IK Gujral Punjab Technical University Jalandhar, Punjab, INDIA
Study Scheme & Syllabus of B. Tech Mechanical Engineering Batch 2018 onwards
Branch / course: Mechanical Engineering
Total credits (4 year course)

Semester III (Second year]
Branch/Course Mechanical Engineering

Sl. No.	Category	Code	Course Title	Hours per week			Total contact hours	Credits
				Lecture	Tutorial	Practical		
1	Professional Core courses	BTME301-18	Fluid Mechanics	3	1	0	4	4
2	Professional Core courses	BTME302-18	Theory of Machines - I	3	1	0	4	4
3	Professional Core courses	BTME303-18	Machine Drawing	1	0	4	3	3
4	Engineering Science courses	BTEC305-18	Basic Electronics Engineering	3	0	0	3	3
5	Professional Core courses	BTME304-18	Strength of Materials-I	3	1	0	4	4
6	Professional Core courses	BTME305-18	Applied Thermodynamics-I	3	1	0	4	4
7.	Professional Core courses	BTME306-18	Mech. Engg. Lab-I (SOM, TOM-I, Fluid Mechanics)	0	0	4	4	2
8	Mandatory courses	BMPD301-18	Mentoring and Professional Development	0	0	2	2	Non-Credit
							Total credits	**24**

Semester IV (Second year]
Branch/Course Mechanical Engineering

Sl. No.	Category	Code	Course Title	Hours per week			Total contact hours	Credits
				Lecture	Tutorial	Practical		
1	Professional Core courses	BTME401-18	Applied Thermodynamics-II	3	1	0	4	4
2	Professional Core courses	BTME402-18	Fluid Machines	3	1	0	4	4
3	Professional Core courses	BTME403-18	Strength of Materials-II	3	1	0	4	4
4	Engineering Science courses	BTME404-18	Materials Engineering	3	0	0	3	3
5	Professional Core courses	BTME405-18	Theory of Machines-II	3	1	0	4	4
6	Mandatory courses	EVS101-18	Environmental Science	2	-	-	-	0
7	Professional Core courses	BTME406-18	Mechanical Engg. Lab-II (Applied Thermodynamics, Fluid Machines, Material Engineering)	0	0	4	4	2
8	Mandatory courses	BMPD401-18	Mentoring and Professional Development	0	0	2	2	Non-Credit
							Total credits	**21**

BTME301-18 FLUID MECHANICS

Course Outcomes:

After studying this course, students will be able to:

1. Understand the concept of fluids and their properties.
2. Apply the concept to solve the problems related to statics, dynamics and kinematics of fluids.
3. Use and apply dimensional analysis and similitude techniques to various physical fluid phenomena.
4. Distinguish various types of flows and learn flow measurement methods.

Detailed Contents:

1. 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. **02 Hrs**

2. 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 subject to: (i) constant acceleration along horizontal, vertical and inclined direction (linear motion), (ii) constant rotation. **06 Hrs**

3. 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. **07 Hrs**

4. 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 motionand 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. **07 Hrs**

5. Dimensional Analysis and Similitude: Need of dimensional analysis; Fundamental and derived units; Dimensions and dimensional homogeneity; Rayleigh's and Buckingham's π - method for dimensional analysis; Dimensionless numbers (Reynolds, Froude, Euler, Mach, and Weber) and their significance; Need of similitude; Geometric, kinematic and dynamic similarity; Model and prototype studies; Similarity model laws. **04 Hrs**

6.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. **06 Hrs**

7.Pressure and Flow Measurement: Manometers; Pitot tubes; Various hydraulic coefficients; Orifice meters; Venturi meters; Borda mouthpieces; Notches (rectangular, V and Trapezoidal) and weirs; Rotameters. **04 Hrs**

Suggested Readings / Books:

