Rankine cycle. Raheat and Regenerative cycle, airline cycles.	11
Fluid Mechanics: Properties of fluid, classifications, ideal fluid, Newtonian and non Newtonian fluids, Inviscid fluid, Newton's law ofviscocity, Fluid statics. Fluid pressure and its variation within fluid at rest. Measurement of fluid pressure, (manometers, micro manometers, etc.)	7
Fluid kinetics: principles fluid flow, rate of flow, average velocity, steady and unsteady flow, one, two and three dimensional flow, Linear and turbulent flow.	6
Fluid dynamics. One dimensional equation of motion, Integration of the equations of motion, Bernaulies equation, application of Bernauli's equation. Dynamic fluid pressure, conservation of linear momentum and its application, study of viscous flow, Linear and turbulent flow through circular and non.circular conduits, Flow through open channel, Chezy's equation, compressible fluid, compressibility factor stagnations enthalpy, temperature pressure and density.	14

SEMESTER II

BASIC ELECTRONICS ENGINEERING   (EC - 201) (72HRS)

DETAILED SYLLABUS	HRS
Energy band theory of crystal, conductor, insulators and semiconductors. Transport phenomena in semiconductors - Drift and diffusion, Mass action law, Continuity equation, Law of junction, diode V-I relation. charge control description. Zener diode, varicap diode. Diode circuits -load line, rectifiers clipping and sampling circuits.	22
PNP and NPN transistors, Ebers - Moll model, transistor characteristics. *FET* s and their characteristics. Biasing and bias stability. Construction and characteristics of JFETs , Transfer Characteristics, depletion type MOSFET, Enhancement type MOSFET CE, CB and CC (CS,CG and CD) configurations. for transistor amplifiers. Small signal equivalent circuits including high frequency considerations h-parameter model, gain input and output impedance for different configurations. Frequency response and cut-off frequencies.	25
Concept of feedback: negative feedback (voltage series) and its effect on performance. Positive feedback and condition of oscillation.	4
Operational Amplifier Introduction, Differential and common mode operation, Constant gain multiplier, voltage summing, voltage buffer. Adder, subtractor, comparator, integrator and differentiator circuits	10
Semiconductor Devices Introduction of silicon controlled rectifier, GTO, TRIAC, DIAC, unijunction transistors, IGBT	8
Cathode Ray Oscilloscope Introduction, Cathode Ray Tube Theory & Construction, measurement with CRO.	3

SEMESTER II

INTRODUCTION TO COMPUTING   (CS - 201) (54 HRS)

DETAILED SYLLABUS	HRS
Introduction: Basic anatomy of the computer, ALD, Memory devices, 110 devices, Concepts of operating system, DOS, Windows and UNIX (only brief user level description). Introduction to Programming: Example of algorithms such as addition of sequential integers, finding roots of a quadratic equation etc, Concept of sequentially following up the steps of the algorithm, pseudocode and flowcharts.	14
Computer languages and Language Translators, structure of programs, object code and executable code. Introduction to editing tools such as vi and MS-VC editor.	13
Programming in C : C Fundamentals: The C character set, identifiers and keywords, data type and sizes, variable names, declaration, statements. Operators and Expressions: Arithmetic operators, relational and logical operators, type conversion, increment and decrement operators, bitwise operators, assignment operators and expressions, precedence & order of evaluation Input and output: standard input and output, formatted output- printf , formatted input scanf Flow of control: statement and blocks, if-else, switch, loops-while, for do. while, break and continue, go to and labels. Fundamentals and program structures: Basics of functions, function types, functions returning values, functions not returning values, auto, external, static and register variables, scope rules, recursion, function prototypes, C preprocessor, command line arguments Arrays and pointers: one dimensional arrays, pointer and addresses, pointers and functions, multidimensional arrays, Structures, union and files .: Basics of structures, structures and functions, arrays of structures, unions, bit fields, formatted and unformatted flies.	27

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<u>ENGINEERING GRAPHICS</u>   (ME - 291) (54 HRS)

DETAILED SYLLABUS	HRS
ISOMETRIC VIEW AND ISOMETRIC PROJECTION: Class sessional work 2 PROBS, Home assignment 2 PROBS	10
SECTIONAL VIEW, TRUE SHAPE OF A SECTION: Class sessional work 1 PROB EACH, Home assignment 1 PROB EACH	8
RIVET HEADS, RIVETED JOINTS Class sessional work: Rivet heads, types, lap-joint, butt joint (single cover) Home assignment: Remaining heads butt-joint (Double cover) THREADS, NUT-BOLT KEY AND COTTER JOINT Class sessional work: Home-work-threads-2types, hexagonal bolt, fitted with a SQ. nut-plan and elevation. Home-work -two views each- 2 probs Home assignment: Remaining threads. SQ. Head bolt and Hexagonal head nut. - 2 probs	5
DEVELOPMENT Class sessional work: Two PROBS Home assignment: Two PROBS	6
INTERPENETRATION Class sessional: From orthographic view- plan, elevation and side view-l PROB. Home assignment: 1 PROB	6
MACHINE PARTS Home assignment: 1 PROB	6
BUILDING DRAWING (CIVIL-R.C.C) Class sessional work: Front line plan to draw plan-elevation .A Brick Foundation showing all components. Home assignment: 2 probs	6
Computer Aided Drafting Introduction. Cartesian and Polar Co-ordinate system, Absolute and Relative Co-ordinates; Basic Editing Commands: Line, Point, Trace, Rectangle, Polygon, Circle, Are, Ellipse, Polyline; Basic Editing Commands: Basic Object Selection Methods, Window and Crossing Window, Erase, Move, Copy, Offset, fillet, Chamfer, Trim, Extend, Mirror; Display Commands: Zoom, Pan, Redraw, Regenerate; Simple dimensioning and text. Simple exercises and practice problems.	7

MARINE ENGINEERING
SEMESTER II

BASIC ELECTRONICS ENGINEERING LAB   (EC - 291) (54 HRS)

DETAILED SYLLABUS	HRS
1. Familiarization with Electronic components such as Resistors, Capacitors, Diodes, Transistors etc.	
2. Familiarization with electrical devices and measuring equipment like DC power supply, Multimeter, Trainer kit etc.	
3. Familiarization with measuring and testing equipment like CRO, Signal generator.	
4. Study on V-I characteristics of Junction Diode.	
5. Study on V-I characteristics of Zener Diode.	54
6. Study on Half Wave and Full Wave rectifiers.,	
7. Study on characteristics ofField Effect Transistors.	
8. Determination of Input offset voltage, Input Bias current, Slew rate of Op- Amp.	
9. Determination of Common Mode Rejection Ratio, Bandwidth, Offset null of Op- Amp.	
10. Characteristics Curve for common base emmitor & common collector transducers	
11. Study of working of data acquisition system.	

ENGINEERING PHYSICS LABORATORY   (PH - 291) (27 HRS)

DETAILED SYLLABUS	HRS
1. To determine the thermal conductivity of a bad conductor by Lee's method.	
2. To determine the thermal conductivity of a good conductor by Searl's method.	
3. Measurement of thermo emf between different types of thermocouples as a function of temperature between the junctions, measurement of an unknown temperature.	
4. Verification of Hooke's law and determination of Young's modulus.	27
5. Determination of Bending Moment and Shear Force of beam by Travelling Microscope.	
6. Determination of rigidity modulus.	
7. Determionation of Spring constant of a Spiral spring & Helical spring.	

COMPUTING LAB   (CS - 291) (54 HRS)

DETAILED SYLLABUS	HRS
Exercises should include but not limited to:	27
1. DOS System commands and Editors (Preliminaries)	
2. UNIX system commands and vi (Preliminaries)	
3. Simple Programs: simple and compound interest. To check whether a given number is a palindrome or not, evaluate summation series, factorial of a number, generate Pascals triangle, fmd roots of a quadratic equation	
4. Programs to demonstrate control structure: text processing, use of break & continue	
5. Programs involving functions and recursion	
6. Programs involving the use of arrays with subscripts and pointers	

| 7. Programs using structures and files. | |

SEMESTER II

ENGINEERING CHEMISTRY LABORATORY (CH - 291) (27 HRS)

DETAILED SYLLABUS	HRS
Suggested List of Experiments	
1. Acid -base titration (estimation of commercial caustic soda)	
2. Redox titration (estimation of iron using permanganometry)	
3. Complexometric titration/(estimation of hardness of water using EDT A titration)	
4. Preparation and analysis of a metal complex (for example thiourea I copper sulfate or nickel chloride I ammonia complexes)	
5. Chemical Kinetics (determination of relative rates of reaction of iodide with $H2O2$ at room temperature (clock reaction)	
6. (Heterogeneous equilibrium)(determination of partition coefficient of acetic acid between n-butanol and water)	27
7. Photochemical oxidation-reduction (study j)fphotochemical reduction of ferric salt)	
8. Viscosity of solutions (determination of percentage composition of sugar solution from viscosity)	
9. Conductometric titration for determination of the strength of a given HCI solution by titration against a standard NaOH solution	
10. pH- metric titration for determination of strength of a given HCI solution against a standard NaOH solution.	

WORKSHOP PRACTICAL (ME - 192 AND ME - 292)
(SEMESTER I – 45 HRS;   SEMESTER II – 54 HRS)

DETAILED SYLLABUS	HRS
Carpentry Timber, defmition, Engineering applications, seasoning and preservation, plywood and plyboards	4
Metal Joining Definitions of welding, brazing and soldering processes, and their applications. Oxy-acetylene glass welding process, equipment and techniques, types of flames and their applications. Manual metal arc welding technique and equipment, AC and DC welding, electrodes, constituents and functions of electrode coating. Welding positions. Types of weld joint. Common welding defects such as cracks, undercutting, slag inclusion, porosity.	10
Metal Cutting Introduction to machining and common machining operations. Cutting tool materials. Defmition of machine tools, specification and block diagram oflathe, shaper,milling, drilling machine and grinder. Common lathe operations such as turning, parting, chamfering and facing. Quick return mechanism of shapero Difference between drilling and boring. Filesmaterial and classification.	12
List of jobs to be Made in the Workshop	
Group A T-Lap joint and Bridle joint (Carpentry shop)	8

Group B
   4) a) Gas welding practice by students on mild steel flat
      b) Lap joint by Gas welding
   5) a) MMA welding practice by students
      b) Square butt joint by MMA Welding
   6) a) Lap joint by MMA Welding
      b) Demonstration of brazing
4) Tin smithy for making mechanical joints and soldering of joints
	23

GroupC
   4) Job on lathe with one step tuming and chamfering operations
   5) Job on shaper and milling machine for finishing two sides of a job
   6) a) Drilling two holes of size 5 and 12 mm diameter on job used / to be used for shaping
      b) Grinding a comer of above job on bench grinder
4) Finishing of two sides of a square piece by filing.
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WORKSHOP TECHNOLOGY   (ME – 301)   (54 hrs.)

