IV– I SEMESTER

S. No	Category	COURSE CODE	COURSE TITLE	L	T	P	C	IM	EM	TM
1	PE	UGME7T0120 UGME7T0220 UGME7T0320	**Professional Elective-III** i. Power plant Engineering ii. Noise vibrations and Harshness iii. Manufacturing for Automotive components	3	-	-	3	30	70	100
2	PE	UGME7T0420 UGME7T0520 UGME7T0620	**Professional Elective-IV** i. Automation in Manufacturing ii. Computational Fluid Dynamics iii. Vibrations and vehicle dynamics	3	-	-	3	30	70	100
3	PE	UGME7T0720 UGME7T0820 UGME7T0920	**Professional Elective-V** i. Refrigeration & Air Conditioning ii. Lean Manufacturing and Six Sigma iii. Fracture Mechanics	3	-	-	3	30	70	100
4	OE/ JOE	UGME7T1020	Mechatronics & robotics	2	-	2	3	30	70	100
5	OE/ JOE	UGME7T1120	Measurements and GD&T	2	-	2	3	30	70	100
6	HSSE	UGMB7T0120	Management Science	3	-	-	3	30	70	100
7	SOC	UGME7K1220	Surface Modeling and Sheet metal working	1	-	2	2	50	-	50
8	Internship	UGME7I1320	Industrial /Research internship (after third year)	-	-	-	3	50	-	50
			Total	**17**	**0**	**6**	**23**	**280**	**420**	**700**
Honors/Minor course (4 credits)										

SEMESTER – VIII (FOURTH YEAR – II SEMESTER)

S. No	Category	Course Code	Course title	L	T	P	C	IM	EM	TM
1	Major Project	UGME8J0120	Major Project	-	-	20	10	100	100	200
2	Seminar	UGME8S0220	Seminar	-	2	-	2	50	-	50
TOTAL CREDITS				**0**	**2**	**20**	**12**	**150**	**100**	**250**

L – Lectures, T – Tutorials, P – Practicals, C – Credits, IM – Internal Marks, EM – External Marks, TM – Total Marks

BS - Basic Science, HSS - Humanities & Social Science, ES - Engineering Science, MC - Mandatory Course, PC - Professional Core, SOC - Skill Oriented Course, OE/JOE - Open Elective/Job Oriented Elective, PE - Professional Elective, HSSE - Humanities & Social Science Elective

POWER PLANT ENGINEERING

Subject Code: UGME7T0120	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives:

- The objective of the course is to provide different methods of power generation
- Understand the non-conventional energy sources like solar energy, Geothermal Energy
- To provide different reactors working principle in nuclear power plants
- To impart knowledge on combined power plant operations used in electric power generation.
- To provide pollution control measures and the economic aspects of power plant operation

SYLLABUS:

UNIT – I **9Hrs**

Introduction to the sources of energy – resources and development of power in India.

STEAM POWER PLANT: Plant layout, working of different circuits, coal handling & ash handling systems. Pulverized fuel burning system, draught system, dust collectors, cooling towers. Feed water treatment.

UNIT – II **8Hrs**

SOLAR ENERGY: Availability of solar energy, Measurement of sunshine, solar radiation data, estimation of average solar radiation, solar energy selection, selective surfaces, Construction of solar flat plate and evacuated tube collectors, Solar heating and cooling.

UNIT – III **10Hrs**

HYDROELECTRIC POWER PLANT: Classification of Hydroelectric Power Plants, Typical Layouts, Plant auxiliaries, Classification of dams and spill ways.

GEOTHERMAL ENERGY: Earth as source of heat energy, stored heat and renewability of earth's heat, Nature and occurrence of geo-thermal field, Classification of thermal fields, Model of Hyper thermal fields & Semi thermal fields.

UNIT – IV **9Hrs**

NUCLEAR POWER STATION: Nuclear fuel – breeding and fertile materials – nuclear reactor – reactor operation.

TYPES OF REACTORS: Pressurized water reactor, boiling water reactor, sodium-graphite reactor, fast breeder reactor, homogeneous reactor, gas cooled reactor, radiation hazards and shielding – radioactive waste disposal.

UNIT – V **8Hrs**

COMBINED OPERATIONS OF DIFFERENT POWER PLANTS: Introduction, advantages of combined working, load division between power stations, storage type hydro-electric plant in combination with steam plant, run-of-river plant in combination with steam plant, co-ordination of hydroelectric and gas turbine stations,

POWER PLANT INSTRUMENTATION AND CONTROL: Importance of measurement and instrumentation in power plant, measurement of water purity, gas analysis, O2 and CO2 measurements, measurement of smoke and dust.

UNIT – VI **10Hrs**

POWER PLANT ECONOMICS AND ENVIRONMENTAL CONSIDERATIONS: Capital cost, investment of fixed charges, operating costs, general arrangement of power distribution, load curves, load duration curve, definitions of connected load, maximum demand, demand factor, average load, load factor, diversity factor – related exercises. pollutants and pollution standards, methods of pollution control.

COURSE OUTCOMES:

Upon the completion of the course, the students will able to:

CO1: Explain the working principles of various power plants and combined operations used in electric power generation.
CO2: Estimate the solar radiation for utilization.
CO3: Understand Hydroelectric and geothermal energy systems that are economically feasible and eco-friendly
CO4: Analyze different technologies adopted in nuclear power plants.
CO5: Apply pollution control techniques, economic analysis in power plants

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2
CO1	2													
CO2	2	2	2	2										
CO3	2	2	2											
CO4	2													
CO5	3	3	3	2		2								

TEXT BOOKS:

1. A course in Power Plant Engineering – Arora and Domkundwar, Dhanpatrai & Co.
2. Power Plant Engineering – P.C.Sharma / S.K.Kataria Pub

REFERENCE BOOKS:

1. Power Plant Engineering: P.K.Nag/ II Edition /TMH.
2. Power station Engineering – ElWakil / McHill.
3. An Introduction to Power Plant Technology / G.D. Rai.

