School of Technology
Department of Mechanical Engineering
Programme : **B. Tech. Mechanical Engineering**
Curriculum for : **THIRD YEAR**

Sanjay Ghodawat University, Kolhapur
Established as a State Private University under Govt. of Maharashtra Act no. XL dated 3rd May 2017
Empowering Lives Globally !

Academic Year 2022-23

Semester V									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme for (L T P)**			
						Component	**Exam**	**WT**	**Pass %**
MET-2501	Dynamics of Machines	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT-I	15	
							CAT-II	15	
							ESE	50	Min 40
MET-2502	Mechanics of Metal Cutting and Tool Design	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
MET-2503	Design of Machine Elements	2	-	-	2	Theory (50)	FET	20	Min 40
							CAT	30	
							ESE	50	Min 40
MET-2504	Fluid and Turbo Machinery	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
MET-2505	Program elective I	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
MET-2506	Workshop Practice – V (Adv. CNC)	-	-	2	1	Practical (100)	FEP	50	Min 40
							POE	50	Min 40
MET-2507	Fluid and Turbo Machinery lab	-	-	2	1	Practical (100)	FEP	50	Min 40
							POE	50	Min 40
MET-2508	Dynamics of Machines Lab	-	-	2	1	Practical (100)	FEP	100	Min 40
MET-2509	Software proficiency -I	-	-	4	2	Practical (100)	FEP	100	Min 40
MET-2510	Program elective I Lab	-	-	2	1	Practical (100)	FEP	100	Min 40
MET 321 MET 322	Foreign language/ Scholastic Program	3	-	-	AU	Theory (100)	FET	100	Min 40
Total		**17**	**-**	**12**	**20**	**Total Hrs:28, Total Credits: 20**			

****NOTE: Internship: (MET-2610)**

Students should undergo Internship at the end of Sem. V during vacation and Evaluation will be in Sem. VI

Program Elective I

Design & Analysis (D&A)	MET-2505.1	Experimental Stress Analysis
Manufacturing Technology & Management (MTM)	MET-2505.2	Production Planning and Control
HVAC (Thermal)	MET-2505.3	Fundamentals of Compressible flow
Automotive Technology (Auto)	MET-2505.4	Automobile Engineering

Program Elective I Lab

Design & Analysis (D&A)	MET-2510.1	Experimental Stress Analysis Lab
Manufacturing Technology & Management (MTM)	MET-2510.2	Production Planning and Control Lab
HVAC (Thermal)	MET-2510.3	Fundamentals of Compressible flow Lab
Automotive Technology (Auto)	MET-2510.4	Automobile Engineering Lab

		L	T	C
MET 2501	**Dynamics of Machines**	03	--	**03**

Course Description

Dynamics of Machines deals with the study of relative motion between the various parts of machine, and forces which act on them. The knowledge of this subject is very essential for an engineer in designing the various parts of a machine. It combines theory, graphical and analytical skills to understand the Engineering Design.

Pre-requisites

FYT 108 Applied Mechanics, MET 2305 Strength of Materials,
MET 2403 Kinematics of Machines.

Course Objectives

1 Know the basic theory on gears.
2 To impart knowledge on various types of Gear Trains and solve the numerical.
3 Study turning moment diagram of flywheel and principles of gyroscope.
4 To determine the static and dynamic forces for mechanical systems.
5 To determine the balancing of masses of rotating and reciprocating machine elements.

	Course Outcomes	Bloom's Level
	Students will be able to	
CO 2501.1	Identify the various types of Gears and Gear Trains	3
CO 2501.2	Explain basics of flywheel and its types	2
CO 2501.3	Analyze forces in various mechanisms	3
CO 2501.4	Solve numerical on balancing	3
CO 2501.5	Analyze the gyroscopic effect on different objects	3

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing		40%		40%	--	--
Planned Marks	30	30	20	100	--	--

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2501.1	1	1												
CO 2501.2	2													
CO 2501.3	1	2										2		
CO 2501.4	2													
CO 2501.5	1	1												
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2501

Dynamics of Machines

Course Content Hrs

Unit 01 **Gears** 7

Geometry of motion, Gear geometry, Types of gear profile- involute and cycloidal, Theory of Spur, Helical and Spiral gears, Interference in involute tooth gears and methods for its prevention, Path of contact, Arc of Contact, Contact

ratio. Efficiency and center distance of spiral gears.

Unit 02	**Gear Trains** Types of Gear trains - Simple, Compound, Reverted, Epicyclic gear train, Numerical on finding the speeds of elements in epicyclic gear train by tabular Method. Differential gear box, Torques in epicyclic gear train (Descriptive Treatment only).	7
Unit 03	**Flywheel** Turning moment diagrams, Fluctuation of energy, Coefficient of fluctuation of speed, Rimmed flywheel.	6
Unit 04	**Static and Dynamic force Analysis** Velocity and acceleration of slider crank mechanism by analytical method, Inertia force and torque, D'Alembert's principle, Dynamically equivalent system, force analysis of reciprocating engine mechanism and four bar chain mechanism.	7
Unit 05	**Balancing** Static and Dynamic balancing of rotary and reciprocating masses. Primary and Secondary forces and couples. Direct and Reverse cranks. Balancing of Single cylinder, Multi cylinder-In-line and Radial Engines for four wheeler.	7
Unit 06	**Gyroscope** Gyroscopic couple, Spinning and Precessional Motion, Gyroscopic couple and its effect on Aero plane, Ship, Four-Wheeler, Two – Wheeled vehicle. Stability conditions for four wheeler and two wheeler vehicles.	6

MET 2501 **Dynamics of Machines**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
1	Theory of Machines	Rattan S.S.	Tata McGraw Hill	3rd Edition
2	Theory of Machines	Dr. V.P.Singh	Dhanpat Rai Publications	2nd Edition
3	Theory of Machines	Dr. Ballaney	Khanna Publication.	3rd Edition

TY B. Tech. Mechanical Engineering **(Semester –V)**

		L	T	C
MET2502	**Mechanics of Metal Cutting and Tool Design**	3	-	3

Course Description

The course covers Theory of metal cutting, cutting tools and its material. Heat generation during machining and the economics of tool life. Fundamentals of Jigs and Fixture, press tools and design of Jigs and Fixture, press tools.

Pre-requisites

Manufacturing Process, Workshop Practice

Course Objectives

1 To study the metal cutting technology including the process, measurement of cutting force etc.
2 .To study the selection of various cutting tools and their industrial specifications.
3 To introduce the students to design practices of Jigs/fixtures.
4 To introduce the students to die design for press work.

	Course Outcomes	Bloom's Level
	Students will be able to	
CO2502.1	Explain metal cutting principle and tool geometry of single and multi point cutting tool	2
CO2502.2	Identify sources of heat generation and economics of machining	2
CO2502.3	Select a standard cutting tool for various applications.	2
CO2502.4	Design drilling jig and fixtures for simple components	6
CO2502.5	Design press tools and cutting/punching dies for simple components	6

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing	40%			40%	--	--
Planned Marks	30	30	20	100	--	--

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO2502.1	1													
CO2502.2	1											1		
CO2502.3	1											3		
CO2502.4	1		2									1		
CO2502.5	1		2											
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2502 **Mechanics of Metal Cutting and Tool Design**

	Course Content	**Hrs**
Unit 01	**Theory of metal cutting:** Cutting tools, tool geometry, concept of speed, feed, depth of cut & cutting action & effect of these on cutting forces, types of chips, Merchant circle of forces. Estimation of cutting forces. Empirical relations. Tool force dynamometers. Measurement of cutting forces and power required in turning & drilling.	08
Unit 02	**Cutting tool standards and materials:** Tool signature ORS & ASA methods, tool standards: Single point cutting tool, drills, broach, reamer, milling cutters. Cutting tool materials. Nonconventional tool geometry: CNC Cutting tool, Advance tool materials, coating on tool, throwaway inserts, tool selection catalogue.	06

Unit 03	**Heat generation, tool life & Economic of cutting tools:** Heat generation in cutting, cutting fluid, tool wear, Tool life equation of Taylor. Factors affecting tool life, Machinability and its rating, criteria for Machinability. Economics of machining, Criteria for minimum cost & maximum production.	06
Unit 04	**Fundamentals of Jigs and fixtures:** Significance and purpose of jigs and fixtures and their functions in manufacturing processes. Classifications of jigs and fixtures. Designs features of main elements of Jigs and fixtures such as locating, clamping and guiding elements and their integrations. Indexing, locking and auxiliary elements. Bodies and bases or frames of Jigs and fixtures. Economics of Jigs and fixtures, Pneumatics & Hydraulics for jig & fixtures.	06
Unit 05	**Design of Jigs & fixtures:** A) Design of jigs: Principles of jig design, types of jigs- plate, template, box, channel, sandwich, latch, turn-over, tumble jig etc., types of bushes, selection of bushes and liners, construction of jig and fixture bodies, use of standard parts. B) Design of fixtures: Principles of fixture design, types of fixtures- gang, straddle, vertical, slot, string milling fixture etc, selection of the suitable type, design of milling fixtures, use of setting block, tennons, T-bolts etc, Concept of Modular Fixtures.	08
Unit 06	**Introduction to press tools :** Dies, punches, simple, compound, combination and progressive dies, press tools for operations like blanking, piercing, drawing, shaving, trimming, etc. **Design of die set for cutting operations :** Theory of metal cutting, cutting force and blank holding force estimation, punch and die clearance, scrap strip layout, design of punches, design of dies, pilots, strippers, stock stops, finger stops, auto stops, center of pressure, selection of die set.	08

MET 2502 **Mechanics of Metal Cutting and Tool Design**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Production Engineering	P. C. Sharma	S. Chand	
02	Production Technology		HMT Handbook	
03	Machine tool Engg.	G.R. Nagapal	Khanna Publication,6th Edition	2nd Edition
04	Thoery of Metal Cutting-	Sen Bhattacharya	New central book agency pvt. Ltd.1st Edition 1984	

Third Year B. Tech. Mechanical Engineering **(Semester –V)**

		L	T	C
MET 2503	**Design of Machine Elements**	02	-	02

Course Description

Design of Machine elements covers fundamental mechanical design topics, such as

general design procedure of a machine element, design simple machine elements subjected to static loading, shafts, Keys, various joints, couplings, springs and power screw

Pre-requisites

Basic concepts of Applied Mechanics and Strength of Materials.

Course Objectives

1 Study basic principles o machine design.
2 Understand the principles involved in evaluating the dimensions of a component to satisfy functional and strength requirements.
3 Learn use of catalogues and design data book.

	Course Outcomes	Bloom's Level
	Students will be able to	
CO 2503.1	Explain general design procedure and select engineering material for machine element	2
CO2503.2	Design simple machine elements on the basis of static loading.	3
CO2503.3	Design transmission shafts,keys, couplings & helical compression springs.	3
CO2503.4	Design of power screws.	3

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing		40%		40%	--	--
Planned Marks	30	30	20	50	--	--

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO2503.1	1	2	2			2								
CO2503.2	1	2	3			2								
CO2503.3	1	2	3			2								
CO2503.4	1	2	3			2								
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2503 Design of Machine Elements

	Course Content	Hrs
Unit 01	**Fundamentals of Machine Design:**	
CO2503.1	Introduction to Machine design, review of theories of elastic failure & their applications, Basic procedure of design of machine elements, Selection of various engineering materials & its properties.	04
Unit 02	**Design against Static loading:**	
CO2503.2	Factor of safety- its selection & significance, Design of Knuckle joint, Turn buckle and bell crank Lever. Design of bolted joints subjected to following conditions- 1) Joints in shear 2)joints subjected to load perpendicular to the axis of bolt.	07
Unit 03	**Design of Shaft, Keys, Couplings & Springs:**	
CO2503.3	Design of solid & hollow shafts, Design of shaft based on strength & torsional rigidity.ASME code for shaft design, Types and Design of Keys, Design of Couplings- Rigid and Flexible couplings Types of springs and their applications, Design of Helical Compression Spring subjected to static loading.	08

Unit 04 CO2503.4	**Design of Power Screw:** Forms of threads, Terminology of Power screw, Torque requirement (lifting and loweringload), Self-locking and overhauling properties, Efficiency of threads, Design of Screw Jack.	07

MET 2503 **Design of Machine Elements**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Design of Machine Elements	V.B.Bhandari	Tata McGraw Hill Publication	3rdEdition
02	Machine Design	R.K.Jain	Khanna Publication	9thEdition,ISBN:978-81-7409-286-1
03	Machine Design	Pandya Shah	Charotar Publication	20thEdition,ISBN: 978-93-85039-10-2
04	Design of Machine Elements	P.Kannaiah	Scitech Publication	ISBN-9789352240296
05	Machine Design:A Basic Approach	Dr.S.S.Wadhwa, S SJolly	Dhanapat Rai and Sons	

Third Year	B. Tech. Mechanical Engineering **(Semester – V)**	L	T	C
MET 2504	**Fluid and Turbo Machinery**	03	--	03

Course Description

This is an introductory course in Fluid Machines. The subject Fluid Machines has a wide scope and is of prime importance in almost all fields of engineering. The course emphasizes the basic underlying fluid mechanical principles governing energy transfer in a fluid machine and also description of the different kinds of hydraulic and pneumatic machines along with their performances.