DETAILED SYLLABUS	HRS
Common workshop tools description and uses of different types of calipers, Straight edges, try squares, vices, Hammers, chisels, Scrapers, files, Drills, reamers, Tapes, V-Blocks, face plate, Marking blocks, Carpentry tools, Patten maker's tools, smithy tools Moulding tools.	6
Machine process & Machine Tools the geometry of cutting processes machines of cutting, chip formation, cutting forces and power, Friction of chip on tools Generation and dissipation of heat in cutting. Standard nomenclature for cutting tools. Cutting speeds and feeds, estimation of machining time. The fundamental Cutting process. Application in hand tools as chisel, file and saw , geometrical control of the cutting edge. Kinematic analysis, specification, operation and inspection of the more important types of metal cutting machine tools including Centre lathes, Capstan and turret lathes, Automatic lathes, drilling and boring machines Shaping slotting and planning machines, Milling and broaching machines. Turning, Screw cutting and taper turning processes on Centre lathe, Abrasive process, Grinding, honing and lapping by hand and machines Shears and punches. Wood working machines. Principles of jigs and fixtures Standardization.	20
Measuring Instruments & Inspection: Description and use of steel rule, Vernier's scale, Micrometer, Dial gauge, Depth gauge, thread gauge, Feeler gauge, Wire Gauge, pattern maker's scale, Taper gauge, snap gauge, plug gauge, Optical methods of measurement, Principles of interchangibility, limit system. Use of limit gauge.	*8*
Fitting and Overhauling: Types of packing and jointing materials and their uses. Design considerations and construction of various types of valves and cocks, Reducing valves for steam and air. Bedding of bearings, marking of engine parts for fitting, machining operations fitting of keys cotters, etc.	*6*
Safety Measures: Sources of danger and methods of protection. Types of guards and safety devices, factory Act regulations.	*4*
W3lding; Welding Equipment & Applications, Electric welding (A.C & D.C) Spot-welding. Gas welding, soldering & Blazing. Different Welding & Electrodes, Solders & Brazing Fluxes	*10*

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SEMESTER III

MATHEMATICS – III   (MM – 302)   (72 hrs)

DETAILED SYLLABUS	HRS
*Sampling Theory- **Population and Sample, Sampling with and without replacement, Random Samples, Population parameters, sample statistics, samples mean, sampling distribution of means, sample variance, mean, variance and moments for grouped data.***	*6*
Curve Fitting, Regression and Correlation- *Curve fitting, the method of least squares, the least squares line, least square line in terms of Simple 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, interpretations of regression and correlation.*	*20*
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. **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-	*8*
The Calculus of Finite Difference : *Differences of a function, Fundamental operators of the calculus of Finite Difference operators, Fundamental equations statisfied 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.*	*20*
<u>**Computing-**</u> *Design of efficient algorithms of problems like-factorial of a positive integer, Fibonacci Swquence generation, Sinx, cos x, e^x serried summation Linear search problem, Bubble sort Problem, Merging Problem, Calculation of computational complexity.*	*18*

SEMESTER III

ECONOMICS & COMMERCIAL GEOGRAPHY   (MECG – 303)
(54 Hrs.)

DETAILED SYLLABUS	HRS
PART - A *Importance of economics in Marine Engineering study, Basic economic concepts and terms, Demand analysis, Supply analysis, Elasticity of demand, Elasticity of supply.*	*9*
Factors of production, Forms of business organization, Economic system with reference to India.	*4*
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*
Money:- Types, Functions, Standard. Inflation :- Types, Causes. Commercial Banks - Functions, Functions of Central Banks. Features of Money and Capital market. National Income concepts.	*7*
Taxation - Direct and Indirect, Govt. Budgets. Economic development, Growth, features of underdevelopment with reference to India. Globalisation of Indian economics.	*4*
PART - B *Difference between Domestic and foreign trade. Basis of International Trade: - Trade-theories. Free-Trade Vs Protection. Balance of paymentscomponents, 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.*	*10*
Major Shipping Routes. Ports :- Types, Problems, factors for good port. Major ports of Indian and World. Port-pricing. Pollution of water - causes and remedies. Deep-sea fishing, Major sea-fishing zofles, Off-shore oil producing zones. India's overseas Trade and Economic Importance with reference to Economic zones.	*7*
Allocation of market resources in a wealth-maximising manner, Public policy issue in marine transportation, Chartering of ships, Flag of convenience, Policy of protection and subsidy.	*3*

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SEMESTER III

MACHINE DRAWING (MED – 304)   (54 HRS)

DETAILED SYLLABUS	HRS
Machinery Component Drawing: Drawing of complete machine components in assembly (Orthographic to Orthographic and isometric of Orthographic) with details like couplings, Glands, Return and non-return valves, cocks & plugs, cylinder and piston assembly connecting rod with bearings, Boiler mountings.	*20*
Marine component Drawing: Assembly Drawings of simple marine components in Orthographic projection from Isometric views e.g. Bilge Strainer Boxes, Marine Diesel Piston & 4 stroke types, Control Valves, Cylinder Relief Valve, Boiler Blow-down valves, Diesel Engines' Rocker arms.	20
*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.***	*14*

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SEMESTER III
APPLIED THERMODYNAMICS – 1 (MAT – 305)   (72 HRS)

DETAILED SYLLABUS	*HRS*
The second Law of Thermodynamics: Different statements of the second Law of Thermodynamics. Carnots cycle, Thermodynamic Reversibility. Carnots Principle, Carnot's cycle for a gas, Deductions from carnot's cycle. Thermodynamic Temperature scale. Steam and Gas Processes on T-S and H-S charts Entropy and Irreversibility. Applied problems.	*6*
*Steam and two phase system: **Phase Equation of Steam, Temperature Pressure Diagrams, Triple Point, Specific Enthalpy and Entropy, Use of Steam Tales and Steam Charts, Pressure volume and Enthalpy- entropy Diagrams.***	*8*
*Boilers and Evaporators: **Boiler Calculations; Boiler thermal efficiency and Equivalent of a boiler; Basic Calculations on the effect of Condenser Leakage and impure Feed, dissolved solids in Boilers. Density of water and its control in Boilers; Density of water and its control I Boilers & Evaporators. Basic Calculations on performance of single-effect, multi-effect and Flash-type Evaporators. Basic Calculations on performance of single-effect, multi effect and flash-type Evaporators'; Applied Problems.***	*9*
*Ideal Gas Cycles: **constant Volume Cycle Constant Pressure Cycle, Diesel Cycle, Dual combustion Cycle, 4 Stroke Cucle, Criteria of Performance, compression Ratio and Thermal Efficiency, Indicator Diagrams; Indicated Power, Brake Power, Friction Power, Mechanical Efficiency, Specific Fuel consumption, Energy Balance, Applied Problems.***	*8*
Steam cycle :- *Carnot cycle for steam and Ideal Efficiency. Rankine cycle with dry saturated steam and superheated steam. Feed Pump work. Rankine Efficiency, work Ratio, Reheating and Regenerative Feed Heating and their effect on Thermal Efficiency. Applied Problems.*	*10*
Steam Engines :- *Modified Rankine cycle for steam Engines, Hypothetical Indicator Diagram. Mean Effective pressure and work transfer, diagram Factor. Indicated Thermal Efficiency. Efficiency Ratio, Engine Efficiency, Energy Balance, compound steam Engines, Missing quantity.*	*6*
Applied Problems. *Reciprocating Compressors: **Ideal cycle for compressors, work Transfer in single stage Compressor, Mass and volume flow. Free Air Delivery, Effect of clearance and volumetric Efficiency in Single stage compressors, Multi-stage compression neglecting clearance and with clearance. Condition for Minimum work Input and Perfect Intercooling, Tandem and In-line arrangement in compressors. Rotary positive Displacement Types of compresses air Motors Applied Problems.***	*12*
Properties of Mixtures of Gases and Gas & Vapours:- *Dalton's Law of partial pressure, Amagat's Law of partial volume, Volumetric and Gravimetric Analysis of Gas Mixtures, Gibb's – Dalton Law, Mean value of a Gas constant. Equivalent Molecular weight, Density, specific volume, Specific Heat and Molar Heat capacity of gas mixture. Advanced problem of Adiabatic Mixing.*	10
Air and Water vapour mixture, Specific Humidity, Relative Humidity, Dew point, unsaturated and saturated Air, Principle of cooling Tower and Air Leakage Problem in surface condenser.	3

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MATERIALS SCIENCE – I   (MMS – 306)   (54 HRS)

DETAILED SYLLABUS	HRS
Solid Solution: **Properties of solid solutions and alloys. Types of Binary alloys, thermal Equilibrium Diagrams, cooling curves, Eutectic and peritectic alloys. Intermetallic compounds.**	10
Allotropy of Iron, Iron-carbon Equilibrium Diagrams for Non-ferrous metals and alloys.	3
Heat treatment: **Heat treatment principles and processes for Ferrous and non-ferrous metals and alloys. Effect on structures and properties. Deformation and fracture of materials in services. Creep phenomena and creep resisting alloys. Creep curve. Short time and long time creep tests. Development of creep resisting alloys.**	9
Fatigue: **Fatigue loading, Mechanisms of fatigue, fatigue curve, Fatigue teats. Design criteria in fatigue, Corrosion fatigue.**	5
Corrosion and its prevention: **Mechanism of corrosion, chemical Corrosion, Electrochemical corrosion, Anodic and Cathodic protection, Forms of metallic coatings. Anodising, Phosphating.**	4
Selection of Materials in Shipbuilding & Marine Engineering: **Boilers, Steam and Gas turbine and diesel engine components. Pumping Mechinery , Piping. Engine seating. Propellers and rudders. Composition, strength valueand other requirements for materials used.**	2
Metals and alloys**; Different types of iron and steel; their manufacture, properties and uses in industry. Alloys of iron and steel. Non-ferrous metals and alloys. Properties and uses; Miscellaneous engineering materials; their properties and uses.**	6
Miscellaneous Engg**. Materials; Refractories, Insulating materials; Plastics and Rubber; PVC, Resins, Paints etc. Manufacture, properties and selection for various engineering applications.**	4
Testing of Materials**: destructive tests; Tensile; Compression Test; Hardness Test; Bend test; Torsion Test & Impact Test.**	3
Non-destructive Tests**: Magnetic Dust; Fluorescent Test; Ultrasonic Test; Radiography Test etc.**	2

SEMESTER III

ELECTRICAL MACHINE – I (MEL – 307)(36 HRS)

DETAILED SYLLABUS	HRS
Direct current machines-principle of working, construction, winding, e.m.f. equation, armature reaction, commutation, brush shift, compensating winding etc.	12
D.C. generator, their characteristics, methods of excitation, parallel operation, equalizer busbar, performance equations.	8
D.C. motor-their characteristics, starting and reversing, speed-torque equations, starters, speed control, testing of d.c. machines for finding out losses and efficiency, barking of d.c. motor.	8
D.C. and A.C. transmission and distribution-two wire and three wire d.c. system, use of balancer, a.c. transmission single phase and three phase, three wire four wire distribution, comparision of d.c. and a.c. transmission, effect of voltage drop, copper utilization under different systems, single and double fed distributors, fuses, d.c. air circuit breaker, a.c. air and oil circuit breakers.	8

MECHANICS OF MATERIALS – I (MMM – 308)   (72 HRS)

Simple stress 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. Uniaxial loading and deformations; Thermal Stress; Axial Stresses in composite materials.**	10
Stain Energy in Simple Stresses:: **Concept of strain Energy, Strain Energy due to normal and shear Stresses; Strain Energy due to impact loads; Resilience.**	5
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
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.**	12
Welded Joints:: **Strength of Welded Joints. Torsion effect on welded joint.**	8
*Bending Stress***; Pure Bending, 2nd moment of area, Stresses due to bending. Position of Neutral a)(is, Radius of Curvature, Combined bending and direct stress. Shqrt Column with eccentric loading. Composite beams. Bending beyond the limit of proportionality.**	12
*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.**	15

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WORKSHOP PRACTICALS   (MWP – 309)   (54 HRS)

DETAILED SYLLABUS	HRS
Workshop Layout;	
Steam & Exht. Line Tracing;	
Feed, Distilled, Cool Water & Fuel Tracing ;	
Scotch Boiler Familiarization;	
Globe Valve & sluice Valve Overhauling;	
Return & Non-return Valve Overhauling;	
Cock Overhauling;	
Shaft Key Making;	*54*
Thread cutting by Taps & Die;	
Thread cutting by Lathe Machine.	
General Overhauling Work:	
Dismantling, refitting and studying of a return-type and non-return type valves.	
Overhauling of Glove Valve	
Dismantling, refitting and studying the operation of a sluice Valve	
Overhauling of a steam stop valve	
Cutting of joints and packing for various uses.	

