Bharati Vidyapeeth
(Deemed to be University), Pune, India
College of Engineering, Pune
Department of Mechanical Engineering

Vision of the Department

To develop high quality Mechanical Engineers through dynamic education to meet social and global challenges

Mission of the Department

- To provide extensive theoretical & practical knowledge to the students with well-equipped laboratories & ICT tools through motivated faculty members
- To inculcate aptitude for research, innovation and entrepreneurial qualities in students
- To acquaint students with ethical, social and professional responsibilities to adapt to the demands of working environment.

Name of Programme: B. Tech. Mechanical Engineering

Programme Educational Objectives (PEOs)

- To fulfill need of industry and society with theoretical & practical knowledge
- To perform research, innovation, lifelong learning and continued professional development
- To fulfill professional ethics and social responsibilities

Programme Outcomes (POs)

The graduates will be able to

a. apply knowledge of mathematics, science and engineering fundamentals for solving complex engineering problems

b. identify the need, plan and conduct experiments, analyze data for improving the mechanical processes.

c. design and develop mechanical systems considering social and environmental constraints.

d. design and develop a complex mechanical system using research based knowledge, advanced mathematical, statistical tools and techniques.

e. use information technology (IT) tools for prediction and modeling of routine activities to enhance the work performance.

f. know social responsibilities while doing professional engineering practices.

g. familiarize with eco-friendly, sustainable and safe working environment.

h. take into account professional ethics while designing engineering systems.

i. work efficiently as a group leader as well as an individual.

j. communicate in written and verbal form with subordinates and supervisors.

k. apply project and finance management techniques in multidisciplinary environments.

l. take interest in higher education and update the knowledge.

Programme Specific Outcomes (PSOs)

- Apply the knowledge of thermal, design, manufacturing engineering and computational sciences to solve Mechanical Engineering problems.
- Apply Mechanical Engineering principles for research, innovation and develop entrepreneurial skills.
- Apply concepts of Mechanical Engineering to assess societal, environmental, health, safety issues with professional ethics.

B. Tech. Mechanical Sem.-III

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	UE	IA	TW	TW & OR	TW & PR	Total	L	P TW/OR/PR	T	Total
1		Thermodynamics-Principles	4	2	-	60	40	-	50	-	150	4	1	-	5
2		Mechanisms of Machines*	4	2	-	60	40	-	50	-	150	4	1	-	5
3		Mechanics of Fluids	4	2	-	60	40	-	-	50	150	4	1	-	5
4		Manufacturing Technology[@]	3	-	-	60	40	-	-	-	100	3	-	-	3
5		Strength of Machine Components	3	2	1	60	40	25#	-	-	125	3	1	1	5
6		Manufacturing Technology Laboratory	-	2	-	-	-	25#	-	-	25	-	1	-	1
7		Python Programming-I	-	4	-	-	-	-	-	50	50	-	2	-	2
8		Vocational Course-I [$] (Automobile Servicing-I)	-	-	-	-	-	-	50	-	50	-	2	-	2
9		MOOC-I	-	-	-	-	-	-	-	-	-	-	-	-	2
10		Environmental Studies (Mandatory Course)[+]	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total		**18**	**14**	**1**	**300**	**200**	**50**	**150**	**100**	**800**	**18**	**9**	**1**	**30**

*End Sem. Examination of 4 Hrs; [@]Industry Taught Course-I; $ To be conducted in service centre after office hours: 4 hrs/week; + End sem. Exam. of 100 marks

B. Tech. Mechanical Sem.-IV

Sr. No.	Course Code	Name of Course	Teaching Scheme (Hrs./Week)			Examination Scheme (Marks)						Credits			
			L	P	T	UE	IA	TW	TW & OR	TW & PR	Total	L	P TW/OR/PR	T	Total
1		Thermodynamics-Applications	4	2	-	60	40	-	50	-	150	4	1	-	5
2		Machine Design & Analysis-I*	4	2	-	60	40	-	50	-	150	4	1	-	5
3		Science of Engineering Materials	4	-	-	60	40	-	-	-	100	4	-	-	4
4		Entrepreneurship Development Skills[@]	3	-	-	60	40	-	-	-	100	3	-	-	3
5		Theory of Machines	3	2	1	60	40	-	50	-	150	3	1	1	5
6		Solid Modelling	-	4	-	-	-	-	-	50	50	-	2	-	2
7		Python Programming-II	-	4	-	-	-	-	-	50	50	-	2	-	2
8		Vocational Course-II[$] (Automobile Servicing-II)	-	-	-			-	50	-	50	-	2		2
9		Social Activities-I	-	-	-			-	-	-	-	-	-		2
10		Disaster Management (Mandatory Course)[+]	-	-	-			-	-	-	-	-	-		-
	Total		**18**	**14**	**1**	**300**	**200**	**-**	**200**	**100**	**800**	**18**	**9**	**1**	**30**

*End Sem. Examination of 4 Hrs; [@]Industry Taught Course-I; $ To be conducted in service centre after office hours: 4 hrs/week; + End sem. Exam. of 100 marks

Designation of Course	**Thermodynamics Principles**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hours/ Week	End Semester Examination	60 Marks	04
Practical: - 02 Hours/ Week	Internal Assessment	40 Marks	
	Term Work and Oral	50 Marks	01
	Total	**150 Marks**	**05**

Course Prerequisites:	1. Engineering Mathematics. 2. Engineering Physics.
Course Objectives: -	To provide knowledge about 1. Laws of thermodynamics & their applications. 2. Properties of pure substances & vapor processes. 3. Fuels and concepts of combustion.
Course Outcomes: -	On completion of the course, students will be able to– 1. **Understand** concepts of first law of thermodynamic and its application. 2. **Understand** concepts second law of thermodynamics, entropy and availability. 3. **Apply** the knowledge of Properties of steam for different vapor Processes. 4. **Apply** the knowledge of properties of steam for different power cycles. 5. **Understand** the different air standard cycles and **analyze** it. 6. **Understand** the different type of fuels, concepts of combustion and analyze exhaust gas composition.

Course Contents

Unit-I	**First Law of Thermodynamics**	**(08 Hrs.)**

Introduction of thermodynamics, Review of basic definitions, (State, Process, Cycle, Path, Quasi- static process, path fiction and point function, Equilibrium), energy and work transfer, zeroth law of thermodynamics, statement of first law of thermodynamics, Joule's experiment, Limitations of first law of thermodynamics.

Reversibility and Irreversibility, Applications of first law to flow and non-flow processes and cycles. Steady flow energy equation and its application to different devices (Boiler, Diffuser, Turbine, Compressor, Condenser, throttling process), PMM-I.

Unit-II	**Second Law of Thermodynamics, Entropy and Availability**	**(08 Hrs.)**

Heat engine, refrigerator and heat pump, Kelvin-Planck's statement & Clausius statement, equivalence of Kelvin-Planck's and Clausius statements, perpetual motion machine of second kind (PMM-II), Carnot cycle & Carnot heat engine.

Entropy: Clausius Theorem, Entropy as a property, second law analysis for entropy, Clausius inequality, principle of increase of entropy, irreversibility, Temperature – Entropy relation, Third law of thermodynamics.

Availability: High- and low-grade energy, available and unavailable energy, loss of available energy due to heat transfer through a finite temperature difference.

Unit-III	**Properties of Pure Substances and Vapor Processes**	**(08 Hrs.)**

Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-v, T-s and Mollier diagram for steam, use of P-V, T-S, H-S diagrams for Pure substance, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling, and combined).

Non flow and steady flow vapor processes, constant Pressure Process, constant volume Process, constant temperature Process, Isentropic Process, Polytrophic Process, Hyperbolic Process, work transfer & heat transfer.

Unit-IV	Vapor Power Cycles	(08 Hrs.)
Carnot cycle, Rankine cycle, Comparison of Carnot cycle and Rankine cycle, Efficiency of Rankine cycle, Relative efficiency, Performance parameters of vapor power cycle, Effect of operating variables on Rankin cycle (Superheating, Boiler pressure, condenser pressure).		
Unit-V	**Air Standard Cycles**	**(08 Hrs.)**
Analysis of Air standard cycle, Efficiency and Mean Effective Pressure, Carnot Cycle, Otto Cycle, Diesel cycle, Dual cycle, Comparison of cycles, Atkinson Cycle, Ericsson Cycle, Brayton cycle, Sterling Cycle		
Unit-VI	**Fuels and Introduction to Combustion**	**(08 Hrs.)**
Solid- Biomass, Coal types, liquid: petrol, diesel, bio-oil, their Application, Gas: Bio-gas, low calorific value gases, LPG, CNG, and their application. Properties of fuels, Mass fraction, mole fraction, combustion equation, theoretical air, excess and deficient air, stoichiometric and actual air to fuel ratio, Measurement of calorific value of fuels, analysis of products of combustion, gravimetric and volumetric analysis and their conversions, method to determine flue gas analysis - CO, CO_2, O_2, HC, NO_x, smoke.		

Term Work

Term work shall consist of following **eight** experiments. Hand calculations must be confirmed through a computer programme using any programming language.

1. First laws of thermodynamics apply to steady flow energy equation.
2. Study of different types of steam calorimeters.
3. Determination of dryness fraction using any commercially available test rig.
4. Determination of calorific value using bomb calorimeter.
5. Study of Boy's gas calorimeter.
6. Study and demonstration of exhaust gas analysis by using any commercially available test rig.
7. Demonstration of smoke meter
8. Study of Orsat apparatus.
9. Study and Demonstration of Flash Point.
10. Study and Demonstration of Pour Point.

Assignment:

Numerical and/or theory questions on following topics from previous year question papers of GATE/ESE Mechanical Engg. examinations.

3. Steady flow energy equation with applications
4. Concept of second law of thermodynamics, entropy.
5. Vapour processes.
6. Rankine cycle and vapour power cycle.
7. Air standard cycles.
8. Combustion of fuels.

Text Books

1. V. P. Vasandani and D. S. Kumar, Heat Engineering Metropolitan Book Company, New Delhi.
2. R S Khurmi and J K Gupta, Textbook of Thermal Engineering, S Chand publications.

Reference Books

1. P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications.
2. Y. A. Cengel & M.A. Boles, Thermodynamics -An engineering approach, Tata McGraw Hill Publications.
3. Rayner Joel, Engineering Thermodynamics, ELBS Longman.
4. R. K. Rajput, Engineering Thermodynamics, Laxmi Publications.

5. Kothandarman & S. Domkundwar, “Thermal Engineering” Dhanpat Rai and Sons.
6. P. L. Ballaney, Thermal Engineering, Khanna Publications.

Project Based Learning

Following is the list of topics for project based learning (Not Limited to) based on the syllabus contents:

1. To demonstrate steady flow energy equation for engineering applications such as heat exchangers, turbo machinery, boiler, etc.
2. To demonstrate first law of thermodynamic by using Joule’s experiment.
3. To demonstrate first law of thermodynamic through real life application such as heating of water using a cook stove, operation of a boiler, operation of a turbo machinery, etc.
4. To demonstrate second law of thermodynamic through real life application. (Kelvin-Planck's statement)
5. Demonstration second law of thermodynamic through real life application. (Clausius statement)
6. To demonstrate Boyle's law.
7. To demonstrate Charles's law.
8. To prepare a chart on identification of gas/vapour processes in various real-life applications such as boiler, steam turbine, gas turbine, IC engine cylinder, etc.
9. To prepare a chart on comparison among different air standard cycles for given conditions.
10. To determine calorific values of different types of solid and liquid fuels.

Unit Test

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	**Mechanisms of Machines**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hours/ Week	End Semester Examination	60 Marks	04
Practical: - 02 Hours/Week	Internal Assessment	40 Marks	
	Term Work and Oral	50 Marks	01
	Total	**150 Marks**	**05**

Course Prerequisites:-	1. Engineering Mathematics 2. Engineering Physics 3. Engineering Mechanics
Course Objectives:-	1. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications. 2. To develop the competency to analyse the velocity and acceleration in mechanisms using analytical and graphical approach. 3. To develop the competency to analyse the friction clutches, Brakes, dynamometer and flywheel.
Course Outcomes:-	1. **Understand** the fundamental concept of Lower pair mechanisms and **apply** to real life and industrial applications. 2. **Understand** the basic concept of kinematic analysis and **evaluate** forces acting on reciprocating engine by graphical and analytical method. 3. **Understand** the concept of velocity and acceleration of any planar mechanism and **analyze** it graphically by using relative velocity - acceleration method and ICR method, Coriolis component of acceleration. 4. **Understand** the concept of friction and apply it in application of clutches. 5. **Apply** the concept of friction to **analyse** different parameter in Brakes and Dynamometer 6. **Understand** the fundamental concept of Turning moment diagram and flywheel; and**evaluate** coefficient fluctuation speed and energy.