NOISE, VIBRATION AND HARSHNESS

Subject Code: UGME7T0220	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objective:

- Understand the role of NVH in automotive industry
- Explain the facilities and instrumentations in measuring the NVH levels in automotive applications
- Acquire knowledge in controlling NVH levels in automobiles and improving comfort for the users

SYLLABUS:

UNIT I **8hrs**

NVH IN THE AUTOMOTIVE INDUSTRY - Sources of Noise and Vibration - Design Features - Common Problems - Marque Values - Noise Quality - Pass-By Noise Requirements. Target Vehicles and Objective Targets - Development Stages in a New Vehicle Programme and the Altering Role of NVH Engineers.

UNIT II **8hrs**

SOUND AND VIBRATION THEORY - Sound Measurement - Human Sensitivity and Weighting Factors. Combining Sound Sources - Acoustical Resonances - Properties of Acoustic Materials - Transient and Steady State Response of One Degree of Freedom System Applied to Vehicle Systems Transmissibility - Modes of Vibration.

UNIT III **8hrs**

VEHICLE INTERIOR AND EXTERIOR NOISE - Internal noise sources in vehicles such as engine noise; road noise; aerodynamic (wind) noise; brake noise; squeak, rattle and tizz noises; sound package solution to reduce the interior noise: acoustic isolation, acoustic absorption and damping material solutions; Exterior noise sources in vehicles such as air intake systems and exhaust systems; Tyre noise.

UNIT IV **8hrs**

SOURCES OF VEHICLE VIBRATION - Power train and Engine vibrations; driveline vibrations; chassis and suspension vibrations; Control strategies; Human response to vehicle vibrations, concept of harshness; subjective and objective evaluation of vehicle harshness.

UNIT V **8hrs**

VIBRATION ISOLATION AND CONTROL - Introduction; damping of vibrations; vibration isolation and absorption; design of a Vibration Absorbers, unconstrained and constrained layer damping treatment, add on dampers and stiffeners, Introduction to Active Vibration Control.

UNIT VI **8hrs**

VIBRATION MEASUREMENT AND INSTRUMENTATION - Definition of Modal Properties, Modal analysis theory, FE & Experimental modal analysis, Transducers and accelerometers Excitation sources Impact Excitation, Shaker excitation, Excitation signals, applications of Modal Analysis, laser based vibration measurements; analysis and presentation of vibration data.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Describe the sources and common problems in automotive industry to control NVH.

CO2: Explain the theory of vibration and sound measurement for the automotive applications

CO3: Discuss the facilities and instrument to measure the NVH levels in automobiles

CO4: Describe the strategies to control Noise, Vibration and Harshness for the comfort of the passengers

Mapping of COs to PO

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

Text Books:

1. Norton M P, Fundamental of Noise and Vibration, Cambridge University Press, 1989
2. Munjal M.L., Acoustic Ducts and Mufflers, John Wiley, 1987

Reference Books:

1. Baxa, Noise Control of Internal Combustion Engine, John Wiley, 1984.
2. Ewins D. J., Model Testing: Theory and Practice, John Wiley,1995.
3. Boris and Kornev, Dynamic Vibration Absorbers, John Wiley, 1993.
4. McConnell K, "Vibration Testing Theory and Practice", John Wiely, 1995.

MANUFACTURING FOR AUTOMOTIVE COMPONENTS

Subject Code: UGME7T0320	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

COURSE OBJECTIVES

The course content enables students to:

- To acquaint the students with the basic concepts of manufacturing process.
- To make the students to be familiar with different techniques of surface coatings.
- To introduce the students the potential of plastics and their implications in making automotive components.
- To make the students to be familiar with latest manufacturing techniques adopted in automobile industries.

SYLLABUS:

UNIT-1

Forged Engine Components: Material selection and Manufacturing methods for Crank shaft, Connecting rod, Cam shaft, valve, Piston pin, Push rod, Rocker arm, tappets, spark plug

UNIT-II

Casted Engine Components: Material selection and Manufacturing methods for Piston, Piston rings, Cylinder block, wet and dry liners, Engine head, Oil pan, Carburetors. Thermal barrier coating of Engine head and valves.

UNIT-III

Transmission System : Material selection and Manufacturing methods for Clutch – Clutch lining – Gear Box – Gear – Propeller Shaft – Differential – Axle Shaft – Bearing – fasteners – Wheel drum. Methods of Gear manufacture – Gear hobbing and gear shaping machines - gear generation - gear finishing and shaving – Grinding and lapping of hobs and shaping cutters – gear honing – gear broaching

UNIT-IV

.**Body Components:** Introduction, thermoforming and hydro forming, press forming, welding of body panels, resistance, welding and other welding processes. Introduction - moulding of instrument panel, moulding of bumpers, reinforced reaction injection moulding, tooling and tooling requirements, manufacture of metal/polymer/metal panels. Adhesives and sealants, leaf spring manufacturing, composite leaf springs, wrap forming of coil springs.

UNIT-V

Vehicle Chassis: Material selection and manufacturing methods for chassis, dead axle, leaf spring, coil spring and shock absorbers – wheel housing – steering system, Brake shoes, wheel rim, Tyres.

UNIT-VI

Plastics: Plastics – Plastics in Automobile vehicles – Processing of plastics - Emission control system – catalytic converter – Hydro forming of exhaust manifold and lamp housing – stretch forming of Auto body panels – MMC liners –Selection of materials for Auto components.

COURSE OUTCOMES:

Upon Successful Completion of this course, Students will be able to

CO1: Comprehend the steps involved in the manufacturing of engine components through casting and forging with their relative merits and demerits.
CO2: Identify the optimal material and manufacturing process for making the transmission system and other chassis components.
CO3: Analyze and make a selection out of different forming and welding techniques for manufacturing automotive components.
CO4: Evaluate the performance of different coating techniques
CO5: Explicate the importance of plastics and their fabrication techniques.
CO6: Comprehend the recent manufacturing techniques followed in automotive industries.