COMPUTER PRACTICALS   (MEP – 310)   (36 HRS)

DETAILED SYLLABUS	HRS
Windows operating system: *Starting, Setting the colour scheme, screen saver, icons etc., Using the desktop items, Managing folders and files, System setting, Maintaining the system, Concept of using the network neighbor hood in LAN, Using DOS from windows, Using applications and utilities. Installing softwares from CD or floppy.*	*7*
Microsoft Word	*10*
Microsoft Excel	*10*
Microsoft Power point	*6*
Internet and Email	*3*

SEMESTER III

MATERIAL LABORATORY *(MMSP – 312)* *(36 HRS)*

DETAILED SYLLABUS	HRS
To verify the Principles of Moment with the help of (a) Bell Crank Lever & (b) Moments of Stand.	
To determine the magnitude and nature of forces acting on the different members of (a) Wall Crank, (b) Shear Leg Apparatus, & (c) Derrick Crane.	
To determine the reactions of a Loaded Beam.	
To determine the co-efficient of friction between leather and metal in an inclined plane.	
To prove that if a system of uniplanar forces are in equilibrium, the links respectively given in magnitude and direction taken in order, from a closed polygon.	
If any number of forces acting at a point be such that they can be represented in magnitude and sense by the sides of closed polygon taken in order, then they shall be in equilibrium.	
To prove in a frictionless simple machine that Mechanical Advantages in the same as the Velocity Ratio.	
To find out the Mechanical Advantage, Velocity Ratio, Theoretical Effort, Efficiency, friction, the Equation giving the relation between Load and actual Effort and draw graphs with load as base for (i) Efficiency, (ii) Actual Effort, (iii) Mech Advantage and (iv) Friction for the following machines;	36
(a) Screw Jack; (b) Worm and Worm Wheel; (c) Compound Wheel and Axle, (d) Single Purchase Crab and (e) Double Purchase Crab.	
To verify that the efficiency of a square thread is greater than that of V-thread with the help of multi-thread Screw Jack.	
To verify that E_1 x $E_2 = E_3$ *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*	
To determine the value of 'g' (acceleration due to gravity) by means of- (a) Atwoods Machine, and (b) Fletcher's Trolley	
To determine the Moment of Inertia and Radius of Gyration of a Fly Wheel.	
To determine Absolute Viscosity and Kinematic Viscosity of oil by Red Wood Viscometer.	
To determine the Flash Point of a given sample of oil.	
To determine the percentage of CO_2, CO and Oxygen in the fuel gases. To determine the Colorific valve of the fuel with the help of a Bomb Calorimeter.	

SEMESTER - IV

SOCIAL STUDIES   _(MSS – 401)_   _(54 HRS)_

DETAILED SYLLABUS	HRS
Society definition, characteristics, functions, Norms, Social Groups, Race, Caste, Class and Conflicts.	4
Social change & Social Institutions- Theory, characteristics, Progress & control Definition of Institution, Classification, Association, community, functions of Institution, Family, Educational Institutions, its aims, problems standards, Religion functions, Secularism, Industry. Markets.	4
Ethical & Social values-Ethics, values, Human sprit, moral values, code of Conduct. Cultural Advancement, Rationalism, Social values, Laws, Justice, Liberty, Equality & Fraternity.	4
Modern Society & Indian Problems- social problems, Economic inequality, Education & cultural problems, Health, Unemployment, Criminal tendencies, corruption, Labour problems, Social stratifications, Evolution & Mobility; French & Russian Revolutions, social Democracy, Individual in Industrialised Society, Historical Development of Technology, Industrial revolution. Impact of Rationalisation and Automation on Industrial works, technology & Society Social & Economic problems of India; Population, Poverty, Illiteracy, lack of Capital, poor quality of Human Capital, Low level of technology.	12
Political Institutions society & the State, Origin, social contract theory. Nationality and Nation, Origin Of State, Classification, Democray, Party System, Public Opinion, Electorate, Distatorship, Totalitarianism, nazism, Fascism, Communism, Capitalism, Socialism, Democratic Socialism. The Constitution of India. Local self-government, International ?Cooperation, UNO, India in World Affairs.	10
Social welfare & Welfare State, Planned Economy, Democratic in a Developing country frame work, Prerequisite limitations, Five-yer plans. Achievement & Failoure of Economic Planning.	4
Industrial Psychology-Aims, Motivation, Ethical & Social values I Human Relations, Environment, Safety, Pollution, Productivity & Efficiency Methods, Participative Management.	4
Industrial Labour & Trade Unions in India-Problems, Principles of fixing minimum wage, Principles of Labour Legislation, Industrial Labour-Indian Scenario, Trade Union movement Measures to improve Recruitment and Training, Employment Exchange, Labour legislation Factory Act 1948 Workmen's Compensation Act 1923; ESI act, Employees provident Fund Industrial Disputes Act, Minimum Wages Act.	12

SEMESTER IV

BASIC SHIP STRUCTURE   (MBSS 402)(54 HRS)

DETAILED SYLLABUS	HRS
Ships Terms: Various terms used in ship Construction with reference to Ship's parameter e.g.L.B.P. Moulded Depth, Moulded draught etc. General Classification of Ships.	5
Stresses in Ship's structure: Hogging, Sagging, Racking, Pounding, Panting, etc. and Strength members to counteract the same.	6
Sections and materials use: Type of section like Angles, Bulb Plates. Flanged beams used in ship construction. Rivetting & Welding. Testing of welds. Fabricated components.	7
Bottom & side Framing: Double bottoms, Water tight floors, Solid and bracket floors, Longitudinal framing keels, side framing like Tankside brackets, Beam knee, Web Frame, etc.	8
Shell & Decks : Planting system for shells, Deck plating & Deck girders, discontinuities like hatches and other openings. Supporting & closing arrangements, mid-ship Section of ships.	7
Bulk heads & Deep Tanks: Water tight bulkheads, Arrangements of plating and stiffeners. Water tight openings through bulkheads for electric cables pipes and shafting. Deep tank for oil fuel or oil cargo corrugated bulk heads.	7
Fore-End Arrangements: Stem construction. Arrangement to resist panting, panting stringers, Forepeak-Collision bulk heads Bulbous bows. Anchor and cable arrangements.	6
After-End-Arrangements: Stem construction. Arrangements to resist panting, panting stringers, Forepeak-Collision bulk heads. Bulbous bows. Anchor and cable arrangements.	8

MARINE AUXILIARY MACHINERY-1 (MMA 403) (54 HRS)

DETAILED SYLLABUS	*HRS*
Engine Room Layout : Lay out of main and auxillary machinery in engine rooms in different ships. *Piping arrangement for steam, bilge, ballast and oil fuel systems, Lub oil and Cooling system with various fittings. Domestic fresh water and sea water hydrophore system.*	*15*
Pumps: Types of pumps for various requirements, their characteristics and application in ships. Centrifugal, Gear Pumps, Screw pumps and Reciprocating pumps. Care and Maintenance of pumps.	*10*
Evaporators : Construction and Operation of different types of evaporators. Fresh Water generators. Fresh Water generators and distillers. Conditioning arrangements of distilled water for drinking purpose. Care Maintenance of pumps of various types.	*5*
Deck Machinery : Various types of deck machinery used in ships e.g. Winches, and Wind lass, their requirements. Operations and maintenance. Deck Cranes.	*12*
Filters: strainers and filters, types of marine filters, autocleaner and Duplex filters, Static filters. Priming and core maintenance of filters.	*6*
Heat Exchangers: tubular and plate type, reasons of corrosion, tube removal, plugging, and	

materials used.	

SEMESTER IV

APPLIED THERMODYNAMICS – II   (MAT - 405)   (72 HRS)

DETAILED SYLLABUS	HRS
Fuels , Combustion & Dissociation:- *Definition of Fuel, combustion. Combustion Equation, Analysis of the Products of Combustion, stoichiometric combustion, Actual combustion, Excess Air, Mixture strength, Dissociation. Effect of Dissociation on I.C. Engines.*	10
Gas Dynamics:- *One Dimensional steady flow of compressible fluids, lsentropic flow, Effect of Friction, Flow through Nozzles and Diffuser. Critical condition, Mach Number, Subsonic, Sonic and Supersonic Flow. Flow of steam through Nozzles and Diffusers. Supersaturated Flow of steam; Applied Problems.*	10
Steam Turbines:- *General Principles of Impulse and Reaction Turbines- Velocity Diagrams for simple Impulse and Impulse-Reaction Turbine. Compounding of Impulse Turbine-Pressure and velocity compounding. Force on blades, Work done by Blades, Axial Thrust, Blade or Diagram Efficiency. Effect of Friction on Blades, Applied Problems.*	14
Refrigeration :- *Reversed Carnot cycle, Vapour compression cycles, Refrigerating Effect, Co-efficient of performance, cooling capacity, Rating of a Refrigerating Plant, Methods of improving C.O.P. Use of Vapour Tables, Applied Problems. Typical Marine Refrigeration in liquefied gas carriers.*	16
Transmission of Heat:- *Fourier's Law of Heat conduction. Thermal conductivity of Insulating materials. Conduction through flat & cylindrical ,spherical surfaces in series. Heat Transfer from fluids through walls. Application of Heat Transfer in Marine Heat Exchangers, like Coolers ,Heaters , Condensers. Pre-diction of convection Heat Transfer rates. Use of Non-Dimensional Groups.*	14
Prandtl No. Nusselt No., Reynolds No., Stanton No., Grashof No, Graetz No.. etc, Natural and Forced Convection.	*6*
Radiation: Basic, Stephen-Boltzman law, Grey I Black bodies etc.	2

SEMESTER IV

SEAMANSHIP, ELEMENTARY NAVIGATION *(MMA 406)* *(54 HRS)*

DETAILED SYLLABUS	HRS
Seamen & their duties : Ship's Department, General ship knowledge and nautical terms like Poop-Deck Forecastle, Bridge etc.	2
*Deck Equipment: **Windlass, Derricks Cranes, Gypsy, Capstan, Hatches, and their function.***	*10*
*Navigational Lights and Signals : **Port and Starboard and aft mast light, Colours and Location. Look out, Precautions and Bad weather, Flags used on ships, Flag etiquette, Morse and Semaphore signaling, Sound signals.***	*6*
*Rope Knots and Moorings :**Types of knots. Practice of knot formation, Materials of ropes, Strength, Care and maintenance, use of mooring line, heaving line, Rat guards, Canvas and its use.***	*2*
*Anchors : **Their use, Dropping and Weighing anchor, Cable stopper.***	*6*
*Navigation :**General knowledge of principle stars. Sextant, Navigation compasses, Echo Sounder, Log and uses, barometer and weather classification, G.M.T. and Zonal time, wireless Navigational Instruments, radar satellite Navigation etc.***	*8*
*Life boats & 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.***	*10*
*Practicals : **Knots, bends and hitches, Ropes splice, Donning of Life jackets life boat drills. Lowering & hoisting of life boats(model).***	*10*

ELECTRICAL MACHINE – II *(MEL - 407)* *(54 HRS)*

DETAILED SYLLABUS	HRS
Transformers – Principle of action, e.m.f. equation, phasor diagrams for no load conditions, useful and leakage flux, leakage reactance, equivalent circuits, voltage regulation, losses and efficiency, open circuit and short circuit tests, parallel operation, three phase transformer – core and shell type auto transformer, current and potential transformer.	20
Three phase induction motor – principle of operation and theory of action, slip speed, rotor to stator relationship, rotor frequency, rotor e.m.f. and current, equivalent circuit relationship between rotor IR loss and the rotor slip characteristics, starting torque and maximum running torque, reversing, speed control of induction motor, starting of induction motor, testing of motor, use of circle diagram.	28
Single phase induction motor – principle and operational characteristics, starting control, constructional details. Failure and repair of electrical machines	*6*

SEMESTER IV

MECHANICS OF MATERIALS – II (MMM - 408) (72 hrs)

DETAILED SYLLABUS	HRS
Compound Stress and Strain : **Stresses on an Oblique section, General two dimensional stress system, Materials subjected to Direct & Shear Stresses.**	*12*
Principal plane & Principal Stresses: **Strain on an oblique section. Determination of principal strains in 3-dimentions. 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.**	*20*
Deflection of Beams: Strain energy due to bending. Application of impact. Deflection by integration, Macaulay's Method. Moment area Methods of deflection coefficients. Deflection due to shear, Deflection by graphical method. Applied problems.	20
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.**	*20*

WORKSHOP – II   (MWP - 409)   (90 HRS)

DETAILED SYLLABUS	HRS
Rectangular Block making by Shaping Machine. *Key Way making Milling Machine.* *Reciprocating Pump Overhauling.* *Centrifugal Pump Overhauling;* *Air Compressor Overhauling;* *Boiler Familiarization;* *Machine Shop Job;* *Double-V Weld;* *T-Weld (inner & outer);* *Pipe repair & Fabrication;* *Diesel Engine Familiarization & Overhauling.*	90

MARINE ENGG. DRAWING   (MED - 404)   (90 HRS)

DETAILED SYLLABUS	HRS
Drawing : Advanced Marine Machinery assembly drawings.	*90*
Part - I (Auxiliary Machine) Marine machinery components as assorted stop & sluice valves and auxiliary equipment dismantled; to be conceptualised in assembly and laid out as working & functional parts. Sectional views in elevation & plans executed. Part sectional views depiction.	

