Department of Mechanical Engineering

Syllabus

For

B.Tech. Mechanical (ME) and B.Tech. Mechanical and Automobile engineering (MAE)

Course code	Course title	L	T	P	Credits
ME-207 C	**THERMODYNAMICS**	3	1	0	4

Course Objectives:
This course introduces the student to the fundamental laws of thermodynamics, the interaction between Energy and matter, the quantitative and qualitative aspects of energy and its transformations, the Properties of the working substance and their relationship.

UNIT-1: FUNDAMENTALS AND BASIC CONCEPTS

System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & In exact Differentials, Quasi–static Process, Reversible and Irreversible Process, Causes of Irreversibility, Energy and its forms, Work and heat (sign convention), Equality of Temperature, Zeroth Law of Thermodynamic and its utility, Problems.

UNIT-2: FIRST LAW OF THERMODYNAMICS

Thermodynamic definition of work ,Displacement work and flow work, Displacement work for various non-flow processes, Joules' experiment, First law analysis for closed system(non-flow processes),Internal energy and enthalpy, PMM-I, Numericals Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc., Numericals.

UNIT-3: SECOND LAW OF THERMODYNAMICS AND ENTROPY

Limitations of Ist law, Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin Planck and Clausius statement of second law of thermodynamics, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II. Clausius inequality ,Concept of Entropy, Entropy change of pure substance indifferent thermodynamic processes, Tds equation, Principle of entropy increase, Statement of the third law of thermodynamics, Availability and Irreversibility Problems

UNIT-4: PROPERTIES OF PURE SUBSTANCES

Pure substance, Property of Pure Substance (steam),Triple point, Critical point, Saturation states, Sub-cooled liquid state, Superheated vapour state, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T &P- V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier chart, Dryness fraction and it's measurement, processes involving steam in closed and open systems. Simple Rankine cycle.

UNIT-5: THERMODYNAMIC RELATIONS, IDEAL AND REAL GASE

Maxwell Relations, Clapeyron Equation, Relations for changes in Enthalpy and Internal Energy & Entropy, Specific Heat Capacity Relations, Joule Thomson coefficient & inversioncurve.
Idealgases,Idealgaslaws, realgases,compressibility factor, compressibility charts.

TEXT BOOKS

Nag, P.K., "Engineering Thermodynamics", Tata McGraw Hill.

REFERENCE BOOKS:

1. Rao, Y VC., "Theory and Problems of Thermodynamics", Wiley Eastern Ltd, 2007
2. Arora C P., "Engineering Thermodynamics", Tata McGraw Hill; 2008
3. Domkundwar., "Thermal Engineering", Dhanpat Rai & Company, 2006
4. Estope, TD and Meconkey A., "Applied Thermodynamics for Engineers Technologists", AWL, 1999

Course outcome:

Course Outcome:
CO1-Students will be able to explain the basic principles and applications of the thermody0mics to the various real life systems.
CO2-Students will be able to describe fundamental laws of thermodynamics.
CO3-Students will be able to apply the concepts such as Entropy, Energy Balance also the calculations of heat, work and other important thermodynamic properties for various ideal gas processes.
CO4-Students will be able to estimate performance of various thermody0mic gas power cycles and gas refrigeration cycle and availability in each case.
CO5-Students will be able to examine the condition of steam and performance of vapour power cycle and vapour compression cycle

Course code	Course title	L	T	P	Credits
ME – 205 C	**ENGINEERING MECHANICS**	3	1	0	4

Course Objectives:
Engineering Mechanics is one of the core subjects that introduces the student to analysis of forces and motion and prepares the student for studying strength of materials and theory of machines.

UNIT-1: FORCE SYSTEMS

Basic concepts of space, time, mass, force, particle and rigid body; scalars and vectors; principle of transmissibility; force classification; Representation of force in vector form; rectangular components of two dimensional force systems; resultant of two dimensional and concurrent force systems. moment about a point; Varignon's theorem; Representation of moment in vector form; couple. Numerical.

UNIT-2: EQUILIBRIUM

Equilibrium in two dimensions; Lame's Theorem; system isolation and the free-body-diagram; modeling the action of forces; equilibrium conditions; Numerical.

UNIT-3: PROPERTIES OF SURFACES/CROSS SECTIONS

Centre of mass; determining the centre of gravity; centre of gravity of areas including composite sections; moments of inertia; MI of plane figures; parallel axis & perpendicular axis theorem;; MI of composite figures. Numerical.

UNIT-4: RECTILINEAR AND CURVILINEAR MOTION

Types of motion, definitions of displacement, distance, velocity, speed, acceleration Newton's laws of motion, Uniform and non-uniform motion equations of motion, motion under gravity. Numerical.

UNIT-5: PROJECTILES

Angle of projection, Trajectory, Range of projectile , Duration of flight , Path of Projectile, Greatest height attained by a projectile. Numerica

TEXT BOOKS

Meriam, J. L. "Engineering Mechanics", John Wiley & S

REFERENCE BOOKS:

1. Beer, F.P. and Johnston, E.R. "Mechanics of Materials", Tata McGraw Hill
2. Shames, I.H. "Engineering Mechanics", 4th Edition, Pearson Education, 2003
3. Pytel, A and Kiusalaas, J. Thomsom, "Mechanics of Materials", Brooks & Cole, 2003

Course Outcome:
CO1. Solve engineering problems involving the equilibrium of particles and rigid bodies.
CO2. Solve the problems involving dry friction and virtual work.
CO3. Determine the centroid, center of gravity, and moment of inertia of various surfaces and solids.
CO4. Solve problems related to kinematics and kinetics of a rigid body.
CO5. Solve problems using the energy-momentum principle for a particle and rigid bodies in plane motion.

Course code	Course title	L	T	P	Credits
ME-260 C	**MACHINE DRAWING**	0	0	4	2

Course Objectives:
This course makes the student to learn the presentation of components and assemblies in to various views and vice versa. This will enable the student to learn to conceive an object and go For its production. AutoCAD is introduced to facilitate this process.

1. INTRODUCTION

Introduction to Graphic language, Sectional views, Types of sectional views, Hatching, Isometric scale, Isometric drawing of Circles; Conversion of isometric to orthographic and vice versa.

2. TOLERENCE AND MACHINE COMPONENTS

Standard abbreviation – Limits , Fits and Tolerance, Surface finish; Gear terminology, types of gear; Draw the gear profile; Springs, Belts & Pulleys, Bearings.

3. KEYS AND COTTERS

Various types of keys and cotters, Spigot and socket joint, Gib and cotter joint, Knuckle joint

4. JOINTS AND COUPLINGS

Rivets and Riveted Joints, Caulking and fullering of riveted joints, Types of riveted joints, Bolts and nuts, Welded Joint, Flange coupling (Protected and non-protected), muff coupling and half-lap muff Coupling.

5. ASSEMBLY DRAWING

Assembly of Lathe Tail stock, Machine vice; Cylinder, Piston, rings and Connecting rod; Steam stop valve, Stuffing box, Drill jigs and Milling fixture, Screw Jack.

LIST OF EXERCISES

1. Introduction of AUTOCAD and drawing simple figures by using Draw and Modify tools in AUTOCAD
2. To make complex / Engineering; Objects by using Layers with proper dimensioning tools
3. Conversion of Isometric views to orthographic views
4. Conversion of Orthographic views to Isometric views
5. Objects are given in Isometric views and that are to be converted in sectional views
6. Excises on Threads; Bolts and nuts
7. Excises on Riveted Joints and welded joints
8. Excises on Shafts; keys cotter and pin joints
9. Excises on Couplings
10. Geometrical tolerance; Limits and fits
11. Excises on springs; belts and Pulleys
12. Excises on Gears and bearings
13. Assembly drawing of Cylinder; Piston; rings and connected rod And part drawing of crank shaft
14. Assembly drawing of screws Jack
15. Block Diagrams;(Power plant; Civil ;Electronics etc)
16. Assembly drawing of stop valve
17. Assembly drawing of spring loaded safety Valve
18. Assembly drawing of Tailstock of Lathe
19. Assembly drawing of Shaper tool slide
20. Conversion of Assembly drawing to part drawing sand vice versa

TEXT BOOK

Singh, Ajeet., “Machine Drawing”, McGraw-Hill2008

REFERENCE BOOKS

1. Gill, P. S., “Machine Drawing”, SK Katariaand Sons, 2008

2. Bhatt, N. D, and Panchal, V. M., “Machine Drawing”, Charotar Publishing House, 2008

Course outcomes:

CO1. Upon completion of this course, the students can able to perform free hand sketching of basic geometrical constructions and multiple views of objects.
CO2. Students can able to prepare isometric and perspective sections of simple solids
CO3. Students can able to demonstrate computer aided drafting
CO4. Students will get insight of technical skills regarding assembly, production and part drawings.
CO5. Students will be familiarized with various limits, fits and tolerances.

Course code	Course title	L	T	P	Credits
ME-204 C	**STRENGTH OF MATERIALS**	3	1	0	4

Course Objectives:
The strength of materials is one of the core subjects and aim is to provide a sound foundation to design various element of mechanical equipment

UNIT-1: SIMPLE STRESSES AND STRAINS

Resistance to deformation; Hook's law and stress-strain diagram; types of stresses; stresses and strains in bars of varying sections; stresses in composite bars; lateral strain and Poisson's ratio; volumetric strain, modulus of rigidity and bulk modulus; relation between elastic constants. Numerical

UNIT-2: TORSION OF CIRCULAR SHAFTS AND REACTION OF BEAMS

Torsion formula of circular shaft, power transmission by shaft, types of beams and loads, reaction produced on supports for beams with point load uniformly distributed load, uniformly varying load and combined loads. Numerical.