Course Contents

Unit-I	**Mechanisms with Lower Pair**	**(08 Hrs.)**
Introduction, Pantograph, Straight line mechanisms- Exact and Approximate, Hook Joint, Double Hook's Joint, Steering gear mechanisms: Condition for correct steering, Davis steering gear mechanism, Ackermann steering gear mechanism. Theory and analysis of Compound Pendulum, Concept of equivalent length of simple pendulum, Bifilar suspension, Trifiler suspension.		
Unit-II	**Inertial Forces in Reciprocating Parts**	**(08 Hrs.)**
Analytical method for displacement, velocity and acceleration analysis of slider cranks Mechanism. Klein's construction. **Dynamics of Reciprocating Engines:** Two mass statically and dynamically equivalent system, Correction couple, static and dynamic force analysis of reciprocating engine mechanism, Torque Exerted on crankshaft.		
Unit-III	**Kinematic Analysis of Mechanisms: Graphical Methods**	**(08 Hrs.)**
Relative Velocity Method: Relative velocity of a point on a link, Angular velocity of a link, Sliding velocity, Velocity polygons for simple mechanisms. **Relative Acceleration Method:** Relative acceleration of a point on a link, Angular acceleration of a link, Acceleration polygons for simple mechanisms. **Coriolis component of acceleration.** **Instantaneous Centre of Rotation (ICR)Method**(limit to only 6 link mechanisms)- Kennedy's Theorem, Body and space centrode.		

Unit-IV	Friction Clutches	(08 Hrs.)
Friction: Friction in turning pair, friction circle, friction axis, friction in slider crank mechanism. Pivot and collar friction. **Friction clutches-** design considerations, Classification of Clutches, torque transmitting capacity of – Single plate and multi-plate clutch, cone clutch and centrifugal clutch		
Unit-V	**Brakes and Dynamometers**	**(08 Hrs)**
Brakes-Introduction, Classification of brakes, material for brake lining, types of brakes, braking torque of - shoe brakes, internal shoe brake, disc brake. **Dynamometer-**Types of dynamometers, brake power of absorption and transmission type dynamometers – prony brake, rope brake, belt transmission.		
Unit-VI	**Turning Moment Diagrams and Flywheel**	**(08 Hrs.)**
Introduction, Turning Moment Diagrams for different types of Engines, Fluctuations of Energy and Speed of Crankshaft, Coefficient of fluctuation of Energy and speed. **Flywheel-**Introduction, Coefficient of fluctuation of speed, Energy stored in flywheel, dimensions of flywheel rim, Flywheel in punching press.		

Term Work

The following experiments shall be performed

1. Compound Pendulum
2. Bifilar Suspension Method
3. Trifilar Suspension Method
4. Velocity and acceleration analysis using Graphical methods by Klein's construction
5. Velocity analysis using Graphical methods by ICR.
6. Velocity and acceleration analysis using Graphical methods by Polygon method.
7. Velocity and acceleration analysis using Graphical methods i.e., polygons involving Coriolis component.
8. To determine Corioli's Component of Acceleration at various speeds of rotation and water flow rates.
9. To measure torque transmitting capacity of friction clutch experimentally.
10. Velocity and acceleration analysis of slider cranks mechanism using Computer programming.
11. Tutorial on Turning Moment Diagrams and Flywheel with computer programming
12. Mini-project based on contents of Syllabus.

Assignment

Numerical and/or theory questions on each unit from previous year question papers of GATE/ESE Mechanical Engg. examinations.

Reference Books

1. Thomas Bevan, "Theory of Machines", CBS Publishers & Distributors, Delhi.
2. Shigley J.E. and Uicker J.J., "Theory of Machines and Mechanisms", McGraw Hill, Inc.
3. Ghosh Amitabh and Malik A.K., "Theory of Machines and Mechanisms", East-west Press.
4. Hall A.S., "Kinematics and Linkages Design", Prentice-Hall.
5. Erdman, A. G. & Sandor, G.N., "Mechanism design, Analysis and synthesis", Vol 1, Prentice – Hall of India.

Text Books

1. Rattan S. S., "Theory of Machines", Tata McGraw Hill.
2. Ballaney P. L., "Theory of Machines", Khanna Publishers, Delhi.
3. R. S. khurmi, "Theory of Machines', S Chand Publication.

Project Based Learning

Following is the list of topics for project based learning (Not Limited to) based on the syllabus contents:

1. To develop demonstration model of Pantograph mechanism
2. To develop demonstration model of Ackerman steering gear mechanism.
3. To develop demonstration model of Davis steering gear mechanism.
4. To develop demonstration models of exact straight line motion mechanism.
5. To develop demonstration model to understand Coriolli's Effect.
6. To prepare chart oncomparison among different types of clutches with their application.
7. Case study on real life application of clutches used in automobile.
8. To develop demonstration model of Prony brake dynamometer
9. Case study on real life application of Brakes used in automobile.
10. To prepare chart on comparison among different types of dynamometer.
11. To develop demonstration model of flywheel energy storage system.

Unit Tests

Unit Test-I	Unit-I, II, III
Unit Test-II	Unit-IV, V, VI

Designation of Course	**Mechanics of Fluids**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hours/ Week	End Semester Examination	60 Marks	04
Practical: - 02 Hours/ Week	Internal Assessment	40 Marks	
	Term Work and Practical	50 Marks	01
	Total	**150 Marks**	**05**

Course Prerequisites: -	1. Engineering Mathematics 2. Engineering Physics 3. Engineering Mechanics
Course Objectives: -	To provide knowledge about 1. Properties of fluids, concepts of fluid statics, kinematics & dynamics 2. Concepts of laminar & turbulent fluid flows 3. Flow around immersed bodies and boundary layer flow 4. Dimensional analysis
Course Outcomes: -	On completion of the course, students will be able to– 1. **Understand** properties of fluids and analyze concepts of fluid statics. 2. **Understand** concepts related to fluid kinematics and analyze practical problems. 3. **Understand** concepts related to fluid dynamics and analyze practical problems. 4. **Understand** concepts related to laminar flow, flow around immersed bodies and analyze practical problems. 5. **Understand** concepts related to flow through pipes, dimensional analysis and **analyze** practical problems. 6. **Understand** concepts related to turbulent flows, boundary layer theory and analyze practical problems.

Course Contents

Unit-I	**Properties of Fluids & Fluid Statics**	**(08 Hrs.)**
Properties of Fluid: - Definition of fluid, concept of continuum, Density, Specific Weight, Specific Gravity, Dynamic Viscosity, Kinematic Viscosity, Newton's law of viscosity, types of fluid, Rheological diagram, Surface Tension, Capillarity, Compressibility, Vapour pressure, Classification of fluid. **Fluid Statics:** Hydrostatic law, Pascal's Law, Pressure at a point, Total Pressure, Centre of pressure, Liquid pressure on a plane(Horizontal, Vertical, Inclined) & Curved surfaces, Archimedes Principle, Buoyancy and stability of floating and submerged bodies, Metacentric height.		
Unit-II	**Fluid Kinematics**	**(08 Hrs.)**
Description of fluid motion- Eulerian and Langragian approach, Types of flow (steady, unsteady, uniform, non-uniform, laminar, turbulent, One, Two and Three dimensional, compressible, incompressible, rotational, Irrotational), Continuity equation in Cartesian co-ordinates, flow net, Control volume, Material derivative and acceleration, Visualization of flow field (Stream, Path and Streak line), velocity in two-dimensional flow, stream function and velocity potential function.		
Unit-III	**Fluid Dynamics**	**(08 Hrs.)**
Linear momentum Equation using differential Approach, Introduction to Navier-Stoke's Equation, Euler equation of motion. Derivation of Bernoulli's equation along a streamline, application of Bernoulli's equation to Pitot tube, Venturimeter, Orifice meter, Triangular Notch & Rectangular Notch (Without considering Velocity of Approach), Concept of HGL and THL or TEL.		
Unit-IV	**Laminar Flow & Flow around Immersed Bodies**	**(08 Hrs.)**
Definition, relation between pressure and shear stresses, laminar flow through round pipe, fixed parallel plates. Introduction to CFD Methodology (Elementary Treatment). Forces on immersed bodies: -Lift and Drag, Classification of Drag, Flow around circular cylinder and Aerofoil, Development of lift on Aerofoil.		

Unit-V	Flow Through Pipes & Dimensional Analysis	(08 Hrs.)
Energy losses through pipe-Major and Minor losses, Pipes in series and parallel, Darcy-Weisbach equation, Moody diagram, Syphon, Transmission of power, Water hammer in pipes **Dimensional Analysis:** Dimensions of physical quantities, dimensional homogeneity, Rayleigh's method, Buckingham pi Theorem, Important dimensionless numbers, Model analysis (Reynolds, Froude and Mach).		
Unit-VI	**Turbulent Flow, Boundary Layer Flow**	**(08 Hrs.)**
Boundary layer, Laminar and Turbulent flow, Velocity distribution, Development of boundary layer on a flat plate, Boundary layer thickness-displacement, Momentum and Energy, Laminar sub layer, Separation of boundary layer and Methods of controlling, Introduction to compressible fluid flow.		

Term Work

Term work shall consist of following **eight** experiments. Hand calculations must be confirmed through a computer programme using any programming language.

1. Study of Pressure Measuring Devices.
2. Measurement of Viscosity using Redwood Viscometer.
3. Stability of Floating Bodies and Optimum Loading Capacity.
4. Verification of Modified Bernoulli's Equation.
5. Calibration on Venturi meter.
6. Calibration of Orifice meter.
7. Laminar and Turbulent Flow by Reynold's Apparatus.
8. Discharge over Notches.
9. Study of Minor Losses due to Pipe Fitting.

Assignment:

Numerical and/or theory questions on following topics from previous year question papers of GATE/ESE Mechanical Engg. examinations.

1. Fluid statics
2. Fluid kinematics.
3. Venturimeter & orifice meter.
4. Laminar flow and flow around Immersed bodies.
5. Flow through pipes and Dimensional analysis.
6. Boundary conditions for the velocity profiles.

Text Books

1. Dr. R.K. Bansal, A Textbook of Fluid Mechanics and Hydraulic Machines ", Laxmi Publication Pvt. Ltd., New Delhi.
2. R.K. Rajput, A Textbook of Fluid Mechanics and Hydraulic Machines, S. Chand & Company Ltd. New Delhi.

Reference Books:

1. Streeter V. L. and Wylie E. B. Fluid Mechanics McGraw Hill International Book Co.
2. Yunus Cengel, Jhon Cimbala, Fluid Mechanics, Tata McGraw Hill, New Delhi.
3. Streeter & Wylie, Fluid Mechanics, Tata McGraw Hill.
4. Frank White, Fluid Mechanics, McGraw Hill.
5. Dr. P.N. Modi and Dr. S.M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House.
6. Garde R. J. and Mirajgaonkar, Engineering Fluid Mechanics, Nem Chand & Bros, Roorkee, SCITECH, Publication (India) Pvt. Ltd.

Project Based Learning:

Following is the list of topics for project based learning (Not Limited to) based on the syllabus contents:

1. To demonstrate Pascal's law through real life application such as hydraulic jack, hydraulic press, hydraulic lift, etc.
2. To demonstrate Archimedes's Principle through real life application.
3. To prepare an experimental setup for measurement of viscosity of different oils.
4. To demonstrate different types of fluid flow through Reynold's experiment.
5. To prepare a chart on real life application of different types of fluid flows and its characteristics.
6. To measure the flow velocity using Pitot tube.
7. To prepare a chart on real life application on fluid flow measuring devices.
8. To develop demonstration model for turbulent and laminar flow.
9. To develop demonstration model of simple viscous damper for earthquake resistance.
10. To prepare a chart for industrial applications of Pascal's law.

Unit Test –

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	**ITC-I: Manufacturing Technology**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 03 Hours/ Week	End Semester Examination	60 Marks	03
	Internal Assessment	40 Marks	
	Total	**100 Marks**	**03**

Course Prerequisites:-	The student should havebasic knowledge of 1. Manufacturing Processes. 2. Machining Processes.
Course Objectives:-	The student should 1. To acquire the knowledge of Foundry Technology. 2. To acquire the knowledge of hot working and cold working processes. 3. To acquire the knowledge of lathe, drilling, milling, and abrasive machining.
Course Outcomes:-	The students should be able to– 1. **Understand** the pattern making and mold making. 2. **Understand** the **v**arious casting processes and **apply** the best casting process for a specific product. 3. **Understand** the hot working and cold working processes and **apply** them in Manufacturing. 4. **Understand** different operations on lathe machine and **apply**them to create the job. 5. **Understand** different operations of drilling machine and milling machine and **apply**themto create the job. 6. **Understand** various grinding machines and plastic moulding machine and **apply** them for create the shape.