Pre-requisites

MET-2304 Thermodynamics, MET-2404 Fluid Mechanics

Course Objectives

1 To learn the fundamental concepts and applications of energy conversion in fluid machines.

2 To differentiate between impulse and reaction turbines.

3 To illustrate various propulsion systems used in gas turbines.

Course Outcomes Bloom's Level

Students will be able to

CO 1	Design simple hydraulic and gas impulse and reaction turbines using design principles.	3
CO 2	Calculate various heads and efficiencies related to hydraulic centrifugal pumps.	3
CO 3	Illustrate the concept of reciprocating and centrifugal compressor to understand various parameters related to air compressors	3
CO 4	Compare various methods to improve thermal efficiency and specific output of the gas turbines using mathematical equations.	3

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing		40%		40%	--	--
Planned Marks	30	30	20	100	--	--

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO1	3		2										1	
CO2	3		2										1	
CO3	3		2										1	
CO4	3		2										1	
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2504

Fluid and Turbo Machinery

Course Content Hrs

Unit 01 Basic Concepts of Turbo machines and its applications 06

Definition, Classification, Dimensional analysis and similitude of in-compressible and compressible flow in turbo-machines, Energy transfer-Euler turbine equation, Degree of reaction, Impact of jets,

Pelton turbine - velocity triangles at inlet and exit of buckets, performance calculations considering losses in nozzle and buckets, condition for maximum hydraulic efficiency. Introduction Deriaz turbine - (No derivations).

Unit 02 Hydraulic Turbines(Reaction) 07

Francis Turbine - reaction, impeller shapes for different shape heads, calculations of impeller dimensions, blade angles and performance using velocity triangles, draft tube theory.

Kaplan turbine - reaction, impeller blades (fixed and adjustable) and guide blades, calculation of performance using velocity triangles, Design parameters to be considered, Governing of turbines, utilization factor.

Unit 03 Hydraulic Pumps 07

Centrifugal pumps, velocity triangles, work done by the impeller on water,

types of casing, various heads and efficiencies related to it, priming and cavitations, various methods to prevent cavitations, minimum starting speed of the centrifugal pump, theoretical head-capacity relation for pumps, Multi-staging, NPSH, Pump characteristics.

Unit 04 Air Compressors 07

Application of compressed air, Classification of compressor, Reciprocating compressors, construction , Work input, Necessity of cooling, Isothermal efficiency, Heat rejected, Effect of clearance volume, Volumetric efficiency, Necessity of multistage, construction, Optimum intermediate pressure for minimum work required, After cooler, Free air delivered, air flow measurement, Capacity control. Roots blower and vane blower (Descriptive treatment)

Unit 05 Rotodyanamic Air Compressors 07

Centrifugal compressor, velocity diagram. Theory of operation, losses, Adiabatic efficiency, Effect of compressibility, Diffuser, Prewhirl, Pressure coefficient, Slip factor, performance. Axial flow compressors, Velocity diagram, Degree of reaction, polytrophic efficiency, Surging, Chocking, Stalling, performance and comparison.

Unit 06 Gas turbines and Jet Propulsion 06

Classification, methods for improving the thermal efficiency and specific output with p-v and T-s diagram (detailed discussion).
Introduction to Propulsion, various types (detailed discussion), Fuels used in rockets

MET 2504 **Fluid and Turbo Machinery**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
1	Principle of Turbo machinery	Shepherd D.G	Macmillan Co. New York	1956
2	Fluid Mechanics	Douglas J.F, Gasiorek J.M and Swaffield J.A	Addison-Weisly	1999
3	Energy Conversion Turbo Machines	Kadambi and Prasad	Wiley Eastern,1997	Vol.-III
4	Turbo Machines	Yahya S.M	Satya Prakashana, New Delhi	

B. Tech. Mechanical Engineering

Third Year	**(Semester –V)**	L	T	C
MET 2505.1	**Experimental Stress Analysis**	03	-	03

Course Description

The course covers the basic aspects of experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photoelasticity and strain

gauges. In addition it also provides the fundamental aspects of different experimental techniques such as Moiré, Brittle Coatings.

Pre-requisites
Knowledge of stress analysis, Strength of Material

Course Objectives
1 Introduce the concept of elementary elasticity and experimental stress analysis
2 Prepare mechanical engineering students for advanced graduate studies in various experimental stress analysis techniques like photo elasticity, strain gauge
3 Supply qualified personnel to meet the requirement of specialist in experimental stress analysis

	Course Outcomes *Students will be able to*	Bloom's Level
CO 2505.1.1	Explain the concept and principles of using strain gauges and its applications	2
CO 2505.1.2	Demonstrate the commercial strain indicators, potentiometer circuit, strain gauge rosettes and Transducer with their applications	2
CO 2505.1.3	Apply two dimentional photoelasticity technique to stress analysis	3
CO 2505.1.4	Analyze the concept of coating methods and Moiré fringes for stress analysis	2

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing		40%		40%	--	--
Planned Marks	30	30	20	100	--	--

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2505.1.1	1													
CO 2505.1.2	3	2		2										
CO 2505.1.3	3	2		2								2	1	2
CO 2505.1.4	2											2		1
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2505.1

Experimental Stress Analysis

Course Content

Hrs

Unit 01 **Principles of Experimental Approach**

Method for stress analysis, Introduction to Experimental Stress analysis, advantages scope of Experimental Mechanics in design, various experimental methods of stress analysis and their relative merits and demerits.Types of tools 4

used for experimental stress analysis method in details.

Unit 02	**Strain Measurement Using Strain Gauges** Electrical resistance strain gauge –Introduction, principle, types, construction, materials used in construction, sensitivity, gauge factor, cross sensitivity. Semiconductor strain gauge, advantages and limitations Selection and mounting of strain gauge, Criteria for selection, mounting of gauge and checking its installation.	8
Unit 03	**Strain Gauge Circuitry** Wheatstone bridge circuit, its role in measurement of resistance change, condition for bridge balance, output voltage of Wheatstone bridge, relationship between output voltage and strain, Commercial strain indicators, potentiometer circuit. Strain gauge rosettes and Numerical on it. Transducer applications of strain gauge.	8
Unit 04	**I.Two Dimensional Photoelasticity** Principle of photo elasticity, Stress optics law, material fringe, Polariscope-various configurations of polariscope. Effect of stressed model in plane and circular polariscope, isoclinics, isochrometics, their significance in photoelastic stress analysis. Compensation methods like babinetsoleil compensation method and Tardy's method (Derivation).	7
Unit 05	**I.Analysis of Photoelastic Data** Determination of direction of principal stress at a given point, determination of exact fringe order N and difference of principal stresses at a given point. Shear difference method, oblique incidence method. Photoelastic Materials and their properties, Photoelastic sheet casting and model making, Calibration of photoelastic material.	7
Unit 06	**Coating Method and Moire Fringe** Brittle coating- interpretation of crack pattern data, crack detection techniques. Birefringent coating: Limitations and applications, use of reflection polariscope, merits and demerits. Moiré fringe method - stress analysis Mechanism of fringe formation, advantages, limitations and applications	6

MET 2505.1 Experimental Stress Analysis

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Experimental stress analysis	Dally and Riley	McGraw Hill	ISBN-13: 978-0070152182
02	Experimental stress analysis	Dr. Sadhu Singh	Khanna Publications	ISBN:978-81-7409-182-3
03	Experimental stress analysis	L.S.Srinath	Tata McGraw Hill	ISBN13:9780074519264
04	Moiré fringes	Theocoris	Pergamon press limited	

(Semester – V)

MET-2505.2	**Production Planning and Control**	03	--	**03**

Course Description

Production planning and control (or PPC) is defined as a work process which seeks to allocate human resources, raw materials, and equipment/machines in a way that optimizes efficiency. ... It enables efficiency, coordination, and the leveraging of production-related data to drive improvement.

Pre-requisites

Course Objectives

1 To provide a comprehensive exposure to Production Planning & Control (PPC) and its significance in Industries.
2 To acquaint students with various activities of PPC.
3 To appraise about need and benefits of planning functions related to processes
4 To give exposure to production scheduling and sequencing
5 Modeling, simulating and analyzing an inventory system

CO's	**Course Outcomes** *Students will be able to*	Bloom's Level
2505.2.1	Illustrate production planning functions and manage manufacturing functions in a better way.	4
2505.2.2	Develop works order for various manufacturing methods.	3
2505.2.3	Estimate the demand using appropriate forecasting techniques.	2
2505.2.4	Recommend the aggregate production planning strategies capacity based on the demand pattern and the capacity	4
2505.2.5	Develop competency in scheduling and sequencing in manufacturing operations and effect affordable manufacturing lead time	3

Evaluation Strategy

Component	**CAT-01**	**CAT-02**	**FET**	**ESE**	**FEP**	**POE**
% Contribution	15%	15%	20%	50%		
Passing		40%		40%		
Planned Marks	30	30	100	100		

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
2505.2.1	1								2	2				1
2505.2.2	1								2	2				1
2505.2.3	1								2	2				1
2505.2.4	1								2	2				1
2505.2.5	1								2	2				1
	(1 – Low, 2 – Moderate, 3 – High)													

MET-2505.2 **Production Planning and Control**

Course Content Hrs

Unit 01 **Concepts of PPC**:
Manufacturing systems- components and types, need for PPC, functions of PPC, relationship of PPC with other departments. Factors influencing PPC in the organization, manufacturing methods- projects & jobbing products, batch, mass / flow production, continuous / process production.

Unit 02 **Forecasting and Planning:**
Need and importance of Forecasting, Forecasting Techniques: Delphi Method, Simple and Moving average, Exponential Smoothing, Correlation and Regression Analysis,

Unit 03 **Capacity and Aggregate Planning:**
Capacity- Definition, Measure of Capacity, capacity strategies Estimation of number of machines, Overcapacity and under capacity factors, Aggregate Planning, Aggregate Planning Strategies, Pure and mixed strategies.

Unit 04 **Job Sequencing and Scheduling:**
Inputs for scheduling, loading and scheduling devices, factors influencing scheduling, scheduling techniques, use of Gantt Charts and basic scheduling problems. Product sequencing, dispatching: progress report & expectation of manufacturing lead time technique for aligning completion time &due dates

Unit 05 **Inventory Control:**
Introduction, meaning of inventory, types of inventories, inventory control terminology, and inventory cost relationships, inventory models.

Unit 06 **Planning and Controlling Projects:**
Objectives of Network Analysis, applications of Network analysis, Basic concepts in Network, Fulkerson's rule,CPM,PERT,Time cost Trade off

MET-2505.2 **Production Planning and Control**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
1	Production Planning and Control,	L. C. Jhamb	Everest Publishing House	
2	Production Planning and Control	W. Boltan	Longman Scientific & Technical.	
3	Production Systems- Planning, Analysis & Control	James. L. Riggs	John Wiley & Sons	
4	Production & Operations Management	S.N. Chary	McGraw Hill Publication	
5	Production Management	Lockyer	ELBS	

(Semester – V)

MET-2505.3	**Fundamentals of Compressible Flow**	03	--	**03**

Course Description

One-dimensional compressible flows including basic concepts; isentropic flow; normal and oblique shock waves; flows with heat transfer (Rayleigh line), friction (Fanno line), and mass addition; simple waves; small perturbation theory for linearized, steady flows; method of characteristics for two-dimensional, steady flow and one-dimensional, unsteady flow.