UNIT-3: SHEAR FORCE & BENDING MOMENT

Definitions: SF and BM diagrams for cantilevers, simply supported beams with or without overhang and calculation of max. BM and SF and point of contra-flexure under i) concentrated loads, ii)uniformly distributed loads over wholes pan or part of it iii) combination of concentrated and uniformly distributed loads

UNIT-4: ANALYSIS OF PERFECT FRAMES

Types of frames, Assumptions made in finding out the forces in frames, Reactions of supports of a frame, Analysis of frame by Method of Joint, Analysis of frames by Method of Section.

UNIT-5: MOHR CIRCLE OF STRESSES

Mohr's circle of stress for a material under similar stresses in two mutually perpendicular plane, Mohr's circle of stress for a material under dissimilar stresses in two mutually perpendicular plane Mohr's circle of stress for a material under similar stresses in two mutually perpendicular plane along with shear stresses acting on all the planes, Mohr's circle for a material under dissimilar stresses in two mutually perpendicular plane along with shear stresses acting on all the planes. Numerical

TEXT BOOKS

Ferdinand P Beer &Russel E Johnston;—Mechanics of Materials‖, Tata McGraw Hill;2009

REFERENCE BOOKS:

1. Hibbeler, R. C.,—Mechanics of Materials ,Pearson Education, 2005
2. Ryder,G H., —Strength of Materials‖, Macmillan, 2001
3. Srinath LS,—Strength of Materials‖, Macmillan, 2001
4. Andrew / Kiusalaas, Jaan., —Mechanics of Materials‖, Thomson, 2003

Course outcomes:

CO1-Students will be able to predict mechanical behavior of the member by determining the stresses, strains and deflections produced by the loads up to the elastic limit.

CO2- Students will be able to solve the stresses in determinate and indeterminate, homogeneous and composite bars under concentrated loads, self-weight and thermal loads.

CO3-Students will be proficient to construct Shear Force and Bending Moment diagrams for statically determinate beam due to concentrated load, uniformly distributed load, uniformly varying load and couple.

CO4-Students will be able to determine bending and shear stresses in machine elements

CO5-Students will be able to Evaluate Slope and Deflection of Statically Determi0te beams subjected to concentrated load, uniformly distributed load, uniformly varying load and couple and also strain energy in members subjected to Gradual, sudden and impact loads

Course code	Course title	L	T	P	Credits
ME-307C	**SOLID MECHANICS**	3	1	0	4

Course Objectives:
The strength of materials is one of the core subjects and aim is to provide a sound foundation to design various elements of mechanical equipment

UNIT-1: BENDING STRESS

Flexural formula for straight beam under pure bending, Flexural formula for curved beam under pure bending, Development of bending stress in rectangular, I-sectional and T-sectional beams. Numerical

UNIT-2: TRANSVERSE SHEAR AND BIAXIAL STRESSES

The shear formula; shear stress in beams for rectangular cross section , shear stress in beams for I-section , Shear flow in rectangular section ,I-Section , C-section , T-section. . Numerical

UNIT-3: SLOPE AND DEFLECTION OF BEAMS

Relationship between bending moment; slope and deflection, Calculations of slope and deflection by method of integration; Calculations of slope and deflection by Macauley's method, Castigliango's theorem to find slope; deflection of beams. Numerical.

UNIT-4: COLUMNS AND STRUTS

Column under axial load, Concept of instability and buckling, slenderness ratio; Euler's formula for elastic buckling load for a column hinged at both the ends, Euler's formula for elastic buckling load for a column fixed at one end and free at other end, Euler's formula for elastic buckling load for a column fixed at both ends, Euler's formula for elastic buckling load for a column fixed at one end and hinged at other end, Equivalent length of a column, Slenderness Ratio, Rankines formula. Numerical.

UNIT-5: THIN & THICK CYLINDERS

Thin walled pressure vessels; Hoop stress and longitudinal stress for A thin cylindrical vessel ,Hoop stress and longitudinal stress for a thin spherical vessel, Derivations of Lame's equations for thick cylinders; Radial and hoop stresses and strains in thick cylinders,

TEXT BOOKS

Ferdinand P Beer & Russel E Johnston;—Mechanics of Materials, Tata McGraw Hill;2009

REFERENCE BOOKS:

1. Hibbeler, R. C.,— Mechanics of Materials ,Pearson Education, 2005
2. Ryder,G H., —Strength of Materials‖, Macmillan, 2001
3. Srinath LS, —Strength of Materials‖, Macmillan, 2001
4. Andrew / Kiusalaas, Jaan., —Mechanics of Materials‖, Thomson, 2003

Course outcomes:

1. Learn about the elastic and plastic behavior of material and evaluate stress invariants, principal stresses and their directions.
2. Determine strain invariants, principal strains and their directions.
3. Develop constitutive relationships between stress and strain for linearly elastic solid.
4. Analyze theories of failure and design components for safe operation.
5. Examine the properties of ideally plastic solid and apply the concepts of energy methods in solving structural problems.

Course code	Course title	L	T	P	Credits
ME-202 C	**APPLIED THERMODYNAMICS**	3	1	0	4

Course Objectives:
It enables the students to understand the use of thermodynamic laws in design and functioning of Various equipment used in steam power systems and compressors.

UNIT-1: CLASSIFICATION OF FUELS

Classification of fuels –solid; liquid and gaseous fuels; Combustion equations; Stoichiometric air-fuel ratio; Excess air. Calorific values of fuel; Exhaust gas analysis; Orsat apparatus; Enthalpy and internal energy of combustion; Enthalpy of formation; Adiabatic flame temperature; Problems

UNIT-2: BOILER

Boiler:-Classification ;comparison between fire and water tube boilers Essentials of a good boiler; Constructional and operational details of Babcock - Wilcox; Cochran; Locomotive and Lancashire Boilers;Highpressureboilers-Benson;Lamont;LoefflerandVeloxboilers;Boilermountings and accessories; Boiler performance; Natural and Artificial Drafts; Chimney height; Maximum draft and chimney efficiency; Boiler heat balance Sheet; Problems

UNIT-3: BASIC POWER CYCLES & NOZZLES & TURBINES

Carnot and Rankine vapor cycles effect of operating Conditions on thermal efficiency of Rankine cycle; Rankine cycle with superheat; reheat And regeneration Binary Vapor cycle Problems Classification of nozzles ,Velocity and heat drop; mass discharge through a nozzle; critical pressure ratio and its significance effect of friction and nozzle efficiency; Supersaturated flow; design pressure ratio; Problems

UNIT-4: STEAM TURBINES

Classification; Impulse Turbine Flow through blades; velocity Diagram; power output and efficiency maximum blade efficiency of single stage impulse Turbine; Blade friction; compounding of impulse turbine. Reaction Turbine-Flow through Impulse reaction blades degree of reaction; velocity diagram; power output; efficiency And blade height comparison of impulse and impulse reaction turbines; Losses in steam Turbines; stage efficiency; overall efficiency and reheat factor; Governing of steam Turbines Problems

UNIT-5: CONDENSER & COMPRESSOR

Elements of a condensing plant; types of condensers and their studies comparison of jet and surface condensers; Condenser vacuum; sources of air leakage and its Disadvantages; vacuum efficiency and condenser efficiency; Problems. Working of a single stage reciprocating air compressor; calculation of work input; Volumetric efficiency; Isothermal efficiency; Advantages of multi stage compression;

Two stage compressor with Inter-cooling; Perfect Inter cooling; Optimum intercooler pressure Problems

TEXT BOOKS

Eastop, T. D, and McConkey., “Applied Thermodynamics for Engineering Technologists”, Pearson

REFERENCE BOOKS:

1 Domkundwar., “Thermal Engineering”, Dhanpat Rai and Company.

2 Vasandani, V. P., and Kumar, D. S., “Heat Engineering”, Metropolitan Book Co

3 Ballaney, P. L., “Thermal Engineering”, Khanna Publishers,

Course outcomes:

CO1-Students will be able to explain the basic principles and applications of the thermody0mics to the various real life systems.
CO2-Students will be able to describe fundamental laws of thermody0mics.
CO3-Students will be able to apply the concepts such as Entropy, Energy Balance also the calculations of heat, work and other important thermodynamic properties for various ideal gas processes.
CO4-Students will be able to estimate performance of various thermody0mic gas power cycles and gas refrigeration cycle and availability in each case.
CO5-Students will be able to examine

Course code	Course title	L	T	P	Credits
ME-208 C	**KINEMATICS OF MACHINES**	3	1	0	4

Course Objectives:

1. To understand the basic components and layout of linkages in the assembly of a system / machine.
2. To understand the principles in analyzing the assembly with respect to the displacement, velocity, and acceleration at any point in a link of a mechanism.
3. To understand the basic concepts of toothed gearing and kinematics of gear trains and the effects of friction in motion transmission and in machine components.

UNIT-1: INTRODUCTION OF MECHANISMS AND MACHINES

Concepts of Kinematics and Dynamics, Mechanisms and Machines, Planar and Spatial Mechanisms, Kinematic Pairs, Kinematic Chains, Kinematic Diagrams, Kinematic Inversion, Four bar chain and Slider Crank Mechanisms. And their Inversions, Degrees of Freedom, Mobility and range of movement-Kutzbach and Grubler's criterion, Number Synthesis, Grashoff's criterion Position analysis of Four bar, slider crank mechanisms, transmission angle, Mechanical Advantage.

UNIT-2: VELOCITY AND ACCELERATION ANALYSIS

Velocity and Acceleration Analysis: Velocity and Acceleration Diagrams, Instantaneous Centre of Velocity, Rubbing Velocity, Corioli's component of acceleration.
Special Mechanisms: Straight line mechanisms, Hooke's Joint, Steering Mechanisms.

