# COURSE STRUCTURE & SYLLABUS

**IV Year - I Semester**

| S.No | Category | Course Code | Course Title | L | T | P | C | IM | EM | TM |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | PE | UGME7T0122<br>UGME7T0222<br>UGME7T0322 | **Professional Elective-III**<br>Power Plant Engineering<br>Noise Vibrations and Harshness<br>Manufacturing for Automotive components | 3 | - | - | 3 | 30 | 70 | 100 |
| 2 | PE | UGME7T0422<br>UGME7T0522<br>UGME7T0622 | **Professional Elective-IV**<br>Automation in Manufacturing<br>Computational Fluid Dynamics<br>Vibrations and Vehicle Dynamics | 3 | - | - | 3 | 30 | 70 | 100 |
| 3 | PE | UGME7T0722<br>UGME7T0822<br>UGME7T0922 | **Professional Elective-V**<br>Refrigeration & Air Conditioning<br>Lean Manufacturing and Six Sigma<br>Fracture Mechanics | 3 | - | - | 3 | 30 | 70 | 100 |
| 4 | OE/JOE | | Open elective/Job oriented elective | 2 | - | 2 | 3 | 30 | 70 | 100 |
| 5 | OE/JOE | | Open elective/Job oriented elective | 2 | - | 2 | 3 | 30 | 70 | 100 |
| 6 | HSSE | UGMB7T0122 | Management Science | 3 | - | - | 3 | 30 | 70 | 100 |
| 7 | SOC | UGME7K1022 | Surface Modeling and Sheet metal working | 1 | - | 2 | 2 | 50 | - | 50 |
| 8 | Internship | UGME7I1122 | Industrial/Research Internship(after third year) | - | - | - | 3 | 50 | - | 50 |
| | | | **Total** | **17** | **0** | **6** | **23** | **280** | **420** | **700** |
| **Honors/Minor Course (4 Credits)** | | | | | | | | | | |

## IV Year - II Semester

| S.No | Category | Course Code | Course Title | L | T | P | C | IM | EM | TM |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Major Project | UGME8J0122 | Major Project & Internship (6 Months) | - | - | 20 | 10 | 60 | 140 | 200 |
| 2 | Seminar | UGME8S0222 | Seminar | - | 2 | - | 2 | 50 | - | 50 |
| | | | **Total** | **0** | **2** | **20** | **12** | **110** | **140** | **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**

### Job oriented electives of Mechanical Engineering Department

| S.No | Category | Course Code | Course Title | L | T | P | C | IM | EM | TM |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | JOE | UGME0T0122 | Measurements and GD&T | 3 | - | - | 3 | 30 | 70 | 100 |
| 2 | JOE | UGME0T0222 | Mechatronics and Robotics | 3 | - | - | 3 | 30 | 70 | 100 |
| 3 | JOE | UGME0T0322 | Advanced Materials | 3 | - | - | 3 | 30 | 70 | 100 |
| 4 | JOE | UGME0T0422 | Supply chain management | 3 | - | - | 3 | 30 | 70 | 100 |
| 5 | JOE | UGME0T0522 | Mining technology | 3 | - | - | 3 | 30 | 70 | 100 |

**POWER PLANT ENGINEERING**

**(Professional Elective-III)**

**Subject Code: UGME7T0122** **L T 0 P0 C 3**

**IV Year / I Semester** **3**

**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** **9Hrs**

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

**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** **12Hrs**

**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.

**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 – IV** **9Hrs**

**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 – V** **9Hrs**

**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: comprehend the diverse sources of energy harnessed in the generation of electric power.
CO2: Demonstrate the working and layout of steam power plants, Hydroelectric and geothermal energy systems.
CO3: Estimate the solar radiation for utilization.
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 | 3 | | 3 | | | | | | | | | | | |
| CO2 | 3 | | 3 | | | | | | | | | | | |
| CO3 | 3 | | 3 | | | | | | | | | | | |
| CO4 | 3 | | 3 | | | | | | | | | | | |
| CO5 | 3 | | | | | 3 | 3 | | | | | | | |

**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**
**(Professional Elective-III)**

| | | | | |
|---|---|---|---|---|
| **Subject Code: UGME7T0222** | **L** | **T** | **P** | **C** |
| **IV Year / I Semester** | **3** | **0** | **0** | **3** |

**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.

**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 IV** **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 V** **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: Explain the sources and prevalent challenges in the automotive industry related to controlling NVH

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

CO3: Explore the facilities and instruments employed for measuring NVH levels in automobiles

CO4: Outline the approaches utilized to mitigate Noise, Vibration, and Harshness (NVH) in pursuit of improving passenger comfort

**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 OF AUTOMOTIVE COMPONENTS**
**(Professional Elective-III)**

| | | | | |
|---|---|---|---|---|
| **Subject Code: UGME7T0322** | **L** | **T** | **P** | **C** |
| **IV Year / I Semester** | **3** | **0** | **0** | **3** |

**SYLLABUS:**

**UNIT-I**

**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.

**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: Explain the sequential stages in the production of engine components using casting and forging processes

CO2: Apply the optimal material and manufacturing process for making the transmission system and other chassis components.

