Semester III (Second year]

Course Type	Course Code	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
Professional Core courses	BTME301-18	Fluid Mechanics	3	1	0	40	60	100	4
Professional Core courses	BTME302-18	Theory of Machines -I	3	1	0	40	60	100	4
Professional Core courses	BTME303-18	Machine Drawing	1	0	6	40	60	100	4
Professional Core courses	BTME304-18	Strength of Materials-I	3	1	0	40	60	100	4
Engineering Science courses	BTEC305-18	Basic Electronics Engineering	3	0	0	40	60	100	3
Professional Core courses	BTME305-18	Basic Thermodynamics	3	1	0	40	60	100	4
Professional Core courses	BTME306-18	Strength of Material (Lab)	0	0	2	30	20	50	1
Professional Core courses	BTME307-18	Theory of Machine (Lab)	0	0	2	30	20	50	1
Professional Core courses	BTME308-18	Fluid Mechanics (Lab)	0	0	2	30	20	50	1
Mandatory courses	BMPD301-18	Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
Total			16	4	14	330	420	750	26

Semester IV (Second year]

Course Type	Course Code	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
Professional Core courses	BTME401-18	Applied Thermodynamics	3	1	0	40	60	100	4
Professional Core courses	BTME402-18	Fluid Machines	3	1	0	40	60	100	4
Professional Core courses	BTME403-18	Strength of Materials-II	3	1	0	40	60	100	4
Engineering Science courses	BTME404-18	Materials Engineering	3	0	0	40	60	100	3
Professional Core courses	BTME405-18	Theory of Machines-II	3	1	0	40	60	100	4
Mandatory courses	EVS101-18	Environmental Science	3	-	-	100	0	100	0
Professional Core courses	BTME406-18	Applied Thermodynamics (Lab)	0	0	2	30	20	50	1
Professional Core courses	BTME407-18	Fluid Machines (Lab))	0	0	2	30	20	50	1
Professional Core courses	BTME408-18	Material Engineering (Lab)	0	0	2	30	20	50	1
Mandatory courses	BMPD401-18	Mentoring and Professional Development	0	0	2	Satisfactory / Un-Satisfactory			Non-Credit
Total			18	4	8	390	360	750	22

Semester V (Third year)

Course Type	Course Code	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
Professional Core courses	BTME501-18	Heat Transfer	3	1	0	40	60	100	4
Professional Core courses	BTME502-18	Design of Machine Elements-I	3	1	0	40	60	100	4
Professional Core courses	BTME503-18	Manufacturing Processes-I	3	0	0	40	60	100	3
Engineering Science courses	BTME504-18	Numerical Methods	3	0	0	40	60	100	3
Mandatory courses	HSMC101-18 /HSMC102-18*	Humanities-I	3	0	0	40	60	100	3
Professiona l Core courses	BTME505-18	Heat Transfer (Lab)	0	0	2	30	20	50	1
Professional Core courses	BTME506-18	Manufacturing Processes (Lab)	0	0	2	30	20	50	1
Engineering science courses	BTME507-18	Numerical Methods (Lab)	0	0	2	30	20	50	1
Mandatory courses	BTMC102-18	Essence of Indian knowledge Tradition	3	0	0	100	00	100	Non-Credit
Total			18	2	6	390	360	750	20

7

Subject offered for Minor Degree in B. Tech. Mechanical Engineering

Core Subjects

Sr. No.	Subject Code	Couse Title	Credits
1	BTME-	Manufacturing Processes-I	3
2	BTME-	Manufacturing Processes-II	3

Elective Subject (Odd Semester)

Sr. No.	Subject Code	Couse Title	Credits
1	BTME301-18	Fluid Mechanics	4
2	BTME302-18	Theory of Machines-I	4
3	BTME304-18	Strength of Materials-I	4
4	BTME305-18	Basic Thermodynamics	4
5	BTME-	Heat Transfer	4

Elective Subject (Even Semester)

Sr. No.	Subject Code	Couse Title	Credits
1	BTME-	Automobile Engineering	4
2	BTME405-18	Theory of Machines-II	4
3	BTME403-18	Strength of Materials-II	4
4	BTME401-18	Applied Thermodynamics	4
5	BTME-	Refrigeration and Air Conditioning	4

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).

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.

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:

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

BTME305-18 BASIC THERMODYNAMICS

Course Objectives:

The course has been designed to cover the interconversion of heat energy into work energy and vice versa; balance of energy between the System and its Surroundings; to learn about the application of First and Second law to various thermodynamic Systems, to learn about gas power cycles and IC Engines, to learn about steam formation and its properties, to learn about vapor power cycles.

Course Outcomes:

1. Apply energy balance to Systems and Control Volumes in situations involving heat and work interactions.
2. Evaluate changes in thermodynamic properties of substances.
3. Evaluate performance of energy conversion devices.
4. Explain and apply various gas power and vapor power cycles.

1. Basic Concepts

Definition of thermodynamics, Concept of Thermodynamic System and of thermodynamic equilibrium, Boundary and Surroundings; Open, Closed and Isolated Systems. Property, state, path, process and cycle; dot/point functions and path functions, Phase and pure substances, Equation of State, reversible, Quasi-static and irreversible processes; Energy and its forms, Energy transfer across the System boundaries. Types of work transfer, heat and work; sign conventions for heat and work interaction, Concept of temperature and heat, microscopic and macroscopic approach, Concept of continuum, Zeroth law of thermodynamics. Concept of thermal equilibrium and principles of thermometry. Ideal gas and characteristic gas equation. (4)

2. First Law of Thermodynamics

Concept of First law of thermodynamics, essence and corollaries of First law; internal energy and enthalpy, analysis of non flow and flow processes for an ideal gas for constant volume(*isochoric*), constant pressure(*isobaric*), constant temperature(*isothermal)*, adiabatic and polytropic processes. Changes in various properties, work done and heat exchange during these processes, free expansion and throtting process and its applications in Engineering processes; Steady Flow Energy Equation and its application to various thermodynamic Systems(ie, in *engineering devices*); (8)

3. Second Law of Thermodynamics

Limitations of First law of thermodynamics, concept of Kelvin Plank and Clausius statements of the Second law and their ***equivalence*** *and* their application *to Refrigerator, Heat Pump and Heat Engine*. Thermodynamic temperature scale, Efficiency and philosophy of Carnot cycle and its consequences, Carnot Engine and Carnot theorem; Carnot refrigerator, Heat Pump and Heat Engines. Clausius theorem; Clausius inequality; concept of entropy, principle

of increase in entropy, representation of various processes on T-S coordinates and change in entropy for different processes, concept of entropy generation in Closed and Open systems, high grade and low grade energy, available and unavailable energy; availability and unavailability, Second law efficiency and energy analysis of Thermodynamic Systems, Third law of Thermodynamics (definition only). (8)

4. Gas Power Cycles

Air-standard efficiency, Nomenclature of Piston-Cylinder arrangement w.r.t. swept volume; clearance volume, compression ratio and mean effective pressure; Analysis and philosophy of Air-Standard Cycles i.e. Otto Cycle, Diesel Cycle and Dual Cycle; their compression ratio, mean effective pressure, power output and Efficiency; Comparison between the three Cycles. (9)

5. Internal Combustion Engines

Classification and application, constructional and working details of two stroke and four stroke cycle engines.

6. Properties of Steam

Pure Substance; steam formation at constant pressure and the properties of steam; use of steam tables, constant volume, constant pressure and isentropic process, simple Ranking cycle. Construction, working, classification and applications of gas turbines, comparison of gas turbines with steam turbines and IC engines, performance analysis of constant pressure gas turbine cycle (Brayton cycle), thermal refinements like regeneration, inter-cooling and re-heating, selection

Suggested Books:

1. Sonntag R. E, Borgnakke C. and Van Wylen G. J., Fundamentals of Thermodynamics, Wiley India Pvt. Ltd.
2. Jones, J. B. and Duggan R. E., Engineering Thermodynamics, Prentice-Hall of India.
3. Moran M. J. and Shapiro H. N., Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag P.K., Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.
5. Mahesh Rathore, Thermal Engineering, McGraw-Hill Education (India) Pvt. Ltd.
6. R. Yadav, Sanjay and Rajay, Applied Thermodynamics, Central Publishing House.

BTME306-18 Strength of Material Lab

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.

List of Practical

1 To perform tensile and compression test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2 To perform compression test on Cast Iron
3 To perform any hardness tests (Any one from 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.

BTME307-18 Theory of Machine (Lab)

Course Outcomes:

After studying this course, students shall be able to:

1. Determine gyroscopic couple, balancing of rotating masses and Cam profile analysis.
2. Determine gear- train value of compound gear trains and epicyclic gear trains.

List of Practical

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.

BTME308-18 Fluid Mechanics (Lab)

Course Outcomes:

After studying this course, students shall be able to:

1. Distinguish various type of flows and flow measurement methods and concept of statics and dynamics of liquids.
2. Determine discharge and head loss, hydraulic and friction coefficient, for different types of flow in pipe and open channels.

