GOVERNMENT OF INDIA
MINISTRY OF
PARLIAMENTARY AFFAIRS

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Azadi Ka
Amrit Mahotsav

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GOV
मेरी सरकार

PREAMBLE TO THE CONSTITUTION

PREAMBLE

WE, THE PEOPLE OF INDIA,

having solemnly resolved to constitute India

into a **SOVEREIGN SOCIALIST SECULAR DEMOCRATIC**

REPUBLIC and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity;

and to promote among them all

FRATERNITY assuring the dignity of the individual and

the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this 26th day of

November, 1949, do HEREBY ADOPT, ENACT AND GIVE

TO OURSELVES THIS CONSTITUTION.

I have read the Preamble

Signature

23-01-2022

SRI SIDDHARTHA ACADEMY OF HIGHER EDUCATION

("Deemed to be University u/s 3 of the UGC Act, 1956")

Accredited 'A+' Grade by NAAC

Agalakote, B.H.Road, Tumkur – 572 107.KARNATAKA, INDIA.

No. SSAHE/ACA-S&C/ 21/UG(BE)/2024   Date: 15/07/2024

NOTIFICATION

Sub: - Ordinance pertaining to Curriculum of Undergraduate Programme Bachelor of Engineering (3rd Year Mechanical Engineering)

Ref: Proceedings of the Academic Council meeting held on 10/07/2024 vide agenda No. SSAHE/AC/XXVIII-12/2024

In exercise of the powers vested under section 6 of 6.05 of MoA / Rules of SSAHE, the Revised Ordinance pertaining to Curriculum of Undergraduate Programme Bachelor of Engineering (3rd Year Mechanical Engineering) is notified herewith as per Annexure.

By Order,

REGISTRAR

REGISTRAR
Sri Siddhartha Academy of Higher Education
TUMKUR - 572 107, Karnataka.

To,
Dean / Principal, Sri Siddhartha Institute of Technology,

Copy to
1) Office of the Chancellor, SSAHE, for kind information,
2) PA to Vice-Chancellor / PA to Registrar / Controller of Examinations / Finance Officer, SSAHE
3) All Officers of the Academy Examination Branch / Academic Section
4) Guard File / Office copy.

DEPARTMENT OF MECHANICAL ENGINEERING, SSIT

Vision:

To carve technically proficient and competent mechanical engineering graduates capable of addressing the needs of the society and the nation.

Mission:

➢ To impart quality technical education in core areas of Mechanical Engineering.
➢ To inculcate Industrial practices for better professional growth.
➢ To imbibe ethical values, promote entrepreneurship, impart soft skills and teamwork capabilities.
➢ To ensure self-learning capabilities with an aptitude for research focusing on societal needs

Program Educational Objectives [PEOs]:

PEO– 01   Provide students with sound foundation in mathematical, scientific and engineering fundamentals necessary to formulate, solve and analyze problems in the core/allied areas of Mechanical Engineering.

PEO– 02   Provide graduates with competency in the synthesis, modeling and analysis of mechanical/thermal/fluid data, assemblies and systems, research and consultancy in core areas of mechanical engineering, ensuring noticeable social impact.

PEO– 03   Promote awareness about professional ethics, inculcate skills for usage of software tools and prepare graduates of the program for continuous learning capabilities in interdisciplinary/multidisciplinary domains

Program Outcomes [POs]:

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, engineering specialization to the solution of complex engineering problems.

2. **Problem Analysis:** Identify, formulate, review research literature, analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health, safety, cultural, societal and environmental considerations.

4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis , interpretation of data and synthesis of the information to provide valid conclusions.

5. **Modern Tool Usage:** Create, select, apply appropriate techniques, resources, modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
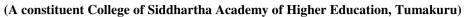
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, demonstrate the knowledge and need for sustainable development.

8. **Ethics:** Apply ethical principles, commit to professional ethics, responsibilities and norms of the engineering practice.

9. **Individual and Team work:** Function effectively as an individual, as a member or leader in diverse teams in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend , write effective reports and design documentation, make effective presentations, give and receive clear instructions.

11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life- Long Learning:** Recognize the need for, have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcomes (PSOs):

PSO1: Automated/Additive Manufacturing--demonstrates knowledge ,understanding of manual and automated assembly/manufacturing systems including additive manufacturing systems.

PSO2: Entrepreneurship--recognize the need for and ability to engage in entrepreneurial activities.

Scheme of Teaching and Examination (160 Credits Scheme, NEP Batch)
Third Year B.E. Mechanical Engineering

5ᵗʰ Semester B.E.   **Effective from the Academic year 2024-25**

SI No		Course Code	Course Title (Course coordinators)	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs
1	PC	22ME501	Theory of Machines	ME	3	-	-	3	50	50	100	3
2	PC	22ME502	Thermal Engineering	ME	3	-	2	4	50	50	100	3
3	PC	22ME503	CAD / CAM & CIM	ME	3	-	2	4	50	50	100	3
4	PE	22ME5PE4x	Professional Elective-I	ME	3	-	-	3	50	50	100	3
5	OE	22ME5OE5x	Open Elective-I	ME	3	-	-	3	50	50	100	3
6	PC	22IE56x	Institutional Elective	ME	2	-	-	2	50	50	100	3
7	PC	22ME507	Dept. Skill Lab-3: Python Programming for Mechanical Engineering	ME	1	-	2	2	50	50	100	3
8	HS	22SK508	Skill Development -II	T&P	-	-	2	1	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	**18**	**-**	**8**	**22**	**400**	**350**	**750**	**--**

22ME5PE4x - Professional Elective-I	
22ME5PE41	Additive Manufacturing
22ME5PE42	HVAC
22ME5PE43	Composite materials

22ME5OE5x - Open Elective-I	
22ME5OE51	Human Resource Management
22ME5OE52	Engineering Economics
22ME5OE53	Industrial Design & Ergonomics

22IE56x : Institutional Elective	
22IE561	Research Methodology
22IE562	Management & Entrepreneurship
22IE563	Project Management

Department: Mechanical Engineering   **Semester: V**

THEORY OF MACHINES

Subject Code: 22ME501

Course Objectives: **L – T – P - C: 3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	Learn various mechanisms in machine.
2	Learn motion transmission in planar and find velocity and acceleration, by analytical and graphical approach.
3	Impart knowledge in gyroscopic couple in various vehicles, the velocity ratios in gear trains.
4	Imparts D Alembert's principal in static and dynamic balancing of masses.

