

# **PUNJAB TECHNICAL UNIVERSITY**

## **Scheme& Syllabus of B. Tech. Marine Engineering [MER]**

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**Batch 2013**

**By  
Board of Studies Marine Engineering**

## Third Semester

Contact Hours: 34 Hrs.

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTME301	Strength of Materials- I	3	1	-	40	60	100	4
BTME302	Theory of Machines-I	3	1	-	40	60	100	4
BTME303	Machine Drawing	1	-	6	40	60	100	4
BTME304	Applied Thermodynamics -I	4	1	-	40	60	100	5
BTMR301	Workshop Technology	3	1	-	40	60	100	4
BTME306	Engineering Materials & Metallurgy	3	-	-	40	60	100	3
BTME307	Engineering Materials & Metallurgy Lab	-	-	2	30	20	50	1
BTME308	Strength of Materials Lab.	-	-	2	30	20	50	1
BTME309	Applied Thermodynamics Lab	-	-	2	30	20	50	2
Advisory Meeting		-	-	1	-	-	-	-
BTME 310	Workshop Training*	-	-	-	60	40	100	1
Total		18	3	13	390	460	850	29

\* Workshop Training will be imparted in the Institution at the end of 2<sup>nd</sup> semester for Four (04) weeks duration (Minimum 36 hours per week). Industrial tour will also form part of this training.

## Fourth Semester

Contact Hours: 32 Hrs.

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTME401	Strength of Materials – II	4	1	-	40	60	100	5
BTME402	Theory of Machines – II	4	1	-	40	60	100	5
BTME403	Fluid Mechanics	4	1	-	40	60	100	5
BTME404	Applied Thermodynamics - II	4	2	-	40	60	100	5
BTMR405	Basic Ship structure & design-1	3	1	-	40	60	100	4
BTME406	Fluid Mechanics Lab	-	-	2	30	20	50	1
BTMR407	Workshop Technology Lab	-	-	2	30	20	50	1
BTME408	Theory of Machines Lab	-	-	2	30	20	50	1
Advisory Meeting		-	-	1	-	-	-	-
General Fitness		-	-	-	100	-	100	-
Total		20	05	07	390	360	750	27

## Fifth Semester

Contact Hours: 30

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTMR501	Marine Auxiliary machine	3	1	-	40	60	100	4
BTMR502	Ship Construction	3	1	-	40	60	100	4
BTMR503	Electrical Machines	3	1	-	40	60	100	4
BTMR504	Mechanics of machines-I	3	1	-	40	60	100	4
BTMR505	Electronics	3	1	-	40	60	100	3
BTMR506	Workshop practical(marine)	-	-	4	30	20	50	2
BTMR507	Electrical Engg., Electronics & Microprocessor Lab	-	-	2	30	20	50	1
BTMR508	Electrical machine lab	-	-	2	30	20	50	1
BTMR509	Computer Aided Marine Engineering Design and Analysis Lab	-	-	2	30	20	50	1
BTMR510	Industrial Training*	-	-	-	60	40	100	1
Total		15	5	10	380	420	800	25

\*The marks will be awarded on the basis of 06 weeks industrial training conducted after

## Sixth Semester

Contact Hours: Hrs. 30

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTMR601	Ship Operation Management	3	-	-	40	60	100	3
BTME501	Design of Machines-I	3	1	-	40	60	100	4
BTMR602	Mechanics of machines-II	3	1	-	40	60	100	3
BTME603	Fluid Machinery	3	1	-	40	60	100	4
BTMR604	Naval Architecture	3	-	-	40	60	100	4
BTMR605	Marine Boilers Workshop	-	-	4	30	20	50	2
BTME606	Fluid Machinery Lab.	-	-	2	30	20	50	1
BTMR606	Fire Fighting, Controls and Simulators Lab	-	-	2	30	20	50	1
BTMR607	Material testing Lab	-	-	4	30	20	50	2
	General Fitness				100	-	100	
Total		15	3	12	420	380	800	24

Seventh /Eighth Semester Contact Hours: Hrs. 29

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTME803	Mechanical Vibrations	3	-	-	40	60	100	3
BTME804	Refrigeration and Air Conditioning	3	1	-	40	60	100	4
BTMR701	Project	-	-	12	150	150	300	6
BTME601	Design of Machines-II	3	1	-	40	60	100	4
BTMR7XX	Elective	3	1	-	40	60	100	4
BTME812	Refrigeration and Air Conditioning lab	-	-	2	30	20	50	1
	General Fitness	-	-	-	100	-	100	-
Total		12	03	14	440	410	850	22

**Seventh /Eighth Semester    Contact Hours: Hrs. 29**

Course Code	Course Name	Load Allocation			Marks Distribution		Total Marks	Credits
		L	T	P	Internal	External		
BTMR801	Marine Training	-	-	-	150	100	250	8
BTMR802	Industrial Training	-	-	-	300	200	500	10
	<b>Total</b>	-	-	-	450	300	750	18

**LIST OF ELECTIVES****BTMR702** SSEP & Safe Watch Keeping**BTMR703** Marine Control and automation**BTMR704** Environment science and Engineering

# *Third Semester*

## **BTME 301 Strength of Materials – I**

**Course Objective/s and Expected Outcome/s:** The course is designed to understand the basic concepts of stress, strain and their variations due to different type of loading. The concept of Mechanical properties, Poisson's ratio, bulk modulus, elastic modulus, modulus of rigidity, combined stress and strain, principal stress, principal plane, bending moment and shear force in

beam under various loading conditions, Understanding of torsional shear stress in solid and hollow shaft; principal and maximum shear stress in a circular shaft subjected to combined stresses, stresses in struts and columns subjected to axial load; bending stress, slope and deflection under different loading and supporting conditions. After the study of this course, a student is expected to analyze different stresses, strains and deflection for designing a simple mechanical element under various loading conditions.

### Unit –I

**Simple, Compound Stresses and Strains:** Stress and Strain and their types, Hook's law, longitudinal and lateral strain, Poisson's ratio, stress-strain diagram for ductile and brittle materials, extension of a bar due to without and with self weight, bar of uniform strength, stress in a bar, elastic constants and their significance, relation between elastic constants, Young's modulus of elasticity, modulus of rigidity and bulk modulus. Temperature stress and strain calculation due to axial load and variation of temperature in single and compound bars. Two dimensional stress system, stress at a point on a plane, principal stresses and principal planes, Mohr's circle of stress ellipse of stress and their applications. Generalized Hook's law, principal stresses related to principal strains.

### Unit –II

**Bending Moment (B.M) and Shear Force (S.F) Diagrams:** S.F and B.M definitions; relation between load, shear force and bending moment; B.M and S.F diagrams for cantilevers, simply supported beams with or without overhangs, and calculation of maximum B.M and S.F and the point of contra flexure under the following loads:

- a) Concentrated loads
- b) Uniformity distributed loads over the whole span or part of span
- c) Combination of concentrated and uniformly distributed load
- d) Uniformly varying loads
- e) Application of moments

### Unit –III

**Bending Stresses In Beams:** Assumptions in the simple bending theory; derivation of formula and its application to beams of rectangular, circular and channel, I and T- sections. Combined direct and bending stresses in afore-mentioned sections, composite / flitched beams.



**Unit –IV**

**Torsion:** Derivation of torsion equation and its assumptions and its application to the hollow and solid circular shafts. Torsional rigidity, combined torsion and bending of circular shafts; principal stress and maximum shear stresses under combined loading of bending and torsion.

**Unit –V**

**Columns and struts:** Introduction, failure of columns, Euler's formula, Rankine-Gordon's formula, Johnson's empirical formula for axially loaded columns and their applications.

**Unit –VI**

**Slope and deflection:** Relationship between moment, slope and deflection; method of integration, Macaulay's method, moment area method and use of these methods to calculate slope and deflection for the following:

- a) Cantilevers
- b) Simply supported beams with or without overhang
- c) Under concentrated loads, uniformly distributed loads or combination of concentrated & uniformly distributed loads.

**Suggested Readings / Books:**

- D.S. Bedi, *Strength of Materials*, Khanna Book Publishing Company.
- E.P. Popov, *Mechanics of Materials-(SI Version)*, Prentice Hall India.
- R.S. Lehari and A.S. Lehari, *Strength of Materials*, Kataria and Sons.
- S.S. Rattan, *Strength of Materials*, Tata McGraw Hill.
- Timoshenko and Young, *Elements of Strength of Materials*, East West Press (EWP).
- James M Gere and Barry J. Goodno, *Strength of Materials*, Cengage Learning.

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**BTME-302 Theory of Machines-I**

**Course Objective/s & Expected Outcome/s:** The course under Theory of Machine-I has been designed to cover the basic concepts of kinematic aspects of mechanical machines and major parts used in running of the machines. The students will understand the basic concepts of machines and able to understand constructional and working features of important machine elements. The students should be able to understand various parts involved in kinematics of machines for different applications. The students shall also be able to understand requirements of basic machine parts which would help them to understand the design aspects of the machine parts

**Unit –I**

**Basic Concept of machines:** Link, Mechanism, Kinematic Pair and Kinematic Chain, Principles of Inversion, Inversion of a Four Bar Chain, Slider-Crank-Chain and Double Slider-Crank-Chain.

Graphical and Analytical methods for finding: Displacement, Velocity, and Acceleration of mechanisms (including Coriolis Components).

## Unit –II

**Lower and higher Pairs:** Universal Joint, Calculation of maximum Torque, Steering Mechanisms including Ackerman and Davis approximate steering mechanism, Engine Indicator, Pentograph, Straight Line Mechanisms, Introduction to Higher Pairs With Examples

## Unit –III

**Belts, Ropes and Chains:** Material & Types of belt, Flat and V-belts, Rope & Chain Drives, Idle Pulley, Intermediate or Counter Shaft Pulley, Angle and Right Angle Drive, Quarter Turn Drive, Velocity Ratio, Crowning of Pulley, Loose and fast pulley, stepped or cone pulleys, ratio of tension on tight and slack side of belts, Length of belt, Power transmitted by belts including consideration of Creep and Slip, Centrifugal Tensions and its effect on power transmission.

