I K Gujral Punjab Technical University

(Minutes of Meeting)

A meeting of members of the Board of Studies **Mechanical Engineering/ Production Engineering/ Industrial/ Automobile Engineering** was held through online (Google meet) as on **May 24th 2021 at 12:00 PM.**

Following members of BOS and special invitees have attended the meeting:

1. Dr. Om Pal Singh (Chairman), BCET Gurdaspur
2. Dr. Jagdev Singh (Professor), BCET Gurdaspur
3. Dr. Paramjit Singh Bilga (Professor), GNDEC, Ludhiana.
4. Dr. Vikas Chawla, Professor, IKGPTU Campus Hoshiarpur
5. Dr. Lakhvir Singh, Professor, BBSBEC, Fatehgarh Sahib
6. Dr. Vijay Kumar Jadon, Professor, Chitkara University.
7. Dr. R. P. Singh Suker-Chakia, Director, PCTE, Ludhiana.
8. Dr. Sarabjit Kaushal, HOD ME, GGI Ludhiana (Special Invitee)
9. Dr. Rachin Goyal, CGC, Landran.
10. Dr. Amit Bansal, Assistant Professor (Coordinator), Department of Mechanical Engineering, Main Campus, I. K. Gujral Punjab Technical University, Kapurthala.

The BOS has made the following recommendations:

1) The scheme and syllabus of 7th Semester B. Tech. (Mechanical Engineering) has been thoroughly discussed and finalized.
2) The syllabus for Mechanical Vibrations has been prepared by Dr. Neel Kanth Grover and Dr. Vikas Chawla.
3) The syllabus for the Automation in Manufacturing has been prepared by Dr. Lakhvir Singh and Dr. Devinder Singh.
4) The syllabus for the Fundamentals of Management for Engineers in Humanities -III has been prepared by Dr. Vivek Aggarwal and Dr. Amit Bansal.
5) The open elective courses have been taken from the other department's open elective list.
6) The List of departmental Electives have been recommended as the open electives for all other branches.
7) All the detailed syllabus and scheme of 7th semester of B. Tech. (Mechanical Engineering) are presented in Annexure-A
8) For B. Tech. (Automobile Engg.) and B. Tech. (Automation & Robotics Engineering), the detailed scheme and syllabus have been finalized for 7th semester as proposed by the expert from the GGI, Ludhiana and are attached at Annexure-B & C respectively.
9) The 8th semester will be industrial training for all branches i.e. B. Tech. (Mechanical Engineering), B. Tech. (Automobile Engineering), and B. Tech. (Automation & Robotics Engineering).

Dr. Amit Bansal, Coordinator 22/06/2021

Dr. Om Pal Singh, Chairman 22/06/2021

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	4	1	0	40	60	100	5
Professional Core courses	BTME502-18	Design of Machine Elements	4	1	0	40	60	100	5
Professional Core courses	BTME503-18	Manufacturing Processes	4	0	0	40	60	100	4
Mandatory courses	BTME504-18	Management and Engineering Economics	3	0	0	40	60	100	3
Professional 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	3	30	20	50	1.5
Mandatory courses	BTMC102-18	Essence of Indian knowledge Tradition	3	0	0	100	00	100	Non-Credit
	BTME409-18	4-weeks Industrial Training *	0	0	6	60	40	100	Non-credit
Total			18	2	13	410	340	750	20.5

* The grade of Satisfactory/ Un-satisfactory of Industrial/Institutional Training imparted at the end of 4th Semester will be included here.

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
Mandatory courses	BTME604-18	Introduction to Industrial management.	3	1	0	40	60	100	4
Professional Elective		Elective-I	3	0	0	40	60	100	3
Professional Core courses	BTME605-18	Refrigeration and Air conditioning (Lab)	0	0	2	30	20	50	1
Professional Core courses	BTME606-18	Mechanical Measurements & Metrology (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 Elective I, II and III (For 6th, 7th and 8th semester)

Sr. No.	Name of Subject	Subject Code
1)	Internal Combustion Engines.	BTME609-18
2)	Mechatronics Systems.	BTME610-18
3)	Microprocessor in Automation	BTME611-18
4)	Composite Materials	BTME612-18
5)	Computer Aided Design.	BTME613-18
6)	Product Design and Development	BTME614-18
7)	Non-Conventional Energy Resources.	BTME615-18
8)	Operation Research	BTME616-18
9)	Maintenance and Reliability	BTME617-18

Semester 7th / 8th

Course Type	Course Code	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
Professional Core courses	BTME701-18	Mechanical Vibrations	3	1	0	40	60	100	4
Professional Core courses	BTME702-18	Automation in Manufacturing	3	0	0	40	60	100	3
Professional Core courses	BTME703-18	Fundamentals of Management for Engineers	3	0	0	40	60	100	3
Professional Elective courses		Elective-II	3	0	0	40	60	100	3
Professional Elective courses		Elective-III	3	0	0	40	60	100	3
Choose from other department		Open Elective	3	0	0	40	60	100	3
	BTME704-18	Project-II	0	0	8	40	60	100	6
Total			18	1	8	280	420	700	25

Semester 7th / 8th

Course Code	Course Title	Evaluation Internal		External	Total Marks	Credits
		Institute	Industry			
BTME-801	Software Training	100	50	100	250	8
	Industrial Training	100	50	100	250	8
Total		200	100	200	500	16

List of Open Elective Subject offered to other Departments :

Sr. No.	Name of Subject	Subject Code
1)	Internal Combustion Engines.	BTME609-18
2)	Mechatronics Systems.	BTME610-18
3)	Microprocessor in Automation	BTME611-18
4)	Composite Materials	BTME612-18
5)	Computer Aided Design.	BTME613-18
6)	Product Design and Development	BTME614-18
7)	Non-Conventional Energy Resources.	BTME615-18
8)	Operation Research	BTME616-18
9)	Maintenance and Reliability	BTME617-18

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

Core Subjects

Sr. No.	Subject Code	Couse Title	Credits
1	BTME501-18	Manufacturing Processes	4

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	BTME501-18	Heat Transfer	4

Elective Subject (Even Semester)

Sr. No.	Subject Code	Couse Title	Credits
1	BTME603-18	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	BTME601-18	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

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 successfully completing this course, the students/learners will be able to:

1. Demonstrate recalling and applying knowledge of Basic Sciences, Graphics & Drawing, Basic Manufacturing Processes and Material Science, for design procedures of various Mechanical components.
2. Comprehend the effect of different stresses and strains under various loading conditions on the mechanical components and identify the mechanism/mode of failure.
3. Examine and solve design problems involving machine elements on the basis of various theories of failure.
4. Synergize forces, moments and strength information to develop ability to analyze, design and/or select machine elements aiming for safety, reliability, and sustainability.

Detailed Contents:

Introduction

Meaning of design with special reference to machine design, general design considerations, concept of tearing, bearing, shearing, crushing, bending and fracture.

Design for Fatigue

Soderberg, Goodman and Gerber design Criteria

Design of shaft

Design of shafts under static and fatigue loadings, Design of solid and hollow shafts for transmission of torque, bending moments and axial forces, Design of shaft for rigidity.

Design of Bearings

Slider: Principle of hydrodynamic lubrication, modes of lubrication, bearing performance parameters, slider bearing design.

Roller: Types, selection guidelines, static and dynamic load carrying capacity, Stribeck's equation, equivalent bearing load, load life relationship.

Design of Transmission Drives

Belt drives: Design of Flat belt, V-belt, Design of the pulley for the same. Chain Drives: Roller chains, polygonal effect, power rating. Selection from the manufacturer's catalogue.

Gear drives: Standard system of gear tooth and gear module, gear tooth failure, strength of gear tooth, terminology of spur, helical, bevel, worm and worm wheel, Design of spur, helical, straight bevel gears,

worm and worm wheel.

Design of Springs

Design of springs: helical compression, tension, torsional and leaf springs

Design of clutches and brakes

Design of contact clutches i.e. plate, multi-disc, cone and centrifugal clutches, Design of band, disc, block with shoe and internal expanding brakes.

Design of joints: Threaded fasteners, pre-loaded bolts and welded joints.

Design, Analysis and Applications of Power screws and flexible coupling.

Books

1. Joseph E. Shigley, Charles Russell Mischke, Richard Gordon Budynas, Mechanical Engineering Design, McGraw-Hill
2. Robert L. Norton, Machine Design; An Integrating Approach, Pearson Publication.
3. Robert C. Juvinall Fundamentals of machine component design, JohnWiley Eastern
4. V.K Jadon, Analysis and design of machine elements, I.K. International
5. V.B Bhandari, Design of Machine elements, Tata Mc-Graw. Hill

Note: Design Data book is allowed in Examination.

BTME503-18 MANUFACTURING PROCESSES

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:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for makingdifferent 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

Unit V Tooling

Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; press tools – configuration, design of die and punch; principles of forging die design.

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 MANAGEMENT AND ENGINEERING ECONOMICS

Course objectives:

- Acquire knowledge of economics to facilitate the process of economic decision making
- Acquire knowledge on basic management aspects

Course Outcomes:

On completion of this subject students will be able to

6. Explain the development of management and the role it plays at different levels in an organization.
7. Comprehend the process and role of effective planning, organizing and staffing for the development of an organization.
8. Understand the necessity of good leadership, communication and coordination for establishing effective control in an organization.
9. Understand engineering economics demand supply and its importance in economics decision making and problem solving.
10. Calculate present worth, annual worth and IRR for different alternatives in economic decision making.
11. Understand the procedure involved in estimation of cost for a simple component, product costing and depreciation, its methods.

Detailed Contents:

Unit-1: **Management**

Introduction: Meaning - nature and characteristics of Management, Scope and Functional areas of management - Management as a science, art of profession - Management & Administration - Roles of Management, Levels of Management, Development of Management Thought early management approaches – Modern management approaches.

Planning:

Nature, importance and purpose of planning process Objectives -Types of plans (Meaning Only)
Decision making Importance of planning -steps in planning & planning premises - Hierarchy of plans.

Unit-II: Organizing and Staffing

Nature and purpose of organization Principles of organization - Types of organization - Departmentation Committees- Centralization Vs Decentralization of authority and responsibility - Span of control - MBO and MBE (Meaning Only) Nature and importance of staffing: Process of Selection & Recruitment (in brief).

Directing & Controlling:

Meaning and nature of directing Leadership styles, Motivation Theories, Communication - Meaning and importance - coordination, meaning and importance and Techniques of Co Ordination. Meaning and steps in controlling - Essentials of a sound control system - Methods of establishing control (in brief)

Unit-III: **Introduction**

Engineering and economics, Problem solving and decision making, Laws of demand and supply, Difference between Microeconomics & Macroeconomics, equilibrium between demand & supply, elasticity of demand, price elasticity, income elasticity. Law of Returns, Interest and interest factors, simple and compound interest, Cash flow diagrams, personal loans and EMI payment calculation with flexible interest rates, Discussion and problems

Unit-IV: **Present, future and annual worth and rate of returns**

Basic present worth comparisons, Present worth-equivalence, Assets with unequal lives and infinites lives, future worth comparisons, payback comparisons, Equivalent annual worth comparisons, situations for annual worth comparisons. Asset life, Rate of return, minimum acceptable rate of return, IRR anomalies and misconceptions, Cost of capital, comparisons of all present future and annual worth with IRR, product costing, Discussions and problems

Unit-V: **Costing and Depreciation**

Costing and depreciation:

Components of costs, estimation of selling price, marginal cost, first cost, all kinds of overheads, indirect cost estimation with depreciation, mensuration and estimation of material cost, cost estimation of mechanical process, idling time. Product costing (approaches to product costing), causes of depreciation, methods of computing depreciation charges, straight line method, declining balance method, sum of years method, sinking fund method, service output methods, taxation concepts, personal income taxes and corporate taxes, Discussions and problems.

Text Books:

1. Principles of Management by Tripathy and Reddy
2. Mechanical estimation and costing, T.R. Banga & S.C. Sharma, 17th edition 2015
3. Engineering Economy, Riggs J.L. McGraw Hill, 2002
4. Engineering Economy, Thuesen H.G. PHI , 2002

Reference Books:

1. Management Fundamentals- Concepts, Application, Skill Development - RobersLusier - Thomson
2. Basics of Engineering Economy, Leland Blank & Anthony Tarquin, McGraw Hill Publication (India) Private Limited
3. Engineering Economics, R.Paneerselvam, PHI publication
4. Fundamentals of Management: Essential Concepts and Applications, Pearson Education, Robbins S.P. and Decenzo David A.
5. Economics: Principles of Economics, N Gregory Mankiw, Cengage Learning
6. Modern Economic Theory, By Dr. K. K. Dewett& M. H. Navalur, S. Chand Publications

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, machining (Conventional and non-conventional) 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

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:

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

Detailed Contents:

1. Basic Concepts

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. (4)

2. Vapour Compression Refrigeration Cycles

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). (8)

3, **Refrigerants**

Classification and nomenclature of refrigerants; Desirable thermodynamic, chemical and physical properties of refrigerants; comparative study of commonly used refrigerants and their fields of application; Azeotropes; 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**

Classifications and working of Compressors, Condensers, Expansion devices and Evaporators. Performance characteristics of the condensing unit, Performance characteristics of the compressor-capillary tube. (6)

5. Vapour Absorption Refrigeration Cycle

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). (4)

6. Psychrometry

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. (5)

7. Psychometric Processes

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. (5)

8. Air conditioning Load Calculations

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. (4)

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 a 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:

MECHANICAL MEASUREMENT SYSTEMS: (04)

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.

SENSORS AND TRANSDUCERS: (05)

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

LINEAR AND ANGULAR MEASUREMENTS: (04)

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

MEASUREMENT OF FORCE, TORQUE AND STRAIN: **(06)**

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.

DISPLACEMENT, VELOCITY/SPEED AND ACCELERATION MEASUREMENT: (05)

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

TEMPERATURE MEASUREMENT: (05)

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

METROLOGY: (02)

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

METROLOGY OF GEARS AND SCREW THREADS: (06)

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.

METROLOGY OF SURFACE FINISH: (06)

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

COMPARATORS: (04)

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

MISCELLANEOUS METROLOGY: (04)

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

2. Power Unit: 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: 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 duel fuel supply systems.

4. Lubrication and Cooling Systems: 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 and water cooling systems; radiator, thermostat, pump and fan.

5. Chassis and Suspension: Loads on the frame, considerations of strength and stiffness, engine mounting, conventional and independent suspension systems; adaptive suspension systems; shock absorbs and stablizers; wheels and tyres.

6. Transmission system: 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: 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: 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: 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: 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 : Concept and types of electric & Hybrid Vehicles . Fuel cell technology, Use of Natural Gas, Liquefied Petroleum Gas, Bio-diesel, Bio-ethanol, Gasohol and Hydrogen in Automobiles- Engine modifications required –Performance,

12. Maintenance: Preventive maintenance, trouble shooting and rectification in different systems; engine turning and servicing

Text/Reference Books:

10. W.H Crouse, Automotive mechanics, McGraw Hill

11. J. Heitner, Automotive Mechanics, East West Press

12. Kirpal Singh, Automobile Engineering Vol. I and II, Standard Publishers

13. J. Webster, Auto Mechanics, Glencoe Publishing Co.

14. P.S Gill, Automobile Engineering, S.K Kataria

BTME604-18 INTRODUCTION TO INDUSTRIAL MANAGEMENT

Course objectives:

- To help the students gain understanding of the functions and responsibilities of industrial managements.
- To enable them to analyze and understand the environment of the organization.
- To help the students to develop cognizance of the importance of management principles.
- To provide them tools and techniques to be used in the performance of the managerial job.

Course Outcomes:

- Understand the complexities associated with management in the organizations and integrate the learning in handling these complexities.
- Demonstrate the roles, skills and functions of management.
- Understand the concepts related to industrial management.

Detailed Contents:

Unit-1: Concept of industrial engineering, Roles of industrial engineer, Tools of management science, Introduction to quality, Excellence in manufacturing, Excellence in service, factors of excellence, relevance of total quality management.
Unit-II: Concept of production, Production system, Input output model, definition of quality, Total quality control and Total Quality Management, salient features of total quality control and total quality management, benefits of total quality management.
Unit-III: Introduction to product design, Effect of design on cost, Requirements of a good product design, Factors affect product design, Product life cycle, Need and concept of product planning, Concept of product development. Introduction of industrial cost, Elements of cost, Breakeven analysis.
Unit-IV: Materials management, Purchasing, Objectives of purchasing, Activities, duties and functions of purchasing department, Purchase organizations, Buying techniques, Purchasing procedure.
Unit-V: Concept of plant maintenance, Objectives and importance of plant maintenance, Duties, functions and responsibilities of plant maintenance department, Organization of maintenance, Scheduled, preventive and predictive maintenance.
Unit-VI: Inventory, Inventory control, Objectives of inventory control, ABC analysis, Just-in-time (JIT), Definition: Elements, benefits, equipment layout for JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.
Unit-VII: Benchmarking: Meaning of benchmarking and its concept, Definition of benchmarking, Benefits of bench marking, process and types of benchmarking.

Unit-VIII: Customer: Types of customers, Customer satisfaction, Role of marketing, Data collection, Customer complaints, Redressal mechanism.

Text Books:

1. Industrial Engineering and Management/ O. P. Khanna/ Dhanpat Rai and Sons
2. General and Industrial Management/ H Fayol/ Pitman
3. Industrial Management/ I. K. Chopde and A. M. Sheikh/ S. Chand
4. A Text Book of Industrial Management/ A. P. Verma and N. Mohan/ Katson
5. Total Quality Management/ Jeol E. Ross/ Taylor and Francis Limited.

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.

BTME609-18 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 horse power, brake horse power, indicated horse power, 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.

BTME610-18 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 microprocessor

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

Sensors and transducers: classification, Development in Transducer technology, Optoelectronics-Shaft encoders, CD Sensors, Vision System, etc.;

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

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,

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,

Mechatronic systems: Mechatronic designs, Case studies.

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

Text Books:

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

BTME611-18 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:

Unit I: Number Systems, codes: BCD, Excess 3, digital electronics: Logic Gates, combinational circuits design: Mux, Demux, Sequential logic circuits design: Flip-flops, Shift registers.

Unit II: 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.

Unit III: 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).

Unit IV: 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

BTME612-18 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.

Text Books:

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

BTME613-18 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:

Unit 1: Introduction: Historical Development, Geometric Modeling, Explicit and Implicit Equations, Intrinsic Equations, Parametric Equations, Coordinate Systems.

Unit 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.

Unit 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.

Unit 4: Solid Design: Fundamental of Solid Design, Parametric Space of a Solids, Continuity and Composite Solids, Surfaces and Curves in a Solid.

Unit 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.

Unit 6: Transformations: Translation, Rotation, Scaling, Symmetry and Reflection, Homogeneous Transformations, Orthographic Projections, Axonometric Projections, Oblique Projections, Perspective Transformation.

Unit 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).

BTME614-18 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.

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

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

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

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,

Modern Approaches to product Design: Concurrent Design, Quality Function Deployment (QFD)

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

BTME615-18 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 economical 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.

Text Books:

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.

BTME616-18 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

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)

2. Deterministic Models

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. (6)

3. Probabilistic Models

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)

4. Simulation

Concept general approach and application. Use of Monte-Carlo simulation technique to queuing and inventory problems. (3)

5. Dynamic Programming

Introduction to deterministic and probabilistic dynamic programming. Solution of simple problems. (3)

6. Queuing Theory

Types of queuing situation: Queuing models with Poisson's input and exponential service, their application to simple situations. (4)

7. Replacement Models

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. (4)

8. Inventory Models

Inventory models: Classification of inventory control models: Inventory models with deterministic demand, inventory models with probabilistic demand, inventory models with price breaks. (4)

9. Network Models

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. (6)

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.

BTME617-18 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, House keeping 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.

MECHANICAL VIBRATIONS
(BTME701-18)

Course Outcomes

After completion of this course, the students will be able to
CO1: Formulate mathematical models of problems in vibrations using Newton's second law or energy principles
CO2: Understand the need and measurement of vibration in mechanical systems
CO3: Calculate principal modes of vibration
CO4: Explore the suitable methods of vibration reduction and absorption
CO5: Ability to determine vibratory responses of SDOF and MDOF systems
CO6: Create the mathematical model of a vibratory system to determine its response

UNIT - I Introduction, Classification of Vibration Systems, Harmonic motion, Vector representation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical and numerical methods. Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping.
UNIT - II Single Degree Freedom: Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, forced vibrations with rotating and reciprocating unbalance, support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments.
UNIT- III Two Degree Freedom systems Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled system, Principle of vibration absorber, Undamped dynamic vibration absorbers, Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.
UNIT- IV Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts.
UNIT- V Multi Degree Freedom system: Numerical Analysis by Rayleigh's method, Dunkerely's, Holzer's and Stodola methods, Rayleigh-Ritz method 5 Critical speed of shafts, Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

Books and References:

1. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee.
2. Mechanical Vibrations-Theory & Practice, S Bhave, Pearson Education.
3. Mechanical Vibrations-N K Grover, PBS Publications.
4. Theory of Vibrations with Applications, Thomson & Dahleh, Pearson Education.
5. Elements of Vibration Analysis, L Meirovitch, McGraw-Hill Education.
6. Mechanical Vibrations – Tse, Morse & Hinkle
7. Mechanical Vibrations – V. Rama Murthy, Narosa Publications 8. Mechanical Vibrations – D. Nag, Wiley

AUTOMATION IN MANUFACTURING
(BTME702-18)

Course Outcomes

After completion of this course, the students will be able to
CO1: Students should be able to design and implement automated systems using pneumatics.
CO2: Students should be able to provide hydraulic solutions for designing automated systems.
CO3: Students should be able to design and implement electro-pneumatic/hydraulic solutions for automated systems.
CO4: Students should be able to apply PLC programming and implement it on PLC kits.
CO5: Students should be able to devise Assembly automated systems using feeders, orienteers and escapement devices

Course Objectives: To understand the importance of automation and a thorough knowledge of its various elements such as sensors, pneumatics, hydraulics and CNC.

Introduction:
Importance of automation in the manufacturing industry. Use of mechatronics. Systems required. Rigid and Flexible automation, Computer control of Machine Tools and Machining Centers,

Design of an automated system:
Building blocks of an automated system, working principle and examples, Fabrication or selection of various components of an automated system. Specifications of various elements. Use of design data books and catalogues.

Data Acquisition:
Study of various sensors required in a typical automated system for manufacturing. Construction and principle of operation of sensors, signal conditioning and data acquisition, use of microprocessor or micro controllers. Configurations. Working.

Drives:
Electrical drives – types, selection criteria, construction and operating principle.

Automation Mechanisms:
Ball screws, linear motion bearings, cams, systems controlled by camshafts. Electronic cams, indexing mechanisms, tool magazines, and transfer systems.

Hydraulic and Pneumatic systems:
hydraulic power pack, pumps, valves, designing of hydraulic circuits, configurations, compressors, valves, distribution and conditioning.

CNC technology:
NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, basic elements, interpolators and programming.

Books

1. Tonshoff, H.K. and I. Inasaki, Sensors in manufacturing,Wiley-VCH, 2001.
2. HMT Ltd. Mechatronics, Tata McGraw-Hill, New Delhi, 1988.
3. Bradley, D. A., Dawson D., Burd, N. C. and Loader A. J.,Mechatronics: Electronics in products and processes, CRC Press, Florida, USA, 2010.

4. Rothbart, H. A., CAM Design Handbook, McGraw-Hill, 2004.• Norton, R. L., Cam Design and Manufacturing Handbook,Industrial press Inc, 2002.
5. Groover, M. P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice Hall, 2001.
6. Parr, A. A., Hydraulics and pneumatics, Elsevier, 1999.
7. Smid, P., CNC Programming Handbook, Industrual Press,New York, USA, 2008.
8. Rao, P. N., CAD/CAM Principles and Applications, Tata McGraw Hill, New Delhi, 2010.

Fundamentals of Management for Engineers
(BTME703-18)

Course Objectives: -

- To understand the Management Concepts, applications of Concepts in Practical aspects of business and development of Managerial Skills for Engineers.
- To help the students gain understanding of the functions and responsibilities of industrial managements.
- To enable them to analyze and understand the environment of the organization.
- To help the students to develop cognizance of the importance of management principles.
- To provide them tools and techniques to be used in the performance of the managerial job.

Course Outcomes: -

- The students understand the significance of Management in their Profession.
- The various Management Functions like Planning, Organizing, Staffing, Leading, aspects are learnt in this course.
- Understand the complexities associated with management in the organizations and integrate the learning in handling these complexities.
- Demonstrate the roles, skills and functions of management.

UNIT-I

Introduction to Management: Definition, Nature and Scope, Functions of Management, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management.

UNIT-II

Introduction to Operations Management, Types of Plant Layout, Introduction to Total Quality Management (TQM), Total Quality Management Models, Benefits of TQM, Basics of Six Sigma and Lean Manufacturing.

