DEPARTMENT OF MECHANICAL ENGINEERING
GURU JAMBHESHWAR UNIVERSITY OF SCIENCE & TECHNOLOGY, HISAR

B.Tech. (Mechanical Engineering) Programme

V- Semester

Sr. No.	Category	Course Code		Course Title	Hours per week			Course Credits		
		Theory	Practical		L	T	P	Theory	Practical	Total
1.	Open Elective Courses	OE (refer to list)#	--	Open Elective-I	3	0	0	3.0	--	3.0
2.	Humanities & Social Sciences including Management Courses	HSMC302-T	--	Fundamental of Management for Engineers	2	0	0	2.0	--	2.0
3.	Professional Core Courses	PCC-ME301-T	PCC-ME301-P	Kinematics of Machines	3	0	2	3.0	1.0	4.0
4.	Professional Core Courses	PCC-ME302-T	PCC-ME302-P	Hydraulic Machines	3	1	2	4.0	1.0	5.0
5.	Professional Core Courses	PCC-ME303-T	PCC-ME303-P	Internal Combustion Engines and Gas Turbines	3	0	2	3.0	1.0	4.0
6.	Professional Core Courses	PCC-ME304-T	--	Design of Machine Elements	2	2	0	4.0	--	4.0
7.	Project work, Seminar and Internship in Industry	--	PROJ-ME301-P	Industrial Training Presentation-I	0	0	2	--	1.0	1.0
8.	Mandatory Courses	--	MC-ME301-P	Technical Presentation	0	0	2	--	0.0	0.0
					16	3	10			
Total credits										23.0

#Open Elective -I	
Course Code	**Course Name**
OE-PTG391-T	Fundamentals of Printing
OE-CSE391-T	Information and Cyber Security
OE-ECE391-T	Principles of Digital Electronics
OE-FT391-T	Processing and Preservation of Foods
OE-CE391-T	Introduction to Civil Engineering
OE-EE391-T	Utilization of Electrical Energy

5th Semester

KINEMATICS OF MACHINES (THEORY)

General Course Information

Course Code: PCC-ME301-T Course Category: Professional Core Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define the various terminologies of kinematics of machines like element, kinematic pair, kinematic chain, mechanism, machine, motion of elements and fundamental laws of kinematics.	L1
CO2	Students will be able to describe the concept of mechanisms, machines, their components and relative motion between them.	L2
CO3	Students will be able to solve different kind of problems related to machines and mechanisms while applying the principles of kinematics.	L3
CO4	Students will be able to analyse different mechanisms for displacement, velocity and acceleration graphically.	L4
CO5	Students will be able to select and design appropriate mechanism required for a specific type of relative motion and for a particular application.	L5

Course Contents

UNIT-I

Introduction: Mechanism and Machines, Kinematic Links, Kinematic Pairs, Kinematic Chains, Degree of Freedom, Kinematic Inversion, Inversions of Four Bar Kinematic Chain, Inversions of Single Slider Kinematic Chain, Inversions of Double Slider Kinematic Chain, Problems

Mechanism with Lower Pairs: Pantograph, Straight Line Mechanisms, Exact Straight Line Motion Mechanisms, Approximate Straight Line Motion Mechanisms, Steering Gear Mechanisms, Davis Steering Gear, Ackerman Steering Gear, Problems

UNIT-II

Velocity in Mechanisms: Relative Velocity Method: Motion of a Link, Velocity of a Point on a Link by Relative Velocity Method, Velocities in a Slider Crank Mechanism, Instantaneous Centre Method: Space and Body Centrodes, Velocity of a Point on a Link by Instantaneous Centre Method, Aronhold Kennedy Theorem, Methods of Locating Instantaneous Centres in a Mechanism, Problems

Acceleration in Mechanisms: Acceleration diagram for a link, Acceleration of a point on a link. Acceleration in the Slider Crank Mechanism, Coriolis Component of Acceleration, Problems

UNIT-III

Cams: Classification of Cams and Followers, Disc Cam Nomenclature, Construction of Displacement, Velocity and Acceleration Diagrams for Different Types of Follower Motions, Determination of Basic Dimension, Synthesis of Cam Profile by Graphical Approaches, Problems