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO 12	PS O1	PS O2
CO1	2		2	2	3	1						1		
CO2	1	1	2		2							1		
CO3	2	2	1		1							1		
CO4	1				1							1		
CO5	2	2		2	1							1		
CO6	2	1	2		1							1		

AUTOMATION IN MANUFACTURING

Subject Code: UGME7T0420	**L**	**T**	**P**	**C**
IV Year / II Semester	**3**	**0**	**0**	**3**

Course Objectives:

- Understand the concept of Automation in machine tools.
- Learn methods of work transfer, storage design and fabrication in automated flow lines.
- Understand Assembly lines and improving balancing methods of assembly lines.
- Understand functioning in material handling and storage systems in manufacturing.
- Describe the concept and control of Adoptive control systems.
- Knowledge the concept of Automated Inspection and methods of Coordinate Measuring Machine.

SYLLABUS

UNIT – I **8 hrs**

INTRODUCTION: Types and strategies of automation, pneumatic and hydraulic components circuits, Automation in machine tools, Mechanical feeding and tool changing and machine tool control, transfer the automaton.

UNIT – II **10 hrs**

AUTOMATED FLOW LINES: Methods of work part transport, transfer of Mechanical buffer storage, control function, design and fabrication consideration.

ANALYSIS OF AUTOMATED FLOW LINES: General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

UNIT – III **8 hrs**

ASSEMBLY SYSTEM AND LINE BALANCING: Assembly process and systems assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT – IV **8 hrs**

AUTOMATED MATERIAL HANDLING AND STORAGE SYSTEMS: Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems, Automated storage systems, automated storage and retrieval systems, work in process storage, interfacing handling and storage with manufacturing.

UNIT- V **10 hrs**

ADAPTIVE CONTROL SYSTEMS: Introduction, adaptive control with optimization, Adaptive control with constraints, Application of A.C. in Machining operations. Consideration of various parameters such as cutting force, Temperatures, vibration and acoustic emission in adaptive control systems.

UNIT VI **8 hrs**

AUTOMATED INSPECTION: Fundamentals, types of inspection methods and equipment, Coordinate measuring machines, Machine vision.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Enumerate the concept of Automation.

CO2: Discuss about analysis of automated flow lines in industry.

CO3: Awareness about assembly systems and line balancing.

CO4: Design material handling and material storage systems for an automated factory.

CO5: Interpret the importance of adaptive control systems.

CO6: Implement the methods of inspecting automated systems.

Mapping of COs to POs:

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	3						3		3	
CO2	3	3	3	3	3						3		3	
CO3	3	3	3	3	3						3		3	
CO4	3	3	3	3	3						3		3	
CO5	3	3	3	3	3						3		3	
CO6	3	3	3	3	3						3		3	

TEXT BOOKS:

1. Automation, Production Systems and Computer Integrated Manufacturing : M.P. Groover./ PE/PHI
2. CAD / CAM/ CIM by Radha krishnan.

REFERENCE BOOKS:

1. Computer control of Manufacturing Systems by Yoram Coreom.
2. Automation by W. Buekinsham.

COMPUTATIONAL FLUID DYNAMICS

Subject Code: UGME7T0520	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- Understand the philosophy of CFD and basic principles of numerical techniques.
- Acquaint with the Numerical Methods for Matrix inversion problems.
- Use the governing equations for fluid flows and heat transfer concepts.
- Learn to solve heat transfer problems using finite difference method.
- Analyze problem solving techniques for parabolic and hyperbolic equations.
- Acquaint with the basic concepts and equations of finite volume method.

SYLLABUS:

UNIT-I: ELEMENTARY DETAILS IN NUMERICAL TECHNIQUES: 8hrs

Elementary details in numerical Techniques: Number system and errors, Representation of integers, Fractions, Floating point Arithmetic, loss of significance and error propagation, condition and instability, computational methods for error estimation, Convergence of Sequences.

UNIT-II: APPLIED NUMERICAL METHODS: 8hrs

Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices.

UNIT- III: REVIEW OF EQUATIONS GOVERNING FLUID FLOW AND HEAT TRANSFER: 8hrs

Review of Equations Governing Fluid Flow and Heat Transfer: Introduction, conservation of mass, Newton's second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle, special forms of the Navier-stokes equations.

UNIT-IV: FINITE DIFFERENCE APPLICATIONS IN HEAT CONDUCTION AND CONVENTION: 8hrs

Steady flow, dimensionless form of Momentum and Energy equations, Stokes equation, conservative body force fields, stream function - Vorticity formulation.

Finite Difference Applications in Heat conduction and Convention – Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

UNIT-V: FUNDAMENTALS OF FLUID FLOW MODELING: 8hrs

Finite Differences, discretization, consistency, stability, and Fundamentals of fluid flow modeling: Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods. Introduction to first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme.

.

UNIT-VI: FINITE VOLUME METHOD: 8hrs

Finite Volume Method: Approximation of surface integrals, volume integrals, interpolation and differentiation practices, Upwind interpolation, Linear interpolation and Quadratic interpolation.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Understand the basic principles of numerical techniques.
CO2: Apply the finite difference method for heat transfer problems.
CO3: Analyze the governing equations for fluid flows and heat transfer concepts.
CO4: Analyze the basic concepts and equations of finite volume method.
CO5 Understand flow physics and mathematical properties of governing Navier- Stokes equations and define proper boundary conditions for solution.
CO6: Develop solution techniques for parabolic and hyperbolic equations.