UNIT-III

Introduction to Marketing, Functions of Marketing, Types of Marketing, Marketing vs. Selling, Marketing Mix, Product Life Cycle, Market Segmentation, Supply Chain Management (SCM).

UNIT-IV

Introduction to Work Analysis, Definition, need and scope of work analysis, Method Study: Objectives, Step-by-step procedure, Charts and diagrams for recording data, Principles of Motion economy, Therbligs, Work Measurement: Definition, Various techniques of work measurement such as Work Sampling, Stop Watch Time Study, Analytical Estimating, Predetermined Motion Time System, Need for operator rating, Methods of rating, Allowances and their types, Standard time

UNIT-V

Introduction to Productivity: Definition, Reasons for low productivity, methods to improve productivity, Value Engineering: Definition, Types of values, concept, phases and applications of value engineering

UNIT-VI

Introduction to Personnel Management, aims and objectives of personnel management, Principles of a good personnel policy, Recruitment and selection of employees, Education and training of employees, Safety engineering.

BOOKS:

6. Industrial Engineering and Management/ O. P. Khanna/ Dhanpat Rai and Sons
7. Management Essentials/ Andrew Dubrin/ Cengage Learning
8. Fundamentals of Management/ Stephen P. Robbins/ Pearson Education
9. General and Industrial Management/ H Fayol/ Pitman
10. Industrial Management/ I. K. Chopde and A. M. Sheikh/ S. Chand
11. A Text Book of Industrial Management/ A. P. Verma and N. Mohan/ Katson

B. TECH (AUTOMOBILE ENGINEERING)

STUDY SCHEME

BATCH 2018-19 ONWARDS

I.K.G.P.T.U KAPURTHALA

3rd Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAE301-18	Strength of Materials	3	1	0	4	40	60	100	4
BTAE302-18	Engineering Thermodynamics	3	1	0	4	40	60	100	4
BTAE303-18	Fluid Mechanics and Fluid Machines	3	1	0	4	40	60	100	4
BTAE304-18	Machine Drawing	1	0	6	7	40	60	100	4
BTAE305-18	Automotive Materials	3	0	0	3	40	60	100	3
BTAE306-18	Strength of Materials Lab	0	0	2	2	30	20	50	1
BTAE307-18	Fluid Mechanics and Fluid Machines Lab	0	0	2	2	30	20	50	1
BTAE308-18	Engineering Thermodynamics Lab	0	0	2	2	30	20	50	1
BMPD301-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**290**	**360**	**650**	**22**

4th Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAE401-18	Manufacturing Processes	4	0	0	4	40	60	100	4
BTAE402-18	Kinematics and Theory of Machines	3	1	0	4	40	60	100	4
BTAE403-18	Heat Transfer and Combustion	4	0	0	4	40	60	100	4
BTAE404-18	Automotive Electrical and Electronics Systems	4	0	0	4	40	60	100	4
BTAE405-18	Transport Management and Automobile Industry	3	1	0	4	40	60	100	4
EVS101-18	Environment Science	3	0	0	3	100	00	100	Non - credit
BTAE406-18	Manufacturing Processes Lab	0	0	2	2	30	20	50	1
BTAE407-18	Automotive Electrical and Electronics Systems Lab	0	0	2	2	30	20	50	1
BTAE408-18	Kinematics and Theory of Machines Lab	0	0	2	2	30	20	50	1
BMPD401-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**390**	**360**	**750**	**23**

5th Semester; Contact Hours: 28

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAE501-18	Automotive Chassis system	4	0	0	4	40	60	100	4
BTAE502-18	Numerical Methods	3	1	0	4	40	60	100	4
BTAE503-18	Automotive Petrol and Diesel Engines	3	0	0	3	40	60	100	3
BTAE504-18	Vehicle Body Engineering	4	0	0	4	40	60	100	4
HSMC101-18 /HSMC102-18*	Humanities-I	3	0	0	3	40	60	100	3
BTMC102-18	Essence of Indian Knowledge Traditions	3	0	0	3	100	00	100	Non-Credit
BTAE505-18	Automotive chassis System Lab	0	0	2	2	30	20	50	1
BTAE506-18	Numerical Methods Lab	0	0	2	2	30	20	50	1
BTAE507-18	Vehicle Body Engineering Lab	0	0	2	2	30	20	50	1
BMPD501-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**390**	**360**	**750**	**21**

6th Semester; Contact Hours:

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAE601-18	Vehicle Safety Engineering	4	0	0	4	40	60	100	4
BTAE602-18	Automation Transmission	4	0	0	4	40	60	100	4
BTAE603-18	Design of Automotive Components	3	1	0	4	40	60	100	4
BTAE604-18	Introduction to Industrial Management	3	0	0	3	40	60	100	3
BTAE605-18	Vehicle Maintenance and Diagnostics	4	0	0	4	40	60	100	4
BTAE606-18	Vehicle Maintenance and Diagnostics Lab	0	0	2	2	30	20	50	1
BTAE607-18	Automotive Transmission Lab	0	0	2	2	30	20	50	1
BTAE608-18	Engine Testing & Pollution Measurement Lab	0	0	2	2	30	20	50	1
BTAE609-18	Project -I	0	0	4	4	30	20	50	2
BMPD601-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
	Total				**31**	**320**	**380**	**700**	**24**

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.

Semester 7th / 8th

Course Type	Course Code	Course Title	Load Allocations			Marks Distribution		Total Marks	Credits
			L	T	P	Internal	External		
Professional Core courses	BTAE701-18	Vehicle Dynamics	3	1	0	40	60	100	4
Professional Core courses	BTAE702-18	Automotive heating ventilation and air conditioning	4	1	0	40	60	100	5
Professional Core courses	BTAE703-18	Measurement and Instrumentation	3	0	0	40	60	100	3
Professional Elective courses		Elective-I	3	0	0	40	60	100	3
Professional Elective courses		Elective-II	3	0	0	40	60	100	3
	BTAE704-18	Automotive Heating, ventilation and air conditioning lab	0	0	2	30	20	50	1
	BTAE705-18	Measurement and Instrumentation lab	0	0	2	30	20	50	1
	BTAE706-18	Project-II	0	0	8	40	60	100	4
	BMPD	Mentoring and Professional Development	0	0	2	Satisfactory/ un-satisfactory			Non-credit
Total						300	400	700	24

List of Elective –I and Elective-II

1. BTAE707-18 Computer Aided Design and Manufacturing
2. BTAE708-18 Automotive Aerodynamics
3. BTAE709-18 Hydraulic & Pneumatics systems for automobiles
4. BTAE710-18 Tractors & Farms Equipment
5. BTAE711-18 Off Road Vehicles
6. BTAE712-18 Automotive fuels & Emission
7. BTAE713-18 Computation fluid dynamics
8. BTAE714-18 Mechatronics
9. BTAE715-18 Alternate fuels and energy systems

Semester 7th / 8th

Course Code	Course Title	Evaluation Internal		External	Total Marks	Credits
		Institute	Industry			
BTAE-801	Software Training	100	50	100	250	8
	Industrial Training	100	50	100	250	8
	Total	200	100	200	500	16

DETAILED SYLLABUS
FOR 3rd to 8th SEMESTER

3rd Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAE301-18	Strength of Materials	3	1	0	4	40	60	100	4
BTAE302-18	Engineering Thermodynamics	3	1	0	4	40	60	100	4
BTAE303-18	Fluid Mechanics and Fluid Machines	3	1	0	4	40	60	100	4
BTAE304-18	Machine Drawing	1	0	6	7	40	60	100	4
BTAE305-18	Automotive Materials	3	0	0	3	40	60	100	3
BTAE306-18	Strength of Materials Lab	0	0	2	2	30	20	50	1
BTAE307-18	Fluid Mechanics and Fluid Machines Lab	0	0	2	2	30	20	50	1
BTAE308-18	Engineering Thermodynamics Lab	0	0	2	2	30	20	50	1
BMPD301-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**290**	**360**	**650**	**22**

BTAE301-18 STRENGTH OF MATERIALS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100s	4

Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Detailed Contents:

Deformation in solids-Hooke's law, stress and strain-tension, compression and shear stresses-elastic constants and their relations-volumetric, linear and shear strains-principal stresses and principal planes-Mohr's circle. **(8)**

Beams and types, transverse loading on beams-shear force and bending moment diagrams-Types of beam supports, simply supported and over-hanging beams, cantilevers, theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads. **(8)**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems. **(8)**

Torsion stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs. **(8)**

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure **(8)**

Course Outcomes:

1. After completing this course, the students should be able to recognise various types loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. The students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Suggested Readings/Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.

2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.

3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.

4. S. S. Rattan, "Strength of Materials", Tata McGraw Hill, New Delhi.

5. R. K. Bansal, "A Text Book of Strength of Materials", Laxmi Publications, New Delhi.

6. D. K. Singh, "Strength of Materials", Ane Books Pvt. Ltd., New Delhi.

7. Sadhu Singh, Strength of Materials, Khanna Publishers, Delhi.

BTAE302-18 ENGINERING THERMODYNAMICS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To learn about of 1st law for reacting systems and heating value offuels
2. To learn about gas and vapor cycles and their first law and second law efficiencies
3. To learn the about reciprocating compressors, refrigeration and air conditioning systems.

Detailed Contents:

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis-First law analysis of combustion reactions-Heat calculations using enthalpy tables-Adiabatic flame temperature-Chemical equilibrium and equilibrium composition calculations using free energy. **(8)**

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra-super-critical Rankine cycle-Gas power cycles, Air standard Otto, Diesel and Dual Cycles-Air standard Brayton cycle, effect of reheat, regeneration and intercooling-Combined gas and vapor power cycles-Vapor compression refrigeration cycles, refrigerants and their properties. Refrigeration and Air-Conditioning: Principles of refrigeration, air-conditioning and heat pumps, vapour compression and vapour absorption systems, co-efficient of performance, Properties of refrigerants. **(15)**

Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point. **(4)**

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser. **(8)**

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. **(5)**

Course Outcomes:

1. The students will get a good understanding of various practical power cycles and heat pump cycles.
2. They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
3. They will be able to understand phenomena occurring in high-speed compressible flows
4. The students will be able to understand principal of refrigeration and air conditioning and their applications.

Suggested Readings/Books:

1. Nag. P.K, Engineering Thermodynamics, Tata McGraw Hill Co Ltd., Seventh Edn, 1993.
2. Mayhew and Rogers, Engineering Thermodynamics, Longman Green & Co Ltd., London, E.L.B.S. Edn, 1990.
3. Van Wylen. G.J. and Sonntag. R.E., Fundamentals of Classical Thermodynamics (SI Version) 2nd Edn, 1986
4. D.H. Bacon, Engineering Thermodynamics, Butterworth & Co., London, 1989.
5. M.A. Sadd Thermodynamics for Engineers, Prentice Hall of India Pvt Ltd., 1989

BTAE303-18 FLUID MECHANICS AND FLUID MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To learn about the application of mass and momentum conservation laws for fluid flows
2. To understand the importance of dimensional analysis
3. To obtain the velocity and pressure variations in various types of simple flows
4. To analyze the flow in water pumps and turbines.

Detailed Contents:

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, incompressible flow, Bernoulli's equation and its applications. **(9)**

Exact flow solutions in channels and ducts, Couette and Poiseuille flow, laminar flowthrough circular conduits and circular annuli- concept of boundary layer–measures of boundary layer thickness–Darcy Weisbach equation, friction factor, Moody's diagram. **(9)**

Need for dimensional analysis–methods of dimension analysis–Similitude–types of similitude Dimensionless parameters–application of dimensionless parameters–Model analysis. **(6)**

Euler's equation–theory of rotodynamic machines–various efficiencies–velocity components at entry and exit of the rotor, velocity triangles–Centrifugal pumps, working principle, work done by the impeller, performance curves–Cavitation in pumps-Reciprocating pump – working principle. **(8)**

Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines-Pelton wheel, Francis turbine and Kaplan turbines, working principles–draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines. **(8)**

Course Outcomes:

1. Upon completion of this course, students will be able to mathematically analyze simple flow situations
2. They will be able to evaluate the performance of pumps and turbines.

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. Frank M. White, "Fluid Mechanics", Tata Mc Graw Hill Publications, 5th Edition, 2012.

BTAE304-18 MACHINE DRAWING

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
1	0	6	7	40	60	100	4

Objectives:
The student will acquire a knowledge of fastening arrangements such as welding, riveting the different styles of attachment for shaft. The student also is enabled to prepare the assembly of various machine or engine components and miscellaneous machine components; from the individual part drawing.

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)**

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)**

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)**

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)**

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.

Suggested Reading/Books:

1. P.S Gill, "Machine Drawing", S K Kataria and sons, 18th edition, 2017reprint
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).

BTAE305-18 AUTOMOTIVE MATERIALS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	40	60	100	3

Objectives:
To present a problem oriented in depth knowledge of automotive materials and manufacturing. To address the underlying concepts and methods behind automobile materials and manufacturing including the surface treatment of the materials.

Detailed Contents:
Introduction: Engineering materials, material classifications, mechanical, thermal, electrical, magnetic, chemical, optical and physical properties of materials, effects of alloying elements on properties of steel, carbon steel, low alloy steels, stainless steel, tool steels and die steels. Alloys of Ni, Al, Cu, Mg; properties and their applications, recrystallization temperature, their effect on the properties of materials**.** **(4)**

Ceramic Materials: Introduction, nature of ceramic materials, types, products, properties developments in ceramics. **Glass:** Introduction, composition, structure, types of glass and their properties, use of glass, fracture in glass**.** **(3)**

Rubber: Introduction, characteristics of rubbers, structure of elastomers, types of elastomers, vulcanization of rubber, uses of rubber and applications. (2)

Plastics Materials: Introduction, definition and concept, properties of plastics, thermoplastics, thermosetting plastics, deformation of plastics, plastic alloys. (2)

Fundamentals of Composites- need for composites–Enhancement of properties -classification of composites – Matrix-Polymer matrix composites (PMC), Metal matrix composites (MMC), Fiber reinforced composites, Applications of various types of composites. (3)

Polymer Matrix Composites Polymer matrix resins – Thermosetting resins, thermoplastic resins – Reinforcement fibres –various types of fibres, Fibre reinforced plastics (FRP), Glass fibre reinforced plastics (GRP). (4)

Ceramic Matrix Composites Engineering ceramic materials–properties–advantages–limitations–Monolithic Ceramics-Need for CMC– Ceramic matrix -Various types of Ceramic Matrix composites- oxide ceramics–non oxide ceramics–aluminum oxide–silicon nitride – reinforcements – particles- fibres whiskers. Sintering - Hot pressing – Cold isostatic presses–Hot isostatic pressing. (4)

Advances in Composites Carbon / carbon composites–Advantages of carbon matrix–limitations of carbon matrix Carbon fibre. (2)

Heat Treatment and Surface Treatment: Heat treatment of steel–Annealing, Normalizing, Hardening and tempering with their types and application to automotive components, (3)

Surface Hardening Techniques: Induction, flame and chemical hardening, coating of wear and corrosion resistance, Electroplating, Phosphating, Anodizing, hot dipping, thermal spraying, hard facing and thin film coatings. (4)

Selection of Materials: Factors affecting the selection of materials, Cryogenic wear, corrosion, fatigue, creep and oxidation resistance application. Criteria of selecting materials for automotive components viz cylinder block, Cylinder head, piston, piston ring, Gudgeon pin, connecting rod, crank shaft, crank case, cam, cam shaft, engine valve, gear wheel, clutch plate, axle, bearings, chassis, spring, body panel - radiator, brake lining etc. Materials for heavy duty vehicles: special alloys, plastics, seat fabrics and materials for bumpers. (6)

Course Outcomes:

1. The students can identify different areas of automobile materials and manufacturing.
2. The students can find the applications of all the areas in day to day life.

Suggested Readings / Books:

1. Khanna. O.P., "Material Science and Metallurgy ", Dhanpat Rai and Sons.
2. Agarwal B.K., "Introduction to Engineering Materials", Tata McGraw-Hill.
3. Dogra Rakesh, "Advances in Material Science", Katson Books.
4. Mathews F.L. and Rawlings R.D., "Composite Materials", Chapman and Hall, London, England, 1st edition, 1994.
5. Chawla K.K., "Composite materials", Springer – Verlag, 1987.
6. Strong A.B., "Fundamentals of Composite Manufacturing", SME, 1989.
7. Sharma S.C., "Composite materials", Narosa Publications, 2000.
8. Daniel Yesudian C., "Materials Science and Metallurgy", Scitech Publications (India), 2004.

BTAE306-18 STRENGTH OF MATERIALS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Course Outcomes:

After studying this course, students shall be able to:

1. Measure the various mechanical properties such as tensile and compressive strength, impact strength, torsion strength and fatigue strength and hardness of brittle and ductile materials.
2. Calculate load carrying capacity of long columns and their buckling strength.

List of Experiments:

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 any hardness tests (any one; from Rockwell, Brinell & Vicker's test).
3. To perform impact test to determine impact strength.
4. To perform torsion test and to determine various mechanical properties.
5. To perform Fatigue test on circular test piece.
6. To perform bending test on beam and to determine the Young's modulus and modulus of rupture.
7. Determination of Bucking loads of long columns with different end conditions.

BTAE307-18 FLUID MECHANICS AND FLUID MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

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 Experiments:

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 friction coefficients, head loss in pipes.
5. To determine the velocity distribution for pipeline flow with a pitot static probe.
6. Determination of various efficiencies of Hydraulic Ram
7. To draw characteristics of Francis turbine/Kaplan Turbine, Pelton Turbine and Centrifugal pump.

BTAE308-18 ENGINEERING THERMODYNAMICS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

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. Understand to prepare the heat balance sheet for IC Engines.

List of Experiments:

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

2. 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.

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

4. 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.

4th Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAE401-18	Manufacturing Processes	4	0	0	4	40	60	100	4
BTAE402-18	Kinematics and Theory of Machines	3	1	0	4	40	60	100	4
BTAE403-18	Heat Transfer and Combustion	4	0	0	4	40	60	100	4
BTAE404-18	Automotive Electrical and Electronics Systems	4	0	0	4	40	60	100	4
BTAE405-18	Transport Management and Automobile Industry	3	1	0	4	40	60	100	4
EVS101-18	Environment Science	2	0	0	2	Non-Credit Mandatory Course			
BTAE406-18	Manufacturing Processes Lab	0	0	2	2	30	20	50	1
BTAE407-18	Automotive Electrical and Electronics Systems Lab	0	0	2	2	30	20	50	1
BTAE408-18	Kinematics and Theory of Machines Lab	0	0	2	2	30	20	50	1
BMPD401-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**290**	**360**	**650**	**23**

BTAE401-18 MANUFACTURING PROCESSES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

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.

Detailed Contents:

Conventional Manufacturing processes: Casting and Moulding: Metal casting processes and equipment, Heat transfer and solidification, shrinkage, riser design, casting defects and residual stresses. **(5)**

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. **(4)**

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. **(8)**

Additive Manufacturing: Rapid prototyping and rapid tooling. **(3)**

Joining/Fastening Processes: Physics of welding, brazing and soldering; design considerations in welding, Solid and liquid state joining processes; Adhesive bonding. **(4)**

Unconventional Machining Processes:

Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters. **(5)**

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. **(8)**

Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining. **(3)**

Course Outcomes:

Upon completion of this course, students will be able to understand the different conventional and unconventional manufacturing methods employed for making different products

Suggested Readings/Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014
2. Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems
3. Degarmo, Black & Kohser, Materials and Processes in Manufacturing

BTAE402-18 KINEMATICS AND THEORY OF MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components.
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link.
3. To be able to design some linkage mechanisms and cam systems to generate specified output motion and to understand the kinematics of gear trains.

Detailed Contents:

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms **(8)**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesis three position graphical synthesis for motion and path generation **(8)**

Classification of cams and followers- Terminology and definitions- Displacement Diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers **(8)**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics **(8)**

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction clutches- belt and rope drives- friction in brakes **(8)**

Course Outcomes:

The students can design various types of linkage mechanisms for obtaining specific motion and analyse them for optimal functioning.

Suggested Readings/Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

BTAE403-18 HEAT TRANSFER AND COMBUSTION

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

1. The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2. Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
3. The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers

Detailed Contents:

Conduction: Fourier law of heat conduction for isotropic material. Thermal conductivity. Derivation of the energy equation in three dimensions including transient effect, Non dimensional-thermal diffusivity and Fourier number, Types of boundary conditions- (Dirchlet, Neumann, mixed type), One-dimensional solution with and without heat generation, Analogy with electrical circuits. (10)

Fins: rectangular and pin fins. Fin effectiveness and efficiency. Critical thickness of insulation. (2)

Radiation: Physical mechanism of thermal radiation, laws of radiation, definition of black body emissive power, intensity of the radiation, emissivity, reflectivity, transmittivity, irradiation, radiosity. Radiation exchange between black bodies. Concept of Gray-Diffuse Isotropic (GDI) surface. Radiation exchange between GDI surfaces. (8)

Convection: Introduction, Newton's law of cooling and significance of the heat transfer co-efficient. Momentum and energy equations in two dimensions, non-dimensional, importance of non-dimensional quantities and their physical significance. Order of magnitude analysis for flow over a flat plate. Velocity and Analogies between momentum, heat and mass transfer. Natural convection. (9)

Heat exchangers: Types of heat exchangers, parallel and counter flow types, Introductions to LMTD. Correction factors, fouling factor. (4)

Combustion Analysis: Fuels, HCV and LCV, Air requirements, excess air, analysis of products of combustion. Enthalpy of formation, adiabatic flame temperature, enthalpy of combustion, heat of reaction. Analysis of fuels and flue gas, Orsat's apparatus. (7)

Course Outcomes:

1. After completing the course, the students will be able to formulate and analyze a heat transfer problem involving any of the three modes of heat transfer.
2. The students will be able to obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer
3. The students will be able to design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Suggested Readings/Books:

1. A. Bejan, Heat Transfer John Wiley, 1993
2. J.P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3. F.P. Incropera, and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, John Wiley, Sixth Edition, 2007.

4. Massoud Kaviany, Principles of Heat Transfer, John Wiley, 2002
5. Yunus A Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002
6. D.S. Kumar. Heat and Mass Transfer, S.K. Kataria & Sons, 2013

BTAE 404-18 AUTOMOTIVE ELECTRICAL AND ELECTRONIC SYSTEMS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

The students should be able to

1. Acquire the knowledge of Electrical and Electronics engineering concepts.
2. Understand the construction and applications of Electrical and electronics components in various automotive electrical circuits.
3. Understand the construction and working of various automotive electrical systems and components.
4. Identify, demonstrate and compare the various components and systems of Auto electrical systems.

Detailed Contents:

Introduction Earth returns and insulated return systems, 6, 12, and 24-volt systems. Positive & negative earth systems, Fusing of circuits, relays, switches, low and high voltage automotive cables, wiring diagram for typical automotive wiring systems, maintenance and servicing. (2)

Batteries Principles of lead acid cells and their characteristics-construction and working of lead acid battery, types of batteries, testing of batteries, effect of temperature on: capacity and voltage, battery capacity, voltage, efficiency, charging of batteries, sulphation and desulphation, maintenance and servicing, Battery failures & checking, Maintenance free Batteries, High energy and power density batteries for electric vehicles. (4)

Charging system Principle of generation of direct current. Shunt generator characteristics. Armature reaction. Third brush regulation. Cut-out. Voltage & current regulators, compensated voltage regulator. Alternators - principle, constructional and working aspects, bridge rectifiers. Principle of Magneto, Flywheel Magneto, Maintenance and servicing. Trouble shooting in charging systems. (3)

Starting system Condition at Starting–starting torque and power requirements, behavior of starter during starting, Series motor and its characteristics, Principle & construction of starter motor, working of different starter drive units, care & maintenance of starter motor, Starter switches, safety mechanism, maintenance, servicing and trouble shooting. (3)

Ignition system Types, construction & working of battery & coil and magneto ignition systems. Relative merits, Ballast Resistor, Ignition coil, Distributor, Contact breaker Point, centrifugal and vacuum advance mechanisms, Limitations of conventional ignition systems, Transistorized Ignition systems, Spark plugs - construction, different types, plug fouling, maintenance, servicing and fault diagnosis, Electronic Ignition system. Programmed ignition, distributor less ignition. (5)

Lighting system Principle of automobile illumination, headlamp construction and wiring, reflectors–types, signaling devices flashers, stop lights, fog lamps, auxiliary lighting-engine, passenger, reading lamp, rear-plate lamps. Automatic illumination system, head light leveling devices. Study of a modern headlight system with improved night vision. (4)

Electrical Equipment and Accessories Oil pressure gauge, fuel level gauge, engine temperature gauge, electrical fuel pump, speedometer, odometer, trip meter, engine rpm meter, Headlamp & Windshield washer and wiper, heaters and defrosters, horns, stereo/radio, power antennae. Central locking, power window winding. Sun/Moon Roof. Motorized rear view mirrors, reverse warning, Bumper collision warning. Other accessories in modern vehicles. (4)

Fuel Cells Thermodynamic aspects; types-hydrogen and methanol, power rating and performance, various components and working of fuel cell, heat dissipation. (2)

Drive Motors and controllers: Drive arrangements in Hybrid and Electric vehicles, Drive motors: types and construction, Controlling of motor operations, Motor-generator in hybrid vehicles and its controls (2)

Basic electronics: Semiconductors- P type-N type, diode-introduction-half wave rectification-full wave bridge rectifier-full wave bridge rectifier with capacitor filter, zener diode-introduction, zener diode as voltage regulator, LED and photo diode-introduction-applications, transistor-introduction NPN and PNP transistor-applications-transistor as switch. (7)

Course Outcomes:

After studying this course, students shall be able to:

1. Explain basic terminologies, components and concepts of electrical and electronics engineering.
2. Understand the purpose, construction and working of different batteries, electrical systems, components of charging and starting system used in Automobiles.
3. Understand purpose, circuits, construction and working of components of ignition system, lighting and accessories system.
4. Explain purpose, circuits, construction and working of components of lighting and accessories system.