List of Practical

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

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

1. Sports/NSS/NCC
2. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

BTME401-18 APPLIED THERMODYNAMICS

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 and super-heated(*super-saturated*) steam; Sensible heat*(sensible enthalpy)*, latent heat(*latent enthalpy*) and total/stagnation heat(*total/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; Areas 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.
5 Hrs

6. Steam Turbines(Impulse Turbine): Introduction; Classification; Impulse v/s Reaction turbines. Simple **impulse**/**De Level** turbine: Pressure and velocity variation, Compounding of impulse turbines: purpose types; pressure and velocity variation, velocity diagrams/triangles; Combined velocity diagram/triangles 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/triangles 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.

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 Applied Thermodynamics (Lab)

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.

List of Practical

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

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 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.

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.

BTME407-18 Fluid Machines (Lab)

Course Outcomes:

After studying this course, students shall be able to:

1. 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.
2. Understand the working of various hydraulic machines (turbines and pumps) and can suggest remedial solutions for various faults.

List of Practical

1	Determination of various efficiencies of Hydraulic Ram
2	To draw characteristics of Francis turbine/Kaplan 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/Blower
7	A visit to any Hydroelectric Power Station

BTME408-18 Material Engineering (Lab)

Course Outcomes:

After studying this course, students shall be able to:

1. Analyse the microstructure of different ferrous and non-ferrous samples.
2. Explore the effect of heat treatment on various engineering materials by analysing its microstructure and hardness.

List of Practical

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. 3.3
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 milsteel.
7	Determination of hardenability of steel by Jominy End Quench Test.

Guidelines regarding Mentoring and Professional Development

The objective of mentoring will be development of:

- Overall Personality
- Aptitude (Technical and General)
- General Awareness (Current Affairs and GK)
- Communication Skills
- Presentation Skills

The course shall be split in two sections i.e. outdoor activities and class activities.
For achieving the above, suggestive list of activities to be conducted are:

Part – A
(Class Activities)

1. Expert and video lectures
2. Aptitude Test
3. Group Discussion
4. Quiz (General/Technical)
5. Presentations by the students
6. Team building Exercises

Part – B
(Outdoor Activities)

3. Sports/NSS/NCC
4. Society Activities of various students chapter i.e. ISTE, SCIE, SAE, CSI, Cultural Club, etc.

Evaluation shall be based on rubrics for Part – A & B
Mentors/Faculty incharges shall maintain proper record student wise of each activity conducted and the same shall be submitted to the department.

ENVIRONMENTAL STUDIES FOR B.TECH CIVIL, ELECTRONICS, ELECTRICAL ENGINEERING, MECHANICAL AND COMPUTER SCIENCE

Sl. No.	Category	Course Code	Course Title	Hours per week			Total contact hrs,	Credits
				Lecture	Tutorial	Practical		
1	Mandatory Non-credit Course	EVS101-18	Environmental Studies	2	0	0	21	0

*** 40 Hours are kept for various activities under the head of activities. There will be a final theory examination for the students of 50 marks but these marks will not be added to their final result as assessment will be satisfactory or non-satisfactory.**

Course Outcomes:

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.
2. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.
3. The students will apply interdisciplinary approach to understand key environmental issues and critically analyze them to explore the possibilities to mitigate these problems.
4. Reflect critically about their roles and identities as citizens, consumers and environmental actors in a complex, interconnected world

Environmental Studies [L:2; T:0; P:0 (Credits-0)]

1. Environment Science (Mandatory non-credit course)

We as human being are not an entity separate from the environment around us rather we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethos. There is a direct application of this wisdom even in modern times. Idea of an activity based course on environment protection is to sensitize the students.

Detailed Contents

Module 1 : Natural Resources :Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources : Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources : Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources : Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources : World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources : Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies.
f) Land resources : Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resoureces for sustainable lifestyles.

Module 2 : Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem.
Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

a. Forest ecosystem
b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3 : Biodiversity and its conservation

- Introduction – Definition : genetic, species and ecosystem diversity.
- Biodiversity at global, National and local levels.
- Inida as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India

Module 4 : Social Issues and the Environment

- From Unsustainable to Sustainable development
- Resettlement and rahabilitation of people; its problems and concerns.
- Environmental ethics : Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion,

  Nuclear accidents and holocaust. Case Studies.

- Public awareness.

***ACTIVITIES**

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

Identify a tree fruit flower peculiar to a place or having origin from the place.

Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).

Videography/ photography/ information collections on specialties/unique features of different types of common creatures.

Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

1 ***(A) Awareness Activities:***

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
b) Slogan making event
c) Poster making event
d) Cycle rally
e) Lectures from experts
f) Plantation
g) Gifting a tree to see its full growth
h) Cleanliness drive
i) To live with some eminent environmentalist for a week or so to understand his work vi) To work in kitchen garden for mess
j) To know about the different varieties of plants
k) Shutting down the fans and ACs of the campus for an hour or so
l) Visit to a local area to document environmental assets

river/forest/grassland/hill/mountain/lake/Estuary/Wetlands

m) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
n) Visit to a Wildlife sanctuary, Pushpa Gujral Science City, Kapurthala, National Park or Biosphere Reserve

Suggested Readings

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net (R)
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)

5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p

6. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)

7. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press 1140p.

8. Mhaskar A.K., Matter Hazardous, Techno-Science Publication (TB)

9. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co. (TB)

10. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p

11. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (TB)
12. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (R)

13. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (TB)

14. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p.

BTME501-18 HEAT TRANSFER

Course objectives:
To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications

Course Outcomes:

1. To teach students the basic principles of conduction, radiation, and convection heat transfer. Students will demonstrate an understanding of the basic concepts of conduction, radiation, and convection heat transfer.

2. To extend the basic principle of conservation of energy to systems that involve conduction, radiation, and heat transfer. Students will demonstrate an understanding of the concept of conservation of energy and its application to problems involving conduction, radiation, and/or convection heat transfer. This principle will be used to formulate appropriate mathematical models and associated thermal boundary conditions.

3. To train students to identify, formulate, and solve engineering problems involving conduction heat transfer. Students will demonstrate the ability to formulate practical conduction heat transfer problems by transforming the physical system into a mathematical model, selecting an appropriate solution technique, and evaluating the significance of results.

4. To train students to identify, formulate, and solve engineering problems involving forced convection heat transfer, natural convection heat transfer, and heat exchangers. Students will demonstrate the ability to formulate practical forced and natural conduction heat transfer problems by transforming the physical system into a mathematical model, selecting an appropriate solution technique, and evaluating the significance of results. Students will also demonstrate an ability to analyze the performance of heat exchangers

5. To train students to identify, formulate, and solve engineering problems involving radiation heat transfer among black surfaces and among diffuse gray surfaces. Students will demonstrate the ability to formulate practical radiation heat transfer problems by transforming the physical system into a mathematical model, selecting an appropriate solution technique, and evaluating the significance of results.

Detailed Contents:

Unit-1

Introduction to Heat Transfer: Thermodynamics and Heat Transfer. Modes of Heat Transfer: Conduction, convection and radiation. Effect of temperature on thermal conductivity of materials; Introduction to combined heat transfer mechanism.

Conduction: Fourier's law of heat conduction. Coefficient of thermal conductivity. Effect of temperature and pressure on thermal conductivity of solids, liquids and gases. Three-dimensional general conduction equations in rectangular, cylindrical and spherical coordinates.

Steady State one-dimensional Heat conduction-I: Deduction of one-dimensional steady state heat conduction equation in rectangular; cylindrical and spherical coordinates with and without internal heat generation for uniform thermal conductivity of material. Concept of variable thermal conductivity.

Steady State one-dimensional Heat conduction-II: Electrical network analysis for heat transfer through composite/multilayer material. Application of heat conduction with internal heat generation in case of piston crown and in nuclear fuel rod with/ without cladding. Concept of equivalent area. Conduction shape factor. Conduction through edges and corners of walls. Critical thickness of insulation layers on electric wires and pipes carrying hot fluids.

Unit-II

One Dimensional Transient Conduction Heat Transfer: Systems with negligible internal resistance – Significance of Biot and Fourier Numbers –Infinite bodies- Chart solutions of transient conduction systems- Concept of Semi-infinite body.

Theory of Fins: Concept of fin. Classification of fins and their applications. Straight fins of uniform cross-section. Individual and total fin effectiveness and efficiency. Application of fins in temperature measurement of flow through pipes and determination of error in its measurement.

Unit-III

Convection: Classification of systems based on causation of flow, condition of flow, configuration of flow and

medium of flow. Dimensional analysis as a tool for experimental investigation. Buckingham Pi Theorem and method. Application for developing semi-empirical, non- dimensional correlation for convection heat transfer, Significance of non-dimensional numbers. Concepts of continuity, momentum and energy Equations.

Forced convection: External Flows: Concepts about hydrodynamic and thermal boundary layer and use of empirical correlations for convective heat transfer. -Flat plates and Cylinders. Internal Flows: Concepts about Hydrodynamic and Thermal Entry Lengths Division of internal flow based on this Use of empirical relations for Horizontal Pipe Flow and annulus flow.

Natural Convection: Physical mechanism of natural convection. Buoyant force. Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates and cylinders, and sphere. Combined free and forced convection

Unit-IV

Heat Exchanger: Types of heat exchangers; Fouling factors; Overall heat transfer coefficient; Logarithmic mean temperature difference (LMTD) method; Effectiveness-NTU method; Compact heat exchangers. 3 **Condensation and Boiling** Boiling: Definition and types of boiling. Different regimes and heat transfer during pool boiling of a liquid. Nucleation and different theories accounting for increased heat transfer coefficient during nucleate phase of boiling. Condensation: Definition and types of condensation, film wise condensation on a vertical and inclined surface.