1. S.K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill Publications, 3rd edition, 2011.
2. D.S. Kumar, "Fluid Mechanics and Fluid Power Engineering", S.K. Kataria and Sons Publishers, 1st Edition, 2009.
3. C.S.P. Ojha, R. Berndtsson and P.N. Chandramouli, "Fluid Mechanics and Machinery", Oxford University Press,1st Edition, 2010.
4. Y.A. Cengel and J.M. Cimbala, "Fluid Mechanics - Fundamentals and Applications", Tata McGraw Hill Publications, 3rd Edition, 2013.
5. V.L. Streeter, E.B. Wylie and K.W. Bedford, "Fluid Mechanics", McGraw Hill BookCompany, New York, 9th Edition, 1998.
6. Frank M. White, "Fluid Mechanics", Tata Mc Graw Hill Publications, 5th Edition, 2012.

BTME302-18 THEORY OF MACHINES -I

Course Outcomes:

After studying this course, students will be able to:

1. Understand constructional and working features of important machine elements.
2. Design belt, rope and chain drives for transmission of motion from one shaft to another.
3. Identify different Cam and follower pairs for different applications and construct cam profile for required follower motion.
4. Understand the function of brakes, dynamometers, flywheel and governors.

Detailed Contents:

1. 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 Corliolis Components. **06 Hrs**

2. 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. **05 Hrs**

3. 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. **05 Hrs**

4.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 camprofiles with various motions (SHM, uniform velocity, uniform acceleration and retardation,cycloidal Motion). Analysis of follower motion for circular, convex and tangent cam profiles. **05 Hrs**

5.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). **06 Hrs**

6.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. **03 Hrs**

7.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. **06 Hrs**

Suggested Readings / Books:

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

BTME303-18 MACHINE DRAWING

Course Outcomes:

After studying this course; the student will be able to:

1. Read, draw and interpret the machine drawings and related parameters.
2. Use standards used in machine drawings of machine components and assemblies.
3. Learn the concept of limits, fits and tolerances in various mating parts.
4. Visualize and generate different views of a component in the assembly.
5. Use CAD tools for making drawings of machine components and assemblies.

Note:

1. Drawing Practice is to be done as per IS code SP 46:2003 by Bureau of Indian Standards.
2. The Question paper shall have following structure/weightage:
   Section A – Short answer type Questions based upon whole syllabus – 10 question of 02 marks each (All questions are compulsory).
   Section B – Free hand sketching of machine parts etc.; – out of 03 questions of 05 marks each, 02 Questions are to be attempted.
   Section C – Assembly drawing (from Unit-III) of machine parts with at least two views (with bill of materials) – out of 02 questions of 30 marks each;01 question is to be attempted.

Detailed Contents:

1. Introduction: Classification of drawings, Principles of drawing, Requirements of machine Drawing, sectional views and conventional representation, dimensioning, concept of limits, fits & tolerances and their representation, machining symbols, various types of screw threads, types of nuts and bolts, screw fasteners, welded joints and riveted joints, introduction and familiarization of code SP 46:2003 by Bureau of Indian Standards. **15 Hrs**

2.Free hand sketches of:

a. **Couplings**: solid and rigid couplings, protected type flange coupling, pin type flexible coupling, muff coupling.
b. Knuckle and cotter joints.
c. **Pipe and Pipe fittings**: Flanged joints, spigot and socket joint, union joint, hydraulic and expansion joint. **15 Hrs**

3.Assembly of:

a. **IC Engine Parts:** piston and connecting rod.
b. **Boiler Mountings**: Steam stop valve, blow off cock, feed check valve and spring loaded safety valve.
c. **Bearing:** Swivel bearing, Plummer Block and Foot Step bearing.
d. **Miscellaneous:** Screw jack, Tail Stock and crane hook. **20 Hrs**

4. Practice using Computer Aided Drafting (CAD) tools for:

(a) Machine components, screw fasteners, Keys cotters and joint, shaft couplings, Pipe joints and fittings, riveted joints and welded Joints.