Suggested Readings/Books:

1. Kohli P.L., “Automotive Electrical Equipment ", Tata McGraw-Hill.
2. Chapman, “Principles of Electricity and Electronics for the Automotive Technician”, Thomson Asia, 2000.
3. Judge A.W., "Modern Electrical Equipment of Automobiles", Chapman & Hall, London.
4. Vinal G.W., "Storage Batteries ", John Wiley & Sons Inc.
5. W.H. Crouse, “Automobile Electrical Equipment ", McGraw Hill Book Co. Inc.

BTAE405-18 TRANSPORT MANAGEMENT AND AUTOMOBILE INDUSTRY

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To learn about management training and operations
2. To learn about vehicle maintenance and vehicle parts.
3. To learn the about motor vehicle acts.

Detailed Contents:

Management Training and Operations: Basic principles of supervising. Organizing time and people. Job instruction training, training devices and techniques. Driver and mechanic hiring. Driver checklist, Lists for driver and mechanic. Trip leasing. Vehicle operation and types of operation. Automobile Industry: History and development of the automobile industry, market trends, current scenario in Indian auto industry, Auto ancillary industries, Role of the automobile industry in national growth. (10)

Vehicle Maintenance: Scheduled and unscheduled maintenance Planning and scope. Evaluation of PMI program, Work scheduling, Overtime, Breakdown analysis, Control of repair backlogs, Cost of options.

Scheduling and Fare Structure: Route planning, Scheduling of transport vehicles, Preparation of timetable, Costs, fare structure, methods of the fare collection, Preparation of fare table. (10)

Vehicle Parts, supply management and budget: Cost of inventory, balancing inventory cost against downtime, Parts control, Bin tag systems, Time management, Time record keeping, Budget activity, Capital expenditures, Classification of vehicle expenses, Fleet management and data processing, Data processing systems- Software, Models–Computer controlling of fleet activity, energy management. (10)

Motor Vehicle Act: Schedules and sections, Registration of motor vehicles, Licensing of drivers, Control of permit, Limits of speed, traffic signs. Constructional regulations. Description of goods carrier, delivery van, tanker, tipper, Municipal, firefighting and break down service vehicle. (8)

Course Outcomes:

After completing this course, the students will get a good understanding of various management training operations and will able to understand vehicle maintenance techniques and methodologies. They will be able to understand supply management and budget for the production. They will be able to understand the motor \vehicle acts.

Suggested Readings/Books:

1. John Dolu, Fleet Management, McGraw Hill Co., 1984
2. Government Publication, The Motor Vehicle Act, 1989
3. Kitchin. L. D., Bus Operation, IIIiffe and Sons Ltd., London, III Edition, 1992
4. Kadiyali. L.R., Traffic Engineering and Transport Planning.

EVS101-18 ENVIRONMENT SCIENCE

L	T	P	Total	Credit points
3	0	0	3	Non-Credit

Objectives:

1. To learn about management training and operations
2. To learn about vehicle maintenance and vehicle parts.
3. To learn the about motor vehicle acts.

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 resource 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 rehabilitation 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.

I. Identify a tree fruit flower peculiar to a place or having origin from the place.
II. 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).
III. Videography/ photography/ information collections on specialties/unique features of different types of common creatures.
IV. 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) Drive for segregation of waste
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, National Park or Biosphere Reserve

Course Outcomes:

Students will enable to understand environmental problems at local and national level through literature and general awareness. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.

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

BTAE406-18 MANUFACTURING PROCESSES LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Course Outcomes:

After studying this course, students shall be able to:

1. Understand the basics of various welding process and will be able to prepare joints using welding process i.e. MIG, Arc welding and spot welding.
2. Understand the working of various machines.

List of Experiments:

1. Study of Arc welding equipment and making a weld joint by this process.
2. Study of MIG welding equipment and making a weld joint by this process.
3. Study of Spot welding and preparing a weld joint by this process.
4. Study of constructional features of following machines through drawings/ sketches and an exercise based on them: -a) Universal milling machine b) Grinding machines (Surface, cylindrical) c) Hydraulic Press d) Lathe e) Shaper
5. Industrial Visit for demonstration of Machines

BTAE407-18 AUTOMOTIVE ELECTRICAL AND ELECTRONICS SYSTEMS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Course Outcomes:

After studying this course, students shall be able to:

1. Understand the construction and applications of Electrical and electronics components in various automotive electrical circuits.
2. Understand the construction and working of various automotive electrical systems and components.

List of Experiments:

1. To study of rectifier and filters
2. Testing of starting motors and generators
3. To Study of SCR and IC timer, D/A and A/D.
4. Diagnosis of ignition system faults
5. Study of Automobile electrical wiring.
6. Study of logic gates, adder and flip-flops
7. Interfacing A/D converter and simple data acquisition
8. Micro controller programming and interfacing

BTAE408-18 KINEMATICS AND THEORY OF MACHINE LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

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 Experiments:

1. Conduct experiments on various types of governors and draw graphs between height and equilibrium speed of a governor.
2. Determination of gyroscopic couple (graphical method).
3. Balancing of rotating masses (graphical method).
4. Cam profile analysis (graphical method)
5. Determination of gear- train value of compound gear trains and epicyclic gear trains.
6. To draw circumferential and axial pressure profile in a full journal bearing.

5th Semester; Contact Hours: 28

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAE501-18	Automotive Chassis system	4	0	0	4	40	60	100	4
BTAE502-18	Numerical Methods	3	1	0	4	40	60	100	4
BTAE503-18	Automotive Petrol and Diesel Engines	3	0	0	3	40	60	100	3
BTAE504-18	Vehicle Body Engineering	4	0	0	4	40	60	100	4
HSMC101-18 /HSMC102-18*	Humanities-I	3	0	0	3	40	60	100	3
BTMC102-18	Essence of Indian Knowledge Traditions	3	0	0	3	100	00	100	Non-Credit
BTAE505-18	Automotive chassis System Lab	0	0	2	2	30	20	50	1
BTAE506-18	Numerical Methods Lab	0	0	2	2	30	20	50	1
BTAE507-18	Vehicle Body Engineering Lab	0	0	2	2	30	20	50	1
BMPD501-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**390**	**360**	**750**	**21**

BTAE501-18 AUTOMOTIVE CHASSIS SYSTEMS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
4	0	0	4	40	60	100	4

Detailed Contents:

Introduction Types of chassis layout with reference to power plant locations and drive, Vehicle frames. Load acting on vehicle frame due to different systems**.**

Front Axle & Steering System Types of front axles, Constructional details, materials. Front wheel geometry viz. Castor, Camber, King pin inclination, Toe. Wheel Alignment. Steering geometry. Ackerman and Davis steering system. Different types of steering gear boxes. Steering linkages and their layouts. Power and power assisted steering. Steering of crawler tractors. Multi axle steering systems.

Driveline and Differential Effects of driving thrust and torque reactions. Hotch kiss drive, torque tube drive and radius rods. Transverse rods. Propeller shaft, Universal joints. Constant velocity universal joints. Drive Shaft. Front wheel drive. Different types of final drives. Spiral bevel gear and hypoid gear final drives. Double reduction and twin speed final drives. Differential principles. Constructional details of a differential gear unit. Non-slip and Limited slip differential. Differential locks -Differential housings. Comparison of front wheel, rear wheel and all-wheel drive arrangement.

Drive axles Construction of rear axles. Types of loads acting on rear axles. Fully floating, three quarter floating, and semi floating rear axles. Rear axle housing. Construction of different types of axle housing, multi axle vehicles. Construction details of multi drive axle vehicles. Dead axles.

Suspension system Need of suspension system, Types of suspension, Suspension springs, Constructional details and characteristics of leaf, coil and torsion bar springs, Independent suspension, Types: Mc Pherson strut, Double wishbone, Five link type, etc, Rubber suspension, Pneumatic suspension, Shock absorbers.

Wheels and Tires Types of wheels – wire spoke, disc – solid and split type, alloy type, offset, onset & zero set, denomination of rim. Tires, materials, construction, structure, denomination and function of tires, types of tires, comparison of radial and bias ply tires. Tubes – construction and types, Tubeless tires. Tire inflation, effects of tire pressure on tire performance. Tire wears patterns and their causes. Rolling Resistance and self-aligning torque, Wheel Balancing – need, procedure. All season tires, tire quality grading, changing tire sizes. Run flat tires (RFT), new heat resistant tires for better mileage, fuel efficient handling and safety.

Braking System Weight transfer during braking and stopping distances. Classification of brakes - drum brakes and disc brakes. Constructional details. Theory of braking, Brake split and proportioning. Mechanical, hydraulic and pneumatic brakes - Servo brake, power and power-assisted brakes -Different types of brake retarders like eddy current and hydraulic retarder. Skidding of wheels on braking and remedies, Anti-lock braking systems:- types, system components, operations, fluids. Power Brakes and Parking Brakes, Additive, self-energizing brakes, regenerative and emergency braking system.

Suggested Readings/Books:

1. Reimpell and Betzler, “The Automotive Chassis: Engineering Principles”, Second Edition Butterworth Heinemann London.
2. Giancarlo Genta, “The Automotive Chassis volume I and volume II”, Springer.
3. Heinz Heisler, “Advanced Vehicle Technology”, Second Edition Butterworth Heinemann London.
4. Gilles T., “Automotive Chassis Brakes Steering and Suspension”, Thomson USA.
5. Newton Steeds and Garrot, “Motor vehicles ", Butterworths, London.
6. Judge A.W., “Mechanism of the car ", Chapman and Halls Ltd., London.

BTAE502-18 NUMERICAL METHODS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
3	1	0	4	40	60	100	4

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).

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.

BTAE503-18 AUTOMOTIVE PETROL AND DIESEL ENGINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
3	0	0	3	40	60	100	03

Detailed Contents:

Fundamentals Engine terminology, classification. Working principle of two stroke and four stroke engines, scavenging, scavenging processes. Thermodynamic cycles for automobile engine- Air standard cycle, Otto cycle, Diesel cycle, Dual cycle, Comparison between different cycles, Valve timing diagram for engine under different conditions, Firing order, Factors affecting on selection of firing order, Square Engine, Wankel engine, Engine Mountings.

Constructional Details Cylinder block, Engine cylinder, Cylinder liner, Cylinder Head and cover, Piston for C.I. and S.I. engine, Piston rings, Piston pin, Connecting rod, Crank shaft, Main bearings, Cam shaft, Oil pan, Engine mountings and Engine balancing, Vibration Damper, Cam shafts & drives, Inlet and exhaust valves, Valve actuating mechanism including variable control system, Air cleaner, Manifold & gasket – intake and exhaust, silencer, tail pipe.

Combustion in S.I. Engine Ignition limits, Stages of combustion in petrol engine, Ignition lag, Effect of engine variables on ignition lag, Effect of engine variables on flame propagation, Abnormal combustion, Detonation, Effects of detonation, Theories of detonation, Effects of engine variables on knock, Control of knock. Surface ignition, Pre ignition, Post ignition, S.I. engine combustion chamber design, Types of combustion chambers for S.I. engine, Very high output combustion chamber engines

Combustion in C.I. Engine Air fuel ratio in C.I. engine, Stages of combustion in C.I. engine, Delay period, Variables affecting on delay period, Diesel knock, Methods of controlling diesel knock, C.I. engine combustion chamber, Direct injection type, Open type, Turbulent type, Pre chamber, M combustion chamber, Cold starting of C.I. engine- decompression devices, heater plug, inlet manifold heater, Chemical spray

Petrol Engine Fuel Supply System Methods of fuel supply system- gravity system, pressure system, Vacuum system, pump system, Components of fuel supply system –Fuel tank, fuel pump (Mechanical and Electrical) Vapor return line, Air cleaner, Fuel filters, Carburetion, Functions of carburetor, simple carburetor, Limitations of simple carburetor, Types of Carburetor-Solex and SU carburetor, Special features of modern carburetor. Benefits of electronic fuel injection system.

Diesel Engine Fuel Supply System Comparison of diesel engine with petrol engine, Requirements of diesel injection system, Fuel feed pump, Types of injection system, fuel injection pump, and fuel injectors. Fuel filter, air cleaner, Phasing and calibration of fuel injection pump, Injector Testing (pressure test, leak test) Electronic control of fuel injection system

Engine Friction, Lubrication and Lubricants Total engine friction, Effects of engine variables on engine friction, Lubrication- Objectives of lubrication, Lubricants used, Requirements & selection of lubricants, Viscosity rating, Multi grade oil, Additives used in lubricant, Effects of engine variables on lubricating oil, Oil consumption, Different parts of engine to be lubricated, Types of lubrication system- petrol system, Wet sump method, Dry sump method, fully and partially pressurized lubrication system, Components of lubrication system-oil strainer, Oil filter and its types.

Engine Cooling System: Distribution of heat supplied to engine, Necessity of engine cooling, Piston and engine Cylinder temperatures, Factors affecting on piston temperature, Types of cooling system, Air cooling system, Water cooling system, Thermosyphon cooling, Cooling with thermostatic regulator. Components of water-cooling system-Radiator, Pressure Cap, Expansion Reservoir, Coolants, Thermostat, Water Pump, Viscous coupling, Comparison between water cooling and air cooling. Effects of over and under cooling.

Supercharging Objects of supercharging, Relative power with and without supercharging, supercharging of spark ignition engine, Supercharging of C.I. engine, Effects of supercharging on performance of engine, Supercharging limits for S.I. and C.I. engine, Methods of super charging, Supercharges, Turbo charging, Comparison with supercharging, Methods of turbo charging, Limitations of turbo charging**.**

Performance Testing of Engine Losses in the engine, Performance parameters, Performance curves, Methods of improving performance of engine, testing of engine, Classification of testing, Basic measurement- Speed, Fuel consumption, Air consumption, mean effective pressure, Brake power, Indicated power, Frictional power (with different methods), Mechanical efficiency, Thermal efficiency, volumetric efficiency, Heat balance sheet, Engine analyzer.

Modern technologies in I.C. engines: HCCI Engines – construction and working, CRDi injection system, GDI

Technology, E - Turbocharger, Variable compression ratio engines, variable valve timing technology, Hybrid vehicle Technology

Suggested Readings/Books:

1. Ganesan.V., “Internal Combustion Engines ", Tata-McGraw Hill.
2. Ramalingam K.K., "Internal Combustion Engines Theory and Practice", Scitech Publications (India).
3. Gupta H.N., “Fundamentals of Internal Combustion Engines”, PHI Learning.
4. Willard W. Pulkrabek, “Engineering fundamentals of the Internal combustion engine”, Pearson Prentice Hall.
5. Maleev.V.M., “Diesel Engine Operation and Maintenance ", McGraw Hill.
6. William H. Crouse, “Automotive Engines ", McGraw Hill.
7. Hua Zhao, “HCCI and CAI engines for the automotive industry”, Woodhead Publishing

BTAE504-18 VEHICLE BODY ENGINEERING

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
4	0	0	4	40	60	100	4

Detailed Contents:

Introduction: Classification of automobiles on different basis, Types of vehicle bodies, requirements of automobile body, constructional details.
Car body details: Types: Saloon, hatchback, convertibles, Limousine, Estate Van, racing and sports car, etc. Car body construction types – frame and unitary (monocoque), various body panels and their constructional details
Bus body details: Types: Mini bus, single and double Decker, split level and articulated bus, Bus body lay out, Floor height, Engine location, Entrance and exit location, Seating dimensions, Constructional details: Frame construction, Double skin construction, Types of metal section used, Regulations, Conventional and integral type construction.
Commercial vehicle details: Types of commercial vehicles. Commercial vehicle body details, flat platform, drop side, fixed side, tipper body, tanker body, tractor trailer.
Body loads: Idealized structure, structural surface, shear panel method, symmetric and asymmetric vertical loads in a car, longitudinal load, and different loading situations.
Body materials, trim and mechanisms: Carbon fibers, plastics, timber, GRP; ferrous and non-ferrous materials used in vehicle. Corrosion and anticorrosion method. Paint and painting process, Corrosion, Anticorrosion methods, Body trim items, Body mechanisms.
Special Purpose vehicle details: Various types, Needs and constructional details - Fire station vehicle, tankers, pumping vehicles, ladder vehicle, Concrete mixer transport vehicles; Ambulance, Towing vehicle, Road trains, Off road vehicles, cement trucks.
Safety in vehicle design: Basics of impacts protection, design for crashworthiness, front impact and side impact analysis, bumper system, energy absorbent forms. Indian Motor acts and its application- The motors vehicle acts 1988, Driving license, Registration of vehicles, Rules of the road, Motor Insurance.

Suggested Readings/Books:

1. J Powloski, “Vehicle Body Engineering”, Business Books Ltd., London.
2. Kirpal Singh, “Automobile Engineering Vol-1”, Standard Publishers distributors
3. Braithwaite J.B., “Vehicle Body building and drawing ", Heinemann Educational Books Ltd., London.
4. Sydney F. Page “Body Engineering” Chapman & Hill Ltd., London,
5. John Fenton, “Handbook of Automotive Body and Systems Design”, Wiley.
6. Heinz Hezler “Advance vehicle Technology”

BTAE505-18 AUTOMOTIVE CHASSIS SYSTEMS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of Experiments:

1. Study of layout of a chassis and its different components, of a vehicle.
2. Trouble shooting in different types of steering systems mechanical and power and various steering linkages.
3. Measurement of steering geometry angles – Wheel Alignment.
4. Study of impact of steering geometry angles on vehicle
5. Study of different types of wheels (rims) and tires and their defects
6. Conducting Wheel balancing of a given wheel assy.
7. Trouble shooting in Propeller Shafts and Drive shafts including constant velocity joints.
8. Trouble shooting in different types of dead axles (front or rear)
9. Trouble shooting in different types of live axles and Differential systems.
10. Trouble shooting in suspensions of following types:

a) Leaf Spring

b) Double Wishbone with Torsion Bar or Coil Spring

c) McPherson Strut Type

d) Five Bar Link type

e) Air Suspension system

f) A shock absorber (damper)

Trouble shooting in braking system in master and wheel cylinder, drum and disc brakes, overhauling and adjusting of system and its testing on brake tester

BTAE506-18 NUMERICAL METHODS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

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.

BTAE 507-18 VEHICLE BODY ENGINEERING LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of Experiments:

1. Study of typical car body construction and propose new design sketches.
2. Study driver's seat position, passenger seat position, its requirement and construction of typical truck/bus body and propose new design sketches.
3. To prepare the analysis of the vehicle body weight and the weight distribution in different conditions and its effect on tractive performance.
4. Measurement of drag, lift force of a scaled model in wind tunnel
5. Study the anti-corrosion and body painting and repainting procedures.
6. Study the construction of a special purpose vehicle.
7. To prepare the analysis of the vehicle body weight and the weight distribution in different conditions and its effect on steering performance.

BTAE 601-18 VEHICLE SAFETY ENGINEERING

L	T	P	Internal Marks: 40
4	0	-	External Marks: 60

Course Objectives:	
1	To broaden the understanding of role of safety systems in automobiles
2	To introduce vehicle structural crashworthiness and crash testing
3	Identify different safety systems and its role in automobiles

CO	Course Outcomes
CO-1	**Understand** the concept of crumple zone, safety sandwich construction and monocoque chassis construction.
CO-2	**Illustrate** different safety concepts including active and passive safety.
CO-3	**Understand** the working of ABS, EBD and other safety equipment's
CO-4	**Interpret** the concept of collision warning and avoidance systems
CO-5	**Summarize** various comfort and convenience systems.

1. **Introduction:** Design of the body for safety, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumple zone, safety sandwich construction, monocoque chassis construction.
2. **Safety Concepts:** Active safety: driving safety, conditional safety, perceptibility safety, operating safety, passive safety: exterior safety, interior safety, deformation behavior of vehicle body, and speed, stopping distance.
3. **Safety Equipment's:** Seat belt, regulations, automatic seat belt tightening system, collapsible steering column, tilt-able steering wheel, air bags, electronic system for activating air bags, bumper design for safety, Anti-lock Braking System (ABS), introduction to Electronic Stability Programme (ESP) & Electronic Brake Force Distribution (EBD).
4. **Collision Warning and Avoidance**: Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions, pedestrian detection.
5. **Comfort And Convenience System:** Steering and mirror adjustment, central locking system, Garage door opening system, tyre pressure control system, rain sensor system, environment information system.

Book:

1. Bosch, "Automotive Handbook" - 5th edition - SAE publication;2000.
2. J.Powloski - "Vehicle Body Engineering" - Business books limited, London;1969.
3. Ronald. K. Jurgen - "Automotive Electronics Handbook" - Second edition- McGraw Hill Inc.; 1999.
4. Hucho. W.H. - "Aerodynamic of Road Vehicles" - Butterworths Co., Ltd.;1997.

BTAE-602-18 AUTOMOTIVE TRANSMISSIONS

L	T	P	Internal Marks: 40
4	1	-	External Marks: 60

Course Objectives:	
1	On completion of this course, the student will know about the clutch, gearbox, hydrodynamic drives, automatic transmission, hydrostatic drive and electric drive-in automobiles, their principle of operation and performance.
2	To provide the knowledge about the components and operation of manual and automatic transmissions

CO	Course Outcomes
CO-1	**Recognize** the need for automotive transmission system and their classification.
CO-2	**Understand** operation, constructional details, and design aspects of various types of clutches and gears.
CO-3	Study and **distinguish** between hydrodynamic drive and hydrostatic drive.
CO-4	Know about principle and performance characteristics of electric drives.
CO-5	**Illustrate** Automatic transmission and applications

1. Introduction: Need for Transmission system, Tractive effort and resistances to Motion of a Vehicle, Requirements of transmission system, Classification of Transmission systems, Different Wheel drive systems (Single, Two and Four), Drives (Belt, Chain, Shaft, Hydraulic and Electric drives), Multi-axle drives, Location of transmission system, Different Transmissions units in scooter, car, MUVs and different transport vehicles of Indian make.

2. Clutch: Principle of operation, Constructional details, torque capacity and design aspects of different types of clutches, Operation of single plate: helical spring and diaphragm type, and multi-plate clutch, Centrifugal and Automatic Clutches, Dry and Wet type of clutch, Friction lining materials, Over-running clutches, Modes of Operating clutch – mechanical, hydraulic and electric, Dual Clutch transmission.

3. Gear box: Determination of gear ratios for vehicles, Different types of gearboxes – sliding, constant and synchromesh type, need for double declutching and working of synchronizing unit, Power and economy modes in gearbox, Transfer box, Transaxles, Overdrives, Gear shifting mechanisms – mechanical link and wire types, Paddle shift.

4. Hydrodynamic drive: Fluid coupling- principle of operation, constructional details, Torque capacity, Performance characteristics, Reduction of drag torque, Torque converter, converter coupling- Principle of operation, constructional details & performance characteristics.

5. Hydrostatic drive: Hydrostatic drive, various types of hydrostatic systems, Principles of hydrostatic drive system, Advantages and limitations, Comparison of hydrostatic drive with hydrodynamic drive, Construction and working of typical Janny hydrostatic drive.

6. Electric drive: Electric drive, Principle of early and modified Ward Leonard Control system, Advantage & limitations, Performance characteristics.

7. Automatic transmission & applications: Block diagrams of- Chevrolet "Turbo-glide" Transmission, Power-glide Transmission & Clutch Hydraulic Actuation system, Introduction to Toyota "ECT-i" Automatic Transmission with Intelligent Electronic controls system.

Books:

1. Singh Kirpal, “Automobile Engineering Vol-1”, Standard Publishers distributors.
2. Jaiganesh S., “Automotive Transmissions”, (moallemy.persiangig.com/.../AUTOMOTIVE

TRANSMISSION.pdf)
3. Newton and Steeds, "Motor vehicles ", llliffe Publishers.
4. Judge. A.W., "Modern Transmission systems ", Chapman and Hall Ltd.
5. Crouse. W.H., Anglin, D.L., "Automotive Transmission and Power Trains construction", McGraw-Hill.