Unit	Description	Hours
I	Link or element, pairing of elements with degrees of freedom, Grubler's criterion (without derivation), Kinematic chain, Mechanism, Mobility of Mechanism, Inversion, Machine. Kinematic chain with Four bar chain; Single slider crank chain & Double slider crank chain and their inversions. i) Quick return motion mechanisms - Whitworth mechanism ii) Intermittent Motion mechanisms–Geneva mechanism and Ratchet & Pawl mechanism. Cams: Types of cams, Types of followers, Displacement diagrams. Cam profile for roller follower.	08
II	Velocity and Acceleration Analysis of Mechanisms (Graphical Methods): Velocity and acceleration analysis of Four Bar mechanism and Slider crank mechanism by vector polygons, Relative velocity and acceleration of particles in a common link, relative velocity and accelerations of coincident Particles on separate links, Static Force Analysis: Reaction between members without friction. Analysis of engine mechanism, four bar mechanism (without friction)	08
III	Dynamics of Engine Mechanism: Design of Flywheel and Turning Moment Diagrams for single cylinder and multi cylinder IC Engines. Gyroscope: Vectorial representation of angular motion, Gyroscopic couple, Effect of gyroscopic couple on ship, plane, two wheeler and four wheeler	08
IV	Spur Gear: Law of gearing, Definitions, Path of contact, Arc of contact, Contact ratio, Backlash and Interference in involute gears (No Problems). Gear Trains: Simple gear trains, Compound gear trains for large speed reduction, Reverted gear trains, Epicyclic gear trains, and tabular methods of finding velocity ratio of epicyclic gear trains.	08
V	Balancing of rotating masses: Static and dynamic balancing, balancing of single rotating mass in same plane and in different planes. Balancing of several rotating masses in same plane and in different planes. Balancing of Reciprocating masses: Balancing of reciprocating masses. single cylinder engine, balancing of multi cylinder-inline Engine.	08

Course Outcomes:

Course outcome	Descriptions
CO1	Apply the knowledge of mechanisms and machines for engineering applications
CO2	To identify and analyses the motion transmitted in planar mechanisms and to find the velocity and acceleration in different links by graphical approach
CO3	To design a flywheel using turning moment diagram and to determine and analyze the effect of gyroscopic couple in vehicles. determine the gear parameters for analyzing the velocity ratio in different gear trains
CO4	To Identify and determine static and Dynamic balancing systems involving rotating and partial balancing of reciprocating masses.

Course Articulation Matrix

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

Text Books:

SI No	Text Book title	Author	Volume and Year of Edition
1	Theory of Machines.	Rattan S.S	Ed 4. Tata McGraw-Hill. New Delhi. 2017. ISBN: 978-9351343479, 9351343472
2	Theory of Machines	Sadhu Singh.	Ed 2. Pearson Education (Singapore), Indian Branch. New Delhi. 2012

Reference Books:

SI No	Text Book title	Author	Volume and Year of Edition
1	Machines & Mechanisms	Shigley J.V. and Uickers J.J	Ed 2. McGraw Hill ,International. 1995. ISBN-10: 0070569304
2	Theory of Machines	J.K. Gupta and R.S. Khurmi	August 2005, Eurasia Publishing House

Department: Mechanical Engineering   **Semester: V**

THERMAL ENGINEERING

Subject Code: 22ME502

Course Objectives: **L – T – P - C: 3 – 0 – 2 – 4**

Sl. No	Course Objectives
1	To understand and apply concepts of thermodynamics to various energy conversion processes and systems.
2	To study the various working aspects of internal combustion engines.
3	To study the various aspects of energy conversion in vapor power cycles, gas turbines and refrigeration systems.
4	To study various psychrometric processes and understand the working of air conditioning systems.

Unit	Description	Hrs
I	**Gas Turbines:** Brayton cycle, derivation of actual gas turbine cycle from Ideal cycles, Methods to improve the thermal efficiency, Numerical problems.	9
II	**IC engines:** Performance analysis of SI and CI engines, Heat balance sheet, Morse test, numerical problems.	9
III	**Vapour Power cycles:** Carnot Vapour power cycle, Rankine cycle, Deviation of actual Vapour cycle from Ideal cycle, methods to improve the efficiency of Rankine cycle, numerical problems	9
IV	**Refrigeration:** Revised Carnot cycle, Air refrigeration system, Vapour compression refrigeration system (Ideal and Actual), selecting the right refrigerant, Vapour absorption refrigeration system, numerical problems.	9
V	**Psychometrics:** Atmospheric air and Psychometric properties: DBT, WBT, DPT, partial pressures, Specific and Relative Humidity, Saturation Ratio, Mixing of air streams, Psychometric chart, analysis of various processes, summer and winter air conditioning, numerical problems.	9

Lab Content

Sl. No	Experiment Description
1	Determination of Flash and Fire point of Lubricating and fuel oils.
2	Determination of viscosity of lubricating oils using Redwood viscometers
3	Determination of viscosity of lubricating oils using torsional viscometers.
4	Determination of viscosity of lubricating oils using Saybolt's viscometer
5	Use of Planimeter to find area under a P-V curve.
6	Valve timing diagram of a 4-stroke IC engine.

7	Test the performance characteristics of 4 stroke diesel engine.
8	Test the performance characteristics of 4 stroke petrol engine
9	Heat balance sheet analysis on 4 stroke I C engine.
10	Performance test on multi-cylinder petrol engine (Morse test).

Course Outcomes:

Course outcome	Descriptions
CO1	Understand and apply the characteristics of standard Thermodynamic Air Cycles and their analysis. [L2, L3]
CO2	Understand and evaluate the essential principles of psychrometry and analyze A/C systems. [L2, L4, L5]
CO3	Apply and analyze the working concepts of IC Engines performance characteristics. [L3, L4]
CO4	Analysis and evaluate the Rankine Cycle and Refrigeration cycles with various configurations to adopt in the design of power plants.[L4, L5]

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Basic and Applied thermodynamics	P.K. Nag	Tata McGraw Hill Publications. 2nd Edition, 2017
2	Applied Thermodynamics	Kestoor Praveen	1st Edition, Suggi Publications, Bangalore. 2020

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Thermodynamics an engineering approach	Yunus A Cengel and Michael A Boles	Tata McGraw hill Publications.8th edition, 2017
2	Thermal Engineering	R.K. Rajput	Laxmi Publications, 2007

Department: Mechanical Engineering   **Semester: V**

CAD / CAM & CIM

Subject Code: 22ME503

Course Objectives: **L – T – P - C: 3 – 0 – 2 – 4**

Sl. No	Course Objectives
1	To understand the need for CAD/CAM in Manufacturing
2	To study the automated assembly systems
3	To understand and develop part programming for CNC machines
4	To understand the fundamentals of robots and its configuration