## Unit –IV

**Cams:** Types of cams and follower, definitions of terms connected with cams. Displacement, velocity and acceleration diagrams for cam followers. Analytical and Graphical design of cam profiles with various motions (SHM, uniform velocity, uniform acceleration and retardation, cycloidal Motion). Analysis of follower motion for circular, convex and tangent cam profiles.

## Unit –V

**Friction Devices:** Concepts of friction and wear related to bearing and clutches. Types of brakes function of brakes. Braking of front and rear tyres of a vehicle. Determination of braking capacity, Types of dynamometers, (absorption, and transmission).

## Unit –VI

**Flywheels:** Turning moment and crank effort diagrams for reciprocating machines' Fluctuations of speed, coefficient of fluctuation of speed and energy, Determination of mass and dimensions of flywheel used for engines and punching machines.

## Unit –VII

**Governors:** Function, types and characteristics of governors. Watt, Porter and Proell governors. Hartnell and Willson-Hartnell spring loaded governors. Numerical problems related to these governors. Sensitivity, stability, isochronisms and hunting of governors. Governor effort and power, controlling force curve, effect of sleeve friction.

**Suggested Readings / Books:**

- S. S. Rattan, Theory of Machines, Tata McGraw Hill, New Delhi.
- Jagdish Lal, Theory of Mechanisms & Machines, Metropolitan Book Co.
- Thomas Beven, Theory of Machines, Longman's Green & Co., London.
- W. G. Green, Theory of Machines, Blackie & Sons, London
- V.P. Singh, Theory of Machines Dhanpat Rai.

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### BTME 304 Applied Thermodynamics-I

**Course Objective/s and Expected Outcome/s:** This course is designed for comprehensive study of combustion and thermal aspects in internal combustion engines, steam power plants and its allied components. This will enable the students to understand combustion phenomenon and thermal analysis of steam power plant components. The students will be able to identify, track and solve various combustion problems and evaluate theoretically the performance of various components involved in steam power plants and internal combustion engines.

#### Unit –I

**Combustion:** Combustion Equations (Stoichiometric and non- Stoichiometric). Combustion problems in Boilers and IC engines/Calculations of air fuel ratio, Analysis of products of combustion, Conversion of volumetric analysis into gravimetric analysis and vice-versa, Actual weight of air supplied, Use of mols, for solution of combustion problems, Heat of formation, Enthalpy of formation, Enthalpy of reaction, Adiabatic flame temperature.

#### Unit –II

**IC Engines Introduction:** Actual Engine Indicator diagrams and valve-timing diagrams for two stroke and four stroke S.I. and C.I. Engines; **Construction and Working Principle** of Wankel rotary engine; Principle of simple carburetor, Injection systems in Diesel and Petrol Engines (Direct Injection, MPFI in SI and CI Engines, respectively). Essential requirements for Petrol and Diesel Fuels. Theory of combustion in SI and CI Engines; Various stages of combustion; Pressure-time/crank - Angle diagrams; Various phenomenon such as turbulence, squish and swirl, dissociation, pre-ignition/auto- ignition, and after burning etc.; Theory of knocking (ie., detonation) in SI and CI Engines; Effect of engine variables on the Delay Period in SI and CI engines; Effect of various parameters on knock in SI and CI Engines; Methods employed to reduce knock in SI and CI Engines; Octane and Cetane rating of fuels; Knockmeter; Dopes and inhibitors; Performance

curves/maps of SI and CI Engines; Effect of knocking on engine performance; Effect of *compression ratio* and *air-fuel ratio* on power and efficiency of engine; Variation of engine power with altitude; Supercharging and turbo charging of SI and CI Engines; Advantages and applications of supercharging; Emissions from SI and CI Engines and methods to reduce/control them. Logarithmic plotting of PV-diagrams. High speed Engine Indicators.

### Unit –III

#### Properties of Steam

Pure substance; Steam and its formation at constant pressure: wet, dry, saturated and super-heated steam; Sensible heat(enthalpy), latent heat and total heat (enthalpy) of steam; dryness fraction and its determination; degree of superheat and degree of sub-cool; Entropy and internal energy of steam; Use of Steam Tables and Mollier Chart; Basic thermodynamic processes with steam (isochoric, isobaric, isothermal, isentropic and adiabatic process) and their representation on **T-S** Chart and Mollier Charts(h-s diagrams). Significance of Mollier Charts.

### Unit –IV

**Steam Generators - Definition:**Classification and Applications of Steam Generators; Working and constructional details of fire-tube and water-tube boilers: (Cochran, Lancashire, Babcock and Wilcox boilers); Merits and demerits of fire-tube and water-tube boilers; Modern high pressure boilers (Benson boiler, La Mont boiler) and Super critical boilers (**Once throughboilers-Tower type**); Advantages of forced circulation; Description of boiler mountings and accessories: Different types of Safety Valves, Water level indicator, pressure gauge, Fusible plug, Feed pump, Feed Check Valve, Blow-off Cock, Steam Stop-Valve, Economiser, Super-heater; Air pre-heater and Steam accumulators; Boiler performance: equivalent evaporation, boiler efficiency, boiler trial and heat balance; Types of draught and Calculation of chimney height.

### Unit –V

**Vapour Power Cycle**Carnot Cycle and its limitations; Rankine steam power cycle, Ideal and actual; Mean temperature of heat addition; Effect of pressure, temperature and vacuum on Rankine Efficiency; Rankine Cycle Efficiency and methods of improving Rankine efficiency: Reheat cycle, Bleeding (feed-water-heating), Regenerative Cycle, Combined reheat-regenerative cycle; Ideal working fluid; Binary vapour cycle, Combined power and heating cycles.

**Unit –VI**

**Steam Nozzles** - Definition, types and utility of nozzles; Flow of steam through nozzles; Condition for maximum discharge through nozzle; Critical pressure ratio, its significance and its effect on discharge; Area of **throat** and at **exit** for maximum discharge; Effect of friction; Nozzle efficiency; Convergent and convergent-divergent nozzles; Calculation of Nozzle dimensions (length and diameters of throat and exit); Supersaturated (or metastable) flow through nozzle.

**Unit –VII**

**Steam Turbines** Introduction; Classification; Impulse versus Reaction turbines. **Simple impulse turbine**: pressure and velocity variation, Velocity diagrams/triangles; Combined velocity diagram/triangle and calculations for force, axial thrust, work, power, blade efficiency, stage efficiency, maximum work and maximum efficiency, effect of blade friction on velocity diagram, effect of speed ratio on blade efficiency, condition for axial discharge;

**Unit –VIII**

**DeLaval Turbine**: Compounding of impulse turbines: purpose, types and pressure and velocity variation, velocity diagrams/triangles, combined velocity diagram/triangle and calculations for force, axial thrust, work, power, blade efficiency, stage efficiency, overall efficiency and relative efficiency;

**Unit –IX**

**Impulse-Reaction Turbine**: pressure and velocity variation, velocity diagrams/triangles, Degree of reaction, combined velocity diagram/triangle and calculations for force, axial thrust, work, power, blade efficiency, stage efficiency, overall efficiency and relative efficiency, maximum work and maximum efficiency; Calculations of blade height; **Multistaging**: Overall efficiency and relative efficiency; Reheating, Reheat factor and condition curve; Losses in steam turbines; Back pressure and extraction turbines; Co-generation; Economic assessment; Governing of steam turbines.

**Unit –X**

**Steam Condensers** Function; Elements of condensing unit; Types of condensers; Dalton's law of partial pressures applied to the condenser problems; Condenser and vacuum efficiencies; Cooling water calculations; Effect of air leakage; Method to check and prevent air infiltration; Description of air pump and calculation of its capacity; **Cooling towers**: function, types and their operation.

**Suggested Readings / Books:**

- R. Yadav, Sanjay and Rajay, Applied Thermodynamics, Central Publishing House.

- J.S. Rajadurai, Thermodynamics and Thermal Engineering, New Age International (P) Ltd. Publishers.
- D.S. Kumar and V.P. Vasandani, Heat Engineering, Metropolitan Book Co. Pvt. Ltd.
- K. Soman, Thermal Engineering, PHI Learning Pvt. Ltd.
- G. Rogers and Y. Mayhew, Engineering Thermodynamics, Pearson.
- W.A.J. Keartan, Steam Turbine: Theory and Practice, ELBS Series.
- Heywood, Fundamentals of IC Engines, McGraw Hill.
- V. Ganeshan, Internal Combustion Engines, Tata McGraw Hill.

### **(BTMR-303) Workshop technologies**

- 1. 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, pattern maker's tools, Smithy tools and Moulding tools. Application of hand tools as chisel, file and saw. (5)
- 2. Metal cutting Machines:** Kinematic analysis, specification, operation and inspection of the more important types of metal cutting machine tool including Centre lathes, Capstan and turret lathes, Automatic lathes, drilling and boring machines. Shaping slotting and planning machines, Milling and broaching machines. (4)
- 3. Machine Process & Machine Tools:** The geometry of cutting processes, Chip formation, Cutting forces, Stresses and power; Friction of chip on tool. Generation and dissipation of heat in cutting. Standard nomenclature for cutting tools. Cutting speeds and feeds, estimation of machining time. The fundamental Cutting process, geometrical control of the cutting edge Turning, Screw cutting and taper turning processes on Centre lathe. (5)
- 4. Abrasive process:** Grinding, honing and lapping by hand and machines. Shears and punches. Wood working machines. Principles of jigs and fixtures Standardization (3)
- 5. Measuring Instruments & Inspection:** Description and use of steel rule, Vernier's scale, Micro-meter, 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 interchange ability, limit system, Use of limit gauge (4)
- 6. 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, Pipe work. (4)
- 7. Safety Measures:** Sources of danger and methods of protection. Types of guards and safety devices, Factory Act regulations. (3)

- 8. Welding:** Welding Equipment & Applications, Electric welding (A.C & D.C) spot welding. Gas welding. Soldering & Brazing. Different welding & Electrodes, Solders & Brazing Fluxes. Defects in welding Safe working practices - Personal Protection Equipment

**Suggested Readings / Books:**

- A. Manna, A Textbook of Manufacturing Science and Technology, PHI Publishers.
- H.S. Shan, Manufacturing Processes, Vol.I. , Pearson Publishers.
- P. N. Rao, Manufacturing Technology, Foundry, Forming & Welding, Tata McGraw Hill.
- R.S. Parmar ,Welding Engineering & Technology, Khanna Publishers.
- SeropeKalpakjian and Steven R. Schmid, Manufacturing Engineering and Technology, Pearson Publishers.