Kinematic Synthesis: Kinematic Synthesis: Dimensional synthesis, function generation, path generation and motion generation, Synthesis of Four Bar linkage for specified Instantaneous conditions, Problems

UNIT-IV

Gears: Fundamental Law of Gearing, Forms of Gear Teeth, Path of Contact, Arc of Contact, Interference and Undercutting, Non Standard Gear Teeth, Helical, Spiral, Bevel and Worm Gears, Problems

Gear Trains: Synthesis of Simple, Compound and Reverted Gear Trains, Analysis of Epicyclic Gear Trains, Problems

Text and References Books

1. KJ, Waldron and GL, Kinzel, Kinematics, Dynamics and Design of Machinery, Wiley Publishers, Edition, 2016.
2. A, Ghosh and AK, Malik, Theory of Mechanisms and Machines, East West Press Private Limited Publishers, Edition, 2017.
3. JJ, Uicker (Jr), GR, Pennock and JE, Shigley, Theory of Machines and Mechanisms, Oxford Publishers, 2016.
4. SS, Rattan, Theory of Machines, Tata McGraw Hill Publishers, Edition, 2017.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	--	--	--	--	--	--	--	3	3	--	--
CO2	3	2	1	1	--	--	--	--	--	2	--	3	3	--	--
CO3	3	3	2	1	1	--	--	--	1	2	--	3	3	--	--
CO4	3	3	2	2	1	--	--	1	2	2	--	3	3	1	1
CO5	3	2	3	2	2	--	--	1	2	2	--	3	3	2	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

KINEMATICS OF MACHINES (LAB)

General Course Information

Course Code: PCC-ME301-P Course Category: Professional Core Course Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to name various terms related to kinematics of machines like link, kinematic pair, kinematic chain, mechanism and machine.	L1
CO2	Students will be able to describe link, kinematic pair, kinematic chain, mechanism and machine through models.	L2
CO3	Students will be able to solve different kind of problems related to links, mechanisms and machines experimentally.	L3
CO4	Students will be able to analyse different links, kinematic pairs, kinematic chains, mechanisms though models and experimentally.	L4
CO5	Students will be able to select and design appropriate element, pair, mechanism and machine required for a particular application.	L5

Lab Contents

1. To Study Various Types of Kinematic Links, Pairs, Chains and Mechanisms.
2. To Study Inversions of Four Bar, Single Slider and Double Slider Crank Chains.
3. To Find Coefficient of Friction Between Belt and Pulley, and Rope and Pulley.
4. To Study Various Types of Cam and Follower Arrangements.
5. To Plot Follower Displacement Vs Cam Rotation for Various Cam Follower Systems.
6. To Generate Spur Gear Involute Tooth Profile using Simulated Gear Shaping Process.
7. To Study Various Types of Gears: Spur, Helical, Double Helical, Worm, Spiral and Bevel Gears.
8. To Study Various Types of Gear Trains: Simple, Compound, Reverted and Epicyclic Gear Trains.
9. To Determine the Speed Ratio of a Gear Train.
10. To Compute the Efficiency of an Epicyclic Gear Train.
11. Create various types of linkage mechanism in CAD and simulate for motion outputs and study the relevant effects.
12. Creation of various joints like revolute, planes, spherical, cam follower and study the degree of freedom and motion patterns available.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	1	--	--	--	--	--	--	--	3	3	--	--
CO2	3	2	1	1	--	--	--	--	--	2	--	3	3	--	--
CO3	3	3	2	1	1	--	--	--	1	2	--	3	3	--	--
CO4	3	3	2	2	1	--	--	1	2	2	--	3	3	1	1
CO5	3	2	3	2	2	--	--	1	2	2	--	3	3	2	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

HYDRAULIC MACHINES (THEORY)

General Course Information

Course Code: PCC-ME302-T Course Category: Professional Core Course Course Credits: 4.0 Contact Hours: 4 hours/week (L: 3; T: 1) Mode: Lectures and Tutorials Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define the fundamentals of hydraulic turbines, pumps, and systems.	L1
CO2	Students will be able to understand the constructional details and working principle of hydraulic machines.	L2
CO3	Students will be able to solve the problems related to designs of hydraulic machines.	L3
CO4	Students will be able to evaluate the performance of turbines, pumps and other hydraulic systems.	L4