Unit	Description	Hours
I	**Introduction to CAD/CAM & CIM:** CAD/CAM & CIM Definition, operations in manufacturing,product life cycle and CAD/CAM,CAD/CAM in Automation, CIM-lean production, facilities layout, types of layout, layout facilities for automated manufacturing, information process in manufacturing, Advantages and disadvantages of CAD , CAM& CIM.	**09**
II	**Automation:** definition, types of automation, levels of automation, automation strategies, mathematical model for production parameters, problems. **High volume production:** introduction, automated flow lines, flow line configurations, work part transport methods, work part transfer mechanism, buffer storage, need for buffer storage.	**09**
III	**Automated Assembly Systems:** Automated assembly systems: Product design for automated assembly, types of automated assembly systems, Part feeding and delivery system-hopper, part feeder, selector, feedback, escapement and placement. **Automated Guide Vehicles:** introduction, automated material handling, types of material handling equipment, principles of material handling, selection of material handling equipment, Automated guide vehicle systems, vehicle guiding and routing.	**09**
IV	**CNC Machining Centres:** Introduction to NC, NC Technology, importance of NC, NC coordinate system, NC motion control system, Basics of NC machine operation, Application, advantages and limitations of NC Systems. Introduction to CNC, need for CNC, CNCsystem, Need for CNC system, CNC machining centres(HMC &VMC),Advantages of CNC systems. **CNC Programming;** part programming, fundamental steps involved in development of part programming,Manual part programming for milling, drilling and turning.	**09**
V	**ROBOTICS:** Introduction, Robotic Fundamentals, Physical configuration of robot, Robot motions, Joints in Robot, Technical features of robots, End effectors, Robot sensors and Robot applications.	**09**

Lab Content

Sl. No	Experiment Description
	PART A-CAM
1	Simulation of Turning operations using CAM simulation software
2	Simulation of Drilling operations using CAM simulation software
3	Simulation of Milling operations using CAM simulation software
4	Simulation of Canned Cycles for Milling operations using CAM simulation software
5	Simulation of Canned Cycles for Turning operations using CAM simulation software
	PART B - Robotics
6	Designing 2 DOF of ROBOT manipulators using ROBO Analyzer software
7	Designing 3 DOF of ROBOT manipulators using ROBO Analyzer software
8	Designing R-R-R(Revolute- Revolute - Revolute) type of ROBOT manipulators using ROBO Analyzer software
9	Designing P-R-P(Prismatic- Revolute - Prismatic) type of ROBOT manipulators using ROBO Analyzer software
10	Designing P-P-P(Prismatic- Prismatic- Prismatic) type of ROBOT manipulators using ROBO Analyzer software

Course Outcomes:

Course outcome	Descriptions
CO1	Explain the terminology related to CAD/CAM & CIM, robot configurations, robot motions and robot applications
CO2	Understand the various automated flow lines and retrieving line balancing
CO3	Describe the various types of automation and production concepts
CO4	Analyze appropriate automated assembly systems and DesignCNC part programming

Course Articulation Matrix

PO/PSO \ CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3				2						2	2	3	
CO2					2						2	2	3	

CO3				2				2		2	3	
CO4	3	3	2					2			2	3	

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Automation, Production system & Computer Integrated manufacturing,	M. P. Groover	Pearson India, 2nd edition, 2007.
2	CAD/CAM	Zeid	Tata McGraw Hill,2009.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Computer Integrated Manufacturing,	J. A. Rehg and Henry. W. Kraebber.	Pearson India , 2nd Edition , 2000
2	Principles of Computer Integrated Manufacturing,	S. Kant Vajpayee	Prentice Hall India,2011

Department: Mechanical Engineering   **Semester: V**

ADDITIVE MANUFACTURING

Subject Code: 22ME5PE41   **L – T – P - C: 3 – 0 – 0 – 3**

Course Objectives:

Sl. No	Course Objectives
1	To study the basics of additive manufacturing/rapid prototyping and its applications in various fields.
2	To understand mechanical properties and geometric issues relating to specific rapid prototyping applications.
3	To familiarize students with different processes in rapid prototyping systems.
4	To understand the software requirements for RP.

Unit	Description	Hours
I	**Introduction:** Definition of Prototype, Types of prototypes, Need for the compression in product development, History of Rapid Prototyping (RP) systems, Survey of applications, Growth of RP industry and classification of RP systems. **Stereo lithography Systems:** Principle, Process parameter, data files, machine details, process details, build styles, advantages, limitations and Application.	**08**
II	**Selective Laser Sintering:** Principle of operation, materials, process parameters, data preparation for SLS, advantages, limitations and Applications. **Fused Deposition Modeling:** Principle of operation, detailed process step, materials, Process parameter, advantages, limitations and applications.	**08**
III	**Solid Ground Curing:** Principle of operation, Machine details, process parameter, advantages, limitations and Applications. **Laminated Object Manufacturing:** Principle of operation, system hardware details, LOM materials, process details and applications. **Concepts Modelers:** Principle, Thermal ink jet printer, Sander's model maker, 3D printer and Laser Engineering Net Shaping.	**08**
IV	**Rapid Tooling:** Indirect Rapid tooling: Silicon rubber tooling, Aluminum filled epoxy tooling (composite tooling), Spray metal tooling, **Direct Rapid Tooling:** Direct AIM, Quick cast process, DMLS, Laminate tooling, soft Tooling vs. hard tooling.	**08**
V	**Software for RP:** STL files, Overview of Solid view, magics, mimics, magic communicator. Application of Rapid Prototyping and Technology: Functional models,pattern for investment,Vacuum casting, medical models,	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Understand Additive manufacturing (AM), important technology trends for product development and innovation.
CO2	Exhibit comprehensive knowledge of the broad range of AM processes, devices, capabilities and materials.
CO3	Understand the various software's, processes, techniques that enable additive manufacturing and fabrication.
CO4	Learn how to make physical objects that fulfill product development/prototyping requirements, using additive manufacturing devices and processes.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Stereo Lithography and other RP & M Technologies	Paul F. Jacobs	SME NY, 1996
2	Rapid Manufacturing	D.T. Pham and S.S. Dimov	Springer 1st Edition, 2019.

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Rapid Prototyping	Terry Wohlers Wohler's Report 2000	Wohler's Association, 2000.
2	Rapid Prototyping Materials	Gurumurthi	IISc Bangalore.2017
3	Rapid Automated	Lament wood.	Indus press New York , 2019. 4 Rapid Prototyping Ramesh S. 1 ST Edit
4	Rapid Prototyping	Ramesh S.	1st Edition Ane books Pvt. Ltd 2015

Department: Mechanical Engineering   **Semester:**

HEATING VENTILATION AND AIR CONDITIONING (HVAC)

Subject Code: 22ME5PE42

Course Objectives: **L – T – P - C: 3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	To emphasize the importance of heating and ventilation systems.
2	Able to know the necessary skills in heating, ventilation and air conditioning systems.
3	An understanding of safe HVAC practices and how important they are in the HVAC environment.
4	??????