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**BTME-306 Engineering Materials & Metallurgy**

**Course Objective/s and Outcome/s:** This course is designed to develop fundamental concepts of crystallography, phase transformation and heat treatment processes. The students will learn the atomic structure of metals, imperfections, diffusion mechanisms and theories of plastic deformation. They will also understand equilibrium diagrams, time-temperature transformation curves and heat treatment processes. Upon completion of the course, the students will be able to understand the concepts of crystal structure, microstructure and deformation. They will also be able to understand the phase diagrams which are useful for design and control of heat treating processes.

**Unit –I**

**Crystallography:** Atomic structure of metals, atomic bonding in solids, crystal structures, crystal lattice of body centered cubic, facecentered cubic, closed packed hexagonal; crystalline and non crystalline materials; crystallographic notation of atomic planes; polymorphism and allotropy; imperfection in solids: theoretical yield strength, point defects, line defects and dislocations, interfacial defects, bulk or volume defects. Diffusion: diffusion mechanisms, steady-state and non-steady-state diffusion, factors affecting diffusion. Theories of plastic deformation, recovery, re-crystallization.

**Unit –II**

**Phase Transformation:** General principles of phase transformation in alloys, phase rule and equilibrium diagrams, Equilibrium diagrams of Binary systems. Iron carbon equilibrium diagram and various phase transformations. Time temperature transformation curves (TTT curves): fundamentals, construction and applications.

**Unit –III**



**Heat Treatment:** Principles and applications. Processes viz. annealing, normalizing, hardening, tempering. Surface hardening of steels: Principles of induction and oxyacetylene flame hardening. Procedure for carburising, nitriding and cyaniding. Harden-ability: determination of harden-ability. Jominy end-quench test. Defects due to heat treatment and their remedies; effects produced by alloying elements. Composition of alloy steels.

#### Unit –IV

**Ferrous Metals and Their Alloys:** Introduction, classification, composition of alloys, effect of alloying elements (Si, Mn, Ni, Cr, Mo, W, Al) on the structures and properties of steel.

#### Suggested Readings / Books:

- B. Zakharov, Heat Treatment of Metals, University Press.
- T. Goel and R.S. Walia, Engineering Materials & Metallurgy.
- Sidney H Avner, Introduction to Physical Metallurgy, Tata Mcgraw-Hill.
- V. Raghavan, Physical Metallurgy: Principles and Practice, PHI Learning.
- Y. Lakhin , Engineering Physical Metallurgy, Mir Publishers.

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#### **BTME-307 Engineering Materials & Metallurgy Lab**

1. Preparation of models/charts related to atomic/crystal structure of metals.
2. Annealing the steel specimen and study the effect of annealing time and temperature on hardness of steel.
3. Hardening the steel specimen and study the effect of quenching medium on hardness of steel.
4. Practice of specimen preparation (cutting, mounting, polishing ,etching) of mild steel, aluminium and hardened steel specimens.
5. Study of the microstructure of prepared specimens of mild steel, Aluminium and hardened steel.
6. Identification of ferrite and pearlite constituents in given specimen of mild steel.
7. Determination of hardenabilty of steel by Jominy End Quench Test.

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#### **BTME-308 Strength of Materials Lab**

1. To perform tensile test in ductile and brittle materials and to draw stress-straincurve and to determine various mechanical properties.
2. To perform compression test on Cast Iron.
3. To perform any one hardness tests (Rockwell, Brinell&Vicker's test).
4. To perform impact test to determine impact strength.
5. To perform torsion test and to determine various mechanical properties.
6. To perform Fatigue test on circular test piece.



7. To perform bending test on beam and to determine the Young's modulus and modulus of rupture.
  8. Determination of Bucking loads of long columns with different end conditions.
  9. To evaluate the stiffness and modulus of rigidity of helical coil spring.
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### **BTME 309 Applied Thermodynamics Lab.**

1. Study of construction and operation of 2 stroke and 4 stroke Petrol and Diesel engines using actual engines or models.
  2. To plot actual valve timing diagram of a 4 stroke petrol and diesel engines and study its impact on the performance of engine.
  3. Study of working, construction, mountings and accessories of various types of boilers.
  4. To perform a boiler trial to estimate equivalent evaporation and efficiency of a fire tube/ water tube boiler.
  5. Determination of dryness fraction of steam and estimation of brake power, Rankine efficiency, relative efficiency, generator efficiency, and overall efficiency of an impulse steam turbine and to plot a Willian's line.
  6. Determine the brake power, indicated power, friction power and mechanical efficiency of a multi cylinder petrol engine running at constant speed (Morse Test).
  7. Performance testing of a diesel engine from no load to full load (at constant speed) for a single cylinder/ multi- cylinder engine in terms of brake power, indicated power, mechanical efficiency and specific fuel consumption and to measure the smoke density. Draw/obtain power consumption and exhaust emission curves. Also make the heat balance sheet.
  8. Performance testing of a petrol engine from no load to full load (at constant speed) for a single cylinder/ multi- cylinder engine in terms of brake power, indicated power, mechanical efficiency and specific fuel consumption and to measure the exhaust emissions. Also draw/obtain power consumption and exhaust emission curves.
  9. Study of construction and operation of various types of steam condensers and cooling towers.
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# *Fourth Semester*

**BTME 401 Strength of Materials-II**

**Course Objective/s and Outcome/s:** The course is designed to understand the concepts of strain energy, resilience, stress under impact loading; shear stress distribution in a beam of various cross sections; stress in curved cross sections; stresses in helical, spiral and leaf springs; stress and strain analysis of thin, thick cylinder and spheres subjected to internal pressure; and various failure theories. The outcome of the course is to enhance deep and vigorous understanding of stress analysis in various machine elements, so that a student can properly analyze and design a mechanical member from the strength point of view under various conditions.

### Unit –I

**Strain energy:** Introduction to strain energy, energy of dilation and distortion. Resilience, stress due to suddenly applied loads. Castigliano's and Maxwell's theorem of reciprocal deflection.

### Unit –II

**Theories of failure:** Maximum principal stress theory, maximum shear stress theory, maximum principal strain theory, total strain energy theory, shear strain energy theory. Graphical representation and derivation of equation for these theories and their application to problems related to two dimensional stress systems.

### Unit –III

**Springs:** Open and closed coiled helical springs under the action of axial load and/or couple. Flat spiral springs- derivation of formula for strain energy, maximum stress and rotation. Leaf spring- deflection and bending stresses

### Unit –IV

**Thin cylinders and spheres:** Calculation of Hoop stress, longitudinal stress in a cylinder, effects of joints, change in diameter, length and internal volume. Principal stresses in sphere, change in diameter and internal volume.

### Unit –V

**Thick cylinders:** Derivation of Lamé's equations, calculation of radial, longitudinal and hoop stresses and strains due to internal pressure in thick cylinders, compound cylinders, hub shrunk on solid shafts, shrinkage allowance and shrinkage stress.

### Unit –VI

**Bending of curved beams:** Calculation of stresses in cranes or chain hooks, rings of circular and trapezoidal section, and chain links with straight sides.

## Unit –VII

**Shear stresses in beams:** Shear stress distribution in rectangular, circular, I, T and channel section; built up beams. Shear centre and its importance.

## Unit –VIII

**Rotational discs:** Stresses in rotating discs and rims of uniform thickness; disc of uniform strength.

### Suggested Readings / Books:

- D.S. Bedi, Strength of materials, Khanna book publishing company.
- G.H. Ryder, Strength of materials, Macmillan India Ltd.
- R.S. Lehi and A.S. Lehi, Strength of materials, vol. 2, S. K. Kataria and Sons.
- S.S. Rattan, Strength of materials, Tata McGraw Hills.
- Timoshenko and Gere, Mechanics of materials, CBS publishers.

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## BTME 402 Theory of Machines – II

**Course Objective/s & Outcome/s:** The students will understand the basic concepts of inertia forces & couples applied to reciprocating parts of a machine. Students should be able to understand balancing of masses and design of gears & gear trains. They will also gain knowledge of kinematic synthesis and different applications of gyroscopic effect.

## Unit –I

**Static force analysis:** Concept of force and couple, free body diagram, condition of equilibrium, static equilibrium of mechanism, methods of static force analysis of simple mechanisms. Power transmission elements, considerations of frictional forces

## Unit –II

**Dynamic force analysis** Determination of forces and couples for a crank, inertia of reciprocating parts, dynamically equivalent system, analytical and graphical method, inertia force analysis of basic engine mechanism, torque required to overcome inertia and gravitational force of a four bar linkage.

## Unit –III

**Balancing:** Necessity of balancing, static and dynamic balancing, balancing of single and multiple rotating masses, partial unbalanced primary force in an engine, balancing of reciprocating masses,

and condition of balance in multi cylinder in line V-engines , concept of direct and reverse crank, balancing of machines, rotors, reversible rotors.

#### Unit –IV

**Gears:** Toothed gears, types of toothed gears and its terminology. Path of contact, arc of contact, conditions for correct gearing, forms of teeth, involutes and its variants, interference and methods of its removal. Calculation of minimum number of teeth on pinion/wheel for involute rack, helical, spiral, bevel and worm gears. Center distance for spiral gears and efficiency of spiral gears

#### Unit –V

**Gear Trains:** Types of gear trains, simple, compound and epicyclic gear trains, problems involving their applications, estimation of velocity ratio of worm and worm wheel.

#### Unit –VI

**Gyroscopic motion and couples:** Effect on supporting and holding structures of machines. stabilization of ships and planes, Gyroscopic effect on two and four wheeled vehicles and stone crusher.

#### Unit –VII

**Kinematic synthesis of Mechanism:** Freudenstien equation, Function generation errors in synthesis, two and three point synthesis, Transmission angles, least square techniques.