Course Contents

UNIT-I

Impact of free jets & Basics of Fluid Machines: Introduction, Impulse momentum principle, Force exerted by a jet on a stationary and moving vertical flat plate, Force exerted by a jet on stationary and moving inclined flat plate, Force exerted by a jet on stationary and moving curved vane, Force exerted by a jet on a series of flat plates, Force exerted by a jet on a series of radial curved vanes, Force exerted by a jet on a hinged plate, Jet propulsion of ships, general classification of fluid machines, Hydraulic machines and its main parts, Numerical Problems.

Pelton Turbine (Impulse Turbine): Introduction, Classification of hydraulic turbines, Impulse turbine operation principle, General layout of a hydro-electric power plant, Heads and efficiencies of a hydraulic turbine, Water wheel, Pelton turbine (Pelton wheel), Governing of Pelton turbines, Velocity triangles, work done, and efficiency of the Pelton turbine, Design aspects of the Pelton turbine, Numerical Problems.

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UNIT-II

Francis Turbine (Radial Flow Reaction Turbines): Introduction, Radial flow reaction turbines: inward and outward radial flow reaction turbines, Construction, working operation and governing of Francis turbine, Velocity triangles, work done, and efficiency of radial flow reaction turbines and Francis turbine, Degree of reaction, Working proportions of a Francis turbine and radial flow reaction turbines, Design and shape of Francis turbine runner, Numerical Problems.

Propeller & Kaplan Turbines and Performances of Hydraulic Turbines: Introduction, Construction and working of Propeller and Kaplan turbines, Governing of Kaplan turbines, Working proportions of Kaplan and propeller turbines, Draft tube: Theory & its Efficiency, Cavitation in turbines, Introduction to New types of turbines: Deriaz, Tubular and Bulb turbines, Unit quantities: speed, discharge and power, Specific speed, Model relationship and testing of turbines, Characteristic curves, Selection of turbines, Numerical problems.

UNIT-III

Centrifugal Pumps: Introduction, Classification of pumps, Construction and working of centrifugal pumps, Priming devices, Velocity triangles and work done by centrifugal pump, Head of a centrifugal pump, Pressure rise in the impeller, Losses, power and efficiencies of centrifugal pumps, Effect of outlet vane angle on manometric efficiency, Slip factor, Minimum starting speed, Design considerations, Multistage pumps, Specific speed of centrifugal pumps, Model testing of centrifugal pumps, Performance characteristics of centrifugal pumps, Maximum suction lift, Net positive suction head (NPSH), Cavitation in centrifugal pumps, Numerical problems.

Reciprocating Pumps: Introduction, Main parts and working of a reciprocating pump, Discharge, work done, and power required for driving single and double acting reciprocating pumps, Effect of variation of velocity in the suction and delivery pipes, Indicator diagrams: Maximum speed of a reciprocating pump and Effect of acceleration and friction in suction and delivery pipes on indicator diagram, Air vessels: Work done by a reciprocating pump and its Maximum speed with air vessel, Characteristic curves of a reciprocating pump, Rotary positive displacement pumps and Numerical problems.

UNIT-IV

Dimensional Analysis and Model Similitude: Introduction, Dimensional homogeneity, Methods of dimensional analysis: Rayleigh and Buckingham pi methods, Similitude-types of similarities, Dimensionless numbers and their significance, Similarity laws or model laws: Reynolds model law, Froude model law, Euler model law, Weber model law, Mach model law, Types of models, Scale effects in models and numerical problems

Hydraulic systems: Introduction, Hydraulic press, Hydraulic accumulator, Hydraulic intensifier, Hydraulic ram, Hydraulic lift, Hydraulic crane, Hydraulic coupling, Hydraulic torque converter and Numerical problems.