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

SEMESTER V

ELEMENTARY DESIGN AND DRAWING   (MED - 504)   (45 HRS)

DETAILED SYLLABUS	HRS
Procedure in Machine Design: Concepts of design, procedure & processes, Design synthesis, Economic consideration in design, Feasibility, Preliminary design alternative, Final design alternative, Preliminary and Final plans and drawings. Use of standards in design, selection of preferred sizes,	*3*
Common useful materials and manufacturing considerations in design. Properties of materials, heat treatment processes, BIS system of designation of steels. Review of failure criteria in mechanical design, Basis of good design Failure of machine parts, deformation, wear corrosion.	*3*
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 and combined loads, fatigue strengths, dynamic stresses, selection of materials.	*4*
Specifications: Fit, Tolerance, Finish – BIS Design & drawing to specifications for parts subjected to direct loads. Fasteners, bolts and screws, cotter & knuckle joints, keys & couplings, pipe joints, riveted & welded joints. Design of welded machine parts. Power transmission: Shafts and axles, bearings, clutches & brakes, belt drives, design & drawing of tooth gearing like spur & bevel gears, rack & pinion, worm & worm wheels, helical gears etc.	*5*

MARINE ENGINEERING DRAWING:
Advanced marine machinery assembly drawing.
    1. 4 – stroke piston & rod
    2. Hydraulic steering gear
    3. Stern tube and tailshaft
    4. High lift safety valve
    5. Full bore safety valve
    6. Plate type gauge glass
    7. Turbine flexible coupling
    8. Flow regulator
    9. Air inlet valve
    10. Fuel valve
    11. Quick closing valve
	30

SHIP CONSTRUCTION   (MBSS - 502)   (18 HRS)

DETAILED SYLLABUS	HRS
Loading of Tonnage *Definition of free board and various assigning conditions, Loadline Surveys, tonnage regulations, calculation as per 1969 convention, details of markings permanently carved.*	2
Shipyard Practice *Layout of shipyard, Mould loft, fabrication of assembly, sub assembly, units in construction, role of Surveyors in construction, role of Surveyors in construction of Ship; Keel laying, Launching, Seatrial.*	2
Ship Types *Tankers, bulk carriers, container ships. LNG, LPG and chemical carries, Lash ships, Passenger ships, Dredger, Tugs etc.- Constructional details and requirements.*	4
Offshore Technology *Drilling Ships and platforms, supply/ support Vessels-types and constructions, Dynamics Postioning, Deep Sea diving system, fire fighting arrangement, Cable laying vessels.*	3
Ship Surveys *Survey rules, Functioning of ship classification Societies, Surveys during construction, Periodical surveys as per statutory regulations, retention/suspension of class of a ship, constructional features and rule guidelines for a merchant vessel as per Marpol regulations.*	2
Statutory Certificates and their validity, Ships registration formalities, Intact Stability Criteria under damaged conditions (constructional point of view in compliance with statutory regulations), Enhanced Survey requirements, HSSC.	5

MARINE AUXILIARY MACHINERY – II   (MMA - 503)   (27 HRS)

DETAILED SYLLABUS	HRS
Oil Purification : Theory of oil Purification, Principles of operation and construction of different Centrifuges for heavy fuel and lubricating oil.	3
Blowers and Compressors : Operational and Constructional details of blowers and Compressors used on board ships. Uses of compressed air.	5
Steering gears: Operation and Constructional details of various types of steering machinery. Telemotor systems, transmitters and receivers Variable Delivery Pumps used in steering gears, axial and radial displacement types. Hunting action of Steering gear. Emergency Steering arrangement. Care and Maintenance of Steering Gear Plants. Shafting : Methods of shaft alignment, constructional details and working of Thrust blocks. Intermediate shaft bearing and Stern tube bearing. Oil water lubricated stern Tubes. Sealing Glands. Stresses in Tail End, Intermediate and Thrust Shafts.	11
Dry Docking : Methods of dry docking of ships. Inspection and routine overhauling of underwater fittings and hull. Measurement of clearances and drop. Removal and fitting of propellers.	3
Other Ship board equipments: Incinerators, Sewage Treatment Plant, Engine room crane, chain blocks, tackles, Anchor chain, its testing and survey requirements.	3
Different types of ship stabilizer. Bow Thrusters, Hull protection arrangements.	2

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SEMESTER V

ELEMENTARY DESIGN & DRAWING (504) (45 HRS)

DETAILED SYLLABUS	HRS
Procedure in Machine Design, Design process, Need, Feasibility, preliminary Design Alternative. Final Design alternative, Preliminary & Final Plan & Drawings.	1
Common useful materials & Manufacturing considerations in design. Failure Criteria in Mechanical Design: Basis of good design. Failure of machine parts. Deformation, Wear Corrosion	*1*
Machine Design: *Strength Consideration for design: Strength of machine elements 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 for induced stresses.*	*3*
Specifications-Fit, tolerance, finish- BIS.: Design & Drawing to specifications for parts subjected to direct loads.	*1*
Fasteners: Bolts & screws, Cotter 7 knuckle joints, Keys & couplings, Pipe joints, Rivetted & welded joints, Design of Welded machine parts.	*8*
Power transmission: Shafts & axis, Beatings, clutches & brakes, Belt drives, chain drives, design & drawing of tooth gearing like spur & Bevel gears. Rack & pinion, worm & worm wheels, helical gears etc.	*10*
MARINE ENGG. DRAWING *Advanced Marine machinery assembly drawing.* *(1) 4-stroke piston & rod* *(2) Flow regulator* *(3) Hydraulic steering gear* *(4) Air inlet valve* *(5) Stern tube & tail shaft* *(6) Full bore safety valve* *(7) High lift safety valve* *(8) Fuel valve* *(9) Plate type gauge glass* *(10) Quick closing valve* *(11) Turbine flexible coupling*	<u>20</u>

SEMESTER V

MECHANICS OF MACHINES – I (MMOM - 505)   (45 HRS)

DETAILED SYLLABUS	*HRS*
Drives and Brake: Belt and Rope drives; Open and cross 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 Dynamometer and their working principles, Absorption Dynamometer Band & rope Brake Dynamometer, Hydraulic Dynamometer	*10*
Governors; functions 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*
Turning Moment of Flywheel : Function of a flywheel , Crank effort diagrams. Fluctuation of speed and energy. Effect of centrifugal tension of flywheel, Inertia torque and its effects on Crank effort diagrams.	*4*
Kinematic and link-Mechanisms : Relative motion between bodies moving in different planes. Instantaneous 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 alink connecting rods etc. Effect of friction.	*9*
Cams : Types of cams and followers, Specified motion of followers. Uniform acceleration & deceleration, S.H.M. and uniform velocity Graphical construction of cam-profile.	*4*
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.	*4*
Spur Gearing : Various definition e.g. p.c.d., module, path of contact, velocity of sliding, Interference, Gear ratio and center distance of simple and compound gear trains.	*4*

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SEMESTER V

MECHANICS OF FLUIDS   *(MME - 506)*   *(36 HRS)*

DETAILED SYLLABUS	HRS
Introduction : Definition of Fluid. Different properties, i.e. capillarity, Surface tension, viscosity etc.	*1*
Hydrostatics : Equilibrium of floating bodies; Fluid pressure; Measurement of 6f pressure; total thrust due to liquid pressure on immersed plane surface; Centre of pressure; Total force and center of pressure on immersed surfaces such as Tanks, bulkheads, lock gates, manhole doors etc.	*8*
Fluid in Motion:- Energy of flowing fluid, pressure energy, potential energy, kinetic energy total energy; Bernoulli's Equation for steady motion; Variation in pressure head along a pipe. Measurement of pipe flow rate by venturimeter, Discharge through a small orifice under a constant head; Co-efficient of discharge for a small orifice; Experimental determination of orifice co-efficient. Power of a jet; Force exerted by a jet normal to a stationary or a moving flat vane; jet inclined to a stationary or moving flat vane.	*10*
Flow through pipes: Losses of energy in pipe lines; losses due to sudden increase in pipe diameter. Losses due to sudden contraction in diameter, Friction losses, derivation of Darcey's and Chezy's formula; parallel flow through pipes; Transmission of power by pipe line; Condition for maximum power transmission. Time required to empty reservoirs of various shapes flow from one reservoir to the other reservoir; Inflow and outflow.	*8*
Fluid Friction, Viscous and Laminar flow: Resistance co-efficient, variation of resistance co-efficient with Reynold's; oiled bearings; Viscous flow; Flow between parallel planes; Critical velocity; Viscous flow in pipes; Power required for viscous flow;	*5*
Vortex Motion & Radial Flow: Real & Ideal Fluid Flow : Steady & unsteady flow. Two Dimensional flow Theory , forced vortex, free vortex, Radial flow free spiral vortex, Compound Vortex.	*4*

ELECTRICAL MACHINE – III   *(MEL - 507)*   *(27 HRS)*

DETAILED SYLLABUS	HRS
Alternators-general arrangement of alternators, construction of salient pole and cylindrical-rotor types of stator windings, single and double layer windings, e.m.f. equation of an alternator, distribution and pitch factor, waveform of generated e.m.f., alternator on load, percentage regulation, internal voltage drop, production of rotating magnetic field, resultant magnetic field distribution, mathematical derivation of the rotating field condition, magneto-motive force or ampere-turn waveform distribution, reversal of direction of rotation of rotating field.	*15*
Synchronous alternator and motor *Armature reaction in synchronous alternator, armature reactance, prediction of voltage regulation, open circuit test, short circuit test, synchronous impedence method, torque/angle characteristics, infinity busbar, synchronizing current, torque and power, hunting of phase swinging, parallel operation of alternators, a.c. generators in parallel excitation control, throttle control, load sharing –KW and KVA, principle of action of three-phase synchronous motor, effects of varying load and excitation, methods of starting, advantages and disadvantages of synchronous motor.*	*12*

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SEMESTER V

MECHANICS OF MATERIALS – III   *(MMM - 508)*   *(27 HRS)*

DETAILED SYLLABUS	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.	*9*
Thick Cylinders: Thick cylinders, Lame's theory, compound cylinders, solid shaft subjected to radial pressure, shrinkage allowance. Applied problems.	*9*
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.	*9*

MARINE ORIENTED WORK SHOP   *(MWP – 509)*   *(54+360=414 HRS)*

DETAILED SYLLABUS	HRS
1. Dismantling, overhauling, inspection & assembling of Centrifugal Pump.	
2. Dismantling, overhauling, inspection & assembling of a gear pump & screw pump.	
3. Dismantling, overhauling, inspection & assembling of a reciprocating pump	
4. Dismantling, overhauling, inspection & assembling of variable displacement pump (swash plate)	
5. Dismantling, overhauling, inspection & assembling of sludge pump.	
6. Dismantling overhauling & testing of fuel injector.	
7. Dismantling, overhauling, inspection & assembling of Air Compressor.	
8. Dismantling, overhauling, inspection & assembling of purifier.	
9. Inspection & Overhauling of air bottle, mountings.	
10. Dismantling, overhauling, inspection & assembling of shell & tube type cooler.	
11. Dismantling, overhauling, inspection & assembling of plate type cooler.	*414*
12. Operation & working principles of F.W. Generator & Reverse osmosis system.	
13. Operation & working principles of oily water separator.	
14. Overhauling inspection & assembling of Boiler safety v/v.	
15. Overhauling inspection & assembling of feed check v/v.	
16. Overhauling inspection & assembling gauze glass.	
17. To fabricate & weld a pipe with given pipe length & flanges.	
18. To repair a leak in pipe by fitting a doubler.	
19. To make a pipe line with bends (welding).	
20. To dismantle, inspect & overhaul a hydraulic pp for deck crane.	
21. Practice of welding.	
22. Practice of Brazing & Soldering.	
23. Tracing of pipelines.	
24. Turning, cutting and similar operations by Lathe machine.	