(b) Assemblies: - Bearings (Plumber Block, Footstep, Swivel), boiler mountings, screw jack, Exercise in computer Plots of drawing

(c) Case studies in computer plots and industrial blueprint **10 Hrs**

Suggested Reading/Books:

1. P.S Gill, "Machine Drawing", S K Kataria and sons, 18th edition, 2017 reprint
2. N.D.Bhatt, "Machine Drawing". Charotar publications, 49th edition, 2014
3. Ajeet Singh, "Machine Drawing (including Auto CAD)", Tata McGraw Hill, 2nd edition,2012
4. G. Pohit, "Machine Drawing with Auto CAD", Pearson Education Asia, 2007.
5. IS code SP 46(2003): Engineering Drawing Practice for schools and colleges by Bureau of Indian Standards.

Topic for Self-Learning (TSL)

1.Conventional representation of common feature like Springs, Gear Assembly, Braking of shaft, Pipe, Screw threads etc.

2.Drawing of special Types of bolts, nuts and washers.

3.Importance of bill of materials (BOM)

4.Free hand sketch of bearings (i.e. ball bearing and roller bearing).

BTEC305-18 BASIC ELECTRONICS ENGINEERING

Course Objectives:
The objective of this Course is to provide the students of B.Tech Mechanical Engineering with an introductory and broad treatment of the field of Electronics Engineering to facilitate better understanding of the basic Electronics devices.

Course Outcomes:
After undergoing this course students will be able to

1. Understand construction of diodes and their rectifier applications.
2. Appreciate the construction and working bipolar junction transistors and MOSFETs.
3. Design Op-Amp IC based fundamental applications.
4. Comprehend working of basic elements of digital electronics and circuits.

Unit I: **Semiconductor Diodes and Applications** - Semiconductor Diode - Ideal versus Practical, Diode as a Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Breakdown Mechanisms, Zener Diode – Operation and Applications; Opto-Electronic Devices – LEDs, Photo Diode and Applications;

Unit II: **Transistors & Amplifiers** - Bipolar Junction Transistor (BJT) – Construction, Operation, Common Base, Common Emitter and Common Collector Configurations, Distortion, Operating Point, Voltage Divider Bias Configuration; Introduction to nMOS and pMOS.

Unit III: Operational Amplifiers and Applications - Introduction to Op-Amp, Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground, Op-Amp Applications – Adder, Subtractor, Voltage Follower and Comparator; Differentiator and Integrator, Square Wave and Triangular Wave Generation.

Unit IV: Digital Electronics -Boolean Algebra - Binary, Octal, Hexadecimal Number Systems, Addition, Subtraction using 1's and 2's compliment method, Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR Integrated Circuits (ICs); K-Map simplification Truth Tables and Functionality of Flip-Flops – SR, JK and D Flip-Flop.

Text/Reference Books:

1. David. A. Bell (2003), Laboratory Manual for Electronic Devices and Circuits, Prentice Hall, India.
2. SantiramKal (2002), Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India.
3. Thomas L. Floyd and R. P. Jain (2009), Digital Fundamentals by Pearson Education.
4. Paul B. Zbar, A.P. Malvino and M.A. Miller (2009), Basic Electronics – A Text-Lab. Manual, TMH
5. R. T. Paynter (2009), Introductory Electronic Devices & Circuits, Conventional Flow Version, Pearson.

BTME304-18 STRENGTH OF MATERIALS-I

Course Outcomes:

At the end of the course, the student will be able to

1. Understand the concepts of stress and strain at a point, in the members subjected to axial, bending, torsional loads and temperature changes.
2. Determine principal stresses, maximum shearing stress and their angles, and the stresses acting on any arbitrary plane within a structural element.
3. Find bending moment and shear force over the span of various beams subjected to different kinds of loads.
4. Calculate load carrying capacity of columns and struts and their buckling strength.
5. Evaluate the slope and deflection of beams subjected to loads.