Unit	Description	Hrs
I	**INTRODUCTION TO HVAC**: Fundamentals-Modes of Heat Transfer-Sensible Heat and Latent Heat-Basic Components of Air-Conditioning and Refrigeration machines-Basic Refrigeration System or Vapor Compression Cycle-Pressure –Enthalpy Chart-Function & Types of Compressor Function & Types of Condenser-Function & Types of Expansion Valves, Function & Types of Evaporator-Accessories used in the System-Refrigerant and Brines.	8
II	**CLASSIFICATION OF AIR-CONDITIONING SYSTEM:** Window A/C-Working of Window A/C with Line Diagrams-Split A/C-Types - Working of Split A/C with Line Diagrams-Ductable Split A/C Working of Ductable Split A/C with Line Diagrams-Variable Refrigerant Volume (VRV)/ Variable Refrigerant Flow (VRF)-Ductable Package A/C-Working of Ductable Package A/C with Line Diagrams.	8
III	**STUDY OF PSYCHROMETRIC CHARTS**: Dry Bulb Temperature-Wet Bulb Temperature-Dew Point Temperature-Relative Humidity-Humidity Ratio-Processes, Heating, Cooling, Cooling and Dehumidification, Heating and Humidification.	8
IV	**LOAD CALCULATION:** Survey of Building-Cooling Load Steps-Finding Temperature difference (ΔT)- Wall, Glass, Roof, partition-Finding 'U' Factor-Wall, Glass, Roof, Partition-Finding Ventilation requirement for IAQ-Load Calculations (Manually using E-20 form)- ESHF, ADP & Air Flow Rate (CFM)Calculation.	8
V	**STATIC PRESSURE CALCULATION:** Selection of Motor HP-Selection Fan/Blower RPM-Hydronic System-Classification of Water Piping-Pipe sizing for chill water system-Fittings used in the HVAC Piping System-Valves used in the HVAC Piping System-Function of Valves-Openings for CHW Pipes passing through Wall-Sectional drawing @ CHW Pipe supports-Pump Head Calculation Selection of Pump.	8

Course Outcomes:

CO's	Descriptions
CO1	Understand and Remember understand the principles and working HVAC systems.
CO2	Identify site hazards and perform preventive maintenance on heating and air conditioning systems.
CO3	Analyze psychrometric chart and solve of the real time problems in refrigeration systems.
CO4	Analyze and develop problem solving skills through the application of thermodynamics.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	HVAC Fundamentals - Volume-l	James E. Brumbou,	Publisher : T. Audel , 4Edition
2	Fundamentals of HVAC Systems	Robert Mcdowall	Academic Press, 2007
3	HVAC Fundamentals	Samuel C. Sugarman	Fairmont Press, 2005

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Ventilation Systems: Design and Performance	Hazim B. Awbi.	Routledge, 2007
2	Industrial Ventilation Applications	ISHRAE Hand Book	2009
3	HVAC Hand book.	Hand book	ISHRAE

Department: Mechanical Engineering   Semester: V

COMPOSITE MATERIALS

Subject Code: 22ME5PE43

Course Objectives: **L – T – P - C: 3-0-0-3**

Sl. No	Course Objectives
1	To get an understanding about what composite materials are and how they are classified.
2	To study the manufacturing methods for producing PMC's and MMC's.
3	To study the various physical, mechanical and elevated temperature properties of MMC's.
4	To study the different machining and joining methods used for composites.

Unit	Description	Hours
I	**Introduction to composite Materials:** Definition and Classification of composites based on matrix and reinforcement, Characteristics of composite Materials, Role of Matrix and Reinforcements, Fibrous composites, Laminated Composites and Particulate composites, Factors which determine the properties of composites, Benefits of composites. Properties and types of matrices and reinforcements, Interface in composites, types and bonds at the Interface.	**08**
II	**Manufacturing Process for MMC's:** Introduction, Metallic matrices, Classification of MMC's, Need for production of MMC's, Interface Reactions, Processing methods like powder metallurgy, diffusion bonding. Melt Stirring, Compo/Rheo Casting, Squeeze casting, Liquid melt Infiltration, spray deposition and Insitu Processes Properties of MMC's: Physical, Mechanical, Wear, Machinability and other properties. Effect of Size, Shape and distribution of particulate on properties	**08**
III	**Fiber reinforced plastic processing:** Layup and curing, fabricating process- open and closed mould process- hand layup techniques- structural laminate bag molding, production procedures for bag molding- filament winding, pultrusion, pulforming, thermo-forming, injection, injection molding, liquid molding, blow molding.	**08**
IV	Introduction, types of ceramic matrices, Advantages of CMC's over other composites, Processing of CMC's. **Fabrication of Composites:** Cutting and Machining of Composites: Water jet cutting, Laser Beam Cutting, Reciprocating Knife Cutting, Cutting of Cured Composite, Abrasive water jet cutting. Joining of Composites: Mechanical Fastening, Adhesive Bonding and Welding processes.	**08**
V	**Mechanics of Composite Materials :** Continuous Fibres: Iso-stress Condition, Iso-strain Condition, Critical Volume Fraction of Fibre and minimum Volume fraction of fibre, Simple Numericals, and Mechanics of Discontinuous fibers, Stress Vs Strain Curves for PMC's, MMC's. **Application of Composites:** Automobile, Aircrafts, missiles, Space hardware, Electrical and electronics, marine, recreational and Sports equipment, future potential of composites.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Describe the properties and synthesis of fibre reinforcements, matrix materials and identify matrix-reinforcement combination for given engineering application
CO2	Select an appropriate MMC's synthesizing process for engineering applications such as Filters, Piston, Bearings, connecting rod etc., confirming to given specifications and also compare the advantages of MMC's with monolithic materials
CO3	Identify and select a suitable manufacturing technique for FRP's with an understanding the limitations of the technique
CO4	Identify and Describe the joining and machining methods employed in FRP's and MMC's to achieve joining/machining in composites, Apply the fundamental principles micro mechanics application of composites

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Composite Science & Engineering	K.K.Chawala	Springer Verlag, 1998.
2	Introduction to composite materials	Hull and Clyne	Cambridge University. Press, 2nd edition, 1990.

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Composite materials hand book	MeingSchwaitz	McGraw Hill Book Company, 1984.
2	Mechanics of composite Materials	Robert M. Jones	McGraw HillKogakusha Ltd.,1998.

Department: Mechanical Engineering   **Semester: V**

HUMAN RESOURCE MANAGEMENT

Subject Code: **22ME5OE51**   **L – T – P - C: 3 – 0 – 0 – 3**

Course Objectives:

Sl. No	Course Objectives
1	To educate students on evolution of HRM and their function
2	To know Man power planning, forecasting, Inventory
3	To understand recruitment, selection process and its basic procedure
4	To understand training needs, evaluation and procedure.