BTAE-603-18 DESIGN OF AUTOMOTIVE COMPONENTS

L T P — Internal Marks:40
4 1 - — External Marks:60

Course Objectives:	
1	An understanding of professional, ethical, and economic issues and responsibilities.
2	An ability to analyze a problem, identify and define the computing requirements appropriate to its solution
3	An ability to apply knowledge of computing and mathematics appropriate to information technology.
4	An ability to apply the knowledge of engineering and management principles to effectively manage projects in diverse environments as a member/leader in the team.

CO No.	Course Outcomes
CO-1	Be proficient in applying the knowledge of engineering principles in product design process and systematic design conceptualization.
CO-2	Be able to understand the underlying principles of design in Aesthetics and ergonomics and various manufacturing considerations in designing a component from economic point of view.
CO-3	Be able to design components like braking systems, gears, springs, clutches, and flywheels.
CO-4	Be proficient in analysing various design problems and to identify the parameters required for the solution of the design related problems.
CO-5	Be able to apply the knowledge of mathematical concepts to solve the design related problems.

1. Meaning of design: Definition and understanding of various types of design, Elaborated Design process.

2. Design and creativity: Systematic design conceptualization, product design definition & manufacturing considerations in design, underlying principles of design in Aesthetics and ergonomics, free body diagram for components design.

3. General Design Considerations: Theory of Failure, Selection of materials, Basic criteria of selection of material for automotive parts like piston, cylinder, connecting rod, crankshaft and camshaft, mechanical properties of those materials in brief. Study of Stress concentration, factor of safety under different loading conditions,

4. Design against Static Loading: Bolted Joints- Understanding the various stresses/ failure in bolted joints, basic and eccentrically loaded bolts, Welded Joints- Design for various loading conditions in torsion, shear, or direct loads.

5. Design against Fluctuating Loading: Design of automobile coupling & Springs, Flywheel, Braking Systems, self-energizing brakes, shoe brakes - internal & external expanding, band brakes and disc brakes.

6. Transmission: Clutch-Design considerations for single plate clutch, centrifugal clutch, cone clutch, energy dissipated, torque transmission capacity of clutch. Gears - Design of spur, helical and straight bevel gears, Final Drive- Design consideration for different types of propeller shafts & rear axles. Bearing - Basics of bearings, their types, nomenclature, and Selection criteria.

Books:

1. Singh Kirpal, "Automobile Engineering Vol-1", Standard Publishers distributor's;

2. Automotive Mechanics by Giri. N.K, Khanna Publisher,
3. Fundamental of Machine component design by Juvenal R.C, John Wiley, PSG Design Data book by PSG College of Technology,
4. J.A. Charles – Selection & use of engineering materials –Butterworth –Heinemann;
5. V.B. Bhandari- Design of Machine Elements –Mc Graw Hill, ED
6. Mechanical Engg. Design by Joseph Edward Shigley.

BTAE604-18 INTRODUCTION TO INDUSTRIAL MANAGEMENT

Course objectives:

- To help the students gain understanding of the functions and responsibilities of industrial managements.
- To enable them to analyze and understand the environment of the organization.
- To help the students to develop cognizance of the importance of management principles.
- To provide them tools and techniques to be used in the performance of the managerial job.

Detailed Contents:

Unit-1: Concept of industrial engineering, Roles of industrial engineer, Tools of management science, Introduction to quality, Excellence in manufacturing, Excellence in service, factors of excellence, relevance of total quality management.
Unit-II: Concept of production, Production system, Input output model, definition of quality, Total quality control and Total Quality Management, salient features of total quality control and total quality management, benefits of total quality management.
Unit-III: Introduction to product design, Effect of design on cost, Requirements of a good product design, Factors affect product design, Product life cycle, Need and concept of product planning, Concept of product development. Introduction of industrial cost, Elements of cost, Breakeven analysis.
Unit-IV: Materials management, Purchasing, Objectives of purchasing, Activities, duties and functions of purchasing department, Purchase organizations, Buying techniques, Purchasing procedure.
Unit-V: Concept of plant maintenance, Objectives and importance of plant maintenance, Duties, functions and responsibilities of plant maintenance department, Organization of maintenance, Scheduled, preventive and predictive maintenance.
Unit-VI: Inventory, Inventory control, Objectives of inventory control, ABC analysis, Just-in-time (JIT), Definition: Elements, benefits, equipment layout for JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.
Unit-VII: Benchmarking: Meaning of benchmarking and its concept, Definition of benchmarking, Benefits of bench marking, process and types of benchmarking.

Unit-VIII: Customer: Types of customers, Customer satisfaction, Role of marketing, Data collection, Customer complaints, Redressal mechanism.

Course Outcomes:

- Understand the complexities associated with management in the organizations and integrate the learning in handling these complexities.
- Demonstrate the roles, skills and functions of management.
- Understand the concepts related to industrial management.

Text Books:

1. Industrial Engineering and Management/ O. P. Khanna/ Dhanpat Rai and Sons
2. General and Industrial Management/ H Fayol/ Pitman
3. Industrial Management/ I. K. Chopde and A. M. Sheikh/ S. Chand
4. A Text Book of Industrial Management/ A. P. Verma and N. Mohan/ Katson

Total Quality Management/ Jeol E. Ross/ Taylor and Francis Limited.

BTAE 605-18 VEHICLE MAINTENANCE & DIAGNOSTICS

L T P — Internal Marks:40
4 0 - — External Marks:60

Course Objectives:	
1	To acquire knowledge about basic maintenance principle of vehicle
2	To diagnose automotive systems and engine using various techniques.
3	To develop maintenance schedule and understand principles of condition-based maintenance.
4	To select appropriate vehicle maintenance tools and equipment's.

CO	Course Outcomes
CO-1	**Apply** the knowledge of engineering fundamental to the solution of problems occurring in different parts and systems of the vehicle.
CO-2	**Identify** and **formulate** the problems occurring in different systems of the vehicle by learning proper inspection and motoring methods.
CO-3	**Select,** and **apply** appropriate techniques and tools for the repair and diagnostics of the vehicles.
CO-4	**Develop** the schedule for the maintenance problems occurring in automotive systems and components like engine, clutch, suspension, steering and brakes.
CO-5	Utilize the gained knowledge as lifelong learning practice and **select** the safe practices and procedures for the maintenance of vehicles with advanced technology.

1. Introduction: Maintenance Objectives, classification, preventive, running and breakdown maintenance, maintenance schedules, workshop manuals, owner's manual, Warranty Procedures, pre-delivery inspection (PDI): front manager, service advisor: functions and duties.

2. Condition Based Maintenance (Cbm): Benefits, Objectives, Principles, what and when to monitor, Techniques, manual inspections, performances monitoring, vibration monitoring, oil debris spectroscopy, thermography and corrosion monitoring, Reliability centered maintenance (RCM), logic, benefits evaluations.

3. Vehicle Maintenance Tools And Equipments: Specifications of standard tools, non-Standard tools, denting tools, painting equipment, testing equipment's, Service station equipment's, Hydraulic lift, Tyre changer, Tyre inflation gauge, Car Washer, Air Compressor, Spark Plug Cleaner and Tester, brake and transmission bleeding equipment, Grease Guns, Hydraulic Hoist, Analyzers: CO, HC, NOx, smoke meter, Engine analyzer- Petrol and Diesel, Ignition timing light, Wheel Balancer, Wheel aligner, Headlight aligner, Cylinder boring and honing, crankshaft grinder, Brake lathe m/c, ridge cutter and boring m/c, Trolley Jacks, Engine lifting cranes.

4. Maintenance Schedule: Difference between chassis and ball bearing grease, use of lubricants: SAE 20 -30, SAE 40-50, SAE 90-120, Machine oil, Brake fluid, Lubrication and maintenance schedules for clutch system, Gear Box, Propeller shaft, universal joints, differential, axles, wheel bearings, tires, Cooling and lubrication system, Specification of petro / diesel Engine, Engine Troubles and Diagnosis.

5. Engine Tuning: S.I Engine tuning; use of compression gauge, vacuum gauge, engine analyzer, exhaust analyzer, battery tester S.G tester, Cam-dwell angle, valve tappet clearance, replacement of engine oil and filter, ignition timing setting, Tyre inflation pressure, checking fuel consumption, MPFI and CRDI, Engines: assembly line diagnostic link (ALDL) connector, ALDL read out scan tool, test light, ohmmeter, digital volt meter, jumper wires, vacuum gauge, Tachometer, computerized automotive

maintenance system. Knowledge of diagnostic codes, service engine soon (SES) light, ECM, CALPAK, TPS, IAC valve, ECM, MAP sensor, engine coolant temp sensor, IAT sensor, VSS, camshaft and Crankshaft – position sensor, start signal, PSP switch, Oxygen sensor, Fuel Vapour Cannister, Catalytic Converter, Particulate filter, Troubles and diagnosis MPFI engines.

6. Clutch, Drive Line, Suspension, Steering and Brakes: Disassembly, cleaning, visual inspection; inspection by measurement and assembly of clutch; gearbox; universal joints; propeller shaft; differential; axles; steering and suspension system (leaf spring and McPhearson strut); Drum and disc Brakes; bleeding of brakes; Gaps and Clearances. Tyre maintenance and wheel balancing; service limits and wheel alignment

7. Engine Overhauling: Procedure for engine removal from vehicle; disassembly; cleaning procedures; agents; Decarburizing; Top overhauling; Visual inspection; inspection by measurement; Engine inspection sheets: Service limits; machining of component parts : boring and honing of Engine components; camshaft grinding and lapping of engine valves; Fitting valve seat inserts and guides; Idea of oversize pistons and undersize split bearings; testing of cylinder heads and valve springs; Cooling system :maintenance and Service; troubles and diagnosis.

Books:

1. Shrivastava, Sushil Kumar., "Industrial Maintenance Management", S Chand & Company Ltd.
2. Kohli, P.L., "Automotive Chassis and Body", McGraw Hill;
3. Maruti Suzuki Manual;

BTAE 606-18 VEHICLE MAINTENANCE & DIAGNOSTICS LAB

L T P — Internal Marks: 30

- - 2 — External Marks: 20

Course Objectives:	
1	Demonstrate Fault finding, dismantling, cleaning, inspection, rectifying and reassembling of components of vehicle.

CO	Course Outcomes
CO-1	Practice Inspection, measuring and maintenance of vehicle.
CO-2	Practice dismantling & cleaning of all parts/ systems of vehicle.
CO-3	Fault diagnosis of Engine.

LIST OF EXPERIMENTS

(Students shall be required to perform any eight practical, minimum three from each section)

Section A

(Power unit including electrical)

1. Engine Reboring
2. Crank shaft grinding
3. Valve Seat grinding and Valve Lapping.
4. Silencer Decarbonizing
5. Fuel Nozzle reconditioning
6. Fuel Injection Pump Calibration.
7. Engine Ignition System of a SI system
8. Engine Starting system of a CI system

Section B

(Transmission unit & power train)

9. Demonstration of garage, garage equipment's & tools, preparation of different garage layouts
10. Demonstration of washing & greasing of vehicle
11. Engine oil change & periodic maintenance of vehicle
12. Clutch overhaul of light / heavy duty vehicle
13. Clutch overhaul of two or three-wheeler vehicle
14. Dismantling & assembly of sliding mesh gearbox
15. Dismantling & assembly of synchromesh gearbox
16. Automobile Electrical & lighting circuit

BTAE-607-18 AUTOMOTIVE TRANSMISSIONS LAB

L T P
- - 2

Internal Marks: 30
External Marks: 20

Course Objectives:	
1	Demonstrate components of transmission system, clutch, gearbox, hydrodynamic drives, automatic transmission, hydrostatic drive and electric drive-in automobiles.

CO	Course Outcomes
CO-1	Practice of assembly/disassembly of transmission system.
CO-2	Practice of Trouble shooting of transmission system of 2 wheelers and four wheelers.

List of experiments

1. Study of a layout of transmission system for a front wheel drive, rear wheel drive and a four-wheel drive arrangement.
2. Trouble shooting in different types of friction clutches.
3. Study of layout of gears and shafts in a manual type gearbox and a transaxle & their troubleshooting.
4. Study of layout in a manual & automatic gearbox for a two-wheeler & its troubleshooting.
5. Study of layout of an automatic gearbox.
6. Study of gear shifting controls in an automatic gearbox & its troubleshooting.
7. Study of a manual and electric transfer case & its troubleshooting.
8. Study of an electric drive in an Electric vehicle.

BTAE-608-18 ENGINE TESTING & POLLUTION MEASUREMENT LAB

L T P
- - 2

Internal Marks: 30
External Marks: 20

Course Objectives:	
1	To impart knowledge on performance and emission characteristics on petrol and diesel engine.

CO	Course Outcomes
CO-1	Students will be able to determine the performance characteristics of various types of engines.
CO-2	Students will be able to Conduct emission tests on various engines.

List of experiments

1. Study of Valve Timing and Port Timing Diagrams.
2. Performance test of petrol (4-stroke) engine both at full and part load.
3. Performance test of diesel (4-stroke) engine both at full and part load.
4. Study and testing on MPFI Engine and Variable compression ratio Engine.
5. Study of NDIR gas Analyser and FID.
6. Study of Chemiluminescent NOx Analyser.
7. Measurement of HC, CO, CO2, O2 using exhaust gas analyzer.
8. Diesel Engine Smoke Measurement.

Vehicle dynamics

L T P
3 1 -

Internal Marks: 40
External Marks: 60

CO No.	Course Outcomes
CO-1	Students will be able to **apply** knowledge of mathematics and engineering fundamentals to predict the dynamic response of the vehicle
CO-2	Students will be able to **identify** the problems related to vehicle handling and stability in different road conditions.
CO-3	Students will be able to **select** the effective spring rate required for the suspension system and identify the requirements of the suspension system based on applications of the vehicle.
CO-4	Students will be able to learn methods of vibration analysis for single, two and millidegree of freedom systems, and **apply** the knowledge for the vibration analysis of the vehicles and have the preparation to engage in independent learning in the context of technological change
CO-5	Students will be able to **demonstrate** knowledge and understanding the of the vehicle dynamics principles specially steering and suspension systems to apply in project work.

Introduction: Fundamental of vibration, Mechanical vibrating systems, Modeling and Simulation - Model of an automobile -Single, two and multi degrees of freedom systems – Free, forced and damped vibrations, Magnification factor -Transmissibility - Vibration absorber.

Multi Degree of Freedom Systems: Closed coupled system - Eigen valve problems - Far coupled Systems Orthogonality of mode shapes – Modal analysis - Forced vibration by matrix inversion. Approximate methods for fundamental frequency - Dunkerley's lower bound - Rayleigh's upper bound - Hozler method for close coupled and branched systems.

Suspension and Tyres: Requirements, Sprung mass frequency, Wheel hop, wheel wobble, wheel shimmy, Choice of suspension spring rate, Calculation of effective spring rate, Vehicle suspension in fore and apt directions. Ride characteristics of tyre - Effect of driving and braking torque - Gough's tyre characteristics.

Vehicle Handling: Over steer, under steer, steady state cornering, Effect of braking, driving torques on steering, Effect of camber, transient effects in cornering, Directional stability of vehicles.

Stability of Vehicles: Load distribution, Calculation of Tractive effort and reactions for different drives - Stability of a vehicle on a slope, on a curve and a banked road.

Books:

1. Gillespie.T.D., Fundamental of Vehicle Dynamics, Society of Automotive Engineers, USA;
2. Heldt.P.M., "Automotive Chassis", Chilton Co., NewYork;

3. Giles.J.G. Steering, Suspension and Tyres, llliffe Books Ltd,London
4. Giri.N.K., Automobile Mechanics, Khanna Publishers. NewDelhi
5. Rao.J.S. &Gupta.K., Theory and Practice of Mechanical Vibrations, Wiley Eastern Ltd., NewDelhi;

Automotive heating, ventilation and air conditioning

L T P
4 1 -

Internal Marks:40
ExternalMarks:60

CO No.	Course Outcomes
CO-1	Students will be **able to apply** the knowledge of mathematics and engineering fundamentals to determine the performance parameters of air conditioning systems in vehicles.
CO-2	Students will be **able to identify** and **analyse** the problems occurring in air conditioning systems and be able to troubleshoot it.
CO-3	Students will be **able to select** eco-friendly refrigerants to prevent global warming issues and contribute in societal and environmental contexts.
CO-4	Students will be **able to develop** design solutions for air conditioning and refrigeration systems by understanding the principles of psychrometry.

Air conditioning fundamentals: Fundamentals of refrigeration, basics of vehicle air conditioning system, location of air conditioning component in a car – schematic layout of a refrigeration system, component like compressor, condenser, fan blower, expansion device – expansion valve calibration, evaporator pressure regulator, lowand
high pressure switch.

Air conditioning heating system: Automotive heaters – manually controlled air conditioner – heater system –automatically control air conditioner – air conditioning protection with heater diagnosis chart.

Refrigerants: Introduction, classification, properties, selection criteria, commonly used refrigerants, eco-friendly refrigerants, global warming and ozone forming potential of refrigerants, containers, handling of refrigerants.

Psychrometry: Introduction, Psychometric properties, Inside and outside design conditions of air conditioning system. Air distribution: introduction, factors affecting design of air distribution system, types of air distribution system, air flow through the dashboard recalculating unit, duct system, ventilation, vacuum reserve.

Air conditioning maintenance and service: Cause of air conditioner failure, trouble shooting of air conditioning system, servicing heater system, removing and replacing components, leak testing, compressor service, charging and discharging, performance testing.

Books:

1. Automotive air Conditioning William H. Crouse, Tata McGraw Hill publication;
2. Automotive air Conditioning, Mitchell information service, PHI;
3. Hucho. W.H. - “Aerodynamic of Road Vehicles” – Butterworths Co.,

Measurements and Instrumentation

L T P
3 0 -

Internal Marks: 40
External Marks: 60

CO	Course Outcomes
CO-1	Students will be able to describe the basic statistical concepts and measurement standards used in industrial applications and identify the errors involved in the measurement.
CO-2	Students will be able to understand the concept of static and dynamic characteristic of a measuring instrument.
CO-3	Students will be able to explain the different types of sensors and strain gauge and circuits used in measuring system.
CO-4	Students will be able to illustrate the measurement of displacement, velocity, acceleration, force and torque with various measurement techniques and instruments.
CO-5	Students will be able to illustrate the methods of pressure, flow and temperature measurement with details of the instruments used.

Basic Statistical Concepts: Types of Measured Quantities (Discrete and Continuous), Central Tendency of Data, Mode, Median, Arithmetic Mean, Range, Deviation, Variance, Standard Deviation,

Instruments and Their Representation: Introduction, Typical Applications of Instrument Systems, Functional Elements of a Measurement System, Classification of Instruments, Standards and Calibration

Static and Dynamic Characteristics of Instruments: Range and span, accuracy and precision, calibration, hysteresis and dead zone, sensitivity and linearity, threshold and resolution; speed of response, lag, fidelity and dynamic error, dead time and dead zone. Zero, ramp and sinusoidal input signals.

Errors in Measurement: Sources of errors, systematic and random errors; statistical analysis of test-data, probable error and probability tables, ejection of test data; curve fitting, error propagation; Design and planning of experiments and report writing.

Sensors and Transducer: Introduction, Analog and Digital Transducers, Electromechanical; Potentiometric, Inductive and reluctance type, Electromagnetic, Electrodynamics, Eddy Current, Magnetostrictive, Variable Inductance, Linearly Variable Differential Transformer, Variable Capacitance, Piezo-Electric Transducer and Associated Circuits, Unbonded and Bonded Resistance Strain Gages. Strain Gage Bridge circuits, Temperature Compensation, Balancing and Calibration, Opto-Electrical Transducers, Photo Conductive Transducers, Photo Voltaic Transducers, Digital Transducers, Frequency domain transducer, Vibrating string transducer, Data, Acquisition Systems,

Data processing, Data Display and Storage, Modern Automotive Instrumentation, Study of automotive sensors and actuators.

Position, Displacement, and Velocity Measurement: Introduction, Relative motion Measuring Devices, Electromechanical, Optical, Photo Electric, Moire-Fringe, Pneumatic, Absolute Motion Devices.

Force, Acceleration and Torque Measurement: Seismic Devices, Spring Mass & Force Balance Type, Calibration, Hydraulic Load Cell, Pneumatic Load Cell, Elastic Force Devices, Separation of Force Components, Electro Mechanical Methods, Strain Gage, Torque Transducer, Toque Meter.

Pressure Measurement: Moderate Pressure Measurement, Monometers, Piezo Transducer, Dynamic Effects of Connecting Tubing, High Pressure Transducer, Low Pressure Measurement, Calibration and Testing.

Flow Measurement: Quantity Meters, Positive Displacement Meters, Flow Rate Meters, Variable Head Meters, Variable Area Meters, Rotameters, Pitot - static tube Meter, Drag Force Flow Meter, Turbine Flow Meter, Electronic Flow Meter, Electro Magnetic Flow meter. Hot-Wire Anemometer.

Temperature Measurement: Introduction, Measurement of Temperature, Non-Electrical Methods, Solid Rod Thermometer, Bimetallic Thermometer, Liquid-in -Glass thermometer, Pressure Thermometer, Electrical Methods, Electrical Resistance Thermometers, Semiconductor Resistance Sensors (Thermistors), Thermo–Electric Sensors, Thermocouple Materials, Radiation Methods (Pyrometry), Total Radiation Pyrometer, Selective Radiation Pyrometer.

Books:

1. Kumar D. S. , “Mechanical Measurements”, by, Kataria & Sons.
2. Doebelin, “Measurement systems Application and Design”, Tata McGrawHill;2002.
3. Francis S. Tse, Ivan E. Morse and Marcel Dekker, “Measurement and Instrumentation Engineering” CRC Publishers;
4. Alan S. Morris, “Principles of Measurement and Instrumentation”, Prentice Hall of India;
5. B.C. Nakra and K.K. Chaudhary, “Instrumentation, Measurement and Analysis”, Tata McGraw Hill.
6. Mechanical Measurements and Control 4th Revised & Englarged Edition;Metropolitan Book Co. Pvt. Ltd.2009

Automotive Heating, Ventilation and Air Conditioning Lab

L T P
- - 2

Internal Marks: 30
External Marks:20

CO No.	Course Outcomes
CO-1	Student will be able to understand the various components of vapour compression system
CO-2	Student will be able to calculate the COP of automobile refrigeration system.
CO-3	Student will be able understand the automobile heating system
CO-4	Student will be able to calculate the cooling and heating load for a vehicle

List of experiments

1. Study of various elements of a vapour compression refrigeration system.
2. Calculate the COP of automobile air-conditioning system.
3. Study the various components of automobile heating system.
4. Calculation/ Estimation of cooling load and heating load for a Vehicle.
5. Filling of gas inside automobile air-conditioning/refrigeration system
6. Visit to Automobile air-conditioning service station.

Measurements and Instrumentation Lab

L T P
- - 2

Internal Marks: 30
External Marks: 20

CO No.	Course Outcomes
CO-1	Students will be able to do measurement with the help of Vernier calliper, micrometre and sine bar.
CO-2	Students will be able to measure surface roughness
CO-3	Students will be able to measure speed, torque, acceleration and vibration of automobile engine.
CO-4	Students will be able to understand Calibration of a pressure gauge with the help of a dead weight gauge tester

List of experiments

1. Measurement with the help of vernier caliper and micrometer.
2. Stroboscope: measure speed of rotating elements.
3. Measurement of an angle with the help of sinebar.
4. Measurement of surface roughness.
5. Measurement of speed and torque of an engine.
6. Measurement of Acceleration and vibration of an engine
7. Calibration of a pressure gauge with the help of a dead weight gauge tester.
8. Measurement of temperature using RTD /thermocouple.
9. Determination of frequency & phase angle using C.R.O.
10. Measurement of Inductance by Maxwell's Bridge.

Computer Aided Design and Manufacturing

L T P — Internal Marks: 40
3 0 0 — External Marks: 60

After successfully completing this course the students will be able to:

CO1: Describe the function of computer systems in design and production.
CO2: Recognize geometric models, geometric modelling and practice numerous strategies
CO3: Describe Working Methodology of NC / CNC / DNC and part programming to set up FMS
CO4: Examine the combination of CAD/CAM and commercial elements in organization.

1. **Fundamentals of CAD;** Design process with and without computer; CAD/CAM system and its evaluation criteria, brief treatment of input and output devices, Display devices; Functions of a graphics package and Graphics standard GKS, IGES and STEP; Modeling and viewing; Application areas of CAD.

2. **Geometric Transformations:** Mathematics preliminaries, matrix representation of 2 and 3-dimensional transformation: Concatenation of transformation matrices. Application of geometric transformations.

3. **Geometric Modeling:** Wireframe model: solid modeling: Boundary Representation (B-rep), Constructive Solid Geometry (CSG), Parametric Modeling Technique; Mass, volumetric properties calculations; surface modeling, concepts of hidden-line removal and shading: Mechanical Assembly Kinematics analysis and simulation.
4. **Representation of curves and surfaces:** Non-parametric and parametric representation of curves. Parametric representation of Hermite Cubic, Beizer and B-spline curves; Surface and its analysis. Representation of Analytical and synthetic surfaces.