UNIT-V

Thermal Radiation: Process of heat flow due to radiation. Definition of emissivity, absorptivity, reflectivity and transmissivity. Concept of black and grey bodies. Plank's law of non chromatic radiation. Wien's displacement law. Kirchoff's law. Stefan Boltzmann's law. Lambert's Cosine law. Definition of intensity of Radiation, irradiation and radiosity. Geometric/ configuration factor and its use in heat exchange between two black bodies. Electrical network analysis for radiation exchange between two, three or four bodies (e.g. boiler or other furnaces). Simplification of electrical network analysis for its application to simple bodies like two parallel surfaces, concentric cylinders/spheres and a body enveloped by another body. Use of radiation shields.

Text/Reference Books: 1. Incropera F.P. and De Witt D.P., "Fundamentals of Heat and Mass transfer", John Wiley, 7th Edition, 2011.
2. Cengel, A. Yunus, "Heat and Mass Transfer", Tata McGraw Hills Education Private Ltd, 4 th Edition, 2013.
3. Kumar, D.S. "Fundamentals of Heat and Mass Transfer", S K Kataria & Sons, 7th Edition, 2013.
4. Chapman. A. J, "Heat Transfer", McGraw Hill, 7th Edition, 1990.
5. Holman, J.P. "Heat Transfer", Tata McGraw-Hill Publishing Company Ltd, 9th Edition, 2008.

BTME502-18 DESIGN OF MACHINE ELEMENTS -I

Course objectives:

To provide knowledge of design procedure for simple components like keys, cotters, fasteners, shafts, couplings, pipe joints and levers under static and fatigue loading. Objective of this course is to make the students capable of designing mechanical systems consisting of wide range of machine elements.

Course Outcomes:

After studying this course, students shall be able to:

1. Understand the meaning of machine design process and types of design processes.
2. Understand various design considerations like stress concentration factor, factor of safety and to be able to segregate components and design them independently.
3. Design fasteners and cotter joints.
4. Design shafts under different loading conditions.
5. Design keys and couplings under different loading conditions.
6. Design pipe joints and Levers under different loading conditions.

Detailed Contents:

1. **Basic Design Considerations**: Meaning of design with special reference to machine design, definition and understanding of various types of design such as Empirical design, Rational design, Aesthetic design, Ergonomic design, general design considerations, design process, concept of tearing, bearing, shearing, crushing, bending and fracture. introduction to 'Design for X', manufacturing considerations in machine design, stress concentration, factor of safety.

2. **Material Selection:** Designation of materials according to Indian standards code, basic criteria of selection of material, mechanical properties of materials.

3. **Design of fasteners:** Design of rivets for boiler joints, structure joints, lozenge joints, eccentrically loaded joints. Design of welded joints for various loading conditions in torsion, shear or direct loads, eccentrically loaded joints. Bolts and bolted joints with and without initial tightening loads, Bolted joints under eccentric loading.

4. **Design of Cotter Joints:** Design of spigot and socket cotter joint, Design of gib and cotter joint and Design of knuckle joint.

5. **Design of shaft and axles:** Design of solid and hollow shafts for transmission of torque, bending moments and axial forces, Design of shaft for rigidity, Design of axle.

6. **Design of keys and couplings:** Design of keys, design of splines, design of sleeve and solid muff coupling, clamp or compression coupling, rigid and flexible flange coupling, design of universal joint.

7. **Design of levers and links:** Design of levers (foot lever, hand lever, cranked lever, bell crank lever, safety valve lever and shoe brake lever), design of link.
8. **Design of pipe joints:** Stresses in pipe joints, design of pipe joints with oval flange, square flange, design of seals and gaskets.

Recommended Books

1. Joseph E. Shigley, Charles Russell Mischke, Richard Gordon Budynas, Mechanical Engineering Design, McGraw-Hill
2. Robert C. Juvinall Fundamentals of machine component design, Wiley

3. M.F. Spotts and T.E. Shoup, 'Design of Machine Elements', Pearson Education, New Delhi, 2003.
4. R.L. Norton, 'Machine Design: An Integrated Approach', Pearson Education, New Delhi, 2006.
5. V.B Bhandari, Design of Machine elements, Tata Mc. Hill
6. C.S. Sharma and K. Purohit, 'Design of Machine Elements', Prentice Hall, New Delhi, 2003.

Note: Design data book is not allowed.

BTME503-18 MANUFACTURING PROCESSES-I

Course objectives:
To motivate and challenge students to understand and develop an appreciation of the processes in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.

Course Outcomes:
After studying this course, students shall be able to:

1. Understand the principle and fundamentals of various metal casting processes, along with casting defects.
2. Learn about fundamentals of hot & cold working processes, principles and equipment involved in bulk and sheet metal forming processes, and powder metallurgy.
3. Able to select different types of the metal machining processes needed for the manufacturing of various geometrical shapes of products and learn about different cutting tool materials, cutting fluids, CNC machining, and rapid prototyping.
4. Learn about physics of welding, brazing, soldering and fundamental principles and applications of different solid and liquid state joining processes.
5. Understand the principle and fundamentals of various unconventional machining processes along with their process and other parameters.
6. Understand the different conventional and unconventional manufacturing methods employed for making different products.

Detailed Contents:
Unit -1 Conventional Manufacturing Processes:
Casting and moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses.

Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending) principles of powder metallurgy.

Metal cutting: Single and multi-point cutting; Orthogonal cutting, various force components: Chip formation, Tool wear and tool life, Surface finish and integrity, Machinability, Cutting tool materials, Cutting fluids, Coating; Turning, Drilling, Milling and finishing processes, Introduction to CNC machining.

Unit II: Additive manufacturing:
Rapid prototyping and rapid tooling

Unit III: Joining/fastening processes:
Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding.

Unit IV Unconventional Machining Processes:
Unconventional Machining Processes: Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters.
Electrical Discharge Machining, principle and processes parameters, MRR, surface finish, tool wear, dielectric, power and control circuits, wire EDM; Electro-chemical machining (ECM), etchant &maskant,

process parameters, MRR and surface finish. Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining

Text/Reference Books:

1. Rao P N, Manufacturing Technology, Foundry, Forming & Welding, Tata McGraw Hill.
2. Kalpakjian S and Steven R. Schmid, Manufacturing Engineering and Technology, Pearson Publishers.
3. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
4. Degarmo, Black &Kohser, Materials and Processes in Manufacturing
5. Ghosh A, & Mallik A K 1986. Manufacturing science: Ellis Horwood.
6. Campbell J S, Principles of manufacturing materials and processes: Tata McGraw-Hill
7. Shan H S, Manufacturing Processes, Vol. I, Pearson Publishers.
8. Little, Welding and Welding Technology, McGraw-Hill Education (India) Pvt Ltd.
9. NPTEL courses, http://www.nptel.iitm.ac.in/courses.php?disciplineId=112 web and video resources on Manufacturing Processes I

BTME504-18 NUMERICAL METHODS

Course objectives:
This course deals with the basic concepts of mathematical statistics and numerical analysis. The objective of this course is to introduce these concepts and focus on application of these for handling the problems arising in science, engineering and technology.

Course Outcomes:
After completing the course, the students will be able to

1. Apply the concepts of mathematical statistics in modeling processes and decision making.
2. Apply the concepts of numerical methods for solving problems arising in science, engineering and technology.
3. Solve continuous problems numerically which are difficult to deal with analytically.

Detailed Contents:

Unit-I

Probability and Probability Distributions: Population, Sample space, Events, Random Variables; Definitions of probability, conditional Probability, expectation, Binomial, Poisson and Normal distributions.
Testing of Hypothesis: Types of Error, Power of a test, Goodness of a fit, Student t and Chi-Square tests.

Unit-II

Floating-Point Numbers: Floating-point representation, Rounding, Chopping, Error Analysis. Condition and instability.
Solution of Algebraic and Transcendental Equations: Errors in numerical computation, bisection method, Newton-Raphson's method and method of false position, System of nonlinear equations: Newton-Raphson's method.

Unit-III

Linear System of Equations: Gauss elimination method and Gauss Jordan method. Eigenvalue Problem: Power Method.
Interpolation: Interpolation with Unevenly Spaced Points: Lagrange Interpolation, Newton's Divided Difference Interpolation; Interpolation with Evenly Spaced Points: Newton's Forward Difference Interpolation Formula, Newton's Backward Difference Interpolation Formula, Spline interpolation

Unit-IV

Numerical Differentiation and Integration: Numerical differentiation: Newton's Forward Difference Formula, Newton's Backward Difference Formula, Newton's Divided Difference Formula; Numerical Integration: Trapezoidal rule, Simpson's 1/3-rule and Simpson's 3/8 rule.
Numerical solution of ordinary differential equations (ODEs):
Initial Value Problems of ODEs: Taylor series method, Euler's methods, Runge-Kutta methods and linear multi-step methods (Adams-Bashforth & Adams-Moulton).
Note: The students are required to develop computer programs (using any high level language) for different Numerical Methods as part of assignment work.