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	2												
CO2	2	2	2											
CO3	2	2	2											
CO4		2	2											
CO5	2	2	2											
CO6		2	2											

TEXT BOOKS:

1. Numerical heat transfer and fluid flow / Suhas V. Patankar- Butter-worth Publishers
2. Computational fluid dynamics - Basics with applications - John. D. Anderson / Mc Graw Hill.

REFERENCES:

1. Computational Fluid Flow and Heat Transfer/ Niyogi, Pearson Publications
2. Fundamentals of Computational Fluid Dynamics – Tapan K. Sengupta / Universities Press.
3. Computational Fluid Flow and Heat Transfer , by K. Muralidhar and T. Sundararajan –Narosa-Second Edition

VIBRATIONS & VEHICLE DYNAMICS

Subject Code: UGME7T0620	L	T	P	C
IV Year / I Semester	3	0	0	3

COURSE OBJECTIVES:

- This gives an overview of vibration introduction and single degree of freedom systems
- This involves study of multi degree freedom systems
- This gives the overview of tire characteristics based on load and road conditions.
- This gives the overview of design of suspension system and suspension characteristics
- This gives an overview of vehicle performances in Longitudinal dynamic conditions
- This gives an overview of vehicle performances in Lateral dynamic conditions

SYLLABUS:

UNIT-I: **8hrs**

INTRODUCTION to vibrations & basic concepts

SINGLE DEGREE OF FREEDOM SYSTEMS - Undamped and damped free vibrations, Forced vibrations, Coulomb damping, Response to harmonic excitation, Rotating unbalance and support excitation. Vibration isolation and transmissibility, Introduction to non harmonic excitation.

UNIT - II **8hrs**

TWO DEGREE FREEDOM SYSTEMS - Principal modes, Undamped and damped free and forced vibrations, Undamped vibration absorbers. Multi rotor systems, Empirical relations

MULTI DEGREE FREEDOM SYSTEMS: Matrix formulation, Stiffness and flexibility influence coefficients, Eigen value problem, Normal modes and their properties, Free and forced vibration by Modal analysis, Method of matrix inversion, Torsional vibrations of multi-rotor systems and geared systems, Discrete time systems.

UNIT - III **8hrs**

STABILITY OF VEHICLES - Load Distribution, Stability on Curved Track and on slope, Gyroscopic Effect, weight Transfer during Acceleration, Cornering and Braking, Overturning and Sliding. Cross wind stability and Equations of motions

UNIT - IV **8hrs**

TIRE DYNAMICS - Rolling Radius, Rolling Resistance – Factors, Forces acting on tyres – Tractive and Braking efforts, Dynamic Tyre Stiffness, Vibration Characteristics, Noise Levels of Tyres

UNIT - V **8hrs**

CORNERING BEHAVIOUR: Behaviour while Cornering, Slip angle, Cornering force, Cornering Properties, Camber Thrust, Camber Scrub and Camber Steer.

ROLL STABILITY: Road irregularities, Suspension Angles, Roll Center, Roll Axis, Roll Center Height, Roll Stability, Suspension Roll and Bump steer.

UNIT - VI **8hrs**

VEHICLE HANDLING - Steady State Handling Characteristics- Under steer, Over steer, Directional stability of vehicles. Steady state response to steering input, handling Diagram, Active Suspension Systems, Suspension Optimization.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Evaluate the natural frequency of a single and multi-degree freedom systems
CO2: Predict the stability of vehicle at different operating conditions
CO3: Predict the behaviour of tyres during braking, acceleration and cornering
CO4: Discuss the roll stability of a vehicle
CO5: Analyse the directional stability of the vehicle during cornering

Mapping of COs to PO

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

TEXT BOOKS:

1. Fundamentals of Vibrations by Leonard Meirovitch; Publisher: McGraw Hill
2. Mechanical Vibrations by Groower G. K.
3. J. Y. Wong, Theory of Ground Vehicles, 3rd Edition, Wiley-Interscience, 2001
4. Rajesh Rajamani, Vehicle Dynamics and Control, 1st edition, Springer, 2005

REFERENCES:

1. Mechanical Vibrations by Tse and Morse
2. Mechanical Vibrations by Rao S. S., Publisher: Pearson
3. Mechanical Vibrations by Rao V Dukkipati & J. Srinivas, Publisher: Prentice Hall
4. Mechanical Vibrations by V. Ram Murthy
5. Michael Blundell & Damian Harty, The Multibody Systems Approach to Vehicle Dynamics, Elsevier Limited, 2004
6. Hans B Pacejka, Tire and Vehicle Dynamics, 2nd edition, SAE International, 2005

REFRIGERATION AND AIR CONDITIONING

Subject Code: UGME7T0720	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

COURSE OBJECTIVES:

- Know the fundamentals of refrigeration and concept of Air Refrigeration Systems.
- Understand the Vapour compression Refrigeration System and evaluate their performances
- Identify required refrigerants for refrigeration and air-conditioning systems and understand their impact on the environment
- Illustrate the concept of Vapour absorption and Steam Jet Refrigeration Systems
- Select the appropriate air conditioning processes using principles of Psychrometry
- Perform cooling and heating load calculations in an air conditioning system and Understand functions of various A/C systems

SYLLABUS:

UNIT I: 8hrs

INTRODUCTION TO REFRIGERATION: Necessity and applications – Unit of refrigeration and C.O.P. – Mechanical Refrigeration –Ideal cycle of refrigeration. Air Refrigeration: Bell Coleman cycle, Open and Dense air systems, Refrigeration systems used in Air craft & problems.

UNIT-II: 8hrs

VAPOUR COMPRESSION REFRIGERATION working principle and essential components of the plant – simple Vapour compression refrigeration cycle – COP – Representation of cycle on T-S and p-h charts – effect of sub cooling and super heating – cycle analysis – Actual cycle Influence of various parameters on system performance – Use of p-h charts – numerical Problems.