5. **Overview of FEM,** Advantages and applications, recent advance in FEM, FEA software Basic principles and general procedure of FEM.

6. **NC/CNC Machine Tools;** NC machine tools- basic components, coordinate systems; features of NC machine tools. Computerized Numerical Control (CNC): Tooling for NC machines - tool presetting equipment, flexible tooling, tool length compensation, tool path graphics; NC motion control system; Manual part programming, fixed/floating zero. Block format and codes: Computer assisted part programming. DNC and Adaptive Control: Direct numerical control: Adaptive control in machining system; Combined DNC/CNC system.

7. **Group Technology (GT):** Part families; part classification and coding system: Group technology machine cells: Advantages of GT.

8. **Computer Aided Process Planning:** Introduction and benefits of CAPP. Types of CAPP systems, machinability, data selection systems in CAPP.

9. **Computer Integrated Manufacturing Systems:** Basic Concepts of CIM: CIM Definition, The meaning of Manufacturing, Types of Manufacturing systems; Need, Elements, Evolution of CIM; Benefits of CIM; Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations; FMS benefits.

Books:

1. Mikell P. Groover, Emory W. Zimmers, CAD/CAM, PHI
2. D.D. Bedworth, M.R Henderson & P.M. Wolfe, Computer Integrated Design and Manufacturing, Tata McGraw Hill
3. Zeid Ibraham, CAD/CAM - theory and Practice, Tata McGraw Hill
4. P. N Rao, CAD/CAM, Tata McGraw Hill
5. C. Elanchezhian, G. Shanmuga Sundar, Computer aided manufacturing (CAM), Firewall Media

Automotive Aerodynamics

L T P
3 0 0

Internal Marks: 40
External Marks: 60

CO No.	Course Outcomes
CO-1	Understand the flow phenomenon related to vehicles and performance potential of vehicle aerodynamics.
CO-2	Illustrate the aerodynamic drag and strategies for aerodynamic development in a car.
CO-3	Interpret various shape optimizations in a car with front and rear wind shield angles.
CO-4	Calculate forces and moments on a vehicle and their effects on vehicle stability.
CO-5	Understand the principle of wind tunnels for automotive aerodynamics and various measurement techniques.

Introduction: Scope, historical developments, fundamental of fluid mechanics, flow phenomenon related to vehicles, external and Internal flow problem, resistance to vehicle motion, performance, fuel consumption and performance potential of vehicle aerodynamics, engine cooling requirement, air flow to passenger compartment, duct for air conditioning, cooling of transverse engine and rear engine.

Aerodynamic Drag of Cars: Cars as a bluff body, flow field around car, drag force, types of drag force, analysis of aerodynamic drag, drag coefficient of cars, strategies for aerodynamic development, low drag profiles.

Shape Optimization of Cars: Front end modification, front and rear wind shield angle, boat tailing, hatch back, fast back and square back, dust flow patterns at the rear, effects of gap configuration, effect of fasteners.

Vehicle Handling: The origin of forces and moments on a vehicle, lateral stability problems, methods to calculate forces and moments – vehicle dynamics under side winds, the effects of forces and moments, characteristics of forces and moments, dirt accumulation on the vehicle, wind noise, drag reduction in commercial vehicles.

Wind Tunnels For Automotive Aerodynamics: Introduction, principle of wind tunnel technology, limitation of simulation, stress with scale models, full scale wind tunnels, measurement techniques, equipment and transducers, road testing methods, numerical methods.

Books

1. Hucho. W.H. - "Aerodynamic of Road Vehicles" - Butterworths Co.,Ltd.;
2. A. Pope, "Wind Tunnel Testing" John Wiley & Sons, 2nd Edition, New York
3. Automotive Aerodynamic: Update SP-706 -SAE
4. Vehicle Aerodynamics - SP-1145 –SAE;

Hydraulic & Pneumatics System for Automobile

L T P
3 0 0

Internal Marks: 40
External Marks: 60

CO No.	Course Outcomes
CO-1	**Understand** properties of fluid and application of hydraulics and pneumatics in various fields of engineering. CH1
CO-2	**Illustrate** the design considerations and working of various elements of hydraulic system and recognize their symbols in a circuit. CH1 CH2
CO-3	**Understand** the control of hydraulic elements and demonstrate various hydraulic circuits. CH3
CO-4	**Identify** basic requirements of pneumatic systems and understand the working and selection criteria of its elements.CH4
CO-5	**Understand** the rules of the block diagram algebra in automatic control systems and mathematical conversion of its control components.CH5

SECTION-I

Introduction to Fluid Power: Application of hydraulics and pneumatics in various fields of engineering, properties of fluids, effect of temperature, Hydraulic symbols- Circuit elements, fluid pumps, motors, valves, types of control, reservoirs, advantages and disadvantages of hydraulic systems.
Elements of Hydraulic System: Pumps- Types of pumps and its selection. Hydraulic cylinders and rams- II Single acting and double acting, telescopic, seals, design considerations for pump, motor, cylinder and ram, fluid power plumbing requirements, type and purpose of strainer, filter, accumulator and its types, design considerations, reservoir, fluid temperature control, types of heat exchangers.
Control of Hydraulic Elements: Types of pressure control, Directional control valves-Two-way, four-way two position, four-way three position, manual operated, solenoid operated. Flow control valves, pressure switches, check valves, quick exhaust valve.
Hydraulic Circuits: Pressure regulating circuit, speed control circuit, accumulator circuit, booster and intensifier circuit, motion synchronizing circuit, servo circuit.

SECTION – II
Introduction to Pneumatics:
Application of pneumatics in engineering, basic requirements of pneumatic system, comparison with hydraulic system
Elements of Pneumatic System: Air compressor - Types, selection criteria, capacity control, piping layout, fittings and connectors, pneumatic control, Direction control valves, two-way, three-way, four-way check valves, flow control valves, pressure control valves, speed regulators. Quick exhaust valves, solenoid, pilot operators, Cylinders- Types and their mountings, hoses and connections, Air motors- Types, comparison with hydraulic and electric motor. Filters- Types of filters, regulators, lubricators, mufflers, dryers.
Pneumatics Circuits and Applications: Basic pneumatic circuit, impulse operation, speed control, pneumatic motor circuit, sequencing of motion time delay circuit & their applications.
Automatic Control: Need of control: Manual v/s automatic control, advantages of automatic control, open loop v/s closed loop control, generalized control system, merits, demerits and Applications, Mathematical conversion of control components: Helical spring, viscous damper and their combinations, resister, inductors, capacitor, series and parallel electrical circuits and mech. Systems, thermal and fluid systems, direct and inverse analog, grounded chair representation for material system. Block diagram algebra: Rules of block diagram algebra, reduction of block diagram, block diagram transfer function representation of speed, temperature and fluid systems, AC & DC Motors. Modes of control: On off control, proportional (P) control, integral (I) control, derivative control, P+I, P+D, P+I+D (including an analytical treatment).

Books:

1. Majumdar S.R., “Pneumatics systems-Principles and Maintenance”, Tata Mc Graw Hill Book Co., NewDelhi;
2. Majumdar S.R., “Oil Hydraulic systems-Principles and Maintenance”, Tata Mc Graw Hill Book Co., NewDelhi;
3. Pippenger J.J, “Industrial Hydraulic”, Mc-Graw Hill Book Co. Ltd., NewDelhi;
4. Pease D.A., “Basic fluid power” Prentice Hall of India, NewDelhi;
5. Stewart H.L., “Pneumatics and Hydraulics”, Taraporevala,Mumbai;
6. Esposito A., “Fluid power with application”, Prentice Hall of India, NewDelhi;
7. Yeaple, “Fluid power design handbook”, Marcel Dekkar Inc, NewYork;
8. Pneumatic handbook:R.S.Warrring;

Tractors & Farms Equipment

L T P
3 0 0

Internal Marks: 40
External Marks: 60

CO No.	Course Outcomes
CO-1	Classify various farm equipments and understand the working principles of various automotive systems.
CO-2	Illustrate various transmissions and final drive systems in tractors and earth moving machinery.
CO-3	Understand the main tractor assemblies and to illustrate various forces acting on a tractor and its weight distribution.
CO-4	Understand basic functions of plant protection & harvesting equipment's

Status of Farm Power in India, Sources of Farm Power , I.C. engines, working principles of I C engines, comparison of two stroke and four stroke cycle engines, Study of different components of I.C. engine, I.C. engine terminology and solved problems, Familiarization with different systems of I.C. engines: Air cleaning, cooling, lubrication ,fuel supply and hydraulic control system of a tractor, Familiarization with Power transmission system : clutch, gear box, differential and final drive of a tractor , Tractor types, Cost analysis of tractor power and attached implement, Familiarization with Primary and Secondary Tillage implement, Implement for hill agriculture, implement for intercultural operations, Familiarization with sowing and planting equipment, calibration of a seed drill and solved examples, Familiarization with Plant Protection equipment, Familiarization with harvesting and threshing equipment.

Recommended books

1. 'Farm Machinery and Equipment', Tata McGraw Hill Publishing Co.
2. 'Farm Power and Machinery', Kitab Mahal.
3. S.C Jain and C.R. Rai, 'Tractor Engine'.

Off Road Vehicles

L T P **Internal Marks:40**
3 0 0 **External Marks:60**

Course Outcomes: At the end of the course, the students will understand the types, special features, design methodology, working principle, application of various off – road vehicles.

UNIT I INTRODUCTION AND CLASSIFICATION OF VARIOUS OFF ROAD VEHICLES

Introduction and Overview of off road vehicles; Capacity, application and requirement of off road vehicles: Earth Moving machines, Land clearing machines, scrapers and graders, Shovels, Ditchers, Tractors, Trolleys, Trailers, Platform lift truck, Fork lift trucks, Dump trucks, Truck mounted cranes, Crawler cranes, Hoisting vehicles, Multiaxle vehicles.

UNIT II TRACTORS: General description; Specifications; functions and applications; different types of tractors like light, medium and heavy-duty tractors; recent trends in tractor design; Power shift transmission and final drive in caterpillar tractor; Factors affecting efficiency of output of tractors; Troubleshooting of tractors; Merits and demerits.

UNIT III EARTH MOVING MACHINES AND FARM EQUIPMENTS: Constructional details and working features of various types of Earthmoving machines like Bulldozers, Cable and hydraulic dozers, Crawler crane, Dump trucks and dumpers, loaders-single bucket, Multi bucket and rotary types, excavators-drag and self-powered types, Cement Mixing Trucks, Water Tankers, Road Pavers, Land clearing machines, Bush cutters, rippers, Power and capacity of earth moving machines.

UNIT IV SCRAPPERS, GRADERS, SHOVELS AND DITCHERS: Constructional details and working features of Scrapers, elevating graders, Power shovel, revolving and striper shovels, drag lines, ditchers, capacity of shovels.

UNIT V MILITARY RECOVERY WHEECLES: Special features and constructional details of military recovery vehicles, tankers, gun carriers and transport vehicles.

UNIT VI ALL WHEEL DRIVE VEHICLES: Introduction and constructional details of all wheel drive vehicles.

TEXT BOOKS:

1. Georing, C.E., Stone, D.W. Smith, P,K.Turnquist “Off-Road Vehicle Engineering Principles”, ASAE2005
2. Robert L. Peurifoy, “Construction, planing, equipment and methods” Tata McGraw Hil Publishing company Ltd.
3. Nakra C.P., “Farm machines and equipments” Dhanparai Publishing company Pvt.Ltd.
4. Abrosimov K. Bran berg.A and Katayer.K., "Road making machinery", MIRPublishers.

Automotive Fuels & Emissions

LTP **Internal Marks: 40**
3 0 0 **External Marks:60**

CO No.	Course Outcomes
CO-1	**Recognize** the scenario of the conventional auto fuels and need for alternate fuels with the engine modifications required for the gaseous, bio-fuels, bio-gas, methanol, emulsified fuels. PO2 PO6 PO7
CO-2	**Recognize** the importance of future alternative fuels such as ammonia, boron and water with their features and analysis. PO7 PO8 PO12
CO-3	**Understand** the impact of different emissions on environment and **demonstrate** the formation of HC and CO in SI engines, Smoke emission in CI engines, with effects of operating variables on emission formation. PO7 PO4
CO-4	**Analyze** the exhaust gas composition before treatment and understand the NOx treatment and diesel trap oxidizers. PO7 PO6 PO4
CO-5	**Develop** control techniques for engine emission reduction. PO3 PO5 PO7 PO8

SECTION A

Introduction to Fuels

Classification of automotive fuels and drivetrains, Scenario of conventional auto fuels, Oil reserves of the world fuel quality aspects related to emissions, technological up gradations required, Need for alternate fuel, business driving factors for alternative fuels, roadmap for alternative fuels, alternate fuel development worldwide.

Automotive Fuels: Properties, production, storage, handling, performance and safety aspects, advantages and disadvantages, Emissions, Engine modifications of the following

- Gaseous Automotive Fuels: Hydrogen, Compressed natural gas, Liquefied petroleum gas:
- Bio –Fuels
- Biogas, Biodiesel
- Alcohols
- Methanol, Ethanol, DEE, DME:
- Synthetic alternate Fuels
- Wood Gas, Tyre Pyrolysis Oil:
- Reformulated Conventional Fuels
- Emulsified Fuels:

Future alternative fuels:

Ammonia: properties, ammonia in nature, hazards, carrier for hydrogen, storage, stationary engine application, ammonia for fuel cell vehicles.

Boron: properties, overview of the boron – water process, features, analysis. Water:Japanese water car, water fuel cell, hydrogen boosters, water to gas technology**.**

SECTION B

Introduction to emission

Pollutants, sources, formation of HC and CO in SI engines, NO formation in SI and CI engines, Particulate emission from SI and CI engines, Smoke Emission in CI engines. Effect of operating variables on Emission formation, Transient operational effects on pollution

SI Engine & CI Engines Combustion and Pollutant Formation

Basic Chemistry combustion - HC and CO formation in 4-stoke and 2-stroke SI engines - NO formation, - Particulate emissions, - Effects of operating variables on emission formation.

Smoke emissions, Color and aldehyde emissions. Photochemical smog, Sulphur, Phosphorus emissions,

Post Combustion Treatment

Introduction, physical conditions and exhaust gas compositions before treatment, catalytic mechanism. Thermal reactions, installation of catalyst in exhaust lines, NOx treatment in diesel engines. Diesel trap oxidizers

Control Techniques Engine Emission Reduction
Design changes - Optimization of operating factors - Exhaust gas recirculation - Fumigation - Air injection PCV system - Exhaust treatment in SI engines - Thermal reactors - Catalytic converters
- Catalysts - Use of unleaded petrol.
Test Procedure & Instrumentation for Emission Measurement
Test procedures, NDIR analyzer, thermal conductivity and flame ionization detectors, Chemi-liuminescent analyzer, analyzers for NOx, Gas chromatograph - Orsat apparatus -Smoke meters, spot sampling and continuous indication types like Bosch, Hart ridge.

Text Books:

1. Thipse S.S., “Alternative Fuels”, Jaico Publications.
2. Pundir B.P., “Engine Emissions: Pollutant Formation and Advances in Control Technology”, Narosa Publications.
3. Oberts E.F., “Internal Combustion Engine and Air Pollution”, Harper and Row Publisher.
4. Willard H.H., “Instrumental Method of Analysis”, CBS Publishers and Distributors.
5. Heywood.J.B., "Internal Combustion Engine Fundamentals", McGraw Hill
6. “Motor Vehicles Act / Emission Norms”, Govt of India Publications.

Computational Fluid Dynamics

L T P	**Internal Marks: 40**
3 0 0	**External Marks: 60**

Course Outcomes

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

CO1. Understand basic knowledge of computational methods in Fluid flow applications

CO2. Analyze Initial Boundary Value problems and determine various quantities of Interest.

CO3. Apply appropriate solution strategy and estimate the accuracy of the results for a given flow case CO4. Select and formulate various CFD problems by considering appropriate boundary conditions.

CO5. Adapt to various commercial software for solving numerical problems

Unit I: Introduction: Philosophy of Computational Fluid Dynamics (CFD), Impact of CFD and its use as research and design tool. Application areas: Automobile & Engine, Civil engineering, Environmental, Naval Architecture.

Unit II: Governing Equations of fluid dynamics: Derivation, discussion of their physical meaning, models of the flow, substantial derivative, Divergence of a velocity, Navier-Stokes Equation, Physical boundary conditions, Forms of governing equation suited to CFD

Unit III: Mathematical behavior of Partial Differential Equations: Classification of Quasi-Linear PDE, The Eigenvalue Method, Hyperbolic, parabolic & Elliptic equations

Unit IV: Simple CFD Techniques: The Lax-Wendroff and Mac Cormack's Technique, space marching, Relaxation Technique, aspects of numerical Dissipation and Dispersion, Artificial Viscosity, Alternating Direction-Implicit (ADI) technique. The SIMPLE Algorithm

Unit V: Application: Numerical Solution of Quasi One-dimensional Nozzle flows, two dimensional supersonic flows (Prandtl-Meyer Expansion Wave), Incompressible Couette Flow (Implicit method & the pressure correction method)

Books and References:

1. Computational Fluid Dynamics: Jr. Anderson
2. Numerical Heat Transfer and Fluid Flow: Suhas V. Patankar
3. An introduction of computation fluid dynamics: Versteeg &Malalasekera

Mechatronics System

LTP **Internal Marks: 40**
3 0 0 **External Marks: 60**

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, andinterrupts 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 and8253 ICs with 8085 microprocessor

Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface;
Sensors and transducers: classification, Development in Transducer technology, Optoelectronics-Shaft encoders, CD Sensors, Vision System, etc.;

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

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,

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,

Mechatronic systems: Mechatronic designs, Case studies.
Course Outcomes: Upon completion of this course, students will get an overview of mechatronics applications and the use of micro-sensors and microprocessors.

Text Books:

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

Alternative Fuels and Energy Systems

LTP **Internal Marks: 40**
3 0 0 **External Marks: 60**

Course Outcomes: •1. Student will be able to understand broad comprehension of future alternative transportation fuels alcohol, biodiesel, biogas and their production technologies.
2. Student will be able to understand the use, production and performance of hydrogen as engine fuel.
3. Students will be able to understand the use, production and performance of biogas, natural gas and lpg gas
4. Student will be able to understand Electric, Hybrid fuel cell and solar vehicle technologies and their economic consideration

UNIT I Alcohols as fuels Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives. Performance emission and combustion characteristics in CI and SI engines.

UNIT II Vegetable Oils as fuels various vegetable oils and their important properties. Different methods of using vegetable oils engines – Blending, preheating Transesterification and emulsification of Vegetable oils - Performance in engines – Performance, Emission and Combustion Characteristics in diesel engines.

UNIT III Hydrogen as Engine Fuel Production methods of hydrogen. Combustive properties of hydrogen. Problems associated with hydrogen as fuel and solutions. Different methods of using hydrogen in SI and CI engines. Performance, emission and combustion analysis in engines. Hydrogen storage - safety aspects of hydrogen.

UNIT IV Biogas, Natural GAS and LPG as fuels Production methods of Biogas, Natural gas and LPG. Properties studies. CO2 and H2S scrubbing in Biogas., Modification required to use in SI and CI Engines- Performance and emission characteristics of Biogas, NG and LPG in SI and CI engines
.
UNIT V Electric, Hybrid and Fuel Cell Vehicles Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

Text Book: 1. Ayhan Demirbas, 'Biodiesel A Realistic Fuel Alternative for Diesel Engines', Springer-Verlag London Limited 2008, ISBN-13: 9781846289941.

Reference Book:

1. Devaradjane. Dr. G., Kumaresan. Dr. M., "Automobile Engineering", AMK Publishers, 2013.

B. TECH (AUTOMATION & ROBOTICS)

STUDY SCHEME and SYLLBUS

BATCH 2018 ONWARDS

I.K.G.P.T.U KAPURTHALA

Semester third

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAR301-18	Industrial Automation and Robotics	4	0	0	4	40	60	100	4
BTAR302-18	Strength of Materials	3	1	0	4	40	60	100	4
BTAR303-18	Mathematics -III	3	1	0	4	40	60	100	4
BTAR304-18	Fluid Mechanics and Fluid Machines	3	1	0	4	40	60	100	4
BTAR305-18	Kinematics and Theory of Machines	3	1	0	4	40	60	100	4
BTAR306-18	Strength of Materials Lab	0	0	2	2	30	20	50	1
BTAR307-18	Fluid Mechanics and Fluid Machines Lab	0	0	2	2	30	20	50	1
BTAR308-18	Kinematics and Theory of Machines Lab	0	0	2	2	30	20	50	1
BMPD301-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**290**	**360**	**650**	**23**

Semester fourth

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAR401-18	Design of Machine Elements	4	1	0	5	40	60	100	5
BTAR402-18	Manufacturing Technology	4	0	0	4	40	60	100	4
BTAR403-18	Hydraulic and Pneumatics	4	0	0	4	40	60	100	4
BTAR404-18	Basic Electronics Engineering	3	0	0	3	40	60	100	3
BTAR405-18	Industrial Safety	3	0	0	3	40	60	100	3
EVS101-18	Environment Science	3	0	0	3	100	00	100	Non Credit
BTAR406-18	Manufacturing Technology Lab	0	0	2	2	30	20	50	1
BTAR407-18	Hydraulic and Pneumatics Lab	0	0	2	2	30	20	50	1
BMPD401-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**360**	**340**	**700**	**21**

Semester Fifth

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR501-18	Electronics Devices and Circuits	4	0	0	4	40	60	100	4
BTAR502-18	Computer Aided Design and Manufacturing	4	0	0	4	40	60	100	4
BTAR503-18	Robotics Engineering and Applications	4	0	0	4	40	60	100	4
BTAR504-18	Digital Electronics	3	0	0	3	40	60	100	3
HSMC101-18 /HSMC102-18*	Humanities -I	3	0	0	3	40	60	100	3
BTAR505-18	Electronics Devices and Circuits Lab	0	0	2	2	30	20	50	1
BTAR506-18	Computer Aided Design and Manufacturing Lab	0	0	2	2	30	20	50	1
BTAR507-18	Digital Electronics Lab	0	0	2	2	30	20	50	1
BTAR508-18	German/Japanese/ French Language Lab	0	0	2	2	30	20	50	1
BMPD501-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**320**	**380**	**700**	**22**

Semester Sixth

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR601-18	Power Electronics and Drives	3	1	0	4	40	60	100	4
BTAR602-18	Numerical Methods	3	1	0	4	40	60	100	4
BTAR603-18	Electronic Measurement and Instrumentation	4	0	0	4	40	60	100	4
BTAR604-18	Microprocessors and Microcontrollers	4	0	0	4	40	60	100	4
BTAR605-18	Introduction to Industrial Management	3	0	0	3	40	60	100	3
BTAR606-18	Microprocessors and Microcontrollers Lab	0	0	2	2	30	20	50	1
BTAR607-18	Electronic Measurement and Instrumentation Lab	0	0	2	2	30	20	50	1
BTAR608-18	Project -I (Project/Internship)	0	0	4	4 / 90hrs	30	20	50	2
BMPD601-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**29**	**290**	**360**	**650**	**23**

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.

Semester 7th / 8th

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR701-18	Control Systems	4	0	0	4	40	60	100	4
BTAR 702-18	Programming Industrial Automation systems	4	0	0	4	40	60	100	4
	Elective -I	3	1	0	4	40	60	100	4
	Elective-II	3	0	0	3	40	60	100	3
BTAR703-18	Advanced Robotics	3	0	0	3	40	60	100	3
BTAR704-18	Advanced Robotics Lab	0	0	2	2	30	20	50	1
BTAR705-18	Major Project	0	0	8	8	30	20	50	4
BMPD	Mentoring and Professional development		0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**260**	**340**	**600**	**23**

List of Elective –I and Elective-II

1. BTAR706-18 Communication system
2. BTAR707-18 Sensors & Signal Processing
3. BTAR708-18 Micro-controller and PLC
4. BTAR709-18 Linear Integrated Circuits
5. BTAR710-18 Human Resources management
6. BTAR711-18 Mechanical Vibration
7. BTAR712-18 Electromechanically energy conversion and DC Machines
8. BTAR713-18 Total Quality Management

Semester 7th / 8th

Course Code	Course Title	Evaluation Internal		External	Total Marks	Credits
		Institute	Industry			
BTAR-801	Software	100	50	100	250	8
	Industrial	100	50	100	250	8
	Total	200	100	200	500	16

DETAILED SYLLABUS

3rd Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAR301-18	Industrial Automation and Robotics	4	0	0	4	40	60	100	4
BTAR302-18	Strength of Materials	3	1	0	4	40	60	100	4
BTAR303-18	Mathematics -III	4	1	0	5	40	60	100	4
BTAR304-18	Fluid Mechanics and Fluid Machines	4	1	0	5	40	60	100	4
BTAR305-18	Kinematics and Theory of Machines	3	1	0	4	40	60	100	4
BTAR306-18	Strength of Materials Lab	0	0	2	2	30	20	50	1
BTAR307-18	Fluid Mechanics and Fluid Machines Lab	0	0	2	2	30	20	50	1
BTAR308-18	Kinematics and Theory of Machines Lab	0	0	2	2	30	20	50	1
BMPD301-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**290**	**360**	**650**	**23**

BTAR301-18 INDUSTRIAL AUTOMATION AND ROBOTICS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

1. To develop the student's knowledge in various robot structures and their workspace.
2. To develop student's skills in performing spatial transformations associated with rigid body motions and robot systems.
3. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
4. To provide the student with some knowledge and analysis skills associated with trajectory planning and robot control.