Text/Reference Books:

1. Gupta S.C., Kapoor V.K. (2014), Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi.
2. Jain M. K., Iyengar S. R. K, Jain R. K. (2007), Numerical methods for Scientific and Engineering Computation, New Age International Publishers, New Delhi.
3. Sastry S. S. (2012), Introductory Methods of Numerical Analysis, Prentice Hall of India, Delhi.

BTME505-18 Heat Transfer Lab.

Course objectives:
To provide knowledge about application of conduction, convection and radiation heat transfer concepts to different practical applications

Course Outcomes:
After undergoing this course, students shall be able to:

1. Design and fabricate the experimental setups related to heat transfer phenomena.
2. Measure and analyse different heat transfer parameters.
3. Apply finite difference methods to solve simple heat transfer problems.

A. Two to three students in a group are required to do one or two practicals in the form of Lab. Project in the topic/s related to the subject matter of Heat Transfer and in consultation with teacher. The complete theoretical and experimental analysis of the concerned topic is required to be performed (including design and fabrication of new experimental set up; if required; or modifications/retrofitting in the existing experimental set ups).
B. Each student is required to use Finite Difference Method for analysis of steady state one dimensional and two dimensional conduction problems (Minimum two problems one may be from the Lab. Project) such as conduction through plane/cylindrical/spherical wall with or without internal heat generation; heat transfer through fins; bodies with irregular boundaries subjected to different boundary conditions.
Minimum twelve experiments from the following:
1. Composite Slab Apparatus – Overall heat transfer co-efficient.
2. Heat transfer through lagged pipe.
3. Heat Transfer through a Concentric Sphere
4. Thermal Conductivity of given metal rod.
5. Heat transfer in pin-fin
6. Experiment on Transient Heat Conduction
7. Heat transfer in forced convection apparatus.
8. Heat transfer in natural convection
9. Parallel and counter flow heat exchanger.
10. Emissivity apparatus.
11. Stefan Boltzman Apparatus.
12. Critical Heat flux apparatus.
13. Study of heat pipe and its demonstration.
14. Film and Drop wise condensation apparatus

BTME506-18 Manufacturing processes lab

Course Outcomes:

After studying this course, students shall be able to:

1. Determine/calculate the clay content, moisture content, hardness, permeability and grain fineness number of moulding sand sample.
2. Use oxy-acetylene gas welding, manual arc welding, MIG, TIG and spot-welding processes to make various joints.
3. Use machine tools such as lathe, shaper and milling machine for machining/cutting various profiles on work pieces.
4. Learn about the constructional features and working of grinding machines, hydraulic press, draw bench, rolling mills, drawing and extrusion equipment.

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- acetylene gas 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.

BTME507-18 Numerical Method Lab

Course Objectives:
This course provides understanding of implementations of basic numerical methods for solving different problems *viz.* nonlinear equations, system of equations, numerical integration and ordinary differential equations etc. The basic objective of this course is to develop capability of programming of numerical methods in the students so that they can develop and implement their own computer programs of the methods for solving different problems arising in science, engineering and technology etc.

Course Outcomes: After completion of this course, the students will be able to:

- Understand different implementation modes of numerical methods.
- Use the numerical methods with the understanding of limitations of these methods for solving problems.
- Develop and implement their own computer programs.
- Solve problems more accurately and efficiently in low computational time.
- Handle the problems conveniently which are difficult to deal with manually.

.**List of experiments:**

1. Make a program of bisection method for solving algebraic/transcendental equations and implement it on some problems.
2. Develop a program of Newton-Raphson's method for solving algebraic/transcendental equations and implement it on some problems.
3. Develop and implement a program of Method of False Position for solving algebraic/transcendental equations.
4. Develop and implement a program of Gauss-elimination method for solving a system of linear equations.
5. Develop and implement a program of trapezoidal rule to approximate a definite integral.
6. Develop and implement a program of Simpson's rule to approximate a definite integral.
7. Develop and implement a program of Euler's method for solving initial value problems of ordinary differential equations.
8. Develop and implement a program of fourth order Runge-Kutta method for solving initial value problems of ordinary differential equations.
9. Develop and implement a program of two-step Adams-Bashforth method for solving initial value problems of ordinary differential equations.
10. Develop and implement a program of two-step Adams-Moulton method for solving initial value problems of ordinary differential equations.

Note. Use any programming language/computer algebra system to develop and implement the following programs

6th Semester Study Scheme

Course Type	Course Code	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
Professional Core courses	BTME601-18	Refrigeration and Air conditioning	3	1	0	40	60	100	4
Professional Core courses	BTME602-18	Mechanical Measurements & Metrology	4	0	0	40	60	100	4
Professional Core courses	BTME603-18	Automobile Engineering	3	0	0	40	60	100	3
Open Elective Course	XXXX###-18	Open Elective - I	3	1	0	40	60	100	4
Professional Elective Course	XXXX###-18	Professional Elective-I	3	0	0	40	60	100	3
Professional Core courses	BTME605-18	RAC (Lab)	0	0	2	30	20	50	1
Professional Core courses	BTME606-18	MMM (Lab)	0	0	2	30	20	50	1
Professional Core courses	BTME607-18	Auto. Engg.(Lab)	0	0	2	30	20	50	1
Professional Core courses	BTME608-18	Minor Project	0	0	2	30	20	50	1
Total			**16**	**2**	**08**	**290**	**380**	**700**	**22**

The project work will be carried out in parts as minor project in 6th semester and major project in 7/8th semester. The literature survey, problem formulation, assessment for viability of the project, objectives and methodology for the project shall be decided in 6th semester. The same project problem is to be extended in the major project in semester. The minor project may be carried out by a group of students 2 to 4.

List of Professional Elective Courses:

1) Internal Combustion Engines.
2) Mechatronics Systems.
3) Microprocessor in Automation
4) Composite Materials
5) Computer Aided Design.
6) Product Design and Development
7) Non-Conventional Energy Resources.
8) Operation Research
9) Maintenance and Reliability

BTME601-18 REFREGERATION AND AIR CONDITIONING

Course objectives:

To introduce the students, the basic refrigeration cycles of various refrigeration systems. To impart the students with basic understanding of and air conditioning systems for different climatic seasons. To give the basic understanding of design aspects of RAC components such as evaporators, condensers, capillary tubes, expansion valve etc.

Course Outcomes:

After undergoing this course, the student will:

1. Illustrate the fundamental principles and applications of refrigeration and air conditioning system
2. Obtain cooling capacity and coefficient of performance by conducting test on refrigeration systems.
3. Calculate the energy requirements of cooling and heat equipment for air conditioning applications.
4. Explain the properties, applications and environmental issues of different refrigerants.
5. Demonstrate an ability to analysis psychrometric processes and cycles of air conditioning systems.

Detailed Contents:

1. Basic Concepts [4]

Classification of refrigeration systems, Refrigeration effect, cooling capacity, heating effect, heating capacity; Units of refrigeration; Coefficient of performance and Energy Performance Ratio; Single Phase Reversed Carnot cycle and its limitations; Two Phase Reversed Carnot cycle and its limitations.

2. Vapour Compression Refrigeration Cycles [8]

Modifications of reversed Carnot cycle with vapour as a refrigerant, Vapour compression refrigeration cycle & system; Representation of this cycle on P-V, T-S and P-H diagrams and its analysis using T-S and P-h diagrams and Refrigeration Tables for sub cooled, saturated and superheated refrigerant, volumetric efficiency of compressor; Effect on performance of VCRS due to change in evaporator pressure, condenser pressure, sub cooling of liquid refrigerant, super heating of suction vapours; Actual vapour compression refrigeration cycle on T-sand P-h diagrams (no mathematical analysis); Numerical problems. Compound compression with single evaporator, Multi evaporators with single compressor, along with schematic representation of these systems with use of flash chamber, water intercooler, flash intercooler, with individual and multiple expansion valves arrangements. (Without numerical problems).

3, **Refrigerants** **[4]**

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; Zeotropes; Effect of moisture and oil miscibility; Antifreeze solution; Leak detection and charging of refrigerants; Environmental aspects of conventional refrigerants; Eco-friendly refrigerants and action plan to reduce ecological hazards.

4. **Vapour Compression Refrigeration System Components** **[6]**

Classifications and working of Compressors, Condensers, Expansion devices and Evaporators. Performance characteristics of the condensing unit, Performance characteristics of the compressor-capillary tube.

5. Vapour Absorption Refrigeration Cycles **[4]**

Principle of vapour absorption refrigeration; basic components of the vapour absorption refrigeration system; Desirable properties of absorption system refrigerant and absorbent; Aqua - ammonia vapour absorption refrigeration system; Lithium Bromide - water absorption system; Electrolux refrigeration system; comparison between vapour absorption and compression systems (no mathematical analysis).

6. Psychrometry **[5]**

Dry Air; Moist Air; Basic laws obeyed by Dry Air and Moist Air; 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 and its use; Numerical problems. Human requirement of comforts; effective temperature and comfort charts; Industrial and comfort air conditioning.

7. Psychometric Processes **[5]**

Basic psychometric processes; Adiabatic mixing of two air streams Sensible heating; Sensible cooling; cooling with dehumidification; cooling with humidification; Heating with dehumidification; Heating with humidification; By-pass factor; Contact factor; Sensible heat factor; Room sensible heat factor; Grand sensible heat factor.