#### Suggested Readings / Books:

- S.S. Rattan, Theory of Machines, Tata Mc. Graw Hill.
- John, Gordon, and Joseph, Theory of Machines and Mechanisms, Oxford University Press.
- Hams Crone and Roggers, Theory of Machines.
- Shigley, Theory of Machines, Mc Graw Hill.
- V.P. Singh, Theory of Machines, Dhanpat Rai and Sons.

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### BTME 403 Fluid Mechanics

**Course Objective/s and Expected Outcome/s:** This course is designed for the undergraduate mechanical engineering students to develop an understanding of the behavior of fluids at rest or in motion and the subsequent effects of the fluids on the boundaries as the mechanical engineers have to deal with fluids in various applications. This course will also develop analytical abilities related to fluid flow. It is expected that students will be able to have conceptual understanding of fluids and their properties, apply the analytical tools to solve different types of problems related to fluid flow

in pipes, design the experiments effectively and do the prototype studies of different types of machines and phenomenon.

### Unit –I

**Fundamentals of Fluid Mechanics:** Introduction; Applications; Concept of fluid; Difference between solids, liquids and gases; Concept of continuum; Ideal and real fluids; Fluid properties: density, specific volume, specific weight, specific gravity, viscosity (dynamic and kinematic), vapour pressure, compressibility, bulk modulus, Mach number, surface tension and capillarity; Newtonian and non-Newtonian fluids.

### Unit –II

**Fluid Statics:** Concept of static fluid pressure; Pascal's law and its engineering applications; Hydrostatic paradox; Action of fluid pressure on a plane submerged surface (horizontal, vertical and inclined): resultant force and centre of pressure; Force on a curved surface due to hydrostatic pressure; Buoyancy and flotation; Stability of floating and submerged bodies; Metacentric height and its determination; Periodic time of oscillation; Pressure distribution in a liquid subjected to : (i) constant acceleration along horizontal, vertical and inclined direction (linear motion), (ii) constant rotation.

### Unit –III

**Fluid Kinematics:** Classification of fluid flows; Lagrangian and Euler flow descriptions; Velocity and acceleration of fluid particle; Local and convective acceleration; Normal and tangential acceleration; Path line, streak line, streamline and timelines; Flow rate and discharge mean velocity; One dimensional continuity equation; Continuity equation in Cartesian (x,y,z), polar (r,θ) and cylindrical (r,θ,z) coordinates; Derivation of continuity equation using the Lagrangian method in Cartesian coordinates; Rotational flows: rotation, vorticity and circulation; Stream function and velocity potential function, and relationship between them; Flow net.

### Unit –IV

**Fluid Dynamics:** Derivation of Euler's equation of motion in Cartesian coordinates, and along a streamline; Derivation of Bernoulli's equation (using principle of conservation of energy and equation of motion) and its applications to steady state ideal and real fluid flows; Representation of energy changes in fluid system (hydraulic and energy gradient lines); Impulse momentum equation;

Kinetic energy and momentum correction factors; Flow along a curved streamline; Free and forced vortex motions.

### Unit –V

**Dimensional Analysis and Similitude:** Need of dimensional analysis; Fundamental and derived units; Dimensions and dimensional homogeneity; Rayleigh's and Buckingham's  $\pi$  - method for dimensional analysis; Dimensionless numbers (Reynolds, Froudes, Euler, Mach, and Weber) and their significance; Need of similitude; Geometric, kinematic and dynamic similarity; Model and prototype studies; Similarity model laws.

### Unit –VI

**Internal Flows:** Laminar and Turbulent Flows: Reynolds number, critical velocity, critical Reynolds number, hydraulic diameter, flow regimes; Hagen – Poiseuille equation; Darcy equation; Head losses in pipes and pipe fittings; Flow through pipes in series and parallel; Concept of equivalent pipe; Roughness in pipes, Moody's chart.

### Unit –VII

**Pressure and Flow Measurement:** Manometers; Pitot tubes; Various hydraulic coefficients; Orifice meters; Venturi meters; Borda mouthpieces; Notches (rectangular, V and Trapezoidal) and weirs; Rotameters.

#### Suggested Readings / Books:

- D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S.K. Kataria and Sons Publishers.
- S.K. Som, G. Biswas and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill.
- C.S.P. Ojha, R. Berndtsson and P.N. Chandramouli, Fluid Mechanics and Machinery, Oxford University Press.
- Y.A. Cengel and J.M. Cimbala, Fluid Mechanics - Fundamentals and Applications, Tata McGraw Hill.
- B.R. Munson, D.F. Young, T.H. Okiishi and W.W. Huebsch, Fundamentals of Fluid Mechanics, John Wiley and Sons.
- J.F. Douglas and J.M. Gasiorek, J.A. Swaffield and L.B. Jack, Fluid Mechanics, Pearson.
- V.L. Streeter, E.B. Wylie and K.W. Bedford, Fluid Mechanics, Tata McGraw Hill.

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## BTME 404 Applied Thermodynamics-II

**Course Objectives and Expected Outcomes:** This course is designed for providing comprehensive understanding and thermodynamic analysis of positive displacement air compressors and thermal turbo machines used in power generation, aircraft, spacecraft and rocket propulsion. The students will be able to understand the thermodynamic working as well as performance of thermal turbo power machinery. They will also be able to select various thermal devices required for aforesaid applications.

**Unit –I**

**Air Compressors- Introduction:** Classification of Air Compressors; Application of compressors and use of compressed air in industry and other places; Complete representation of compression process on P-v and T-s coordinates with detailed description of areas representing total work done and polytropic work done; Areas representing *energy lost* in internal friction, *energy carried away by cooling water* and *additional flow work* being done for un-cooled and cooled compression on T-S coordinates; Best value of index of compression; Isentropic, polytropic and isothermal efficiencies and their representation in terms of ratio of areas representing various energy transfers on T-s coordinates.

**Unit –II****Reciprocating Air Compressors**

Single stage single acting reciprocating compressor (with and without clearance volume): construction, operation, work input and best value of index of compression, heat rejected to cooling medium, isothermal, overall thermal, isentropic, polytropic, mechanical efficiency, **Clearance Volumetric efficiency**, Overall volumetric efficiency, effect of various parameters on volumetric efficiency, free air delivery; Multistage compressors: purpose and advantages, construction and operation, work input, heat rejected in intercoolers, minimum work input, optimum pressure ratio; *isothermal*, *overall thermal*, *isentropic*, *polytropic* and *mechanical* efficiencies; Performance curves.

**Unit –III**

**Positive Displacement Rotary Compressors Introduction:** Comparison of rotary positive displacement compressors with reciprocating compressors; Classification of rotary compressors; Construction, operation, work input and efficiency of positive displacement type of rotary compressors like Roots blower, Lysholm compressor and Vane type Blower.

**Unit –IV**

**Thermodynamics of Dynamic Rotary Compressors:** Applications of Steady Flow Energy Equation and thermodynamics of dynamic (i.e., *centrifugal* and *axial flow m/cs*) compressors; Stagnation and static values of pressure, Temperature and enthalpy etc. for flow through dynamic rotary machines; Complete representation of compression process on T-S coordinates with detailed description of areas representing total work done, polytropic work done; ideal work required for compression process, areas representing energy lost in internal friction, energy carried away by



cooling water on TS coordinates for an uncooled and cooled compression; *isentropic*, *polytropic*, and *isothermal efficiencies* as ratios of the areas representing various energy transfers on T-S coordinates.

### Unit –V

**Centrifugal Compressors:-** Complete thermodynamic analysis of centrifugal compressor stage; Polytropic, isentropic and isothermal efficiencies; Complete representation of compression process in the centrifugal compressor starting from ambient air flow through the suction pipe, Impeller, Diffuser and finally to delivery pipe on T-S coordinates; Pre-guide vanes and pre-whirl; Slip factor; Power input factor; Various modes of energy transfer in the impeller and diffuser; Degree of Reaction and its derivation; Energy transfer in backward, forward and radial vanes; Pressure coefficient as a function of slip factor; Efficiency and out-coming velocity profile from the impeller; Derivation of non-dimensional parameters for plotting compressor characteristics; Centrifugal compressor characteristic curves; Surging and choking in centrifugal compressors.

### Unit –VI

#### Axial Flow Compressors

Different components of axial flow compressor and their arrangement; Discussion on flow passages and simple theory of aerofoil blading; Angle of attack; coefficients of lift and drag; Turbine versus compressor blades; Velocity vector; Vector diagrams; Thermodynamic analysis; Work done on the compressor and power calculations; Modes of energy transfer in rotor and stator blade flow passages; Detailed discussion on work done factor, degree of reaction, blade efficiency and their derivations; *Isentropic*, *polytropic* and *isothermal efficiencies*; Surging, Choking and Stalling in axial flow compressors; Characteristic curves for axial flow compressor; flow parameters of axial flow compressor like Pressure Coefficient, Flow Coefficient, Work Coefficient, Temperature-rise Coefficient and Specific Speed; Comparison of axial flow compressor with centrifugal compressor and reaction turbine; Field of application of axial flow compressors.

### Unit –VII

**Gas Turbines Classification** and comparison of the Open and Closed cycles; Classification on the basis of combustion (at *constant volume* or *constant pressure*); Comparison of gas turbine with a steam turbine and IC engine; Fields of application of gas turbines; Position of gas turbine in power industry; Thermodynamics of constant pressure gas turbine cycle (Brayton cycle); Calculation of net output, work ratio and thermal efficiency of ideal and actual cycles; Cycle air rate, temperature ratio;

Effect of changes in specific heat and that of mass of fuel on power and efficiency; Operating variables and their effects on thermal efficiency and work ratio; Thermal refinements like regeneration, inter-cooling and re-heating and their different combinations in the gas turbine cycle and their effects on gas turbine cycle i.e. gas turbine cycle. Multistage compression and expansion; Dual Turbine system; Series and parallel arrangements; Closed and Semi-closed gas turbine cycle; Requirements of a gas turbine combustion chamber; Blade materials and selection criteria for these materials and requirements of blade materials; Gas turbine fuels.