Course Contents

Unit-I	**Pattern and Mould Making**	(06 Hrs.)
Introduction to casting, Foundry Layout, Foundry departments and sections, Pattern and pattern making, Design and allowances for patterns, Colour codes for patterns, Storage of patterns. Moulding sand and core sands, Sand control Test, Core and core making –Introduction, Core making Procedure, Types of cores, Core print, Core boxes. Mould and mould making- Moulding Methods, Moulding processes, Design of Gating System.		
Unit-II	**Sand Casting and Die Casting Practice**	**(06 Hrs.)**
Sand Casting Practice: Melting furnaces and their selection, Cupola furnace, Induction melting furnaces, Advantages, Limitations, applications, pouring practice and equipment's, Ladle technology, Strike out, Fettling, Cleaning and Surface preparation of castings, Defects in castings. **Die Casting Practice:**Pressure and gravity die casting, Shell mould casting, Investment casting, Continuous casting, centrifugal casting, Applications, Merits and limitations.		
Unit-III	**Hot and Cold Working Processes**	**(06 Hrs.)**
Hot Working Processes: Principle rolling, forging - drops, press, upset. Rolling, forging- extrusion, drawing, spinning, Angle of Contact of rolling, effect of hot working. Cold Working Processes: Cold rolling, swaging, forges extrusion- forward backward impact. Roll forging, tube drawing, wire drawing, spinning, shot peening, high energy rate forming, Stresses in wire drawing operations		

Unit-IV	**Theory of Metal Cutting**	**(06 Hrs.)**
Introduction, function, types, construction, accessories, operations, thread cutting, single and multi-start thread cutting, different tools, tool materials, Tool Geometry- Single Point cutting tool, Tool Wear and Tool Life, Mechanics of Metal cutting- Merchant's Circle Diagram, concept of speed, feed, depth of cut. Introduction to Boring Machines- general arrangement and nature of work done.		
Unit-V	**Drilling and Milling Machines**	**(06 Hrs.)**
Drilling Machines: Fundamentals of drilling process, twist drill geometry, tool holders, Types of drilling machines, drilling operations. Types of drills, reaming process. **Milling Machines:** Fundamentals of milling process, cutters-types and geometry, Operations performed on milling machines. Dividing head, methods of indexing.		
Unit-VI	**Abrasive Machining Processes, Plastics & Plastic Moulding**	**(06 Hrs.)**
Abrasive Machining Processes: Abrasive machining, abrasives -types, size and geometry, Grinding, grinding wheels, wheel marking, wheel selection. Wheel mounting. Types of grinding machines, grinding faults, Honing, lapping, super finishing, buffing, burnishing process. **Plastics & Plastic Moulding:** Moulding characteristics of plastic, Moulding process- compression, transfer and injection blow moulding. Mould design- Materials and construction, bulk factor, shrinkage, moulding parameters, moulding machines, extruders.		

Assignments:

1. Pattern and Mould Making.
2. Sand Casting and Die Casting Practice.
3. Hot Working processes and Cold Working Processes.
4. Turning, boring related process.
5. Drilling Machines.
6. Milling Machines.
7. Abrasive Machining Processes and superfinishing processes.
8. Plastics & Plastic Moulding.

Text Books:

1. O. P. Khanna, A text book of Foundry Technology, Dhanpat Rai and Sons
2. P. C. Sharma, Production Engineering, S. Chand Publications
3. R. K. Jain, Production Technology, Khanna Publishers

Reference Book

1. P. N. Rao, Manufacturing Technology- Vol 1, McGraw Hill Education (India) Private Limited
2. P. N. Rao, Manufacturing Technologyp, Vol- II, McGraw Hill Education (India) Private Limited
3. G. R. Nagpal, Tool Engineering and Design, Khanna Publishers
4. B. S. Raghuwanshi, Workshop Technology, Vol-II, Dhanpat Rai & Co.
5. Hajra Chaudhari, Workshop Technology, Vol.-II
6. Roy A. Lindberg, Process & Materials of Manufacture, PHI
7. E. P. DeGrmo, J. T. Black and A. Kosher, Material and processes in manufacturing, PHI
8. HMT Handbook, Production Technology, TMH

Project Based Learning:

Following is the list of topics for project based learning (Not Limited to) based on the syllabus contents:

1 To develop a pattern of a any component using different types of material.
2 To develop a core part by using different types of materials.

3 To develop ademonstration model of gating system for any mechanical component.
5 To develop a demonstration model of Cupola furnace
6 To develop a demonstration model of pouring equipment's.
7 To prepare aflowchart for investment casting process
8 To develop a demonstration model of centrifugal casting
9 To develop a demonstration model of wire drawing process
10 To develop a demonstration model of mechanical press
11 To develop a demonstration model of short penning process
12 To develop a demonstration model of different types of rolling mills
13 Case studyon different types of tools for thread cutting operations
14 To prepare a chart on concept of single point cutting tools & its geometry
15 To develop a demonstration model of mini bench tapping machine
16 To develop a demonstration model of milling mechanisms for vertical/horizontal movement
17 To develop a demonstration model of indexing mechanism
19 To develop a demonstration model of plastic molding machine
20 To develop a demonstration model of buffing machine
21 To develop a demonstration model of abrasive belt grinder

Unit Test -

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	Strength of MachineComponents		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 03 Hours/ Week	End Semester Examination	60 Marks	03
Practical: - 02 Hours/Week	Assignments Internal	40 Marks	
Tutorial: - 01 Hours/ Week	Term Work	25 Marks	01
	Tutorial	-	01
	Total	**125 Marks**	**05**

Course Prerequisites:-	1. Engineering Mathematics 2. Engineering Mechanics 3. Engineering Science
Course Objectives:-	1. Understand simple and principal stress and strain 2. Able to find principal stresses on any oblique plane by analytical and graphical method. 3. Able to draw shear force and bending moment diagram and find slope and deflection of beam 4. Able to draw bending stress and shear stress diagram at different cross section in I, C and T section beam. 5. Able to find stresses in shaft in torsional, combined torsional and bending, combined torsional and axial loading. 6. Able to solve problems on strain energy and Euler's column.
Course Outcomes:-	1. **Understand** the concept of simple stress and strain and apply to find it for simple component. 2. **Understand** the concept of principal stress analytical and graphical by Mohr's circle; and apply it to find stresses on any oblique plane inclined to principal plane. 3. **Understand** the concept of shear force and bending moment and apply it to find shear force diagram and bending moment diagram for any loading condition on simply supported beam and cantilever beam. 4. **Understand** the concept of slope and deflection and apply it to find for any loading condition on simply supported beam and cantilever beam by maculays double integration method 5. **Understand** the concept of pure bending and shear and apply it to find bending stress and shear stress diagram of I, C and T section of beam. 6. **Understand** the concept of column theory and strain energy and apply it for loading condition.

Course Contents

Unit-I	**Simple Stress and Strain**	**(06 Hrs)**
Load,Direct or normal stress ,Direct strain, Sign convention for direct stress and strain ,Elastic materials, Hooke's law,Modulus of elasticity - Young's modulus, Tensile test,Ductile materials,Brittle materials, Poisson's ratio,Application of Poisson's ratio to a two-dimensional stress system, Shear stress, Shear strain, Modulus of rigidity,Relationship Between E , G and K, Double shear,Allowable working stress -factor of safety, Load factor,Thermal stresses,		
Unit-II	**Principal Stresses, Theories of Failure**	**(06 Hrs)**
Principal Stresses: Introduction to principal stresses with application, Transformation of Plane Stress, Principal Stresses, and planes (Analytical method and Mohr's Circle), Stresses due to combined Normal and Shear stresses. **Theories of Elastic failure:** Introduction to theories of failure with application, Maximum principal stress theory, Maximum shear stress theory, Maximum distortion energy theory, Maximum principal strain theory, Maximum strain energy theory.		

Unit-III	Shear Force and Bending Moment Diagram, Slope and Deflection	(06 Hrs)
Types of supports and beams, shear force (S.F.), bending moment (B.M.), S.F. and B. M. sign convention, S.F. and B.M. diagrams for beams carrying different loading conditions. Points of contra flexure, Relationship between S.F, B.M. and intensity of loading. Introduction, Simple bending theory, Neutral axis, Section modulus, second moment of area, Relationship between loading, S.F., B.M., slope and deflection, Double integration method, Macaulay's method for all loading conditions.		
Unit-IV	**Stresses in Beams, Thin and Thick cylinders**	**(06 Hrs)**
Bending stresses: Theory of simple bending, assumptions, derivation of flexural formula, second moment of area of common cross sections (rectangular, I,T,C) with respect to centroidal and parallel axes, bending stress distribution diagrams, moment of resistance and section modulus. **Shear stresses:** Concept, derivation of shear stress distribution formula, shear stress distribution diagrams for common symmetrical sections, maximum and average shears stresses, shear connection between flange and web. Concept of shear centre, Stresses and deformation in Thin Cylindrical and Spherical shells subjected to internal pressure.		
Unit-V	**Torsion**	**(06 Hrs)**
Simple torsion theory, Polar second moment of area, Shear stress and shear strain in shafts, Section modulus, Torsional rigidity. Principal stresses, Strain energy in torsion, Variation of data along shaft length-torsion of tapered shafts, Power transmitted by shafts. Stresses in solid circular shaft- Torsional load only, bending load only, combined torsional and bending, Combined Torsion and axial loading.		
Unit-VI	**Euler's Columns and Strain Energy**	**(06 Hrs)**
Concept of buckling of columns, derivation of Euler's formula for buckling load for column with hinged ends, concept of equivalent length for various end conditions, limitations of Euler's formula, Rankine's formula, safe load on columns.Strain energy: Strain energy due to axial load (gradual, sudden and impact), Strain energy due to self-weight.		

Term Work

Term work shall consist of following experiments. Hand calculations must be confirmed through a computer programme using any programming language.

1. Tension test for ductile materials
2. Tension test for brittle materials
3. Compression test for ductile materials
4. Compression test for brittle materials
5. Shear test for ductile materials
6. Shear test for brittle materials
7. Torsion test for ductile materials
8. Torsion test for brittle materials
9. Impact Test- IZOD and Charpy
10. Strain Gaugeand rosettes theory
11. Testing of hardness by Rockwell
12. Graphical simulation of
    a. Shear force and bending moment diagrams with different end conditions.
    b. Slope and deflection.
    c. Principal stresses through graphical and analytical method.

List of Assignments

Numerical and/or theory questions on following topics from previous year question papers of GATE/ESE Mechanical Engg. examinations.

1. Simple stress and strain.
2. Principal stresses and strain.
3. Shear force and Bending moment diagram and slope and deflection
4. Stresses in beams, thickand thin cylinder

5. Torsion
6. Euler's column and strain energy method

List of Tutorial

Numerical and/or theory questions on following topics from previous year question papers of GATE/ESE Mechanical Engg. Examinations.

1. Stresses in simple bar, Elastic modulus and two-dimensional stress systems.
2. Normal, tangential and resultant stresses on any oblique plane inclined to normal plane by analytical and graphical method.
3. Shaft diameter and factor of safety by using theories of failure.
4. Shear and bending moments on cantilever and simply supported beam and draw SFD and BMD.
5. Slope and deflection at any section between beams by using Macaulay's method.
6. Stresses in beam and draw shear stress diagram and bending stress diagram.
7. Shaft diameter and stresses when shaft subjected to torsion, bending combined torsional and bending, combined torsional and axial loads.
8. Euler's column theory and strain energy.

Textbooks

1. A textbook of strength of material by R.K.Bansal

Reference Books

1. V. B. Bhandari, Design of Machine Elements, Tata McGraw Hill Publication
2. J. E. Shigley, Mechanical Engineering Design, McGraw Hill
3. R. Subramanian strength of Material
4. S Ramamrutham, Strength of Material
5. R.K Rajput, Strength of materials

Project Based Learning

Following is the list of topics for project-based learning (Not Limited to) based on syllabus contents:

1. To prepare demonstration model of cantilever beam for the study of deflection in it.
2. To prepare demonstration model of simply supported beam for the study of deflection in it.
3. To prepare demonstrationmodel of fixed beam for the study of deflection in it.
4. To prepare demonstrationmodel of Overhang beam for the study of deflection in it.
5. To prepare the chart on relation between E, G, K with derivation.
6. To prepare demonstration model for studying strain energy with consideration of various conditions like impact load, sudden load, gradual load.
7. To prepare the chart on various concepts used in Principal Stresses& planes.
8. To prepare the chart on concept use in Mohr's Circle method using graphically & analytically.
9. To prepare the chart on Rules and guidelines use for drawing SFD & BMD.
10. To prepare the chart on finding bending stress for I cross-sections.
11. To prepare the chart on finding bending stress for T cross-sections.
12. To prepare the chart on finding bending stress for C cross-sections.
13. To prepare the chart on concepts used in solid &hollow shafts.
14. To prepare the chart and demonstration model of Euler's formula for buckling load.