NOTE: 54Hrs.   – 6 hrs per week for 9 weeks during class days as a part of practical.
**   360 Hrs. – 40 hrs per week for 9 weeks workshop training in lieu of external workshop**

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SEMESTER V

ELECTRICAL MACHINES LAB   (MEL - 510)   (18 HRS)

DETAILED SYLLABUS	HRS
1. *To study and run rotary convertor under different conditions to record the generated voltage on d.c. side against variation of load.*	
2. *To perform load test on a 6-pulse, 2 way bridge rectifier and to obtain the characteristic curves.*	
3. To study the slip-torque characteristics of an induction motor and to find out the full load slip.	
4. *To study the different types of Motors, connect the motor AG. supply, run the motor and obtain its speed load characteristics. (The experimental multi-motor set).*	
5. *To determine the regulation of a 3-phase alternator by synchronous impedance method.*	
6. *To compute full load input, torque, slip, power factor and efficiency of 3-phase induction motor from circle diagram. Also to compare the results from the circle diagram with actual full load test on the motor.*	*18*
7. *Synchro transmeter and Repeater.*	
8. *Transformer connections.*	
9. *Determination of phase-sequence of the given 3-phase supply.*	
10. *Study of single-phase controller.*	
11. *Observation of the wave-form of magnetizing current and hysteresis loop.*	
12. *Study of transformer differential relay.*	

SEMESTER VI

MANAGEMENT SCIENCE   (MMNG - 601)   (36 HRS)

DETAILED SYLLABUS	HRS
Introduction to Management Principles & Practice: Need for sound Management principles and Practice & Growth of Modern management through, various Managerial Functions, Planning, Organising, staffing, Directing, controlling & Co-ordination; Principles of Locating a Plant & Developing Organisation Structure. Various Types of organization structure. Various types of organizational structures; Authority & Responsibility. Boundaries of Authority.	9
Production Management: Functions of production Planning and Control, Product Development Principles, Standardization, simplification & Specialization, Plant Layout & Material Handling, Introduction to Operations Research. Linear Programming, Distribution Methods, Network Technique in Management – Critical Path Method (CPM), programme Evaluation & Review Technique (PERT). Resources Allocation & load smoothing, Operational Sales Forecasting; Inventory Control, Safety stock, Determinational Introduction to Decision. Theories in Management, Decision under Certainty, Right and uncertainity, Works Study, Job Evaluation & Merit Rating, Quality Control, Preventive Maintenance.	12
Finance : Methods of capital formation & control of Working Capital, Continuous & Discounted Cash & Project Apparaisal, Break even Analysis, Cost Benefit Analysis, Methods of Depreciation Factory Costing, Estimating, Balance Sheet, Financial & Physical Ratios; Project & Budgetary Control.	*8*
Personnel Management : The personnel function Requirement & Selection Role of Psychological Tests in Reqcruitments Training Performance Appraisal and Reward System, Legal Requirements and Regulation of Working Condition, Employer's Liabilities for Health and Safety, Leadership and Discipline, Motivation and Incentives, Problems of Accident – Proveners, Fatigue, etc., Relationship with Trade, Union and Workers Participation in Management.	*7*

West Bengal University of Technology
BF-142, Salt Lake, Sector-1, Kolkata-700064
MARINE ENGINEERING

SEMESTER VI

MARINE BOILER   (MMB - 602)   (27 HRS)

DETAILED SYLLABUS	HRS
General Considerations governing the design of Boilers: **Types of marine boilers, comparison of smoke tube and water boilers; Destructive and Non destructive tests on plates, rivets, welded seams, classification societies requirements for boilers construction.**	5
Smoke Tube Boilers: **Various types in marine use, Principal dimensions and staying of flat surface of multitubular cylindrical Boilers. Vertical Auxiliary Boilers.**	2
Water Tube Boilers: **General description with sketches of principal types of boilers in marine use, Superheater, Economizer, Air preheater & steam preheater; circulation and use of Unheated Down comers in highly rated boilers; Superheat temperature control, Attemperators and Desuperheaters.**	5
Waster heat boilers; **Waste heat recovery calculation, Lamont exhaust gas boiler. Scotch composite Boiler, Cochran exhaust gas and composite boiler, spanner marine exhaust gas and Composite boiler. Forced Water Circulation boiler, Double evaporation Boiler.**	4
Boiler Mountings: **Safety Valves- Improved High Lift, Full lift and full Bore type: Gauge glass- Ordinary plate type and remote Indicator; Automatic feed regulator, three element High & Low water level alarms, Main Steam stop valves, Retractible type Soot blower etc.**	4
Operation, Care & Maintenance : **Precommissioning procedures, Hydraulic, steam raising and operating procedures, Action in the event of storage of water. Blowing down of boiler, Laying up a boiler; General maintenance. External and internal tube cleaning. Tube renewals, etc. maintenance, inspection and survey of boilers.**	3
Refractory : Purposes of refractory, types of refractory and reasons for	2
Oil burning: *1. Procedure of Liquid fuel burning in open furnace.* *2. Various types of atomizer.* 3. Furnace arrangement for oil burning. 4. Boiler Control System i.e. master control, fuel control, air control and viscosity control.	2

SEMESTER VI

MARINE AUXILIARY MACHINERY-III   (MMA - 603)   (45 HRS)

DETAILED SYLLABUS	HRS
Marine Refrigeration and A.C. Plants: design and Constructional details of various equipment for refrigeration and Airconditioning Refrigerators used in marine practice and their justification, Control of temperature in various rooms in Cargo or domestic Plants. Control of Humidity in A.C. Plants. Operation and maintenance of Plants. Control and Safety equipment.	*20*
Machinery and Cargo Ventilation: Design and constructional details, International Requirements, Operation & maintenance of Equipment.	*4*
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 machines. Detuners, Dampers with reference to torsional vibrations dampers, use of torsiographs.	*10*
Fuels: Source of supply, Study of Primary Fuels, Coal, petroleum, natural gas, classification of fuels. Treatment of fuels for combustion in marine I.C.E. and steam plants.	*5*
Lubrication: Theories of Lubrication, Types of Lubricants and their Properties suitability of Lubricants for various uses; solid and fluid lubricants. Additive Oils and their specific use, Teminology used in Lubrication systems. Loading pattern of various bearings in marine use and Lubrication system adopted. Different types of bearings used for marine machineries.	*6*

SEMESTER VI

MARINE INTERNAL COMBUSTION ENGG - I   (MICE - 604)   (27 HRS)

DETAILED SYLLABUS	HRS
Practical Diesel Engine Cycle: 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. General Descriptionof I.C. Engines; Marine Diesel Engine of M.A.N., sulzer, Doxford, B & W makes etc. Comparative study of slow speed, medium speed and high speed diesel engines – suitability and requirements for variouspurpose.	*5*
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.	*5*
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; Uniflow, loop, cross loop and reverse loop scavenging, their merits and demerits, Scavenge pumps for normally aspirated engines; under piston scavenging, Scavenge manifolds. Turbocharger and its details.	*3*
Supercharging arrangements : pulse and constant pressure type; Their relative merits and demerits in highly rated marine propulsion engines. Air movements inside the cylinders.	*2*
Combustion of fuels in I.C. Engines; Grades of suitable fuels, Preparation of fuels of efficient combustion. Fuel atomization and requirements of fuel injectors. Design aspects of combustion chamber.	*3*
Compression pressure ratio and its effect on engines. Reasons for variation in compression pressure and peak pressure, ignition delay, after burning.	*1*
Cooling of I.C. Engines: Various cooling media used; their merits and demerits, cooling of pistons, cylinder heads, coolant conveying mechanism and systems, maintenance of coolant and cooling system.	*2*
Safety and Prevention of mishaps in I.C. Engines: Causes and prevention of crank-case explosion, and Scavenge fires. Detection of same and safety fittings provided to prevent damage.	*3*
Special features of I.C. Engines :Development of long-stroke Engines, Implication of stroke-bore ratio, Development in materials in construction & heat treat in M.E. components.	*3*

SEMESTER VI

MECHANICS OF MACHINES – II   (MMOM - 605)   (36 HRS)

DETAILED SYLLABUS	HRS
Toothed gearing : Types of gears, condition for transmission of constant velocity; methods of avoiding interference; Transmission of power by gear trains on parallel shafts; Rack and pinion , Bevel gears, Worm and worm wheel, Spur gears Helical gears, Spiral gears; Epicyclic gear trains, Torque on gear trains, acceleration of gear trains.	6
Balancing: Balancing of masses rotation in different planes, dynamic forces at bearings; Primary and secondary balance of multicylinder in-line Engines and configurations.	4
Gyroscope : Gyroscopic couple. Vector representation to torque and angular movement, Steady rectangular precession, vector treatment; Steady conical precession; Motion involving steady precession; Application to Ship's stabilization.	4
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.	6
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.	3
Forced Vibrations : Forced Linear and angular Vibrations, Periodic force transmitted to support, periodic movement of the support.	3
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.	4
Whirling of shafts-Whirling of shafts, critical speed, effect to slope of the disc, effect of end thrust.	2
Damped vibrations: Idea of Viscous and Coulomb damping, Linear and angular vibrations with Viscous damping, Forced damped liner and angular Vibrations, Periodic movement of support.	4

DIMENSIONAL ANALYSIS & FLUID MACHINES   (MMF - 606)   (27 HRS)

DETAILED SYLLABUS	HRS
Dimensional Analysis & Dynamical Similarity : Use of Dimensions for finding conversion factors; Dimensions of common quantities; Dimension equations; Method of finding dimensionless groups; Geometrical and dynamical similarity problems.	5
Reciprocating pumps: Various types, single and double acting, single and multi cylinder, co-efficient of discharge; theoretical indicator Diagrams; Effect of acceleration and friction; use of air vessel.	5
Centrifugal Pump : Calculations of Various heads; Losses and Efficiency. Work done per unit weight, Dimensions of Impellers; Velocity diagrams at inlet and exit; Calculation for power input; Torque on shafts; Cavitation in Centrifugal pumps.	8
Impulse and Reaction turbines: Pelton Wheel: Inward flow reaction turbine; Efficiency and vane angles, vane speed and head lost in runner, Specific speed; Applied problems.	9

SEMESTER VI

MARINE ELECTRICAL TECHNOLOGY – I   (MEL - 607)   (18 HRS)

DETAILED SYLLABUS	HRS
Power Generation and Distribution: Selection of D.C. & A.C. generators for use on ships with reference to its prime mover, Merits & Demerits of A.C. & D. C. on ships; Rules and Regulations governing electrical machinery on ships, Location & Installation of Generator sets. Rating and Characteristics of main switch boards. Arrangements of preferential trips & Protective devices with wiring diagrams. Construction & Characteristics of brushless high speed A.C. generators with automatic Voltage Regulator of Magnetic amplifier type. Rapid Voltage response of A.C. Generators. A.C. distribution on ships, regulations regarding layout of distribution system on general cargo ships and on Oil Tanker Navigation Lights and running light Indicator panel. Special requirements for lighting of deck & pump house of oil tankers. Wiring appliances. Determination of Wire size for A.C. Power circuits. System earthing : Insulted Neutral systems. Resistance earthed system.	*10*
Motor & Control Equipments: Characterestics of continuous Maximum rated machines. Centralised control of Motors in machinery spaces. Classes of insulation-'A', 'B', & 'E' & temperature rise. Rotary generators.	*3*
Starters for Miscellaneous electrical equipment for machinery space auxiliaries & centralized control of motors in machinery space. e.g. sequential starting and cut outs for an automatic fired boiler incorporating safety devices & combustion control equipment. Sequential starting for refrigerating plants, incorporating, safety devices like High Pressure cut out, Cooling water failure cut out Automatic defrosting with the help of timer. Special requirements of motors & starters for Anchor Windlass & Capstan, Wiring diagram, lowering & hoisting arrangements, Over load protection, magnetic disc, Brakes.	*5*

SEMESTER VI

MARINE STEAM ENGINEERING - I   (MSE - 608)   (36 HRS)