Text and Reference Books

1. Fluid Mechanics and Hydraulics Machines, Mahesh Kumar, Pearson Education, 2019.
2. Hydraulics & Fluid Mechanics – Modi & Seth, Pub. - Standard Book House, N.Delhi, 2010
3. Hydraulic Machines – Jagdish Lal, Metropolitan, 1998
4. Fluid Mechanics and Hydraulic Machines – S S Rattan, Khanna Publishers, 1998
5. Introduction to Fluid Mechanics and Fluid Machines – S K Som and G Biswas, Tata McGraw Hill, 2009
6. Fluid Mechanics and Fluid Power Engineering – D S Kumar, S K Kataria and Sons, 2010
7. Fluid Mechanics and Hydraulic Machines-R. K. Rajput, S. Chand & Company, 2014
8. Fluid Mechanics and Hydraulic Machines-R. K. Bansal, Laxmi Publications, 2010
9. Fluid Mechanics-Cengel and Cimbala, Mc Graw Hill Education, 2014

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	1	--	--	2	3	2	2	3	--	3	3	3	2
CO2	3	1	1	--	--	2	3	2	2	3	--	3	3	2	2
CO3	3	3	3	3	3	3	3	3	3	3	2	3	3	2	2
CO4	3	2	3	3	3	3	3	3	3	3	3	3	3	2	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

HYDRAULIC MACHINES (LAB)

General Course Information

Course Code: PCC-ME302-P Course Category: Professional Core Course Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to learn the basics elements of hydraulic machines and their layout.	L1
CO2	Students will be able to classify hydraulic machines.	L2
CO3	Students will be able to operate hydraulic machines and evaluate their performance.	L3
CO4	Students will be able to compare the performance of hydraulic machines and able to create characteristic curves at given conditions.	L4

Lab Contents

1. To determine the water power, mechanical power and efficiency of a Pelton turbine.
2. To draw the following performance characteristics of Pelton turbine-constant head, constant-speed and constant efficiency curves.
3. To determine the hydraulic efficiency of a Francis turbine.
4. To draw the constant head, constant speed and constant efficiency performance characteristics of a Francis turbine.
5. To study the construction details of a Kaplan turbine and draw its fluid flow circuit.
6. To draw the constant head, speed and efficiency curves for a Kaplan turbine.
7. To study the constructional details of a Centrifugal Pump and evaluate its performance at different operating conditions.
8. To study the constructional details of a Reciprocating Pump and draw its characteristics curves.
9. To study the construction details of a Gear oil pump and its performance curves.
10. To study the constructional details of a Hydraulic Ram and determine its efficiency.
11. To study the model of Hydro power plant and draw its layout.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1	--	--	--	--	1	--	--	2	--	3	3	2	--
CO2	3	--	--	--	--	--	--	--	--	2	--	3	2	--	--
CO3	3	2	2	3	3	2	1	2	3	3	1	3	2	3	2
CO4	3	2	2	3	3	2	1	2	3	3	2	3	2	3	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

INTERNAL COMBUSTION ENGINES AND GAS TURBINES (THEORY)

General Course Information

Course Code: PCC-ME303-T Course Category: Professional Core Course Course Credits: 3.0 Contact Hours: 3 hours/week (L: 3; T: 0) Mode: Lectures Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to describe the basics of SI & CI, air standard cycles, rotary compressors, and gas turbines.	L1
CO2	Students will be able to explain the combustion phenomenon, lubrication and cooling of IC engines.	L2
CO3	Students will be able to demonstrate knowledge of the operating characteristics of common internal combustion engines.	L3
CO4	Students will be able to examine the operating conditions of IC engine, rotary compressor, and gas turbines.	L4
CO5	Students will be able to evaluate the performance parameters of IC engine, rotary compressor, and gas turbines.	L5

Course Contents

UNIT-I

Air Standard Cycles: Internal and external combustion engines; classification of I.C. Engines, Cycles of operation in four stroke and two stroke I.C. Engines, Wankel Engines, Assumptions made in air standard cycle; Otto cycle; diesel cycle, dual combustion cycle, comparison of Otto, diesel and dual combustion cycles; sterling and Ericsson cycles; air standard efficiency, specific work output, specific weight; work ratio; mean effective pressure; deviation of actual engine cycle from ideal cycle. Problems.

Carburetion, fuel Injection and Ignition systems: Mixture requirements for various operating conditions in S.I. Engines; elementary carburetor, Requirements of a diesel injection system; types of inject systems; petrol injection, Requirements of ignition system; types of ignition systems ignition timing; spark plugs. Problems.