UNIT-III: 8hrs

SYSTEM COMPONENTS: Compressors – General classification – comparison – Advantages and Disadvantages. Condensers – classification – Working Principles, Evaporators – classification – Working Principles, Expansion devices – Types – Working Principles.

REFRIGERANTS – Desirable properties – classification refrigerants used – Nomenclature – Ozone Depletion – Global Warming. Alternate Refrigerants.

UNIT -IV: 8hrs

VAPOR ABSORPTION SYSTEM – Calculation of max COP – description and working of NH_3 – water system and Li Br – water (Two shell & Four shell) System. Principle of operation of Three Fluid absorption system, salient features.

STEAM JET REFRIGERATION SYSTEM Working Principle and Basic Components. Principle and operation of Thermoelectric refrigerator and Vortex tube or Hilsch tube.

UNIT-V: **8hrs**

INTRODUCTION TO AIR CONDITIONING: Psychometric Properties & Processes – Characterization of Sensible and latent heat loads –– Need for Ventilation, Consideration of Infiltration – Load concepts of RSHF, GSHF- Problems, Concept of ESHF and ADP temperature.

UNIT-VI: 8hrs

Requirements of human comfort and concept of effective temperature- Comfort chart –Comfort Air Conditioning – Requirements of Industrial air conditioning, Air conditioning Load Calculations.

AIR CONDITIONING SYSTEMS- Classification of equipment, cooling, heating humidification

and dehumidification, filters, grills and registers fans and blowers. Heat Pump – Heat sources – different heat pump circuits. Introduction to Automotive air conditioning.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Understand the principles, applications and components of various refrigeration systems and heat transfer relationships.

CO2: Analyze and evaluate the performance parameters of Vapour Compression Refrigeration System

CO3: Identify required refrigerants for refrigeration and air-conditioning systems and understand their impact on the environment

CO4: Illustrate the concept of Vapour absorption and Steam Jet Refrigeration Systems

CO5: Select the appropriate air conditioning processes using principles of Psychrometry

CO6: Estimate cooling load and heating load considering human comfort and optimize the air conditioning system as per requirements.

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2
CO1	2	2	3				1							
CO2	2	1	2											
CO3	1		2				3							
CO4	1		2											
CO5			2											
CO6	1	2	2											

TEXT BOOKS:

1. A Course in Refrigeration and Air conditioning / SC Arora & Domkundwar / Dhanpatrai
2. Refrigeration and Air Conditioning / Manohar Prasad / New Age.

REFERENCES:

1. Refrigeration and Air Conditioning / CP Arora / TMH. 2. Principles of Refrigeration - Dossat / Pearson Education.
2. Refrigeration and Air Conditioning-P. L. Bellaney
3. Basic Refrigeration and Air-Conditioning – Anantha narayanan / TMH
4. Refrigeration and Air Conditioning – R.S. Khurmi & J.K Gupta – S. Chand – Eurasia Publishing House (P) Ltd.

LEAN MANUFACTURING AND SIX SIGMA

Subject Code: UGME7T0820	**L**	**T**	**P**	**C**
IV Year / I Semester	**3**	**0**	**0**	**3**

Course Objectives:

- Apply the Principles of Lean manufacturing to eliminate waste and meet customer satisfaction.
- Adopt different methodologies and minimize the problem using different statistical approaches.
- Plan different strategies to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimizing the variability in manufacturing and business processes

UNIT-I: 6 hrs

PRINCIPLES OF LEAN MANUFACTURING: Review of manufacturing paradigm; Objectives of lean manufacturing, key principles and implications of lean manufacturing, traditional versus lean manufacturing characteristics; Value creation and waste elimination-major kinds of manufacturing waste, concept of talk time, continuous flow , continuous improvement, single piece flow.

UNIT –II: 8 hrs

GROUP TECHNOLOGY AND JUST IN TIME MANUFACTURING: Group technology philosophy: Part family, Machine cell design and analysis; JIT-Elements of JIT.

LEAN MANUFACTURING IMPLEMENTATION: Poka-Yoke , Value stream mapping, 5s , visual factory case studies. Road map for lean manufacturing implementation.

UNIT-III: 8 hrs

CONCEPTS OF LEAN SIX SIGMA: Overview of six sigma concept: definition, origin, terms. Foundations of lean six sigma –four keys, five laws of lean six sigma, and types of lean six sigma: DMAIC versus DMADV – lean six sigma project selection: selection of team members

SIX SIGMA ROLES AND RESPONSIBILITIES; Team stages: characteristics of effective teams, six sigma training plan; Six sigma metrics: DPMO calculation, quality cost, cost of poor quality- roadmap for implementation; Common implementation issues and management strategies.

UNIT-IV: 10 hrs

Define Phase:

Project Identification: Voice of customer (VOC), Project selection, Stake holder Analysis, Process inputs and output. Project Management Basics: Project charter, Communication plan, Project planning, Project Management Tools and Phase reviews.

Measure Phase: Data Collection plans, Qualitative and quantitative data, Data Collection techniques, Measurement system Analysis, Gauge repeatability and Reproducibility

UNIT-IV: **7 hrs**

ANALYSE PHASE:

Process Analysis Tools: Lean Tools, Failure Mode and Effects analysis, Root Cause Analysis: 5 Whys, Process mapping, Force field Analysis, Matrix charts, Data Analysis: Basic Distribution types, Common and Special causes of variation, Correlation and Regression, E-Hypothesis testing.

UNIT-VI: **7hrs**

Implementation Techniques: Kaizen and Kaizen Bltiz, PDCA, Cost Benefit Analysis

Control tools and Documentation: Control plan, Control charts and Document control.

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Apply the concepts of Lean Manufacturing

CO2: Construct a value stream mapping and adopt JIT in manufacturing

CO3: Integrate Lean manufacturing with six sigma and plan the strategies for executing and training.

CO4: Define the problem and use different methods of measuring the problem.

CO5: Analyze variations in parameters of business models using six sigma tools.