DETAILED SYLLABUS	HRS
Marine Steam Turbines: Development in steam engines. Reciprocating engines to low pressure steam turbines and to high Superheat, Reheat and Regenerative plants. General principles of construction and design., Simple Impulse, Pressure compounded Impulse, pressure Compounded Impulse, Pressure Velocity Compounded Impulse, Parsons Axial flow reaction turbine, Double flow turbine. Radial flow Reaction turbine, Double Casing Turbine.	*5*
Layout of plants : General Layout and description of a modern geared Steam turbine installation including auxiliaries in marine use combined Gas Turbine & steam turbine circuits. Location of gears, Flexible Couplings and thrust Blocks. Steam Exhaust and Drain line system. Gland Steam System.	*4*
Selection of Materials: Materials used for various components like blades, rotors, gears, casing and sealing glands etc and their justification.	*2*
Constructional Details: Types of Blades & methods of fixing, Solid Built-up and Drum rotor for impulse and Reaction turbines, Casings for H.P & L.P. Impulse and reaction turbines, Diaphragms; nozzles and glands, Carbon glands and labyrinth packing glands, bearing and gears. All addendum gearing; Epicyclic gearing, Articulated type double reduction gearing for marine use. *Reduction gears: Reduction ratio, type of gear teeth, gear construction, various arrangement of marine gearing, gear defects, flexible coupling, quill shaft.*	*16*
Lubrication of Turbines : Suitable oil and their properties Film Lubrication, Forced Lubrication, Lubrication of main bearings and gears. Types of all oil jets. Emergency lubrication arrangements.	*4*
Condensers: Shapes and types of condensers, constructional details, location & method of securing, working principles, contraction and expansion allowances, leak test. Effect - change of temperature, circulating water quantity, change of main engine power, condenser surface.	*5*

SEMESTER - VI

MARINE ORIENTED WORK SHOP   *(MWP – 609)*   *(54+360=414 HRS)*

DETAILED SYLLABUS	HRS
1. *Dismantling, overhauling, inspection & assembling of a A/E cyl. Head.*	
2. *Dismantling, overhauling, inspection & assembling of Cylinder liner, piston & piston ring.*	
3. *Dismantling, overhauling, inspection & assembling of main bearing & bottom end bearing.*	
4. *C/Shaft deflection & inspection of C/case.*	
5. *Dismantling & overhauling of M/E exhaust valve.*	
6. *Dismantling & overhauling of M/E cylinder head relief v/v, Air staring v/v.*	
7. *Dismantling & overhauling of Turbochargers.*	
8. *Working principles & demonstration of working of a hydraulic steering gear system, safety checks & routine inspection.*	
9. *Detection of cracks & dealing with cracked pieces*	
10. *To fabricate & weld a pipe with given pipe length & flanges.*	
11. *To repair a leaks pipe by fitting a doubler.*	
12. *To make a pipe line with bends (welding).*	
13. *Practice of welding.*	
14. *Practice of Brazing & Soldering.*	*414*
15. *Detection of cracks & dealing with cracked pieces*	
16. *Tracing of pipelines.*	
17. *Turning, cutting and similar operations by Lathe machine.*	
Using a simulator the 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;*	

NOTE: 54Hrs.   – 6 hrs per week for 9 weeks during class days as a part of practical.
     360 Hrs. – 40 hrs per week for 9 weeks workshop training in lieu of external workshop

SEMESTER VI

BOILER CHEMISTRY LABORATORY   (MMBL - 610)   (18 hrs)

DETAILED SYLLABUS	HRS
To determine hardness content of the sample of boiler water in P.P.M. – in terms of CaCo$_3$	
To determine Chloride content of the sample of water in P.P.M. in terms of CaCo$_3$	
To determine alkalinity due to Phenolphthalein, Total Alkalinity and Caustic Alkalinity of the sample of water in P.P.M.	
To determine Phosphate Content of the sample of water.	18
To determine dissolved oxygen Content of the sample of water.	
To determine sulphate content of the given sample of water.	
To determine Ph-Value of given sample of water.	
*Fuel Oil & L. Oil Testing Laboratory – **To test for viscosity, Acidity, H$_2$O content, infestation, spectrometric & chromatographic analysis; pH testing of oil, carbon residue test, sludge test***	

SEMESTER VII

NAVAL ARCHITECTURE – I   (MNAR - 702)(54 HRS)

DETAILED SYLLABUS	HRS
Geometry of ship & hydrostatic calculation : Ships lines, Displacement Calculation, First and Second moment of area, Simpsons rules, application to area and volume, Trapezoidal rule, mean and mid-ordinate rue, Tchebycheff's rule and their applications, Tonnes per Cm. Immersion. Co-efficient of form, Wetted surface area, Similar figures. Centre of gravity, effect of addition and removal of masses, Effect of suspended mass.	*24*
Transverse Stability of Ships: Statical stability at small angles of heel, Calculation of B.M. Metacentric, Inclining experiment, Free surface effect, stability at large angles of heel, curves of statical stability, dynamical stability, angle of loll; stability of a wall sided ship.	*20*
Resistance & Power : Frictional, Residuary & Total resistance, Froude's Law of comparison, Effective power calculations, Ships correlation Factor (SCF), Admiralty co-efficient, Fuel Co-efficient and Fuel consumption. Effect of viscosity and application of ITTC formula.	*10*

MARINE MACHINERY SYSTEM DESIGN   (MED - 703)   (108 HRS)

DETAILED SYLLABUS	HRS
Manufacturing methods, Castings, Forgings, Fabrication & Plastic Moulding : Machining Tolerances, surface Finishes: Application to basic design principles in respect of function, Available materials, Production methods, Economics, Aesthetic appeal. Initial and Servicing costs, Analysis of force, Flow through on Assembly and it effect on the design. Design with reference to Repairs and reconditioning specially "at sea" work with its normal restrictions and limitations.	*18*
Marine Machinery component Designs : Design and Drawing of marine machinery components subject to combined bending, twisting and direct loading like Crankshafts etc., Design and Drawing of flywheel, safety valves, Reducing valves, Compression & Torsion springs, Journal bearings, Thrust bearings etc., Design of lifting equipment e.g. Engine room overhear crane, Mechanical Pilot etc.	*18*
Advanced Design of Marine Systems : Design and Drawing of *Water cooling systems including Pumps, filters, Heat exchangers for diesel and Steam engine plants.* *Lubricating Oilsystems including Pumps, Purifiers Pressure bypass valves.* *Electro-hydraulic Steering gear system including Rudder, Rudder stock, Tiller arm & rams etc.* *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.* *Power Transmission system including Thrust Blocks, Intermediate shaft and Tail-End shaft.* *Design of Steam Turbine Plants.* *Design of Gas Turbine Plants.*	*60*
Computer aided design: *Analysis of stress ,strain, vibration ,thermal stress, deflection through method of Finite Element Analysis by use of various software*	*12*

SEMESTER VII

West Bengal University of Technology
BF-142, Salt Lake, Sector-1, Kolkata-700064
MARINE ENGINEERING
MARINE INTERNAL COMBUSTION ENGINEERING (MICE - 704)
(72 HRS)

DETAILED SYLLABUS	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 sped marine engines.	*10*
Manouevring Systems : Starting and reversing systems of different Marine Diesel engines with safety provisions.	*10*
Indicator diagrams; and power calculations : Construction details of indicator instrument. Significance of diagram Power Calculations, fault detection, simple draw cards and out of phase diagrams. Power balancing, Performance characterestic Curves, Test bed and Sea trials of diesel engines.	*5*
Lubrication Systems : Lubrication arrangement in diesel engines including Coolers & filters Cylinder, Lubrication, Liner wear mechanism and preventive measures, combinations of lubricating oil its effect and preventive measures.	*8*
Medium Speed Engines : Different types of medium speed marine Diesel engines, couplings, and reduction gears used in conjuction with medium speed Engine, development in exhaust valve design, V-type engine details.	*8*
Gas Turbines : general Constructional and Design features for marine plants, materials of construction, Heat exchangers and Reheat arrangements, Comparison of Free Piston engine gasifiers and conventional air-stream combustion chambers.	*8*
Automation in modern diesel engine plants : Remote operation, Alarm and fail safe system, Governors and their basic functions. Constant speed and Overspeed governors. Constructional details and hunting of governor.	*8*
Maintenance of diesel engines : Inspection and replacement of various Component members such as Piston ring, Cylinder head, Liner, Bearings, Driving chain and gears etc. crankshaft deflection and alignment. Engine holding down arrangements, Trouble shooting in diesel engine.	*10*
Modern trends in development: Current Engines (Sulzer RTA, B&W CMC& SMC, SEMT Pielstik), Intelligent Engine (Camless concept), improvement in design for increased TBO. U.M.S. Operations of ships.	*5*

SHIP SAFETY, ENVIRONMENTAL PROTECTION & SAFE WATCH KEEPING –1   (MSSEP - 705)   (72 hrs)

DETAILED SYLLABUS	HRS
Precautions against fire and explosions, fire prevention, detections and extinction in all parts of a ship, & personal Survival Techniques and life saving appliances in ship. Medical Care.	5
Ship fire prevention & control *Fire hazard aboard ships: Fire triangle, 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 and C fires.*	<u>5</u>
Fire protection built in the ships: SOLAS convention, requirements in respect of materials of construction and design of ships, fire detection and extinction systems, escape means, electrical installations, ventilation system and venting system for tankers. Statutory requirements for fire fighting systems and equipments on different vessels.	*15*
Detection and Safety Systems: Fire Safety precautions on cargo ships and tankers during working. Types of detectors, Selection of fire detectors and alarm systems and their operational limits. Commissioning and periodic testing of sensors and detection system. Description of various systems fitted on ships.	*10*
Fire Fighting Equipment : Fire pumps, hydrants and hoses, Couplings, nozzles and international shore connection, Construction, operation and merits of different types of portable, non-portable and fixed fire extinguishers for ships. Properties of Chemicals used. Bulk Carbon Di-Oxide and inertgas systems. Fireman's outfit, its use and care. Maintenance, testing and recharging of appliances. Preparation, Fire appliance Survey.	*15*
Fire control: Action required and practical techniques adopted for extinguishing fires in accommodation, machinery spaces, boiler rooms, Cargo holds, galley etc. fire fighting in port and dry dock. Procedure for re-entry after putting off fire. Rescue operations from affected compartments. First aid, fire organization on ships. Fire signal and muster. fire drill. Leadership and duties.	*6*
Introduction & Safety, Emergency situations, principles of survival, use of survival equipment., survival craft and rescue boat. Methods of helicopter rescue, launching arrangements, life boat engines and accessories, Evacuation, Signaling equipment and pyrotechnics etc.	5
First Aid, radio Equipment, launching and handling of survival craft in rough weather, understanding practical applications of medical guides, process of radio medical advices. Knowledge of actions to be taken in case of accidents or illness that are likely to occur on board ships.	5
Personal Safety & social Responsibility – Different aspects of personal relationships on board.	6

SEMESTER VII

MARINE HEAT ENGINES & MAR. AIRCONDITIONING (MHE - 706) (72 HRS)

DETAILED SYLLABUS	HRS
Steam turbines : Compounding of steam turbine pressure compounding velocity compounding and pressure velocity compounding of Impulse turbines. Conditions for maximum Energy transfer in above cases. Impulse-reaction or person's turbine, Degree of reaction, condition for maximum Energy transfer in Reaction turbines, Stage efficiency, overall efficiency and heat factor, condition curve.	*16*
Vapour Power cycles : Carnot's cycle with vapour, Rankine Cycle, Modified rankin cycle, superheat cycle, reheat cycle regenerative cycle, Binary vapour cycle and its effect on Thermal Efficiency, steam machinery plants, Nuclear power plants.	*16*
Gas Turbine Plants : Constant volumes or Explosion Cycle Gas Turbine plant, constant pressure cycle or Jouc – Brayton cycle Gas turbine plant simple C-B-T cycle, condition maximum work output and thermal efficiency in simple cycle, Methods of improvement of Thermal Efficiency and work ratio of Gas Turbine plants. C-B-T-H cycle, complex cycles, closed cycle operation of Gas turbine plants, its merits and demerits. Total head or stagnation conditions.	*12*
Axial Flow Compressor : Principle of centrifugal compression and pressure rise in a centrifugal compressor change in Angular Momentum. Pre-whirl and Pre-whirl vanes. Mach number at inlet to a centrifugal compressor. Manual Refrigerating and A.C. Plants: Typical marine Refrigerating plants with multiple compression and evaporator system. Heat pump cycles, refrigeration in liquefied Gas carriers. Applied problems.	*18*
Principle of Air conditioning, psychrometric –properties of air comfort conditions, control of humidity Air flow and A.C. capacity, Calculation for ship plants.	*10*