8. Air conditioning Load Calculations **[4]**

Sources of heat load; sensible and latent heat load; Cooling and heating load estimation; Apparatus dew point temperature; Rate and state of supply air for air conditioning of different types of premises.

Text/Reference Books:

1. C.P. Arora, Refrigeration and Conditioning, Tata McGraw Hill
2. Manohar Prasad, Refrigeration and Conditioning, Wiley Eastern Limited
3. Jordan and Priester, Refrigeration and Conditioning, Prentice Hall of India
4. W.F. Stoecker, Refrigeration and Conditioning, McGraw Hill

BTME602-18 MECHANICAL MEASURMENT AND METROLOGY

Course objectives:

1. To provide knowledge about measurement systems and their components
2. To learn about various sensors and transducers used for measurement of mechanical quantities
3. To learn about usage of various measuring instruments
4. To learn metrology of screw, gear and surface texture

Course outcomes:

After undergoing this course, the student will be able to:

1. Interpret characteristics of measuring instruments.
2. Describe various industrial metrological instruments for measuring linear, angular, screw thread and gear profiles.
3. Apply the fundamental principles for measurement of various mechanical quantities like Force/torque etc.
4. Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality measurements.

Detailed Contents:

1. MECHANICAL MEASUREMENT SYSTEMS [4]

Need of mechanical measurement, basic and auxiliary functional elements of a measurement system Basic definitions: Hysteresis, Sensitivity, Linearity, Resolution, Threshold, Drift, zero stability, loading effect and system response. Dead Time and dead zone, Measurement methods, Generalized Measurement system, Static performance characteristics, Errors, and their classification.

2. SENSORS AND TRANSDUCERS [5]

Introduction to sensors and transducers, types of sensors, review of electro-mechanical sensors and transducers - variable resistance, inductance and capacitive pickups, photocells and piezoelectric transducers, Introduction to signal processing and conditioning.

3. LINEAR AND ANGULAR MEASUREMENTS [4]

Vernier calliper, Micrometer, Interval measurements: Slip gauges, Checking of slip gauges for surface quality, Optical flat, Limit gauges.

4. MEASUREMENT OF FORCE, TORQUE AND STRAIN [6]

Load cells, cantilever beams, proving rings, differential transformers.

Torsion bar dynamometer, Servo controlled dynamometer, Absorption dynamometers. Power Measurements.

Mechanical strain gauges, Electrical strain gauges, strain gauge material, gauge factors, theory of strain gauges, bridge arrangement, temperature compensation.

5. DISPLACEMENT, VELOCITY/SPEED AND ACCELERATION MEASUREMENT [5]

Working principal of Resistive Potentiometer, Linear variable differential transducers (LVDT), Electro-Magnetic Transducers, Mechanical, Electrical and Photoelectric Tachometers, Piezoelectric Accelerometer, Seismic Accelerometer,

6. TEMPERATURE MEASUREMENT [5]

Thermocouples, Resistance Temperature Detectors, Thermistor, Liquid in glass Thermometers, Pressure Thermometers, Pyrometer, Bimetallic strip. Calibration of temperature measuring devices.

7. METROLOGY [2]

Basics of Metrology, Line end and wavelength standards, Need for Inspection, Accuracy and Precision, Objectives, Standards of measurements.

8. METROLOGY OF GEARS AND SCREW THREADS [6]

Sources of errors in manufacturing of gears, Measurement of tooth thickness: Gear tooth Vernier, Constant chord method, Addendum comparator method and Base tangent method, Measurement of tooth profile: Tool maker's microscope or projector, Involute tester, Measurement of pitch, Measurement of run out, Lead and Backlash checking. Measurement of concentricity, Alignment of gears.

Errors in threads, screw thread gauges, measurement of element of the external and internal threads, thread calliper gauges.

9. METROLOGY OF SURFACE FINISH [6]

Concepts and terminology, Analysis of surface traces, Specification of surface Texture characteristics, Method of measuring surface finish: Stylus system of measurement, Stylus probe instruments, Wavelength, frequency and cut off, other methods for measuring surface roughness: Light Interference microscopes, Mecrin Instruments

10. COMPARATOR [4]

Functional Requirements, Classification, Mechanical Comparators, Mechanical Optical Comparators, Electrical Comparators, Pneumatic Comparators.

11. MISCELLANEOUS METROLOGY [4]

Precision Instrumentation based on Laser Principals, Coordinate measuring machines: Structure, Modes of Operation, Probe, Operation and applications. Optical Measuring Techniques: Tool Maker's Microscope, Profile Projector, Optical Square. Basics of Optical Interference and Interferometry, Optoelectronic measurements,

Suggested Books:

1. E.O Doebelin, Measurement System: Application and Design, McGraw Hill

2. J.P Holman, Experimental Methods for Engineers, McGraw Hill

3. D.S Kumar, Mechanical Measurement and Control, Metropolitan Book Co.

4. R.K Jain, Engineering Metrology, Khanna Publishers

5. B.C Kuo, Automatic Control systems, Prentice Hall

BTME603-18 AUTOMOBILE ENGINEERING

Course objectives:

- To understand the construction and working principle of various parts of an automobile.
- To have the practice for assembling and dismantling of engine parts and transmission system

Course Outcomes:

After undergoing this course, the student will be able to:

1. Identify the different parts of the automobile.
2. Explain the working of various parts like engine, transmission, clutch, brakes, steering and the suspension systems.
3. Develop a strong base for understanding vehicle safety systems and future developments in the automobile industry.

Detailed Contents:

1. Introduction [2]

Basic structure, general layout and type of automotive vehicles, Frameless and unitary construction; position of power unit.

2. Power Unit [5]

Power requirements - motion resistance and power loss, tractive effort and vehicle performance curves; selection of power unit and engine performance characteristics; pollution due to vehicle emission and exhaust emission control system., turbo chargers (WGT, VGT), engine emission control by 3-way catalytic converter system, Emission norms (Euro & BS).

3. Fuel Supply System [4]

Air cleaner and fuel pumps; Air fuel requirements and carburation; constructional details of fuel injection systems (MPFI) used in Indian make vehicles. Diesel fuel system (IDI, DI & CRDI) - cleaning, injection pump, injector and nozzles. Introduction to Gasoline Direct Injection and dual fuel supply systems.

4. Lubrication and Cooling Systems [4]

Necessity of lubrication; Desirable properties of lubricants; various types of lubricants and oil additives; different systems of lubrication - oil filters, oil pumps and oil pressure indicator; crank case ventilation and dilution. Purpose of cooling: air-cooling and water-cooling systems; radiator, thermostat, pump and fan.

5. Chassis and Suspension [3]

Loads on the frame, considerations of strength and stiffness, engine mounting, conventional and independent suspension systems; adaptive suspension systems; shock absorbs and stablisers; wheels and tyres.

6. Transmission system [4]

Basic requirements and components of transmission systems; constructional features of automobile clutch, gear boxes & types, differential, front and rear axles; overdrives, propeller shaft, universal joint and torque tube drive; Rear wheel vs front wheel drive, principle of automatic transmission. Types of automatic transmissions (Torque convertor AT, AMT, CVT, DCT/DSG). Traction control system.

7. Steering System **[3]**

Requirement and steering geometry; castor action, camber and king pin angle, toe-in of front wheels, steering linkages and steering gears; wheel balancing & alignment; power steering (electrical and hydraulic).

8. Braking System **[3]**

General braking requirements; Weight transfer during braking and stopping distances; Mechanical, hydraulic, vacuum power and servo brakes; Adaptive cruise control and braking system

9. Electric System **[3]**

Conventional (coil and magneto) and transistorized ignition systems; Charging, capacity ratings and battery testing; starter motor and drive arrangements: voltage and current regulation

10. Vehicle safety systems **[3]**

Active and passive safety systems in an automobile. Air bags, collapsible steering system, seat belts, side impact rods, crumple zones etc. ABS & EBD, ESP, diver alert system.

11. Alternative Energy Sources **[4]**

Concept and types of electric & Hybrid Vehicles. Fuel cell technology,Use of Natural Gas, Liquefied Petroleum Gas, Biodiesel, Bioethanol, Gasohol andHydrogen in Automobiles- Engine modifications required –Performance

12. Maintenance **[2]**

Preventive maintenance, trouble shooting and rectification in different systems; engine turning and servicing

Text/Reference Books:

1. W.H Crouse, Automotive mechanics, McGrawHill
2. J. Heitner, Automotive Mechanics, East WestPress
3. Kirpal Singh, Automobile Engineering Vol. I and II, StandardPublishers
4. J. Webster, Auto Mechanics, Glencoe PublishingCo.
5. P.S Gill, Automobile Engineering, S.KKataria

BTME605-18 REFREGERATION AND AIR CONDIITONING LAB

Course Outcomes:

1. Conduct and analyze the experimental data of performance of vapour compression refrigeration system in domestic refrigerator and water cooler.
2. Conduct and analyze the experimental data of performance of Electrolux Refrigerator.
3. Conduct the performance of window type room air conditioner and system.
4. Analyze the industrial set up for the working and use of vapour compression refrigeration system in cold storage.

Course Objectives:

To introduce the students for hand on practice to perform the experiment and evaluate the experimental record pertaining to refrigeration cycles of various refrigeration systems. To impart the students with training of interfacing the theoretical and practical skills. Refrigeration and Air Conditioning and its primary components such as evaporators, condensers, capillary tubes, expansion valve etc.