Detailed Contents:

1. **Introduction:** Concept and scope of automation: Socio economic impacts of automation, Types of Automation, Low Cost Automation
2. **Fluid Power:** Fluid power control elements, Standard graphical symbols, Fluid power generators, Hydraulic and pneumatic Cylinders - construction, design and mounting; Hydraulic and pneumatic Valves for pressure, flow and direction control.
3. **Basic hydraulic and pneumatic circuits:** Direct and Indirect Control of Single/Double Acting Cylinders, designing of logic circuits for a given time displacement diagram & sequence ofoperations, Hydraulic & Pneumatic Circuits using Time Delay Valve & Quick Exhaust Valve, Memory Circuit & Speed Control of a Cylinder, Troubleshooting and "Causes & Effects of Malfunctions" Basics of Control Chain, Circuit Layouts, Designation of specific Elements in a Circuit.
4. **Fluidics:** Boolean algebra, Truth Tables, Logic Gates, Coanda effect.
5. **Electrical and Electronic Controls:** Basics of Programmable logic controllers (PLC), Architecture & Components of PLC, Ladder Logic Diagrams
6. **Transfer Devices and feeders:** Classification, Constructional details and Applications ofTransfer devices, Vibratory bowl feeders, Reciprocating tube, Centrifugal hopper feeders
7. **Robotics:** Introduction, Classification based on geometry, control and path movement,Robot Specifications, Robot Performance Parameters, Robot Programming, Machine Vision, Teach pendants, Industrial Applications of Robots

Course Outcomes:

1. Students will demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.
2. Students will demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.
3. Students will demonstrate an ability to solve inverse kinematics of simple robot manipulators.
4. Students will demonstrate an ability to obtain the Jacobian matrix and use it to identify singularities.

Suggested Readings/Books:

1. Anthony Esposito, Fluid Power with applications, Pearson

2. S. R Majumdar, Pneumatic Control, McGraw Hill
3. S. R Deb, Robotic Technology and Flexible Automation, Tata Mc Hill
4. Saeed B. Niku Introduction to Robotics, Wiley India
5. Ashitava Ghosal, Robotics, Oxford

BTAR302-18 STRENGTH OF MATERIALS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Detailed Contents:

1. Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.
2. Beams and types, transverse loading on beams- shear force and bending moment diagrams-Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.
3. Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorem.
4. Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at ends, stresses and deflection of helical springs.
5. Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

Course Outcomes:

1. Students should be able to recognize various types of loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. Students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Suggested Readings/Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.
4. S. S. Rattan, "Strength of Materials", Tata McGraw Hill, New Delhi.
5. R. K. Bansal, "A Text Book of Strength of Materials", Laxmi Publications, New Delhi.
6. D. K. Singh, "Strength of Materials", Ane Books Pvt. Ltd., New Delhi.
7. Sadhu Singh, Strength of Materials, Khanna Publishers, Delhi.

BTAR303-18 MATHEMATICS-III

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To encourage and enable students to: recognize that mathematics permeates the world around us.
2. To learn and solve signal problems.
3. To develop and solve real life problems using PDE.

Detailed Contents:

1. Fourier Series Periodic functions, Euler's formula. Even and odd functions, Change of Interval, half range expansions, Fourier series of different wave forms.

2. Laplace Transforms: Definition, Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Transform of multiplication and division by t, convolution theorem, Laplace transform of unit step function. Applications to solution of ordinary linear differential equations with constant coefficients.

3. Special Functions: Frobenius method for power series solution of differential equations, Bessel's equation, Bessel functions of the first and second kind, Legendre's equation, Legendre polynomial.

4. Partial Differential Equations: Formation of partial differential equations, Equations solvable by direct integration, Linear partial differential equations, homogeneous partial differential equations with constant coefficients. Solution by method of separation of variables, Applications: Wave equation and Heat conduction equation in one dimension. Solution of two-dimensional Laplace equation (Cartesian co- ordinates).

5. Functions of Complex Variable: definition of Limit, continuity, derivative of complex functions, and analytic function. Necessary and sufficient conditions for analytic function (without proof), Cauchy-Riemann equation (Cartesian and polar co-ordinates), harmonic functions, orthogonal system, determination of conjugate functions. Miller's Thomson method, Applications to fluid flow problems. Brief introduction to basic transformations, Bilinear transformations, complex integration: Line integrals in the complex plane, Cauchy's integral theorem, Cauchy's integral formula for analytic function and its derivatives. Taylor's and Laurent's expansions, singular points, poles, residue, Cauchy's Residue theorem, evaluation of real integrals by contour integration (F(*cosx, sinx*)

Course Outcomes:

1. Apply the fundamental concept of Fourier series and be able to give Fourier expansions of a given function.
2. Solve various first order differential equations with their applications.
3. Illustrate the mathematical aspects that contribute to the solution of heat and wave equations.

Suggested Readings/Books

1. Kreyszing Erwin, Advanced Engineering Mathematics, Wiley Eastern
2. B.S Grewal, Higher Engineering Mathematics, Khanna Publishers
3. N.K Jain, Numerical Solutions of Differential Equations, Prentice Hall
4. Sharma and Gupta, Differential Equations, Krishna Prakashan Media
5. N.P Bali, Text book of Engg. Mathematics, Laxmi Publishers

BTAR304-18 FLUID MECHANICS AND FLUID MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To learn about the application of mass and momentum conservation laws for fluid flows.
2. To understand the importance of dimensional analysis.
3. To obtain the velocity and pressure variations in various types of simple flows.
4. To analyze the flow in water pumps and turbines.

Detailed Contents:

1. Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.
2. Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.
3. Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.
4. Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle.
5. Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.

Course Outcomes:

1. Students will be able to mathematically analyze simple flow situations.
2. They will be able to evaluate the performance of pumps and turbines.

Suggested Readings/Books:

1. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S.K. Kataria and Sons Publishers.
2. S.K. Som, G. Biswas and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill.
3. R.L. Daughaty, Hydraulic Turbines, McGraw Hill.
4. K. Subramaniam, Hydraulic Machines, Tata Mc Graw Hill.

BTAR305-18 KINEMATICS AND THEORY OF MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3. To understand the kinematics of gear trains

Detailed Contents:

1. Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

2. Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesis, three position graphical synthesis for motion and path generation

3. Classification of cams and followers- Terminology and definitions- Displacement Diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions-specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers

4. Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics

5. Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction clutches- belt and rope drives- friction in brakes

Course Outcomes:

1. Students can design various types of linkage mechanisms for obtaining specific motion andanalyze them for optimal functioning

Suggested Readings/Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

BTAR306-18 STRENGTH OF MATERIALS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To understand the procedure of doing different tests like hardness, compression, torsion, tension and impact etc. in various materials.
2. To impart knowledge about the testing of springs and beams and behavior of materials.

List of experiments:

1. To perform tensile 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 one hardness tests (Rockwell, Brinell & Vicker's test).
4. To perform impact test to determine impact strength.
5. To perform torsion test and to determine various mechanical properties.
6. To perform Fatigue test on circular test piece.
7. To perform bending test on beam and to determine the Young's modulus and modulus of rupture.
8. Determination of Bucking loads of long columns with different end conditions.

Course Outcomes:

1. Describe the behavior of materials upon normal external loads.
2. Predict the behavior of the material under impact conditions.
3. Recognize the mechanical behavior of materials.

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BTAR307-18 FLUID MECHANICS AND FLUID MACHINES LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To provide practice in estimating friction losses.
2. To impart training to use various flow measuring devices for making engineering judgments.

List of experiments:

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 determine the friction coefficients for pipes of different diameters.
6. To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.
7. To determine the velocity distribution for pipeline flow with a pitot static probe.
8. To draw characteristics of Francis turbine/Kaplan Turbine
9. To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance
10. To draw the characteristics of Pelton Turbine
11. To draw the various characteristics of Centrifugal pump

Course Outcomes:

1. Estimate the friction and measure the frictional losses in fluid flow.
2. Experiment with flow measurement devices like venturimeter and orifice meter.
3. Predict the coefficient of discharge for flow through pipes.

BTAR308-18 KINEMATICS AND THEORY OF MACHINES LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To equip students with understanding of the fundamental principles and techniques for identifying different types of dynamic systems and classify them by their governing equations.
2. To develop a model of a mechanical system using a free body diagram.
3. To develop equations of motion for translational and rotational mechanical systems.

List of experiments:

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.

Course Outcomes:

1. Compute the moment of inertia of rigid bodies.
2. Demonstrate the working principles of gyroscope and cam.
3. Experiment with vibrations and balancing.

4th Semester; Contact Hours: 28

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAR401- 18	Design of Machine Elements	4	1	0	5	40	60	100	5
BTAR402- 18	Manufacturing Technology	4	0	0	4	40	60	100	4
BTAR403- 18	Hydraulic and Pneumatics	4	0	0	4	40	60	100	4
BTAR404- 18	Basic Electronics Engineering	3	0	0	3	40	60	100	3
BTAR405- 18	Industrial Safety	3	0	0	3	40	60	100	3
EVS101-18	Environment Science	3	0	0	3	100	00	100	Non credit
BTAR406- 18	Manufacturing Technology Lab	0	0	2	2	30	20	50	1
BTAR407- 18	Hydraulic and Pneumatics Lab	0	0	2	2	30	20	50	1
BMPD401- 18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**360**	**340**	**700**	**21**

BTAR401-18 DESIGN OF MACHINE ELEMENTS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	1	0	5	40	60	100	5

Objectives:

1. To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.
2. To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.
3. To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.

Detailed Contents:

1. Scope and meaning of machine design. Sources of design data. Design considerations from economics, manufacturing, aesthetics and ergonomics aspects. Design Process, Selection of Materials.

2. Screwed Joints

Design of Bolted joints, Bolted Joints under eccentric Loading. Welded Joints: - Design of Fillet Welded Joints, Butt Joints, Un-symmetric Welded sections, eccentrically loaded welded joints.

3. Riveted Joints

Design of Lap Joints, Butt Joints, Diamond Riveting, Eccentrically loaded riveted joints, Design of Cotter and Knuckle Joints.

4. Shafts

Design of shafts under different types of loading conditions.

5. Keys & Couplings

Design of rectangular and square keys, muff coupling, split muff coupling, flange coupling, bushed-pin flexible coupling.

6. Levers

Design of straight levers, Bell - Crank levers, foot levers, hand levers.

7. Brakes and Clutches

Design of friction plate and cone clutches, simple type brakes.

8. Introduction to Design for Manufacturing and Assembly.

Course Outcomes:

Students will get an overview of the design methodologies employed for the design of various machine components.

Suggested Readings/Books

1. J.E. Shigley, Mechanical Engineering**,** McGraw-Hill Education (India) Pvt Ltd.
2. Dr. Sadhu Singh, Machine Design, Khanna Publishers.
3. R.S.Khurmi & J.K.Gupta, A text book of machine design**,** S. Chand & Co.
4. D.K.Aggarwal & P.C.Sharma, Machine Design**,** S.K Kataria and Sons.
5. Krishnamurthi, Design and Manufacturing S.K. Kataria and Sons.

BTAR402-18 MANUFACTURING TECHNOLOGY

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

1. To provide knowledge on machines and related tools for manufacturing various components.
2. To understand the relationship between process and system in manufacturing domain.
3. To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Detailed Contents:

1. Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; presstools – configuration, design of die and punch; principles of forging die design.

2. Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and workpiece quality.

3. Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices.

4. Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling; Production planning & control: Forecasting models, aggregate production planning, materials requirement planning. Inventory Models: Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT. Simple queuing theory models.

Course Outcomes:

Students will be able to recognize the tooling needed for manufacturing, the dimensional accuracy and tolerances of products, assembly of different components and the application of optimization methods in manufacturing.

Suggested Readings/Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
3. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

BTAR403-18 HYDRAULIC AND PNEUMATICS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:
The course elaborates principles of hydraulic and pneumatic devices, electro-pneumatic components. It gives an overview of control systems associated with hydraulic applications.

Detailed Contents:

1. **Fluid Power Principles and Fundamentals**

Introduction to fluid power, Advantages and applications, Fluid power systems, Types and Properties of Hydraulic fluids, Basics of hydraulics, Principles of flow, Work, Power and Torque, Reynolds number, Influence of temperature on viscosity, High water-based fluid, Fluid preparation, Common fire-resistant fluid**,** Biodegradable oils**.**

2. **Hydraulic Linear Actuators**

Hydraulic cylinder, Construction of cylinders, Seals in cylinders, Cylinder reliability, Cylinder force, Acceleration and losses, Calculation of cylinder forces, Flow velocity, Cylinder efficiency, Sizing of cylinder tubes, Piston rod design, mounting style of cylinders, Cushioning of hydraulic cylinder, Hydraulic cylinder and their characteristic application.

3. **Hydraulic motors**

Vane Motor, Gear Motor, Piston motor, Selection of hydro motor, Hydraulic or electrical motor,Hydraulic motor in circuits, Types of hydraulic transmission, Pump motor combination, Open loop and close loop system, Application of hydrostatic transmission.

4. **Filter and Filtration**

Nature, effect and sources of contamination, Effect of dirt on hydraulic components, System failure, Contamination level and standardization, Filter rating, Terminology and Design types of filters and Filter construction, Location of filter, Magnetic filter, Optimum filtration, Automatic particle counter and its performance characteristics.

5. **Hydraulic Pumps**

Pump classification-Gear Pump, Internal Gear pump, Gerotor Pump, Screw Pump, Vane Pump, Piston Pumps, Selecting and sizing of Hydraulic pumps, Pump ripple.

6. **Hydraulic Reservoir and Accumulators**

Common types of reservoirs- their mounting and construction, Reservoir shapes and size, Reservoir accessories, Integral reservoirs, Hydraulic accumulator, Accumulators in circuit, Accumulator selection.

7. **Hydraulic Circuits**

Hydraulic circuits, Manual or Automatic Hydraulic systems, Regenerative circuits, Use of check Valve in hydraulic circuits, Standards in circuit diagram representation, Speed variation in cylinder motion, Some basic circuits, Functional diagram, Application of functional diagram, Electrical control of hydraulic system.

8. **Hydro Pneumatic**

Compressibility, Solution, Types of hydro Pneumatic systems, Hydraulic check unit, Hydro pneumatic cylinder, Parallel check unit, Integral air oil cylinder, Types of feed, Intensifier, Comparison of Hydro pneumatic, Hydraulic and pneumatic system.

9. Automation and Principle of Pneumatic Circuit Design

Pneumatic controls, Functional diagram in pneumatic circuit, Movement diagram, Cascade system of Pneumatic circuit design.

10. Maintenance and Trouble Shooting of Pneumatic system

Maintenance need of Pneumatic systems, Common problems in Pneumatic system, Maintenance schedule of Pneumatic system, Trouble shooting, Maintenance tips, Flow resistance, Seal failures, Maintenance of air compressor, Instructions for removal of operating troubles of air compressor.

Course Outcomes:

1. Demonstrate knowledge of fundamental concepts of Pneumatic and Hydraulic control.
2. Identify various components of Pneumatic and Hydraulic control systems.
3. Design and analyze problems relating to Pneumatic and Hydraulic control systems and components.

Suggested Readings/Books:

1. S.R. Majumdar, Oil Hydraulic Systems-Principles and Maintenance, Tata McGraw Hill.
2. S.R. Majumdar, Pneumatic Systems-Principles and Maintenance, Tata McGraw Hill.
3. Farel Bradbury, Hydraulic Systems and Maintenance, Butterworth & Co (Publishers) Ltd.
4. R. Srinivasan, Hydraulic and Pneumatic Controls, Vijay Nicole.
5. Anthony Esposito, Fluid Power with Applications, PHI/Pearson Education.

BTAR404-18 BASIC ELECTRONICS ENGINEERING

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	40	60	100	3

Objectives:
To provide an overview of electronic device components to students.

Detailed Contents:

1. **Semiconductor Devices and Applications**: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XXand 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a singlestage CE amplifier, frequency response and bandwidth.
2. **Operational amplifier and its applications:** Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.
3. **Timing Circuits and Oscillators:** RC-timing circuits, IC 555 and its applications as a stable and mono-stable multi-vibrator, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.
4. **Digital Electronics Fundamentals:** Difference between analog and digital signals, Number System, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables.
5. **Electronic Communication Systems**: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Course Outcomes:
1. Understand the principles of semiconductor devices and their applications.
2. Design an application using Operational amplifier.
3. Understand the working of timing circuits and oscillators.
4. Understand logic gates, flip flop as a building block of digital systems.
5. Learn the basics of Electronic communication system.

Suggested Readings/Books:
1. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc GrawHill, 3rd Edition, 2001

BTAR405-18 INDUSTRIAL SAFETY

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	40	60	100	3

Objectives:

1. To know about Industrial safety programs and toxicology, Industrial laws, regulations and source models
2. To understand about fire and explosion, preventive methods, relief and its sizing methods
3. To analyze industrial hazards and its risk assessment.

Detailed Contents:

1. Safety

Meaning & need for safety, Relationship of safety with plant design, Equipment design and work environment, Industrial accidents, Natures, Types and causes.

2. Assessment of Accident Costs

Prevention of accidents, Industrial hazards, Hazard identification techniques, Accident investigation, Reporting and analysis.

3. Planning for Safety

Definition, Purpose, Nature, Scope and procedure, Range of planning, Variety of plans, Policy formulation and implementation of safety policies, Safety measures in a manufacturing organization, Safety, Economics, Safety and productivity, Employees participation in safety, Safety standards and legislation.

4. Meaning of Environment and Need for Environmental Control

F-factors in industry, Effect of temperature, Illumination, Humidity, Noise and vibrations on human body and mind. Measurement and mitigation of physical and mental "fatigue", Basics of environment design for improved efficiency and accuracy at work.

5. Ventilation and Heat

Control Purpose of ventilation, Physiology of heat regulation, Thermal environment and its measurement, Thermal comfort, Indices of heat stress, Thermal limits for comfort, Efficiency and freedom from health risk, Natural ventilation and mechanical ventilation, Air conditioning Process ventilation, Control of heat exposures, Control at source, Insulation and local exhaust ventilation, Control of radiant heat, Dilution ventilation, Local relief.

6. Industrial Lighting

Purpose of lighting, Benefits of good illumination, Phenomenon of lighting and safety, Lighting at work, Sources and types of artificial lighting, Principles of good illumination, recommended optimum standards of illumination, design of lighting installation, Maintenance standards relating to lighting and colour.

7. Noise & Vibrations

Continuous and impulse noise, Effect of noise on man, Noise measurement and evaluation of noise, Noise isolation. Noise absorption techniques, Silencers vibrations: Effect, Measurement and control measures.

8. Environment Standards

Introduction to ISO-14000, Environment standards for representative industries

Course Outcomes:

1. Analyze the effect of release of toxic substances
2. Understand the industrial laws, regulations and source models.

3. Apply the methods of prevention of fire and explosions.
4. Understand the relief and its sizing methods.
5. Understand the methods of hazard identification and preventive measures.

Suggested Readings/Books:

1. Joselin, Ventilation, Edward Arnold.
2. Beranek, Noise Reduction, McGraw Hill.
3. Reamer D.C., Modern Safety and health Technology, R. Wiley.
4. Heinrich H.W, Industrial Accident Prevention, McGraw Hill.
5.Firenze, The process of Hazard Control, R.J. Kendale.

EVS101-18 ENVIRONMENT SCIENCE

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	100	00	100	Non Credit

Objectives

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 ethoses. 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 resources 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 rehabilitation 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) Drive for segregation of waste
j) To live with some eminent environmentalist for a week or so to understand his work
k) To work in kitchen garden for mess
l) To know about the different varieties of plants
m) Shutting down the fans and ACs of the campus for an hour or so
n) Visit to a local area to document environmental assets river/ forest/ grassland /hill/ mountain/ lake/ Estuary/ Wetlands
o) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
p) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

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.

Suggested Readings/Books

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad.
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
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.
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.

BTAR406-18 MANUFACTURING TECHNOLOGY LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To impart students with the knowledge of various machine tools and its operations.
2. To familiarize with the selection of suitable production process for the desired component

List of experiments:

Measurement of cutting temperature and tool life in turning and machine tool alignment test on machine tools.

Pattern Making; pattern material, pattern allowances and types of patterns. Mould making Practice: Uses of moulding tools: green sand moulding, gating system, risering system, core making.

Method Study on Bolt, Washer and Nut Assembly

Flow Process Chart [Man Type/Material Type] 4. Man-Machine

Study & use of software for Inventory control, Facility Design, Process planning, Production control.

Study of simulation software and applications in material flow.

Integrated automation, computers and managerial challenges.

Modern cutting tools and tool management, CAPP, high speed machining, precision machining.

Course Outcomes:

1. Explain the working principle of various machines used in manufacturing.
2. Identify the appropriate production process and machines.
3. Demonstrate the working of advance machine tools.

BTAR 407-18 HYDRAULIC AND PNEUMATICS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To provide knowledge on electrical circuits, signal conditioning
2. To make familiar about control system and power electronics in designing hydraulic and pneumatic systems.

List of experiments:

1. Design and testing of hydraulic circuits using-

i. Pressure control

ii. Flow control

iii. Direction control

2. Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electro- hydraulic Trainer.

3. Design and testing of pneumatic circuits using-

i. Pressure control

ii. Flow control

iii. Direction control

iv. Circuits with logic controls

v. Circuits with timers

vi. Circuits with multiple cylinder sequences in pneumatic electro pneumatic trainer.

4. Design of circuits using mechanical feedback systems.

5. Velocity control of single and double acting hydraulic and pneumatic cylinders.

6. Design of Pneumatic system using any commercially available simulation software.

7. Design of Hydraulic system using any commercially available simulation software.

Course Outcomes:

1. Describe hydraulic and pneumatic systems and overview of control systems & actuators.
2. Differentiate between various sensors, transducers and actuators and their applications.
3. Relate various signal conditioning units, amplifiers, logic gates and their role in programmable logic controllers.

5th Semester; Contact Hours: 28

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR501-18	Electronics Devices and Circuits	4	0	0	4	40	60	100	4
BTAR502-18	Computer Aided Design and Manufacturing	4	0	0	4	40	60	100	4
BTAR503-18	Robotics Engineering and Applications	4	0	0	4	40	60	100	4
BTAR504-18	Digital Electronics	3	0	0	3	40	60	100	3
HSMC101-18 /HSMC102-18*	Humanities -I	3	0	0	3	40	60	100	3
BTAR505-18	Electronics Devices and Circuits Lab	0	0	2	2	30	20	50	1
BTAR506-18	Computer Aided Design and Manufacturing Lab	0	0	2	2	30	20	50	1
BTAR507-18	Digital Electronics Lab	0	0	2	2	30	20	50	1
BTAR508-18	German/Japanese/ French Language Lab	0	0	2	2	30	20	50	1
BMPD501-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**320**	**380**	**700**	**22**

BTAR-501-18 Electronic Devices and Circuits

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Detailed Contents:

1. Semiconductor devices

H parameters equivalent circuit, Common emitter amplifier, DC behavior: the load slope and the Q point, AC behaviour, Emitter follower amplifier, Field effect transistors: JFET and MOSFET.

2. Power supplies

Review of Rectification with and without filters, Linear regulators. 78XX and 79XX family. Switching regulators.

3. Operational amplifiers Fundamentals & Applications

Basic opamp circuit, Opamp parameters, Opamps as DC Amplifiers, Voltage followers, Non- Inverting and Inverting Amplifier, Summing and Difference Amplifier, Opamp as AC Amplifier, Opamp Frequency Response, Opamp Applications as Voltage Source, Current Source, Current Amplifiers, Instrument Amplifiers, Precision Half Wave and Full Wave Rectifier, Limiters, Clampers, Peak Detectors, Sample and Hold Circuits, V-I and I-V converter, Schmitt Trigger.

4. Opamp applications as Voltage Regulator, Timer and Data Converters

IC 555 Timer used as Astable and Monostable Multivibrator, PLL, VCO, D-A and A-D Converter.

5. Digital Techniques: combinational circuits and sequential circuits

Truth tables. Karnaugh's diagram. Miniterm addition. Maxiterm product. Synthesis of combinational circuits. Logic comparators. Codifiers. Decodifiers. Multiplexers, de-multiplexers. Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse-Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop.

6. Analysis of Sequential Circuits

Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter.