Pre-requisites

Thermodynamics, Fluid Mechanics, Heat and Mass Transfer

Course Objectives

1 To understand the fundamentals of compressible fluid flow.
2 To study the basic equations of compressible flow
3 To analyze compressible flow through constant and variable area duct
4 To analyze propulsive system by applying principles of Fluid mechanics.

	Course Outcomes *Students will be able to*	Bloom's Level
2505.1	Impart Knowledge and understanding of the physical phenomena of gas dynamics.	L1
2505.1	Outline governing equations of compressible fluid flow.	L1
2505.2	Analyze one dimensional compressible flow through variable area duct.	L2
2505.3	Analyze compressible flow having normal shock.	L2
2505.4	Apply governing equations to compressible flow through constant area duct with friction.	L2
2505.5	Apply governing equations to compressible flow through constant area duct with heat transfer.	L3

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%		
Passing		40%		40%		
Planned Marks	30	30	100	100		

Mapping of COs with POs:

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
2505.1	1				2		1							
2505.2	1													
2505.3	1		2		2									
2505.4	1				2									
2505.5	1		2											
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2505.3	**Fundamentals of Compressible Flow**	
	Course Content	Hrs
Unit 01	**Basic Equation of Compressible Flow:** Thermodynamics of fluid flow, first law of thermodynamics, second law of thermodynamics, thermal and calorical properties, perfect gas.	6

Unit 02	**Isentropic Flow with Variable Area:** Mach number variation, stagnation and critical states, area ratio as function of Mach No., flow through nozzles and diffusers.	6
Unit 03	**Flow with Normal Shock Waves:** Development of shock waves, the governing equations, Prandtl-Meyer relation, Mach No. downstream of the normal shock wave, change of entropy across the shock, determination of Mach No. of supersonic flows.	6
Unit 04	**Flow with Oblique Shock Waves:** Nature of flow through oblique shock waves, Prandtl's equation, Rankine-Hugoniot equation, variation of flow parameters, Oblique shock relation from normal shock equations.	7
Unit 05	**Flow in Constant Area Ducts with Friction:** The Fanno curves, Fanno flow equations, solution of Fanno flow equations, variation of flow properties, variation of Mach No. with duct length.	7
Unit 06	**Flow in Constant Area Ducts with Heat Transfer:** The Rayleigh line, fundamental equations, Rayleigh flow relations, Variation of flow properties, maximum heat transfer.	6

Course code	**Name of the course**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
1	Fundamental of Compressible Flow	S M Yahya	New Age International (P) Limited	Third Edition May 1982 81-224-1468-0
2	Gas Dynamics	E. Rathakrishnan	Prentice Hall of India(P) Limited	PHI June, 2012 978-81-203-4605-5
3	Dynamics and Thermodynamics of Compressible Fluid Flow	A. H. Shapiro	Ronalds Press, New Year	Volume 1 Jan 1991 978-0-471-06691-0
4	Gas Dynamics	Zucrow and Hoffmann	Wiley	11 Feb 2010 047198440X, 9780471984405

Third Year	B. Tech. Mechanical Engineering **(Semester –V)**	L	T	C
MET-2505.4	**Automobile Engineering**	02	--	02

Course Description

This course introduces the students to various automobile chassis systems like transmission, Steering, Suspension, Brakes, Wheels, Tyres, Electrical and Electronic Systems. Students will learn the constructional features, operational principles, types and various configurations of these systems.

Pre-requisites

FYT1351 Elements of Mechanical Engineering

Course Objectives

1 To study basic principles of actual automobile systems

2 To study importance and features of different automobile systems like transmission, Steering, Suspension, Brakes, Wheels, Tyres, Electrical and Electronic Systems
3 To know some modern trends in automobile systems

	Course Outcomes *Students will be able to*	Bloom's Level
CO2505.4.1	Describe components of automobile, its materials & various types of automobiles	01
CO2505.4.2	Demonstrate various automobile systems like transmission system, steering & suspension system, brake, wheels and Tyres, and its construction and working	02
CO2505.4.3	Demonstrate various electrical and electronic systems like lighting, starting charging electronic controlled management system and its construction and working principle.	02

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing		40%		40%	--	--
Planned Marks	30	30	20	50	--	--

Mapping of COs with POs:

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO2505.4.1	1					1								1
CO2505.4.2	2	1				1								2
CO2505.4.3	2					1								2
	(1 – Low, 2 – Moderate, 3 – High)													

2505.4 Automobile Engineering

Course Content Hrs

Unit 01 **Introduction and Transmission System** 08

Automobile history, Components of an automobile, Classification, vehicle layouts- engine location and drive arrangement, Type of vehicle bodies, body parts, Chassis types, Types of Frames, sub frames, frameless vehicles.
Clutch – Function and requirements, Classification, Construction and working of Single- plate, Multi-plate, Semi-centrifugal and centrifugal clutches, Fluid flywheel. Gear Box – Necessity, classification, construction of manual gear boxes like Sliding mesh, constant mesh, Synchromesh, Epicyclic gear train, Automatic transmission, Torque convertor, Overdrive. Propeller shaft, Differential and final drive.

Unit 02 **Steering and Suspension Systems** 08

Live and dead axles, live axle arrangement.
Steering systems, function, principle of steering, Ackerman and Davis, steering geometry, center point steering, cornering force, slip angle, scrub radius, steering characteristic, steering gearbox, power steering, collapsible steering.
Suspension system- Functions, Sprung and unsprung mass, Types of suspension linkages, types of spring - leaf, coil, air springs, telescopic shock absorber, hydro gas suspension, rubber suspension, interconnected suspension, self-leveling suspension (active suspension) Air suspension

Unit 03 **Brakes, Wheels and Tyres** 07

Brakes: Need, principle, types, Mechanical, hydraulic and pneumatic brakes disc

and drum types, air brakes, servo and power braking, ABS, their relative merits.
Wheels and Tyres: Wheel construction, alloy wheel, Types, tyre construction, tread design, specification, factors affecting tyre performance, tyre wear and its causes, wheel balancing.

Unit 04 **Electrical and Electronic Systems** 07

Automotive batteries - lead acid batteries, Advances in batteries, battery charging system, alternators, principle and operation of cut-out and regulators, starter motor, Bendix drive, solenoid drive, magneto coil and solid stage ignition systems, lighting and electrical
Accessories, automobile air conditioning, panel board instruments. Electronic Controlled Management (ECM) Systems, Automobile wiring. Sensors used in automobile.

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Automobile Engineering	Dr. Kirpal Singh	Standard Publishers, New Delhi.	(Vol. I and II) ISBN- 81-8014-119-5
02	Automobile Mechanics	N K Giri	Khanna Publication	8th Edition,ISBN-81-7409-216-1
03	Automobile Engineering	G.B.S. Narang	Khanna Publication	3rd Edition
04	Automotive Technology	H.M. Sethi	Tata McGraw-Hill	2001
05	Automobile Engineering	Banga and Singh	Khanna Publication	3rd Edition, ISBN-81-7409-221-8

TY	B. Tech. Mechanical Engineering **Third Year (Semester –)**	L	P	C
MET-2506	**Workshop Practice – V(Advanced CNC)**	**-**	**2**	**1**

Course Description
By undergoing this lab the students will learn to use the CNC machines efficiently for
manufacturing desired products and knowledge of programming and use of CNC tooling

Pre-requisites
Elements of Mechanical Engineering, Manufacturing Technology I
(Workshop Labs I, II and IV)

Course Objectives
1 Understand the codes (G-code and M- Code) used in CNC machines for programming

2 Develop Programming skills and crate a component for required drawing, Simulate the prepared part Programme using available simulation software's and prepare the parts on CNC

3 By undergoing this lab, the students will learn to use the CNC machines efficiently for manufacturing desired products and knowledge of programming and use of CNC tooling

	Course Outcomes *Students will be able to*	Bloom's Level
CO 1	Explain cycle time and selection of cutting tools and holders.	2
CO 2	Develop advance CNC part programming techniques.	3
CO 3	Execute a part program for a simple component on CNC lathe.	3
CO 4	Inspect different settings in CNC machine	2

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	--	--	--	--	50%	50%
Passing		--		--	40%	40%
Planned Marks	--	--	--	--	100	50

Mapping of COs with POs:

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 1	1													
CO 2	1											1		
CO 3	1	2	2									1		
CO4	1												1	
	(1 – Low, 2 – Moderate, 3 – High)													

MET-2506 **Workshop Practice – V(Advanced CNC)**

Sr. No. **List of Experiments**

01 Study construction and working of (CNC/VMC/HMC).

02 Study of cycle time sheet, Selection of cutting tools and holders

03 One job on CNC Machine with advance programming group of maximum four students, plain turning, step turning, Taper turning, Threading, drilling, radius turning, boring, parting.

04 Preventive maintenances for CNC and VMC machine.

05 Chuck setting, chuck greasing, tailstock greasing and reverse-forward stroke setting in CNC machine (Actual performance).

06 Checking, setting and filling the hydraulic oil, lubrication oil, cutting oil for CNC machine.

07 Industrial visit to study operations of Vertical Machining centre, Horizontal Machining centre and Turn-mill Centres.

Reference Books /Text Books /Handbooks /Catalogues /Other

School of Technology
Department of Mechanical Engineering
Programme : **B. Tech. Mechanical Engineering**
Curriculum for : **THIRD YEAR**

Sanjay Ghodawat University, Kolhapur
Established as a State Private University under Govt. of Maharashtra Act no. XL dated 3rd May 2017
Empowering Lives Globally !

Academic Year 2022-23

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	CAD/CAM- Principals and Applications	P.N. Rao	McGraw Hill	2nd Edition
02	S. K HajraChoudhury	Elements of workshop technology – Vol. II	Media Promoters And Publishers, Mumbai	3rd Edition
03	Chennakesava R. Alavala	CAD/CAM- Concepts and Applications	PHI	1st Edition
04	Fundamentals of Tool Design-.		ASTME Publication	

Third Year	B. Tech. Mechanical Engineering **Third Year (Semester – V)**	L	P	C
MET 2507	**Fluid and Turbo Machinery lab**	**--**	**02**	**01**

Course Description

This is an introductory course in Fluid Machines. The subject Fluid Machines has a wide scope and is of prime importance in almost all fields of engineering. The course emphasizes the basic underlying fluid mechanical principles governing energy transfer in a fluid machine and also description of the different kinds of hydraulic and air machines along with their performances.

Pre-requisites

MET-2304 Thermodynamics, MET-2404 Fluid Mechanics

Course Objectives

1 To understand the fundamental concepts of fluid machines.
2 To differentiate between impulse and reaction turbines.
3 To illustrate various propulsion systems and gas turbines.
4 To know how to apply the knowledge of PLC to modified the existing component in CAD/CAM or to develop the new component.

	Course Outcomes *Students will be able to*	Bloom's Level
CO1	Explain the performance characteristics of impulse turbine and reaction turbine	2
CO2	Interpret the characteristics of single stage and multi-stage centrifugal pumps and centrifugal air blower	2
CO3	Interpret the characteristics of reciprocating pump.	2

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	--	--	--	--	50%	50%
Passing		--		--	40%	40%
Planned Marks	--	--	--	--	100	50

Mapping of COs with POs:

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 1		3												
CO 2		3												
CO 3		2			2									

(1 – Low, 2 – Moderate, 3 – High)

MET 2507 | **Fluid and Turbo Machinery lab**

Sr. No. **List of Experiments**

01 Analyze Performance Characteristics of Pelton wheel.
02 Analyze Performance characteristics of Kaplan turbine.
03 Performance characteristics of Francis turbine.
04 Trial on Centrifugal Pump (Rated speed).
05 Trial on Centrifugal Pump (Variable speed).
06 Study and Trial on Air Blower.
07 Performance characteristics of a Reciprocating pump.
08 Industrial visit to pump manufacturing unit/hydro-electric power station and submission of report

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Turbomachines	Yahya S.M	SatyaPrakashan, New Delhi.	
02	Turbines, Compressors and Fans	Yahya S.M	TMH, New Delhi,	2005.
03	Fluid Mechanics, Thermodynamics of Turbomachinery	Dixon S.L	Pergamon,	2006.

B. Tech. Mechanical Engineering
(Semester –V)

		L	P	C
MET 2508	**Dynamics of Machines Lab**	--	**2**	**01**

Course Description
The study of this course gives basic understanding of dynamics of machines by examining it through different experimental set ups. .