UNIT-3: CAMS AND FOLLOWERS

Cams and Followers: Introduction: Classification of cams and followers, nomenclature, displacement diagrams of follower motion. Synthesis and Analysis: Determine of basic dimensions and synthesis of cam profiles using graphical methods, cams with specified contours.

UNIT-4: Gears & Gears Train

Gears: Terminology, Law of Gearing, Characteristics of involute and cycloidal action, Interference and undercutting, center distance variation, minimum number of teeth, path of contact, contact ratio,
Gear Trains: Synthesis of Simple, compound &reverted gear trains, Analysis of epicyclic gear trains.

UNIT-5:

Friction: Types of friction, laws of friction, motion along inclined plane, screw threads, efficiency on inclined plane, friction in journal bearing, friction circle and friction axis, pivots and collar friction, uniform pressure and uniform wear.

Belts and pulleys: Open and cross belt drive, velocity ratio, slip, material for belts, crowning of pulleys, law of belting, types of pulleys, length of belts, ratio of tension, centrifugal tension, power transmitted by belts and ropes, initial tension, creep, chain drives, chain length, classification of chains.

TEXT BOOKS

1. Rattan S.S, Theory of Machines,Tata McGraw-Hill Publishing Company Ltd., New Delhi, 4th Edition, 2014.
2. Ambekar A. G., Mechanism and Machine Theory, PHI, 2009.

REFERENCE BOOKS:

- Shigley, J.E and Uicker, J.J: Theory of Machines and Mechanisms, Oxford University Press
- Rattan S.S.: Theory of Machines Tata McGraw-Hill Publishing Co. Ltd. NewDelhi
- Rao J.S. and Dukkipati R.V: Mechanisms and theory Machines theory, Wiley Eastern Ltd.
- Mabie H.H and Ocvirk, F.W: Kinematic and Dynamics of Machinery, 3rd EditionJohn wiley and sons.
- Green, W.G: Theory of Machines, 2nd Edition, Blackie, London, 1992.
- Hollowenko, A.R: Dynamics of Machinery, John wiley and sons. Inc. NewYork, 1955.
- Wilson, Kinematics and Dynamics of Machinery, 3rd Edition, Pearson Education.
- Bevan Thomas, Theory of Machines

Course outcomes:	
1.	Upon completion of this course, the students can able to apply fundamentals of mechanism for the design of new mechanisms and analyse them for optimum design.
2.	Students can able to understand the effects of friction in motion transmission and in machine components.
3.	understand the motion resulting from a specified set of linkages, design few linkage mechanisms and cam mechanisms for specified output motions
4.	It enables design of **cam** mechanisms for specified output motions and solving of problems in toothed gear trains and the effects of friction in machine components.
5.	Gain knowledge on the basic concepts of mechanisms, cam, gear train and their kinematics.

Course code	Course title	L	T	P	Credits
ME-301 C	**DYNAMICS OF MACHINES**	3	1	0	4

Course Objectives:

To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms.

To understand the undesirable effects of unbalances resulting from prescribed motions in mechanism.

To understand the effect of Dynamics of undesirable vibrations

UNIT-1: SATIC AND DYNAMIC FORCE ANALYSIS

Static force analysis of planer mechanisms, dynamic force analysis including inertia and frictional forces of planer mechanisms.
Dynamics of Reciprocating Engines : engine types, indicator diagrams, gas forces, equivalent masses, inertia forces, bearing loads in a single cylinder engine, crankshaft torque, engine shaking forces. Introduction to flywheel

UNIT-2: GOVERNORS

Watt, Porter, Proell, Hartnell and spring controlled governors, governor effort, power, stability, inertia effects. Hunting of governors and Isochronism, Intertia Governors

UNIT-3: BRAKES

Types of brakes, shoe brake, band brake, band and block brake, internal expanding shoe brake and effect of braking
Dynamometers: types of dynamometers, Prony brake, rope brake and band brake dynamometers, belt transmission dynamometer, torsion dynamometer, hydraulic dynamometer.

UNIT-4: GYROSCOPE

Principle of gyroscopic couple, effect of gyroscopic couple and centrifugal force on vehicle taking a turn, gyroscopic stabilization, stabilization of sea vessels stability of four wheel and two wheel vehicles moving on curved paths.

UNIT-5: BALANCING OF ROTATING COMPONENTS

Static/dynamic balancing; Balancing of rotating masses; Two plane balancing –graphical and analytical methods; balancing of rotors; field balancing; balancing machines.
BALANCING OFRECIPROCATING PARTS: Balancing of single cylinder engine, balancing of multi- cylinder inline/radial/V-type engines, firing order.

TEXT BOOKS

1. Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms" ,3rd Edition, Oxford University Press, 2009.
2. Rattan, S.S, "Theory of Machines", 3rd Edition, Tata McGraw-Hill,

REFERENCE BOOKS

1. Grover. G.T., "Mechanical Vibrations", Nem Chand and Bros.,
2. William T. Thomson, Marie Dillon Dahleh, Chandramouli Padmanabhan, "Theory of Vibrationwith Application", 5th edition, Pearson Education, 2011
3. V.Ramamurthi, "Mechanics of Machines", Narosa Publishing House,
4. Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications,

Course outcomes:

CO1. Upon completion of this course, the Students can able to predict the force analysis in mechanical system and related vibration issues and can able to solve the problem.

CO2. Implement the concept of Cam systems and their analysis of Forced vibration.

CO3. Apply principles of governors and gyroscopes.

CO4. Students will be equipped with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.

CO5. Develop knowledge of analytical and graphical methods for calculating balancing of rotary and reciprocating masses.

Course code	Course title	L	T	P	Credits
ME-203 C	**FLUID MECHANICS**	3	1	0	4

Course Objectives:
It imparts the basic concept; knowledge and laws of fluid flow; Fluid dynamics and kinematics and idea of estimation of various losses encountered in fluid flow PRE REQUISITES Knowledge of Thermodynamics

UNIT-1: FLUID PROPERTIES AND FLUID STATICS

Concept of fluid and flow; ideal and real fluids; Continuum concept; properties of fluids; Newtonian and non-Newtonian fluids; Pascal's Law; hydrostatic equation; hydrostatic forces on plane and curved surfaces; stability of Floating and submerged bodies; relative equilibrium; Problems

UNIT-2: FLUID KINEMATICS AND DYNAMICS

Eulerian and Lagrangian description of fluid flow; stream; streak and path lines; types of flows; flow rate and continuity equation; differential equation of Continuity; rotation; vorticity and circulation; stream and potential functions; Problems Concept of system and control volume; Euler's equation; Bernoulli's equation; venturimeter; pitot tubes; orifice meter; kinetic and momentum correction factors; Impulse momentum relationship and its applications; Problems

UNIT-3: VISCOUS FLOW

Flow regimes and Reynolds's number; Relationship between shear stress and pressure gradient; uni-directional flow between stationary and moving parallel plates; Counter flow; laminar flow through pipes

UNIT-4: FLOW THROUGH PIPES

Friction loss in pipe flow; Darcy-Weisbach formula co-efficient of friction and friction factor: Major and minor losses in pipes; hydraulic Gradient and total energy lines; series and parallel connection of pipes; branched pipes; Equivalent pipe; power transmission through pipes; Problems

UNIT-5: BOUNDARY LAYER CONCEPT

displacement; momentum and energy thickness; von-karman momentum integral equation; laminar and turbulent boundary layer flows; drag on a flat plate; boundary layer separation; Stream lined and bluff bodies; lift and drag on a cylinder and an airfoil; Problems

TEXT BOOKS

Kumar, K.L., "Engineering Fluid Mechanics", Eurasia Publication House, 2002

REFERENCE BOOKS:

1. Kumar, D. S., "Fluid Mechanics and Fluid Power Engineering", SK Kataria and Sons,1998
2. Wylie, E. B, Streeter VL; "Fluid Mechanics";McGrawHill1983
3. SomSKandBiswasG.,"IntroductiontoFluidMechanicsandFluidMachines",TataMcGrawHill, 1998
4. Bansal RK, "A Text Book of Fluid Mechanics" Laxmi Publications
5. Agrawal, S.K."Fluid Mechanics and Machinery",Tata McGraw Hill.

Course outcomes:

CO 1-Students will be able to understand basic knowledge of the definition and the fundamental concepts of fluid mechanics including continuum, velocity field, surface tension, flow visualization etc.

CO 2-Students will able to apply the basic equation of fluid statics to determine forces on planer and curved surfaces that are submerged in a static fluid.

CO 3-Students will able to use conservation laws in integral form and apply them to determine forces and moments on surfaces of various shapes and simple machines

CO 4-Students will able to use Euler's and Bernoulli's equations and the conservation of mass to determine velocities, pressures, and accelerations for incompressible and in viscid fluids

CO 5- Students will able design simple pipe systems to deliver fluids under specified conditions and also the loosed during the flow of the fluid.

Course code	Course title	L	T	P	Credits
ME- 303 C	**MANUFACTURING TECHNOLOGY**	3	0	0	3

Course Objectives:

1. To gain theoretical and practical knowledge in material casting processes and develop an understanding of the dependent and independent variables which control materials casting in a production setting.
2. Introduce students to good foundry practices and product design considerations.
3. Provide an overview of joining processes; discuss in detail the weld the welding process and the physics of welding.
4. Introduce students to different welding processes weld testing and advanced processes to be able to appreciate the practical applications of welding.