Unit	Description	Hours
I	**Introduction to HRM:** Overview, objectives, environmental Influence, competitive advantage and skills required. H.R Policies, need of HRM **Human Resource Planning:** HRP at different levels, Methods of HRP, Process of HRP, Control and review mechanism.	**08**
II	**Recruitment:** Sources and techniques of recruitment (internal, external) assessment of recruitment program. **Selection, Placement and Induction:** Meaning, Significance, factors Affecting decisions, procedure, concept of testing, Interviews, Placement and Induction process.	**08**
III	**Motivation:** Motivation and Motivators, The hierarchy of needs theory, Theory X and Theory Y, The Motivation Hygiene theory, Immaturity Maturity theory. **Leadership:** Defining leadership, Ingredients of leadership, Leadership behaviour and styles. **Communication:** The communication function, Communication process, Communication in enterprise, Barriers and break downs in communication, Effective communication. Electronic Media in communication.	**08**
IV	**Performance Appraisal:** Meaning, need, purpose,. Methods of performance appraisal- traditional, graphic rating scales, ranking, paired comparison, forced distribution, checklist, critical incidence, essay or free form, group confidential reports. Modern Behaviorally Anchored Rating Scales (BARS) and related Modern Scales, Assessment Centre, Characteristics of an Effective Appraisal System and its Uses. Problems of performance Appraisal, Performance Appraisal through Computers.	**08**
V	**Counseling** Characteristics, Need, Function, Types and suggestions for Personnel Development. **Compensations Management -** Concept and Theories of wage machinery, statutory requirement in compensation Management.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Recruit and select the candidates properly to suite the requirements in the organizations.
CO2	Identify the training needs effectively and thus train and develop the employees properly.
CO3	Make communication effective and informative in the organizations.
CO4	Evaluate the performances of employees through proper performance Appraisal methods.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	"Human Resource Management and Industrial Relations",	P. SubbaRao	Himalaya Publishing House
2	Human resource management	K.Aswathappa	Khanna Publications

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	" Counseling in Industry Personnel Psychology"	Peter C. Cairo	

2	Wayne F Casio, "Management Human Resources"		TATA McGraw Hill New Delhi
3	"Human Resource Management",	H.John Bernardino, and Joyce E.A Russel	McGraw Hill International Editions.
4	"Personnel Management"	C.B. Memoria	Himalaya Publishing House

Department: Mechanical Engineering   **Semester: V**

ENGINEERING ECONOMICS (Open Elective)

Subject Code: **22ME5OE52**   **L – T – P - C: 3 – 0 – 0 – 3**

Course Objectives:

Sl.No	Course Objective
1	To perform, evaluate present worth, future worth and annual worth analyses on economic alternatives
2	To determine the total cost incurred before and after manufacturing a component
3	To evaluate benefit/cost, life cycle and breakeven analyses on economic alternatives
4	To learn replacement analysis, depreciation, break even analysis on different alternatives with case studies.

Unit	Description	Hours
I	**Introduction:** Principles of Engineering Economy, Engineering Decision- Makers, Engineering and Economics, Decision Makers and Decision making, Problems solving, Intuition and Analysis, Tactics and Strategy. **Interest and Interest Factors:** Interest rate, simple interest, Compound interest, Cash-flow diagrams, Exercises and Discussion	**08**
II	**Present Worth Comparisons**: Condition for present worth comparisons, Basic present worth comparisons, present worth equivalence, Net Present worth, Assets with unequal lives, Infinite lives, Future worth comparisons, Pay-back comparisons, Exercises, Discussions and problems.	**08**
III	**Equivalent Annual Worth Comparisons**: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparison, Consideration of asset life, Comparison of asset with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, exercises, problems	**08**
IV	**Replacement Analysis**: Introduction, Reasons for replacement, Individual Replacement of machinery or equipment with/without value of money, Group Replacement Policies, Problems **Break Even Analysis** : Basic concepts, Assumptions of BEA, Graphical methods of reducing BEP, Profit-Volume ratio, Problems on BEP	**08**
V	**Depreciation and Taxes**: Causes of depreciation, basic methods of computing depreciation charges, Definition and types of taxes with examples . **Estimating and Costing**: Components of costs such as Direct Material Cost, Direct Labor Cost, Fixed Over-Heads, Factor Cost, Administrative Over-Heads, Selling price, Estimation for simple components.	**08**

Question paper Pattern:

Two questions to be set from each unit and students has to answer any one question from each unit. Totally 5Qs need to be answered

Course outcome	Description
CO1	Understand, explain problem solving and decision-making process in Engineering Economy
CO2	Apply Engineering Economy tools to compare alternative proposals
CO3	Apply economic principles to prices and quantities in competitive supply and demand for goods and for money.
CO4	To learn replacement analysis, depreciation, break even analysis on different alternatives with case studies

Course Articulation Matrix

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

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Engineering Economy	Riggs J.L	McGraw Hill, 2002
2	Engineering Economy	Thuesen H.G	PHI,2002

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Engineering Economy	Tara Chand	Nem Chand and brothers' publisher,2016.
2	Industrial Engineering and Management	O.P Khanna	Dhanpat rai & sons,2018.
3	Financial management	I M Pandey,	Vikas publishing house,2020.
4	Engineering Economy	Paul Degarmo	Macmillan Publishing Co,2001

Department: Mechanical Engineering   **Semester: V**

INDUSTRIAL DESIGN AND ERGONOMICS

Subject Code: 22ME5OE53

L – T – P - C: 3 – 0 – 0 – 3

Course Objectives:

Sl. No	Course Objectives
1	To understand the methods and procedures of designing the industrial products.
2	To study the different procedures of Industrial Design in Practice.
3	To analyze the effective utilization of men and machines.
4	To design the man machine systems ergonomically.

Unit	Description	Hrs
I	**Introduction:** An approach to industrial design, elements of design structure for industrial design in engineering application in modern manufacturing systems. Ergonomics and Industrial Design: Introduction, general approach to the man- machine relationship, workstation design, working position.	08
II	**Control and Displays:** Shapes and sizes of various controls and displays multiple displays and control situations, design of major controls in automobiles, machine tools. **Applied Anthropometry and Work Space:** Anthropometry, Use of anthropometric data, work space and its design, science of seating.	08
III	**Visual Effects of Line and Form:** The mechanics of seeing- psychology of seeing, general influences of line and form, elements of visual design.	08
IV	**Colour:** Colour & light, colour and objects, colour and the eye, colour consistency, colour terms, reactions to colour & colour continuation.	08
V	**Aesthetic Concepts:** Concept of unity, concept of order with variety, concept of purpose style and environment, Aesthetic expressions. Industrial Design in Practice: General design, specifying design equipment's, rating the importance of industrial design, industrial design in the design process.	08

Course Outcomes:

Course outcome	Descriptions
CO1	Describe the concept of industrial design ,ergonomics and psychology of visual effects.
CO2	Design the various controls and displays by knowing the anthropometric datas.
CO3	Apply the different colour combinations for optimal design of engineering equipments.
CO4	Realize the importance of environmental factors and aesthetics in industrial design.

Course Articulation Matrix:

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Industrial Design for Engineers	Mayall W.H.	London Hiffee books Ltd. -1988
2	Human Factors in Engineering design.	Sander & McCormick	McGraw Hill Publications – 6 th Edition, 2012

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Applied Ergonomics Hand Book	Brain Shakel - Butterworth	Scientific. London - 1988.
2	Work study and ergonomics	S.Dalela and Sourabh	Standard book house,2017.