Detailed Contents:

1.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. Generalized Hook's law, principal stresses related to principal strains. **08 Hrs**

2.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 different loads: Concentrated loads, Uniformity distributed loads over the whole span or part of span, Combination of concentrated and uniformly distributed load, Uniformly varying loads and Application of moments. **06 Hrs**

3.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. **05 Hrs**

4.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. **05 Hrs**

5.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.

05 Hrs

6.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: Cantilevers, Simply supported beams with or without overhang, Under concentrated loads, uniformly distributed loads or combination of concentrated &uniformly distributed loads. **07 Hrs**

Suggested Readings/Books:

1. Timoshenko and Gere, "Mechanics of Materials", CBS Publishers and Distributors, New Delhi.
2. Pytel&Kiusalaas, "Mechanics of Materials", Cengage Learning, New Delhi.
3. S. S. Rattan, "Strength of Materials", Tata McGraw Hill, New Delhi.
4. R. K. Bansal, "A Text Book of Strength of Materials", Laxmi Publications, New Delhi.
5. D. K. Singh, "Strength of Materials", Ane Books Pvt. Ltd., New Delhi.
6. Sadhu Singh, Strength of Materials, Khanna Publishers, Delhi.

BTME305-18 APPLIED THERMODYNAMICS-1

Course Outcomes:

After studying this course, students will be able to:

1. Learn the functioning and performance evaluation of reciprocating air compressors.
2. Analyze the combustion phenomenon in boilers and I.C. engines.
3. Use of Steam Tables and MollierChart to solve vapour power cycle problems.
4. Explain the constructional features and working of steam power plants and to evaluate their performance.

1.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 and 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. **5 Hrs**

2. Thermodynamics of Combustion in Boilers and IC Engines: Principle of Combustion; Stoichio-metric and non-stoichiometeric combustion; Combusion Problems in boilers & 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/combustion and it's evaluation; first law analysis of reacting system: steady flow and Closed Systems, adiabatic flame temperature and its determination. Various stages of combustion in IC Engines. **5 Hrs**

3. Steam: Properties of Steam Pure substance ; Steam and its formation at constant pressure: wet, dry, super-saturated and super-heated (*super-saturated*) steam; Sensible heat*(sensible enthalpy)*, latent heat (*latent enthalpy*) and total or stagnation heat (*total or stagnation 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 Charts; Basic thermodynamic processes with steam(isochoric, isobaric, isothermal, isentropic and adiabatic processes) and their representation on T-S Charts and Mollier Charts(**h-s** diagrams), significance of Mollier Charts. **5 Hrs**

4. 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. **5 Hrs**

5. SteamNozzles: 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; Convergert andConvergant-divergant nozzles. Calculation of Nozzle dimensions(length and diameters of throat and exit); Supersaturated(or metastable) flow through nozzle. **5 Hrs**

6. Steam Turbines(Impulse Turbine): Introduction; Classification; Impulse versus Reaction turbines. Simple impulse/**De Level** turbine: pressure and velocity variation, 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, maximum work and maximum efficiency overall efficiency and relative efficiency, effect of blade friction on velocity diagram, effect of speed ratio on blade efficiency, condition for axial discharge. **5 Hrs**

7.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. **5 Hrs**

8. 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. **5 Hrs**

Suggested Books:

1. R. Yadav, "Applied Thermodynamics", Central Publishing House , Allahabad.
2. D.S. Kumar and V.P. Vasandani, "Heat Engineering", Metropolitan Book Co. Pvt. Ltd.
3. G Rogers and Y. Mayhew , "Engineering Thermodynamics", Pearson, Wesley Longman (Singapore) Pte, 482 F.I.E Patparganj, Delhi-110 092.
4. W.A.J. Keartan, Steam Turbine: , "Theory and Practice", ELBS Series.
5. V. Ganeshan, "Internal Combustion Engines", Tata McGraw Hill Education Pvt. Ltd., 7 West Patel Nagar, New Delhi-110 008.
6. P.K.Nag, "Basic & Applied Thermodynamics", Tata McGraw Hill Education Pvt. Ltd., 7 West Patel Nagar, New Delhi-110 008.
7. P.K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Education Pvt. Ltd., 7 West Patel Nagar, New Delhi-110 008.
8. E.F. Obert, "Concepts of Thermodynamics", Tata McGraw Hill Education Pvt. Ltd., 7 West Patel Nagar, New Delhi-110 008.
9. C.P. Arora, "Thermodynamics", Tata McGraw Hill Education Pvt. Ltd., 7 West Patel Nagar, New Delhi-110008.