Unit Tests

Unit Test-I	Unit-I, II, III
Unit Test-II	Unit-IV, V, VI

Designation of Course	**Manufacturing Technology Laboratory**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Practical: - 02 Hours/ Week	Term Work	25 Marks	01
	Total	**25 Marks**	**01**

Course Prerequisites:-	1. Manufacturing Processes 2. Machining Processes and Materials.
Course Objectives:-	1. To acquire the knowledge of Foundry technology 2. To acquire the knowledge of Machine Technology
Course Outcomes:-	The students should be able to– 1. **Understand** the **v**arious casting processes and **apply** the best casting process for a specific product. 2. **Understand** different operations on lathe, drilling, milling and grinding machine and **apply** it to create the job.

Course Contents

Unit-I	**Foundry Technology**	(12 Hrs.)
Introduction to casting, Pattern and pattern making, Design and allowances for patterns, Moulding sand and core sands, Sand control Test, Core and core making –Introduction, Core making Procedure, Types of cores, Core print, Core boxes. Mould and mould making-Moulding Methods, Moulding processes, Gating System. Melting furnaces and their selection, Cupola furnace, pouring practice and equipment's Ladle technology, Strike out, Fettling, Cleaning and Surface preparation of castings, Defects in castings.		
Unit-II	**Machining Technology**	**(12 Hrs.)**
Lathe-Introduction, function, types, specification, construction accessories, attachments, operations. Oflathe machine. Drilling-Introduction, Types of drilling machines,operations. Milling-Introduction,Types of milling machines,operations, Milling cutters, Dividing head, methods of indexing. Abrasive machining-Introduction, grinding wheels, wheel marking, Types of grinding machines, Grinding faults. Plastic Moulding- Moulding characteristics of plastic, plastic moulding process.		

List of Experiments: (AnyEight)

1. Moulding and core sand testing (Clay content test, moisture content test etc).
2. Strength of Green sand mould and greens sand core.
3. Mold Making Practice.
4. Job on drilling, reaming, tapping.
5. Casting of component by using green sand molding / Die casting.
6. Individual job on center Lathe.
7. Study of dividing indexing mechanism on milling machine.
8. Gear cutting job on Milling Machine.
9. Study and demonstration of Grinding Machines.
10. Job on Grinding Machine.
11. Job on Plastic Molding Machine.

Text Books

1. O. P. Khanna, A textbook of Foundry Technology, DhanpatRai and Sons
2. P. C. Sharma, Production Engineering, S. Chand Publications
3. R. K. Jain, Production Technology, Khanna Publishers

Reference Book

1. P. N. Rao, Manufacturing Technology- Vol 1, McGraw Hill Education (India) Private Limited
2. P. N. Rao, Manufacturing Technologyp, Vol- II, McGraw Hill Education (India) Private Limited
3. G. R. Nagpal, Tool Engineering and Design, Khanna Publishers
4. B. S. Raghuwanshi, Workshop Technology, Vol-II, DhanpatRai& Co.
5. HajraChaudhari, Workshop Technology, Vol.-II
6. Roy A. Lindberg, Process & Materials of Manufacture, PHI
7. E. P. DeGrmo, J. T. Black and A. Kosher, Material and processes in manufacturing, PHI
8. HMT Handbook, Production Technology, TMH

Designation of Course	**Python Programming-I**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Practical: - 04 Hours/ Week	Term Work and Practical	50 Marks	02
	Total	**50 Marks**	**02**

Course Prerequisites:-	Basics of C and C^{++}Programming
Course Objectives:-	The students should be able to 1. Readily use the Python programming language 2. Apply various data types and controlstructure. 3. Understand and begin to implementcode
Course Outcomes:-	Upon completion of the course, students will be able to 1. **Understand** how to install and run python 2. **Understand** flow control 3. **Understand** complex datatypes 4. **Understand** and **Apply** functions 5. **Understand** various modules 6. **Understand** and **Apply** NumPymodule

Course Contents

Unit-I	**Python introduction**	**(08 Hrs.)**
Learn to install and run Python on your computer, Keywords and Identifiers, Statement, Indentation and Comments, Variables, Constants and Literals, Data Types, Type Conversion and Type Casting, Input,Output and Import		
Unit-II	**Python Flow Control**	**(08 Hrs.)**
Learn to install and run Python on your computer, Keywords and Identifiers, Statement, Indentation and Comments, Variables, Constants and Literals, Data Types, Type Conversion and Type Casting, Input, Output and Import		
Unit-III	**Datatypes**	**(08 Hrs.)**
Numbers, Type Conversion and Mathematics, List, Tuple, Strings, Sets, Dictionary		
Unit-IV	**Python Functions**	**(08 Hrs.)**
Function Arguments, Recursion, Anonymous/Lambda Function, Global, Local and Nonlocal variables, Global Keyword		
Unit-V	**Python Modules**	**(08 Hrs.)**
Modules in Python, import modules in Python, import statement, Import with renaming, from...import statement, Import all names, Python Module Search Path		
Unit-VI	**NumPy Module**	**(08 Hrs.)**
Python Matrix, Add Two Matrices, Transpose a Matrix, Multiply two matrices		

Term Work

1. Basic Exercise for Beginners
   Practice and quickly learn Python's necessary skills by solving simple questions and problems. Topics: Variables, Operators, Loops, String, Numbers, List
2. Python LoopExercise
   This Python loop exercise aims to help developers to practice branching and Looping techniques in Python.
   Topics: If-else statements, loop, and while loop.
3. Python FunctionsExercise
   Practice how to create a function, nested functions, and use the function arguments effectively in Python by solving differentquestions.
   Topics: Function's arguments, built-in functions.

4. Python String Exercise
   Solve Python String exercise to learn and practice String operations and manipulations.
5. Python Data Structure Exercise
   Practice widely used Python types such as List, Set, Dictionary, and Tuple operations in Python
6. Python ListExercise
   This Python list exercise aims to help Python developers to learn and practice list operations.
7. Python DictionaryExercise
   This Python dictionary exercise aims to help Python developers to learn and practice dictionary operations.
8. Python Tuple Exercise
   This exercise aims to help Python developers to learn and practice tuple operations.

Text Books

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher,
2. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd., 2015.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python: AnInter- disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.

Reference Books

1. Python Programming using problem solving Approach by Reema Thareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.
2. Data Structures and Algorithms in Python by Michael T Goodrich and Robertto Thamassia, Micheal S Goldwasser, Wiley Publisher (2016)
3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1st edition (6th February2009)

Supplementary Resources:

1. http://www.w3schools.com
2. http://docs.python.org
3. http://www.tutorialspoint.com
4. http://www.learnpython.org

Designation of Course	Vocational Course I: Automobile Servicing- I		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
	Term Work and Oral	50 Marks	02
	Total	**50 Marks**	**02**

Course Prerequisites:	1. Inclination for taking up Two-Wheeler Repairs and Service as a self-employment occupation 2. Knowledge of Mechanical Engineering System
Course Objectives: -	1. To perform skilled mechanical work in diagnosing, repairing and maintaining all major vehicle systems of two-wheeler 2. To provide knowledge on automotive industry and job-related activities as an automotive service technician. 3. To work safely and responsibly within all shop standards and environmental guidelines.
Course Outcomes: -	1. **Understand** the suspension system of two-wheeler and **apply** it to diagnosing, repairing and maintaining. 2. **Understand** the braking and steering system of two-wheeler and **apply** it to diagnosing, repairing and maintaining. 3. **Understand** the transmission system of two-wheeler and **apply** it to diagnosing, repairing and maintaining clutch and gear box. 4. **Understand** the engine system of two-wheeler and **apply** it to diagnosing, repairing and maintaining. 5. **Understand** the ignition system of two-wheeler and **apply** it to diagnosing, repairing and maintaining. 6. **Understand** the electrical system other accessories of two-wheeler and **apply** it to diagnosing, repairing and maintaining.

Course Contents

Unit-I	**Suspension System in Two Wheelers**	**(08 Hrs.)**
Safety, Hand Tools and Equipment's, Nomenclature of different parts of vehicle and their locations,Introduction & Function of various parts & System of Two-Wheeler **Suspension System:** Introduction, Objectives of suspension, Basic requirement, Function of suspension springs, Types of suspension springs, Suspension system trouble shooting.		
Unit-II	**Brake and Steering Systems**	**(08 Hrs.)**
Brake System: Principle, Braking requirements, Types of brakes, Drum brakes Disk brakes, Mechanical Brakes, Hydraulic brakes, Brake fluid, Disc brake pads, Braking system trouble shooting. **Steering:** Steering system & their use, Inspect and adjust rake of front fork, dismantle trailing link, adjust heavy duty thrust races.		
Unit-III	**Transmission system in Two Wheelers**	**(08 Hrs.)**
Gear Box: Function of transmission, Necessity of transmission, Types of transmission, Manual transmission, sliding mesh gear box, constant mesh gear box, synchromesh gear box, **Clutch:** Definition, Requirements of clutch, Principle of friction clutches, Dry friction clutches (Single plate clutch, Multiplate clutch, Centrifugal clutch) Preliminary inspection of clutch, clutch adjustment, Clutch overhaul, clutch trouble shooting. Chain & chain Drive, sprocket (chain, sprocket, shafts)		
Unit-IV	**Engine system of Two Wheelers**	**(08 Hrs.)**
Basic engine terminology, Types of engine, Constructional details, working of 2-stroke and 4-stroke engine, Classification of 2-stroke & 4-Stroke Engine & their difference, Engine servicing, Repairing method of Engine, engine removal, engine installation, General theory of Carburetion & Silencer.		

Unit-V	Ignition Systems of Two Wheelers	(08 Hrs.)
Ignition System: Function, Requirement of an ignition system, Types of ignition system, Battery ignition, Magneto ignition Electronic ignition, Components of battery and electronic ignition system, Testing and servicing of ignition system components, Ignition system trouble shooting,Kick-starting system of 2 wheelers.		
Unit-VI	**Electrical Systems and Accessories in Two-Wheeler**	**(08 Hrs.)**
Electrical and electronic components used in auto electrical, auto electrical parts wiring, battery inspection and maintenance, testing of battery voltage, testing of electrical parts such as head lamp, horn side indicator,brake light etc. Use ofECM bike scanner.		

List of Experiments-

1. **Introduction:** Importance of safety and general precaution, Elementary First Aid, Identify the parts &general servicing of Two-Wheeler, washing, cleaning, oiling, greasing and lubricating.
2. **Suspension Work:** Servicing of suspension changing bush, checking shock absorbers. Cleaning, Checking and oil filling of shock absorbers. Cleaning & checking the wheel bearings and greasing.
3. **Break Work:** Adjusting brake pedal play, servicing the brake system, cleaning, checking, greasing and assembling. Inspecting the shoes and wheel drums, changing of brake lining. Repairing and maintenance of hydraulic disc brake used in Motorcycles.
4. **Transmission:** Adjusting clutch lever free play, removing clutch assembly from Two-wheeler, cleaning and inspecting parts. Replacing defective parts. Fitting clutch assembly. Repair work of Automatic clutch and automatic transmission used in motor vehicle
5. Checking, adjusting and replacing defective parts (chain, sprocket, shafts) in power transmission from engine to driving wheel.
6. **Engine Work:** Dismantling the unserviceable engine, cleaning and inspecting the parts, checking engine bore piston rings, connecting rod, bearings, crankshaft, assembling all the parts and measures the gaps. Engine Timing setting and Valve Timing setting of 4 -S Engine. Dismantling a four-stroke engine of two-wheeler cleaning, inspecting and assembling parts.
7. Dismantling the air cleaner, cleaning, inspecting, cleaning fuel tank, servicing carburetor, rectifying causes for engine not starting, and high fuel consumption.
8. Starting engine, tuning for slow speed, checking smoke, and setting for exhaust gas emission measurement as per norms.
9. **Ignition System:** Dismantling the C.B. point cleaning electronic Ignition system & inspecting and replacing the pitted points. Making wiring harness and check different Electrical circuits used in Two-wheelers.
10. **Steering work:** Inspect and adjust rake of front fork, dismantle trailing link, adjust heavy duty thrust races.
11. **Electrical accessories repair:** Tracing the A.C /D.C electrical circuit in a two-wheeler, checking horn, head light, indicator and replacing if necessary.
12. Practice on how to read job-card, General Servicing & road testing of Two-Wheeler.