CO6: Evaluate Six Sigma practices in manufacturing problems and service sectors.

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Mapping of COs to PO

COs		POs											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2								3		3	3		3
CO2	2								3	3	3	3		3
CO3	2			3					3	3	3	3		3
CO4	3	3		3					3	3	3	3		3
CO5	3	3		3	3				3	3	3	3		3
CO6	3	3		3	3				3	3	3	3		3

Text Books:

Govind Ramu, The certified six sigma Yellow belt Hand book, AS Quality press.

REFERENCES:

1. Askin R G, Goldberg J B, "Design and Analysis of Lean Production Systems", John Wiley and Sons Inc., 2003.
2. S. R. Devadasan, V. Sivakumar, "Lean and Agile Manufacturing: Theoretical, Practical and Research futurities", PHI, 2012.
3. Micheal Wader, "Lean Tools: A Pocket Guide to Implementing Lean Practices", Productivity and Quality Pub, 2002.
4. Kenichi Sekine, "One-Piece Flow", Productivity Press, Portland, Oregon, 1992.
5. Alan Robinson, "Continuous Improvement in Operations", Productivity Press, Portland, Oregon, 1991.
6. Beata Mrugalska, Magdalena K. Wyrwicka, "Towards Lean Production in Industry 4.0", Procedia Engineering, 182, 2017.

FRACTURE MECHANICS

Subject Code: UGME7T0920	L	T	P	C
IV Year / I Semester	3	0	0	3

OBJECTIVE:

- To impart knowledge on mechanics of cracked components of different modes by which these components fail under static load conditions.
- Fracture mechanics provides a methodology for prediction, prevention and control of fracture in materials, components and structures.
- It provides a background for damage tolerant design.
- It quantifies toughness as materials resistance to crack propagation.

UNIT I: Fracture mechanics principles: 9 hr

Introduction and historical review, Sources of micro and macro cracks. Stress concentration due to elliptical hole, Strength ideal materials, and Griffith's energy balance approach. Fracture mechanics approach to design, NDT and Various NDT methods used in fracture mechanics, Numerical problems. The Airy stress function. Effect of finite crack size. Elliptical cracks, Numerical problems.

UNIT II Plasticity effects: 9 hr

Irwin plastic zone correction. Dugdale's approach. The shape of the plastic zone for plane stress and plane strain cases. The plate thickness effect, numerical problems. Determination of Stress intensity factors and plane strain fracture toughness: Introduction, estimation of stress intensity factors. Experimental method- Plane strain fracture toughness test, The Standard test, size requirements.

UNIT III The energy release rate, 9 hr

Criteria for crack growth. The crack resistance (R curve). Compliance. Tearing modulus. Stability.

Elastic plastic fracture mechanics:

Fracture beyond general yield. The Crack-tip opening displacement. The Use of CTOD criteria. Experimental determination of CTOD. Parameters affecting the critical CTOD.

UNIT IV FATIGUE CRACK GROWTH CURVE 9 hr

Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum -- rain flow method– external factors affecting the K1c values- leak before break analysis.

UNIT V Plastic Zone Modelling and Fracture Toughness Testing 9 hr

Evaluation of SIF for Various Geometries SIF for Embedded Cracks SIF for Surface Cracks Modeling of Plastic Deformation, Irwin's Model, Dugdale Model, Fracture Toughness Testing-Plane Strain Fracture Toughness Testing

UNIT VI APPLICATIONS OF FRACTURE MECHANICS 9 hr

Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods, provide fail-safety, Paris law, Required information for fracture mechanics approach.

Course Outcome:

At the end of the course students will:
CO1: Develop basic fundamental understanding of the effects of cracklike defects on the performance of aerospace, civil, and mechanical Engineering structures.
CO2: Learn to select appropriate materials for engineering structures to insure damage tolerance.
CO3: Learn to employ modern numerical methods to determine critical crack sizes and fatigue crack propagation rates in engineering structures.
CO4: Gain an appreciation of the status of academic research in field of fracture mechanics.

Mapping of COs to PO

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO11	PO 12	PS O1	PS O2
CO1	3	3	2											
CO2	3	2	3	2										
CO3	3	3	3	3	3									
CO4	3	3	2	3	3	2								

Text Books

1. Elements of Fracture Mechanics by Prasant Kumar, Mc Graw Hill Education, 2009 Edition

2. Anderson , "Fracture Mechanics-Fundamental and A pplication", T.L CRC press1998.

3. David Broek, "Elementary Engineering Fracture Me chanics", Springer Netherlands,2011

Reference Books

1. Karen Hellan , "Introduction to fracture mechani cs", McGraw Hill, 2 nd Edition

2. S.A. Meguid , "Engineering fracture mechanics" E lsevier Applied Science, 1989

3. Jayatilaka, "Fracture of Engineering Brittle Mat erials", Applied Science Publishers, 1979

4. Rolfe and Barsom , "Fracture and Fatigue Control in Structures" , Prentice Hall, 1977

5. Knott , "Fundamentals of fracture mechanisms", Butterworths, 1973

MECHATRONICS & ROBOTICS

Subject Code: UGME7T1020	**L**	**T**	**P**	**C**
IV Year / I Semester	**2**	**0**	**2**	**3**

COURSE OBJECTIVES

The course content enables students to:

- Explore the concepts and techniques in robotic engineering, manipulator kinematics, dynamics and control, chose, and incorporate robotic technology in engineering systems.
- Get acquainted with the theoretical aspects of Robotics.
- Expose the students to various robots and their operational details.

SYLLABUS

Robotics

UNIT I: 8 hrs

INTRODUCTION: Robot Components, Classification of robots by coordinate system and control system, Precision of movement, SCARA and PUMA Robots, End Effectors and their types, comparison of Electric, Hydraulic and Pneumatic types of locomotion devices.