Pre-requisites
FYT 108 Applied Mechanics, MET 2305 Strength of Materials,
MET 2403 Kinematics of Machines.

Course Objectives
1 To verify different phenomenon of dynamics experimentally.
2 Demonstrate different experimental set ups for better understanding of principles learned in theory.

Course Outcomes		Bloom's Level
	Students will be able to	
CO 2508.1	Examine different principles in Dynamics of machinery	4
CO 2508.2	Solve critical numerical in Dynamics of Machinery	3
CO 2508.3	Explain different procedures of Gear Manufacturing and Balancing.	2

Evaluation Strategy

Component	**CAT-01**	**CAT-02**	**FET**	**ESE**	**FEP**	**POE**
% Contribution	--	--	--	--	100%	--
Passing		--			40%	--

Planned Marks	--	--	--	--	100	--							

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2508.1	1	2							2					
CO 2508.2		3												
CO 2508.3								2	2					
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2508 Dynamics of Machines Lab

	Course Content	Hrs
Lab 01	Generation of involute profile using rack cutter method	2
Lab 02	Experiment on Torque Measurement in Epicyclic Gear Train	2
Lab 03	Experiment on Gyroscope.	2
Lab 04	Determination of M.I. using Bifilar suspension system.	2
Lab 05	Determination of M.I. using Trifilar suspension system.	2
Lab 06	Experiment on Balancing of rotary masses.	2
Lab 07	Problems on balancing of reciprocating masses. (Minimum 3)	2
Lab 08	Determination of M.I. of connecting rod by Compound pendulum method.	2
Lab 09	Study of Flywheel and its application.	2
Lab 10	Industrial visit based on above syllabus.	2

MET 2508 Dynamics of Machines Lab

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
1	Theory of Machines	Rattan S.S.	Tata McGraw Hill	3rd Edition
2	Theory of Machines	Dr. V.P.Singh	Dhanpat Rai Publications	2nd Edition
3	Theory of Machines	Dr. Ballaney	Khanna Publication.	3rd Edition

TY B. Tech. Mechanical Engineering **Third Year (Semester –V)**

		L	P	C
MET 2509	**Software Proficiency I**	**-**	**4**	**2**

CATIA : Wireframe Modeling and Surfacing

Course Description

In this course students will get to practice skills such as creating wireframes and surfaces, creating surface shells and solid parts, and working with multiple parts that are referencing a common part. This course provides you with an exercise database for additional practice on CATIA Surface Design. The exercises have been created based on Industry practices.

Pre-requisites

FYT 111: Engineering Graphics Laboratory, MET 112: Machine Drawing and CAD Lab

Course Objectives

1 To understand the how to apply your shape skills into practice on selected scenarios for surface design
2 To apply the recommended methodology in various situations and thus enhance your understanding and usage of the Shape workbenches.

	Course Outcomes	Bloom's
	Students will be able to	Level
CO 2509.1	Create the points and curves in 3D at any points.	2
CO 2509.2	Create the surface by using the different commands.	2
CO 2509.3	Perform the operation necessary for finishing.	2
CO 2509.4	Convert the surface into part with desired thickness or can draft.	3

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	--	--	--	--	100%	-
Passing		--		--	40%	-
Planned Marks	--	--	--	--	100	-

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2509.1	1				3								1	
CO 2509.2	2		2		3								1	2
CO 2509.3	1				3				1					
CO 2509.4	1				3									
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2509

Software Proficiency I
CATIA : Wireframe Modeling and Surfacing

Sr. No. **List of Experiments / Activities**

01 **Introduction to Surface Design :**

Surface design, About the generative shape design workbench, Terminologies, General process.

02 **Creating Wireframe Geometry :**

About 3D wireframe geometry, Creating points in 3d, Creating the lines in 3D, Creating the planes in 3D, Creating the curves in the 3D.

03 **Creating Surfaces :**

About the surface geometry, Creating the basic surfaces, Creating the swept surface, Creating the offset from surface, Creating the multi-section surface, Axis for a surface of revolution.

04 **Performing the Operation in the Geometry :**

About the operation in the geometry, Joining elements, Splitting elements, trimming elements, Creating fillets, Creating chamfer, Transforming elements, Extrapolating elements, Trimming tangent surfaces.

05 **Completing the Geometry in Part Design:**

Giving the thickness to the surfaces, Creating the solids from the surfaces, Completing the geometry recommendations.

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	CATIA V5 for Designers	Sham Tickoo	BPB Publication	15, 2017
02	https://academy.3ds.com/en/learn-online.			

Third Year	B. Tech. Mechanical Engineering **Third Year (Semester –V)**	L	P	C
MET 2510.1	**Experimental Stress Analysis Lab**	--	**2**	**1**

Course Description

In this course therefore, an attempt has been made to develop skills required of experimental stress analysis that includes exhaustive treatment of the most versatile techniques like photoelasticity and strain gauges. In addition it also provides the fundamental aspects of different experimental techniques such as Moiré, Brittle Coatings.

Pre-requisites

Knowledge of stress analysis, Strength of Material

Course Objectives

1 To understand the elementary elasticity and experimental stress analysis like photo elasticity, strain gauge
2 To meet the requirement of specialist in experimental stress analysis

	Course Outcomes *Students will be able to*	Bloom's Level
CO 2510.1.1	Determine strain value by bonding of strain gauge or rosette and use of strain indicators for given applications.	2
CO 2510.1.2	Demonstrate photo elastic techniques of stress analysis using diffused light polariscope	3
CO 2510.1.3	Explain the concept of Brittle coating methods and Moiré fringes	2

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	--	--	--	--	50%	--
Passing		--		--	40%	--
Planned Marks	--	--	--	--	100	--

Mapping of COs with POs:

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2510.1.1	2	2	1	1								2		
CO 2510.1.2	2	2	1	1								2	1	2
CO 2510.1.3	2	2										1		
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2510.1 **Experimental Stress Analysis Lab**

Sr. No. **List of Experiments**

01 Bonding Of Strain Gauge And Checking Its Installation
02 Determination of gauge factor for
a. one arm sensitive and two arm sensitive configuration
b. four arm sensitive and four arm sensitive two linear and two lateral configuration
03 Strain Measurement by Using Commercial Strain Indicator and Transducers.
04 Strain Measurement by Using Digital Strain Indicator and Transducers.
05 Study of Photoelastic materials.
06 Study of photoelastic stress analysis using diffused light transmission polariscope & Calibration of photoelastic materials -determination of material fringe value
07 Determination of fractional fringe order using Tardy's method.
08 Study of Brittle Coating Method & Moiré Fringe Technique.

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Experimental stress analysis	Dally and Riley	McGraw Hill	ISBN-13: 978-0070152182
02	Experimental stress analysis	Dr. Sadhu Singh	Khanna Publications	ISBN:978-81-7409-182-3
03	Experimental stress analysis	L.S.Srinath	Tata McGraw Hill	ISBN13:9780074519264
04	Moiré fringes	Theocoris	Pergamon press limited	--

TY B. Tech. Mechanical Engineering
Third Year (Semester –V)

		L	P	C
MET 2510.2	**Production Planning and Control Lab**	**--**	**1**	**2**

Course Description:

Production planning and control (or PPC) is defined as a work process which seeks to allocate human resources, raw materials, and equipment/machines in a way that optimizes efficiency. ... It enables efficiency, coordination, and the leveraging of production-related data to drive improvement.

Pre-requisites

Course Objectives

1 To provide a comprehensive exposure to Production Planning & Control (PPC) and its significance in Industries.
2 To give exposure to learn the different methods used by organizations to obtain the right quantities of stock or inventory,
3 To describe the role of demand forecasting and steps required to do successful forecasting.
4 To describe the fundamentals of integration of demand planning with production like MPS, MRP, BOM.

Course Outcomes *Students will be able to*		Bloom's Level
CO 2510.2.1	Explain the fundamentals of integration of production planning with	3

	production	
CO 2510.2.2	Evaluation of all the available means to manage capacity planning like sub-contracting, outsourcing, etc.	4
CO 2510.2.3	Develop skills required for Demand planning and Forecasting	4

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	--	--	--	--	50%	--
Passing		--		--	40%	--
Planned Marks	--	--	--	--	100	---

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2510.2.1	1								2	2				1
CO 2510.2.2	1								2	2				1
CO 2510.2.3	1								2	2				1
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2510.2 **Production Planning and Control Lab**

Sr. No. List of Case Study/Assignments

01 Presentation and Case study on PPC

02 Assignment on Demand Forecasting.

03 Case study on Aggregate Planning

04 Problems on Job sequencing- Single Machine Scheduling, Priority Sequence and Johnson's Algorithm.

05 Case Study to apply different methods and practices to address inventory management problems.

06 Project management by CPM/PERT

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Production Planning and Control,	L. C. Jhamb	Everest Publishing House	
02	Production Planning and Control	W. Boltan	Longman Scientific & Technical.	
03	Production Systems- Planning, Analysis & Control	James. L. Riggs	John Wiley & Sons	

TY B. Tech. Mechanical Engineering
Third Year (Semester – V)

		L	P	C
MET 2510.3	**Fundamentals of Compressible Flow Lab**		**02**	**01**

Course Description

The main objectives of the course are to convey to the students an overview of and familiarity with the field of compressible flows and the importance of this topic in the context of common engineering applications. This means that the student should acquire a general knowledge of the basic flow equations and how they are related to

fundamental conservation principles and thermodynamic laws and relations. The connections with incompressible flows and aero-acoustics as various limiting cases of compressible flows should also become clear. A general knowledge of and some experience with typical CFD codes for compressible flows should also be obtained after this course.

Pre-requisites
Thermodynamics, Fluid Mechanics, Heat and Mass Transfer

Course Objectives

1 To Define the concept of compressibility for flows
2 To understand the solids and liquids with respect to the velocities.
3 To study the wave propagations.
4 To analyze the isentropic and isothermal fluid flows.

CO's	**Course Outcomes** *Students will be able to*	Bloom's Level
2510.3.1	Explain how thermodynamic relations enter into the flow equations	
2510.3.2	Analyze and verify the quality of the numerical solution.	2
2510.3.3	Familiarize with methods for measurement of compressible gas flow and to study gas flow under subsonic and supersonic flow conditions	2

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	--	--	--	--	1000%	--
Passing		--		--	40%	--
Planned Marks	--	--	--	--	40	--

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
2510.3.1	1			2			2							
2510.3.2	1													
2510.3.3	1		2					2						
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2510.3	**Fundamentals of Compressible Flow Lab**

Sr. No. **List of Experiments**

01 To study sound velocity in different solids and fluids.
02 To study various gas properties for different altitude in atmosphere.
03 To study the wave propagation at different Mach number.
04 To study the isentropic flow from variable area duct.
05 To study the flow through constant area duct with friction. (Fanno flow)
06 Flow in constant area duct with heat transfer. (Rayleigh flow)
07 To study the isothermal flow through constant area duct.
08 To find volumetric efficiency of a reciprocating air compressor.

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
1	Fundamental of Compressible Flow	S M Yahya	New Age International (P) Limited	Third Edition May 1982 81-224-1468-0
2	Gas Dynamics	E. Rathakrishnan	Prentice Hall of India(P) Limited	PHI June, 2012 978-81-203-4605-5
3	Dynamics and Thermodynamics of Compressible Fluid Flow	A. H. Shapiro	Ronalds Press, New Year	Volume 1 Jan 1991 978-0-471-06691-0
4	Gas Dynamics	Zucrow and Hoffmann	Wiley	11 Feb 2010 047198440X, 9780471984405

Third Year	B. Tech. Mechanical Engineering **Third Year (Semester–V)**	L	P	C
MET-2510.4	**Automobile Engineering Lab**	**--**	**02**	**01**

Course Description

In this course therefore, an attempt has been made to demonstrate automobile systems with working or non-working models. This lab course provides the basic foundation for automotive diagnostic.