Department: Humanities and Sciences		Semester:	V
RESEARCH METHODOLOGY (Institutional Elective)			
Subject Code:	**22IE561**	**L – T – P - C:**	**2 – 0 – 0 – 2**

Sl. No	Course Objectives
1	To give an overview of the research methodology and explain the technique of defining a research problem.
2	To explain carrying out a literature search, its review and to explain various research designs and their characteristics.
3	To explain the details of sampling designs, and also different methods of data collections.
4	To develop theoretical, conceptual frameworks, writing a review, to explain the art of interpretation and the art of writing research reports.

COURSE TOPICS: The course has 28 lecture hours in 5 Units. 2- Lecture hours per week of 1-hour duration.

Unit	Description	Hrs
I	**Research Methodology:** Introduction, Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research Methods versus Methodology, Research and Scientific Method, Importance of Knowing How Research is Done, Research Process, Criteria of Good Research, and Problems Encountered by Researchers in India. **Defining the Research Problem:** Research Problem, Selecting the Problem, Necessity of Defining the Problem, Technique Involved in Defining a Problem, An Illustration. **Bloom'sTaxonomy Level:**L_1 – Remembering, L_2 – Understanding.	**06**
II	**Reviewing the literature:** Place of the literature review in research, Bringing clarity and focus to your research problem, Improving research methodology, Broadening knowledge base in research area, Enabling contextual findings, How to review the literature, searching the existing literature, reviewing the selected literature, Developing a theoretical framework, Developing a conceptual framework, Writing about the literature reviewed. **Bloom'sTaxonomy Level:**L_1 – Remembering, L_2 – Understanding.	**05**
III	**Research Design:** Meaning of Research Design, Need for Research Design, Features of a Good Design, Important Concepts Relating to Research Design, Different Research Designs, Basic Principles of Experimental Designs, Important Experimental Designs.**Design of Sample Surveys:** Introduction, Sample Design, Sampling and Non-sampling Errors, Sample Survey versus Census Survey, Types of Sampling Designs. **Bloom's Taxonomy Level:** L_1 – Remembering, L_2 – Understanding.	**07**
IV	**Data Collection**: Experimental and Surveys, Collection of Primary and Secondary Data, Selection of Appropriate Method for Data Collection, Case Study Method. **Hypothesis**- Basic concepts, types of hypothesis, Formulation of hypothesis, testing of hypothesis, Analysis of data, **Interpretation of data-** Meaning of Interpretation, Technique of Interpretation, Precaution in Interpretation, Editing, classification and tabulation. **Bloom's Taxonomy Level:** L_1 – Remembering, L_2 – Understanding.	**06**

V	**Report Writing:** Significance of Report Writing, Different Steps in Writing Report, Layout. Types of Reports, Oral Presentation, Mechanics of Writing a Research Report, Precautions for Writing Research Reports. Research ethics, Citations, Similarity check.	**04**
	Bloom'sTaxonomy Level:L_1 – Remembering, L_2 – Understanding, L_3 – Applying, L_4 – Analyzing.	

Course Outcomes:

Course outcome	Descriptions
	At the end of the course the student will be able to:
CO1	Discuss research methodology and the technique of defining a research problem
CO2	Explain the functions of the literature review in research, carrying out a literature search
CO3	Developing theoretical and conceptual frameworks and writing a review
CO4	Explain various research designs, their characteristics. explain the art of interpretation and the art of writing research reports

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Research Methodology: Methods and Techniques	C.R. Kothari, GauravGarg	New Age International4th Edition, 2018
2	ResearchMethodologyastep-by-stepguideforbeginners. (For the topic Reviewing the literature under module 2	Ranjit Kumar	SAGE PublicationsLtd. 3rd Edition, 2011

Reference Books:

Sl No	Reference Book Title	Author	Volume and Year of Edition
1	Research Methods: the concise knowledge base	Trochim	Atomic Dog Publishing2005
2	Conducting Research Literature Reviews: From the Internet to Paper	Fink A	Sage Publications 2009

Question paper pattern: The question paper will have TEN questions. There will be TWO questions from each unit. Each question will have questions covering all the topics under a unit. The students will have to answer FIVE full questions, selecting ONE full question from each unit.

Department: Humanities and Sciences		Semester:	V
MANAGEMENT AND ENTREPRENEURSHIP (Institutional Elective)			
Subject Code:	**22IE562**	**L – T – P - C:**	**2 – 0 – 0 – 2**

Sl. No	Course Objectives
1	Explain fundamentals of management, functions of a manager. Also explain planning, organizing, and staffing, decision making processes and explain the organizational structure
2	Describe the understanding of motivation and different control systems in management, leadership process, understanding of Entrepreneurship and its development process
3	Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur and summarize the preparation of project report, need significance of report. Also to explain about industrial ownership
4	To explain various forms of the intellectual property, its relevance and business impact in the changing global business environment and to discuss leading International Instruments concerning Intellectual Property Rights

COURSE TOPICS: The course has 28 lecture hours in 5 Units,   2- Lecture hours per week of 1-hour duration.

Unit	Description	Hrs
I	**Introduction** - Meaning, nature and characteristics of management, scope and Functional areas of management, goals of management, levels of management, **Planning-** Nature, importance, types of plans, steps in planning, **Organizing**- nature and purpose, types of Organization, Staffing- meaning, process of recruitment and selection. **Directing and controlling**- meaning and nature of directing, leadership styles, motivation Theories, Communication- Meaning and importance, Coordination meaning and importance, Controlling- meaning, steps in controlling, methods of establishing control. **Bloom'sTaxonomy Level:**L_1 – Remembering, L_2 – Understanding.	**06**
II	**Entrepreneur** – meaning of entrepreneur, characteristics of entrepreneurs, classification and types of entrepreneurs, various stages in entrepreneurial process, role of entrepreneurs in economic development, entrepreneurship in India and barriers to entrepreneurship. Identification of business opportunities, market feasibility study, technical feasibility study, financial feasibility study and social feasibility study. **Bloom'sTaxonomy Level:**L_1 – Remembering, L_2 – Understanding.	**05**
III	**Preparation of project and ERP (Enterprise resource planning)** - meaning of project, project identification, project selection, project report, need and significance of project report, contents, formulation, guidelines by planning commission for project report, Enterprise Resource Planning: Meaning and Importance- ERP and Functional areas of Management – Marketing / Sales- Supply Chain Management – Finance and Accounting – Human Resources – Types of reports and methods of report generation. **Bloom'sTaxonomy Level:**L_1 – Remembering, L_2 – Understanding.	**05**
IV	**Micro and Small Enterprises**: Definition of micro and small enterprises, characteristics and advantages of micro and small enterprises, steps in establishing micro and small enterprises, Government of India indusial policy 2007 on micro and small enterprises, case studies in respective domains. Institutional support: MSME-DI, NSIC, SIDBI, KIADB, KSSIDC, TECSOK, KSFC, DIC and District level single window agency. **Bloom'sTaxonomy Level:**L_1 – Remembering, L_2 – Understanding.	**06**

	Intellectual Property: Introduction to IP**:** Importance of IPR, International conventions / agreements / treaties, Origin of IP law and history, laws related to IP in India: Indian Patent Act 1970, WIPO.	**06**
	Patents: Criteria for patentability,patentable and non-Patentable Matters, introduction to Prior Art Search, types of patent application: ordinary, convention, PCT, divisional and Patent of addition, filing procedure, drafting complete specification and claims.	
	Copyright: Criteria, filing procedure, Copyright Infringement, rights of authorship and ownership, Fair Use, first sale doctrine, moral rights and economic rights.	
	Trademarks: definition, eligibility Criteria, types of patents, filing procedure, Classification of Trademarks and well-known mark	
	Geographical Indications: Definitions, importance, filing procedure, GI ecosystem in India and case laws**Industrial design:** eligibility criteria, Non-Protectable Industrial Designs India, Procedure for Registration, importance of design registration.	
	Bloom'sTaxonomy Level:L_1 – Remembering, L_2 – Understanding.	