UNIT-1: SAND CASTING PROCESSES

Advantages and limitations; sand mold making procedure; patterns And core; pattern materials; pattern allowances; types of patterns; color coding; molding materials; Molding sand composition; sand preparation; sand properties and testing; sand molding processes

UNIT-2: MOULD MAKING AND INSPECTION

Types of cores; core prints ; chaplets and chills; Gating system; gates and risers; Melting practice; cupola and induction furnace; charge calculations; casting cleaning and casting defects; fettling; defects in casting and their remedies; methods of testing of casting for their soundness

UNIT-3: SPECIAL CASTING PROCESSES

Shell molding; precision investment casting; permanent mold casting; die casting; centrifugal casting; and continuous casting.

UNIT-4: PLASTICS

Classification and Properties of Plastics, Principle, Selection Operation, Advantages and Limitations of various Moulding Processes, Design Considerations for plastic moulded parts.

UNIT-5: WELDING

Classification; oxy-acetylene welding equipment sand techniques; Electric arc welding Electrodes; manual metal arc welding; inert gas shielded arc welding ;tungsten inert gas welding (TIG); metal inert gas welding (MIG); Submerged arc welding (SAW) Principle; resistance spot welding; resistance seam welding; upset welding; flash welding Other welding processes; introduction of thermit welding; electro slag welding; electron beam welding; friction welding; diffusion welding; brazing and soldering.

TEXT BOOKS

Rao PN., "Manufacturing Technology – Foundry, Forming and Welding", Tata McGraw Hill

REFERENCE BOOKS:

1. Ghosh. A. Mallik A.K., "Manufacturing Science", Affiliated East West Press, 2005
2. Sinha, K P, Goel D B., "Foundry Technology", Standard Publishing, New Delhi, 2005
Richard, L Little., "Welding and Welding Technology", Tata McGraw Hill, 2000
3. Rosenthal; "Principle of Metal Casting", Tata McGraw Hill, 2001 Raghuwanshi B S., "
Workshop Technology", VolI., Dhanpat Rai, 2004

Course outcomes:

CO1. Upon completion of this course, the students can able to apply the different manufacturing Process and use this in industry for component production.

CO2. Students can able to understand the concepts of basic manufacturing processes and fabrication techniques

CO3.The main objective of this course is to emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes and tools used.
CO4. The course is delineated particularly to understand the conventional manufacturing processes like casting, metal forming, and welding process.

Course code	Course title	L	T	P	Credits
ME-206 C	**FLUID MACHINERY**	3	1	0	4

Course Objectives: The students completing this course are expected to understand the properties of fluids, its kinematic and dynamic behavior through various laws of fluids like continuity, Euler's, Bernoulli's equations, energy and momentum equations. Further, the student shall be able to understand the theory of boundary layer, working and performance characteristics of various hydraulic machines like pumps and turbine

UNIT-1: IMPACT OF FREE JETS

Impulse– momentum principle; jet impingement-on a stationary flat plate; inclined plate and a hinged plate; at the center of a stationary vane; on a moving flat plate; inclined plate; a moving vane and a series of vanes; Jet striking tangentially at the tip of a stationary vane and moving vane(s); jet propulsion of ships Problems

UNIT-2: IMPULSE TURBINES

Classification – impulse and reaction turbines; water wheels; component parts; construction; operation and governing mechanism of a Pelton wheel; work done; effective head; available head and efficiency of a Pelton wheel; design aspects; speed ratio; flow ratio; jet ratio; number of jets; number of buckets and working proportions; Performance Characteristics; governing of impulse turbines. Problems

UNIT-3: REACTION TURBINE

Francis Turbines: Component parts; construction and operation of a Francis turbine; governing mechanism; work done by the turbine runner; working proportions and design parameters; slow; medium and fast runners; degree of reaction; inward/outward flow reaction turbines; Performance Characteristics; Problems.
Propeller and Kaplan turbines: Component parts; construction and operation of a Propeller; Kaplan turbine; differences between the Francis and Kaplan turbines; draft tube-its function and different forms; Performance Characteristics; Governing of reaction turbine;

UNIT-4: CENTRIFUGAL PUMPS

Centrifugal Pumps: Classification; velocity vector diagrams and work done; manometry efficiency; vane shape; head capacity relationship and pump losses; pressure rise in impeller; minimum starting speed; design considerations; multi-stage pumps. Similarity relations and specific speed; net positive suction head; cavitation and maximum suction lift; performance characteristics; Brief introduction to axial flow; mixed flow and submersible pumps; Problems.

UNIT-5: RECIPROCATING PUMPS

Reciprocating Pumps: Construction and operational details; discharge coefficient; volumetric efficiency and slip; work and power input; effect of acceleration and friction on indicator diagram (pressure–stroke length plot); separation; air vessels and their utility; rate of flow into or from the air vessel; maximum speed of the rotating crank; characteristic curves; centrifugal V/S reciprocating pumps; brief introduction to screw; gear; vane and radial piston pumps; Problems. **Hydraulic systems:** Function; construction and operation of Hydraulic accumulator; hydraulic intensifier; hydraulic crane; hydraulic lift and hydraulic press; Fluid coupling and Torque converter; Hydraulic ram; Problems.

TEXT BOOKS

1. Hydraulics & Fluid Mechanics– Modi & Seth; Pub.-Standard Book House; N. Delhi
2. Hydraulic Machines–Jagdish Lal; Metropolitan

REFERENCE BOOKS:

1. Fluid Mechanics and Hydraulic Machines – SS Rattan; Khanna Publishers
2.Introduction to Fluid Mechanics and Fluid Machines– SK Som and G Biswas; Tata McGraw Hill
3. Fluid Mechanics and Fluid Power Engineering– D S Kumar; SK Kataria and Sons

Course outcomes:

CO1.Students can able to Examine Single Acting &Double Acting Compressor
CO2.Students can able to understand the basic concepts of Gas power cycles
CO3. Students can able to compare various steam Turbine & Steam Nozzle
CO4. An overall idea about fluid machinery and the knowledge about the calculation of efficiency, power developed by a turbines and power required by a pump.
CO-5: Able to understand basic working principles of various hydraulic machines

Course code	Course title	L	T	P	Credits
ME-305 C	**HEAT TRANSFER**	3	1	0	4

Course Objectives:
This course imparts basic knowledge of heat transfer and the knowledge imparted will enable him to reduce or increase heat transfer in existing equipment as the need may be and be able to go for preliminary design of heat exchanger.

UNIT-1: BASICS AND LAWS

Modes of heat transfer, Steady State Heat Conduction: Boundary conditions in heat transfer; I-D heat conduction: a plane wall; long hollow cylinder; hollow sphere and composite structures; Overall htc. Conduction equation in Cartesian; polar and spherical co-ordinate systems; Initial and Boundary conditions; Critical Thickness of Insulation, Log Mean Area of Cylinder sand Spheres, Numerical

UNIT-2: STEADY STATEANDUNSTEADY STATEHEAT CONDUCTION

Introduction;1–D heat conduction with heat sources; Plane wall; hollow cylinder and sphere; Current carrying conductor ;Extended surfaces(fins);Fin effectiveness Numericals, Systems with negligible internal resistance; Transient heat conduction in plane walls; cylinders; spheres with

convective boundary Conditions; Chart solutions only; Periodic heat transfer in one dimension; Numericals

UNIT-3: CONVECTION (WITH AND WITHOUT PHASE CHANGE)

Forced convection-Thermal and hydro-dynamic boundary layers; Equation of continuity; Momentum and energy equations; some results for flow over a flat plate and flow through tube; Fluid friction and heat transfer (Colburnanalogy);Use of; Empirical relations for free convection from vertical and horizontal planes and cylinders; Numericals, Laminar film condensation on a vertical plate; Drop-wise condensation; Boiling regimes; Free convective; Nucleate and film boiling; Numericals

UNIT-4: THERMAL RADIATION

Absorptivity; Reflectivity; Transmissivity; Black body; emissive power; radiosity; laws of thermal radiation; intensity of radiation; Shape factor and its properties; Hottel's Method; Radiation exchange between black and gray surfaces; Two body; three body enclosures; Radiation shielding; Numericals

UNIT-5: HEAT EXCHANGERS

Classification; Performance variables; Analysis of a parallel and counter flow heat exchanger using LMTD and NTU; Heat exchanger effectiveness; Use of charts for multipass exchanger and Cross flow heat exchanger; Fouling factor; Compact heat exchangers; Plate heat exchangers; Heat Pipe, Numericals

TEXT BOOK

NAG, P. K., "Heat Transfer", McGraw Hill

REFERENCE BOOKS

1. Arpasi, VS., "Conduction Heat Transfer", Addison Wesley
2. Domkundwar., "Heat Transfer",
3. Holman, J. P., "Heat Transfer", Tata McGraw Hill
4. Goshdastidar, P.S., "Heat Transfer", Oxford Univ Press
5. Lienhard, J.V, J. H. Lienhard. V., " A Heat Transfer Text Book

Course outcomes:

CO-1: To develop solutions for transient heat conduction in simple geometries, without heat generation.

CO-2: Understand the fundamentals of convective heat transfer process; evaluate heat transfer coefficients for natural and forced convection; deriving and analysing momentum and energy equations in two dimensions.

CO-3: Analysis of dimensionless quantities of heat transfer.

CO-4: Upon completion of this course, the students can able to understand and apply different heat and mass transfer principles of different applications.

CO-5. Students can able to understand the various heat transfers and also the Heat exchangers.

Course code	Course title	L	T	P	Credits
ME-309 C	**DESIGN OF MACHINE ELEMENTS**	3	1	0	4

Course Objectives:
The objectives are to study characteristics of principle types of mechanical elements under variable loading and to prevent their failure under static and variable loading.

UNIT-1: DESIGN PHILOSOPHY

Design procedure, Preferred numbers; Stress-Strain Curves of various materials; Static loading; Factor of safety; Limits, Fits and Tolerances; Hole basis and shaft basis system; Types of fits; Numericals.