CO3: Analyze different forming and welding techniques for manufacturing automotive components.

CO4: Demonstrate the importance of plastics and their fabrication techniques.

CO5: 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 | PO10 | PO11 | PO 12 | PS O1 | PS O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 3 | 2 | | | | | | | | 1 | | |
| CO2 | 3 | 1 | 3 | 2 | | | | | | | | 1 | | |
| CO3 | 3 | 1 | 3 | 2 | | | | | | | | 1 | | |
| CO4 | 3 | 1 | 1 | 2 | | | | | | | | 1 | | |
| CO5 | 2 | 1 | | 2 | | | | | | | | 1 | | |

**AUTOMATION IN MANUFACTURING**
**(Professional Elective-IV)**

| | L | T | P | C |
|---|---|---|---|---|
| **Subject Code: UGME7T0422** | | | | |
| **IV Year /II Semester** | **3** | **0** | **0** | **3** |

## 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** **10 hrs**

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

**AUTOMATED MATERIAL HANDLING AND STORAGE SYSTEMS:** Automated guided vehicle systems, automated storage systems, automated storage and retrieval systems, work in process storage

**UNIT- IV** **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 V** **10 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, material handling and material storage systems

CO4: Interpret the importance of adaptive control systems.
CO5: 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 | |

**TEXT BOOKS:**

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

**REFERENCE BOOKS:**

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

**COMPUTATIONAL FLUID DYNAMICS**
**(Professional Elective-IV)**

| | L | T | P | C |
|---|---|---|---|---|
| **Subject Code: UGME7T0522** | | | | |
| **IV Year / I Semester** | **3** | **0** | **0** | **3** |

**SYLLABUS:**

**UNIT-I: ELEMENTARY DETAILS IN NUMERICAL TECHNIQUES: 9hrs**

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: 9hrs**

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: 12hrs**

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.

**FINITE DIFFERENCE APPLICATIONS IN HEAT CONDUCTION AND CONVENTION:**

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-IV: FUNDAMENTALS OF FLUID FLOW MODELING: 9hrs**

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-V: FINITE VOLUME METHOD: 9hrs**

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: Comprehend the Fundamental Principles of Numerical Techniques.
CO2: Apply the finite difference method for heat transfer problems.
CO3: Evaluate the Governing Equations for Fluid Flows and Heat Transfer Concepts.
CO4: Analyze the basic concepts and equations of finite volume method.
CO5 Assess the Flow Physics and Mathematical Characteristics of the Navier-Stokes 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 2 | 3 | | | | | | | | | | | | |
| CO 2 | 2 | 3 | 3 | | | | | | | | | | | |
| CO 3 | 2 | 3 | 3 | | | | | | | | | | | |
| CO 4 | | 3 | 3 | | | | | | | | | | | |
| CO 5 | 2 | 3 | 3 | | | | | | | | | | | |

**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**
**(Professional Elective-IV)**

| **Subject Code: UGME7T0622** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **IV Year / I Semester** | **3** | **0** | **0** | **3** |

**SYLLABUS:**

**UNIT-I:** **9 hrs**

**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** **9 hrs**

**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** **12 hrs**

**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

**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 - IV** **9 hrs**

**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 - V** **9 hrs**

**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**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO1 0 | PO1 1 | PO1 2 | PSO 1 | PSO 2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO 1 | 3 | 3 | 2 | 3 | | 2 | 2 | | | | | | | 2 |
| CO 2 | 2 | 3 | 2 | 3 | | | 2 | | | | | | | 2 |
| CO 3 | 2 | 2 | 2 | 3 | | 2 | 2 | | | | | | | 2 |
| CO 4 | 2 | 3 | 2 | 3 | | 2 | 2 | | | | | | | 2 |
| CO 5 | 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, 200

**REFRIGERATION AIR CONDITIONING**
**(PROFESSIONAL ELECTIVE - V)**

| **Subject Code: UGME7T0722** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **IV Year / I Semester** | **3** | **0** | **0** | **3** |

**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.

**VAPOR ABSORPTION SYSTEM** – Calculation of max COP – description and working of NH3 – 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.

**UNIT-IV**: **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-V: 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.
3. Refrigeration and Air Conditioning – R.S. Khurmi & J.K Gupta – S. Chand – Eurasia Publishing House (P) Ltd.

**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

**LEAN MANUFACTURING AND SIX SIGMA**
**(PROFESSIONAL ELECTIVE - V)**

| **Subject Code: UGME7T0822** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **IV Year / I Semester** | **3** | **0** | **0** | **3** |

**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:** **10 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.

**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: Identify 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**
**(PROFESSIONAL ELECTIVE - V)**

| **Subject Code: UGME7T0922** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **IV Year / I Semester** | **3** | **0** | **0** | **3** |

**UNIT I: Fracture mechanics principles: 9 hr**

Introduction and historical review, Sources of micro and macro cracks. Stress concentration due to elliptical holes, 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, and size requirements.