Text Books

1. Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House

Reference Books

1. Automobile Engineering by Kirpal Singh Standard Publishers Distributors.
2. Automotive Engines, A.K. Babu, Khanna Publishing House

Designation of Course	**Thermodynamics Applications**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hours/ Week	End Semester Examination	60 Marks	04
Practical: - 02 Hours/ Week	Internal Assessment	40 Marks	
	Term Work and Oral	50 Marks	01
	Total	**150 Marks**	**05**

Course Prerequisites:-	1. Mechanical Engineering System. 2. Thermodynamic principals
Course Objectives:-	1. Steam generator and their performance analysis. 2. Reciprocating air compressors, Gas turbines & jet propulsion. 3. Various systems and phenomenon of combustion in I.C. Engine; and Performance analysis of I.C. Engine.
Course Outcomes:-	On completion of the course, students will be able to– 1. **Understand** construction working of steam generators and **analysis** their performance. 2. **Understand** construction working of Reciprocating air compressors and **analysis** their performance. 3. **Understand** fundamentals of gas turbine, **analysis** their performance and application of gas turbines & jet propulsion. 4. **Understand** I.C. Engine systems viz. ignition, cooling, lubrication, and governing. 5. **Understand** phenomenon of combustion in S.I and C.I. Engine. 6. **Understand** terms related to I.C. Engine testing and **analysis** their performance.

Course Contents

Unit-I	**High pressure Boilers and Performance of Boilers**	**(08 Hrs.)**
Classification of boilers Features of high-pressure boiler, construction and working of high-pressure boilers, Fluidize bed combustion, boiler mountings and Accessories. Boiler performance calculations- Equivalent evaporation, Boiler efficiency, Energy balance, boiler controls, Boiler draught.		
Unit-II	**Reciprocating Air Compressors**	**(08 Hrs.)**
Uses of compressed air, classification, constructional details of single stage reciprocating compressor, computation of work done, isothermal work done, isothermal efficiency, effect of clearance, volumetric efficiency, FAD, theoretical and actual indicator diagrams, method of improving volumetric efficiency. Need of multi staging, multistage compressor, work done, volumetric efficiency, condition for maximum efficiency, intercooling, actual indicator diagram		
Unit-III	**Gas Turbines & Jet Propulsion**	**(08 Hrs.)**
Theory and fundamentals of gas turbine, Principals, Classification, Assumption for simple gas turbine cycle analysis, Work ratio, Concepts of maximum and optimum pressure ratio, Actual cycle, Effect of operating variable on thermal efficiency, Regeneration, Intercooling. Reheating and their effect on performance, Closed cycle and Semi-Closed cycle gas turbine plant, Application of gas turbines. **Jet Propulsion:** Introduction, Theory of jet propulsion, Types of jet engines, Energy flow through jet engine, Thrust, Thrust power, Propulsive, Thermal and overall efficiency, Turbojet, Turboprop, Turbofan and Ducted fan engines, Pulse jet and Ram jet engines, Application of jet engines, Methods of thrust augmentation, Introduction to rocket engines.		

Unit -IV	I. C. Engine Systems	(08 Hrs.)
Fuel supply system for S.I and C.I. Engines, M.P.F.I. system for modern automobile engines, CRDI. **Ignition and injection System:** Battery & coil ignition system, Magneto ignition system, Electronic ignition system, Advantage over mechanical contact breaker point system. Spark-Advance Mechanisms. **Engine Cooling System**: Necessity of cooling system, effect of overcooling, Air cooling, Water cooling, Thermostatic radiators. **Lubrication System**: Mist lubrication system, Dry sump lubrication, Wet sump lubrications, Comparison between Wet sump and Dry sump systems, Oil pump **Governing System**: Function of Governor, Quality governing, Quantity governing, Hit & miss governing **Supercharging:** Objects of supercharging, Effects on performance, Limitations, Methods of supercharging & turbocharging, Limitation of turbocharging,		
Unit-V	**Combustion in I. C. engines**	**(08 Hrs.)**
Combustion in S. I. Engines: Valve timing Diagram for S.I. engine, Ignition Limit, Stages of combustion, Effect of engine variables on ignition lag & flame propagation, Abnormal combustion: Theories, Effects & Controlling measures, Combustion chambers for S. I. engines Combustion in C. I. Engines: Valve timing Diagram for C.I. engine, Air-fuel ratio for C.I engines, Stages of combustion, Ignition delay & factors influencing delay period, Diesel knock & its control, Combustion chambers for C. I. engines		
Unit-VI	**Performance Characteristics & Testing of I.C. Engines**	**(08 Hrs.)**
Introduction to Indian standards for testing of I.C. Engines, Performance characteristics, Determination of brake power, indicated power, Friction power, Methods to determine power and efficiency, Determination of break thermal efficiency, Mechanical efficiency, volumetric efficiency, Variables affecting performance of engine, Mean Effective Pressure, SFC, Air consumption, Energy balance. Engine Emission and their controls.		

Term Work:

Term work shall consist of following experiments. Hand calculations must be confirmed through a computer programme using any programming language.

1. Study and demonstration of boiler mountings.
2. Study and demonstration of boiler Accessories.
3. Trial on steam power plant.
4. Test on reciprocating air compressor.
5. Performance test on rotary air compressor.
6. Trial on multi cylinder petrol engine – Morse Test.
7. Trial on multi-cylinder diesel engine.
8. Study of superchargers & turbochargers
9. Study of I. C. Engine emission norms.
10. Visit to Boiler House
11. Visit to Automobile service station.
12. Mini-Project on the contents of the syllabus

Assignment:

Numerical and/or theory questions on following topics from previous year question papers of GATE/ESE Mechanical Engg. examinations.

1. Boiler performance.
2. Single and multistage reciprocating air compressors
3. Gas turbine performance
4. I C engine systems
5. I C engine combustions
6. Performance of I C engines.

Text Books

1. V. P. Vasandani and D. S. Kumar, Heat Engineering Metropolitan Book Company, New Delhi.
2. R S Khurmi and J K Gupta, Textbook of Thermal Engineering, S Chand publications.

Reference Books

1. R. K. Rajput, Thermal Engineering, Laxmi Publications
2. Y. Cengel & Boles, "Thermodynamics -An engineering approach", Tata McGraw Hill Publications
3. S. Domkundwar, "Thermodynamics & Heat Engines" Dhanpat Rai and Sons
4. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill Publications
5. P. L. Ballany, "Thermal Engineering", Khanna Publications
6. Ganesan V, "Internal Combustion Engines", Tata McGraw Hill Publishing House
7. R. K. Rajput, "Internal Combustion Engines", Laxmi Publications.
8. M. L. Mathur & R. P. Sharma, "A Course in I. C. Engines", Dhanpat Rai & Sons
9. V. M. Domkundwar, "A Course in I. C. Engines", Dhanpat Rai & Co.
10. Shrinivasan, "Automobile Engines", Tata McGraw Hill Publishing House – CBS Publication

Project Based Learning

Following is the list of Topics for project based learning (Not Limited to) based on the syllabus contents:

1. To prepare a chart on performance testing of boilers.
2. To prepare a chart on comparison among various types of boilers.
3. To prepare a chart on comparison between open and closed cycle gas turbines.
4. To prepare a chart on comparison among various turbo machinery.
5. To prepare a chart on comparison among different types of jet engines.
6. To prepare demonstration model of ignition system.
7. To prepare demonstration model of engine cooling system.
8. To prepare demonstration model of lubrication system.
9. To prepare demonstration model of governing system.
10. To prepare a chart on different processes of combustion in IC engines.
11. Case study on different IC Engine systems used in cars available in market.
12. To prepare a chart on various performance characteristics of IC engines.

Unit Test –

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	Machine Design and Analysis-I		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 04 Hours/ Week	End Semester Examination	60 Marks	04
Practical: -02 Hours/Week	Internal Assessment	40 Marks	
	Term Work and Oral	50 Marks	01
	Total	**150 Marks**	**05**

Course Prerequisites: -	1. Computer Aided Drafting and Visualization 2. Computer Aided Machine Drawing 3. Strength of Machine Components
Course Objectives: -	1. To study basic concepts of machine design. 2. To design and analysis different types of machine elements 3. To design of machine component for finite and infinite life and subjected to fluctuating load.
Course Outcomes: -	1. **Understand** the basic concept of machine design and **evaluate** dimensions of simple components. 2. **Understand** the fundamental concepts for design of shaft, keys and coupling and **evaluate** forces and dimensions. 3. **Understand** the concept of designingof Power Screws and Mechanical spring;and **analyze** it for various applications. 4. **Understand** the basic concept of fluctuating loads and **Analyze** design of components under fluctuating loads. 5. **Understand** the concept of fasteners and threaded joints; and **analyze** when it is subjected to different loading conditions. 6. **Understand** the Design concept of welded & riveted joint;and **analyze** when it is subjected to different loading conditions.

Course Contents

Unit-I	**Introduction to Designand Design against Static Load**	**(08 Hrs)**

Introduction to Design: Need for component design,design process,Introductions to concurrent engineering, Design consideration for casting, forging & machined parts, hot & cold worked parts and welded assembly,Introduction to design for manufacture & assembly,

Design against Static Load: Modes of failure, Factor of safety, Service factor, stress strain relationship, shear stress & strain,stress due to bending moment, Eccentric axial loading.

Design of simple machine parts - Cotter joint, Knuckle joint and Levers, curved beam.

Unit -II	**Shafts, Keys and Coupling**	**(08 Hrs)**

Introduction, Transmission Shafts, Shaft Design on Strength Basis, Shaft Design on Torsional Rigidity Basis, ASME Code for Shaft Design, Design of Hollow Shaft on Strength Basis, Design of Hollow Shaft on Torsional Rigidity Basis, Flexible Shafts

Keys– saddle, sunk, feather, woodruff, square, flat, Kennedy key, key design, Types of keys, splines.**Couplings-** types of couplings, Design of rigid and flexible couplings.

Unit-III	**Power Screws and Mechanical Spring**	**(08Hrs)**

Power Screws, Forms of Threads , Multiple Threaded Screws, Terminology of Power Screw, Torque Requirement—Lifting Load, Torque Requirement—Lowering Load, Self-locking Screw, Efficiency of Square Threaded Screw, Efficiency of Self-locking Screw, Trapezoidal and Acme Threads, Collar Friction Torque, Overall Efficiency, Coefficient of Friction, Design of Screw and Nut, Design of Screw Jack, Differential and Compound Screws, Re-circulating Ball Screw.

Mechanical Spring: Types of Springs, Terminology of Helical Springs, Styles of End, Stress and Deflection Equations, Series and Parallel Connections, Design of Helical Springs, Concentric Springs, Helical Torsion Springs, Surge in Spring, Multi-Leaf Spring, Nipping of Leaf Springs, Shot Peening

Unit-IV	Design for Fluctuating Loads	(08 Hrs)
Stress concentration factor and its Reduction, Stress concentration factor for various machine parts, Cyclic stresses, Fatigue and endurance limit, Notch sensitivity, Cumulative Damage in Fatigue, Design for finite and infinite life, Soderberg, Goodman, Modified Goodman& Gerber criteria.		
Unit-V	**Threaded Joints**	**(08 Hrs)**
Basic Types of Screw Fastening, Cap Screws &Setscrews,Bolt of Uniform Strength,Locking Devices, Terminology of Screw Threads,ISO Metric Screw Threads, Bolt under tension, Eccentrically Loaded Bolted Joints in Shear,Eccentric Load Perpendicular to Axis of Bolt, Eccentric Load on Base plate, Torque Requirement for Bolt Tightening, Dimensions of Fasteners, Design of Turnbuckle.		
Unit-VI	**Welded and Riveted Joints**	**(08 Hrs)**
Welded Joints- Welding Processes, Strength of Butt and Fillet Joints, Strength of Parallel Fillet Welds, Strength of Transverse Fillet Welds, Axially Loaded Unsymmetrical Welded Joints, Eccentric Load in the Plane of Welds, Welded Joint Subjected to Bending Moment and Torsional Moment, Welding Symbols **Riveted Joints**- Types of Rivet Heads and riveted Joints, Rivet Materials, Types of Failure, Strength Equations, Efficiency of Joint, Caulking and Fullering, Eccentrically Loaded Riveted Joint		

Term work

Term work shall consist of following experiments. Hand calculations must be confirmed through a computer programme using any programming language.

1. Symbolic representation of common machine components using Auto-CAD.
2. Design of machine components such as knuckle joint, cotter joint and lever (anyone) using CAD software.
3. Design of coupling system using CAD software.
4. Design of screw jack using CAD software.

Assignment

Numerical and/or theory questions on following topics from previous year question papers of GATE/ESE Mechanical Engg. Examinations.

1. Static loading
2. Design of shafts
3. Power screw
4. Mechanical springs
5. Design of fluctuating load
6. Design of threaded joints
7. Design of welded
8. Riveted joints.

Note: Design data book should be used extensively.