UNIT-2: MECHANICAL JOINTS

ISO Metric screw threads ; Bolted joints intension; Eccentrically Loaded bolted Joints in shear and under combined stresses; Design of spigot and Socket joints; Design of knuckle joints; Design-case study.

UNIT-3: WELDED AND RIVETED JOINTS (UNDER STATIC LOADING):

Introduction to Welding and Riveting; their advantages, disadvantages and applications; Types of Welded Joints; Design of various types of welded joints; eccentric loaded welded joints; Types of Rivets; caulking and fullering; Design of various types of riveted joints under different static loading conditions; eccentrically loaded riveted joints; Design- case study.

UNIT-4: DESIGN OF POWER TRANSMISSION COMPONENTS:

Belts; chains; ropes; design of belt drives; Flat and V Belt drives; condition for transmission of max. power; selection of belt; design of rope drives; design of chain drives with sprockets; Design of Power screws; Design of Screw Jack; Case Study

UNIT-5: DESIGN OF CLUTCHES AND BRAKES:

Types of clutches in use; Design of friction clutches- Disc; Multidisc; Cone and centrifugal; Torque transmitting capacity of clutches; various types of brakes; Self energizing condition of brakes; design of shoe brakes- Internal and external expanding; band brakes; thermal considerations in brake designing; design-case study common alloys.

TEXT BOOK

Bhandari, V. B., “Design of machine elements”, Tata McGraw Hill, 2nd edition, 2007

REFERENCE BOOKS:

1. Chitale, A. K, & Gupta, R. C., “Product Design and Manufacturing”, Prentice Hall of India.
2. Robert, L. Norton., “Machine Design An Integrated Approach”, Addison Wesley
3. Robert, C. Juvinall., “Fundamentals of Machine Component Design”

4. Shigley, J.E., "Mechanical Engg Design", Tata McGraw Hill 8th edition.

Course outcomes:

CO1. Gain knowledge of Steady Stresses and Variable Stresses in Machine Members.
CO2. Study characteristics of Temporary and Permanent Joints and analyze simple joints.
CO3. Upon completion of this course, the students can able to successfully design machine components
CO4. To inculcate an ability to design belt drives and selection of belt, rope and chain drives
CO5. To achieve an expertise in design of Sliding contact bearing in industrial application

Course code	Course title	L	T	P	Credits
ME 304C	**MATERIAL SCIENCE**	3	0	0	3

Course Objectives:
The course provides the knowledge on the composition; testing and applications of materials; It also provides knowledge about the structure of materials and the effect of temperature; composition and time on various metallurgical processes. The study of this course will help the students to identify and select suitable materials for various engineering applications.

UNIT-1: METALS & STRUCTURE OF MATERIALS

Ferrous Metals: Plain carbon steel; high speed steel and cast iron; Crystal structure; Crystal imperfections and their classifications; point defects; line defects; edge & screw dislocations; surface defects; volume defects & effects of imperfections on metal properties

UNIT-2: SOLID SOLUTIONS AND PHASE DIAGRAM

Solid solution and its types; importance and objectives of phase diagram; systems; phase and structural constituents; cooling curves; Gibbs's phase rule; Lever rule; Iron Carbon equilibrium diagram and TTT diagram.

UNIT-3: HEAT TREATMENT

Principles; purpose; classification of heat treatment processes; annealing; normalizing; hardening; tempering; carburizing;nitriding;cyaniding; flame and induction hardening. Allotropy of iron. Martempering and Austempering

UNIT-4: DEFORMATION OF METALS

Elastic and plastic deformation; mechanism of plastic deformation; yield point phenomena; strain ageing; work hardening; Bauschinger effect; season cracking. Recovery; re-crystallization and grain growth.

UNIT-5: CORROSION, CREEP, FATIGUE & ALLOY PROPERTIES

Phenomenon of Corrosion ; Creep concept and creep curve; mechanism of creep; creep testing and prevention against creep ; fatigue; fatigue limit; mechanism of fatigue; factors affecting fatigue; fatigue testing and SN curve. Effect of alloying elements on steel and stainless steel; Properties and applications of non ferrous metals – Aluminium; Copper and their common alloys.

TEXT BOOKS

Narula, Narula and Gupta., "Material Science", Tata McGraw Hill, 2009

REFERENCE BOOKS

1 Budinski, K. G, & Budinski MK., "Engineering Materials Properties and Selection", PMI; 2010
2 VanVlack., "Elements of Material Science and Engineering", Wesley Pub Comp 1998
3 Raghuwanshi, B. S., "Workshop Technology", VolI Dhanpat Rai & Co.

Course outcomes:	
1.	Understand the constitution of alloys and phase diagrams and Phase rules.
2.	Understand the deformation mechanisms of materials.
3.	Upon completion of this course, the students can able to apply the different materials, their processing, heat treatments in suitable application in mechanical engineering fields.

Course code	Course title	L	T	P	Credits
ME –201 C	**MANUFACTURING PROCESS**	3	0	0	3

Course Objectives:
To provide an overview of the basic production techniques and allied / supporting techniques used to produce finished products from raw materials. In addition to theory, students will be given practical training on various basic production techniques. After going through this course, the students will be in a position to understand the working of a mechanical workshop.

UNIT -I

INTRODUCTION: Basic manufacturing processes and safety in workshop. Classification of materials–their general mechanical properties and their selection

UNIT-II

CASTING PROCESSES: Sand casting process; pattern making; types of moulding sands, cores, mould making, melting and pouring of metal; Casting defects. **MACHINING PROCESSES:** Production of components involving turning; facing; taper turning; milling; shaping; planning and drilling operations.

UNIT-III

METAL FORMING PROCESSES: Sheet metal forming operations; shearing, bending, punching and blanking, forging processes as upsetting, drawing down, bending etc.

UNIT-IV

JOINING PROCESSES: Metal arc welding; gas welding; resistance welding; soldering **and mechanical fastening processes.**

UNIT-V

FITTING AND MAINTENANCE: Study of fitting tools, marking tools and measuring instruments like micrometer, vernier calipers and height gauge; introduction to some basic maintenance techniques/processes.

Course outcomes:

CO1-Select appropriate Manufacturing Processing to manufacture any component.
CO2-Interpret foundry practices like pattern making, mold making, Core making and Inspection of defects.
CO3-Differentiate various metal forming processes such as Hot and Cold Working, Rolling, Forging, Extrusion and Drawing Processes.
CO4-Classify different plastic molding processes, Extrusion of Plastic and Thermoforming.
CO5-Select appropriate Joining Processes to join Work piece.

TEXT BOOK

Raghuwanshi, B.S., "A course in Workshop Technology, Vol. I & II", Dhanpatrai & Co.

REFERENCE BOOK

Hazra &Chaudhary, "Workshop Technology Vol. I & II", Asian Book Co

Course code	Course title	L	T	P	Credits
MES-304C	**PLC for Automation**	4	0	0	4

Course Objectives:
1 To learn the basic concepts of PLC 2 Learning of ladder programming for PLC

UNIT I- INTRODUCTION:

Introduction to hardware & software in automation

Hardware identification, PLC, Parts of PLC, PLC Hardware components (I/O section, Discreate I/O module Analog I/O module,special I/O module,I/O specifications,CPU memory design.

UNIT II- PLC PROGRAMMING

Fundamentals of logics, AND,OR,NOT,XOR,NAND,NOR Boolean algebra functions,Hardware Logics verses Programmed logic.
Programming languages, Relay type instructions, Instruction Addressing Branch instruction

UNIT III- PROGRAMMING SOFTWARE
RX logics, studio 5000, TIA, GX WORKS3, Ladder programming examine if closed and examine if open modes of operation, PLC operated water filling and discharge process**.**

UNIT IV - DEVELOPING FUNDAMENTAL PLC WIRING DIAGRAMS & LADDER LOGIC PROGRAM
Smart sensors, Electromagnetic control relays, Proximity sensor, Magnetic read switch. light sensor, Ultrasonic sensor, strain /weight sensors, temp, flow , velocity & position sensors.converting relays schematics into PLC ladder programs.

UNIT V- PROGRAMMING TIMERS & COUNTERS,MECHANICAL TIMING RELAY TIMER INSTRUCTION, COUNTER INSTRUCTION,CASCADING COUNTER.

TEXT BOOK
Programmable Logic Controllor Frank D. Petrusella Tata McGraw –Hill Publication.
Introduction to programming logic controller Gary dunning.Thomson Asia pvt Ltd.

Course outcomes:	
1.	Configure the I/O for a PLC project using PLC software
2.	Restore and monitor a PLC processor file using PLC programming software. Identify the basic components of the PLC and how they function

MES-306C	**IOT for Smart Manufacturing**	**L T P**	**Cr**
		4 0 0	**4**

Course Objectives:

- To understand and have a clear vision to IOT. Data and Knowledge Management and use of Devices in IOT Technology. To build State of the Art architecture
- Application of IOT in real world, understand IOT Design Constraints and Industrial Automation. To meet the evolving IOT industry needs by addressing the challenges in Security in IOT, Integration of large scale heterogeneous network, Integration and interaction of uncertain data, and Service adaptation in the dynamic system environment.