7. Bistable, Monostable and Astable Multivibrator

A fixed bias binary, self-biased binary, commutating capacitors, a direct connected binary, Schmitt trigger, emitter coupled binary. Monostable multivibrator, emitter coupled monostable multivibrator, astable emitter coupled multivibrator.

SUGGESTED READING/ BOOKS:

1. Ronald J Tocci, **Fundamentals of Pulse & Digital Circuits**, TMH.
2. David A Bell, **Analog Electronics**, PHI.
3. John M Yarbrough, **Digital Logic Applications and Design**, Thomson Learning, 2001.
4. Millman and Taub, **Pulse Digital and Switching Waveforms,** McGraw Hill Edition.
5. Millman- Halkias, **Electronic Devices & Circuits**, Tata Mcgraw Hill.
6. Boylestad, **Electronic Devices & Circuits Theory**, PHI Learning Pvt Ltd.

BTAR-502-18 (Computer Aided Design and Manufacturing)

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Detailed Contents:

1. **Fundamentals of CAD**
   Design process with and without computer; CAD/CAM system and its evaluation criteria, brief treatment of input and output devices, Display devices, Functions of a graphics package and Graphics standard GKS, IGES and STEP .Geometric Transformations: Mathematics preliminaries, matrix representation of 2 and 3 dimensional transformation. Geometric Modeling: Wire frame Model, Solid Modeling, Boundary Representation (B-rep), Conductive Solid Geometry(CSG), Introduction to Parametric and Non Parametric representation of Curves.

2. **NC/CNC Machine Tools**
   NC machine tools- basic components, coordinate systems; features of NC machine tools. Computerized Numerical Control (CNC): Tooling for NC machines - tool presetting equipment, flexible tooling, tool length compensation, tool path graphics; NC motion control system; Manual part programming, fixed/floating zero. Block format and codes: Computer assisted part programming. DNC and Adaptive Control: Direct numerical control: Adaptive control in machining system; Combined DNC/CNC system.

3. **Group Technology (GT)**
   Part families; part classification and coding system: Group technology machine cells: Advantages of GT.

4. **Computer Aided Process Planning**
   Introduction and benefits of CAPP. Types of CAPP systems, machinability, data selection systems in CAPP.

5. **Computer Integrated Manufacturing Systems**
   Basic Concepts of CIM: CIM Definition, The meaning of Manufacturing, Types of Manufacturing systems; Need, Elements, Evolution of CIM; Benefits of CIM; Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations; FMS benefits.

6. **Automated Material-Handling and Storage Systems**
   Introduction to Material handling system, principles of material handling, material handling equipment, automated guided vehicle systems (AGVS), components of an AGVS, types of AGVS, AGVS guidance system, advantages of AGVSs over other Material handling systems, automated storage and retrieval systems, functions of storage systems, AS/RS components and terminology used, types of AS/RS, conveyer systems. *Classification of feeders, parts of feeding devices, different types of feeders*

SUGGESTED READING/ BOOKS:

1. Mikell P. Groover, Emory W. Zimmers, CAD/CAM, PHI
2. Automation, Production systems and Computer Integrated Manufacturing: - Groover M. P. PHI
3. Zeid Ibraham, CAD/CAM - theory and Practice, Tata McGraw Hill
4. P. N Rao, CAD/CAM, Tata McGraw Hill
5. Nanua Singh, Approach to computer integrated design and manufacturing, John Wiley and sons.

BTAR-503-18 (Robotics Engineering and Applications)

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Detailed Contents:

UNIT I-Introduction History of robots, classification based on geometry, devices, control and path movement, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

UNIT II- Drive systems and Sensors Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

UNIT III- Kinematics and Dynamics of Robots 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics Of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning.

UNIT IV-Robot Control, Programming and Applications Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control. Introduction to Robotic Programming, On-line and off-line programming, programming examples.

Robot applications- Industrial Applications of Robots for Material handling, Machine loading and unloading, assembly operation, Inspection, continuous arc welding, Spot welding, Spray painting, cleaning, robot for underwater applications etc.

SUGGESTED READING/ BOOKS:

1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
2. Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999. Reference Books:
3. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009. 4. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning., 2009.
5. Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
6. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd., 1995.
7. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.
8. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
9. Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985

BTAR-504-18 (Digital Electronics)

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	40	60	100	3

Detailed Contents:

Unit I Number System and Binary Code: Introduction, Binary, Octal, Decimal and Hexadecimal Number Systems. Signed and unsigned numbers, Binary Subtractions using 1's and 2's compliment, ASCII code, Excess 3 code, Grey code, BCD code and BCD additions.

Unit II Minimization of logic function: OR, AND,NOT,NOR,NAND,EX-OR, EX-NOR, Basic theorem of Boolean Algebra, Sum of Products and Product of Sums, canonical form, Minimization using K-map and Q-M method.

Unit III Combinational Circuits: Introduction, Combinational circuit design, Encoders, Decoders, Adders, Subtractors and Code converters. Parity checker, Seven segment display, Magnitude comparators. Multiplexers, De-multiplexer, Implementation of Combinational circuit using MUX.

Unit IV Sequential Circuits: Introduction, Flip flops, Clocked flip flops, SR, JK, D, T and edge triggered flip-flops. Excitation tables of Flip flops. Shift Registers, Type of Shift Registers, Counter, Counter types, counter design with state equation and state diagrams.

Unit V D/A and A/D Converters: Introduction, Weighted register D/A converter, Binary ladder D/A converter, Steady state accuracy test, D/A accuracy and resolution, parallel A/D converter, Counter type A/D converter Successive approximation A/D converter. Single and dual slope A/D converter, A/D accuracy and resolution.

Unit VI Semiconductor Memories: Introduction, Memory organisation, Classification and characteristics of memories, Sequential memories, ROMs, R/W memories. Content addressable memories. PLA and PAL.

SUGGESTED READING/ BOOKS:

- R. P. Jain, *Modern Digital Electronics*, 3rd edition, Tata McGraw–Hill Publishing Company Limited, New Delhi,2003.
- Morris Mano, *Digital Design*, Prentice Hall of India Pvt. Ltd.
- Donald P. Leach and Albert Paul Malvino, *Digital Principles and Applications*, 5th edition, Tata McGraw Hill Publishing Company Limited, New Delhi,2003.
- Thomas L. Floyd, *Digital Fundamentals*, Pearson Education, Inc, New Delhi, 2003.
- Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, *Digital System -Principles and Applications*, Pearson Education.
- Srivastava, *Digital Design: HDL Based Approach*, Cengage Learning.
- Roth, *Fundamentals of Logic Design*, Cengage Learning.

BTAR-505-18 Electronic Devices and Digital Circuits Lab

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of experiments:

1. Implementation of half and full wave rectifier with C filter and (78XX) voltage regulator.
2. Implementation of full wave rectifier with C filter and voltage regulator (78xx)
3. Input and output characteristics of BJT and FET/MOSFETs.
4. Frequency response of BJT CE amplifier.
5. Opamp as Inverting and NonInverting Amplifier,
6. Opamp as Instrumentation amplifier, Schmitt Trigger/Wave Generating Circuits.
7. IC 555 Timer applications.
8. Study of ADC/DAC.
9. Realization of given Boolean expression using basic gates and universal gates.
10. Realization of adder and subtractor using logic gates.
11. Realization of 4:1 Mux, 1:4 Demux, 8 to 3 encoder, 3 to 8 decoder using ICs.
12. Shift left; shift right, SIPO, SISO, PISO, and PIPO operations using D Flip flop.
13. Realization of asynchronous and synchronous 3-bit counters.
14. Realization of decade counter and Mod-5 counter using 7490.

BTME-506-18 (Computer Aided Design and Manufacturing Lab)

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of experiments:

I. Introduction to modeling (using any CAD software):

1. 2D drawing using sketcher – 2 Drawings
2. 3D modeling using 3D features (Modeling of Crane Hook, Bench Vice, Screw Jack components)
3. Assembling and drafting (any 2 above mentioned assemblies) with proper mating conditions and interference checking
4. Surface modeling – (Computer mouse, Plastic bottles with spraying Nozzle)

II. Computer Aided Manufacturing:

1. Manual part programming on CNC Lathe and CNC Milling – (4 programs, 2 for each)

2. Computer Aided Part programming for CNC Lathe and CNC Milling to generate tool path, NC code, and Optimization of tool path (to reduce machining time) using any CAM software.

BTME-507-18 (Digital Electronics Lab)

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of experiments:

1. Study of Logic Gates: Truth-table verification of OR, AND, NOT, XOR, NAND and NOR gates; Realization of OR, AND, NOT and XOR functions using universal gates.
2. Realization Half Adder / Full Adder using Logic gates.
3. Realization Half Subtractor / Full Subtractor using Logic gates
4. Design 4-Bit Binary-to-Gray & Gray-to-Binary Code Converter.
5. Design 4-Bit magnitude comparator using logic gates. Multiplexer: Truth-table verification and realization of Half adder and Full adder using MUX.
6. Demultiplexer: Truth-table verification and realization of Half subtractor and Full subtractor using DEMUX.
7. Flip Flops: Truth-table verification of RS, JK , D, JK Master Slave Flip Flops.
8. Design MOD-7 Synchronous up-counter using JK/RS/D Flip Flops.
9. Shift Register: Study of shift right, SIPO, SISO, PIPO, PISO & Shift left operations using IC7495 chip.

BTME-508-18 (German/Japanese/French Language Lab)

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

French syllabus:

Module 1

Rencontrer quelqu'un et faire connaisssnce; Saluer et prendre congé.
(Meet someone and get acquainted; Basic expressions to greet and take leave)

Module 2

Se présenter (prénom, âge, nationalité, lieu où l'on habite, les langues que l'on parle)
(Introduce oneself : Name, age, nationality, place where one lives, languages that one speaks)

Module 3

Les nombres jusqu'à 50.
(Numbers till 50)

Module 4

Les jours de la semaine
Les mois de l'année
(Names of days and months)

External Assessment: Viva-voce - 20 marks

1. Présentez-vous. (Introduce yourself) - 10 marks
2. Un jeu de rôle à partir de la thématique : les rencontres.(Dialogue simulation based on the theme : Meetings and greetings) - 5 marks
3. Lecture d'un texte simple d'environ 30 mots ou de 4-5 courtes phrases (Reading of a basic text of about 30 words in French or very short 4-5 sentences in French) - 5 marks

Text Books:

1. Christine Andant etal. ―A propos (livre de l eleve)‖, LANGERS, New Delhi, 2012

German Syllabus:

Objectives: The aim is to develop effective communication skill of the students with greater emphasis on oral communication so that they will be able to write and speak German Language most efficiently and effectively.

Course Contents:

Unit I Introduction to Sound system, Alphabets, Greetings, German culture, professions and various nationalities & Numbers 0-20.

Unit II Articles-Definite, Indefinite, Negative (Nominativ and Akkusativ cases), Vocabulary (nouns), Usage of Adjectives. Time related forms - Formal & informal expressions. Days of the week & Months of the year and Numbers 21-50
(Questions in the form of fill in the blanks should be asked from UNIT I & II combined)

Unit III Conjugation of verbs- Regular & Irregular in the present tense. Introduction of Dativ case and exercises based upon nominative, accusative and dative cases. Various seasons & Time; Numbers 51-100

Unit IV Simple dialogues- Preferably based on the following situations:
Reservation of air/train/bus tickets, hotel rooms, giving directions to a place, taking a phone call, ordering food,

fixing an appointment, etc.
Unit V Comprehension of a small seen/unseen passage (passage should be informative) limited to the vocabulary in the presented textbook.

External Examination: 20 Marks
80 words paragraph on my friend, my family, my father or my teacher. Choice must be given at least 1 out of 3 topics. 10 marks
Questions pertaining to grammar done under the heading "internal examination" above. 5 marks.

Questions based upon "the days of the week", "months of the year", "seasons"
OR
Simple dialogue writing (purchasing of articles/to exchange pleasantries between friends or teacher/to ask ok the address or way). 5 marks.
Note:
SYNTAX will be taken care of by practicing Word order and sentence formation. Practice with mini-dialogues.
COMMUNICATION SKILLS will be taken care of by : Conversing in formal and informal situations, Dialogue writing and Telephone conversations.
For the purposes of PRACTICALS teacher is advised to train the students by using language lab for the improvement of listening and speaking skills as per his/her convenience.

Text Books:
Tangram Aktuell 1 (Deutsch als Fremdsprache) - Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr - Max Hueber Verlag, 2004.

Japanese Syllabus:
Unit -1 Orientation Session, Geographic & Socio, economic perspective to Japan, Japanese people and culture and Basic greetings and responses.

Unit -2 Basic script, Method of writing hiragana and katakana, and Combination sounds and simple words.

Unit -3 Topic marker ―wa‖, Desu / dewa arimasen cupolas, Interrogative particle ―ka‖, Grammar particles ―mo‖, ―no‖, _' Introducing some one: ―Kochira wa ~― and Self introductions: Hajimemashite

Unit -4 Demonstratives ―Kore‖, ―Sore‖, ―Are‖, Demonstrative ―Kono‖, ―Sono‖, ―Ano‖, Possessive nounparticle ―no‖ and Japanese apartments: Greeting your neighbour

Unit -5 Place marakers ―Koko‖, ―Soko‖, ―Asoko‖, Direction markers ―Kochira‖, ―Sochira‖, ―Achira‖ and Japanese department stores: Asking for and buying something.
Asking for and telling the time, Paticle ―ni (at)‖ for time, kara (from) ~ made (until), Particle ―to (and)‖, Time periods: Days of the week, months, time of day, Verbs (Present / future and past tense) and Telephone enquiry: Asking for a phone no. And business hours.
Destination particle ―e‖, Particles ―de (mode of transportation)‖ and ―to (with) and Japanese train station: Asking for Fare and track no. / types of trains

Text Books:
Minna no nohongo – Romaji ban (first 10 lessons of this book), 3A Corporation, Tokyo, 2000.

BTAR601-18 Power Electronics & Drives

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To provide the knowledge of Thyristor family, its characteristics and operations with its commutation technique.
2. To provide the knowledge of different phase controlled technique and its applications.
3. To understand the principle of operations for Choppers, Cyclo converters and Inverters.

Detailed Contents:

1. Thyristors and their characteristics :

Introduction to thyristor family V-I characteristics of SCR, SUS, PUT, SCS, GTO, LASCR, DIAC and TRIAC, Principle of operation of SCR, Two transistor analogy, Turn on methods of a thyristor, Switching characteristics of thyristors during turn-on and turn-off, Gate characteristics, Firing of thyristors, Gate triggering circuits, Series and parallel, operation of SCRs and their triggering circuits, Thyristor specifications; such as latching current and bolding current, dv/dt and di/dt, PTV etc. Protection of SCR from over voltage and over current, Snubber circuits, Power dissipation.

2. Thyristor commutation Techniques :

Load commutation (Class A), Resonant-Pulse commutation (class B), impulse commutation (class D), Line commutation (class F).

3. Phase controlled Techniques :

Introduction to phase angle control, Single phase half wave controlled rectifiers, Single phase half controlled and full controlled bridge rectifiers, Three phase full controlled bridge rectifiers, Effect of resistive, inductive and resistive connductive loads. Basic circuit and principle of operation of Dual Converter, circulating current mode and non-circulating current mode of operation, Applications of rectifiers and dual converters to speed control of DC motor drives.

4. Choppers

Introduction and principle of chopper operations, Control strategies, two quadrant chopper, Four quadrant chopper, Regenerative chopper, Steady state time domain analysis of type A-chopper, voltage commutated chopper or classical Jones chopper.

5. Cyclo converters

Basic circuit and operation of single phase cyclo converter, Single phase bridge cyclo converter, Three phase to single phase to single phase cyclo converter, Advantages disadvantages of cyclo converters.

6. Inverters

Introduction to inverter, Operating principle and already state analysis of single phase, voltage source, bridge inverter. Modified Mcmurray half-bridge and full bridge inverter, Three phase bridge inverter, Voltage control (PWM control etc.) and reduction of harmonics in the inverter output voltage, Series inverter.

Course Outcomes:

1. Students will be able to describe the characteristic, operation and applications of regarding different types of Thyristor.
2. Students will be able to describe the working of controlled rectifiers with different phase controlled technique.
3. They will be able to describe the working principle of Choppers, Cyclo converters and Inverters.

Suggested Readings/Books:

1. P.S. Bimbhra, **Power Electronics**, Khanna Publishers.
2. M.D. Singh, K.B. Khanchandani, **Power Electronics**, Tata Mc Graw Hill Publishing company limited.
3. M.H. Rashid, **Power Electronics**, PHI.
4. P.C. Sen**, Power Electronics**, Tata Mc Graw Hill Publishing company limited.

BTAE602-18 NUMERICAL METHODS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
3	1	0	4	40	60	100	4

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).

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.

BTAR603-18 Electronic Measurement and Instrumentation

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

1. To develop the student's knowledge about basic concepts and definitions in measurement.
2. To provide the student with knowledge of analog and digital Meters.
3. To describe the different AC, DC bridge configurations and their applications.
4. To provide the student with knowledge of different signal generators and waveform analyzers.
5. To provide the student with knowledge of different recorders, display devices and transducers.
6. To provide the student with knowledge of data transmission using telemetry.

Detailed Contents:

Unit I Fundamentals

Generalized instrumentation system – Units and Standards, Calibration Methods, Standards of measurements, Classification of errors, error analysis, Static Characteristics- Accuracy, Precision, sensitivity, linearity, resolution, hysteresis, threshold, input impedance, loading effects etc, Dynamic Characteristics.

Unit II Electronic Meters

Electronic Analog voltmeter: DC voltmeters-Choppers type-DC amplifier, solid state voltmeter, Differential voltmeter, peak responding voltmeter, True RMS voltmeter, calibration of DC voltmeters. Digital Voltmeter:- Introduction, Ramp Techniques, dual slope, integrating type DVM, Successive approximation type DVM, Resolution and sensitivity of digital meters, general specification of a DVM. CRO's study of various stages in brief, measurement of voltage, current phase and frequency, special purpose oscilloscope.

Unit III Measuring Instruments

Principle of operation of galvanometer, PMMC, Moving Iron instruments, Resistance measurements using Wheatstone bridge, Kelvin Double Bridge, Ohm meter, AC bridges: Maxwell bridge, Maxwell wein bridge, Hey's Bridge, Schering Bridge, Anderson Bridge, Campbell Bridge.

Unit IV Instrumentation for Generation and Analysis of Waveforms

Signal generators: Fixed and variable AF oscillators, AF sine and square wave generator,
Function generator: Square and pulse generator, Sweep generator, wave analyzer, harmonic distortion analyzer, spectrum analyzer, spectrum analysis.

Unit V Storage and Display Devices

Necessity of recorders, recording requirements, graphic recorders, strip chart recorders, magnetic tape recorders, digital tape recorders, Electronic indicating instruments, seven segment display, fourteen segmental display Nixie tube.

Unit VI Transducers and DATA Acquisition Systems

Strain gauge, LVDT, thermocouple, piezoelectric, crystal and photoelectric transducers and their applications, Data acquisition systems.

Unit VII Telemetry
Introduction, method of data transmission, types of telemetry systems and applications.

Course Outcomes:

1. Students will demonstrate knowledge of measuring various electrical parameters with accuracy, precision, resolution.
2. Students will learn about different analog and digital Meters.
3. Students will demonstrate the ability to use AC and DC bridges for relevant parameter measurement.
4. Student will learn to generate, analyze and record different types of signals.
5. Students will demonstrate an ability to record, convert and transmit a measured signal.

Suggested Books:

1. Element of Electronic Instrumentation & Measurment, by Carr, Pearson Education.
2. Electronic Measurments & Instrumentation, by Kishore, Pearson Education.
3. Electronic Instrumentation, by H.S. Kalsi, Tata McGraw Hill.
4. Applied Electronics Instrumentation and measurement by David Buchla, Wayne Melachlan.
5. Electronics Measurement and Instrumentation, by B.H and Cag J.M , Tata McGrawHill
6. A.K. Sawhney , Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai
7. D Cooper , Electronic Instrumentation and Measurement Techniques.

BTAR604-18 Microprocessors and Microcontrollers

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

1. To develop the knowledge of internal organization, addressing modes and instruction sets of 8085 processor.
2. To develop the knowledge of various functional units of 8051 microcontroller.
3. To understand assembly language program by using 8051 Instruction sets.
4. To develop the knowledge of interfacing different devices with 8051.

Detailed Contents:

Unit 1: Microprocessor 8085

History of microprocessors; microprocessor 8085 Architecture, Pin configuration; Memory Interfacing; microprocessor programming model; 8085 instructions; Addressing modes; programming techniques, counters and time delays; stack and subroutines; interrupts.

Unit 2: Microcontroller 8051 - Building Blocks

Microprocessor vs microcontroller; RISC vs CISC architectures; microcontroller 8051: architecture, pin configuration, flag-bits and PSW register, input-output ports, register banks and stack; semiconductor memories: ROM, SRAM, DRAM, virtual memory, cache memory; memory organization.

Unit 3: Microcontroller 8051 - Programming

Assembly language programming; data types and directives; jump loop and call instructions; I/O port programming; addressing modes and accessing memory using various addressing modes; arithmetic instructions and programs; logic instructions and programs; single bit instructions and programming, 8051 interrupts; timer/counter programming in the 8051.

Unit 4: Microcontroller 8051 - Interfacing

Parallel and serial ADC& DAC interfacing; LCD interfacing, Keyboard interfacing; sensor interfacing; interfacing with external memory; matrix keypad; stepper motor interfacing; DC motor interfacing and PWM.

Course Outcomes:

At the end of this course student will demonstrate the ability to:

1. Understand architecture & functionalities of different building block of 8085 microprocessor.
2. Understand working of different building blocks of 8051 microcontroller.
3. Comprehend and apply programming aspects of 8051 microcontroller.
4. Interface & interact with different peripherals and devices.

Suggested Books:

1. R S Gaonkar, **Microprocessor Architecture, Programming and Application with 8085**, Penram International Publishing Pvt. Ltd.
2. Douglas Hall, **Microprocessors Interfacing**, Tata McGraw Hill
3. Subrata Ghoshal, **8051 Microcontroller: Internals, Instructions, Programming and Interfacing**, Pearson Education
4. Kenneth Ayala, **The 8051 Microcontroller**, Cengage Learning
5. Krishna Kant, "**Microprocessors and Microcontrollers**" PHI Learning.

BTME605-18 INTRODUCTION TO INDUSTRIAL MANAGEMENT

Course objectives:

- To help the students gain understanding of the functions and responsibilities of industrial managements.
- To enable them to analyze and understand the environment of the organization.
- To help the students to develop cognizance of the importance of management principles.
- To provide them tools and techniques to be used in the performance of the managerial job.

Detailed Contents:

Unit-1: Concept of industrial engineering, Roles of industrial engineer, Tools of management science, Introduction to quality, Excellence in manufacturing, Excellence in service, factors of excellence, relevance of total quality management.
Unit-II: Concept of production, Production system, Input output model, definition of quality, Total quality control and Total Quality Management, salient features of total quality control and total quality management, benefits of total quality management.
Unit-III: Introduction to product design, Effect of design on cost, Requirements of a good product design, Factors affect product design, Product life cycle, Need and concept of product planning, Concept of product development. Introduction of industrial cost, Elements of cost, Breakeven analysis.
Unit-IV: Materials management, Purchasing, Objectives of purchasing, Activities, duties and functions of purchasing department, Purchase organizations, Buying techniques, Purchasing procedure.
Unit-V: Concept of plant maintenance, Objectives and importance of plant maintenance, Duties, functions and responsibilities of plant maintenance department, Organization of maintenance, Scheduled, preventive and predictive maintenance.
Unit-VI: Inventory, Inventory control, Objectives of inventory control, ABC analysis, Just-in-time (JIT), Definition: Elements, benefits, equipment layout for JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.
Unit-VII: Benchmarking: Meaning of benchmarking and its concept, Definition of benchmarking, Benefits of bench marking, process and types of benchmarking.

Unit-VIII: Customer: Types of customers, Customer satisfaction, Role of marketing, Data collection, Customer complaints, Redressal mechanism.

Course Outcomes:

- Understand the complexities associated with management in the organizations and integrate the learning in handling these complexities.
- Demonstrate the roles, skills and functions of management.
- Understand the concepts related to industrial management.

Text Books:

1. Industrial Engineering and Management/ O. P. Khanna/ Dhanpat Rai and Sons
2. General and Industrial Management/ H Fayol/ Pitman
3. Industrial Management/ I. K. Chopde and A. M. Sheikh/ S. Chand
4. A Text Book of Industrial Management/ A. P. Verma and N. Mohan/ Katson
5. Total Quality Management/ Jeol E. Ross/ Taylor and Francis Limited.

BTAR 606-18 Microprocessors and Microcontrollers Lab

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

This is laboratory course meant to write programs using 8085/8086 microprocessor and learn interfacing using 8051 microcontoller for general operations.