Project Based Learning

Following is the list of topics for project based learning (Not Limited to) based on the syllabus contents:

1. To develop Industrial/Real life application demonstration model of different types of Joints. (Cotter joint andKnuckle joint)
2. To observe the system where transmission of power takes place through shaft, Keys, coupling, like Transmission of power from motor to pump/generator/lathe machine/drilling machine. By selecting suitable materials, design the shaft, key and coupling. To prepare design report and assembly drawing indicating overall dimensions, tolerances, and surface finish. Also to prepare bill of materials.

9. To develop a demonstration models of different types of couplings.
10. To develop a demonstration models of different types of keys.
11. To observe the system where transmission of power takes place through power Screws. (e.g. Lead screw of lathe, feed screws of machine tools, Clamping screws, Toggle Jack screw, etc.) Get the required information regarding effort, clamping force, etc., and selecting suitable materials design screw, nut and different simple components in assembly. To prepare design report and assembly drawing indicating overall dimensions, tolerances, and surface finish. Also to prepare bill of materials.
12. To develop demonstration models of different types of springs.
13. To develop demonstration models of different types of threaded joints.
14. To develop demonstration models of different types of fasteners.
15. To develop demonstration models of different types of welded joints.
16. To develop demonstration models of different types of riveted joints.

Textbooks

1. V. B. Bhandari, “Design of Machine Elements”, Tata McGraw Hill Publication Co. Ltd.
2. R. S. Khurmi And J.K. Gupta “Machine Design”, S Chand Publication.
3. Shigley J. E. and Mischke C. R., “Mechanical Engineering Design”, McGraw Hill Publication Co. Ltd.
4. Spotts M. F. and Shoup T.E., “Design of Machine Elements”, Prentice Hall International.

Reference Books

1. Black P.H. and O. Eugene Adams, “Machine Design”, McGraw Hill Book Co. Inc.
2. Willium C. Orthwein, “Machine Components Design”, West Publishing Co. and Jaico Publications House.
3. Hall A. S., Holowenko A. R. and Laughlin H. G, “Theory and Problems of Machine Design”, Schaum’s Outline Series.
4. Sharma C. S. and PurohitKamlesh, “Design of Machine Elements”, PHI LearingPvt. Ltd.
5. D. K. Aggarwal & Sharma P. C., “Machine Design”, S.K Kataria and Sons
6. Gope P. C., “Machine Design: Fundamentals and Applications”, PHI LearingPvt. Ltd.
7. “Design Data- P. S. G.” College of Technology, Coimbatore.
8. V. B. Bhandari, “Design Data Book”, Tata McGraw Hill Publication Co. Ltd.

Unit Tests

Unit Test-I	Unit-I, II, III
Unit Test-II	Unit-IV, V, VI

Designation of Course	**Science of Engineering Materials**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: -04 Hours/Week	End Semester Examination	60 Marks	04
	Internal Assessment	40 Marks	
	Total	**100 Marks**	**04**

Course Prerequisites:-	The student should have 1. Basic knowledge of physics and chemistry 2. Basic information of engineering materials 3. Basic knowledge of manufacturing processes
Course Objectives:-	The student should acquire the knowledge of 1. The scope, objective and application of materials, engineering properties. 2. Material testing to determine the mechanical properties and its applications in mechanical systems. 3. Different methods to change the mechanical properties.
Course Outcomes:-	The students should be able to 1. **Understand** basics of plastic deformation, annealing, re- crystallization and apply in mechanical engineering applications. 2. **Understand and evaluate** different types of mechanical properties. 3. **Understand and apply** fundamental concept of equilibrium diagrams in selections of alloys for different applications. 4. **Understand and apply** the different types of heat treatment processes on steels. 5. **Understand**the different types of alloy steels, tool steels and stainless steels and its applications in mechanical engineering. 6. **Understand** the concept of powder metallurgy and **apply** in manufacturing of components.

Course Contents

Unit-I	**Plastic Deformation, Recrystallization and Strengthening Mechanism**	**(08 Hrs.)**
Mechanism of plastic deformation, Critical resolve shear stress, Deformation of single crystal and polycrystalline metals, Mechanism of plastic deformation at high temperature, effect of grain size, Work Hardening, Cold and hot working, Annealing and re- crystallization, strengthening Mechanism,		
Unit-II	**Mechanical Testing of Metals**	**(08 Hrs.)**
Study of destructive testing Tensile test, Engineering stress and true stress strain, evolution of properties, Numerical based Tensile test, Hardness testing such as Brinell, Rockwell, Vickers and Micro hardness test, Impact test, Fatigue test, Creep test, Cupping test, **Non-Destructive testing** such as Liquid dye penetrate test, Magnaflux test, Eddy current test, Ultrasonic testing and Radiography testing.		
Unit-III	**Equilibrium Diagrams**	**(08 Hrs.)**
Related terms and their definitions, Hume Ruther's rule of solid solubility, solidification, Dendritic growth, cooling curves, Plotting of Equilibrium diagrams, Lever rule, Coring, Isomorph's system, Eutectic system, Partial eutectic and eutectoid system, non-Equilibrium cooling and its effects, Fe- Fe3 C equilibrium diagram.		
Unit-IV	**Heat Treatment of steels**	**(08 Hrs.)**
Transformation products of austenite, Martensite transformation & characteristics of martensite, Time – Temperature Transformation curve, Critical Cooling rate, Heat treatment of steels - Annealing, Normalizing, Hardening, Hardenability, Martempering, Austempering, Retained austenite, tempering, Ausforming, Secondary hardening, Quench cracks.		

Unit-V	Cast Irons, Alloy Steels & Tool Steels	(08 Hrs.)
Classification of alloying elements, Types of cast irons, Properties of different cast irons, Effect of alloying elements on properties,Specifications of steels,Various alloy steels, Stainless steels – Classification, Applications & properties, Tool Steels – Classification, Applications & properties, heat treatment of tool steels.		
Unit-VI	**Powder Metallurgy**	**(08 Hrs.)**
Introduction, Advantages and limitations of powder metallurgy, Production of metals powder, Characteristics of powder, Powder conditioning, Powder Compacting, Hot compacting methods, Sintering and sintering furnaces, Production of powder metallurgical parts such as self-lubricating bearings, ferrites, electric contact materials, Carbide cutting tools etc		

Term Work

Term work shall consist of following experiments

1. Preparation of polystyrene/phenol-formaldehyde/urea-formaldehyde resin.
2. To determine molecular weight/radius of macromolecule polystyrene/ polyvinyl alcohol by viscosity measurement.
3. Estimation of percentage of Iron in Plain Carbon Steel by Volumetric Method.
4. Study of corrosion of metals in medium of different pH.
5. Determination of rate of corrosion of aluminium in acidic and basic medium.
6. Determination of percentage of Ca in given cement sample
7. Preparation of phenol-formaldehyde resin/ urea-formaldehyde.
8. Estimation of copper in brass solution.
9. Determination of rate of corrosion of aluminium in acidic and basic medium.
10. To obtain metallic coating on base metal by using Electroplating and Electroless plating method.

Assignment

Numerical and/or theory questions on following topics from previous year question papers of GATE/ESE Mechanical Engg. examinations.

1. Mechanism of Plastic deformations
2. Mechanism of recrystallizations
3. Tensile test, Hardness testing
4. calculations a phase and its percentages
5. Heat treatment of steels
6. Cast irons applications
7. Stainless steels
8. Heat treatment of tool steels
9. Production of powder productions
10. Production of powder metallurgical parts

Text Books

1. Material Science and Physical Metallurgy", Dr.V.D. Kodgere, Everest Publication, Pune.
2. "Material science and Metallurgy", O P Khanna, Khanna Publication,Delhi
3. "Material Science and Engineering", R K Rajput, S K Kataria and Sons Publication, Delhi

Reference Books

1. "Physical Metallurgy", S H Avner, Tata Micro hill Publication, Delhi
2. "Physical Metallurgy" RaghwanV, PHI Learning Pvt. Ltd,Delhi
3. Polymer Science, V. R. Gowarikar, N. V. Viswanathan, jayadevSreedhar, Wiley Eastern Limited

4. Polymer Science and technology (2nd Edition), P. Ghosh, Tata McGRAW Hill, 2008
5. Polymers: Chemistry & Physics of Modern Materials (2nd edition) J.M.G. Cowie, Blackie Academic & Professional, 1994.
6. Engineering Chemistry by Dr. A. K. Pahari and Dr. B. S. Chauhan, Laxmi Publications (P) Ltd, New Delhi.
7. Engineering Chemistry (16th Edition) Jain, Jain, DhanpatRai Publishing Company, 2013.

Project Based Learning

Following is the list of Topics for Project Based Learning (Not Limited to) based on the syllabus contents:

1. To develop demonstration model of crystal structure.
2. To prepare a chart on different material and its recrystallization temperatures.
3. To develop a tensile test specimen as per the standards and find its U T S and Y S
4. To find the hardness ofany one component by Brinel or Rockwell hardness testing machine
5. To identify flaws and defects in different materials by any NDT methods
6. Case study on case hardening of any mechanical component
7. To perform annealing on any mechanical component
8. To perform hardeningoperation by either oil quenching or water quenching on any mechanical component.
9. To prepare a chart on properties of different cast irons by using microscope, hardness testing or spark testing.
10. To prepare a flowchart on processing of tool steels
11. To developdemonstrations model of manufacturing of metal powder by atomization technique
12. To develop demonstrations model of different type of powder compacting methods
13. To prepare a flow chart of production process of carbide tools, ferrites, clutch plates and elastic contact materials.
14. To prepare a flow chart of any mechanical component manufactured by powder metallurgy technique

Unit Test

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	ITC-II: Entrepreneurship Development Skills		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 03 Hours/ Week	End Semester Examination	60 Marks	03
	Internal Assessment	40 Marks	
	Total	**100 Marks**	**03**

Course Prerequisites: -	The student should have 1. Introduction to all engineering subjects 2. Passion to become entrepreneur. 3. Ambition to create employment.
Course Objectives: -	The student should 1. Acquire knowledge of behavioral sciences and to develop positive attitude. 2. Enjoy process of learning and develop habits of language skills. 3. Learn success and failure stories. 4. Acquire basic knowledge of Functional Managements and leadership lessons.
Course Outcomes: -	The students should be able to– 1. **Understand**and develop personality traits. 2. **Understand** and use communication and interpersonal skills for grooming. 3. Developing habits of life skills books its review and learnings. 4. **Understand** and **analyze** case studies of various organizations. 5. **Understand** basics of entrepreneurship and its allied elements. 6. **Understand** role of functional management and processes of running business.

Course Contents

Unit-I	**Grooming Personality**	**(06 Hrs.)**
Personality types, attitude, developing positive attitude, Effects of Personality management aptitude (PMA), Behavior of human being, under challenging conditions, qualities needed at top level, traits for top executives, enthusiasm, Nevergiveup attitude.		
Unit-II	**Developing Skills**	**(06 Hrs.)**
Communication skills, Interpersonal skills, positive reinforcement, recognition, qualities of a leader, who is leader, behavior of leader, assume infinite responsibility, requirement for professional success.		
Unit-III	**Reviews and learning's from life skill books.**	**(06 Hrs.)**
Books Review and learnings, Seven habits of highly effective people, Rich dad poor dad, Seven divine laws, Power of Positive thinking, You Can win, Leader without title, Think and grow rich.		
Unit-IV	**Case Studies**	**(06 Hrs.)**
Case studies its introduction, types of case studies its relevance and importance, format, and steps of case studies. Mrs Lata Khare, Mericom, Dangal Girl, M S Dhoni, Helen Keller. Ravindra Jain, Arunima Sinha, Study of a successful athlete, Mohammad Ali, Major Dhyanchand, leadership lessons.		
Unit-V	**Entrepreneurship and its allied elements**	**(06 Hrs.)**
Introduction to Entrepreneurship, working capital, introduction to sales, finance, risks and rewards, understand customers, how to develop market, use of social media. Types of marketing, innovation, understand statutory requirements, scaling up, managing vendors, managing employees and contractors, managing banking relations. Ways of raising fund. Understand functional management.		
Unit-VI	**Functional management and business processes**	**(06 Hrs.)**
Process of sales, Ethics in selling, Sale with integrity, Sale with honesty, law of familiarity, sale with passion and integrity, upselling and cross selling. Cash flow, definition of business, managing payables, managing commitments in tough times.		