BTME306-18 MECHANICAL ENGINEERING LAB – 1

Course Outcomes:

After studying this course, students shall be able to:

1. Measure the various mechanical properties such as tensile and compressive strength, impact strength, torsion strength and fatigue strength and hardness of brittle and ductile materials.
2. Calculate load carrying capacity of long columns and their buckling strength.
3. Determine gyroscopic couple, balancing of rotating masses and Cam profile analysis.
4. Determine gear- train value of compound gear trains and epicyclic gear trains.
5. Distinguish various type of flows and flow measurement methods and concept of statics and dynamics of liquids.
6. Determine discharge and head loss, hydraulic and friction coefficient, for different types of flow in pipe and open channels.

Unit 1: Strength of Materials Lab.

1.1 To perform tensile and compression test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.

1.2 To perform any hardness tests (Any one from Rockwell, Brinell &Vicker's test).

1.3 To perform impact test to determine impact strength.

1.3 To perform torsion test and to determine various mechanical properties.

1.4 To perform Fatigue test on circular test piece.

1.5 To perform bending test on beam and to determine the Young's modulus and modulus of rupture.

1.6 Determination of Bucking loads of long columns with different end conditions.

Unit 2: Theory of Machines Lab.

2.1 Conduct experiments on various types of governors and draw graphs between height and equilibrium speed of a governor.

2.2 Determination of gyroscopic couple (graphical method).

2.3 Balancing of rotating masses (graphical method).

2.4 Cam profile analysis (graphical method)

2.5 Determination of gear- train value of compound gear trains and epicyclic gear trains.

2.6 To draw circumferential and axial pressure profile in a full journal bearing.

Unit 3: Fluid Mechanics Lab.

3.1 To determine the metacentric height of a floating vessel under loaded and unloaded conditions.

3.2 To study the flow through a variable area duct and verify Bernoulli's energy equation.

3.3 To determine the coefficient of discharge for an obstruction flow meter (venturi meter/ orifice meter)

3.4 To determine the friction coefficients, head loss in pipes.

3.5 To determine the velocity distribution for pipeline flow with a pitot static probe.

3.6 Experimental evaluation of free and forced vortex flow.

BTME401-18 APPLIED THERMODYNAMICS-2

Course Outcomes:

After studying this course, students will be able to:

1. Understand working and performance of IC Engines.
2. Demonstrate the constructional & design features, understand working principles & performance parameters and conduct thermodynamic analysis of rotary compressors.
3. Conduct thermal analysis of gas turbines
4. Conduct thermal analysis of jet propulsion and rocket propulsion systems.

1. IC Engines: Pressure-Time/Pressure-ɵ diagram, Characteristics of the fuel oil for a diesel engine; Combustion process in diesel engine, and various parameters controlling the delay Period; Uncontrolled combustion, Diesel knock or Fuel knock, period of controlled combustion, effect of turbulence on power and efficiency, after-burning etc. **Petrol Engines:** Royal Automobile club rating of Petrol Engines, causes of lower pressure rise during combustion than expected; Process of combustion in a Petrol engine, Ignition lag and factors effecting it, Rate of flame propagation and various factors effecting it, detonation(in Petrol engines) and various factors affecting it; comparison of diesel knock and detonation and effect of various parameters on these; comparison of pre-ignition and detonation; dopes/antiknock substances for SI/CI Engines; Effect of compression ratio and fuel-air ratio on power and efficiency of **(i)** Diesel Engines **(ii)** Petrol Engines. Performance curves for a petrol engine at constant speed; Consumption loops for Petrol and Diesel engines; Effect of turbulence on Petrol and Diesel engines; Dissociation and it's effect on power and efficiency; Octane and Cetane numbers, Knock-meter; Use of high speed cinmetography for observation of burning gases characteristics; various methods of Governing IC Engines; Super-charging and its methods, Advantages of super-charging; Variation of Engine power with altitude; causes of pressure loss at high altitudes and power requirements of Super-chargers; Effect of Super-charger on PV- diagrams of SI Engines; High Speed Engine Indicators: Farnborough balanced Engine Indicator; Cathode-ray Oscillograph Engine Indicator; Construction and working principle of Rotary or Wankel Engine, it's advantages and disadvantages over reciprocating piston engines; application of Wankel Engine; Logrithmic plotting of PV-diagrams. **6 Hrs**