Course Outcomes:

Course outcome	Descriptions
CO1	Explain management functions of a manager. Also explain planning and decision making processes. Organizational structure, staffing and leadership processes
CO2	Describe the understanding of motivation and different control systems in management and understanding of Entrepreneurships and its development process
CO3	Illustrate Small Scale Industries, various types of supporting agencies and financing available for an entrepreneur. Summarize the preparation of project report, need significance of report
CO4	Shall get an adequate knowledge on patent and copyright for their innovative research works and provide further the way for developing their idea for innovations

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Principles of Management	P. C. Tripathi, P. N. Reddy	Tata McGraw Hill, 4th / 6th Edition, 2010.
2	Intellectual property rights - Unleashing the knowledge economy	PmbuddhaGanguli	Tata MccrawHiU Publishing Company Ltd

Reference Books:

Sl No	Reference Book Title	Author	Volume and Year of Edition
1	Management and Entrepreneurship	KanishkaBedi	Oxford University Press-2017
2	Entrepreneurship Development	S S Khanka	S Chand & Co.
3	Dynamics of Entrepreneurial Development & Management -	Vasant Desai	Himalaya Publishing House

Question paper pattern: The question paper will have TEN questions. There will be TWO questions from each unit. Each question will have questions covering all the topics under a unit. The students will have to answer FIVE full questions, selecting ONE full question from each unit.

Department: Humanities and Sciences		Semester:	V
PROJECT MANAGEMENT (Institutional Elective)			
Subject Code:	22IE563	**L – T – P - C:**	**2 – 0 – 0 – 2**

Sl. No	Course Objectives
1	To understand the scope, timing and quality of the project, and toanalyze the project goals, constraints, deliverables, performance criteria, control needs and resource requirement in consultation with stake holders
2	To implement the process of project management, life cycle and the embodied concepts, tools and techniques in order to achieve project success
3	To understand the team efforts and stakeholders in professional manner, respecting differences, to ensure a collaborative project environment
4	To apply project management practices to new programs, initiatives, products, services and events relative to the needs of stakeholders

COURSE TOPICS: The course has 28 lecture hours in 5 Units,   2- Lecture hours per week of 1-hour duration.

Unit	Description	Hrs
I	**Introduction:** Project, Program, and portfolio, Operations management, Product life cycle, Project life cycle, Project management life cycle, Role of project manager and office, Ten Project Knowledge areas with their associated processes **Project Integration Management**: Develop project charter, Develop project management plan, Direct & manage project work, Monitor control project, Perform integrated change control, Close project / phase. **Bloom's Taxonomy Level:** L_1 – Remembering, L_2 – Understanding. L3-Analyzing	**06**
II	**Project scope management:** Plan scope management, Collect requirements, Define scope, Create WBS(Work Breakdown Structure), Validate Scope, Control scope. **Project Schedule management**: **Plan Schedule management** Define activities, Sequence activities, Estimate activity durations, Develop schedule, and Control schedule. **Bloom's Taxonomy Level:** L_1 – Remembering, L_2 – Understanding. L3-Analyzing	**05**
III	**Project cost management:** Plan cost management, Estimate cost, Determine budget, and Control costs. Project quality management: Plan quality management, Manage quality and Control quality. **Project resource management:** Plan resource management, Estimate activity resources, Acquire resources, Develop team, Manage team and Control resources. **Bloom's Taxonomy Level:** L_1 – Remembering, L_2 – Understanding. L3-Analyzing	**06**
IV	**Project communication management:** Plan communication management, Manage communications and Monitor communications **Project risk management:** Plan risk management, Identify risks, Perform qualitative risk analysis, Perform quantitative risk analysis, Plan risk responses, Implement risk responses and Monitor risks. **Project Procurement management:** Plan procurement management, Conduct procurement, Control procurements. **Bloom's Taxonomy Level:** L_1 – Remembering, L_2 – Understanding. L3-Analyzing	**06**

V	**Project stake holder management:** Identify stake holders, Plan stake holder management, Manage stake holder engagement, and Monitor stake holder engagement. A case study relevant to the domain knowledge of the department is taken up to explain the principles of the project management as brought out above. **Bloom's Taxonomy Level:** L_1 – Remembering, L_2 – Understanding. L3-Analyzing	**05**

Course Outcomes:

Course outcome	Descriptions
CO1	Outline the procedure for analyzing a project and define the rational of work break structure
CO2	Illustrate the use of network techniques for successful project implementation
CO3	Design the procedure for overall financial analysis of the project alongside the resources requirement and ideal quality
CO4	Identify the sources and process for communication, risk management and procurement and build a comprehensive plan for the stakeholder management.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Project Management Book of Knowledge	Book of Knowledge	6th Edition, PMI,USA
2	Project Management	Dennis Lock	Taylor & Francis 10th Edition-2013

Reference Books:

Sl No	Reference Books Title	Author	Volume and Year of Edition
1	Project Planning: Analysis, Selection, Implementation and Review,	Prasanna Chandra	MC-Graw Hill Education, 8th Edition, 2017.
2	Project Management-a system approach to planning, scheduling & controlling	Harold Kerzner	CBS publications and Distributions,2002

Question paper pattern: The question paper will have TEN questions. There will be TWO questions from each unit. Each question will have questions covering all the topics under a unit. The students will have to answer FIVE full questions, selecting ONE full question from each unit.