List of Assignments

1. What are different types of personalities? What make them stand themselves different from each other? Choose one type of personality and make an analysis of your personality traits.
2. What different behavioral aspects are important to be a good leader? Analyze and prepare the design thinking model for inculcating behavioral aspects of a leader.
3. Communication is lubricant to run an organization smoothly. State your suitable reasoning in concern to the statement and prepare the model to implement it in your organization.
4. What are different interpersonal skills? why do they play significant role in developing business at peak. Elucidate with suitable examples.
5. Choose a like skills book of your choice and prepare review of it and implement the learning lessons for your business model.
6. Why do books on life skills important for a businessman? State your reasoning with appropriate examples.
7. What is meant by case studies? What is its relevance in the business world? Choose a topic from the enlisted and prepare a case study on it.
8. What is meant by Entrepreneurship? State the importance of functional management in it with suitable examples.
9. What are different business ethics and how do they help you in developing the appropriate policy for your organization?
10. Illustrate the different business process and their roles in developing a successful business.

Text Book

1. Dynamics of Entrepreneurial Development & Management -Vasant Desai Himalaya Publishing House.

Reference Books

1. Principles of Management -P. C. Tripathi, P. N. Reddy; Tata McGraw Hill, 4th Edition, 2010.
2. Entrepreneurship Development -Small Business Enterprises -Poornima M ChrestomathyPearson Education – 2006.
3. Communication Skills by Pushpa Lata and Sanjay Kumar published Oxford University Press.
4. Developing Communication Skills By Meera Banerjee published by Oxford University Press
5. The Third Wave: An Entrepreneur's Vision of the Future (Hardcover)by Steve Case
6. Losing the Signal: The Untold Story Behind the Extraordinary Rise and Spectacular Fall of BlackBerry by Jacquie McNish
7. The 16 Personality Types: Profiles, Theory, & Type Developmentby A.J. Drenth

Project Based Learning

Following is the list of topics for project based learning (Not Limited to) based on the syllabus contents. Group of students should meet entrepreneur and complete the case studies.

1. Company history, establishment.
2. Type of Industry
3. Entrepreneur personality & his approach.
4. Behavioral aspects (leadership quality)
5. Communication skills & Interpersonal skills
6. Correlation of reference books Review and learnings, seven habits of highly effective people, Rich dad poor dad, Seven divine laws, Power of Positive thinking, You Can win, Leader without title, Think and grow rich. with respect to entrepreneur

7. How the working capital work developed
8. Functioning of Production department,
9. Marketing department
10. Financial department

Unit Test –

Unit Test-I	Unit- I, II, III
Unit Test-II	Unit- IV, V, VI

Designation of Course	**Theory of Machines**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Theory: - 03 Hours/ Week	End Semester Examination	60 Marks	03
Practical: - 02 Hours/Week	Internal Assessment	40 Marks	
Tutorial: - 01 Hour/Week	Term Work and Oral	50 Marks	01
	Tutorial	Internal Evaluation	01
	Total	**150 Marks**	**05**

Course Prerequisites:-	1. Engineering Physics and Mathematics 2. Engineering Mechanics 3. Mechanisms of Machines
Course Objectives:-	1. To develop competency in understanding of theory of spur and helical gear. 2. To develop competency in different types of gear train. 3. To develop understanding of static and dynamic balancing, cam and follower, gyroscopic forces; and moments.
Course Outcomes:-	1. **Understand** the gear theory which will be the prerequisite for gear design. 2. **Understand** torque transmitting capacity in gear trains which will be the prerequisite for gear box design. 3. **Apply** the principles of balancing of masses to various links, mechanisms and engines 4. **Understand** the concept of different types of governor and its applications. 5. **Analyze** various types of cam and followers with different kinds of follower motion. 6. **Apply** the principles of gyroscopic effects and stabilization on various transport vehicles.

Course Contents

Unit-I	**Spur Gears**	**(06 Hrs)**
Classification, Spur gear: definition, terminology, fundamental law of toothed gearing, involute and cycloidal profile, path of contact, arc of contact, conjugate action, contact ratio, minimum number of teeth, interference and under cutting, Friction in gears. **Helical gears:** nomenclature, Center Distance		
Unit-II	**Gear Trains**	**(06 Hrs)**
Types of Gear Trains, analysis of epicyclic gear trains, Holding torque – Simple, compound and epicyclic gear trains, torque on sun and planetary gear train, compound epicyclic gear train, Bevel epicyclic Gear train. Types of gearboxes.		
Unit-III	**Balancing**	**(06 Hrs)**
Static and dynamic balancing, balancing of rotating masses in single and several planes, primary and secondary balancing of reciprocating masses, balancing in single cylinder engines, balancing in multi-cylinder in-line engines, direct and reverse cranks method -radial and V-engines.		
Unit-IV	**Governors**	**(06 Hrs)**
Introduction, Classification, Centrifugal Governor, Terminology, Watt Governor, Porter Governor, Proell Governor, Hartnell Governor, Wilson-Hartnell Governor.Sensitiveness, Stability, Isochronous, Hunting. Effort and Power of Governor, Controlling Forces, Friction and insensitiveness.		
Unit-V	**Cam and Follower**	**(06 Hrs)**
Types of cams and followers, analysis of standard motions to the follower, Determination of cam profiles for different follower motions, analysis of circular arc cam with flat face follower. Methods of control pressure angle, radius of curvature and undercutting. Jump phenomenon of Eccentric cam, Introduction to advanced cam curves (3-4-5 Polynomial cam only)		

Unit-VI	Gyroscope and Step–Less-Regulation	(06 Hrs)
Gyroscopes- Gyroscopic forces and Couples, Gyroscopic stabilisation for ship and Aeroplane, Stability of four-wheel drive vehicle moving on curved path, Stability of a two-wheel vehicle. **Continuous Variable Transmissions** - Geometry, Velocity and torque analysis of Faceplate variators, Conical variators, Spheroidal and cone variators, Variators with axially displaceable cones, PIV drives. (Theoretical Treatment Only)		

Term Work

Term work shall consist of following experiments. Hand calculations must be confirmed through a computer programme using any programming language.

1. To draw conjugate profile for any general type of gear tooth
2. To generate involute gear tooth profile and to study the effect of undercutting and rack shift using model.
3. To study various types of gearboxes- constant mesh, sliding mesh, synchromesh gear box, Industrial gearbox, differential gearbox.
4. To measure holding torque of the epicyclic gear train.
5. To find the percentage of slip of belt material
6. To balance a system of masses revolving in a plane on a rotating shaft on V Lab
7. To determine the effect of varying mass on the centre of sleeve in Porter and Proell Governor
8. To draw the cam profiles and study the effect of Different follower motions, and Different follower (roller) dimensions
9. To verify the gyroscopic principles.
10. Study of Continuous Variable Transmission and Infinite Variable Transmission.
11. Mini Project based on the contents of the syllabus.

Assignments

Numerical and/or theory questions on each unit from previous year question papers of GATE/ESE Mechanical Engg. examinations.

Tutorial

Numerical and/or theory questions on following topics from previous year question papers of GATE/ESE Mechanical Engg. examinations.

1. Spur Gears
2. Gear Trains
3. Balancing
4. Gyroscope
5. Cam and Follower
6. Governors

Reference Books

1. Thomas Bevan, “Theory of Machines”, CBS Publishers & Distributors, Delhi.
2. Shigley J.E. and Uicker J.J., “Theory of Machines and Mechanisms”, McGraw Hill, Inc.
3. Ghosh Amitabh and Malik A.K., “Theory of Machines and Mechanisms”, East-west Press.
4. Hall A.S., “Kinematics and Linkages Design”, Prentice-Hall.
5. Hartenberg and Denavit, “Kinematic Analysis and Synthesis of Mechanisms”.
6. Erdman, A. G. & Sandor, G.N., “Mechanism design, Analysis and synthesis”, Vol 1, Prentice – Hall of India.

Text Books

1. Rattan S. S., "Theory of Machines", Tata McGraw Hill.
2. Ballaney P. L., "Theory of Machines", Khanna Publishers, Delhi.
3. R. S. khurmi, "Theory of Machines', S Chand Publication.

Project Based Learning

Following is the list of topics for project-based learning (Not Limited to) based on the syllabus contents:

1. To prepare a chart on comparison among different types of gears
2. To prepare a chart to understand various terminology of spur gear.
3. To prepare a chart to understand different methods to avoid interference in spur gear.
4. To develop a mechanical system using simple gear train.
5. To develop a mechanical system using compound gear train.
6. To develop a mechanical system using reverted gear train.
7. To develop a mechanical system using epicyclic gear train.
8. To prepare a chart comparison among different types of gear trains.
9. To develop demonstration model of static and dynamic balancing systems.
10. To develop demonstration model of balancing of rotating masses.
11. To develop demonstration model of balancing of reciprocating masses.
12. Case study on real life applications of various types of governors.
13. To develop demonstration model of a Watt Governor/Portal Governor/Proell Governor.
14. To prepare a charton compression among different types of governors.
15. To prepare a chart to understand various terminology of Cam profile.
16. To prepare a chart on comparison among different types of followers.
17. To prepare a chart on comparison among different types of follower motions.
18. To develop demonstration model on real life applications of gyroscopic effect such as Ship, aeroplane,automobile, etc.

Unit Tests

Unit Test-I	Unit-I, II, III
Unit Test-II	Unit-IV, V, VI

Designation of Course	Solid Modelling		
Teaching Scheme:	**Examination Scheme**		**Credits Allotted**
Practical:- 04 Hours/Week	Term Work and Practical	50 Marks	02
	Total	**50 Marks**	**02**

Course Prerequisites: -	1. Computer Aided Drafting and Visualisation 2. Computer Aided Machine Drawing
Course Objectives: -	1. To introduce students to the basicconcepts of CAD modelling. 2. To develop the skills in Reading and Interpretation of Engineering Drawings. 3. To familiarize students with SolidWorks Software to Crate 2D and 3D model, Assembly, Drafting and Sheet metal modelling.
Course Outcomes: -	The students will be able to 1. **Understand** the concepts of CAD modelling. 2. **Creating** 3D machine components using SolidWorks Software. 3. **Creating** Assembly of machine components using SolidWorks Software. 4. **Creating** surface model of Automobile Components using SolidWorks Software. 5. **Creating**detail drawing and generating Bill of Material using SolidWorks Software. 6. **Understand** the basic concepts of Sheet metal Modelling and **Create** a machine component using SolidWorks Software.

Course Contents

Unit-I	**Introduction to CAD**	**(08Hrs.)**
Introduction to CAD and CAE Features of SolidWorks, Various products available in SolidWorks for Product Design, Simulation, Communication SolidWorks Graphical User Interface - Feature manager design tree, Callouts, Handles, Confirmation corner, mouse buttons, keyboard shortcuts, Command Manager. Sketch Entities, Sketch Tools, Block, Relation and Dimensioning		
Unit-II	**Basic Part Modelling**	**(08 Hrs.)**
Part Modelling Tools, Creating Extrude features, Creating Revolve features, Creating Swept features, Creating Loft features, Creating Reference, Creating curves, Fillet features, Inserting Hole types, Creating Chamfer, Shell, rib, pattern and advanced modelling tools.		
Unit-III	**Assembly Modelling**	**(08 Hrs.)**
Introduction to Assembly Modelling & Approaches, Applying Advanced Mates and Mechanical Mates, Manipulating Components, Creating Pattern, Creating Explode Views.		
Unit-IV	**Surface Modelling**	**(08 Hrs.)**
Surface Modelling tools Creating Extrude, Revolve, Swept, loft, Boundary surface. Inserting Planar Surface, Offset Surface, Radiate Surface. Extending a surface, Surface fill, Ruled Surface, Trimming Surface, Mid surface, Replace Face, Delete face, Un-trim surface, Knit surface, Thickening a Surface, Move Face.		
Unit-V	**Draftingof Mechanical Systems**	**(08 Hrs.)**
Generating Views, Creating Dimensions, Inserting Annotations and Bill of Materials.		
Unit-VI	**Sheet Metal Modelling**	**(08 Hrs.)**
Constructing the base flange and miter Flange, addition of an Edge Flange, closing corner, Adding Jog, Unfolding the bends, Adding hem and vent.		

Term Work

Term work shall consist of A-3/A4 size printouts of the problems solved in practical's using Solid Works Software.

1. Sketcher drawings
2. Part modelling
3. Parametric Modelling
4. Assembly Modelling
5. Exploded view of Assembly
6. Surface Modelling
7. Drafting of Mechanical Systems
8. Sheet metal modelling

Text Books

1. Kuang-Hua Chang, "Motion Simulation and Mechanism Design with SOLIDWORKS Motion 2018", SDC Publishers, 2018

Reference Books

1. Ibrahim Zeid and R. Siva-Subramaniam – "CAD/CAM- Theory and Practice", Tata McGraw Hill, Publishing Co. 2009.
2. Rao P. N., "CAD/CAM", Tata McGraw Hill.
3. Foley, Van Dam, Feiner and Hughes, "Computer Graphics Principles and Practice", Second edition, Addison–Wesley, 2000.
4. Martenson, E. Micheal, "Geometric Modelling", John Wiley & Sons, 1995.
5. Ronald E. Barr, DavorJuricic, Thomas J. Krueger, "Engineering & Computer Graphics Workbook Using SolidWorks 2014", SDC Publication, 2014.
6. John Willis, Sandeep Dogra, "SOLIDWORKS 2019: A Power Guide for Beginners and Intermediate User", published by CADArtifex, 2019.