## Unit –VIII

**Jet Propulsion** Principle of jet propulsion; Description of different types of jet propulsion systems like rockets and thermal jet engines, like (i) **Athodyds** (ramjet and pulsejet), (ii) Turbojet engine, and (iii) Turboprop engine. Thermodynamics of turbojet engine components; Development of thrust and methods for its boosting/augmentation; Thrust work and thrust power; Propulsion energy, Propulsion and thermal (internal) efficiencies; Overall thermal efficiency; Specific fuel consumption; Rocket propulsion, its thrust and thrust power; Propulsion and overall thermal efficiency; Types of rocket motors (e.g. solid propellant and liquid propellant systems); Various common propellant combinations (i.e. fuels) used in rocket motors; Cooling of rockets; Advantages and disadvantages of jet propulsion over other propulsion systems; Brief introduction to performance characteristics of different propulsion systems; Fields of application of various propulsion units.

### Suggested Readings / Books:

- R. Yadav, Sanjay and Rajay, Applied Thermodynamics, Central Publishing House.
- J.S. Rajadurai, Thermodynamics and Thermal Engineering New Age International (P) Ltd. Publishers.
- D.S. Kumar and V.P. Vasandani, Heat Engineering, Metropolitan Book Co. Pvt. Ltd.
- K. Soman, Thermal Engineering, PHI Learning Pvt. Ltd.
- G. Rogers and Y. Mayhew, Engineering Thermodynamics, Pearson.
- D.G. Shepherd, Principles of Turbo machinery Macmillan.
- H. Cohen, G.F.C. Rogers and M. Sarvan, Gas Turbine Theory, Longmans.

## BTMR405 Basic Ship structure & design-1

1. **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. Stresses in Ship's structure: Hogging, Sagging, Racking, Pounding, Panting, etc. and Strength members to counteract the same. ( 5)
2. **Sections and materials use:** Type of section like Angles, Bulb Plates. Flanged beams used in ship construction. Rivetting & Welding. Testing of welds. Fabricated components. 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.

(6)

3. **Shell & Decks :** Planting system for shells, Deck plating & Deck girders, discontinuities like hatches and other openings. Supporting & closing arrangements, mid-ship Section of ships.

(4)

4. **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.

(5)

5. **Theory of fire:** *Introduction, safety and fire triangle, fire prevention* Construction, operation and merits of different types of portable and nonportable fire extinguishers and fixed fire extinguishing installations for ships. , (2)

6. **Fire fighting Equipment** *\_fire pumps, construction ,fire fighting in port and dry dock,* 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. (4)

#### *Books recommended*

- Ship design by djeyers
  - Ship design by reeds
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### **BTME 406 Fluid Mechanics LAB**

1. To determine the metacentric height of a floating vessel under loaded and unloaded conditions.
2. To study the flow through a variable area duct and verify Bernoulli's energy equation.
3. To determine the coefficient of discharge for an obstruction flow meter (venturi meter/ orifice meter)
4. To determine the discharge coefficient for a V- notch or rectangular notch.
5. To study the transition from laminar to turbulent flow and to ascertain the lower critical Reynolds number.
6. To determine the hydraulic coefficients for flow through an orifice.
7. To determine the friction coefficients for pipes of different diameters.
8. To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.
9. To determine the velocity distribution for pipeline flow with a pitot static probe.
10. Experimental evaluation of free and forced vortex flow.

**BTMR 407 Workshop Technology Lab****Casting:**

1. To determine clay content, moisture content, hardness of a moulding sand sample.
2. To determine shatter index of a moulding sand sample.
3. To test tensile, compressive, transverse strength of moulding sand in green condition.
4. To determine permeability and grain fineness number of a moulding sand sample.

**Welding:**

1. To make lap joint, butt joint and T- joints with oxy- acetylenegas welding and manual arc welding processes
2. To study MIG, TIG and Spot welding equipment and make weld joints by these processes.

**Machining and Forming**

1. To study constructional features of following machines through drawings/ sketches:
  - a. Grinding machines (Surface, Cylindrical)
  - b. Hydraulic Press
  - c. Draw Bench
  - d. Drawing and Extrusion Dies
  - e. Rolling Mills
2. To grind single point and multipoint cutting tools
3. To prepare job on Lathe involving specified tolerances; cutting of V- threads and square threads.
4. To prepare job on shaper involving plane surface,
5. Use of milling machines for generation of plane surfaces, spur gears and helical gears; use of end mill cutters.
6. To determine cutting forces with dynamometer for turning, drilling and milling operations.

**Note: At least one industrial visit must be arranged for the students for the live demonstration of Casting, Welding, Forming and Machining processes.**

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**BTME 408 Theory of Machines Lab**

1. To draw displacement, velocity & acceleration diagram of slider - crank and four bar mechanism.
2. To study the various inversions of kinematic chains.
3. Conduct experiments on various types of governors and draw graphs between height and equilibrium speed of a governor.
4. Determination of gyroscopic couple (graphical method).

5. Balancing of rotating masses (graphical method).
  6. Cam profile analysis (graphical method)
  7. Determination of gear- train value of compound gear trains and epicyclic gear trains.
  8. To draw circumferential and axial pressure profile in a full journal bearing.
  9. To determine coefficient of friction for a belt-pulley material combination.
  10. Determination of moment of inertia of flywheel.
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# *Fifth Semester*

**(BTMR501) MARINE AUXILIARY MACHINERY****UNIT I ENGINE ROOM LAYOUT**

Layout of main and auxiliary machinery in Engine Rooms in different ships.

**Engine Room Piping Arrangements & Fittings:** Steam and condensate system, water hammering in pipes, Expansion joints in pipelines, Bilge – ballast, fuel oil bunkering and transfer system, bunkering procedure, precautions taken, fuel oil service system to main and auxiliary engines, lubricating oil and Engine cooling system to main and auxiliary engines, central cooling and central priming systems, control and service air system, domestic fresh water and sea water (Hydrophore) service system, drinking water system, fire main system.

**UNIT II VALVES AND COCKS**

Straight way cocks, right angled cock, ‘T’ cock, spherical cock, Boiler gauge glass cock (cylindrical cock).

**Valves:** Globe valves, SDNR valve, swing check valve (storm valve), gate valves, butterfly valves, relief valves, quick closing valves, pressure reducing valves, control valves, change over valve chests, fuel oil transfer chest, valve actuators, steam traps.

**Jointings:** Packings, Insulation of materials, Types,- Various applications. Seals – purpose of bearing seal, description and application of non rubbing seals and rubbing seals, simple felt seal, seals suitable for various peripheral speeds, V-ring seals, Lip seals.

**Filters and strainers:** Filtration, filter elements basket strainers, duplex strainers, edge type strainers, auto-kleen strainers, back flushing strainers, magnetic filter, rotary filters, fine filters.

**UNIT III (OPERATION & MAINTENANCE)**

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

**UNIT IV (THEORY OF OIL PURIFICATION)**

Construction, operation, maintenance of fuel oil and lub oil purifiers, clarifiers together with self de sludge operation. Theory of air compression and uses of compressed air on board. construction, operation, maintenance of main air compress and emergency air compressors.

Types of bow thrusters, operation, maintenance of the same and Deck machinery, operation, maintenance of cargo winches, windless mooring winches.

**UNIT V (METHODS OF SHAFT ALIGNMENT)**

Construction, operation, maintenance of - thrust block. - intermediate shaft. Construction, operation, maintenance stern tube and stern tube bearing both water cooled and oil cooled together with sealing glands. Stresses in shafting, i.e. intermediate shaft, thrust shaft and screw shaft.

**UNIT VI (DRY DOCKING)**

Preparation and procedure to dry docking vessel. Maintenance of hull, underwater fittings and machine maintenance and repairs during dry dock Removal and maintenance of rudder and propeller. Removal and maintenance of tail shaft and stern tube bearing.

**UNIT VII (LINE SYSTEMS)**

Piping diagrams - Drawing and working principle of the line diagram of – Bilge-Ballast- Fuel oil transfer- Fuel oil Service- . Cooling Water – Lubricating oil – Compressed Air - Steam Line – Exhaust Gas - Feed Water.

**TEXT BOOKS:**

1. D.W. Smith, “Marine Auxillary Machinery”, 6th Edition, Butter worths, London, 1987.
2. H.D. McGeorge, “Marine Auxillary Machinery”, 7th Edition, Butter worth, London, 2001.
- 3, DW Smith “Marine Auxiliary Machinery”, 6th edition, Butter Worths, London, 1987.
4. HDMcGeorge, “MarineAuxiliary Machinery” 7th edition, Butter Worths, London, 2001



**(BTMR502) SHIP CONSTRUCTION****UNIT I SHIP 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. Stresses in Ship's structure: Hogging – Sagging – Racking – Pounding – Panting etc., and Strength members to counteract the same.

**Sections and materials use:** Type of sections like angles – Bulb plates flanged beams used in ship construction – Riveting & Welding testing of welds – Fabricated components.

**UNIT II BOTTOM & SIDE FRAMING**

Double bottoms, watertight floors solid and bracket floors – Longitudinal framing keels – side framing like tank side brackets – Beam knee – Web frame etc.,

**Shell & Decks:** Plating systems for shells – Deck plating & Deck Girders-discontinuities like hatches and other openings – supporting & closing arrangements-mid-ship section of ships.

**Bulk heads & Deep Tanks:** water tight bulkheads – Arrangement of platings and stiffeners – water tight sliding doors – Water tight openings through bulkheads for electric cables pipes and shafting – Deep tank for oil fuel or oil cargo corrugated bulkheads.

**UNIT III FORE & AFT END ARRANGEMENTS**

Fore end arrangement, arrangements to resist pounding bulbous bow – Types of sterns stern frame and rudder – Types of rudder – Supporting of rudder – Locking pintle – Bearing pintle – Pallister bearing shaft tunnel – Tunnel bearings.

**UNIT IV FREE BOARD AND TONNAGE**

Significance and details of markings various international Regulations.

**Shipyard Practice:** layout of a shipyard – Mould loft – Optical marking – Automatic plate cutting, Fabrication and assembly etc.,

**Ship Types:** Tankers – Bulk Carriers – Container ships – L.N.G., L.P.G., and Chemical carriers – Lash ships – Passenger ships – Dredgers – Tugs etc., - Constructional details and requirements.