2. 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(for Reciprocating and Rotary compressors) 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 processes 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. Applications of Steady-Flow-Energy Equation and thermodynamics of dynamic(i.e., centrifugal and axial flow machines); Stagnation and static

values of pressure, Temperature and enthalpy (and their co-relation) etc. for flow through dynamic,rotary machines. **5 Hrs**

3. Positive Displacement Rotary Compressors:- Introduction and general classification of rotary Comressors**;** 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. **5 Hrs**

4. Centrifugal Compressors:- Complete thermodynamic analysis of a centrifugal compressor stage; Polytropic, isentropic and isothermal efficiencies; Complete representation of compression process in a centrifugal compressor starting from ambient air flow through the suction pipe, Impeller, Diffuser and finally to the 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 and its effect on efficiency and outcoming ***velocity profile*** from the impeller; Derivation of non-dimensional parameters for plotting compressor characteristics; Centrifugal compressor characteristic curves; Surging and choking in centrifugal compressors. **5 Hrs**

5. 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. **5 Hrs**

6. 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 reheating and their different combinations in the gas turbine cycle and their effects on 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. Gas turbine fuels. **5 Hrs**

7. 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 pulse-jet), **(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. of 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. **5 Hrs**

Suggested Books: -

1. VP Vasandani and DS Kumar, "Heat Engineering"; Metropolitan Book Co. Pvt Ltd., Delhi.
2. R. Yadav, "Thermodynamics and Heat Engines, Vol-II", Central Publishing House, Allahabad.
3. DG Shephered, "Principles of Turbomachinery".
4. Cohen H and Rogers GFC, "Gas Turbine Theory"; Longmans
5. V Kadambi, Manohar Prasad, "An Introduction to Energy Conversion", Wiley Eastern Ltd, AB and Safdarjang Enclave, New Delhi
6. V. Ganeshan ,"Internal Combustion Engines", Tata McGraw Hill Pvt. Ltd.,7 West Patel Nagar, New Delhi-110 008.
7. D.B.Spalding and E.H. Cole,"Engineering Thermodynamic", Edward Wrnold Ltd. And E.L.B.S.(English Language Book Society)

BTME402-18 FLUID MACHINES

Course Outcomes:

After studying this course, students shall be able to:

1. Recognize basic components of turbo machines and understand related fundamental laws/ principles and apply these for calculation of various parameters like work done, force efficiency etc.
2. Know about constructional details, working and design aspects of runner/wheel and evaluate the performance of various turbines like Pelton, Kaplan and Francis.
3. Know about constructional details, working and evaluate the performance of centrifugal pump under different vane shape conditions.
4. Know about constructional details, working and evaluate the performance of reciprocating pump and evaluate the effect of various deviations from the ideal conditions on the work done.
5. Know about constructional details and working of hydraulic devices like fluid coupling, accumulator and intensifier.