SEMESTER VII

MARINE ELECTRICAL TECHNOLOGY & ELECTRICAL MEASUREMENTS – II (MEL - 707)   (72 HRS)

DETAILED SYLLABUS	HRS
Essential equipment and special circuits- Classification society's requirements for electrical equipment for steering gears, electrical control from wheel house for electro-hydraulic steering gear, all electrical steering gear circuit and control equipment, navigation lights.	12
Miscellaneous marine equipment and alarm system-electrical engine room telegraph, remote indicating revolution counter, remote helm indicator, salinity indicators, mist detectors, carbon di-oxide recorder, electrical equipment for water tight door operation, centralized alarm system in machinery space, for the above, fire alarm system for engine room, holds and accommodation, high temperature alarms low and high level alarm.	12
Electric propulsion –systems, difference and relative merits, alternating current, diesel electric and turbo electric propulsion system engines, generators, motors, excitation system and control.	10
Maintenance of electrical equipment-detection of faults and repair, preventive maintenance and periodic survey of equipment. Classification societies requirements for spares on board.	10
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.	10
Single phase and three phase measurements by wattmeter. *Measurement of energy.* *Measurement of speed, frequency and phase difference.* *Measurement of resistance, inductance and capacitance by Bridge Method.* *Magnetic measurement.* *Localization of cable faults.* *Transducers and its application in the measurement of pressure, flow, temperature etc* *Simple electronics measuring devices, such as VTVM, CRO, IC tester, signal generator.*	18

MARINE STEAM ENGINEERING - II   (MSE - 608)   (18 HRS)

DETAILED SYLLABUS	HRS
Operation & Maintenance : Warming up procedure of main propulsion turbines, Ahead and Astern running. Control of Power and speed of propulsion. Throttle valve control & Nozzle control Governing. Self Closing emergency stop valve, Emergency governors, Condenser Vaccum Control, Servomotor governors for generators, Quick engaging turning for turbines.	12
Turbine Trials: Energy losses & heat balance methods of improving turbine efficiency. Emergency Operation of Turbines.	3
Alignment checking, Bridge & Poker Gauge, Allowance of expansion, Sliding foot, Adjustment of Thrust bearing, Energy losses and heat balance, methods of	3

improving.	

SEMESTER VII

MECHANICAL LAB   *(MMEL - 709)*   *(36 HRS)*

To measure circular and liner displacements of cam and flower in case of
  (A) Plate cam-Reciprocating follower
  (B) Tangent cam-with roller oscillating follower and plot the displacement curves hence differentiate the velocity and accelerating curves.
To find the co-efficient of friction both for flat belt and V-Belt with Belt friction apparatus and hence find the slip.
Centrifugal clutch to demonstrate the process of power Transmission and to study its construction.
Investigate the effects to varying the following parameters of the Hartnell Governor.
  (i)   Rotating masses
  (ii)   Spring Rate
  (iii)   Initial Spring Compression
Note the effects of varying the mass of the center sleeve of the Porter Governor and Compare the same with that of Proell Governor.
To determine the characteristic curves of sleeve position against speed to rotation in case of
  (i)   Hartnell Governor
  (ii)   Porter Governor and
  (iii)   Proell Governor
  To determine the moment of inertia of different bodies by the Trifilar suspension by experiment and by calculation.
VIBRATIONS EXPERIMENTS
The following experiments in vibrations are performed with VIBLAB APPARATUS :

To verify the relation $T = 2\Pi\sqrt{\dfrac{L}{g}}$ *in case of simple pensulum and to plot the graph T^2 Vs L.*

To verify the relation $T = 2\Pi\sqrt{\dfrac{K^2 + OG^2}{g.\,OG}}$ *in case of compound pendulum, and find the radius of gyration and*

equivalent length of compound pendulum.
The determine the method of Torsional Oscillation, the radius of gyration of a body, about the center of gravity by using the relation

$$T = 2\Pi \frac{K}{a}\sqrt{\frac{L}{g}}$$

To verify the relation, $T = 2\Pi\sqrt{\dfrac{W}{Kg}}$ *and plot a graph T2 Vs W.*

Study of undamped natural vibrations of a beam pivoted at one end supported by tension spring at the other end.
To find out the natural frequency of a beam with and without load and to verify the Dunkerley's Rule.

MECHANICAL LABS (Contd.)

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. (LONG. VIB).
To study the forced vibrations for vibrations for various amounts of damping and a plot a graph of amplitude factor Vs frequency ratio (Lat. Vib.)
To find out the damping co-efficient 'Ct' for various depth of damping drum (immersed in oil) and to plot a graph of damping torque Vs. depth of damping drum.

To verify the relation experimentally $T = 2\Pi \sqrt{\dfrac{I}{Kt}}$ *and study the relationship between the periodical time and shaft length.*

FLUID MECHANICS EXPERIMENTS
To determine the meter Constant of the Venturimeter.
To determine the efficiency of a pelton wheel.
To determine the co-efficient of velocity, Co-efficient of contraction and Co-efficient of discharge of water through the various orifices.
To determine the friction co-efficient for the flow of water through a pipe.
To determine 'GM' (Metacentric Height) to a floating body
To determine the co-efficient of discharge through the various notches.
Board of impellers of pumps for practical demonstration specially required for Design Work.

HEAT TRANSFER EXPERIMENTS
To determine the Thermal Conductivity of good conductors.
To determine the thermal conductivity of Insulating materials.
Heat transfer Through fins or extended surface.
Heat Transfer through Forced Convection.

FIRE CONTROL LABORATORY *(MFFL - 710)* *(54 hrs)*

DETAILED SYLLABUS	*HRS*
Testing and operation on Jet and spray type nozzles and fire hoses. Operation, charging and maintenance of portable fire extinguishers *(a) Soda acid type* *(b) Foam type* *(c) Dry power type*	
Operation, use and functions of Breathing apparatus. *(a) Self contained type* *(b) Bellow type*	*54*
Use of fireman's outfit.	
Construction and operational details of life raft giving importance to manual and hydrostatic device.	
Study of total flooding system with alarms & cut out arrangements.	
Study of sprinkle system & foam system use of foam applications.	
Smoke & fire detecting units.	
Practical demonstration and participation of extinguishing actual fire.	

SEMESTER VII

ELECTRICAL MEASUREMENT LABORATORY   *(MEL - 711)*   *(18 HRS)*

DETAILED SYLLABUS	HRS
1. *To use wattmeter for single phase & three phase measurements*	
2. *Measurement of energy*	
3. *To determine*	
a) *the speed of high speed machines*	
b) *Frequency*	
c) *Phase difference.*	
4. *Use of Bridge method to measure resistance, inductance & capacitances.*	*18*
5. *To study E.R./ Bridge telegraph ckt.*	
6. *To determine & isolate different faults in ckts.*	
7. *To use transducers for measurements of flow, temperature, pressure etc.*	
8. *To study simulated conditions for ckts. Like shaft generator etc,*	
9. *Study of Impressed current cathodic protection as applied to ships.*	

MATERIAL LABORATORY   *(MMSP – 712)*   *(36 HRS)*

DETAILED SYLLABUS	HRS
To determine the behaviour 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 and (vi) Plotting of Curve of –Stress vs Strain.*	
To determine the behaviour of materials under direct shear force and to study the effect of it and to calculate the shear stress of material.	
To study the behaviour of materials when subjected to bending and to find out the effect of such act on material and to calculate the bending stress of materials.	
Determination of the behaviour of different materials when subjected to sudden shock and to the impact resistance quality or the impact strength of the materials.	*36*
To determine the hardness of materials by indenting a hardened steel ball into the specimen under test by an applied specified load on the ball.	
Determination of behaviour of ductile materials when subjected to torsion and to obtain: *i) Max. torsion stress ii) Modulus of rigidity iii) Plotting of curve of Angle of Twist vs Torque.*	
To determine the stiffness of spring for a) round wire, b) square section wire when subjected to compression.	
Determination of compressive stress and strain of materials under compressive force applied to the material.	
To find out the Tensile stress of materials on hand operated Tensile testing machine	

SEMESTER VIII

MARINE CONTROL ENGG. & AUTOMATION (MCTR - 801) (72 HRS)

DETAILED SYLLABUS	HRS
Control System : Introduction to control terms, Block diagrams for control systems, open loop and closed loop feed back control, comparison of closed loop and open loop, Feed forward control. Feed forward modification. Regulators and Servomechanism. Proportional plus integral plus derivative controls, use of various control modes.	*12*
Graphical Representation of Signals : Inputs of Step Ramp sinusoid , Pulse and Impulse, Exponential Function etc. Error Detector, Controller output elements. *The Dynamics of a simple servo-mechanism for Angular Position Control : The Torque Proportional to Error, Servomechanism, Different response of servomechanism. Technique for improving the general performance of servomechanism. The frequency response test. Series compensation using Nyquist Diagram. Parallel compensation using the Inverse Nyquist Diagram.*	*24*
Process Control Systems : Automatic Closed loop process. Control system Dymanic characteristic of Processes. Dynamic characteristic of controllers. Practical pneumatic controllers. Electronic Instrumentationfor Measurement and control.	*8*
Analog Computing and Simulation : Introduction, Basic concepts. Analog computers. Simulation. The use of Digital computer in the simulation control system. Hybrid Computers.	*4*
Transmission : Pneumatic and electric transmission, suitability for marine use. Pneumatic and types of Controllers hy-draulic, electric and electronic controllers for generation of control action. Time Function controllers.	*8*
Correcting Units : Diaphragm actuators, Valve-positioners, piston actuators, Electro-pneumatic transducers. Electro-hydraulic actuators and Electric actuator control valves.	*8*
Application of Controls on ships : Marine Boiler-Automatic combustion control, Air/fuel ratio control feed water control single two and three element type, steam pressure control, combustion chamber pressure control, fuel oil temperature control, Control in Main Machinery units for Temperature of lubricating oil, jacket cooling water, fuel valve cooling water, piston cooling water and scavenage air, fuel oil visositycontrol Bridge control of main machinery. Instrument for UMS classification.	*8*

SEMESTER VIII

NAVAL ARCHITECTURE II   (MNAR – 802)   (72 HRS)

DETAILED SYLLABUS	*HRS*
Longitudinal Stability and tirm : Longitudinal BM, Moment to change trim one Cm. Change of trim, change of L.C.B. with change of trim, Change of trim due to adding or deducting weights, alteration of draft due to change in density, Flooding calculations, Floodable length curves, M.O.T. method for determination of floodable lengths, factors of subdivision, Loss of stability due to grounding, Docking stability. Pressure on chocks.	*18*
Strength of Ships : Curves of buoyancy and weight, curves of load, Shearing force and bending moments, Alternate methods, standard Conditions, Balancing Ship on wave, Approximation of max, shearing force and bending moment, method of estimating B.M. & Deflection. Longitudinal Strength, Moment of Inertia of Section Modulus.	*15*
Propulsion & Propellers ; Definitions, apparent and real ship wake, thrust, relation between power, relation between mean pressure and speed, measurement of pitch, cavitation, propeller types, fixedpitch, Variable Pitch, ring propeller, Kort nozzles, Voith Schneider propeller, theory, Blade element theory, Law of similitude and model tests with propellers, propulsion test, Geometry and geometrical properties of screw propellers, ship model correlation ship trials.	*16*
Rudder Theory : Action of the Rudder in turning a ship, force on rudder, Torque on stock, calculation of force torque on non-rectangular rudder, angle of heel due to force torque on rudder, Angle of heel when turning. Types of rudder, model experiments and turning trials, Area and shape of rudder, position of rudder, stern rudder Bow rudders.	*14*
Motion of ship on waves : Theory of waves, Trochoidal waves, relationship between line of orbit centres and the undisturbed surface, Sinusoidal waves. Irregular wave pattern, Wave spectra, Wave amplitudes, Rolling in unresisting media, rolling in resisting media, practical aspects of rolling, Antirolling devices, Forces caused by rolling and pitching, Heaving and Yawing.	*9*

SEMESTER VIII

ELECTIVES   (MOPT - 803)   (72 HRS)

Advanced Marine Heat Engines (Co-cycles)

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 Overhall Thermal Efficiency of the entire plant. Design of the most optimum condition and combination of complex plants. Cascade Refrigeration plants. Free piston Gas Generators.