Pre-requisites

MET2505.4 Automobile Engineering

Course Objectives

1 To understand the different automobile layouts
2 To study various automobile systems

	Course Outcomes *Students will be able to*	Bloom's Level
CO2510.4	Demonstrate various types of automobile layouts as per drive given to wheels, Vehicle body parts etc.	02
CO2510.4	Demonstrate various automobile systems like transmission, brake, steering, suspension & electrical & its construction and working.	02

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	--	--	--	--	50%	50%
Passing		--		--	40%	40%
Planned Marks	--	--	--	--	100	50

Mapping of COs with POs:

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO2510.4	2					1								2
CO2510.4	2					1								2

(1 – Low, 2 – Moderate, 3 – High)

MET-2510.4 **Automobile Engineering Lab**

List of Experiments

Sr. No.	
Lab 01	Demonstration of four wheeler chassis layout and vehicle body parts and its materials.
Lab 02	Demonstration of working of single plate automobile clutch and clutch plate lining materials.
Lab 03	Demonstration of synchromesh gearbox.
Lab 04	Demonstration of final drive and differential.
Lab 05	Demonstration of front wheel steering geometry and steering mechanism.
Lab 06	Demonstration of suspension system of a four-wheeler. (Any one suspension system from conventional or independent)
Lab 07	Demonstration of working of Hydraulic braking system.
Lab 08	Demonstration of Lead acid Battery.
Lab 09	Demonstration of electrical charging system, starting system, D. C. Electric Horn, Electric Fuel Gauge, Flasher Unit. & Wiper Circuit
Lab 10	Industry visit to servicing station for study of vehicle maintenance, repairs, wheel balancing and front wheel alignment etc.

Reference Books /Text Books /Handbooks /Catalogues /Other

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Automobile Engineering	Dr. Kirpal Singh	Standard Publishers, New Delhi.	(Vol. I and II) ISBN-81-8014-119-5
02	Automobile Mechanics	N K Giri	Khanna Publication	8th Edition,ISBN-81-7409-216-1
03	Automobile Engineering	G.B.S. Narang	Khanna Publication	3rd Edition
04	Automotive Technology	H.M. Sethi	Tata McGraw-Hill	2001

Course Code		L	T	P	Credits	FET
MET 321	Foreign Language	3	-	-	NC	100
MET 322	Scholastic Program	3	-	-	NC	100

Foreign Language and Scholastic Program is conducted to enhance the students education as well as to his/her career

Semester VI									
Course Code	**Course Title**	**L**	**T**	**P**	**C**	**Evaluation Scheme for (L T P)**			
						Component	**Exam**	**WT**	**Pass %**
MET-2601	Internal Combustion Engines	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT-I	15	
							CAT-II	15	
							ESE	50	Min 40
MET-2602	Design of Power Transmission Elements	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
MET-2603	Heat and Mass Transfer	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT II	30	
							ESE	50	Min 40
MET-2604	Operations Research	2	-	-	2	Theory (50)	FET	20	Min 40

							CAT	30	
							ESE	50	Min 40
MET-2605	Program Elective II	3	-	-	3	Theory (100)	FET	20	Min 40
							CAT I	15	
							CAT II	15	
							ESE	50	Min 40
MET-2606	Internal Combustion Engines Lab	-	-	2	1	Practical (100)	FEP	50	Min 40
							POE	50	Min 40
MET-2607	Heat and Mass Transfer Lab	-	-	2	1	Practical (100)	FEP	50	Min 40
							POE	50	Min 40
MET-2608	Computer Programming lab (MATLAB)	-	-	2	1	Practical (100)	FEP	100	Min 40
MET-2609	Software proficiency-II	-	-	4	2	Practical (100)	FEP	100	Min 40
MET-2610	Internship	-	-	2	1	Project (100)	FEP	100	Min 40
MET 321 MET 322	Foreign language / Scholastic aptitude	3	-	-	AU	Theory (100)	FET	100	Min 40
Total		**17**	**-**	**12**	**20**	**Total Hrs: 28, Total Credits: 20**			

Program Elective II

Design & Analysis (D&A)	MET-2605.1	Tribology
Manufacturing Technology & Management (MTM)	MET-2605.2	Product Design and Development
HVAC (Thermal)	MET-2605.3	Heat Exchangers
Automotive Technology (Auto)	MET-2605.4	Automotive Diagnostics

TY	B. Tech. Mechanical Engineering **(Semester –VI)**	L	T	C
MET-2601	**Internal Combustion Engines**	03	--	03

Course Description

This course gives the fundamentals of internal combustion engines and their performance, efficiency, fuel requirements, and environmental impact

Pre-requisites

FYT1351-Elements of Mechanical Engineering, MET-207-Thermodynamics

Course Objectives

1 Acquire knowledge about the IC engine cycles, classification and working Principles
2 Describe the testing and performance parameters along with heat balance Sheet
3 To provide knowledge on pollutant formation, control, alternate fuel etc

	Course Outcomes *Students will be able to*	Bloom's Level
CO2601.1	Explain function of various parts and working cycles of I. C. engines.	02
CO2601.2	Illustrate importance and functions of I. C. Engine fuel systems.	02
CO2601.3	Compare combustion mechanism of S. I. and C. I. engines	02

CO2601.4	Solve numerical on engine performance parameters	03
CO2601.5	Explain the impact of vehicular pollution and ways to reduce or control the pollution	02

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing		40%		40%	--	--
Planned Marks	30	30	20	100	--	--

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO2601.1	3													
CO2601.2	3													
CO2601.3		2												
CO2601.4	3													
CO2601.5										3				
	(1 – Low, 2 – Moderate, 3 – High)													

MET-2601 Internal Combustion Engines

	Course Content	Hrs
Unit 01	**Introduction to I.C. Engines**	06
CO2601.1	Introduction: Basic Engine components and Nomenclature, Classification of Engines, The working principle of Engines, Comparison of 2-Stroke and 4-Stroke Engines; CI, and SI Engines, Ideal and Actual Working Cycles and their analysis, Valve timing Diagram.	
Unit 02	**Fuel supply system for S.I. & C.I. engines**	07
CO2601.1	Fuel supply system for S.I. engines- Air Fuel Mixture Requirements, Construction and Working of Simple Carburetor, Calculation of Air-Fuel Ratio, Parts of Carburetor, Electronic Petrol injection system (MPFI) – components such as sensors, ECU etc., merits and demerits, Fuel supply system for C.I. engines- Classification of CI Injection Systems, Fuel Feed pump, Injection Pumps, Fuel Injector and Nozzles	
Unit 03	**Combustion in S. I. Engines**	07
CO2601.2	Stages of combustion, Ignition lag, Flame propagation, Factors affecting flame speed, Abnormal combustion, Influence of engine design and operating variables on detonation, Fuel rating, Octane number, Fuel additives, HUCR, Requirements of combustion chambers of S.I. Engines and its types.	
Unit 04	**Combustion in C.I. Engines**	08
CO2601.2	Stages of combustion, Delay period, Factors affecting delay period, Abnormal combustion- Diesel knock, Influence of engine design and operating variables on diesel knock, Comparison of abnormal combustion in S.I. and C.I. Engines, Cetane number, Additives. Requirements of combustion chambers for C.I. Engines and its types.	
Unit 05	**Performance parameters for IC Engines:**	08

CO2601.3	Measurement of performance parameters like torque, power, Volumetric Efficiency, Mechanical Efficiency, BSFC, Brake and Indicated Thermal efficiencies. Numerical on Heat Balance Sheet and engine performance, Performance curves.	
Unit 06 CO2601.4	**Engine Emission and Control** S.I. engine emission (HC, CO, NOx) Control methods- Evaporative (ELCD), Thermal, Catalytic converters, C.I. Engines Emission (CO, NOx, Smog, Particulate), Control methods- Chemical, EGR, Standard pollution Norms like EURO, Bharat, Introduction to alternative fuels for I.C. engines, Introduction to Supercharging and Turbo-charging.	07

MET 2601 Internal Combustion Engines

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Internal Combustion Engines	V. Ganesan	Tata McGraw Hill Publication	2012
02	Internal Combustion Engines	Mathur and Sharma	DhanpatRai Publication , Delhi	ISBN: 9788189928469
03	Internal Combustion Engines	Domkundwar	DhanpatRai Publication	ASIN: B07J2D8KZ 9
04	Internal Combustion Engines	Ramlingam,	SciTech Publication	ISBN10: 8183711022 ISBN-13: 978-8183711029
05	Internal Combustion Engines	Maleev	CBS Publication and Distributors	ASIN: B00OWF55 2M

Final Year B. Tech. Mechanical Engineering **(Semester –VI)**

		L	T	C
MET-2602	**Design of Power Transmission Elements**	03	--	03

Course Description

This course has a prominent position in the curriculum of Mechanical engineering. The design engineer has to consider fundamentals, scientific principles, number of factors, technical information while designing machine elements for particular applications. This course consists studies regarding design for fluctuating loading, selection of rolling contact and sliding contact bearings and design procedure of spur, helical, bevel and worm gear systems

Pre-requisites

MET-2503 Design of Machine Elements

Course Objectives

1 To study the manufacturing considerations in design
2 To design components such as shafts, and springs for fluctuating stresses
3 To design of spur and helical gears

4 To select the bearings for particular applications
5 To design types of gears

COs	Course Outcomes *Students will be able to*	Bloom's Level
CO 2602.1	Design components subjected to fatigue failure	3
CO 2602.2	Explain design considerations for casting, forging, machining	2
CO 2602.3	Select rolling contact bearings and sliding contact bearings for particular applications	3
CO 2602.4	Design of spur, helical, bevel and worm gears based on beam strength and wear strength criteria	4

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing		40%		40%	--	--
Planned Marks	30	30	20	100	--	--

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2602.1			3											
CO 2602.2		2				3								
CO 2602.3			3											
CO 2602.4			3											
	(1 – Low, 2 – Moderate, 3 – High)													

MET-2602 Design of Power Transmission Elements

Course Content Hrs

Unit 01 Design for fluctuating loads: Stress concentration - causes & remedies, fluctuating stresses, S-N. diagram under fatigue, types of load, endurance limit, notch sensitivity, endurance strength- modifying factors, design for finite and infinite life under reversed stresses, cumulative damage in fatigue failure, Soderberg and Goodman diagrams, modified Goodman diagram, fatigue design for components under combined stresses such as shafts, and springs, fatigue test. 06

Unit 02 Design Considerations in Manufacturing & other aspects: General principles of designing for manufacture, such as use, manufacture & design functions. Design for casting, forging and machining, design for assembly and designing with plastics. Servicing & Maintenance, Recycling, ROHS. 04

Unit 03 Selection of Rolling Contact Bearings: Types, static and dynamic load capacities, Stribeck's equation. Equivalent bearing load, load life relationship, bearing life, load factor, Selection of bearing from manufactures catalogue (Precision class). Ball and Roller bearing, Design for variable load and speed, Bearings with probability of survival other 06

	than 90 %. Lubrication and mountings, dismounting and preloading of bearings, Oil seal and packing. Bearing Tolerances and Precision Levels.	
Unit 04	Selection of Sliding Contact Bearings: Bearing material and their properties: Sintered bearing materials, bearing types and their construction details. Hydro-dynamic lubrication :Basic theory, thick and thin film lubrication, Reynolds's equation, Summerfield Number, Design consideration in hydrodynamic bearings, Raimondi and Boyd method relating bearing variables, Heat balance in journal bearings, Thermal Effects on Bearing, Introduction to hydro static bearings.	06
Unit 05	A. Design of Spur Gear: Gear Terminology, accuracy of gears, Backlash effect Design considerations of gears, material selection, types of gear failure. Gear tooth loads, No. of teeth, face width, strength of gear teeth, static beam strength (Lewis equation) Barth equation, dynamic tooth load (Spott's equation) wear strength (Bucking ham's equation), Estimation of module based on beam strength and wear strength. Gear design for maximum power, Methods of gear lubrication. Construction of gears such as hub, web, arm, rim type etc. Design construction of gear box. B. Design of Helical Gears: Formative number of teeth in helical gears, force analysis, beam & wear strength of helical gears, effective load & design of helical gear, Herringbone gears.	09
Unit 06	A. Design of Bevel Gear: Straight tooth bevel gear terminology and geometrical relations. Guideline for selection of dimensions and minimum number of teeth, Force analysis, Mounting of bevel gear and bearing reactions, Beam and wear strength, Dynamic tooth load, Design of straight tooth Bevel gears based on beam and wear strength, Introduction to design of spiral bevel and hypoid gears. B. Design of Worm Gears: Terminology and geometrical relations. Standard dimensions and recommendation of worm gearing, Force analysis, Friction, Efficiency of worm gear drive, Design of worm drive as per IS 7443-1974 based on beam strength and wear strength rating, Thermal consideration in worm drive, Worm and worm wheel material.	08

MET-2602 **Design of Power Transmission Elements**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Design of Machine Elements	V.B. Bhandari	Tata McGraw Hill	10: 9789339221126
02	Machine Design	R.K. Jain	Khanna	10: 81-7409-314-1
03	Design of Machine Element	J.F. Shigley	Tata McGraw Hill	0073529281
04	PSG Design data Book	Kalaikathir Achchagam - Coimbatore	Kalaikathir Achchagam - Coimbatore	13: 9788192735504

School of Technology
Department of Mechanical Engineering
Programme : **B. Tech. Mechanical Engineering**
Curriculum for : **THIRD YEAR**

Sanjay Ghodawat University, Kolhapur
Established as a State Private University under Govt. of Maharashtra Act no. XL dated 3rd May 2017
Empowering Lives Globally !