Detailed Contents:

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. Euler's equation for energy transfer in a turbo machine and specifying the energy transfer in terms of fluid and rotor kinetic energy changes. **07 Hrs**

2. Pelton Turbine: Component parts and operation; velocity triangles; 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; governing of Pelton turbine. **05 Hrs**

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; governing of reaction turbines. **06 Hrs**

4. Centrifugal Pumps: Layout and installation; Main elements and their functions; Various types and classification; Pressure changes in a pump; Heads of a pump - suction; delivery; static; manometric; total; net positive suction head and Euler’s head; 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; model testing and 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. **06 Hrs**

5. **Similarity Relations and Performance Characteristics:** Unit quantities; specific speed and model relationships; scale effect; Cavitation and Thomas's cavitation number; Concept of Net PositiveSuction Head (NPSH) and its application. **04 Hrs**

6. **Reciprocating Pumps:** Introduction to single acting and double acting reciprocating pumps; their components; and 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; Functions of Air vessels. **05 Hrs**

7. Hydraulic Devices and Systems: Construction; operation and utility of simple and differential accumulator; intensifier; fluid coupling and torque converter; Air lift and jet pumps; gear; vane and piston pumps; Hydraulic Ram; Hydraulic lift; Hydraulic crane and Hydraulic press. **03 Hrs**

Suggested Reading/ Books:

1. R.L. Daughaty, Hydraulic Turbines, McGraw Hill
2. Jagdish Lal, Hydraulic Machines by Metropolitan Book Co
3. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, SK Kataria and Sons,
4. K. Subramaniam, Hydraulic Machines, Tata Mc Graw Hill
5. R.K. Purohit., Hydraulic Machines, Scientific Publishers
6. C.S.P.Ojha, R.Berndtsson, P.Chandramouli, "Fluid Mechanics and Machinery", Oxford University Press, 2010

BTME403-18 STRENGTH OF MATERIALS II

Course Outcomes:

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

1. Apply the basics to find stresses in various applications (shells, curved beams and rotating discs).
2. Analyse the change in dimensions of shells, curved beams and rotating discs under operation.
3. Determine stresses, deflection and energy stored in various kinds of springs subjected to load and twist.
4. Understand the concept of failure theories and strain energy.
5. Evaluate shearing stress variation in beams of different cross-section and materials.

Detailed Contents:

1.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. **05 Hrs**

2.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. **05 Hrs**

3.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. **05 Hrs**

4.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. **05 Hrs**

5.Thick Cylinders: Derivation of Lame'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. **05 Hrs**

6.Bending of Curved Beams: Calculation of stresses in cranes or chain hooks, rings of circular and trapezoidal section, and chain links with straight sides. **04 Hrs**

7.Shear Stresses in Beams: Shear stress distribution in rectangular, circular, I, T and channel section; built up beams. Shear centre and its importance. **04 Hrs**

8.Rotational Discs: Stresses in rotating discs and rims of uniform thickness; disc of uniform strength. **03 Hrs**

Suggested Readings/Books:

1. S. S. Rattan, "Strength of Materials", Tata McGraw Hill, New Delhi.
2. R. K. Bansal, "A Text Book of Strength of Materials", Laxmi Publications, New Delhi.
3. Sadhu Singh, Strength of Materials, Khanna Publishers, Delhi.
4. Kirpal Singh, "Mechanics of Materials", Standard Publishers, New Delhi.
5. R.S. Lehri, "Strength of Materials", Katson Publishers, New Delhi.

BTME404-18 MATERIALS ENGINEERING

Course Outcomes:

After studying this course, students shall be able to:

1. Understand the significance of structure-property-correlation for engineering materials including ferrous and nonferrous.
2. Explain the use and importance of various heat treatment processes used for engineering materials and their practical applications.
3. Understand the various structural changes occurred in metals with respect to time temperature transformations.
4. Understand the significance of Fe-C and TTT diagram for controlling the desired structure and properties of the materials.