End Semester Practical/Oral examination:

1. Practical examination duration is Two hours, based on the Term work.
2. Questions provided for practical examination should contain minimum five and not more than ten parts.
3. Evaluation of practical examination to be done based on the performance of students work in laboratory.

***Oral examination should also be conducted to check the knowledge of conventional and SolidWorks drawing.**

Designation of Course	**Python Programming-II**		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
Practical:- 04 Hours/ Week	Term Work and Practical	50 Marks	02
	Total	**50 Marks**	**02**

Course Prerequisites:-	1. Soft Computing I 2. Soft Computing II 3. Python Programming-I
Course Objectives:-	The students should be able to 1. Readily use the Python filehandling 2. Apply array to solve engineeringproblems. 3. Understand data visualizationtechniques
Course Outcomes:-	Students will be able to 1. **Understand** file handling. 2. **Understand** concept ofarrays. 3. **Understand** arraymanipulation. 4. **Understand** and Apply randomnumbers. 5. **Understand** matplotlib modules. 6. **Understand** and **Apply** visualizationtechniques

Course Contents

Unit -I	**Python Files**	**(08 Hrs.)**
Python File I/O, Directory and Files Management, Errors and Built-in Exceptions, Exception Handling Using try, except and finally statement, Custom Exceptions		
Unit -II	**NumPy Array**	**(08 Hrs.)**
Create a NumPyndarray Object, Dimensions in Arrays, 0-D Arrays, 1-D Arrays, 2-D Arrays, 3-D arrays, Access Array Elements, Access 2-D Arrays, Access 3-D Arrays, Negative Indexing		
Unit -III	**NumPy Slicing Arrays**	**(08 Hrs.)**
Array Slicing, slicing 2-D Arrays, Shape of an Array, Array Reshaping, Iterating Arrays, Iterating 2-D Arrays, Joining NumPy Arrays, Splitting NumPy Arrays, Sorting Arrays		
Unit -IV	**NumPy Random**	**(08 Hrs.)**
Pseudo Random andTrueRandom,Generate Random Number, Generate Random Float, Generate RandomArray,GenerateRandomNumberfromArray,NormalDistribution,VisualizationofNormal Distribution, Binomial Distribution, Poisson Distribution, Uniform Distribution, Exponential Distribution		
Unit -V	**Matplotlib**	**(08 Hrs.)**
Install matplotlib, Pyplot API, Figure Class, Axes Class, Multiplot, Subplots () Function, FormattingAxes, Setting Limits, Setting Ticks and Tick Labels		
Unit -VI	**Two Dimensional and Three-Dimensional Visualization**	**(08 Hrs.)**
Bar Plot, Histogram, Pie Chart, Scatter Plot, Pie Chart, Contour Plot, 3D Contour Plot, 3D Wireframe plot, 3D Surface plot		

Term Work

1. Read and write given text file (1exercises)
2. Python NumPy Exercise (2exercises)
3. Practice NumPy questions such as Array manipulations, numeric ranges, Slicing, indexing, Searching, Sorting, and splitting, and more.
4. Random Data Generation Exercise (2exercises)
5. Practice and Learn the various techniques to generate random data in Python.

6. Python Matplotlib Exercise (3exercises)
7. Practice Data visualization using Python Matplotlib. Line plot, Style properties, multi-line plot, scatter plot, bar chart, histogram, Pie chart, Subplot, stack plot.

Text Books:

1. Introduction to Computation and Programming using Python, by John Guttag, PHIPublisher,
2. Timothy A. Budd, "Exploring Python", Mc-Graw Hill Education (India) Private Ltd.,2015.
3. Robert Sedgewick, Kevin Wayne, Robert Dondero, "Introduction to Programming in Python:AnInter-disciplinaryApproach,PearsonIndiaEducationServicesPvt.Ltd.,2016.

Books of References

1. Python Programming using problem solving Approach by ReemaThareja, Oxford University, Higher Education Oxford University Press; First edition (10 June 2017), ISBN-10: 0199480173.
2. Data Structures and Algorithms in Python by Michael T Goodrich and RoberttoThamassia, Micheal S Goldwasser, Wiley Publisher(2016)
3. Fundamentals of Python first Programmes by Kenneth A Lambert, Copyrighted material Course Technology Inc. 1st edition (6th February2009)

Supplementary Resources:

1. http://www.w3schools.com
2. http://docs.python.org
3. http://www.tutorialspoint.com
4. http://www.learnpython.org

Designation of Course	Vocational Course I: Automobile Servicing- I		
Teaching Scheme	**Examination Scheme**		**Credits Allotted**
	Term Work and Oral	50 Marks	02
	Total	**50 Marks**	**02**

Course Prerequisites:	1. Basic knowledge of automobile engineering and servicing
Course Objectives: -	1. To perform skilled mechanical work in diagnosing, repairing and maintaining all major vehicle systems of four-wheeler 2. To provide knowledge on automotive industry and job-related activities as an automotive service technician. 3. To work safely and responsibly within all shop standards and environmental guidelines.
Course Outcomes: -	1. **Understand and apply** different types of tools and workshop equipment in the workshop for servicing. 2. **Understand and apply** dismantle and reassemble of engines, cooling and transmission of different vehicles 3. **Understand and apply** dismantle and reassemble of fuel supply system, Steering Mechanism, Wheel Balancing and Wheel Alignment. 4. **Understand and apply** dismantle and reassemble of Battery, Ignition and Starting System 5. **Understand and apply** dismantle and reassemble of Tyre Repairer/Inspection, Auto Body Repair, Denting & Painting 6. **Understand and apply** overhaul of electrical wire harness, lighting, ignition, electronic and air-conditioning systems etc.

Course Contents

Unit-I	**Introduction to Four-wheeler Servicing:**	**(08 Hrs.)**
Familiarization of workshop manual. Practice on how to read job-card. Identification of different types of vehicle. Identification of Vehicle Identification Number, Chassis no. & Engine no identification of different types of engine components, Lubrication and Maintenance Schedule Necessity for routine maintenance, Importance of service manuals, Specification of engines- petrol and diesel vehicles(a) Engine (b) Clutch (c) Gear Box (d) Propeller shaft (e) Universal joints (f) Differential (g) Axles and hubs (h) Suspension system (i) Steering system (j) Tyre (k) Chassis (l) Brake-drum and disc Battery (m) Self-starter (n)Dynamo, Checking of compression and vacuum, Car wash – before & after servicing using different types of nozzles Check / replenish / top up – lubricating oil, engine coolant, power steering hydraulic oil, wind screen wiper water. Replace – air cleaner, oil filter & fuel filter Apply Grease to parts / through greasing points (if necessary).		
Unit-II	**Engine Servicing, Cooling and Power Transmission**	**(08 Hrs.)**
Engine Service: Introduction, Engine removal, cylinder head, Valve and Valve mechanism, piston connecting rod assembly, cylinder block, crankshaft and main bearing, engine reassembly. Engine tuning: Meaning and scope of engine tuning. Necessity of engine tuning, Engine analysis and tuning with the help of diagnostic computer, Diesel engine injection timing checking. **Engine cooling systems:** Necessity, Methods of cooling, Radiator, Cooling system trouble shooting. **Power Transmission:** Remove & refit vehicle body parts (bonnet, front bumper & door) Check / replenish/top up brake fluid, transmission oil. Adjust Hand brake and replace hand brake cable Adjust clutch and brake pedal plays Replace propeller shaft, wheel hub bearings & brake pads.		

Unit-III	Engine Fuel Supply System, Steering, wheel Balancing and Alignment	(08 Hrs.)
Petrol and Diesel Engine Fuel Supply System: Fuel Supply Systems, Fuel pump, Fuel injection, Fuel pump testing, troubleshooting and service, Fuel supply system troubleshooting, Fuel filters and air cleaners. Maintenance Schedule of diesel engine fuel injector, hot plugs, rotary and reciprocating type of fuel injection pump, fuel injection pump of single cylinder engines, hoses & pipelines, priming unit, tanks.**Front Axle and Steering:** Introduction, Front axle, steering geometry, Steering mechanism, power steering, steering adjustment, Steering trouble shooting. **Wheel Balancing:** Remove tyre from vehicle. Check tyre & rim and check for run out. Fit the tyre assembly to the vehicle. **Wheel Alignment**: Check tyres, ride height, wheel bearings, ball joints, control arms bushings and sway bars, shock absorbers, struts & power steering. Identify components, brief working principle & operation of computerized wheel aligner Procedure to make the aligner ready to check wheel alignment. Procedure for taking readings, interpreting alignment readings and rectify steering geometry with wheel aligner – take a printout. Procedures for test drive to confirm the repairs.		
Unit-IV	**Battery, Ignition and Starting System**	**(08 Hrs.)**
Battery and Ignition System: Remove and refit head lamp assembly. Check power plug and inspect H.T. cables Clean, Check and Adjust spark plug Cleaning and topping up of a lead acid battery, testing battery with hydrometer, battery tester, connecting battery to a charger for battery charging. **Starting System:** Starting motor, Starting drives, Electronic starter control, **i**dea of engine starting-system circuit. Testing the starting system and troubleshooting.**Ignition System:** Idea of Battery-and-coil ignition circuit and its working. Compression ignition of diesel engines.		
Unit-V	**Tyre Repairer/Inspection, Auto Body Repair, Denting & Painting**	**(08 Hrs.)**
Tyre Repairer/Inspection: Removal & re-fitting of wheel from light & heavy vehicle. Measurement of tread wear. Dismantling tyre & tube, checking puncture, assembling, inflate it to correct pressure. Vulcanizing of tubes & tyres. Repair tubeless tyre puncture. Air inflation with nitrogen gas inflator according to the manufacturer's recommendation. Practice on Tyre rotation as per vehicle manufacturers recommendation.**Auto body repair:** Identification of different types of body, chassis and drive lines, Identification of location of parts and panels, Practice on operating the air compressor, Practice on periodical maintenance of air compressor Inspect and decide whether it can be repaired or replaced Remove and refit body panels, doors, floors, wheel boxes and fenders Practice on removing and refitting wind shield glasses.**Auto body painting:** Consumable's clothing safety, Practice on removing paint from the damaged area Practice on mixing and applying body filler Practice on sanding (block) Practice on mixing and applying putty Practice on applying primer Practice on feather edge sanding and masking Base coat application Surface cleaning and degreasing Second and third coat application Preheating the vehicle and cooling Cutting, scuffing, rubbing and polishing.		
Unit-VI	**Modern Electric and Hybrid Vehicles**	**(08 Hrs.)**
Introduction to electric and hybrid electric vehicles, History of hybrid and electric vehicles, Social and environmental importance of electric and hybrid electric vehicles, Electrical basics, Motor and generator basics, Electric and Hybrid Electric Drive Trains Basic concept of electric and hybrid traction, Introduction to various electric and hybrid electric drive train topologies, Advantages, and disadvantages. **Power Flow:** Power flow control in electric and hybrid electric drive train topologies. **Electric Drive Components:** Eletric drive components used in electric and hybrid vehicles, Electric motor requirements, Direct Current (DC) motors (Brushed and Brushless), Power converters, Drive controllers.		

List of Experiments-

1. To Follow standard operating procedures for using workshop tools and equipment for fault diagnosis or troubleshoot problem in a vehicle.
2. To Understand the auto component manufacturer specifications related to the various components/ aggregates in the vehicle (including major aggregates like engine. gear box, transmission systems propeller shaft etc.)

3. To Service, repair and overhaul of steering system.
4. To Service, repair and overhaul of suspension system.
5. To Service, repair and overhaul of tyres.
6. To Service, repair and overhaul of wheels.
7. To Service, repair and overhaul diesel Engines and its fuel system.
8. To Service, repair and overhaul petrol Engines and its fuel system.
9. To Service, repair and overhaul of cooling system and radiator
10. To Service, repair and overhaul of emission and exhaust system.
11. To Service, repair and overhaul of gearbox, drive-train assembly, and transmission systems (manual, automatic etc.)
12. To Service, repair and overhaul of brake system.
13. To Service, repair, and overhaul of clutch assembly.
14. Repair and overhaul of electronic control unit
15. To Repair and overhaul of electrical wire harness, lighting, ignition, electronic and air-conditioning systems etc.

Text Books

1. Automobile Mechanics, A.K. Babu, S.C.Sharma, T.R. Banga, Khanna Publishing House

Reference Books

1. Automobile Engineering by Kirpal Singh Standard Publishers Distributors.
2. Automotive Engines, A.K. Babu, Khanna Publishing House