Unit 1: Smart Manufacturing; Introduction, advantages, key characteristics, Corporate Adaption process, manufacturing challenges vs technologies. Introduction to Internet of Things IOT, Sensing, Actuation, Machine to Machine Communication (M2M), Industrial Internet of Things (IIOT)

Unit-2: Sensors and Data Acquisition for IOT, Wireless Sensors and Transducers, Signal Conditioning Circuits, Data Acquisition Systems, Analog-to-Digital Converter (ADC) and –Digital-to-Analog Converter (DACs), Microcontrollers Interfaces for Data Communication

Unit -3: Sensors interfacing, Actuators interfacing, Communication Protocol study for IOT: UART Communication, RS485 Communication, I2C Protocol, Introduction to Arduino, Integration of Sensors and Actuators with Arduino, Fundamental of IoT Development with ThingWorkx

Unit -4: Case study & advanced IOT Applications: Case Study: Agriculture, Healthcare, Activity Monitoring Sensors, Smart Environment Sensors, Smart Industrial Sensors, Smart Water Sensors, Smart Home Automation, Smart Security Solutions

Unit- 5: Implementation of Real Time IOT Based Projects

Textbook & Reference Books:

[1] Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, ―From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence‖, 1st Edition, Academic Press, 2014.
[2] Vijay Madisetti and ArshdeepBahga, ―Internet of Things (A Hands-on-Approach)‖, 1stEdition, VPT, 2014.
[3] Francis daCosta, ―Rethinking the Internet of Things: A Scalable Approach to Connecting Everything‖, 1st Edition, Apress Publications, 2013
[4] https://nptel.ac.in/courses/106105166/
[5] https://www.ptcu.com/enrollment/student/fundamentals-of-iot-development-with-thingworx

Course outcome:

CO1. Students are encouraged to do Real Time Projects related to IOT based on above Course Learning and Understanding.
CO2. The students will be thorough about the technology behind the IOT and associated technologies.
CO3.The students will be able to use the IOT technologies in practical domains of society.
CO4.The students will be able to gain knowledge about the state of the art methodologies in IOT application domains.
CO5. Energy Efficiency and Cost Savings with IOT

MES-308C	Python for Automation	L-T-P	Credit
		4-0-0	4

OBJECTIVE

To build programming logic and thereby developing skills in problem solving using Python programming language.

UNIT 1: Introduction to Python: Structure of a Python Program, Elements of Python. Python Interpreter, Using Python as calculator, Python shell, Indentation. Atoms,

UNIT 2: Overview of Python Programming: Identifiers and keywords, Literals, Strings, Operators; Arithmetic Operator, Relational operator, Logical or Boolean operator, Assignment, Operator, Ternary operator, Bit wise operator, Increment or Decrement operator.

UNIT 3: Creating Python Programs: Input and Output Statements, Control Statements; Looping- while Loop, for Loop, Loop Control, Conditional Statement-if...else, Difference between break, continue and pass.

UNIT4: Structures & Functions: Numbers, Strings, Lists, Tuples, Dictionary, Date & Time, Modules, Defining Functions, Exit function, default arguments.

UNIT 5: Classes, Object-oriented Programming and Exception: Abstract Data Types and Classes, Inheritance, Encapsulation and information hiding, Handling exceptions

Reference Books;

1. Numerical Python by Robert Johansson, published by Apress
2. Python Data Analysis by Fabio Nelli, published by Apress
3. Introduction to Computation and Programming Using Python by John V Guttag, published by Prentice Hall of India

Websites for references;

1. Scientific Computing using Python; NUMPY, SCIPY, PANDAS, SCIKIT-LEARN
2. Python Tutorial/Documentation www.python.org. 2010
3. http://docs.python.org/3/tutorial/index.html

a) Account class and call different method to test the class

Course outcome

CO1. Explain basic principles of Python programming language

CO2. Implement object oriented concepts,

CO3. Implement database and GUI applications.

CO4. Students will be able to develop the skill of designing Graphical user Interfaces in Python

CO5. To develop the ability to write database applications in Python

MES-310C	Industry 4.0	L-T-P	Credit
		3-0-0	3

Learning Objectives

This course is designed to offer learners an introduction to Industry 4.0, its applications in the business world. Learners will gain deep insights into how smartness is being harnessed from data and appreciate what needs to be done in order to overcome some of the challenges.

Module 1: Introduction to Industry 4.0

The various Industrial Revolutions, Internet of Things (IoT) & Industrial Internet of Things, Overview on Technologies of Industry 4.0. Comparison of Industry 4.0 Factory and Today's Factory

Module 2: Drivers and Enablers

Drivers, Enablers, Reference Architecture and Standards

Module 3: Convergence of Automation & IoT

Smart Manufacturing**;** key characteristics, challenges, stages. Smart Machines; Characteristics, Technologies, interfaces, augmented reality. Cyber physical system (CPS). **IIoT;** smart factory connectivity, key ingredients, Digital Twins, Predictive Maintenance

Module 4: Data Exchange With Machines

Communication Protocols; OPC-UA, MQTT, Ethernet/IP, ProfiiNet, EtherCat IT infrastructure, databases, Cloud Computing Basics, Cloud Computing and Industry 4.0

Module 5: Smart Manufacturing Applications and Opportunities

Internet of things & Internet of Services, Smart Manufacturing, Smart Devices and Products, Smart Logistics, Smart Cities, Predictive Analytics. Opportunities, Challenges, and skills for workers in the Industry 4.0, Supply Chain Management, Readiness of Industry.

Course Outcomes

1. Understand the journey of Industry 4.0 and its drivers, enablers and roadmap.
2. Appreciate the smartness in smart factories, smart manufacturing, smart products, smart services and smart cities,
3. Able to understand various technologies associated with industry 4.0.
4. Understand the opportunities, challenges and future skills required for Industry 4.0.
5. Appreciate the power of Cloud Computing in a networked economy

Reference Books;

1 The Fourth Industrial Revolution by Klaus Schwab

2 The Industries of Future by Alec Ross

3. A course on "industry 4.0: How to Revolutnize your business" on edx

Course code	Course title	L	T	P	Credits
MER- 403 B	**INDUSTRIAL ROBOTS**	4	0	0	4

Course Objectives:
To impart knowledge on numerical methods to find the numerical solution of the problems that arise in engineering and technology. To familiarize the advanced mathematical methods to solve engineering research problems.

UNIT – I

Introduction: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance,robot activation and feedback components.

UNIT – II Motion Analysis and Control: Manipulator kinematics, position representation, robot dynamics, configuration of robot controller, Positions sensors, velocity sensors, actuators sensors, power transmission system.

UNIT – III

End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

UNIT – IV:

Robot Programming: Lead through programming, Robot programming as a path in space, Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations. Robot Languages: Textual robot Languages, Generation, Robot language structures, Elements in function

UNIT – V

Collaborative Robots, Need of COBOTS, Difference between COBOTS and traditional industrial robots, Automation solutions with collaborative Robots.

Robot Application: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application

TEXT BOOKS

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Introduction to Robotic Mechanics and Control by JJ Craig, Pearson, 3rd edition.
3. Robotics / Fu K S/ McGraw Hill.
4. Robotic Engineering / Richard D. Klafter, Prentice Hall
5. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.

Reference Books:

1. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH3
3. Industrial Automation and robotics, Er. A.K. Gupta and S.K. Arora, University Science

Course outcomes:	
1.	Acquire more knowledge in basic concept of engineering mathematics.
2.	Improvement in problem evaluation technique.
3	Choose an appropriate method to solve a practical problem
4	Upon completion of this course, the students can able to apply the basic engineering
5	To learn about application of robot

MES 403B	SMART MANUFACTURING SYSTEMS	L T P	Cr
		4 0 0	4

Course Objectives:

- To understand the basics of smart manufacturing systems in context of Industry 4.0
- To understand the Architecture of Cyber- Physical system (CPS)
- Overall brief description of some associated technologies of smart manufacturing systems
- To understand IoT connectivity for Industry 4.0

Unit-I

Concepts of Smart Manufacturing: Definition and key characteristics of smart manufacturing**,** **C**orporate adaptation processes, manufacturing challenges, challenges vs technologies, Stages in smart manufacturing. Minimizing Six big losses in manufacturing with Industry 4.0, and their benefits

Unit-II

Smart Machines and Smart Sensors: Concept and Functions of a Smart, Machine Salient features and Critical Subsystems of a Smart Machine, **Smart sensors;** smart sensors ecosystem, need, benefits and applications of sensors in industry, Sensing for Manufacturing Process in IIoT, Block Diagram of a IoT Sensing Device, Sensors in IIoT Applications, Smart Machine Interfaces

Unit-III

Architecture of Cyber- Physical system (CPS): Functions of CPS, 5C Architecture; Smart Connection Level, Data-to- Information Level, Cyber Level, Cognition Level, Configuration Level. Design of PHM based CPS systems. Comparison of today's factory and Industry 4.0 factory by the implementation of 5C CPS architecture

Unit-IV

Digital Twin: Introduction, applications of digital twins, impact zones of digital twins in manufacturing (factories/plants and OEMs), advantages of digital twins, basic steps of digital twin technology

Machine Learning (ML) and Artificial Intelligence (AI) in Manufacturing: Introduction, benefits and applications of ML in industries, common approaches of ML; supervised and unsupervised, semi-supervised and reinforced ML

Predictive Maintenance: Introduction of predictive maintenance, difference between preventive and predictive maintenance, working and various components of predictive maintenance, benefits and tools of predictive maintenance. Common approaches to IoT predictive maintenance; Rule-based (condition monitoring) and AI (artificial intelligence) based predictive maintenance.

Condition Monitoring (CM): Introduction and benefits of CM, CM techniques, Condition monitoring vs Condition assessment,

Augmented Reality in Maintenance (Electrical & Mechanical)

Unit-V

IoT connectivity for Industry 4.0: Industrial communication requirement and its infrastructure, an overview of different types of networks, mesh network in industrial IoT, IoT protocols and the internet, TCP/IP (transmission control protocol/internet protocol) model, IoT connectivity standards: common protocols, application layer protocols, internet/network layer protocols, physical layer IoT protocols, choosing the right IoT connectivity protocol

Reference Books

1. Industry 4.0 the Industrial Internet of Things by Alasdair Gilchrist, Apress

2. Industrial Internet of Things, Cyber Manufacturing System by Sabina Jeschke, Christian Brecher, Houbing Song Danda B. Rawat, Springer

Course Outcomes:

On successful completion of this course, the students should be able to:

- Have a knowledge of smart manufacturing systems' components and can handle it more effectively.in context of Industry 4.0
- After understanding the Architecture of Cyber- Physical system (CPS) they can make machines more oriented towards Industry 4.0, which increases productivity
- Overall brief description of associated technologies of smart manufacturing systems enhance their workability knowledge in the industries

- After understanding IoT connectivity for Industry 4.0 they are able to make a system Taylor made as per requirement of the industry

Eventually knowledge of smart manufacturing systems enhances their employability opportunities as a whole.