Turbo Blowers and Turbo Compressors :-
Compressor Characteristics for Axial Flow compressors and Centrifugal compressors. Turbine characteristics. Matching of components like compressor and turbine. Performance of different units in combination in single shaft arrangement.

Combustion and Flame stabilization :-
Combustion of liquid fuels, Atomization, 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.
Design of different types of compact Heat Exchangers for different Applications, E.G. Air Preheater, Gas and oil Heaters etc.

Advanced Hydraulics

Hydraulic Transmission of Power
Hydraulic Motors, Valves, types of Hydrostatic drives. Types of Hydraulic Transmission Systems- Multimotor open-circuit Systems and closed-circuit systems. Applications of Hydraulic Transmission. Advantages and disadvantages of Hydrostatic transmission.

Rotodynamic Transmission
Hydraulic Coupling, torque converter and characteristics of hydraulic coupling and torque Converter. Linear Transmission of Hydraulic Power. Circuit for devices like Hydraulic Press, Jack, Accumalator, Intersifier and Hydraulic lift.

Fluid Power
Introduction. Applications of control systems. Control Signals Hydraulic Servo mechanisms. Servo valves. Valve operated servo mechanisms and pump controlled servo mechanisms.

Fluidics
Introduction and definition. Terms used in fluidics, efficiency of a fluidic device, Digital devices and analog devices.

SEMESTER VIII

ELECTIVES (Contd.)   *(MOPT - 803)*

Renewable energy sources & Applications

Principle of Renewable Energy :

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

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.
Examination of Solar Radiation. Problems.

Solar Water 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.

Photo Voltaic Generation :
Silicon P-N Junction. Photo absorption. Solar Radiation Input. Photo Voltaic Circuit Properties & Loads. Limit to cell efficiency. Solar Cell Photo voltaics & thermoelectric Generation. Problems.

Wind Power
Introduction : Turbine Types & Terms. Linear Momentum & Basic Theory. Dynamic Matching. Steam Tube Theory, Characteristics of the Wing. Power Extraction by /turbine, Electricity Generation. Mechanical Power. Total Systems. Problems.

Wave Energy :
Introduction : Wave Motion, Wave Energy & Power. Wave Patterns. Devices Probems.

Tidal Power :
Introduction. The cause of Tides. Enhancement of Tides, Tidal Flow Power. Tidal Tange Power. World Range Power sites. Problems. Ocean Thermal Energy Convention :
Principles. Heat Exchangers. Pumping Requirements. Other practical considerations. Problems. Hydro power & Geothermal Energy.

Brief Review & Description
Energy storage & Distribution :

Importance of Energy Storage & Distribution. Biological Storage. Chemical Storage. Heat storage. Electrical Storage. Fuel Cells. Mechanical Storage. Distribution of Energy Problems.

<u>*SEMESTER VIII*</u>

<u>*ELECTIVES (Contd.)*</u>　　　<u>*(MOPT - 803)*</u>

Bio mass :
Principles of using Biomass Availability.
Economics.
Biofuels
Introduction, Biofuel Classification, Thermo chemical, 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 fuel Alcoholic fermentation. Directly from sugar cane sugar Beet. Starch crops, Cellulose. Ethanol fuel use. Ethanol production.
Anaerobic Digestion for Biogas-Basic process & energetics Digester sizing. Working Digesters. Agrochemical fuel Extraction advantages & disadvantages.

Advanced Fluid Mechanics

Hydraulic Transmission of Power:
Hydraulic pumps :-
Gear, Screw, Vane pumps of Fixed and variable displacement types, Axial piston pumps of fixed and varible displacement types Swasplate and Bent Axis Design; Radial piston pump.
Hydraulic Accumulators :-
Various type-weight, spring or gas pressure loaded, different principles piston, bladder or diapharm type. Change of condition of the fluid in a loaded accumulator-Adiabatic, Isothermic. Polytropic. Flow graph, sizing,. Pressure setting and the economics.

Hydraulic Rotary Motors :-
Fixed or Variable displacement type, Axial piston unit of Swashplate and bent axis design, fixed displacement axial unit of wobble plate design, Vane type.
Rotodyne Transmission :
Fluid Coupling, Hydraulic Torque Converter and their characteristics, Hydraulic Rotary Actuator of parallel piston type and piston type with rack pinion. Crank lever mechanism.

SEMESTER VIII

ELECTIVES (Contd.) *(MOPT - 803)*

Hydraulic Circuit & Control

Basic fluid Power Components :- Their functions, symbol along with various hydraulic terms.
Different type of pumps, Relief valves, Pressure Control valve Non-return valve, Pilot operated relief valve. Flow Control valves with pilot operation.
Compressibility and Inertia Loading, Hydraulic Stiffnes, System Natural Frequency, Allied problems, Design of hydraulic circuits and different control mechanisms; e.g. mech. Electr., pneumatic/hydraulic.
Hydraulic Power Transmission, Systems; Circuits, different loads e.g. const power, pure inertia, inertia with viscous damping on output shaft etc., related problems.
Hydraulic circuit accessories e.g. Tank, piping, flexible hose, various fittings e.g. compression type, clamp type etc., Weld Nipple with O-ring seal/ face to face seal, pipe couplings, Assembly of different hydraulic components without using piping e.g. Vertical/Horizontal stacking, manifold block etc. Different types of filters, Instruments & control elements e.g. float switch, thermostat, pressure switch etc.

Electromagnetic Interference(EMI) and Electromagnetic Compatibility (EMC)

Introduction to causes of EMI
Sources of conducted interference and its characteristics.
a) Non-Functional Sources (b) Functional Sources of EMI
Characteristics of Interference
a) Bandwidth (b) Amplitude behaviour c) Waveform (d) Occurrence
Design practice for minimizing conducted Interference Sources of Radiated Interference and its characteristics Nature of sources of Radiated Interference.
a) Non-functional sources (b) Functional sources
c) Electromagnetic Pulse (d0 Design Practice
Interference coupling by conduction and radiation.
a) Coupling via conducting path
b) Radiation coupling
c) Radiation coupling
d) Design practice
Grounding and Bounding
Shielding
a) Capable and Connector Shielding
Filtering
a) Filter Design (b) Transient Suppression
c) Power Line Filters (d) Materials and special devices
Mathematical Model
a) Source Model (b) Coupling Model c) Suscepter Model
EMC Specification
a) Military standards and specification

b) Industrial and Government specification
EMC Test Plans and Procedures
a) Measurement methods for Field strength and for conducted Interference.

SEMESTER VIII

SHIP SAFETY,ENVIRONMENTAL PROTECTION & SAFE WATCH KEEPING –2   (MSSEP - 805)   (54 HRS)

DETAILED SYLLABUS	HRS
a) *Legislation:-* *(i)* *National & International legislation.* *(ii)* *IMO & Conventions* *(iii)* *Indian Merchant Shipping Acts & Rules.* *(iv)* *Classification societies.* *(v)* *Statutory survey & Certification* *(vi)* *Port State control & flag state inspection* *(vii)* *ISM, SMC & ISO Codes.*	*15*
b) *Prevention of pollution of Marine Environment:-* *(i)* *While bunkering, loading & discharging oil cargo, tank cleaning, pumping out bilges.* *(ii)* *Knowledge of construction and operation of oil pollution prevention equipment in Engine room & on tankers.* *(iii)* *MARPOL 73/78 and other national legislations like OPA-90.* *(iv)* *MARPOL equipments like ODMCS, OWS, incriminators etc.* *(v)* *Oil record book and sopep manual.*	*15*
c) *STCW Convention & Safe Watch-keeping –*	
Standards of Training, certification & Watch-keeping for sea farers-International Conference of 1978. *Basic Principles to be observed in keeping an engineering watch. 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.*	*8*
Minimum requirement for Ratings of Engine Room watch. Special requirement for engineer officer for Oil Tankers, Chemical Tankers and Gas Tankers. Details of operational guidance for In-charge of an engineering watch.	*4*
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.	*4*
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 Personnels; Pollutions.	*4*

Shipboard Applications-Regulations & Codes of Practice; Ship design & equipment of oil, chemical & Gas Tankers; ship Operation, repair & maintenance; emergency operations; training of other personnels. Requirement of continued up-dating of proficiency. *Modifications of STCW vide june'95 Conference.*	*4*

SEMESTER VIII

SHIP OPERATION AND MANAGEMENT   (MSOM - 806)   (54 HRS)

DETAILED SYLLABUS	HRS
Brief history of shipping: Modern shipping practice. Marine vehicles and cargoes. Development in Shipping and cargo handling Principal shipping organizations. Liner and tramp shipping services, Conference systems. Chartering, Charter parties. Theory of freight rates and fares. Rate fixation machinery and government control. Bills of lading. Carriage of goods by sea act. Cargo Surveys and protests.	*10*
Role of classification society	*2*
Marine Insurance: Underwriting and loss adjusting principles applied to Marine cargo insurance. Hull policy, particular average General average, P & I Clubs.	*8*
Ownerships of vessels, Shipping Company and its administration. Capitalization and finance, Ecemonics of new and second hand tonnage. Subsidies.	*6*
Ship Operations : Planning sailing schedules. Voyage estimates Economic factors.	*6*
Commercial Shipping Practice. Manning of ships. Engagement and disadvantage of crew D. L. B. Seaman's welfare.	*4*
Merchant Shipping act: Registration of ship. Ship's papers. Port Procedures. Pilotage, Duties regarding pollution. Collision, Explosion fire etc. Vessels in distress. Shipping casualties penalties under Merchant Shipping Act.	*18*

MARINE POWER PLANT OPERATION - PRACTICALS (MPPO – 807) (90 HRS)

DETAILED SYLLABUS	HRS
Running of Diesel Engine (Coupled to alternator) : Methods of starting, running under different load conditions (load on the alternators), 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.	*90*
Boiler operation : *i) Smoke Tube Boiler raising steam from cold condition upto its working pressure and maintaining the same while operating the Reciprocating engine and the auxiliary machinery, maintenance schedule for the 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 upto 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 superheater, water level indicators, high and low level alarms and other boiler mountings, Overhauling and adjusting of safety valves. Recording and controlling of various pressure & temp on the Instrument panel. Care of Boiler auxiliaries, feed water system and fuel system.*	

Running of Steam Reciprocation Engine: Warming up of the engine, Lubrication of moving parts and precautions involved. Starting of the engine. Reversing procedure. Running the engine at full power and taking Indicator Cards. 'Linking out' and 'linking in' of the three Cylinders adjusting the 'cut off' period of the engine and studying the effect.	

SEMESTER – VIII

SIMULATORS & CONTROL LABS   (MCTR - 808)   (54 HRS)

DETAILED SYLLABUS	HRS
Simulator Lab Experiments *Description of basic engine functions and their simulation study of Engine running under simulated conditions.* *Manual method of engine operation from engine room station.* *Engine Operation from Remote stations -i.e. engine control room and Navigation bridge.* *Safety and interlocks in UMS-ships and effect of malfunction of main engine auxiliaries.* *Electronic logic circuits in remote control stations.* *Simulation of engine functions in logic circuits. Study and adjustments of logic circuits for remote control operation of main engine and trouble shooting.* *Interfacing Input/Output interfacing and pneumatic interfacing in the system.* *Role of classification societies with reference to UMS-ships.*	54
Control Lab. Experiments. *Operation of Automatic controller and maintaining a specific viscositiy of given fuel.* *Operation of automatic flow controller and measuring the flow from in a given pipe.* *Operation and utility of a 3 Term (P + I + D) Pneumatic controller.* *To study the functioning of a Mist Detector and checking the alarm when the Pre-set value is exceeded.* *Study the operation of fire detection unit using Ionization chamber type detector.*	

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<u>**MARINE ENGINEERING**</u>