List of Experiments

1. Demonstration of various elements of a vapour compression refrigeration system through refrigeration trainer.
2. Performance testing of domestic refrigerator using refrigeration test rig.
3. Performance testing of Electrolux refrigerator.
4. Study of an Ice plant.
5. Calculation/ Estimation of cooling load for a large building.
6. Visit to a central air conditioning plant for the of study air-conditioning system.
7. Visit to a cold storage for study of its working.
8. Performance testing of window type room air conditioner.
9. Performance testing of water cooler.

BTME606-18 MECHANICAL MEASUREMENT AND METROLOGY LAB

The student will be able to:

1. Demonstrate the use of instruments for measuring linear (internal and external), angular dimensions and surface roughness.
2. Identify proper measuring instrument and know requirement of calibration, errors in measurement etc.
3. Apply analytical and experimental methods to make measurements and to find and correct defects in measurement systems.

.**List of experiments:**

1. Vernier Calliper/ vernier height gauge: Principle of vernier scale to measure internal and external dimensions including depth
2. Micrometer and vernier micrometer: concept, principle and use
3. Sine bar and slip gauges and angle gauge: principle and applications
4. Surface texture: Roughness of machined and un-machined plane and spherical surfaces
5. Profile projector: to measure screw and gear elements
6. Three wire method: Diameter of external V-threads
7. Tool makers microscope: to measure screw and gear elements
8. Dead weight gauge: calibration of pressure gauges
9. Stroboscope: measure speed of rotating elements
10. Thermocouple: principle, applications and preparation

BTME607-18 AUTOMOBILE ENGINEERING LAB

The student will be able to:

1. Identify Construction, working, preventive maintenance, trouble shooting and diagnosis of various Automobile Systems.
2. Understand importance and features of different systems like axle, differential, brakes, steering, suspension, and balancing etc.
3. Identify Modern technology and safety measures used in Automotive Vehicles

List of Experiments

1. Valve refacing and valve seat grinding and checking for leakage of valves

2. Trouble shooting in cooling system of an automotive vehicle

3. Trouble shooting in the ignition system, setting of contact breaker points and spark plug gap

4. Demonstration of steering system and measurement of steering geometry angles and their impact on vehicle performance.

5. Trouble shooting in braking system with specific reference to master cylinder, brake shoes, overhauling of system and the adjusting of the system and its testing.

6. Fault diagnosis in transmission system including clutches, gear box assembly and differential.

7. Replacing of ring and studying the method of replacing piston after repair.

8. Dismantling and assembling of diesel and petrol engine.

9. Study of cut section model of Petrol and diesel engine.

PROFESSIONAL ELECTIVES COURSES

BTME###-18 INTERNAL COMBUSION ENGINES

Course Outcomes:

Students who have done this course will have

1. Knowledge about the basics of IC engines
2. Ability to evaluate operational characteristics of IC Engines
3. Ability to ascertain the effects of fuel/supply systems on emission from an engine.
4. Ability to test engine performance

Detailed Contents:

1. Introduction to IC Engines
Definition of engine; Heat Engine, Historical Development of IC Engines, Classification & Nomenclature, Application of IC Engines, Air Standard Cycle, Carnot Cycle, Sterling Cycle, Ericson Cycle, Otto Cycle, Diesel cycle, Dual Cycle, Thermodynamics Analysis of these cycles.

2. Actual Working of I.C. Engine
Working of 4 stroke petrol & diesel engines and their valve timing diagram, working of 2-stroke petrol & diesel engines & their valve timing diagrams, comparison of two stroke & four stroke engines, Actual working of 2 & 4 stroke gas engines and their valve diagram.

3. Fuel Air Cycles and their analysis
Introduction to fuel air cycles and their significance, composition of cylinder gases, variable specific heats, Dissociation, effect of no. of moles, comparison of air standards & fuel air cycles, effect of operating variable like compression ratio, fuel air ratio, actual cycles and their analysis; Difference between Actual and Fuel-Air Cycle, Actual and Fuel-Air Cycles for S.I. and C.I. Engines.

4. Fuel Supply System
Fuel Supply System and fuel pumps, properties of air fuel mixture, a sample carburetor an its working, approximate analysis of simple carburetor, Actual air fuel ratio of single jet carburetor, Exact analysis of single jet carburetor, ideal requirements from a carburetor, limitations of single jet carburetor, different devices used to meet the requirements of an ideal carburetor. modern carburetors.

5. Fuel Injection Systems
Requirement of an Injection system, Classification of Mechanical injection systems, Fuel Feed pump, injection pump, injection pump Governor, mechanical governor, Fuel Injector, Nozzle, Injection of S.I. Engines. Electronic fuel injection system, MPFI system, Electronic Control system, injection timings and modern injection systems.

6. Combustion in S.I. and C.I Engines

Introduction, Stages of Combination in S.I. Engine, Flame font propagation, factor influencing the flame speed, ignition lag and factors affecting the lag, Abnormal combustion and knocking, control and measurement of knock, effect of engine variables on knocking, rating of S.I. Engine fuels and anti-knock agents, combustion chambers of S.I. Engines. Stages of Combination in C.I. Engine, factors affecting delay period, phenomenon of knock in C.I. Engines, comparison of Knocking in S.I and C.I. engines, combustion chambers for C.I. Engines.

7. Supercharging

Introduction, purpose of supercharging, type of superchargers, analysis of superchargers, performance of superchargers, Arrangement of Supercharger and its installation, Turbo charged engines, supercharging of S.I. & C.I. Engines. Limitations of supercharging.

8. Engine Emissions and Control

Introduction, Ambient pollution due to engines, emission norms, engine emissions, hydrocarbons and hydrocarbon emissions, CO emission, Oxides of Nitrogen, particulates, other emissions. Emission control methods, catalytic convertors, particulate traps. Methods to control/reduce harmful emissions.

9. Measurement and Testing

Measurement of friction horsepower, brake horsepower, indicated horsepower, measurement of speed, air consumption, fuel consumption, heat carried by cooling water, heat carried by the exhaust gases, heat balance sheet, governing of I.C. Engines, performance characteristics of I.C. Engines: Performance parameters, performance of S.I. Engines, performance of C.I. Engine, Engine performance maps.

Text/Reference Books:

1. V. Ganesan, Internal Combustion Engines, Prentice Hall.
2. V. M. Damundwar, A Course in Internal Combustion Engines, Dhanpat Rai.
3. John B. Heywood, Internal combustion engine fundamentals McGraw-Hill,
4. Colin R. Ferguson, Allan Thomson, Kirkpatrick Internal combustion engines: applied thermo sciences, John Wiley & Sons
5. Richard Stone, Introduction to Internal Combustion Engines Society of Automotive Engineers.
6. Mathur and Sharma, A course in Internal Combustion Engines, Dhanpat Rai.

BTME###-18 Mechatronics System

After successfully completing this course the students will be able to

CO1: Design mux, demux, flip-flops, and shift registers.

CO2: Describe the block diagram, registers, ALU, bus systems, timing & control signals, instruction cycles, and interrupts of 8085 microprocessors.

CO3: Apply the concept of 8085 microprocessor instruction sets and addressing modes in writing assembly language program for a given problem.

CO4: Describe the interfacing of memory, 8255 PPI, ADC, DAC, 7-segment LED system, stepper motor, 8251 and 8253 ICs with 8085 microprocessors

1. Introduction

Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface

2. Sensors and transducers

Classification, Development in Transducer technology, Optoelectronics-Shaft encoders, CD Sensors, Vision System, etc.

3. Drives and Actuators

Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control

4. Embedded Systems

Hardware Structure, Software Design and Communication, Microprocessors and microcontrollers: Microprocessor systems, Microcontrollers, Applications, programmable logic controller, Basic PLC structure, input and output units, Programmable Logic Devices, Input/output processing, Ladder programming

5. Smart materials

Shape Memory Alloy, Piezoelectric and Magneto strictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration isolation, etc.; Micro mechatronic systems: Microsensors,

6. Mechatronic systems

Mechatronic designs, Case studies.

7. Course Outcomes

Upon completion of this course, students will get an overview of mechatronics applications and the use of micro-sensors and microprocessors.

Textbooks

1) Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.)

2) Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education

3) A Textbook of Mechatronics, R.K. Rajput, S. Chand & Company Private Limited

4) Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall

BTME###-18 MICROPROCESSOR IN AUTOMATION

Course objectives:

To introduce the basic concepts of Digital circuits, Microprocessor system and digital controller

Course outcomes:

Students who have done this course will have a good idea of the use of microprocessors for automation

Detailed Contents:

1. Number Systems, codes: BCD, Excess 3, digital electronics: Logic Gates, combinational circuits design: Mux, Demux, Sequential logic circuits design: Flip-flops, Shift registers.
2. Introduction to 8085 Functional Block Diagram, Registers, ALU, Bus systems, Timing and control signals. Machine cycles, instruction cycle and timing states, instruction timing diagrams, Memory interfacing.
3. Assembly Language Programming: Addressing modes, Instruction set, simple programs in 8085; Concept of Interrupt, Need for Interrupts, Programmable interrupt controller; Interfacing peripherals: Programmable peripheral interface (8255).
4. Interfacing Analog to Digital Converter & Digital to Analog converter, Multiplexed seven segments LED display systems, Stepper Motor Control, Data Communication: Serial Data communication (8251), Programmable Timers (8253)

Text/Reference Books:

1. Digital Electronics: An Introduction to Theory and Practice, William H. Gothmann, PHI Learning Private Limited
2. Digital Computer Electronics: An Introduction to Microcomputers, Albert Paul Malvino, Tata McGraw-Hill Publishing Company Ltd.
3. Microprocessor Architecture, Programming, and Applications with the 8085, Ramesh Gaonkar, PENRAM International Publishers.
4. Digital Control Systems, Benjamin C. Kuo, Oxford University Press (2/e, Indian Edition, 2007).
5. Microcomputer Experimentation with the Intel SDK-85, Lance A. Leventhal, Prentice Hall

BTME###-18 COMPOSITE MATERIALS

Course outcomes:

Students who have studied this course will have

1. Understanding about the concept, need and applications of composite materials.
2. Ability to suggest/select optimum combination of Matrix/Reinforcement for various engineering applications.
3. Ability to analyze the effects of influencing factors on the strength of composite materials.

Detailed Contents:

1. Introduction

Introduction to the concept of composite materials, need of composite materials, various engineering applications of composite materials.

2. Reinforcements

Introduction to types of reinforcements, Flexibility, Fiber Spinning Processes, Stretching and Orientation, Glass Fibers, Fabrication, Structure, Properties and Applications, Boron Fibers, Fabrication, Structure and Morphology Residual Stresses, Fracture Characteristics, Properties and Applications of Boron Fibers, Carbon Fibers, Processing, structural Changes Occurring During Processing, Properties and Applications, Organic Fibers, Oriented Polyethylene Fibers, Aramid Fibers, Ceramic Fibers, Oxide Fibers, Nonoxide Fibers, Whiskers, Other Nonoxide Reinforcements, Silicon Carbide in a Particulate Form, Tungsten Carbide Particles, Effect of High-Temperature Exposure on the Strength of Ceramic Fibers, Comparison of different types of Fibers.

3. Matrix Materials

Polymers, Glass Transition Temperature, Thermoplastics and Thermosets, Copolymers, Molecular Weight, Degree of Crystallinity, Stress–Strain Behavior, Thermal Expansion, Fire Resistance or Flammability, Common Polymeric Matrix Materials, Metals: Structure, Conventional Strengthening Methods, Properties of Metals, Need of Reinforcements. Ceramic Matrix Materials: Bonding and Structure, Effect of Flaws on Strength, Common Ceramic Matrix Materials

4. Interfaces

Wettability, Effect of Surface Roughness, Crystallographic Nature of Interface, Interactions at the Interface, Types of Bonding at the Interface, Mechanical Bonding, Physical Bonding, Chemical Bonding, Optimum Interfacial Bond Strength, Very Weak Interface or Fiber Bundle, Very Strong Interface, Optimum Interfacial Bond Strength, Tests for Measuring Interfacial Strength, Flexural Tests, Single Fiber Pullout Tests, Curved Neck Specimen Test, Instrumented Indentation Tests, Fragmentation Test, Laser Spallation Technique.

5. Polymer Matrix Composites

Processing of PMCs, Processing of Thermoset Matrix Composites, Thermoplastic Matrix Composites, Sheet Molding Compound, Carbon Fiber Reinforced Polymer Composites, Interface in PMCs, Glass Fiber/Polymer, Carbon Fiber/Polymer Interface, Polyethylene Fiber/Polymer Interface, Structure and Properties of PMCs, Structural Defects in PMCs, Mechanical Properties, Applications, Pressure Vessels, Recycling of PMCs.

6. Metal Matrix Composites

Types of Metal Matrix Composites, Important Metallic Matrices, Aluminum Alloys, Titanium Alloys, Magnesium Alloys, Copper, Intermetallic Compounds, Processing, Liquid-State Processes, Solid State Processes, In Situ Processes, Interfaces in Metal Matrix Composites, Major Discontinuities at Interfaces in MMCs, Interfacial Bonding in Metal Matrix Composites, Properties, Modulus, Strength, Thermal Characteristics, High Temperature Properties, Creep, and Fatigue, Applications, Electronic-Grade MMCs, Recycling of Metal Matrix Composites.

7. Ceramic Matrix Composites

Processing of CMCs, Cold Pressing and Sintering, Hot Pressing, Reaction Bonding Processes, Infiltration, Directed Oxidation or the Lanxide™ Process, In Situ Chemical Reaction Techniques, Sol–Gel, Polymer Infiltration and Pyrolysis, Electrophoretic Deposition, Self-Propagating High-Temperature Synthesis, Interface in CMCs, Properties of CMCs, Toughness of CMCs, Crack Deflection at the Interface in a CMC, Thermal Shock Resistance, Applications of CMCs, Cutting Tool Inserts, Ceramic Composite Filters, Other Applications of CMCs

8. Carbon Fiber/Carbon Matrix Composites

Processing of Carbon/Carbon Composites, High Pressure Processing, Oxidation Protection of Carbon/Carbon Composites, Properties of Carbon/Carbon Composites, Thermal Properties, Frictional Properties of the Composites, Ablative Properties, Applications of Carbon/Carbon Composites, Carbon/Carbon Composite Brakes, Other Applications of Carbon/Carbon Composites, Carbon/SiC Brake Disks

9. Multifilamentary Superconducting Composites

The Problem of Flux Pinning, Types of Superconductor, Processing and Structure of Multifilamentary, Superconductors, Niobium–Titanium Alloys, A15 Superconductors, Ceramic Superconductors, Applications, Magnetic Resonance Imaging.

Textbooks:

1. K.K. Chawla, (1998), Composite Materials, Springer-Verlag, New York
2. B.T. Astrom, (1997), Manufacturing of Polymer Composites, Chapman & Hall
3. Composite materials by J.N.Reddy

Reference Books:/

1. Stuart M Lee, J. Ian Gray, Miltz, (1989), Reference Book for Composites Technology, CRC press
2. Frank L Matthews and R D Rawlings, (2006), Composite Materials: Engineering and Science, Taylor and Francis.
3. D. Hull and T.W. Clyne, (1996), Introduction to Composite Materials, Cambridge University Press

BTME###-18 COMPUTER AIDED DESIGN

Course outcomes:

The students will be able to

1. Create the different wireframe primitives using parametric representations.
2. Create surface primitives using parametric modeling.
3. Create the different solid primitives using the different representation schemes.
4. Apply geometric transformations on the created wireframe, surface and solid models.

Detailed Contents:

1. Introduction

Historical Development, Geometric Modeling, Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems.

2. Curve Design

Fundamental of Curve Design, Parametric Space of a Curve, Blending Functions, Reparametrization, Space Curves, Straight lines, Spline Curves, Bezier Curves, B-Spline Curve, Rational Polynomials, NURBS.

3. Surface Design

Fundamental of Surface Design, Parametric Space of a Surface, Reparametrization of a Surface patch, Sixteen Point form, Four Curve Form, Plane surface, Cylindrical and Ruled Surfaces, Surface of Revolution, Bezier Surface, B-Spline Surface.

4. Solid Design

Fundamental of Solid Design, Parametric Space of a Solids, Continuity and Composite Solids, Surfaces and Curves in a Solid.

5. Solid Modeling

Topology and Geometry, Set Theory, Boolean Operators, Set-membership Classification, Euler operators, Graph Based Models, Boolean Models, Instances and Parameterized Shapes, Cell Decomposition and Spatial Occupancy Enumeration, Sweep Representation, Constructive Solid Geometry, Boundary Representation.

6. Transformations

Translation, Rotation, Scaling, Symmetry and Reflection, Homogeneous Transformations, Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformation.

7. Assembly Design

Assembly-Modeling, Analytical Properties, Relational Properties and Intersections, Data Transfer Formats.

Recommended Books:

1. Zeid, I., CAD/CAM, McGraw Hill (2008).
2. Rogers, D. F. and Adams, J. A., Mathematical Elements for Computer Graphics, McGraw Hill (1989).
3. Rogers, D. F., Procedural Elements for Computer Graphics, McGraw Hill (2008).
4. Rooney, J. and Steadman, P., Principles of Computer Aided Design, prentice Hall (1988).
5. Mallineuse, G., Computational Concepts and Methods, Kogan Page Ltd. (1986).]
6. Radhakrishnan, P. and Kothandaraman, C. P., Computer Graphics & Design, Dhanpat Rai Publication (2005).

BTME###-18 PRODUCT DESIGN AND DEVELOPMENT

The student will be able to:

1. Understand desirable design aspects considering various production processes and also understand the economic factors of design.
2. Employ engineering, scientific, and mathematical principles to execute a design from concept to finished product
3. Apply the modern approaches to product design considering concurrent design, quality function deployment and various rapid prototyping methods.
4. Apply innovative process techniques in synthesizing information, problem-solving and critical thinking.