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Course Code	Course title	L	T	P	Credits
MES-405B	**ADDITIVE MANUFACTURING**	**4**	**0**	**0**	**4**

Course Objectives	
1.	Additive Manufacturing (AM) is an economically viable alternative to conventional manufacturing technologies for producing highly complex parts.
2.	The objective of the course is to impart fundamentals of additive manufacturing processes along with the various file formats, software tools, processes, techniques and applications.
3.	The main objective of this course is to acquaint students with the concept of AM, various AM technologies, selection of materials for AM, modeling of AM processes, and their applications in various fields.

UNIT-1: INTRODUCTION OF AM

Introduction to the Basic Principles of Additive Manufacturing, Additive Manufacturing Processes, Extrusion, Beam Deposition.

UNIT-2: OPERATIONS IN AM

Jetting, Sheet Lamination, Direct-Write, Photo-polymerization, Sintering, Powder Bed Fusion

UNIT-3: DESIGN/FABRICATION PROCESSES

Data Sources, Software Tools, File Formats, Model Repair and Validation, Pre- & Post-processing, Designing for Additive Manufacturing, Multiple Materials, Hybrids, Composite Materials, current and future directions.

UNIT-4: PROCESS AND MATERIAL

Process & Material Selection, Direct Digital Manufacturing and Distributed Manufacturing, Related Technologies: Mold-making, Rapid Tooling, Scanning.

UNIT-5: APPLICATIONS OF AM

Aerospace, Automotive, Biomedical Applications of AM. Product Development, Commercialization, Trends and Future Directions in Additive Manufacturing.

TEXT BOOKS:

1. Ian Gibson, David W. Rosen and Brent Stucker, Additive manufacturing technologies: rapid prototyping to direct digital manufacturing, Springer, 2010.
2. C.K. Chua, K.F. Leong and C.S. Lim, Rapid prototyping: Principles and applications, 3rd Edition, World Scientific, 2010.

REFERENCE BOOKS:

1. Hopkinson, Hague, Dickens, Rapid Manufacturing: An Industrial Revolution for the Digital Age. Wiley, 2005.
2. Gibson, Advanced Manufacturing Technologies for Medical Applications. Wiley, 2005
3. Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011.
4. J.D. Majumdar and I. Manna, Laser-assisted fabrication of materials, Springer Series in Material Science, 2013.
5. L. Lu, J. Fuh and Y. S. Wong, Laser-induced materials and processes for rapid prototyping, Kluwer Academic Press, 2001.
6. Zhiqiang Fan and Frank Liou, Numerical modeling of the additive manufacturing (AM) processes of titanium alloy, lnTech, 2012.

Course Outcomes:	
1.	Students will be able to decide between the various trade-offs when selecting AM processes, devices and materials to suit particular engineering requirements.
2.	Students will have in-depth knowledge in latest trends and opportunities in AM, including distributed and direct digital manufacturing, mass customization, and how to commercialize their ideas.
3	Students will demonstrate a basic technical understanding of the physical principles, materials, and operation of the types of AM processes
4	Students will demonstrate the ability to identify characteristics of parts that are fabricated by AM processes
5	Explain the processes used in additive manufacturing

Course code	Course title	L	T	P	Credits
MES- 407 B	**Smart Sensors for Automation**	4	0	0	4

Course Objectives:
.To makes students familiar with the constructions and working principle of different types of sen sors. •To make students aware about the measuring instruments and the methods of measurement and the use of different sensors in automation.

Unit-I

Introduction: Definition and characteristics of sensors, static characteristics, dynamic characteristics, sensor classification, Definition of actuator, classification of actuators, electro-hydrostatic actuation, electro-pneumatic systems

Unit-II

Next Generation Sensors: Need for Next Generation Sensors, Definition, Limitations of smart sensors, intelligent sensors, advantages of intelligent sensors, applications of next generation sensors, design challenges

Unit-III

Smart sensors: Definition, configurations involved in smart sensors, smart sensor node, and Smart sensors functions, accessing sensors and actuators, utility in industrial subunits, Examples of industrial sensors: navigation industry, agricultural industries, healthcare industry, retail industry

Unit-IV

Smart sensors in industrial automation: temperature sensor, accelerometer sensor, gas sensor and their interfacing circuit, sensors in industrial applications: magnetostrictive sensors, torque sensor, speed sensor, PIR sensor, image sensor,

Unit-V

Measurement of proximity, pressure, velocity and displacement: proximity sensors, pressure sensor/flow sensors, ultrasonic sensor, photoelectric sensors, photomicro sensors, industrial applications and control

TEXT BOOKS

1. Sensor & transducers, D. Patranabis, 2nd edition, PHI

Reference Books:

2. Instrument transducers, H.K.P. Neubert, Oxford University press.
3. Measurement systems: application & design, E.A.Doebelin, Mc Graw Hill

Course outcomes:	
1.	Use concepts in common methods for converting a physical parameter into an electrical quantity
2.	Classify and explain with examples of transducers, including those for measurement of temperature, motion and gas
3	Choose proper sensor comparing different standards and guidelines to make sensitive measurements of physical parameters like pressure, flow, acceleration, etc

Course code	Course title	L	T	P	Credits
AE-302 C	**Introduction to Electric Vehicle Technology**	3	1	0	4

Course Objectives:
The purpose of this course is to Acquaint the students in the basic technical aspects component

and anatomy of automobile.

UNIT-1: I.C ENGINES (INTRODUCTION) AND. ENGINE COMPONENT

Working and difference between SI and CI Engines; Two and four stroke cycles; Theoretical heat cycles : idea and actual otto and diesel cycle, mixed cycle; Numerical; Working of two and four stroke SI and CI engines; Scavenging methods of two-stroke petrol engines; Comparison of two and four stroke cycle engines.; Auto engines classifications – arrangement of cylinders, valves and camshaft ;Types of fuels used, engine speed, methods of cooling, engine balance; Principle of combustion, detonation and pre-ignition– Differences.; Valve timing diagrams – SI and CI, two and four stroke engines. Cylinder block : Types; Crankcase, liners : wet and dry; Gaskets,Timing covers, oil pan, cylinder head; SI engines combustion chambers : types and comparison; CI engine combustion chambers : Direct and Indirect injection, Intake & exhaust ports; lubricating passages; Intake & Exhaust valves and mechanisms; Camshafts: Side & overhead, advantages and disadvantages; Valve seat and conical angles, Valve seat insert, Valve springs, locks, Rocker-shaft, rocker arm, push rod, Cam followers-types; Timing of valves; Intake and exhaust manifold; Mufflers-types; Crankshaft: Nomenclature; Flywheel-functions; Oil seals; Engine Bearings : Thrust, ball, taper roller, needle, split, journal; Bearing materials, properties; Connecting rod; Piston : function, types, materials, piston rings: types, design details, Piston Pins, Component material chart : All engine components.

UNIT-2: ENGINE PERFORMANCE

Bore and stroke, swept and clearance volume, compression ratio, effect of C.R, engine torque, mean effective, bmep, bhp, Ihp, fhp; Engine efficiencies – air standard, mechanical, thermal, indicated thermal, brake thermal, volumetric, requirements of high volumetric efficiency, Factors.; Specific fuel consumption; Numerical.

UNIT-3: CHASSIS AND BODY

Types – unitized and separate body and chassis, Advantages, Designs: chassis frame; Chassis side and cross member, sections and joints; Body: requirements, main parts, Material composition, Body shape aerodynamic design, CD for different types of vehicles; Vehicle component's attachments, Front and Rear wheel drive component locations: advantages and disadvantages; Rear mounted engine and rear wheel drive : advantages; Definitions : wheel base, wheel track, minimum radius, front and rear overhang, ground clearance, gradeability, laden and unladen weight; Car seat and seat belt mounting and adjustment.

UNIT-4: CLUTCH SYSTEM GEAR BOX, PROPELLER SHAFT AND DIFFERENTIAL

Principle, requirements, operation, components of conventional single plate clutch, diaphragm clutch, multiple plate wet clutch, centrifugal clutch; Fluid coupling-characteristics,principle, velocity diagrams, efficiency and torque capacity curves; Comparison of conventional and diaphragm clutch and fluid coupling. Clutch operating systems: rod, cable, hydraulic; Clutch Plate: requirements, construction, material, linings : required properties, types; Numerical; Clutch faults and diagnosis, Clutch pedal free play. Necessity of gearbox, types of gear wheels, function, construction and working details of sliding mesh, constant mesh, synchromesh and epicyclic gearbox: application and advantages; Overdrive, torque converter: principle and performance curves; Automatic gearbox; Gear selector mechanisms, synchronizing rings : materials and construction; Continuously variable transmission (CVT); Numericals. Gear box lubrication : Grade of oil, topping : unprocedure, leakage

prevention : static and dynamic seals; Final drive :Hotch Kiss and Torque tube; Propeller shaft : requirement, construction, maintenance, critical speed vibration, double propeller shaft, Maruti half shafts; Universal Joints : types, rubber doughnut, hookes, constant velocity (Birfield), speed variation of hookes coupling, coupling with driven shaft; Numericals; Differential : requirements, principle, construction and working; Bevel gears, hypoid gear, worm and warm wheel, Differential lock, limited slip differential, double reduction. Numericals

UNIT-5: REAR AXLES AND TYRES

Axle Casing, types, rear axle shafts – stresses and load taken, semi floating, ¾ floating and fully floating; Compartitive data : axles; Automobile wheel : loads, torques and stresses, types of wheels, requirements, specifications; Types of rims, Advantages of smaller wheels; Requirement of tyres. Types : conventional, radial and tubeless, Inner tubes; Merits of tubeless tyres over pneumatic tyres; Pneumatic tyres: constructional details: plies, tread designs, characteristics, aspect ratio, inflation pressure : comfort, braking, cornering, cost, fuel consumption, tyre materials; Tyre specifications; Points to increase tyre life : load, vehicle handling, speed, wheel balancing, tyre rotation, wheel alignment Procedure: Tyre retreading.