**UNIT III The energy release rate, 10 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 16 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

**APPLICATIONS OF FRACTURE MECHANICS**

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: Analyze the Selection of Suitable Materials for Engineering Structures to Ensure Damage Tolerance.

CO3: Apply Modern Numerical Methods for Determining Critical Crack Sizes and Fatigue Crack Propagation Rates in Engineering Structures..

CO4: Assess the Current State of Academic Research in the 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 | PO1 1 | 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 Materials", Applied Science Publishers, 1979

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

5. Knott , “Fundamentals of fracture mechanisms”, Butterworths, 19

**MANAGEMENT SCIENCE**
**(Common to all branches)**

| **Subject Code : UGMB7T0122** | **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:**

1. To create awareness about different Managerial concepts like Management, Production, Marketing, Human Resource and Strategic Management.
2. 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: [12 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.

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

**UNIT-IV: [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-V: [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.

**MECHATRONICS &ROBOTICS**
**(Common to all branches)**

| **Subject Code : UGMB7T0222** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **IV Year / I Semester** | **3** | **0** | **0** | **3** |

**PREREQUISITES:**
Familiarity with concepts of Kinematics & Dynamics of Machinery, Theory of Machines and Basic Mathematics.

**COURSE OBJECTIVE:**

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

**Mechatronics**

**UNIT IV:**

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:

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

TEXT BOOKS:

1. Introduction to robotics Analysis,systems,Applications/ Saeed B. Niku/ PHI
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.
3. Industrial Robotics / Groover M P /Pearson Edu.
4. Text book of mechatronics by E.R.Rajput/ S.Chand publishers

REFERENCE BOOKS:

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.

**ADVANCED MATERIALS**
**(Common to all branches)**

| **Subject Code : UGME0T0322** | **L** | **T** | **P** | **C** |
|---|---|---|---|---|
| **IV Year / I Semester** | **3** | **0** | **0** | **3** |

**COURSE OBJECTIVES:**

Gain knowledge regarding various classes of advanced materials and its importance.
Identify various classes of the composites, their properties and applications.
Understanding various manufacturing process in composite preparation.
learn the basic concepts of micro mechanical properties of composite laminates
Expose the concept of nanomaterial properties and its applications.
Familiarize the concept of functional graded material and their applications.
Distinguish various classes of smart materials and their physical properties

**SYLLABUS:**

**UNIT-I: INTRODUCTION TO COMPOSITE MATERIALS 10hrs**

Introduction ,Constituents of composites ,classification of composites, different types of fibers (Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres),whiskers, different Paticulates.

Polymer Matrix Composites:
Introduction, CFRP composites, Manufaturing method (Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM), applications.

**UNIT-II: Metal and Ceramic Matrix Composites 8hrs**

Introduction, Basic of sintering and compaction, advantages and disadvantages, manufacturing methods (solid and liquid state route) , applications.

**UNIT-III: FUNCTIONALLY GRADED MATERIALS 6hrs**

Types of Functionally graded materials, FGM classification, Properties of FGM and their applications

**SMART MATERIALS** **8hrs**

Shape memory alloy characteristics, types of shape memory effects , SMA applications, phase change material and their characteristics, applications of phase change materials

**UNIT–IV:NANO MATERIALS**

**6hrs**

Introduction to nano-materials, their properties comparison with bulk materials, advantages, disadvantages. synthesis of nanomaterial (Ball milling, CVD, PVD, Sol-Gel), Applications of nano materials

**UNIT-V : POWDER METALLURGY**

Definition and concept, Applications of powder metallurgy, Advantages and limitations of powder metallurgy, Powder metallurgy process, Charactristics of metal powders, Production of metal powders, blending and mixing of powders, Compacting , sintering , Hot pressing and secondary operations.

TEXT BOOKS:

1.Nano material by A.K. Bandyopadyay, New age Publishers
2.Material science and Technology- Cahan
3.Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford University Press

REFERENCE BOOKS:

1.R. M. Jones, Mechanics of Composite Materials, McGraw Hill Company, New York, 1975.
2.L. R. Calcote, Analysis of Laminated Composite Structures, Van Nostrand Rainfold.
3.B. D. Agarwal and L. J. Broutman, Analysis and performance of fiber Composites, Wiley-Interscience, New York, 1980
4.Mechanics of Composite Materials, Second Edition (Mechanical Engineering), Autar K.Kaw, CRC

## SURFACE MODELING AND SHEET METAL WORKING

| Subject Code: UGME7K1022 | L | T | P | C |
|---|---|---|---|---|
| IV Year / I Semester | 1 | 0 | 2 | 2 |

**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

Experiment – 10: Steel kitchen sink

**SURFACE MODELING EXPERIMENTS:**

Experiment – 11: Computer Mouse

Experiment – 12: Exhaust Manifold

Experiment – 13: Propellor

Experiment – 14: Badminton Rocket

Experiment – 15: Blower Case

Experiment – 16: Car Bonnet

Experiment – 17: CFL Bulb

Experiment – 18: Hair Drier Cover

Experiment – 19: Water bottle

**Note :** 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: Apply the basic tool operations required for surface modeling and sheet metal operations

CO2: Model different sheet metal operations for engineering applications.

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 | |