Detailed Content:

1. Crystallography: Atomic structure of metals, atomic bonding in solids, crystal structures, crystallattice of body centered cubic, face centered cubic, closed packed hexagonal; crystalline and noncrystalline 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 nonsteady-state diffusion, factors affecting diffusion. Theories of plastic deformation, recovery,re-crystallization. **12 Hrs**

2. Phase Transformation: General principles of phase transformation in alloys, phase rule andequilibrium diagrams, Equilibrium diagrams of Binary systems. Iron carbon equilibrium diagramand various phase transformations. Time temperature transformation curves (TTT curves): fundamentals, construction and applications. **09 Hrs**

3. 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 byalloying elements. Composition of alloy steels. **09 Hrs**

4. Ferrous Metals and Their Alloys: Introduction, classification, composition of alloys, effect ofalloying elements (Si, Mn, Ni, Cr, Mo, W, Al) on the structures and properties of steel. **06 Hrs**

Suggested Readings / Books:

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

BTME405-18 THEORY OF MACHINES-II

Course Outcomes:

After studying this course, students will be able to:

1. Understand the basic concepts of inertia forces & couples applied to reciprocating parts of a machine.
2. Understand balancing of rotating and reciprocating parts of machines.
3. Select suitable type of gears for different application and analyse the motion of different elements of gear trains.
4. Understand the concept and application of gyroscopic effect.
5. Gain knowledge of kinematic synthesis.

Detailed Contents:

1. 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. **05 Hrs**

2. 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. **05 Hrs**

3. 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. **06 Hrs**

4. 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. **07 Hrs**

5. 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. **05 Hrs**

6. 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. **03 Hrs**

7. Kinematic synthesis of Mechanism: Freudenstien equation, Function generation errors in synthesis, two- and three-point synthesis Transmission angles, least square technique. **05 Hrs**

Suggested Readings / Books:

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

BTME406-18 MECHANICAL ENGINEERING LAB –II

Course Outcomes:

After studying this course, students shall be able to:

1. Understand the construction and working of IC engines, and evaluate their performance.
2. Identify the various types of boilers & condensers.
3. Conduct experiments on scaled down models or on actual size hydraulic machines and evaluate results in terms of unit or specific quantities for comparison purpose.
4. Understand the working of various hydraulic machines (turbines and pumps) and can suggest remedial solutions for various faults.
5. Analyse the microstructure of different ferrous and non-ferrous samples.
6. Explore the effect of heat treatment on various engineering materials by analysing its microstructure and hardness.

Unit 1: Applied Thermodynamics Lab

1.1 Study of construction and operation of 2 stroke and 4 stroke Petrol and Diesel engines and to plot actual valve timing diagram of a 4 stroke petrol and diesel engines and study its impact on the performance of engine.

1.2 Study of working, construction, mountings and accessories of various types of boilers.

1.3 To perform a boiler trial to estimate equivalent evaporation and efficiency of a fire tube/ water tube boiler.

1.4 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.

1.5 Determine the brake power, indicated power, friction power and mechanical efficiency of a multi cylinder petrol engine running at constant speed (Morse Test).

1.6 Performance testing of a Petrol and 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 exhaust emission. Draw/obtain power consumption and exhaust emission curves. Also make the heat balance sheet.

Unit 2: Fluid Machines Lab

1.1 Determination of various efficiencies of Hydraulic Ram

1.2 To draw characteristics of Francis turbine/Kaplan Turbine

1.3 To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance

1.4 To draw the characteristics of Pelton Turbine

1.5 To draw the various characteristics of Centrifugal pump

1.6 A visit to any Hydroelectric Power Station

Unit 3: Material Engineering Lab

3.1 Preparation of models/charts related to atomic/crystal structure of metals.

3.2 Hardening/Annealing of steel specimen and study the effect of quenching time/annealing time and temperature on hardness of steel.

3.4 Practice of specimen preparation (cutting, mounting, polishing, etching) of mild steel, Aluminium and hardened steel specimens.

3.5 Study of the microstructure of prepared specimens of Mild Steel, Aluminium and hardened steel.

3.6 Identification of ferrite and pearlite constituents in given specimen of milsteel.

3.7 Determination of hardenability of steel by Jominy End Quench Test.