**UNIT V OFFSHORE TECHNOLOGY**

Drilling ships and Platforms – Supply vessels – fire fighting arrangement – Pipe laying ships – special auxiliary service ships.

**Ship Surveys:** Survey rules – Functions of ship classification – Societies – Surveys during construction – Periodical surveys for retention of class.

**TEXT BOOKS:**

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

2. E.A. Stokoe, “Reed’s Ship Construction for Marine Engineers”, 1st Edition, ThomasReed Publication, London, 2000.

**REFERENCES:**

1. A.J. Young, “Ship Construction sketch & Notes”, 1st Edition, Butter worth –Heinemann, London,1980.
2. H.J. Pursey, “Merchant Ship Construction”,

**(BTMR503) ELECTRICAL MACHINE**

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.

Synchronous alternator and motor Armature reaction in synchronous alternator, armature reactance, prediction of voltage regulation, open circuit test, short circuit test, synchronous impedance method, torque/angle characteristics, infinity busbar, synchronizing current, torque and power, hunting of phaseswinging, 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.

**(BTMR504) MECHANICS OF MACHINES - I****UNIT I MECHANISMS**

Introduction – science of mechanisms – terms and definitions – planar, spherical and spatial mechanisms, mobility classification of mechanisms (indexing mechanism, reciprocating mechanisms, etc.,) straight line generators – kinematic inversion – slider crank chain inversions – four bar chain inversions – Grashoff's law – mechanical advantage. Determination of velocities and acceleration in mechanisms – relative motion method (graphical) for mechanisms having turning, sliding and rolling pair – Coriolis acceleration – analysis using vector mathematics for a four bar mechanism - analysis using complex numbers and loop closure equations for slider crank mechanism, inverted slider crank mechanism – four bar mechanism.

**UNIT II SYNTHESIS OF MECHANISMS**

Classification of kinematics synthesis problems – Tchebycheff spacing – two points synthesis – slider crank mechanism – three position synthesis – four bar mechanism and slider crank mechanism – Freudenstein method – analytical and graphical design – four bar linkage for body guidance – design of four bar linkage as a path generator.

**UNIT III CAMS**

Types of cams and followers – followers motions – uniform, parabolic, SHM, cycloidal and polynomial – synthesis of cam profiles for different followers – undercutting in cams – pressure angle – determination of minimum radius of curvature using design charts – Vamum's Nomogram – cams of specified contour – eccentric circle cam.

**UNIT IV THEORY OF GEARING**

Classification of gears, law of gearing, nomenclature – involutes as a gear tooth profile – lay out of an involute gear, producing gear tooth – interference and undercutting – minimum number of teeth to avoid interference, contact ratio, internal gears – cycloid tooth profiles – comparison of involutes and cycloidal tooth forms, non standard spur gears – extended centre distance system – long and short addendum system – epicyclic gear trains – inversions of epicyclic gear trains, specified ratio and torque calculations, automobile differential, Wilson four speed automobile gear box.

**UNIT V CONTROL MECHANISMS**

Governors – gravity controlled and spring controlled – governor characteristics – governor effort and power, gyroscopes – gyroscopic forces and couple – forces on bearing due to gyroscopic action – gyroscopic effects on the movement of air planes and ships, stability of two wheel drive and four wheel drive, gyroscopic effects in grinding machines.

**TEXT BOOKS**

1. Rao, J.S., and Dukkippatti, R.V., "Mechanism and machinery theory", 2nd Edition, Newage international, Mumbai, 1992.
2. Rattan S.S, "Theory of Machines", Tata McGraw-Hill Publishing Company Ltd., NewDelhi, 1998.

**REFERENCES**

1. Shingley J.E. & John Joseph Uivker, Jr., "Theory of Machines and Mechanisms", 2<sup>nd</sup> edition, McGraw-Hill International Editions, London, 1981.
2. Ghosh A and A.K.Mallick, "Theory of Mechanisms and Machines", Affiliated East-West Pvt. Ltd., New Delhi, 1988.

**Transistor:** Transistor as a small signal amplifier and Frequency Response. Transistorised power amplifier. Relation between Maximum Output Power, Efficiency & Power Dissipation. Characteristics and applications of Field Effect Transistor (FET) & Injunction Transistor (IJT).

**Regulated Power Supplies:** Series & Shunt Regulated Power Supplies. Regulator ICs like 78XX, 79XX, 723.

**Oscillators:** Requirements for Oscillations, phase shift Oscillators, Wein Bridge Oscillator, Crystal Oscillators, Decoupling Filters.

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

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

**Operation Amplifier Theory:** Concept of Differential Amplifiers. Its use in OP-AMPS . Linear OP –amp circuits.

**Converters:** Digital To Analog Converters (Binary weighted, R2R) with applications. Analog To Digital Converters (Simultaneous, Counter Type) with applications

**Digital Circuit & Boolean Algebra:** Logic systems, Logic Gates, Codes. Boolean Algebra and simplification of logical equations. Types of flipflops, Shift Registers, Counters, Multiplexers and Demultiplexers.

**TTL & CMOS Logic Families:** TTL NAND gate. Different TTL Series with typical specifications. Development of CMOS Logic. Typical specifications of CMOS family.

**Electronics Instruments:** Cathode Ray Oscilloscope, Digital Voltmeters and frequency meters, Multimeters; Vacuum Tube voltmeter and signal Generators, Signal generation- operation principle – application ; signal generation as used on board ship like measuring and controlling various variables including rpm , pressure, flow, temperature level, strain. Q-meters.

**Industrial Electronics:** Silicon Controlled Rectifier (SCR) and other devices, VI characteristic. Application of Power rectification, Speed control of DC motor, Inverters. Photo Electric Devices. IC 555 Internal Block Diagram, application as Monostable & Bistable Multivibrator.

**Communication Equipment Overview:** Need of Modulation & Demodulation. Generation of AM & FM with waveforms. Pulse Communication. Radio Transmitter & Receivers. Introduction to RADAR.

**Introduction to Microprocessors:** 8085 Microprocessors architecture, instruction sets. Introduction to Microcontrollers.

#### REFERENCE:

1. Power Electronics by - P.S.Bhimbra
2. Digital Principles and Applications - By Malvino Leach
3. Microprocessors and Microcomputers - Ramesh Gaonkar

### (BTMR506) MARINE ORIENTED WORK SHOP

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 starting 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.
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.

**(BTMR507) ELECTRICAL ENGINEERING ELECTRONICS AND MICRO  
PROCESSOR LAB**

**(A) ELECTRICAL ENGG. LABORATORY**

Load Test on D.C. Shunt Motor

Load Test on D.C.Series Motor

O.C.C. & load characteristic of self/separately excited D.C.Generator.

Parallel operation of D.C.Shunt Generator

Speed control of D.C.Shunt Motor.

Load O.C. & S.C. test on single-phase transformer.

Parallel operation of single-phase transformers.

To connect similar single-phase transformers in the following ways.

Y-Y, A-A, A-Y and Y-A.

Pole changing motor for various speeds.

Determination of characteristics of an A/C brush less generator.

Synchronization of 3-phase alternator.

Trouble shooting in Electric Motors and Transformers.

Exercises in Power Wiring and earthing.

**(B) ELECTRONICS / MICROPROCESSOR LABORATORY**

To study the volt-ampere characteristics of a high current semi conductor diode.

To study the volt-ampere characteristics of a diode and Zener diode.

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

To study the volt-ampere characteristics of a Transistor.

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

To study the characteristics of Silicon Control Rectifier.

To study the Transistor Feed Back Amplifier.

To study the Integrated Circuit operational amplifier.

To study the logic training board.

To study the speed control of D.C. motor using Thyristor.

Arithmetic operations using 8085

Logical operations using 8085

Array operations using 8085

Speed & Direction Control of Stepper motor using 8085.

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.
7. Synchrotransmeter 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.



**(BTMR509) COMPUTER AIDED MARINE ENGINEERING DESIGN AND ANALYSIS**  
**LAB****UNIT I ENGINEERING DESIGN AND COMPUTER AIDED DESIGN**

The design process, concept, analysis, feasibility, Selection of materials and manufacturing considerations in design, Design with reference to repairs and reconditioning, specifically for working out at sea with its restrictions and limitations. Role of computers - Computer Aided Engineering - Computer Aided Design - Design for Manufacturability – Computer Aided Manufacturing - Benefits of CAD.

**UNIT II COMPUTER AIDED DESIGN AND FINITE ELEMENT ANALYSIS**

Creation of Graphic Primitives - Graphical input techniques - Display transformation in 2-D and 3-D – Viewing transformation - Clipping - hidden line elimination - Mathematical formulation for graphics - Curve generation techniques - Geometric Modeling – Wireframe, Surface and Solid models - CSG and B-REP Techniques - Features of Solid Modeling Packages - Parametric and features - Interfaces to drafting, Design Analysis - Exposure to FEA packages.

**UNIT III TYPES OF LOADING AND DESIGN CRITERIA**

static loads, impact loads, repeated loads, variable and cyclic loads, combined and reversible loads. Stress concentration and design factors, fatigue strength, modes of failure, design stresses, factor of safety, theories of failure, wear, corrosion, design criteria, S-N curve Goodman and Soderberg equations.

**UNIT IV JOINTS, SHAFTS AND COUPLINGS**

Design of cotter joints, knuckle joints, bolted joints, welded joints, riveted joints. Design of shafts and couplings – Drafting using CAD packages

**UNIT V BELTS, FRICTION CLUTCHES AND BRAKES**

Design of Belt drives and hoists (Wire ropes), Multiple plate clutches, cone clutch, centrifugal clutch block brakes, internally expanding shoe brakes, external band brakes, differential band brakes - Solid modelling using CAD packages.

**TEXT BOOKS:**

1. Goutam Prohit and Goutam Ghosh, “Machine Drawing with AutoCAD”, 1<sup>st</sup> Impression, Dorling Kindersley (India) Pvt., Ltd., New Delhi, 2007
2. J.E. Shigley, “Mechanical Engineering Design”, 1<sup>st</sup> metric edition, McGraw-Hill, New Delhi, 1986.
3. R.S. Khurmi and J.K. Gupta, “Machine Design”, 5<sup>th</sup> Edition, Eurasia publishing, New Delhi, 2005.