Academic Year 2022-23

B. Tech. Mechanical Engineering
Third Year (Semester – VI)

		L	T	C
MET 2603	**Heat and Mass Transfer**	03	--	03

Course Description

The course elaborates about the mechanism of heat transfer under steady and unsteady conduction conditions, convection conditions and heat transfer through extended surfaces also heat transfer through radiation

Pre-requisites

MET-207 Thermodynamics, MET208 Fluid Mechanics

Course Objectives

1 Quantify the rate at which a system gains/losses thermal energy.

2 Identifies the mode in which energy is transported.

3 Predicts the temperature distribution throughout a body.

	Course Outcomes *Students will be able to*	Bloom's Level
CO 307.1	Identify the mode by which energy is transported.	02
CO 307.2	Explain the concept of steady & Unsteady state heat conduction	02
CO 307.3	Solve heat transfer coefficients for natural & forced convection.	03
CO 307.4	Explain heat transfer from extended surfaces and radiation heat transfer between black body surfaces	02
CO 307.5	Identify the concepts of boiling and Condensation phenomenon.	02

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%		
Passing		40%		40%		
Planned Marks	30	30	100	100		

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs														
CO 307.1	1	2										2		
CO 307.2	1	2												
CO 307.3	2	2												
CO 307.4	2	2										2		
CO 307.5	2													

MET 2603	**Heat and Mass Transfer**	
	Course Content	Hrs

Unit 01 **Introduction to Heat Transfer:**

CO **2603**.1 Scope and application of heat transfer principles in engineering practice, Various Modes of heat transfer. Basic laws of heat transfer, combined modes of heat transfer, Thermal conductivity and its variation with temperature for various Engineering Materials. Introduction to mass transfer, laws 3

Unit 02 **Stead and Unsteady state heat conduction:**

CO **2603**.2 Conduction: Fourier law-thermal conductivity of solids, liquids and gasses, factors affecting thermal conductivity, common conducting and insulating materials, generalized heat conduction equation in Cartesian, cylindrical and spherical co-ordinates and its reduction to Fourier, Laplace and Poisson's equations, one dimensional steady state conduction with and without heat generation, conduction through homogeneous and composite surfaces-plane wall, cylinders and spheres, concept of thermal resistance, critical thickness of insulation, overall heat transfer coefficient. (Numerical treatment)

Lumped Heat capacity Analysis, Biot and Fourier number and their significance, (Numerical based on Lumped Heat capacity Analysis), Use of Hiesler and Grober Charts. 8

Unit 03 **Convection:**

CO **2603**.3 **Fundamentals of Convection:**

Elementary ideas of hydrodynamic and thermal boundary layers, Newton's law of cooling, Local and average convective coefficient for laminar and turbulent flow for flat plate and pipe, factors affecting heat transfer coefficient in forced and natural convection heat transfer, application of dimensional analysis to free and forced convection, significance of Prandtl number, Reynold's number, Grashoff number and Nusselt number. (Numerical treatment)

Forced Convection:

Laminar and turbulent flow heat transfer in a circular pipe, Laminar and turbulent flow heat transfer in flow over a flat plate, flow across a cylinder.

Natural Convection:

Natural convection heat transfer from a plate kept vertical and horizontal- cylinder kept vertical and horizontal, description of natural convection heat transfer from enclosed spaces. (Numerical treatment) 8

Unit 04 **Extended Surfaces :**

CO **2603**.4 **Extended Surfaces:**

Temperature boundary conditions, heat flux boundary condition, convection boundary condition and radiation boundary condition. Governing equation and boundary conditions, Types and applications of fins, pin fin of uniform cross-sectional area, fin effectiveness, fin efficiency, Error estimation in temperature measurement in thermo well. (Numerical treatment) 8

Unit 05 **Radiation:**

CO **2603**.4 Nature of thermal radiation, definitions and concepts, monochromatic and total emissive power, absorptivity, reflectivity and transmissivity, definition of black, grey and real surfaces, concept of a black body, Plank's law, Kirchoff's law, Wein's displacement law and Stefan-Boltzmann law-geometric factor (shape factor) of simple geometries, Heat exchange by radiation between black surfaces of equal, parallel and opposite black squares and discs-black rectangles 7

perpendicular to each other having a common edge, heat exchange between infinite parallel planes of different emissivity, radiation shield (no derivation) (Numerical treatment)

Unit 06 **Condensation and Boiling:**
CO **2603**.5 Filmwise and Dropwise condensation, Nusselt's theory of condensation for vertical plate, Pool boiling and forced boiling, different regimes of pool boiling, Two dimensional steady state heat conduction-governing equation and boundary conditions. (descriptive treatment only) 6

Reference/Text Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*
01	Heat and Mass Transfer	R.K. Rajput	S. Chand and Company Ltd., New Delhi.
02	Heat and Mass Transfer	Dr. D.S. Kumar	S.K. Kataria and Sons, Delhi.
03	Fundamentals of Heat and Mass Transfer	R.C. Sachdeva,	Willey Eastern Ltd.,
04	Heat and Mass Transfer	M.M. Rathod,	Laxmi Publications.
05	Fundamentals of Heat and Mass Transfer	Frank P. Incropera, David P. Dewitt	Wiley India. 5/e.

B. Tech. Mechanical Engineering
(Semester –VI)

		L	T	C
MET 2604	**Operations Research**	02	--	**02**

Course Description

Operations research (OR) is an analytical method of problem-solving and decision-making that is useful in the management of organizations. In operations research, problems are broken down into basic components and then solved in defined steps by mathematical analysis.

Pre-requisites

Course Objectives

1 Know various models in OR
2. Apply the models of operation research such as assignment model, transportation model, Linear programming model, Decision Theory Model to solve the Industry problems

	Course Outcomes *Students will be able to*	Bloom's Level
CO's **2604.1**	Explain the quantitative techniques in OR by using mathematical	4

	models	
2604.2	Solve engineering and managerial situations as LPP.	3
2604.3	Solve assignment and transportation problems for give data using different methods	3
2604.4	Formulate and solve engineering and managerial situations as Decision theory	4

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	30%	----	20%	50%		
Passing		40%		40%		
Planned Marks	60	----	40	100		

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
2604.1	1	1							2					1
2604.2	2	1							2					1
2604.3	2	1							2					1
2604.4	1	1							2					1
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2604 Operations Research

Course Content Hrs

Unit 01 **Basics of Operations Research:**
History, Definition of OR, Characteristics of OR, Methodology of OR, Models in OR, Scope of OR
Linear Programming Formulation:
Introduction, Requirement of LPP,General mathematical form of LPP,Formulation of LPP, 06

Unit 02 **Linear Programming Graphical Method and Simplex method:**
Graphical methods, special cases in LPP Forms of LPP, Simplex procedure for maximization and minimization, Big M Method, Duality concept. 08

Unit 03 **Assignment Model and Transportation Model:**
Assignment Model:
Mathematical statement, Methods to solve balanced and unbalanced assignment problems, Maximization problems, Assignment with restrictions, Traveling salesman problem.
Transportation Model:
Mathematical formulation, methods to obtain initial basic feasible solution (IBFS), NWCR, Least Cost and VAM, Conditions for testing optimality, MODI method for testing optimality solution of balanced and unbalanced problems. 08

Unit 04 **Decision Theory:**

Decision Theory: Introduction, Pay off table, Opportunity loss or regret table, Decisions under uncertainty, Laplace criterion, Maximin or Minmax principle, Maximax or Minimin principle, Hurcuilicz principle, Decisions under risk–maximum likelihood criteria, Expectation principle, Expected opportunity loss or expected regret decision trees

MET 2604 **Operations Research**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
1	Introduction to O.R	Hamdy A. Taha	PHI	
2	Quantitative Techniques in Management	N D Vora	TMH	
3	Operations Research	J.K. Sharma	TMH	
4	Operations Research – Principles & Practice	Ravindran, Phillips & Solberg	John Wily & Sons, Wiley India	
5	Operations Research-Applications & Algorithms	Wayne L. Winston	CENGAGE Learning	

TY	T YB. Tech. Mechanical Engineering **(Semester –VI)**	L	T	C
MET2605.1	**Tribology**	3	-	3

Course Description

Tribology is an important subject in the field of Machine Design. It deals with the basic knowledge of friction, wear and lubrication.

Pre-requisites

MET 2503-Design of Machine Elements

Course Objectives

1 Make student aware about Importance, scope and application of this subject.
2 Introduce the concepts of wear friction and lubrication and its application in design of tribological systems.

	Course Outcomes *Students will be able to*	Bloom's Level
CO2605.1.1	Extend the knowledge in the field of Tribology	1
CO2605.1.2	Summarize basis of friction, wear processes and lubrication	2
CO2605.1.3	Aware about tribological issues in the design of machine components such as journal bearing, thrust bearing, and roller element bearing	2
CO2605.1.4	Familiarize with antifriction and anti wear components of the material and the lubricants used therein.	1
CO2605.1.5	Design the tribological system from strength point of view	3

Evaluation Strategy

Component	**CAT-01**	**CAT-02**	**FET**	**ESE**	**FEP**	**POE**
%	15%	15%	20%	50%	--	--

Contribution						
Passing		40%		40%	--	--
Planned Marks	30	30	20	100	--	--

Mapping of COs with POs :

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO2605.1.1	2												1	1
CO2605.1.2	2												1	1
CO2605.1.3	2												1	1
CO2605.1.4			2										1	1
CO2605.1.5			2										1	1
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2605.1	**Tribology**	
	Course Content	Hrs
Unit 01	**Introduction to Tribology** Introduction, Definition of tribology, Friction, wear and lubrication, Importance of the tribological studies. Properties of oils and equation of flow: Viscosity, Newton's Law of Viscosity, Hagen-Poiseuille Law, Flow between parallel stationary planes, viscosity measuring apparatus. Lubrication principles, Classification properties and applications of lubricants. Regimes of lubrication,	06
Unit 02	**Friction and Wear** Friction-Introduction, laws of friction, Kinds of friction, Causes of friction, Friction measurement, Theories of friction, Effect of surface preparation. Wear- Types of wear, Various factors affecting wear, Measurement of wear, Wear between solids and liquids, Theories of wear	05
Unit 03	**Hydrodynamic Lubrication** Friction forces and power loss in lightly loaded bearing, Petroff's law, Tower's experiments, mechanism of pressure development in an oil film, Reynold's investigation and Reynold's equation in 2D. Numerical problems. Idealized Journal Bearing- Introduction to idealized journal bearing, Load carrying capacity, Condition for equilibrium, Sommerfeld's numbers and significance of it; Partial bearings, End leakages in journal bearing, Numerical problems	09
Unit 04	**Slider / Pad Bearing With a Fixed and Pivoted Shoe** Pressure distribution, Load carrying capacity, Coefficient of friction, Frictional resistance and loss of Power in a pivoted shoe bearing, Numerical examples.	06
Unit 05	**Hydrostatic Lubrication** Introduction to hydrostatic lubrication, Hydrostatic step bearings, Load	06

carrying capacity and oil flow through the Hydrostatic step bearing.
Numerical Examples

Unit 06 **Bearing Materials** 08

Commonly used bearings materials, Properties of typical bearing materials. Advantages and disadvantages of bearing materials. Tribological considerations in the design of gears, cams, reciprocating components, etc. Engine Tribology basics Tribology aspects of engine components such as bearings, piston assembly, valve train and dive train components etc.