UNIT II 10 hrs

ROBOT APPLICATION IN MANUFACTURING: Material Transfer - Material handling, loading and unloading- Processing - spot and continuous arc welding & spray painting - Assembly and Inspection.

MOTION ANALYSIS: Homogeneous transformations as applicable to rotation and translation – problems.

UNIT III 8hrs

MANIPULATOR KINEMATICS: Specifications of matrices, D-H notation joint coordinates and world coordinate systems, Forward and inverse kinematics – problems.

Mechatronics

UNIT IV 8hrs

Introduction to Mechatronics

Sensors & Transducers: Displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT V 8hrs

System interfacing and Data acquisition: Data acquisitions systems, Analog to digital and digital to analog conversions, Digital signal processing-Data flow in DSPs, block diagrams, typical layouts, interfacing motor devices

UNIT VI 8 hrs

Solid state and digital electronic devices:

DIAC, TRIAC and LEDs. Analog signal conditioning, Operational amplifiers, Noise reduction, Filtering, Digital electronics and systems, Digital logic control, microprocessors and micro controllers.

Course Outcomes (COs)

- **CO1:** Apply the Mathematical and physical principles underlying robot manipulation
- **CO2:** Analyze robotic systems using forward and inverse kinematics.
- **CO3:** Summarize the different types of mechatronics systems, sensors and transducers.
- **CO4:** Make use of data interfacing and data acquisition System and interfacing and data acquisition.
- **CO5:** Classify the different types of solid-state electronic devices Solid state and digital electronic devices

Mapping of COs to PO

COs	POs												PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3								3					
CO2	3	3		3					3					
CO3		3							3			2		
CO4		3							3			2		
CO5		3							3			2		

TEXT BOOKS :

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.

REFERENCES:

1. Robotics / Fu K S/ McGraw Hill.
2. An Introduction to Robot Technology, / P. Coiffet and M. Chaironze / Kogam Page Ltd. 1983 London.
3. Robotic Engineering / Richard D. Klafter, Prentice Hall
4. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter-Science.
5. Introduction to Robotics / John J Craig / Pearson Edu.
6. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.

MEASUREMENTS AND GD&T

Subject Code: UGME7T1120	**L**	**T**	**P**	**C**
IV Year /I Semester	**2**	**0**	**2**	**3**

COURSE OBJECTIVES:

- Understand the principles of angular and optical measuring instruments and limits and fits.
- Familiarized with using various methods of surface roughness measurement.
- Apply principles involved in the measurement of temperature and pressure using gauges.
- Get acquainted to the measurement of stress & strain using gauges.
- Illustrate the parts using the principles of Geometric Dimensioning and tolerance.
- Understand and knowledge upon the rules and regulations of GD&T.

SYLLABUS

UNIT –I: 8 hrs

Limits & Fits: Limits and Different types of Fits & Tolerances**,** Taylor's principle of limit gauging, Go and No-Go gauge design, slip gauges – calibration of the slip gauges.

MEASUREMENT OF ANGLES AND TAPERS: Different methods – Bevel protractor – angle slip gauges – spirit levels, methods of using sine bar.

UNIT –II: 8 hrs

OPTICAL MEASURING INSTRUMENTS: Tool maker's microscope and its uses – collimators, optical projector – optical flats and their uses, interferometer.

SURFACE ROUGHNESS MEASUREMENT: Differences between surface roughness and surface waviness-Numerical assessment of surface finish – CLA, R.M.S Values – Rz values, Rz value, Methods of measurement of surface finish-profilograph, Talysurf, ISI symbols for indication of surface finish.

UNIT –III: 8 hrs

MEASUREMENT OF TEMPERATURE: Electrical Resistance – Thermistor – Thermocouple – Pyrometers.

MEASUREMENT OF PRESSURE: Bourdon pressure gauges, Bellows – Diaphragm gauges, Low pressure measurement – Thermal conductivity gauges – ionization pressure gauges, McLeod pressure gauge.

UNIT – IV: 8 hrs

STRESS STRAIN MEASUREMENTS: Various types of stress and strain measurements – electrical strain gauge – gauge factor – method of usage of resistance strain gauge for bending compressive and tensile strains – usage for measuring torque, Strain gauge Rosettes

UNIT-V 8hrs

Introduction to GD&T, Need and benefit of GD&T, GD&T Standard-ASMEY14.5, GD&T Terminology and rules, GD&T Symbols and modifiers, Concept of Datum.

Form Tolerances (Interpretation and inspection methods): Straightness tolerance, Flatness tolerance, Circularity tolerance, Cylindricity tolerance.

Profile Tolerances: Profile of a line tolerance, Profile of a surface tolerance

UNIT-VI

Orientation Tolerances (Interpretation and inspection methods): Parallelism tolerance, Perpendicularity tolerance, Angularity tolerance.

Location Tolerances (Interpretation and inspection methods): Position tolerance, Concentricity tolerance, Symmetry tolerance.

Runout Tolerances (Interpretation and inspection methods): Circular runout tolerance, Total runout tolerance

Course Outcomes:

Upon the completion of the course, the students will able to:

CO1: Measure the angles, taper angle and flatness of surface using their measuring instruments.

CO2: To measure the surface roughness using different methods of measurement.

CO3: Conduct experiment with working devices used to measure temperature and pressure.

CO4: Describe and experiment using gauges for stress-strain measurement.

CO5: Apply the rules of Geometric dimensioning and tolerance of the parts.

Mapping of COs to POs:

COs		POs											PSOs	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	3	3	3	3	3									
CO2	3	3	3	3	3									
CO3	3	3	3	3	3									
CO4	3	3	3	3	3									
CO5	3	3	3	3	3									

TEXT BOOKS:

1. Measurement Systems: Applications & design by D.S Kumar.
2. Mechanical Measurements/BeckWith, Marangoni,Linehard, PHI/PE.
3. Engineering Metrology / I C Gupta./ Danpath Rai.
4. Engineering Metrology / R.K. Jain / Khanna Publishers.
5. Fundamentals of Geometric dimensioning and Tolerancing, Alex Krulikowski,Delmar Thomson learning.