UNIT-II

Combustion in I.C. Engines: S.I. engines; Ignition limits; stages of combustion in S.I. Engines; Ignition lag; velocity of flame propagation; detonation; effects of engine variables on detonation; theories of detonation; octane rating of fuels; pre-ignition; S.I. engine combustion chambers, Stages of combustion in C.I. Engines; delay period; variables affecting delay period; knock in C.I. engines, Cetane rating; C.I. engine combustion chambers.

Lubrication and Cooling Systems: Functions of a lubricating system, Types of lubrication system; mist, wet sump and dry sump systems; properties of lubricating oil; SAE rating of lubricants, engine performance and lubrication, Necessity of engine cooling; disadvantages of overcooling; cooling systems; air-cooling, water cooling; radiators.

UNIT-III

Engine Testing and Performance: Performance parameters: BHP, IHP, mechanical efficiency, brake mean effective pressure and indicative mean effective pressure, torque, volumetric efficiency; specific fuel consumption (BSFC, ISFC), thermal efficiency; heat balance; Basic engine measurements; fuel and air consumption, brake power, indicated power and friction power, heat lost to coolant and exhaust gases; performance curves. Problems.

Air pollution from I.C. Engine and Its remedies: Pollutants from S.I. and C.I. Engines, Methods of emission control; alternative fuels for I.C. Engines; the current scenario on the pollution front.

UNIT-IV

Rotary Compressors: Root and vane blowers; Static and total head values; Centrifugal compressors- Velocity diagrams, slip factor, ratio of compression, pressure coefficient, pre-whirl; Axial flow compressor- Degree of reaction, polytropic efficincy, surging, choking and stalling, performance characteristics, Problems.

Gas Turbines: Brayton cycle; Components of a gas turbine plant; open and closed types of gas turbine plants; Optimum pressure ratio; Improvements of the basic gas turbine cycle; multi stage compression with inter-cooling; multi stage expansion with reheating between stages; exhaust gas heat exchanger, Applications of gas turbines. Problems.

Text and References Books

1. Internal Combustion Engines –V. Ganesan, Tata McGraw-Hill.
2. Engineering fundamental of the Internal Combustion Engine – W.W. Pulkrabek, Pearson Education, 2007.
3. Internal Combustion Engines & Air pollution- Obert E.F, Hopper & Row Pub., New York
4. Internal Combustion Engines Fundamentals- J. B. Heywood, McGraw Hill, New York
5. Internal Combustion Engines- V.M. Domkundwar, Dhanpat Rai &Co., 2008
6. Internal Combustion Engines- R.K. Rajput, Laxmi Publications, 2009
7. Internal Combustion Engines- Matur and Sharma, Dhanpat Rai &Co., 2007

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	--	1	1	1	1	1	1	3	3	3	1
CO2	3	3	3	2	--	1	1	1	1	1	1	3	3	3	1
CO3	3	3	3	2	--	1	1	1	1	1	1	3	3	3	1
CO4	3	3	3	2	--	1	1	2	3	2	2	3	3	3	3
CO5	3	3	3	2	--	1	1	2	3	2	2	3	3	3	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

INTERNAL COMBUSTION ENGINES AND GAS TURBINES (LAB)

General Course Information

Course Code: PCC-ME303-P Course Category: Professional Core Course Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal: 30; external: 70):** Internal practical evaluation is to be done by the course coordinator. The end semester practical examination will be conducted jointly by external and internal examiners.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to define the construction details of internal combustion engines.	L1
CO2	Students will be able to describe the working of commonly used petrol and diesel engines.	L2
CO3	Students will be able to apply performance and exhaust gas analysis tests on petrol and diesel engines.	L3
CO4	Students will be able to test the performance parameters of internal combustion engines.	L4
CO5	Students will be able to evaluate the efficiency and fuel consumption different internal combustion engines.	L5