MET2605.1 **Tribology**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
1	Introduction to Tribology Bearings"	Mr. Mujumdar B. C.	S.Chand Company Pvt.	2008
2	Engineering Tribology	Mr. Prasanta Sahoo,	PHI,Estern Economy Edition.	
3	Fundamentals of Tribology	Mr. Basu S K.	PHI (2006).	

TY	B. Tech. Mechanical Engineering **(Semester – VI)**	L	T	C
MET 2605.2	**Product Design & Development**	3		3

Course Description

It includes identification of opportunity for development of new product based on requirement of customer. Starting from the generation of concepts and its evaluation, preparation of prototype, Product design and testing all aspects of product design are covered. Emphasis is given of aesthetic and ergonomic consideration in design.

Pre-requisites

Manufacturing Processes, Engineering Graphics Lab, Machine Drawing and CAD Lab

Course Objectives

1 Explain how to convert needs of customer into specification.
2 Implement steps in product design, preparations of prototype and product testing.

	Course Outcomes (Students will be able to)	**Bloom's Level**
CO2605.2.1	List challenges/ problems of customer and specify customer needs.	2
CO2605.2.2	Compare different ways for Concept selection & testing.	2
CO2605.2.3	Apply different tools and techniques of product design.	3
CO2605.2.4	Review aesthetic and ergonomic consideration for design of Product.	2
CO2605.2.5	Understand the prototype model design considerations and Estimation of costing.	2
CO2605.2.6	Understand the effects of other human factors on workplace design.	2

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing	40%			40%	--	--
Planned Marks	30	30	20	100	--	--

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO2605.2.1		2				2			2	2				
CO2605.2.2			2						2	2				
CO2605.2.3		2	2						2	2				
CO2605.2.4		2												
CO2605.2.5			2											
CO2605.2.6			2											
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2605.2	**Product Design & Development**	
	Course Content	**Hrs**
Unit 01	**Discovery-** Opportunity identification for new products, Product life cycle, need for new products, strategic planning and new product opportunity, sources of new product ideas, Steps in NPD Product idea generation, creativity and innovation.Identifying Customer Needs, Voice of the customer, gathering customer needs, organizing and prioritizing needs, Product mission statement, Benchmarking and establishing product specifications.	8
Unit 02	**Product Concept Generation, Selection and Testing :** Concept generation process and methods, Concept selection mechanism and techniques, Concept Testing-Purpose, process and methods. Product Architecture-types, establishing architecture, Modular design.	6
Unit 03	**Product Design Process and Tools and Techniques:** Product Design process steps, Stage gate model, Product teardown and experimentation, Concurrent engineering, Quality function Deployment (QFD), Value engineering.	6
Unit 04	**Design Considerations:** Product dimensions, Design for manufacturing and assembly (DFMA), Design for Sustainability, Aesthetic aspects- Symmetry, balance, contrast, continuity, rhythm, Form and styling, Color in product design, Ergonomic considerations, Anthropometry.	6
Unit 05	**Design for Manufacturing and Product Development** Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs – Minimize system complexity – Prototype basics – principles of	8

prototyping – planning for prototypes – Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

Unit 06 **WORK PLACE DESIGN:** 6

Applied anthropometry, Workspace design and seating, arrangement of components within a physical space, interpersonal aspects of work place design, and design of repetitive task, design of manual handling activity task, work capacity, stress, and fatigue.

MET2605.2 Product Design & Development

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
1	Industrial Engineering and Production Management	Dr Martand Telsang	S. Chand & Co. NewDelhi,	2006
2	Product Design and Development	Ulrich, Eppnger, Anita Goel	McGraw Hill Publishing	
3	Product Design	Otto & Wood	Pearson Education	
4	Product and Process Design Principles: Synthesis, Analysis and Evaluation,	Seider , Seader, Lewin,Widagdo	Wiley Publication	
5	The Design of Everyday Things	Don Norman	Basic Books	

TY B. Tech. Mechanical Engineering
Final Year **Third Year (Semester – VI)**

		L	T	C
MET-2605.3	**Heat Exchangers**	**03**	**--**	**03**

Course Description

The course includes the detail understanding of design of various types of heat exchangers.

Pre-requisites

MET-207 (Thermodynamics), MET -307 (Heat & Mass Transfer)

Course Objectives

1 To recognize and differentiate heat exchangers and
2 To know the primary considerations in the selection and design of heat exchangers.

CO	**Course Outcomes** *Students will be able to*	Bloom's Level
2605.3.1	Explain the types of heat exchanger.	02
2605.3.2	Evaluate the performance parameters of shell and tube heat exchangers.	02
2605.3.3	Elaborate the terminologies of Steam condensers and double pipe heat exchangers.	02
2605.3.4	Evaluate the Design & performance of a heat exchanger.	03
2605.3.5	Explain the details of Compact & Air-cooled heat exchangers.	02

Evaluation Strategy

Component	**CAT-01**	**CAT-02**	**FET**	**ESE**	**FEP**	**POE**
Contribution	15%	15%	20%	50%		
Passing		40%		40%		
Planned Marks	30	30	100	100		

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
2605.3.1			2											
2605.3.2	2	2											1	
2605.3.3	1	2												
2605.3.4	3	3	3									1	2	1
2605.3.5		2										1	1	
	(1 – Low, 2 – Moderate, 3 – High)													

MET-2605.3 Heat Exchangers

Course Content Hrs

Unit 01 **Introduction To Heat Exchanger Design:**
Types of heat exchangers and their applications. Flow arrangements and temperature distributions in transfer type of heat exchangers. Overall heat transfer coefficient;- Clean overall heat transfer coefficient, dirt factor dirt overall heat transfer coefficient, dirt factors for various process services. Basic design equation. Mean temperature difference Concept: - LMTD for parallel flow and counter flow arrangement, correction factor for LMTD for cross flow and multi –pass heat exchangers. 06

Unit 02 **Shell And Tube Heat Exchangers:**
Constructional features. Applications. Effectiveness-NTU method for heat exchanger design/ analysis. Rating and sizing problem. Correlations for tube side pressure drop and heat transfer coefficients. Pressure drop and heat transfer coefficient correlations for shell side flow. 06

Unit 03 **Effect Of By – Pass and Leakage Calculation Procedure for Shell and Tube Heat Exchanger:**
Heat balance equations: LMTD: reference temperature calculations: evaluation of fluid properties: flow assignments: tube side flow area calculations; viscosity correction factor, shell side equivalent diameter, calculation of shell side heat transfer coefficient, evaluation for wall temperature, evaluation of overall heat transfer coefficient, Calculation of surface area. Calculations of tube side and shell side pressure drops. 08

Unit 04 **Steam Condensers:**
Specifications of other details as per TEMA standards. Flow arrangement for increased heat recovery: - lack of heat recovery in 1-2 exchangers true temperature difference in a 2-4 exchanger. Calculation procedure for steam condensers. 06

Unit 05 **Double Pipe Heat Exchangers:**
Constructional features. Applications. Design parameters: - tube side and shell side film coefficients cut and twist factor, fin efficiency, overall heat transfer coefficient, mean temperature difference, available surface area, fin geometry fin height, number of fins, tube side and shell side pressure drop. Calculation procedure for the design/analysis of double pipe heat exchanger. 06

Unit 06 **Compact Heat Exchangers:**
Introduction; definition of Geometric Terms, plate fin surface geometries and surface performance data; correlation of heat transfer and friction data; Goodness factor comparisons;
Air-Cooled Heat Exchangers:
Air as coolant for industrial processes; custom-built units; fin-tube systems for air coolers; fin-tube bundles; tube side flow arrangements; cooling air supply by fans; cooling air supply in natural draft towers. 08

MET-2605.3 Heat Exchangers

Reference Books

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Process Heat Transfer	G F Hewuttm G L Shires and T R Bott	CRC Press	1994
02	Fundamentals of Heat Exchanger Design	R K Shah and D P Sekulic	John Wiley & Sons	2003
03	Heat Exchangers	A Kakac, H Liu	CRC Press	2002
04	Handbook for Heat Exchangers and Tube Banks Design	D. Annaratone	Springer Verlag	2010
05	Compact Heat Exchangers	J.E. Hesselgreaves	Pergamon	2001.
06	Advances in Thermal Design of Heat Exchangers	Eric M Smith	John Wiley & Sons, Ltd	2005

TY	B. Tech. Mechanical Engineering **(Semester – VI)**	L	T	C
MET-2605.4	**Automotive Diagnostics**	03	--	03

Course Description

This course explores the fundamentals of service and repair procedures for the automotive chassis, engines & its subsystems. Course also covers how to safely perform basic repair, maintenance operations and diagnose the systems for proper functioning

Pre-requisites

MET 2505.4 Automobile Engineering, MET2606 Internal combustion engines

Course Objectives

1. To make the student understand the need for vehicle maintenance and its importance and to familiarize the maintenance procedure for various components of an automobile
2. To have a complete understanding and hands-on experience of the vehicle maintenance procedures, which will help them to acquire skills in handling situations where the vehicle is likely to fail.

	Course Outcomes *Students will be able to*	Bloom's Level
CO2605.1	Describe importance & significance of different types of maintenance records	2
CO2605.2	Identify faults in engine & transmission systems, to improve tune up	1
CO2605.3	Describe appropriate chassis maintenance methods	2
CO2605.4	Explain electrical system maintenance	1

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	15%	15%	20%	50%	--	--
Passing		40%		40%	--	--
Planned Marks	30	30	20	50	--	--

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO2605.1	1													1
CO2605.2	2	1												2
CO2605.3	2	2												2
CO2605.4	2	2												1
	(1 – Low, 2 – Moderate, 3 – High)													

MET-2605.4	**Automotive Diagnostics**	
	Course Content	Hrs
Unit 01 CO2605.1	**Maintenance record and schedule** Need for maintenance, types of maintenance: preventive and breakdown maintenance, requirements of maintenance, preparation of check lists. Inspection schedule, maintenance of records, log sheets and other forms, safety precautions in maintenance: General safety, tool safety.	06
Unit 02 CO2605.2	**Engine subsystem maintenance** Servicing and maintenance of fuel system, cooling system: water pump, radiator, thermostat. Lubrication system maintenance, Lubrication Charts, Anticorrosion and anti-freeze additives	06
Unit 03 CO2605.2	**Engine maintenance** Tools used for engine disassembly, dismantling of engine components: cylinder head, valve train, cylinder block, connecting rod, piston and crankshaft assembly; cleaning and inspection of engine components, reconditioning of components, engine tune-ups	07
Unit 04 CO2605.2	**Transmission System maintenance** Servicing and maintenance of clutch, gear box, universal joints, propeller shaft, differential system, wheel balancing, wheel alignment, maintenance of tyre and tyre rotation	07
Unit 05 CO2605.3	**Chassis maintenance** Servicing and maintenance of brake – disc and drum brakes, steering wheel and suspension systems, servicing and maintenance of front and rear axle	07
Unit 06 CO2605.4	**Electrical system maintenance** Servicing and maintenance of battery, starter motor, alternator and generator, ignition system, lighting system, electric horn, and wiper motor	06

MET 2605.4	**Automotive Diagnostics**

Reference/Text Book

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Auto Service & Repair: Servicing, Troubleshooting, and Repairing Modern Automobiles: Applicable to All Makes and Models	Martin W. Stockel, Martin T. Stockel, Chris Johanson	Goodheart-Willcox Publisher	ISBN 10: 0870061011
02	Advanced Engine Performance Diagnosis	James D Halderman	PHI	1998
03	Everyday Automobile Repair	Crouse W	Intl. student edition, TMH, New Delhi	1986
04	Car maintenance and repair	A. W. Judge	Motor manual	
05	Auto Diagnosis, Service, And Repair	Martin T. Stockel, Chris Johanson	Goodheart-Willcox Publisher	2003

TY	B. Tech. Mechanical Engineering **Third Year (Semester –VI)**	L	P	C
MET-2606	**Internal Combustion Engines Lab**	**--**	**02**	**01**

Course Description

This course allows the students to estimate the performance of both S.I and C.I engine experimentally. Also student can understand the design and location of various governing parts of I. C. Engines

Pre-requisites

MET-207 Thermodynamics

Course Objectives

1 To study various internal combustion engine systems
2 To provide the detailed understanding of internal combustion engine mainly based on its performance and emission parameters