TEXT BOOK

Crouse, W.H, "Automobile Technology", Tata Mc Graw Hill

REFERENCE BOOKS

Sethi, H. M, "Automotive Technology", Tata McGraw Hill, 2003

Gupta R. B, "Automobile Engineering", Dhanpat Rai & Sons, 1998

Course outcomes:	
1.	Upon successful completion of this course, students will acquire the skills to apply the basics of components and anatomy analyze the automobile.

Course code	Course title	L	T	P	Credits
AE-403C	**AUTOMOTIVE ELECTRICAL & CONTROLS**	3	0	0	3

Course Objectives:
In an automobile the electrical systems are important. It has number of subsystems like starting, charging system etc. Most of the control systems are being converted from mechanical to electronics. The components and systems are described.

UNIT-1: BATTERIES AND ACCESSORIES

Principle and construction of lead acid battery, characteristics of battery, rating capacity and efficiency of batteries various tests on batteries, maintenance and charging. Lighting system: insulated and earth return system, details of head light and side light, LED lighting system, head light dazzling and preventive methods – Horn and wiper system.

UNIT-2: STARTING SYSTEM

Condition at starting, behavior of starter during starting, series motor and its characteristics, principle and construction of starter motor, working of different starter drive units, care and maintenance of starter motor, starter switches, spark plug, magneto.

UNIT-3: CHARGING SYSTEM

Simple generator, automobile generator, armature reaction, third brush regulation, cutout, voltage and current regulators, compensated voltage regulator, alternators principle and constructional aspects and bridge rectifiers.

UNIT-4: FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS

Current trends in automotive electronic engine management system, electromagnetic interference suppression, electromagnetic compatibility, electronic dashboard instruments, onboard diagnostic system, security and warning system.

UNIT-5: SENSORS AND ACTIVATORS

Types of sensors: Sensor for speed, throttled position, exhaust oxygen level, manifold pressure, crankshaft position, coolant temperature, exhaust temperature, air mass flow for engine application. Solenoids, stepper motors relay. Introduction to Microprocessor & Applications in Automobiles.

TEXT BOOK

Kohli, P. L., “Automotive Electrical Equipment”, Tata McGraw-Hill.

REFERENCE BOOKS

1. Young A.P. & Griffiths. L. “Automotive Electrical Equipment”, ELBS & New Press - 1999.
2. William B. Riddens “Understanding Automotive Electronics”, 5th edition – Butter worth Heinemann Woburn, 1998.
3. Bechhold “Understanding Automotive Electronics”, SAE, 1998.
4. Crouse, W.H “Automobile Electrical Equipment”, McGraw-Hill Book Co., Inc., New York, 3rd edition, 1986.

Course outcomes:	
1.	The student will have to know about all theoretical information and about electrical

	components used in a vehicle.
2.	Students can gain Knowledge in vehicle electrical and electronics components for engine operation
3.	Students have gained knowledge of revsor and microprocessor applications in vehicle control systems.

Course code	Course title	L	T	P	Credits
AE-304 C	**DESIGN OF AUTO COMPONENTS**	3	1	0	4

Course Objectives:
At the end the course the student will be able to understand the fundamental principles involved in design of components of automotive chassis; the complete design exercise and arrive at important dimensions of chassis components.

UNIT-1: INTRODUCTION

Variable Loading: Different type of fluctuating/ variable stresses; fatigue strength considering stress concentration; factor; surface factor; size factor; reliability factor etc.; Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's criterion; fatigue design using Miner's equation; problems.

UNIT-2: SHAFTS AND SPRINGS

Detailed design of shafts for static and dynamic loading; Rigidity and deflection consideration. Type of springs; design for helical springs against tension and their uses; compression and fluctuating loads; design of leaf springs; surging phenomenon in springs; design problem.

UNIT-3: BEARINGS

Selection of ball and roller bearing based on static and dynamic load carrying capacity using load life relationship; selection of bearings from manufacturer's catalogue; type of lubrication: boundary; mixed and hydrodynamic lubrication; design of journal bearings using Raimondi and Boyd's charts; design of pivot and collar bearing; lubricants and their properties; selection of suitable lubricants; design problems.

UNIT-4: SPUR AND HELICAL GEARS

Force analysis; selection of material for gears; beam and wear strength of gear tooth; form or Lewis factor for gear tooth; dynamic load on gear teeth: Barth equation and Buckingham equation and their comparison; gear lubrication; design problems.

UNIT-5: DESIGN OF CYLINDER; PISTON; CONNECTING ROD AND FLYWHEEL

Choice of material for cylinder and piston; piston friction; piston slap; design of cylinder; piston; piston pin; piston rings; piston failures; lubrication of piston assembly; material for connecting rod; determining minimum length of connecting rod; small end and big end design; shank design; design of big end cap bolts; connecting rod failures; design of flywheel.

TEXT BOOK

"Design Data Book", PSG College of Technology, Coimbatore, 2000.

REFERENCE BOOKS

1. Heldt, P. M., "High Speed Combustion Engines", Oxford-IBH Publishing Co., 1965.
2. Heywood, B., "Internal Combustion Engine Fundamentals", McGraw Hill 1988.
3. Newton Steeds and Garret., "Motor Vehicle", Illiffe Books Ltd., London; 2000.
4. Joseph Edward., "Mechanical Engg. Design"., McGraw Hill.
5. Norton, R. L., "Machine Design – An Integrated

Course outcomes:	
1.	Can Gain knowledge of Steady Stresses and Variable Stresses in Machine Members.
2.	Study characteristics of Temporary and Permanent Joints and analyze simple joints.
3.	Upon completion of this course, the students can able to successfully design machine components

Course code	Course title	L	T	P	Credits
AE-401C	**AUTOMOBILE MAINTENANCE & SERVICES**	3	0	0	3

Course Objectives:
To know about the various methods of maintaining vehicles and their subsystems.

UNIT-1: INTRODUCTION

Maintenance Objectives; Importance; training and safety; classification :preventive; running and breakdown; preventive maintenance concept; functions; benefits and limitations; service training handbook;maintenance schedules; workshop manuals; owner's manual; Job card; history card; Warranty Procedures; pre-delivery inspection (PDI): front manager; service advisor : functions and duties.

UNIT-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.

UNIT-3: VEHICLE MAINTENANCE TOOLS AND EQUIPMENTS AND MAINTENANCE SCHEDULE

Figs and Specifications of standard tools; non Standard tools; denting tools; painting equipments; testing equipments; Service station equipments; 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. Difference between chassis and ball bearing grease; graphite grease; molybdenum 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; tyres; Cooling and lubrication system; Specification of one petrol and one diesel Engine; Engine Troubles and Diagnosis.

UNIT-4: ENGINE TUNING

Procedure for carburetor based S.I Engine tuning; use of compression gauge; vacuum gauge; engine analyzer; exhaust analyzer; battery tester S.G tester; adjustment of spark plugs electrodes; Cam-dwell angle; valve tappet clearance; CB point; carburettor cleaning; air filter cleaning; replacement of engine oil and filter; ignition timing setting by timing light; tightening head bolts. Tyre inflation pressure; checking fuel consumption; MPFI and CRDI Engines: Study of tools needed to service the system: 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. Study of important components : name; location and functions : 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.

UNIT-5: CLUTCH; DRIVE LINE; SUSPENSION; STEERING AND BRAKES AND ENGINE

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 Mc-Phearson strut); Drum and disc Brakes; bleeding of brakes ; Gaps and Clearances. Tyre maintenance and wheel balancing; service limits and wheel alignment. Procedure for engine removal from vehicle; disassembly; cleaning of parts; cleaning procedures; agents; method of decarburizing; Top overhauling; Visual inspection of component parts; inspection by measurement; preparation of engine inspection sheets: engine; crankshaft main and big end journals; connecting rod bearing and parents bores; camshaft journal and parent bores; service limits; machining of component parts : boring and honing of cylinder bores; cylinder head; crankshaft; connecting rod; big-end Journals; 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.

TEXT BOOK

Shrivastava, Sushil Kumar., “Industrial Maintenance Management”, S Chand & Company Ltd., 2005

REFERENCE BOOKS

1. Kohli, P.L., “Automotive Chassis and Body”,McGraw Hill.
2. Maruti Suzuki Manuals

Course outcomes:	
1.	Upon the completion of the course, the student can able to understand the importance of maintenance and also the step by step procedure for maintain the various automotive sub systems
2.	Students will have the knowledge about condition based maintenance.
3.	Upon the completion of the course, the student can able to understand the importance of Engine tuning.

(VIII SEMESTER)

Course code	Course title	L	T	P	Credits
ME-406C	**INTERNSHIP**	0	0	32	16

Course code	Course title	L	T	P	Credits
ME-402C	**Online Mode -MOOC**	3	0	0	3