4. Sadhu Singh, " Computer Aided Design and Manufacturing ", Khanna Publishers,New Delhi, 1998.

**REFERENCES:**

1. Abdulla Sharif, "Machine Design", 3rd Edition, Dhanpat Roy & Sons, New Delhi,1995.
2. Pandya & Shaw, "Elements Of Machine Design", 1st Edition, CharotarPublishing,Mumbai, 1997.
3. Groover and Zimmers, " CAD / CAM : Computer Aided Design and Manufacturing",Prentice Hall of India, New Delhi, 1994.

# *Sixth Semester*

**(BTMR601)SHIP OPERATION AND MANAGEMENT**

**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.

**Role of classification society**

**Marine Insurance:** Underwriting and loss adjusting principles applied to Marine cargo insurance. Hull policy, particular average General average, P & I Clubs. Ownerships of vessels, Shipping Company and its administration. Capitalization and finance, Economics of new and second hand tonnage. Subsidies.

**Ship Operations :** Planning sailing schedules. Voyage estimates Economic factors. Commercial Shipping Practice. Manning of ships. Engagement and disadvantage of crew D. L. B. Seaman's welfare.

**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.

**(BTME 501) MACHINE DESIGN-1**

1. Meaning of design with special reference to machine design. Definition and understanding of various types of design, Elaborated Design process
2. Design and creativity ; Systematic design conceptualization, product design definition, underlying principles of design in Aesthetics and ergonomics, free body diagram for components design
3. General Design Considerations: a) Concept of tearing, bearing, shearing, crushing, bending etc. b) Selection of materials, Basic criteria of selection of material, their designation, mechanical properties of those materials in brief. c) Study of Stress concentration, factor of safety under different loading conditions,
3. Basic Design: Design for static loading, design for variable loading for both limited and unlimited life, concept of fatigue and endurance strength.
4. Design of fasteners: a) RIVETS: Desing of rivets for boiler joints, lozenge joints (uniform strength joint), eccentrically loaded riveted joints b) BOLTS: Understanding the various stresses/ failure in bolted joints, design of cylindrical covers, basic and eccentrically loaded bolts c) WELDS: Design for various loading conditions in torsion, shear or direct load, eccentrically loaded welded joints. d) MISCELLENEOUS: Design of spigot and socket cotter joint, Gib and Cotter joint and knuckle joint.
5. Design of Transmission Shaft Design of both solid and hollow shafts for transmission of torque, bending moments and axial forces, Design of shaft for critically speed, Design of shaft for rigidity and Design of stepped shafts for assembly
6. Design of Keys and Couplings: Design of sunk keys under crushing and shearing, design of splines, design of sleeve and solid muff coupling, clamp or compression coupling, rigid and flexible flange coupling, design of universal joint
7. Lever design: Basic lever design, design of foot and hand lever, cranked lever, bell crank lever, safety valve lever and shoe brake lever
8. Design of Pipe Joints: Stresses in pipe joints, design of circular flange pipe joint, oval flanged pipe joints, square flange pipe joint

**Text Books**

1. Machine Design by Shigley Tata McGraw hill
2. Machine Design by Juvinal, John-Wiley Publishers
3. Machine Design by Spots, Prentice hall
4. Machine Design by Norton, Prentice Hall
5. Machine Design by Khurmi
6. Machine Design by Goyal and Bahl, Standard Publishers
7. Product Design and Development, Prentice Hall
8. Design Data Book Compiled by PSG College of Engineering & Technology, Coimbatore

**(BTMR602)MECHANICS OF MACHINES – II**

**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.

**Balancing:** Balancing of masses rotation in different planes, dynamic forces at bearings; Primary and secondary balance of multicylinder in-line Engines and configurations.

**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.

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.

**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 multi rotor system. Torsionally equivalent shafts, Geared system.

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

**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.

Whirling of shafts-Whirling of shafts, critical speed, effect to slope of the disc, effect of end thrust.

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

**(BTME 603) FLUID MACHINERY**

1. General Concepts Impulse momentum principle; jet impingement on stationary and moving flat plates, and on stationary or moving vanes with jet striking at the centre and tangentially at one end of the vane; calculations for force exerted, work done and efficiency of jet. Basic components of a turbo machine and its classification on the basis of purpose, fluid dynamic action, operating principle, geometrical features, path followed by the fluid and the type of fluid etc. Euler's equation for energy transfer in a turbomachine and specifying the energy transfer in terms of fluid and rotor kinetic energy changes.
2. Pelton Turbine Component parts and operation; velocity triangles for different runners, work output; Effective head, available power and efficiency; design aspects such as mean diameter of wheel, jet ratio, number of jets, number of buckets with working proportions
3. Francis and Kaplan Turbines Component parts and operation velocity triangles and work output; working proportions and design parameters for the runner; Degree of reaction; Draft tubes - its function and types. Function and brief description of commonly used surge tanks.
4. Centrifugal Pumps Layout and installation; Main elements and their functions; Various types and classification; Pressure changes in a pump - suction, delivery and manometric heads; vane shape and its effect on head-capacity relationships; Departure from Euler's theory and losses; pump output and efficiency; Minimum starting speed and impeller diameters at the inner and outer periphery; Priming and priming devices, Multistage pumps - series and parallel arrangement; submersible pumps. Construction and operation; Axial and mixed flow pumps; Trouble shooting - field problems, causes and remedies.
5. Similarity Relations and Performance Characteristics Unit quantities, specific speed and model relationships, scale effect; cavitation and Thoma's cavitation number; Concept of Net Positive Suction Head (NPSH) and its application in determining turbine / pump setting
6. Reciprocating Pumps :-- Components parts and working; pressure variations due to piston acceleration; acceleration effects in suction and delivery pipes; work done against friction; maximum permissible vacuum during suction stroke; Air vessels
7. Hydraulic Devices and Systems Const., operation and utility of simple and differential accumulator, intensifier, fluid coupling and torque converter, Air lift and jet pumps; gear, vane and piston pumps.

**BOOKS**

1. Hydraulic Turbines by Daughaty RL; McGraw Hill Book Co.
2. Hydraulic Machines by Jagdish Lal; Metropolitan Book Co Pvt. Ltd.
3. Fluid Mechanics and Fluid Power Engineering by Kumar DS; SK Kataria and Sons, Delhi

**(BTMR 603) NAVAL ARCHITECTURE**

**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 rule, Tchebycheff's rule and their applications, Tonnes per Cm. Immersion. Coefficient of form, Wetted surface area, Similar figures. Centre of gravity, effect of addition and removal of masses, Effect of suspended mass.

**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. Resistance & Power : Frictional, Residuary & Total resistance, Froude's Law of comparison, Effective power calculations, Ships correlation Factor (SCF), Admiralty co-efficient, Fuel Coefficient and Fuel consumption. Effect of viscosity and application of ITTC formula.

**Longitudinal Stability and trim :** 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.

**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.

**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.

**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.



**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.

**(BTMR604)MARINE BOILERS WORKSHOP**

**Types of marine boilers**, comparison of smoke tube and water boilers;

**Smoke Tube Boilers:** Various types in marine use, Principal dimensions and staying of flat surface of multitubular cylindrical Boilers. Vertical Auxiliary Boilers. Water Tube Boilers

**Superheater**, Economizer, Air preheater & steam preheater; circulation and use of Unheated Down comers in highly rated boilers; Superheat temperature control.

**Attemperators and Desuperheaters.** Waster heat boilers; Waste heat recovery calculation

**Safety Valves-** Improved High Lift, Full lift and full Bore type: Gauge glass- Ordinary plate type and remote Indicator.

**(BTME606)FLUID MACHINERY LAB**

1. Determination of various efficiencies of Hydraulic Ram
2. To draw characteristics of Francis turbine
3. To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance
4. To draw the characteristics of Pelton Turbine
5. To draw the various characteristics of Centrifugal pump
6. Determine the effect of vane shape and vane angle on the performance of centrifugal fan

**(BTMR605)FIRE FIGHTING,CONTROLS AND SIMULATOR**  
**LABORATORY**

1. Fire hazard aboard ships – inflammability, fire extinguishing use. Control of class A, B & C fires.
2. Fire protection built in ships, extinction systems, and escape means.
3. System for tankers, statutory requirements for fire fighting systems and equipments on different vessels.
4. Fire fighting equipment: fire pumps, hydrants and hoses, couplings, nozzles and International shore connection, Construction, Operation and merits of different types of portable extinguishers.
5. Non-portable and fixed fire extinguishers, installation for ships. Properties of chemical used, bulk carbon-di-oxide, and inert gas systems.
6. Firemen outfit its use and care, maintenance, testing and recharging of appliances, preparation, and fire appliance survey.
7. Fire Control: Action required and practical techniques adopted for extinguishing fires in accommodation, machinery spaces, boiler rooms, Cargo holds, galley etc.,
8. Fire fighting in port and dry dock. Procedure for re-entry after putting off fire, rescue operations from affected compartments.
9. First aid, Fire organisation on ships. Fire signal and muster.

**(BTMR606) MATERIAL LABORATORY**

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.