	Course Outcomes	Bloom's Level
	Students will be able to	
CO2606.1	Demonstrate fuel supply systems, ignition and governing systems of IC Engines	02
CO2606.2	Measure operating characteristics of IC Engines	04
CO2606.3	Compare the experimental results with theoretical trends	02
CO2606.4	Make use of AVL gas analyzer for measurement of emissions	03

Evaluation Strategy

Component	**CAT-01**	**CAT-02**	**FET**	**ESE**	**FEP**	**POE**
% Contribution	--	--	--	--	50%	50%
Passing		--		--	40%	40%
Planned Marks	--	--	--	--	100	50

Mapping of COs with POs:

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n

CO2606.1	1													
CO2606.2	2													
CO2606.3		2												
CO2606.4						3								
	(1 – Low, 2 – Moderate, 3 – High)													

MET-2606 Internal Combustion Engines Lab

Sr. No. **List of Experiments**

01 CO2606.1 Constructional detail of I.C. engines, dismantling and assembly

02 CO2606.1 Study and Demonstration of Engine systems: Air intake, Exhaust, Cooling, Lubrication systems

03 CO2606.1 Study and Demonstration of Ignition systems, Starting systems

04 CO2606.1 Study and Demonstration of fuel supply systems for IC Engines. (S.I. & C.I.)

05 CO2606.3 Test on four stroke Diesel Engine and compare the analytical solution using computer controlled I.C. Engine

06 CO2606.2 Test on four stroke Petrol Engine

07 CO2606.2 Morse Test on Multi Cylinder Engine

08 CO2606.4 Measurement of exhaust emissions of SI / CI Engines.

09 CO2606.1 Visit to an engine manufacturing company / repairing unit

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	Internal Combustion Engines	V. Ganesan	Tata McGraw Hill Publication	2012
02	Internal Combustion Engines	Mathur and Sharma	Dhanpat Rai Publication, Delhi	ISBN: 9788189928469
03	Internal Combustion Engines	Domkundwar	Dhanpat Rai Publication	ASIN: B07J2D8KZ9
04	Internal Combustion Engines	Ramlingam,	SciTech Publication	ISBN10: 8183711022 ISBN-13: 978-8183711029
05	Internal Combustion	Maleev	CBS Publication and	ASIN:

School of Technology
Department of Mechanical Engineering
Programme : **B. Tech. Mechanical Engineering**
Curriculum for : **THIRD YEAR**

Sanjay Ghodawat University, Kolhapur
Established as a State Private University under Govt. of Maharashtra Act no. XL dated 3rd May 2017
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Academic Year 2022-23

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T.Y B. Tech. Mechanical Engineering
Third Year (Semester – VI)

		P	C
MET 2607	**Heat and Mass Transfer Lab**	**02**	**01**

Course Description
The course gives the basic understanding of modes of heat transfer and their phenomenon using different test rigs.

Pre-requisites
MET-207 Thermodynamics, MET-208 Fluid Mechanics

Course Objectives
1 Acquire basic knowledge about conduction, convection and radiation
2 Heat Transfer rate calculations of heat exchanger.

	Course Outcomes *Students will be able to*	Bloom's Level
CO **2607**.1	Compare the temperature distribution and their effect on different materials considering conduction mode of heat transfer.	02
CO **2607**.2	Analyze the heat transfer coefficient for natural and forced convection.	04
CO **2607**.3	Understand the thermal emissivity between gray surface and black body.	02
CO **2607**.4	Experiment with the phenomenon of condensation and boiling.	03

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	--	--	--	--	100%	100%
Passing		--		--	40%	40%
Planned Marks	--	--	--	--	50	50

Mapping of COs with POs :

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 313.1	3													
CO 313.2	2													
CO 313.3		2												
CO 313.4						3								
	(1 – Low, 2 – Moderate, 3 – High)													

Sr. No. **List of Experiments / Assignments**

01 To find and compare the thermal conductivity of given Insulating materials.

02 To find the thermal conductivity and behaviour at different temperatures for Cu, Al and SS metal rods.

03 To find the total thermal resistance and temperature distribution in a given Composite wall.

04 To find local and average heat transfer coefficient in Natural convection heat transfer from a vertical cylinder.

05 To find Heat Transfer Coefficient under forced convection.

06 To find emissivity of a given gray surface and compare the results with Black Surface.

07 To verify Stefan Boltzmann Constant.

08 To find heat transfer coefficient in dropwise and filmwise condensation.

09 Analysis of extended surfaces.

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book /Handbooks /Catalogues*	*Author (s)*	*Publisher /Organization*	*Edition, Year of Publication, ISBN*
01	Heat and Mass Transfer	R.K. Rajput	S. Chand and Company Ltd. New Delhi	
02	Heat and Mass Transfer	Dr. D.S. Kumar	S.K. Kataria and Sons, Delhi	
03	Fundamentals of Heat and Mass Transfer	Frank P. Incropera, David P. Dewitt	Wiley India.	5/e
04	Heat Transfer – A Practical approach	Yunus. A. Cengel	Tata McGraw Hill	

TY	B. Tech. Mechanical Engineering **Third Year (Semester – VI)**	L	P	C
MET-2608	**MATLAB (Software Proficiency)**		2	1

Course Description

MATLAB is a platform used to study data sets, develop models of real-world systems, create algorithms, and solve equations. Engineers use MATLAB to develop, design, simulate, and test their models before it can be developed in the real-world. In the field of mechanical engineering, MATLAB is used for solving problems related to dynamic and static systems, mechanical vibrations, control systems, statics, and more. This makes MATLAB a fundamental software tool for Mechanical engineer.

Pre-requisites

No specific prerequisites are needed. It is advisable to have a have a good familiarity with PC operations and a working knowledge of some basic application software (Excel). Basic knowledge of computer programming and an understanding of matrix and linear algebra are highly beneficial.

Course Objectives

1 To Impart the Knowledge to the students with MATLAB software.
2 To provide a working introduction to the MATLAB technical computing environment
3 To introduce students the use of a high-level programming language, MATLAB.

CO	**Course Outcomes** *Students will be able to*	Bloom's Level
2608.1	Understand the basics of the MATLAB	1
2608.2	Solve mathematical equations and plot graphs using MATLAB	2
2608.3	Get hands-on experience with writing MATLAB scripts to simulate a variety of systems and problems	2

Evaluation Strategy

Component	**CAT-01**	**CAT-02**	**FET**	**ESE**	**FEP**	**POE**

% Contribution	--	--	--	--	50%	50%
Passing		--		--	40%	40%
Planned Marks	--	--	--	--	100	50

Mapping of COs with POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	13	14
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
2608.1	1				2									
2608.2	1			2										
2608.3	1						2							
	(1 – Low, 2 – Moderate, 3 – High)													

MET-2608 MATLAB

Sr. No. **List of Experiments**

01 Introduction
Basic features, A minimum MATLAB session, Starting MATLAB, Using MATLAB as a calculator , Quitting MATLAB, Getting started, Creating MATLAB variables, Overwriting variable, Error messages
Making corrections, Controlling the hierarchy of operations or precedence, Controlling the appearance of floating-point number, Managing the workspace, Keeping track of your work session, Entering multiple statements per line, Miscellaneous commands, Getting help, Exercises

02 Tutorial lessons
Mathematical functions, Examples, Basic plotting, overview, Creating simple plots, Adding titles, axis labels, and annotations, Multiple data sets in one plot, Specifying line styles and colors, Exercises Introduction, Matrix generation, Entering a vector, Entering a matrix, Matrix indexing, Colon operator, Linear spacing, Colon operator in a matrix, Creating a sub-matrix, Deleting row or column, Dimension Continuation, Transposing a matrix, Concatenating matrices, Matrix generators, Special matrices Exercises.

03 Array operations and Linear equations
Array operations, Matrix arithmetic operations, Array arithmetic operations, Solving linear equations Matrix inverse, Matrix functions, Exercises

04 Introduction to programming:
Introduction, M-File Scripts, Examples, Script side-effects, M-File functions, Anatomy of a M-File, Input and output arguments, Input to a script file, Output commands, Exercises

05 Control flow and operators
Introduction, Control flow, The ‘‘if...end’’ structure, Relational and logical, The ‘‘for...end’’ loop, The ‘‘while...end’’ loop, Other flow structures, Operator precedence, Saving output to a file, Exercises.

06 Debugging M-files
Introduction, Debugging process, Preparing for debugging, Setting breakpoints, Running with breakpoints, Examining values, Correcting and ending debugging, Ending debugging, Correcting an M-file

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	*Name of Book*	*Author(s)*	*Publisher*	*Edition, Year of Publication, ISBN*
01	The MathWorks Inc. MATLAB 7.0 (R14SP2).		The MathWorks Inc.	2005
02	MATLAB Programming for	S. J. Chapman	Thomson	2004

	Engineers			
03	Numerical Computing with MATLAB	C. B. Moler	Siam	2004
04	Applications of MATLAB: Ordinary Differential Equations. Internal communication	D. Houcque	Northwestern University	2005
05	A MATLAB Companion for Multivariable Calculus	J. Cooper	Academic Press	2001

TY	B. Tech. Mechanical Engineering **Third Year (Semester –VI)**	L	P	C
MET 2609	**Software Proficiency II CATIA : Sheet Metal Design**	**-**	**4**	**2**

Course Description

In This course student will learn how to design a sheet metal part using associative feature-based modeling. Also, how to integrate both standard and user-defined stamped features into your designs and calculate the resulting flat patterns in accordance with the standard bend allowances

Pre-requisites

Engineering Graphics Laboratory, Machine Drawing and CAD Lab, Manufacturing Processes

Course Objectives

1 To Understand the terminology and the design process for creating a sheet metal part and Define and manage the sheet metal part parameters

2 To Design walls, bends flanges and add features such as cutouts, holes, corners, and Manage folded and unfolded views and export a finished flat pattern

	Course Outcomes Students will be able to	Bloom's Level
CO 2609.1	Understand the applications and necessity of Sheet-metal design.	2
CO 2609.2	Define the sheet metal parameters.	2
CO 2609.3	Create the features like bends, flange corner relief.	3
CO 2609.4	Create the stampings as per required shape.	3
CO 2609.5	Analyze similar features, unfolded view and drafting.	4

Evaluation Strategy

Component	CAT-01	CAT-02	FET	ESE	FEP	POE
% Contribution	--	--	--	--	100%	-
Passing		--		--	40%	-
Planned Marks	--	--	--	--	100	-

Mapping of COs with POs:

POs	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
COs	a	b	c	d	e	f	g	h	i	j	k	l	m	n
CO 2609.1	2		2											
CO 2609.2	2												1	
CO 2609.3	1	2	1		3				1				1	1
CO 2609.4	1	2	1		3								1	1
CO 2609.5	1	2	3	2	3								1	2
	(1 – Low, 2 – Moderate, 3 – High)													

MET 2609	**Software Proficiency II** **CATIA : Sheet Metal Design**

Sr. No. **List of Experiments / Activities**

01 Introduction to Generative Sheet-metal Design:
Generative sheet metal design overview, Defining sheet-metal parameters, Sheet-metal wall, Defining the first wall, Secondary wall.

02 Bends and Unfolded Mode:
Types of Bends, Unfolded/ Folded mode, Corner relief, Creating the flanges.

03 Flanges:
Creating a flange, Creating a hem, Creating a tear drop, Creating a user flange.

04 Sheet-metal Features:
Creating a cutout, Creating a hole, Creating a flanges hole, creating a bed, Creating a circular stamp, Creating a flanged cutout, Creating a stiffened rib.

05 Transformation and Duplication :
Creating rectangular and circular pattern, Creating mirrors, Transformation of parts.

Reference Books /Text Books /Handbooks /Catalogues /Other

Sr. No.	Name of Book	Author(s)	Publisher	Edition, Year of Publication, ISBN
01	CATIA V5 for Designers	Sham Tickoo	BPB Publication	15, 2017
02	https://academy.3ds.com/en/learn-online.			

Course Code		L	T	P	Credits	FEP
MET 2610	Internship	-	-	02	01	100

The Evaluation of the Internship is done in Sem VI

Course Code		L	T	P	Credits	FET
MET 321	Foreign Language	3	-	-	NC	100
MET 322	Scholastic Program	3	-	-	NC	100

Foreign Language and Scholastic Program is conducted to enhance the students education as well as to his/her career.