Course Outcomes

At the end of this Lab course student will be able to:

1. Write programs for common arithmetic operations with 8-bit/16-bit numbers using 8085.
2. Write programs for transfer, sort block of data with 8085/8086 processor(s).
3. Write programs for controlling stepper and DC motors using Microprocessor(s).
4. Write programs to generate waveforms and interface ADC and DAC using of 8051 Microcontroller.

Part-A: Write programs in Assembly language & embedded C to

1. Add two 8-bit numbers stored in registers or internal/External memory locations.
2. Multiply two 8-bit numbers.
3. Multiply two 16-bit numbers.
4. Transfer block of data from internal memory locations to external memory locations
5. Sort block of data in ascending or descending order.
6. Generate 5KHz pulse waveform of 50% duty cycle.
7. Interface ADC and DAC.
8. Interface Matrix Keyboard.
9. Interface LCD Displays.
10. Interface Stepper Motor.
11. Control DC motor using PWM.

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. RFID attendance system
2. Home automation
3. Robotic vehicle
4. Sensor traffic lights
5. Floor cleaning robot
6. Robot for defense applications
7. GPS vehicle tracking
8. Accident identification and SMS

BTAR 607-18 Electronic Measurement & Instrumentation Lab

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of Experiments:

1. Measurement of Inductance by Maxwell's Bridge.
2. Measurement of small resistance by Kelvin's Bridge.
3. Measurement of Capacitance by Schering Bridge.
4. Measurement of Frequency by Wein Bridge.
5. Measurement of medium resistance by Wheat Stone's Bridge.
6. Determination of frequency & phase angle using C.R.O.
7. To find the Q of a coil using LCR-Q meter.
8. To determine output characteristic of a LVDT and determine its sensitivity.
9. Study characteristics of temperature transducer like Thermocouple, Thermistor and RTD with implementation of small project using signal conditioning circuit.
10. Study characteristics of Light transducer like Photovoltaic cell, Phototransistor and Pin Photodiode with implementation of small project using signal conditioning circuit.
11. To study input- output characteristics of a potentiometer and to use two potentiometers as an error detector.
12. To study transmitter- receiver characteristics of a synchro set to use the set as control component.
13. To study the operation of a d-c positional servo system and to investigate the effect of damping and supply voltage on its response.
14. To study the operation of an a.c. position servo-system and to obtain effects of supply voltage and system parameter on its transient response.
15. To study a stepper motor and control its direction speed and number of steps with the help of a microprocessor.

Semester 7th / 8th

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR701-18	Control Systems	4	0	0	4	40	60	100	4
BTAR 702-18	Programming Industrial Automation systems	4	0	0	4	40	60	100	4
	Elective -I	3	1	0	4	40	60	100	4
	Elective-II	3	0	0	3	40	60	100	3
BTAR703-18	Advanced Robotics	3	0	0	3	40	60	100	3
BTAR704-18	Advanced Robotics Lab	0	0	2	2	30	20	50	1
BTAR705-18	Major Project	0	0	8	8	30	20	50	4
BMPD	Mentoring and Professional development		0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**260**	**340**	**600**	**23**

List of Elective –I and Elective-II

1. BTAR706-18 Communication system
2. BTAR707-18 Sensors & Signal Processing
3. BTAR708-18 Micro-controller and PLC
4. BTAR709-18 Linear Integrated Circuits
5. BTAR710-18 Human Resources management
6. BTAR711-18 Mechanical Vibration
7. BTAR712-18 Electromechanically energy conversion and DC Machines
8. BTAR713-18 Total Quality Management

Semester 7th / 8th

Course Code	Course Title	Evaluation Internal		External	Total Marks	Credits
		Institute	Industry			
BTAR-801	Software	100	50	100	250	8
	Industrial	100	50	100	250	8
	Total	200	100	200	500	16

BTAR701-18	Credits	L	T	P	Int	Ext
Control Systems	4	3	1	0	40	60

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Characterize a system and find its study state behaviour
2. Investigate stability of a system using different tests
3. Design various controllers
4. Solve linear, non-linear and optimal control problems

Unit 1: Introduction

Classification with understanding of Industrial Control system examples. Transfer function. System with dead-time. System response. Control hardware and their models: potentiometers, synchros, LVDT, DC and AC servomotors, Tacho generators, Electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis.

Unit 2: Feedback Control systems

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. proportional, integral and derivative systems. Feed forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Unit 3: Second Order systems

Time response of second-order systems, steady-state errors and error constants. Performance specifications in time-domain. Root locus method of design. Lead and lag compensation. Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency-domain. Frequency domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Op-amp based and digital implementation of compensators. Tuning of process controllers. State variable formulation and solution.

Unit 4: State variable Analysis

Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability. Introduction to Optimal control & Nonlinear control, Optimal Control problem, Regulator problem, Output regulator, tracking problem. Nonlinear system – Basic concept & analysis.

Recommended Books:

1. Gopal. M., "Control Systems: Principles and Design", Tata McGraw-Hill, 1997.
2. Kuo, B.C., "Automatic Control System", Prentice Hall, sixth edition, 1993.
3. Ogata, K., " Modern Control Engineering" , Prentice Hall, second edition, 1991.

Nagrath& Gopal, "Modern Control Engineering", New Age International, New Delhi

BTAR 702-18	Credits	L	T	P	Int	Ext
Programming Industrial Automation systems	**4**	**3**	**1**	**0**	**40**	**60**

Course Outcomes

At the end of this course:
CO1. Student will understand the different types of Industrial Process & Process Control Philosophies.
CO2. Student will learn the basics of Programmable Logic Controller.
CO3. Student will learn about the designing of ladder diagram from process control descriptions by using different PLC functions.
CO4. Student will learn about the PLC arithmetic and logical functions & Data Handling functions.

1. Nature of Industrial Process: continuous & discrete state sequential process, process variables and their classification.

2. Introduction to Process Control Philosophies: type of relays, ladder logic methodology, ladder symbols.

3. Introduction to Programmable Logic Controllers: advantages & disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC.

4. PLC programming methodologies: ladder diagram, STL, functional block diagram, creating ladder diagram from process control descriptions, introduction to IEC61131 international standard for PLC.

5.PLC functions: bit logic instructions, ladder diagram examples, interlocking, latching, inter dependency and logical functions, PLC Timer & Counter functions on-delay timer, off-delay timers, retentive on-delay timers, pulse timers, timer examples, up-counter, down-counter and up-down counter, counter examples, register basics.

6. PLC Data Handling: data move instructions, table and register moves, PLC FIFO & LIFO functions**.**

7. PLC arithmetic and logical functions: addition, subtraction, multiplication, division instructions, increment decrement, trigonometric and log functions, AND, OR, XOR, NOT functions, PLC compare and convert functions.

Suggested Books:

1. John Webb, Programmable Logic Controllers Principles & applications, PHI
2. T. A. Hughes, Programmable Controllers
3. C. D. Johnson, Process Control Instrumentation

BTAR703-18	Credits	L	T	P	Int	Ext
Advanced Robotics	3	3	0	3	40	60

Course Outcome

At the end of this course:

CO1. Student will able to use matrix algebra for computing the kinematics of robots.
CO2. Student will able to calculate the forward kinematics and inverse kinematics of serial and parallel robots.
CO3. Student will able to calculate the Jacobian for serial and parallel robot.
CO4. Student will able to do the path planning for a robotic system.

1. Robot Coordinate System

Position and orientation of objects, Object coordinate frames, Rotations matrix, Euler angles , Roll pitch and yaw angles coordinate, Transformations, Joint variables and position of end effecter, Dot and Cross products, coordinates frames, Rotations, Homogeneous coordinates.

2. Forward Kinematic

Introduction to Forward kinematic, Denavit-Hartenberg (D-H) representation (with examples), The arm equation, the arm matrix of serial link manipulators, forward/direct kinematic analysis for serial link manipulators.

3. Inverse Kinematic

Introduction to inverse kinematics, General properties of inverse kinematic solution, Tool configuration vector, Tool configuration of serial link manipulators with examples of five axis. Articulated robot and four-axis SCARA Robot. Inverse kinematics of a serial link manipulator.

4. Velocity and Static Analysis of robotic manipulators

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial manipulators, work space analysis of serial link manipulators

5. Dynamics of serial manipulators

Mass and inertial of links, Lagrangian formulation for equations of motion for serial manipulators, Kinetic and potential energy, Lagrangian-Euller dynamic mode., Direct and inverse dynamics, Recursive dynamics using Newton-Euler formulation

6. Motion Planning and Control

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Nonlinear model based control schemes.

7. Robot programming

On line programming, teach pendant control, Lead through programming, Walk through programming, off line programming, Task programming.

Suggested Books:

1. Schilling, R. J., Fundamentals of Robotics Analysis & Control, Prentice Hall of India
2. Fu, K. S., Gonzalez, R. C. and Lee, C. S., Robotics: Control, Sensing, Vision, and Intelligence, McGraw Hill
3. Craig, J. J., Introduction to Robotics: Mechanics and Control, Pearson Education
4. Deb, S. R., Robotics and Flexible Automation, McGraw Hill.
5. Saha, S. K., Introduction to Robotics, McGraw Hill

BTAR-704	**Credits**	**L**	**T**	**P**	**Int**	**Ext**
Advanced Robotics Lab	**2**	**0**	**0**	**2**	**30**	**20**

List of Experiments

1. Study of different actuators and end effector for robot.
2. Robot Programming with Computer Simulation Software.
3. Programming of robots by manual, lead through and off-line methods, use of robot programming languages to pick and place, stacking of objects in increasing or decreasing size, palletizing operations, assembly and inspection operation etc.
4. Solving Robot Arm Kinematics with Matlab
   a) Matrix multiplication and Concatenation of matrices in matlab, inverse of a matrix
      To solve different transformation matrices, to find the homogeneous transformation matrix of robotic manipulator, to find the joint angles when the end effector position is given.
   b) Robot workspace: Plot of end effector position vector in three-dimensional space.

BTAR706-18	**Credits**	**L**	**T**	**P**	**Int**	**Ext**
Communication System	4	3	1	0	40	60

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

Unit 1: Analog Communication

Review of Signals and Systems, Frequency domain representation of signals, Amplitude Modulation: Transmission and Reception of DSB, SSB and VSB,Angle Modulation, Spectral characteristics of angle modulated signals, Principles of Frequency and Pulse Modulation, Representation of FM and PM signals, Review of white noise characteristics, Noise in amplitude modulation and Angle Modulation systems, Pre-emphasis and De-emphasis.

Unit 2: Digital Communication

Analog to Digital: Need, Sampling process, Pulse Amplitude modulation and Concept of Time division multiplexing, Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation and demodulation, Adaptive and Sigma Delta Modulation, Noise considerations in PCM, Digital Multiplexers.

Unit 3: Elements of Detection Theory

Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Review of probability and random process Gaussian noise characteristics, Baseband Pulse Transmission: Inter symbol Interference and Nyquist criterion.

Unit 4: Digital Modulation Techniques

Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Recommended Books

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

BTAR707-18	Credits	L	T	P	Int	Ext
Sensors and Signal Processing	4	3	1	0	40	60

Course Outcomes

At the end of this course:

1. Student will learn the working of different smart sensors and their applications.
2. Student will learn the introduction about signal conditioning, signal processing and data acquisition.
3. Student will learn the designing of digital filters.
4. Student will learn the introduction about PID controllers.

1. Smart Sensors

Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors – applications -Automobile, Aerospace, Home appliances, Manufacturing, Medical diagnostics, Environmental monitoring.

2. Signal Conditioning And Data Acquisition

Amplification – Filtering – Sample and Hold circuits –Data Acquisition: Single channel and multichannel data acquisition – Data logging.

3. Signal Processing

Introduction, Z-Transform, Region of convergence; Inverse Z Transform methods, properties of Z transform.

4. Design of Digital Filters

Structures of realization of discrete time system, direct form, Cascade form, parallel form and lattice structure of FIR and IIR systems. Linear Phase FIR filters; Design methods for FIR filters; IIR filter design by Impulse Invariance, Bilinear Transformation, Matched Z-Transformation, Analog and Digital Transformation in the Frequency Domain. Finite Precision Effects**:** Fixed point and Floating point representations

5. PID Controller

Process Control, Introduction to Process Control, P-I-D Control, Controller Tuning, Implementation of P-I-D Controllers.

Suggested Books:

1. E. O. Doebelin, Measurement Systems – Applications and Design , Tata McGraw Hill, edition 1992.
2. A. K. Sawhney, A course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai and Co (P) Ltd, 2004.
3. Beckwith, Marangoni and Lienhard, Mechanical Measurements, Addison – Wesley, 5th Edition, 2000.
4. D. Roy Choudry, Sheil Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.

Patranabis. D, Sensors and Transducers, 2nd edition PHI, New Delhi, 2003.

BTAR708-18	Credits	L	T	P	Int	Ext
Microcontroller and PLC	4	3	1	0	40	60

Course Outcomes

At the end of this course:

1. Student will learn the introduction about 8051.
2. Student will learn the assembly language programming of 8051.
3. Student will learn the 8051 microcontroller design and its applications.
4. Student will learn the introduction about Programmable Logic Controllers (PLC).

1. Introduction

Microprocessor, Microcontrollers and their comparison. The 8051 Architecture: Introduction, 8051 microcontroller hardware, input/ output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts.

2. 8051 Assembly Language Programming

The mechanics of programming, assembly language programming process, programming tools and techniques, instruction set (data moving, logical operations, arithmetic operations, jump and call instructions)

3. 8051 Microcontroller Design

Microcontroller specification, external memory and memory space decoding, reset and clock circuits, expanding input and output (I/O), memory mapped I/O, memory address decoding, memory access times, testing the design, timing subroutines, lookup tables for the 8051, serial data transmission

4. Microcontroller Applications

Interfacing keyboards, displays, Digital-to-Analog (D/A) and Analog-to-Digital (A/D), multiple interrupts, serial data communications, introduction to the use of assemblers and simulators Embedded Systems: Introduction to PLDs and FPGA-architecture, technology and design issues, implementation of 8051 core.

5. Programmable Logic Controllers (PLC)

Introduction, operation of PLC, difference between PLC and Hardwired system, difference between PLC and Computer, relay logic and ladder logic, ladder commands and examples of PLC ladder diagram realization, PLC timers, PLC counters, PLC classification.

Suggested Books:

1. Kenneth J Ayola, The 8051 Micro Controller -Architecture, Programming and Application , Penram International Publication
2. John B Peatman, Design with Micro Controller, Tata McGraw Hill
3. Ray A.K and Bhurchand K.M., Advanced Microprocessors and Peripherals; Architecture, Programming and Interfacing , Tata McGraw Hill
4. Mazidi M.A. and Mazidi J.G., The 8051 Micro-controller and Embedded System, Pearson Education.
5. Udayashank ara V. and Mallikarjunaswamy M.S., 8051 Micro controller Hardware, Software and Applications , TataMcGraw Hill Education Pvt. Ltd., (2010)

BTAR709-18	Credits	L	T	P	Int	Ext
Linear Integrated Circuits	3	3	0	0	40	60

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand Differential and Cascade Amplifiers
2. Know the basics, working and characteristics of Op-Amps
3. Investigate various applications of Op-amps
4. Understand some specialized Op-Amps
5. Interpretation of Data Sheets and their Applications thereof.

UNIT I: DIFFERENTIAL ANDCASCADE AMPLIFIERS

Introduction: Differential Amplifier, its Circuit Configuration, Dual Input-Balanced output Differential amplifier, Dual Input Unbalanced output, Single Input Balanced & Unbalanced Output Differential Amplifier, Amplifier with their DC and AC analysis, Differential Amplifier with Swaping resistors, Constant current bias, Current Mirror, Cascaded differential amplifier stages, Level Translator, CE-CB Configuration.

UNIT II: INTRODUCTION TO OPERATIONAL AMPLIFIERS

Block diagram of a typical Op-Amp, Schematic symbol, integrated circuits and their types, IC package types, Pin Identification and temperature range, Interpretation of Data sheets, Overview of typical set of data sheets, Characteristics and performance parameters of and Op-Amp, Ideal Op-Amp, Equivalent circuit of an Op-Amp, Ideal voltage transfer curve, Open loop configurations: Differential, Inverting & Non Inverting. Practical Op-Amp: Input offset voltage, Input bias current, Input offset current, total output offset voltage, Thermal drift, Effect of variation in power supply voltages on offset voltage, Temperature and supply voltage sensitive parameters, Noise, Common Mode configuration and common mode rejection Ratio. Feedback configurations.

UNIT III: APLICATIONS OF OP-AMP

DC and AC amplifiers, Peaking Amp, Summing, Scaling and Averaging Amp, Instrumentation Amplifier, Log and Antilog Amp, Integrator, Differentiator. Active filters: First order LP Butterworth filter, Second order LP Butterworth filter, First order HP Butterworth filter, Second-order HP Butterworth filter, Higher order filters, Band Pass filter, Band reject Filter, All Pass filter, Phase shift Oscillator, Wein Bridge Oscillator, Square wave Oscillator, Basic Comparator, Schmitt trigger, V to F and F to V converters.

UNIT IV: SPECIALIZED IC APPLICATIONS

IC 555 Timer: Pin configuration, Block diagram, application of IC 555 as Monostable and
Astable .Multivibrator., Phase Lock Loops: Operating principles & applications of IC 565 and IC 566,Monolithic PLL TL082, Voltage Regulators: Fixed voltage regulators (78XX and 79XX), Adjustable voltage regulators (LM327), Analog multiplier ICs (MPY634 KP) and their applications, Switching Regulators, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

Recommended Books

1. 1. Op Amps & Linear Integrated circuits by Ramakant A. Gayakwad, Pearson
2. Operational Amplifiers & Linear Integrated circuits by Robert F. Coughlin, Prentice Hall
3. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, TMH.

BTAR710-18	Credits	L	T	P	Int	Ext
Human Resources management	3	3	0	0	40	60

Course Outcome

At the end of this course:

CO 1. Students will learn and understand the meaning, nature and scope of Human Resource Management.
CO2. Students will understand the basics of recruitment and selection process.
CO3. Students will understand the concept of Training and Development and Job analysis.
CO4. Students will understand the concept of Job analysis, design and satisfaction.
CO5. Students will understand the human relation and Industrial relation.

Unit-I Introduction to Human Resource

Definition, Role and Functions of Human Resource Management, Concept and Significance of HR, Changing role of HR managers, HR functions and Global Environment, role of a HR Manager.

Unit-II Human Resources Planning

Need and Process for Human Resource Planning, Methods of Recruitment, Planning Process, Planning at different levels, Recruitment and selection processes, Sources of Recruitment, Restructuring strategies, Placement and Induction, Retention of Employees, , Employment Exchanges (Compulsory Notification of vacancies).

Unit-III Training and Development

Principles of Training, Employee Development, Need for skill up gradation, Assessment of training needs, Retraining and Redeployment methods and techniques of training employees and executives, performance appraisal systems Career Development & Planning.

Unit-IV Job analysis, Design and Satisfaction

Job Analysis: Job Description & Job Description, Job Specification, Job satisfaction and its importance; Motivation, Factors affecting motivation, introduction to Motivation Theory; Workers ' Participation, Quality of work life.

Unit-V Industrial Relations

Factors influencing industrial relations, State Interventions and Legal Framework, Role of Trade unions, Collective Bargaining, Worker's participation in management.

Reference Books:

1. T.N.Chhabra- Human Resource Management (Dhanpat Rai & Co.).
2. Gary Dessler, Human Resource Management (8th ed.), Pearson Education, Delhi
3. Biswajeet Patanayak, Human Resource Management, PHI, New Delhi
4. A Minappa and M. S. Saiyada - Personnel Management (Tata Mc. Graw-Hill)

BTAR711-18	Credits	L	T	P	Int	Ext
Mechanical Vibrations	**4**	**3**	**1**	**0**	**40**	**60**

Course Outcomes

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

CO1: Formulate mathematical models of problems in vibrations using Newton's second law or energy principles

CO2: Understand the need and measurement of vibration in mechanical systems

CO3: Calculate principal modes of vibration

CO4: Explore the suitable methods of vibration reduction and absorption

CO5: Ability to determine vibratory responses of SDOF and MDOF systems

CO6: Create the mathematical model of a vibratory system to determine its response

UNIT - I Introduction, Classification of Vibration Systems, Harmonic motion, Vector re[presentation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical and numerical methods. Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping.

UNIT - II Single Degree Freedom: Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments.

UNIT- III Two Degree Freedom systems Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled system, Principle of vibration absorber, Undamped dynamic vibration absorbers, Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.

UNIT- IV Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts.

UNIT- V Multi Degree Freedom system: Numerical Analysis by Rayleigh's method, Dunkerely's, Holzer's and Stodola methods, Rayleigh-Ritz method 5 Critical speed of shafts, Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

Books and References:

1. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee.
2. Mechanical Vibrations-Theory & Practice, S Bhave, Pearson Education.
3. Mechanical Vibrations-N K Grover, PBS Publications.
4. Theory of Vibrations with Applications, Thomson & Dahleh, Pearson Education.
5. Elements of Vibration Analysis, L Meirovitch, McGraw-Hill Education.
6. Mechanical Vibrations – Tse, Morse & Hinkle
7. Mechanical Vibrations – V. Rama Murthy, Narosa Publications 8. Mechanical Vibrations – D. Nag, Wiley

BTAR712-18	Credits	L	T	P	Int	Ext
Electromechanically energy conversion and DC Machines	**4**	**4**	**0**	**0**	**40**	**60**

Course Outcomes

At the end of this course:

1. Student will learn the basics of Electro-Mechanical Energy Conversion.
2. Student will learn about the working and construction of electrical machines.
3. Student will learn about the working and construction of different D.C machines.
4. Student will learn about the principle of working and construction of Cross-Field Machines with its application.

1. Electro-Mechanical Energy Conversion

Energy stored in electric and magnetic fields, energy conversion in singly and multiple excited systems, reluctance torque, reluctance and hystersis motors.

2. General Description of Electrical Machines

Description of electric circuits in cylindrical rotor and salient pole machines, MMF of Single and multiple coils, harmonic analysis of induced voltages and armature MMF, Effect of slots, winding factors, Torque in terms of flux and mmf.

3. D.C. Machines

Armature windings, single and double layers, windings & winding diagrams, E.M.F. and torque equations, interaction of fields produced by excitation circuit and armature, effect of brush shift, compensating winding, commutation, causes of bad commutation, methods of improving commutation, methods of excitation of d.c. generators and their characteristics. D.C. motors: characteristics, starting of shunt and series motor, starters, speed control methods-field and armature control, Ward Leonard method, Braking: plugging, dynamic and regenerative braking, Testing: Swinburn's test, Hopkinson test, Field test. Estimation of losses and efficiency.

4. Cross-Field Machines

Principle of working, analysis of cross-field generator, typical characteristics with different compensations. Applications.

Suggested Books:

6. Fitzgerald Kingsley & Kusko, Electric Machinery, Tata McGraw-Hill
7. Langsdorff , Principles of D.C. machines, Tata McGraw-Hill
8. Nagrath & Kothari , Electrical Machines, Tata McGraw-Hill Education, Jun 1, 2004
9. P.S. Bhimbhra , Electrical Machinery, Khanna Publishers

BTAR713-18	Credits	L	T	P	Int	Ext
Total Quality Management	**3**	**3**	**0**	**0**	**40**	**60**

Course Outcomes

At the end of this course:

CO1: Understand quality concepts and philosophies of TQM.
CO2: Apply TQM principles and concepts of continuous improvement.
CO3: Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality.
CO4: Understand & remember the quality systems and procedures adopted.

1. **Quality and Total Quality Management:** Excellence in manufacturing/service, factors of excellence, relevance of TQM.
2. **Concept and definition of quality:** Total quality control (TQC) and Total Quality Management (TQM), salient features of TQC and TQM. Total Quality Management Models, benefits of TQM.
3. **Just-in-time (JIT):** Definition: Elements, benefits, equipment layout for JIT system, Kanban system MRP (Material Requirement planning) vs JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.
4. **Customer:** Satisfaction, data collection and complaint, redressal mechanism.
5. **Planning Process:** Policy development and implementation; plan formulation and implementation.
6. **Process Management:** Factors affecting process management, Quality function development (QFD), and quality assurance system.
7. **Total Employees Involvement (TEI):** Empowering employees: team building; quality circles; reward and Recognition; education and training, Suggestion schemes.
8. **Problems solving:** Defining problem, Problem identification and solving process, QC tools.
9. **Benchmarking:** Definition, concept, process and types of benchmarking
10. **Quality Systems:** Concept of quality system standards: relevance and origin of ISO 9000; Benefits; Elements of ISO 9001, ISO 9002, ISO 9003.
11. **Advanced techniques of TQM:** Design of experiments: failure mode effect analysis: Taguchi methods.

BOOKS: 1. Sunder Raju, Total Quality Management, Tata McGraw Hill.
2. M.Zairi, TQM for engineers, Aditya Books.
3. J.L. Hradeskym, Total Quality Management Handbook, McGraw Hill.
4. Dalela and Saurabh, ISO 9000 quality System, Standard Publishers.