1. Introduction to Product Design

Design by Evolution and Innovation, Essential factors of product design, Production consumption cycle, Flow and value addition in Production consumption cycle, The Morphology of Design, Primary design phases and flowcharting, Role of Allowances, process capability and tolerances in detailed design and assembly

2. Product Design and Industry

Product Strategies, Time to Market, Analysis of the Product, Standardization, Simplification and specialization, Basic design considerations, Role of Aesthetics in product design, Functional design practice

3. Design for Production:

Producibility requirements in the design of machine components, Forging design, Pressed component design, Casting design for economical molding, eliminating defects and features to aid handling, Design for machining ease, the role of process Engineer, Ease of location and Clamping, Some additional aspects of production design, Design of powder metallurgical parts

4. Economic Factors Influencing Design:

Product value, Design for safety, reliability and Environmental considerations, Manufacturing operations in relation to design, Economic analysis, profit and competitiveness, break even analysis,

5. Modern Approaches to product Design:

Concurrent Design, Quality Function Deployment (QFD)

6. Rapid Prototyping:

Principle of Rapid Prototyping, Rapid Prototyping Technologies (RPT), RPT in Industrial Design.

Books Recommended

1. Product Design and Development by Kail T Ulrich and Steven D Eppinger

2. Product Design and Development by AK Chitale and Gupta

3. Design of Systems and Devices by Middendorf Marcel Dekker

BTME###-18 NON-CONVENTIONAL ENERGY RESOURCES

Course outcomes:

At the end of the course, the student will be able to:
1. Address smart energy and green infrastructure
2. Build models that simulate sustainable and renewable green technology systems
3. Understand the history, global, environmental and economic impacts of green technology
4. Address nonrenewable energy challenges

Unit I

An introduction to energy sources, Environmental Aspects of Power Generation. Heat Transfer from Solar Energy, Physical principles of conversion of solar radiation into heat utilization, Flat Plate Collectors (FPC), Thermal losses and efficiency of FPC, Practical considerations for flat plate collectors, Applications of FPC – Water heating and drying, Focusing Type Collectors: orientation and sun tracking systems, Types of concentrating collectors – cylindrical parabolic collector, compound parabolic collector, Thermal performance of focusing collectors.

Unit II

Solar energy storage system, Application of solar energy: solar water heating, space heating and cooling, solar photovoltaic, solar cooking, solar distillation & desalination, Solar industrial process heating, Solar power generation. Solar Green Houses, Solar thermo mechanical power, solar refrigeration & air conditioning, Solar ponds.

Unit III

Energy from Biomass: Type of biomass sources, Energy plantation, Methods for obtaining energy from biomass, Biomass conversion technologies-wet and dry processes, Biodigestion, Community/Industrial biogas plants, Factors affecting biodigestion, Design of a biogas plant, Classification, advantages and disadvantages of biogas plants, Problems related to biogas plants, Utilization of biogas. Thermal gasification of biomass, Gasifier- classification, chemistry, advantages, disadvantages and application. Alcohol fuels from biomass: overview, feedstock, methods for alcohol production, Ethanol as an alternative liquid fuel; engine performance with alcohol fuels, biodiesel from biomass.

Unit IV

Wind Energy: Basic principles of wind energy conversion: power in the wind, maximum power, forces on the blades, lift and drag, Components of wind energy conversion systems (WEC), Classification, advantages and disadvantages of WEC systems, Types of wind machines, Performance of wind machines, Design considerations, Energy storage, Application of wind energy, Environmental aspect. Tidal Energy. Components of tidal power plants, Single and double basin arrangements, Estimation of energy and power, Advantages and limitations of tidal power. Wave energy- its advantages and disadvantages, energy and power from wave energy.

Unit V

Chemical Energy Sources: Fuel cells: Design, principle, classification, types, advantages and disadvantages, Work output and EMF of fuel cells, Application of fuel cells, Hydrogen energy, Properties of hydrogen, Methods of hydrogen production, Storage and transportation of hydrogen, Advantages and application.

Textbooks:

1. G D Rai, 'Non-Conventional Energy Sources', Khanna Publishers. Delhi, 2010

2. S P Sukhatme, 'Solar Energy-Principles of Thermal Collection & Storage', Tata McGraw Hill Publishing Company Ltd., New Delhi

Reference Books

1. John A Duffie & William A Beckman, 'Solar Energy Thermal processes', Wiley Interscience publication .

2. P Garg & J Prakash,' Solar Energy - Fundamentals and Applications', Wiley Interscience publication. 3. Jay Cheng, 'Biomass to Renewable Energy Processes', 1st Edition, CRC press, 2009.

BTME###-18 OPERATION RESEARCH

Course objectives:

The course is designed to understand the mathematical, engineering and modeling skills that may be useful for designing and solving complex industrial/social/economic problems using various optimization models like deterministic and probabilistic models, simulations, queuing theory, inventory model, replacements models and network models, etc.

Course outcomes:

1. Explain various mathematical deterministic operation research models.
2. Describe the problems of probabilistic and simulation models.
3. Demonstrate the queuing, inventory and replacement models etc.
4. Formulate and analyze the network models.

Detailed Contents:

1. Introduction [2]

Origin of OR and its role in solving industrial problems: General approach for solving OR problems. Classification of mathematical models: various decision-making environments.

2. Deterministic Models [6]

Formulation of deterministic linear mathematical models: Graphical and simplex techniques for solution of linear programming problems, Big M method and two-phase method, Introduction to duality theory and sensitivity analysis: transportation, assignment and sequencing models; Introduction to goal programming; Solution techniques of linear goal programming problems.

3. Probabilistic Models [4]

Decision making under uncertainty: Maximum and minimum models; Introduction to decision tree. Game theory: Solution of simple two-person zero-sum games: Examples of simple competitive situation.

4. Simulation [3]

Concept general approach and application. Use of Monte-Carlo simulation technique to queuing and inventory problems.

5. Dynamic Programming [3]

Introduction to deterministic and probabilistic dynamic programming. Solution of simple problems.

6. Queuing Theory [4]

Types of queuing situation: Queuing models with Poisson's input and exponential service, their application to simple situations.

7. Replacement Models **[4]**

Replacement of items that deteriorate, Replacement of items whose maintenance and repair costs increase with time, replacement of items that fail suddenly; replacement of items whose maintenance costs increase with time and value of money also changes, individual replacement policy, group replacement policy.

8. Inventory Models **[4]**

Inventory models: Classification of inventory control models: Inventory models with deterministic demand, inventory models with probabilistic demand, inventory models with price breaks.

9. Network Models **[6]**

Shortest route and traveling sales - man problems, PERT & CPM introduction, analysis of time bound project situations, construction of networks, identification of critical path, slack and float, crashing of network for cost reduction, resource leveling and smoothening.

Text/Reference Books:

1. Principles of Operations Research HM Wagner, Prentice Hall.
2. Operations Research PK Gupta and DS Hira, S. Chand & Co.
3. Introduction to Operation Research Taha
4. Introduction to Operation Research F.S. Hiller and G.I. Libermann, Holden Ray.

BTME###-18 MAINTENACE & RELIABILITY

Course objectives:

This course is designed to introduce basic concepts of maintenance and reliability to the students, to introduce various method of reliability analysis with real time problems with constraints and to make understanding the applications of Reliability and maintenance analysis for different types of systems.

Course outcomes:

1. Understand the concepts of reliability and maintainability
2. The students will be able to use statistical tools to characterise the reliability of an item and determine the reliability of a system and will also understand the application of maintenance strategies in a manufacturing environment.
3. The students will develop ability in formulating suitable maintenance strategies to enhance system reliability of a manufacturing system

Detailed Contents:

1. **Introduction**

Objective and characteristics of maintenance function, Organization of the maintenance system, Operating practices in maintenance, Maintenance record keeping.

2. **Cost Aspect of Maintenance**

Costs of machine breakdown, estimation of life cycle costs, Application of work measurement in maintenance, Manpower planning and training, Incentive payments for maintenance.

3. **Planning of Maintenance Activities**

Evaluation of alternative maintenance policies breakdown, preventive and predictive maintenance, fault diagnosis and condition monitoring techniques, simulation of alternative practices, Development of preventive maintenance schedule, Housekeeping practices, total productive maintenance.

4. **Maintenance Engineering**

Maintenance requirements of mechanical, electrical, process and service equipment, Safety aspect in maintenance, Aspect of lubrication; chemical control of corrosion, Computerized maintenance information systems.

5. **Reliability**

Concept and definition, configuration of failure data, various terms used in failure data analysis in mathematical forms, component and system failures, uses of reliability concepts in design and maintenance of different system.

6. **Reliability and Availability of Engineering systems**

Quantitative estimation of reliability of parts, Reliability of parallel and series elements, Accuracy and confidence of reliability estimation, Statistical estimation of reliability indices, Machine failure pattern, Breakdown time distribution.

7. Reliability improvement

Reliability in design, reliability in engineering, systems, systems with spares, reliability simulation, redundant and stand by systems, confidence levels, component improvement element, unit and standby redundancy optimization and reliability-cost trade off.

8. **Fault Tree Analysis**

Introduction and importance, fault tree construction, reliability calculations from fault tree, tie set and cut set methods, event tree and numerical problems.

Suggested Books:

1. Lindley R. Higgins, Maintenance Engineering Handbook, McGraw Hill.
2. R.H. Clifton, Principles of Planned Maintenance, Edward Arnold.
3. A Kelly, Maintenance Planning control, McGraw Hill.
4. L.S Srinath, Reliability Engineering, East West Press.
5. S.K. Sinha, Reliability Engineering, John Wiley.