To determine the hardness of materials by indenting a hardened steel ball into the specimen undertest 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

# *Seventh/Eighth*

# *Semester*

**(BTME 803) MECHANICAL VIBRATIONS**

1. Introduction ; Basic concepts, Methods of vibration analysis, Types of vibration, Periodic & Harmonic vibrations .
2. undamped free vibrations, damped free vibrations and damped force vibrations of single degree of freedom system, vibration isolation transmissibility. vibration measuring instruments.
3. Two degrees of Freedom systems: a) principal modes of vibrations, natural frequencies, amplitude ratio, forced harmonic vibration .combined rectilinear & angular modes. b) Application; Vibration absorber - principle, centrifugal pendulum vibration absorber, torsional vibration damper, untuned viscous damper, dry friction dampers, torsional vibration of two rotor systems.
- 4 a) Multi-degree of freedom systems: undamped free vibrations, influence coefficients, generalised coordinates, orthogonality principal, matrix alteration methods, Rayleigh and Dunkerley, Holzer's , Stodola method, Eigen values & eigen vector b) continuous systems: Vibration of a string, longitudinal vibrations of bars, Euler's equation of motion for beam vibration, natural frequencies for various end conditions, torsional vibration of circular shafts

**Books:**

1. Mechanical Vibrations by GK Grover, Hem chand and Bros, Roorkee
2. Mechanical Vibrations by KK Purjara, Dhanpat Rai and Sons, Delhi
3. Mechanical Vibrations by V.P. Singh,

**(BTME 804) REFRIGERATION AND AIR CONDITIONING**

1. Basic Concept Natural and Mechanical refrigeration; Application of Refrigeration; Units of refrigeration and Coefficient of performance; Refrigeration effect, cooling capacity and COP of a refrigerator; heating effect, heating capacity and COP as heat pump; Reversed Carnot cycle and its limitations
2. Bell Coleman Cycle and Aircraft Refrigeration Bell Coleman Cycle and its analysis; optimum COP and pressure ratio, necessity of air craft refrigeration - air cycle refrigeration systems and their comparison
3. Vapour Compression Refrigeration Cycle Vapour compression cycle on P-V, P-H and T-S diagrams; Deviation of actual cycle from theoretical cycle; Compressor capacity and volumetric efficiency, Analysis of theoretical and actual vapour compression cycles; Effect of suction pressure, discharge pressure, subcooling, super heating and pressure drop in valves on performance and cooling capacity.
4. Vapour Compression Refrigeration with Multiple Evaporators and Compressors Compound compression with single and multiple expansion valves, water intercooling and flash intercooling; multiple load systems with single and multiple expansion valves
5. Vapour Absorption Refrigeration Cycle (No Mathematical Analysis) Principle of absorption system; components of the system; Desirable properties of absorption system refrigerant and absorbent; Aqua - ammonia absorption refrigeration system; Lithium Bromide - water absorption system; Theory of mixtures; temperature concentration and enthalpy concentration diagrams; comparison between absorption and compression systems; Electrolux refrigeration system.
6. Refrigerants Classification and nomenclature of refrigerants; Desirable thermodynamic, chemical and physical properties of refrigerants; comparative study of commonly used refrigerants and their fields of application; Azeotropes; Effect of moisture and oil miscibility; Refrigerants dyeing agents and antifreeze solution; leak detection and charging of refrigerants; environmental aspects of conventional refrigerants; Ecofriendly refrigerants and action plan to reduce ecological hazards.
7. Non-Conventional Refrigeration Systems (No Mathematical Analysis) Steam Jet Refrigeration; Cascade Refrigeration System; Mixed Refrigeration Systems; Vortex Tube Refrigeration, Thermoelectric cooling; Linde and Claude cycles, cryogenics and its engineering applications.
8. Air Conditioning Concept and Applications; Psychometric properties of air; Dry bulb, wet bulb and dew point temperatures; Relative and specific humidity; degree of saturation adiabatic saturation temperature, enthalpy of air and water vapours; psychometric chart. Human requirement of comforts; effective temperature and comfort charts; Industrial and comfort air conditioning.
9. Psychometric Processes Sensible heating and cooling, cooling with dehumidification; Heating with dehumidification; by-pass factor; chemical dehumidification; adiabatic mixing, air washer.
10. Calculations for Air –conditioning Load and for Rate and state of Supply Air Sources of heat load; sensible and latent heat load; sensible heat factor; apparatus dew point temperature; Rate and state of supply - air for air- conditioning of different types of premises.
11. Refrigeration and Air Conditioning Equipment Brief description of compressors, condensers, evaporators and expansion devices; Cooling towers; Ducts; dampers; grills; air filters; fans; room air conditioners; split units; Package and central air conditioning plants.

**BOOKS**

1. Refrigeration and Conditioning by CP Arora, Tata McGraw Hill
2. Refrigeration and Conditioning by Manohar Prasad, Wiley Eastern Limited
3. Refrigeration and Conditioning by Jordan and Priester, Prentice Hall of India
4. Refrigeration and Conditioning by WF Stoecker, McGraw



1. Understand the selection/ Design of each of the transmission components
  - a) Flat, V-Belt and rope drive
  - b) Chain drives
  - c) Gear drives of different types
  - d) Selection of sliding and rolling bearings and their housing
  - e) Flywheel and pulley
  - f) Closed coiled, helical and leaf springs
  - g) Various types of clutches and brakes
  - h) Lubrication in the transmission systems
2. To learn the design or design modification for manufacturing and assembly
3. To understand the basic concept of computer aided design i.e.
  - a) The basic Theory of CAD Techniques
  - b) Design strategies of different CAD/Softwares
  - c) Functioning/ Structure of CAD Softwares
4. To handle live projects of transmission systems efficiently Detailed Contents 1. Design of Flat belt, V-belt and rope (steel wire), Design of the pulley for the same 2. Selection of Chain Drive 3. Design of spur, helical, straight bevel gears, worm and worm wheel 4. Bearing Selection, Design of sliding and rolling type of bearings, Detailed of bearing housing
5. Design of Flywheel for different operation
6. Design of Close-coil, Helical and Leaf springs
7. Design of Contact clutches i.e. Plate and cone types, Band, Block, Band and block brakes
8. Design of Lubrication in transmission system
9. Computers in Design: Basic Theory of CAD Software, structure of CAD software, Design Philosophy, Structure of CAD Softwares, Designing a CAD Software

### **BOOKS**

1. Machine Design by Shigley Tata McGraw hill
2. Machine Design by Juvinall, John-Wiley Publishers
3. Machine Design by Spots, Prentice hall
4. Machine Design by Norton, Prentice Hall
5. Machine Design by Sharma, Aggarwal, Kataria Publishers
6. Machine Design by Goyal and Bahl, Standard Publishers

### **(BTMR703) Project**

### **(BTMR704)ELECTIVE**

### **(BTME 812) REFRIGRATION AND AIR CONDITIONING LAB**

1. Study of various elements of a mechanical refrigerator system through cut sections models / actual apparatus
2. Study and performance of domestic refrigerator,

3. Study the performance of and Electrolux refrigerator
4. Study of an Ice plant and visit to a cod storage for study
5. Calculation/ Estimation of cooling load for large building
6. Visit to a central Air conditioning plant for study of processes for winter and summer air conditioning
7. Study and performance of window type room air conditioner

# *ELECTIVE*

**(BTMR 702) SHIP SAFETY, ENVIRONMENTAL PROTECTION & SAFE WATCH  
KEEPING**

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. 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.

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.

**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.

**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.

**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.

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.

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. Personal Safety & social Responsibility – Different aspects of personal relationships on board.

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.

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.

C) STCW Convention & Safe Watch-keeping –

Standards of Training, certification & Watch-keeping for sea farers-InternationalConference of 1978.

**(BTMR703) Marine control engineering & Automation**

**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.

**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.

**Process Control Systems :** Automatic Closed loop process. Control system Dynamic characteristic of Processes. Dynamic characteristic of controllers. Practical pneumatic controllers. Electronic Instrumentation for Measurement and control.

**Analog Computing and Simulation :** Introduction, Basic concepts. Analog computers. Simulation. The use of Digital computer in the simulation control system. Hybrid Computers.

**Transmission :** Pneumatic and electric transmission, suitability for marine use. Pneumatic and types of Controllers hydraulic, electric and electronic controllers for generation of control action. Time Function controllers. Correcting Units : Diaphragm actuators, Valve-positioners, piston actuators, Electro-pneumatic transducers. Electro-hydraulic actuators and Electric actuator control valves.

**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 scavenging air, fuel oil viscosity control Bridge control of main machinery. Instrument for UMS classification.

**(BTMR704) ENVIRONMENTAL SCIENCE AND ENGINEERING****UNIT I COMPONENTS OF ENVIRONMENT**

Components – Water, air and land – Inter-relationship between components –Subcomponents; Ecosystem – Structure and functional components of ecosystem –Development and evolution of ecosystem – Energy flow and material cycling inecosystem – Natural and man made impacts on water, air and land; Environment anddevelopment – Concept of sustainable development.

**UNIT II SCIENCE OF ENVIRONMENT**

Chemistry, Physics and biology of water, air and land; Stress on the Chemistry, Physicsand Biology of water, air and land owing to the impacts; Environmental quality objectiveandgoals – policies on development projects and their impacts, with emphasis on thebranch of engineering of the student.

**UNIT III CURRENT ENVIRONMENTAL ISSUES**

Current Environmental issues at country level – management of municipal sewage,municipal solid waste, Hazardous waste and Bio-medical waste – Air pollution due toindustries and vehicles; Global issues – Biodiversity, Climate change, Ozone layerdepletion.

**UNIT IV ENGINEERING INTERVENTIONS TO REDUCE  
THE ENVIRONMENTAL STRESSES**

Minimisation of Stress – Principles of Physics, chemistry and biology in engineeringinterventions such as waste treatment – Flow sheets of engineering interventionsrelevant to the Engineering discipline of the student – Waste minimization techniques –Clean technology options – Standards of performance of the interventions.

**UNIT V****(A) TOOLS FOR ENVIRONMENTAL MANAGEMENT**

Environmental impact assessment; Precautionary Principle and Polluter Pays Principle;Constitutional provisions, Legal and economic instruments in EnvironmentalManagement; Role of Non-government organisations – Community participationenvironmental management works; International conventions and protocols; PollutionControl Boards and Pollution Control Acts.

**(B) FIELD STUDY**

In-depth study of environmental issues at least one environmentally sensitive siterelevant to the discipline of the student and preparation of a report thereupon.

**TEXT BOOKS:**

1. G.M. Master, “Introduction to Environmental Engineering & Science”, Prentice Hall, New Delhi, 1997.
2. J.G. Henry and G.W. Heike, “Environmental Science & Engineering”, Prentice Hall International Inc., New Jersey, 1996.

**REFERENCES:**

1. S.K. Dhameja, Environmental Engineering and Management, S. K. Kataria and Sons, New Delhi, 1999.
  2. State of India's Environment – A Citizen's Report, Centre for Science and Environment and others, 1999.
  3. Shyam Divan and Armin Rosencranz, Environmental Law and Policy in India, Cases, Materials and Statutes, Oxford University Press, 2001.
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