Lab Contents

1. To study the constructional details & working principles of two-stroke/ four stroke petrol engine.
2. To study the constructional detail & working of two-stroke/ four stroke diesel engine.
3. Analysis of exhaust gases from single cylinder/multi cylinder diesel/petrol engine by Orsat Apparatus.
4. To prepare heat balance sheet on multi-cylinder diesel engine/petrol engine.
5. To find the indicated horse power (IHP) on multi-cylinder petrol engine/diesel engine by Morse Test.
6. To prepare variable speed performance test of a multi-cylinder/single cylinder petrol engine/diesel engine and prepare the curves (i) bhp, ihp, fhp, vs speed (ii) volumetric efficiency & indicated specific fuel consumption vs speed.
7. To find fhp of a multi-cylinder diesel engine/petrol engine by Willian's line method & by motoring method.
8. To perform constant speed performance test on a single cylinder/multi-cylinder diesel engine & draw curves of (i) bhp vs fuel rate, air rate and A/F and (ii) bhp vs mep, mechanical efficiency & sfc.
9. To measure CO & Hydrocarbons in the exhaust of 2- stroke / 4-stroke petrol engine.
10. To find intensity of smoke from a single cylinder / multi-cylinder diesel engine.
11. To draw the scavenging characteristic curves of single cylinder petrol engine.
12. To study the effects of secondary air flow on bhp, sfc, Mech. Efficiency & emission of a two-stroke petrol engine.

NOTE: *The list is indicative. The teacher can alter/add more number of experiments as per the requirement.*

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	2	-	1	2	1	2	2	2	3	3	3	1
CO2	3	3	3	2	-	1	2	1	2	2	2	3	3	3	1
CO3	3	3	3	2	-	1	2	1	2	2	2	3	3	3	1
CO4	3	3	3	2	-	2	2	2	2	3	2	3	3	3	3
CO5	3	3	3	2	-	2	2	2	2	3	2	3	3	3	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

DESIGN OF MACHINE ELEMENTS (THEORY)

General Course Information

Course Code: PCC-ME304-T Course Category: Professional Core Course Course Credits: 4.0 Contact Hours: 4 hours/week (L: 2; T: 2) Mode: Lectures and Tutorial Examination Duration: 3 hours	**Course Assessment Methods (internal: 30; external: 70)** Two minor tests each of 20 marks, Class Performance measured through percentage of lectures attended (4 marks) Assignment and quiz (6 marks), and end semester examination of 70 marks. For the end semester examination, nine questions are to be set by the examiner. Question number one will be compulsory and based on the entire syllabus. It will contain seven short answers type questions. Rest of the eight questions is to be given by setting two questions from each of the four units of the syllabus. A candidate is required to attempt any other four questions selecting one from each of the remaining four units. All questions carry equal marks.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to understand the principles involved in evaluating the shape and dimensions of a component.	L1
CO2	Students will be able to formulate the design and manufacturing problem for simple and complex mechanical components.	L2
CO3	Students will be able to use catalogues and standard machine components.	L3
CO4	Students will be able to apply the general mechanical engineering sciences in analyses specific to the design of mechanical components and systems	L4

Course Contents

UNIT-I

Design for Variable loading: Variable Loading: Different types of fluctuating/ variable stresses, Fatigue strength considering stress concentration factor, surface factor, size factor, reliability factor etc., Fatigue design for finite and infinite life against combined variable stresses using Goodman and Soderberg's Criterion, Fatigue design using Miner's equation, Problems.

UNIT-II

Springs, Joints & Drives: Types of springs, Design for helical springs against tension and their uses, compression and fluctuating loads, Surging phenomenon in springs, design of cotter and knuckle joints, Design of belt drives, Flat & V-belt drives Design Problem

UNIT-III

Bearings : Selection of ball and roller bearing based on static and dynamic load carrying capacity using load-life relationship, Selection of Bearings from manufacturer's catalogue, Selection of suitable lubricants, Design Problems.

Keys, Clutches & Brakes: Flat, Kennedy Keys, Splines, Couplings design – Rigid & Flexible coupling, turning Moment diagram, coefficient of fluctuation of energy and speed, various types of clutches in use, Design of friction clutches – Single disc, Multidisc, Cone & Centrifugal, Torque transmitting capacity. Various types of Brakes, Self energizing condition of brakes, Design of shoe brakes – Internal & external expanding, band brakes, Thermal Considerations in brake designing.