REFERENCE BOOKS:

1. Measurement systems: Application and design, Doeblin Earnest. O.Adaptation by Manik and Dhanesh/ TMH.
2. Experimental Methods for Engineers / Holman.
3. Mechanical and Industrial Measurements / R.K. Jain/ Khanna Publishers, Instrumentation, measurement & analysis by B.C.Nakra & K.K.Choudhary, TMH
4. BIS standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
5. Fundamentals of Dimensional Metrology 4e / Connie Dotson / Thomson.
6. Handbook of Tribology: Materials, Coating, and Surface Treatments/ Bharat Bhushan and B.K.Gupta.
7. Surface Engineering with Lasers/ Dehosson J.T. Surface Engineering for corrosion and wear resistance / JR Davis/ Woodhead Publishers.

MANAGEMENT SCIENCE

Subject Code: UGMB7T0120	L	T	P	C
IV Year / I Semester	3	0	0	3

Prerequisites:

- General awareness about Principles of Management.
- To have an insight about Production and Operations Management.
- To be able to acquire knowledge about Human Resource Management, Marketing, Strategic Management.

Course Objectives:

- To create awareness about different Managerial concepts like Management, Production, Marketing, Human Resource and Strategic Management.
- To make the students equip with knowledge on techniques of PERT and CPM in project management.

SYLLABUS:

UNIT-I: [8 Hrs]

Introduction to Management : Concept and importance of Management, Functions of management, Evaluation of Management thought, Fayol's principles of Management, Maslow's need hierarchy & Herzberg's two factor theory of Motivation, Decision making process, Designing organizational structure, Principles of Organization, Types of organization structures.

UNIT-II: [8 Hrs]

Operations Management: Plant Location Principles and types of plant Layout , Work study, Materials Management: Objectives - Need for inventory control- Inventory control techniques EOQ , ABC, HML, SDE, VED and FSN analysis.

UNIT-III: [8 Hrs]

Human Resources Management (HRM): Concepts of HRM, Basic functions of HR manager, Job Evaluation and Merit Rating, Performance Appraisal, Methods of Performance appraisal Concepts Compensation.

UNIT-IV: [8 Hrs]

Marketing Management: Functions of marketing, Marketing Mix, Marketing strategies based on Product life cycle, Channels of distribution (Place), Promotional Mix.

UNIT-V: [10 Hrs]

Project Management (PERT/CPM): Network analysis, Program Evaluation and Review Technique (PERT), Critical path method (CPM) - Identifying critical path, Difference between PERT & CPM (simple problems).

UNIT-VI: [8 Hrs]

Strategic Management: Mission, Goals, objectives, policy, strategy, Environmental scanning, SWOT analysis, Steps in strategy formulation and implementation Generic strategy alternatives.

Course Outcomes:

Upon completing the course, student will be able to

COs	Description	Blooms Level
CO 1	Understand the fundamentals of Management with specific insight as its function and role	Understanding
CO 2	Learn the concepts of production, Management of human Resources and Management of Marketing activities along with business environment	Understanding
CO 3	Apply the problem solving skills to demonstrate logical solution to real life problems	Applying
CO 4	Create the awareness of business strategies to deal with the dynamic business environment	Creating

Mapping of COs to POs:

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO 1	PSO 2
CO 1	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO 2	-	-	-	-	-	2	-	-	-	-	-	-	-	-
CO 3	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO 4	-	-	-	-	-	-	-	-	-	-	2	-	-	-

Text Books:

T1. Dr. Arya Sri, "Management Science", TMH 2011.

T2. L.M. Prasad, "Principles & Practices of Management" Sultan chand & Sons, 2007.

Reference Books:

R1. K. Aswathappa and K. Sridhara Bhat, "Production and Operations Management", Himalaya Publishing House, 2010.

R2. Philip Kotler Philip Kotler, Kevin Keller, Mairead Brady, Malcolm Goodman, Torben Hansen, "Marketing Management" Pearson Education Limited, 2016.

SURFACE MODELING AND SHEET METAL WORKING

Subject Code: UGME7K1220	L	T	P	C
IV Year / I Semester	1	0	2	2

COURSE OBJECTIVE:

To impart hands on practical exposure on different sheet metal and surface modeling operations and provide drawing capability for different engineered surfaces through the usage of a modeling software.

SHEET METAL EXPERIMENTS:

Experiment – 1: Mounting Brackets

Experiment – 2: Car Bonnet

Experiment – 3: Hopper

Experiment – 4: Electrical Enclosure

Experiment – 5: CPU Outer Case

Experiment – 6: Electrical Wire Crimp Connector

Experiment – 7: Seat Locking Belt

Experiment – 8: Hinge

Experiment – 9: Radiator

SURFACE MODELING EXPERIMENTS:

Experiment – 10: Computer Mouse

Experiment – 11: Exhaust Manifold

Experiment – 12: Propellor

Experiment – 13: Badminton Rocket

Experiment – 14: Blower Case

Experiment – 15: Car Bonnet

Experiment – 16: CFL Bulb

Experiment – 17: Hair Drier Cover

Experiment-18 : Water bottle

Note : Student need to draw any 5 Experiments from Sheet Metal and 5 Experiments from Surface Modeling

COURSE OUTCOMES:

Upon completion of this course, students will be able to:

CO1: To understand and perform basic tool operations of the surface modeling operations

CO2: To understand and perform basic tool operations of the sheet metal operations

CO3: Generate various engineered surface models with the use of software.

CO-PO MAPPING:

COs	**POs**												**PSOs**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO1					3	2			3	2	3		3	
CO2					3	2			3	2	3		3	
CO3					3	2			3	2	3		3	