UNIT-IV

Gears: Classification, Selection of gears, Terminology of gears, Force analysis, Selection of material for gears, Beam & wear strength of gear tooth, Buckingham equation, Design of spur, helical, bevel including the Consideration for maximum power transmitting capacity, Gear Lubrication, Design Problems.

Text and Reference Books

1. Mechanical Engg. Design - First Metric Editions: Joseph Edward Shigley-MGH, New York.
2. Design of Machine Elements – V.B. Bhandari – Tata McGraw Hill, New Delhi.
3. Machine Design an Integrated Approach: Robert L.Norton, Addison Wesley.
4. Machine Design: S.G. Kulkarini - Tata MacGraw Hill.
5. Design of machine elements-C S Sharma, Kamlesh Purohit, PHI.
6. PSG Design Data Book

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2	2	--	--	--	--	--	1	--	3	2	2	--
CO2	3	2	1	3	--	1	--	2	3	2	2	3	3	2	2
CO3	3	2	2	3	--	--	--	2	1	1	--	2	2	2	2
CO4	3	2	2	3	3	1	--	2	2	3	2	3	3	3	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

INDUSTRIAL TRAINING PRESENTATION-I

General Course Information

Course Code: PROJ-ME301-P Course Category: Project work, Seminar and Internship in Industry Course Credits: 1.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods (internal:100)**Internal continuous assessment of 100 marks on the basis of report writing, presentation and viva voce in practical classes by the team of panel of faculty members.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to get the exposure of 'real' working environment and get acquainted with the organization structure, business operations and administrative functions.	L1
CO2	Students will be able to demonstrate competency in relevant engineering fields through problem identification, formulation and solution.	L2
CO3	Students will be able to develop the ability to work as an individual and in group with the capacity to be a leader as well as an effective team member.	L3
CO4	Students will be able to generate a report based on the experiences with the ability to apply knowledge of Engineering fundamentals	L4
CO5	Students will be master in his profession and perform ethical responsibilities of an engineer	L5

Course Contents

As a part of the B. Tech. Mechanical Engineering Curriculum Industrial Training-I is a Practical course, which the students of Mechanical Engineering should undergo in reputed Private / Public Sector / Government organization / companies as industrial training of four-six weeks in the summer vacation after the IV semester.

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	--	--	--	--	--	2	2	--	--	--	2	3	3	3	3
CO2	3	3	3	3	3	--	--	--	--	2	--	2	2	2	2
CO3	--	--	--	--	--	--	--	2	3	--	--	--	--	--	2
CO4	3	--	--	--	--	--	--	--	--	3	--	2	--	--	2
CO5	--	--	--	--	--	1	--	3	--	2	2	2	2	2	3

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)

TECHNICAL PRESENTATION

General Course Information

Course Code: MC-ME301-P Course Category: Mandatory Course Course Credits: 0.0 Mode: Practical Contact Hours: 02 hours per week	**Course Assessment Methods(Internal: 100):** This is a **non-credit course of qualifying nature**. Internal practical evaluation is to be done by the course coordinator.

Course Outcomes

Sr. No.	Course Outcome	RBT Level
CO1	Students will be able to read and understand recent trends and technologies in the field of Mechanical Engineering	L1
CO2	Students will be able to prepare concise, comprehend and conclude selective topic in the field of Mechanical Engineering	L2
CO3	Students will be able to develop skills in presentation and discussion of research topics in a public forum	L3
CO4	Students will be able to formulate innovative ideas in the field of engineering	L4

Course Contents

The students are required to give power point presentation on the topic related to current research area in the field of Mechanical Engineering. The presentation should be held in the class room/ seminar hall in presence of the course coordinator

Course Articulation Matrix (CO to PO/PSO Mapping)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	2	--	--	--	--	--	--	2	2	3	--	2
CO2	3	1	2	2	--	--	--	--	--	2	--	2	2	--	--
CO3	--	--	--	--	--	--	--	--	--	3	--	2	--	--	--
CO4	3	2	2	2	--	--	--	--	--	2	--	2	2	2	2

1 : (Slight/Low), 2:(Moderate/Medium), 3 :(Substantial/High)