Department: Mechanical Engineering   **Semester: V**

PYTHON PROGRAMMING FOR MECHANICAL ENGINEERING
Subject Code: 22ME507
Course Objectives: **L – T – P - C: 1 – 0 – 2 – 2**

Sl. No	Course Objectives
1	Understand the purpose and practical application of various Python programming constructs
2	Explore the operational principles of various Python data structures
3	Gain hands on experience on using Python Libraries for efficient data manipulation, analysis and visualization

Unit	Description	Hours
I	**PART A** a. Introduction to python: ➢ Data Types, Operators and Expressions ➢ Flow control: Conditional statements and Iteration loops. ➢ Lists and Dictionaries. ➢ Working on strings.	15
II	**PART B** a. Working with array/Matrices using NumPy Library: ➢ Creating and indexing of Arrays ➢ Rank, determinant and trace of an array ➢ Linear matrix equation b. Working with Data using Pandas Library: ➢ Manipulating of Tabular data. ➢ Analysis of Tabular data c. Data Visualization using Matplotlib Library: ➢ Plotting of 2D Line graphs ➢ Plotting of 2D Bar Charts	25
	Question paper Pattern: The student has to write and execute Two programs from each part. Each program carries 10marks and viva voce carries 10marks	

Course Outcomes:

Course outcome	Descriptions
CO1	Understand and remember the Python programming skills in the field of Mechanical engineering
CO2	Demonstrate expertise in handling various Python programming constructs
CO3	Identify and use appropriate data structures to efficiently represent and access data
CO4	Develop Python scripts to analyze and visualize huge datasets

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Develop Python scripts to analyze and visualize huge datasets	Richard L. Halterman	Southern Adventist University, 2019, E-book, ISBN:9781539530268
2	Automated the Boring Stuff with Python	A L Sweigart	2nd Edition, No Starch press, San Francisco, ISBN: 59327-992-2

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	How to Think Like a Computer Scientist: Learning with Python 3 Documentation	Jeffrey Elkner, Peter Wentworth, Allen B. Downey, and	Chris Meyers Releasing 3rd Edition (Using Python 3.x), April, 2020.
2	Learning Python	N Nagesh Rao	1st Edition, A Cyberplus publication, 2017, ISBN:9788193392300

Department: Humanities and Sciences   **Semester: V**

SKILL DEVELOPMENT-II (APTITUDE SKILLS)

Subject Code: **22SK508**   **L – T – P - C: 0 – 0 – 2 – 1**

Sl. No	This course will enable the students to
1	Develop Critical Thinking and Reasoning Skills
2	Master Seating and Arrangement Techniques
3	Enhance Analytical and Mathematical Reasoning
4	Apply Advanced Problem-Solving Strategies

Course Objectives:

COURSE TOPICS: The course has 28 lecture hours in 5 Units, 2- lecture hours per week of 1-hour duration.

Unit	Description	Hrs
I	**Logical Aptitude** - Syllogism, Venn-diagram method, Three statement syllogism, Deductive and inductive reasoning. Introduction to puzzle and games organizing information, parts of an argument, common flaws, arguments and assumptions. **Linear Seating Arrangement** Single or Double rows facing each other or away from each other in the same direction **Circular Seating Arrangement :** · Uni- & Bi-directional problems on · Circular, Square, Rectangular, Hexagonal tables **Coding Decoding:** Letter Coding, Number Coding, symbol coding **Crypt arithmetic**: Basic concepts , addition , subtraction, multiplication of coded alphabets, Types of cryptarithm, Clocks and Calendar **Reasoning** – a. Verbal - Blood Relation, Sense of Direction, Arithmetic & Alphabet. Non- Verbal reasoning - Visual Sequence, Visual analogy and classification. Analytical Reasoning - Single & Multiple comparisons, Linear Sequencing.	06
II	**Permutation and Combination**: Understanding the difference between the permutation and combination, Rules of Counting-rule of addition, rule of multiplication, factorial function, Concept of step arrangement, Permutation of things when some of them are identical, Concept of 2n, Arrangement in a circle. **Probability**: Single event probability, multi event probability, independent events and dependent events, mutually exclusive events, non-mutually exclusive events, combination method for finding the outcomes.	06
III	**Number System** · Divisibility & Remainder, · Multiples & Factors,· Integers,· LCM & HCF,· Complete a number Series,· Find the Missing Term and Wrong Term **Simplification**: BODMAS Rule, · Approximation, · Decimals, · Fractions, · Surds & Indices **Percentage:** Calculation-oriented basic percentage, Profit and Loss, Successive Selling type, Discount & MP, Dishonest Dealings, Partnerships Interest : Simple Interest, Compound Interest, Mixed Interest, Instalments. **Data Interpretation**: Approach to interpretation - simple arithmetic, rules for comparing fractions, Calculating (approximation) fractions, short cut ways to find the percentages, Classification of data– Tables, Bar graph, line graph, Cumulative bar graph, Pie graph, Combination of graphs. Combination of table and graphs	06

IV	**Averages and Allegations mixtures**: Average: relevance of average, meaning of average, properties of average, deviation method, concept of weighted average. Allegation method: a situation where allegation technique, general representation of allegations, the straight line approach, application of weighted average and allegation method in problems involving mixtures. Application of allegation on situations other than mixtures problems. **Data Sufficiency**: Questions based on> Quantitative aptitude, > Reasoning aptitude > Puzzles		**04**
V	**Ratio and Proportion :** · Simple Ratios, · Compound Ratios, · Comprehend and Dividend · Direct & Indirect Proportions, · Problems on ages,· Mixtures & Allegation **Speed, Time and Distance :** · Relative Speed, · Average Speed, · Problems on Train, · Boat & Stream. **Time and Work** · Work Efficiency, · Work & Wages, Pipes & Cisterns		**06**

Course Outcomes:

Course outcome	At the end of the course students will be able to
CO1	Enhanced Logical and Analytical Thinking
CO2	Proficiency in Advanced Arrangement and Sequencing Problems
CO3	Strong Numerical and Mathematical Aptitude
CO4	Effective Data Interpretation and Quantitative Analysis

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	How to Prepare for Logical Reasoning for CAT" by Arun Sharma	Arun Sharma	• ISBN-10: 9352602280 • ISBN-13: 978-9352602287
2	A Modern Approach to Verbal & Non-Verbal Reasoning" by R.S. Aggarwal	R.S. Aggarwal	• ISBN-10: 8121924987 • ISBN-13: 978-8121924986

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Quantitative Aptitude for Competitive Examinations" by R.S. Aggarwal	R.S. Aggarwal	☐ ISBN-10: 9352534026 ☐ ISBN-13: 978-9352534021
2	Logical Reasoning and Data Interpretation for the CAT" by Nishit K. Sinha	Nishit K. Sinha	☐ ISBN-10: 933922269X ☐ ISBN-13: 978-9339222694

Scheme of Teaching and Examination (160 Credits Scheme, NEP Batch)
Third Year B.E. Mechanical Engineering

6thSemester B.E.   **Effective from the Academic year 2024-25**

SI No		Course Code	Course Title	Teaching Dept.	L	T	P	Credits	CIE Marks	SEE Marks	Total Marks	Exam Hrs
1	PC	22ME601	Product Design and Development	ME	3	-	-	3	50	50	100	3
2.	PC	22ME602	Heat Transfer	ME	3	-	2	4	50	50	100	3
3.	PC	22ME603	Design of Machine Elements	ME	3	-	2	4	50	50	100	3
4.	PE	22ME6PE4x	Professional Elective-II	ME	3	-	-	3	50	50	100	3
5.	OE	22ME6OE5x	Open Elective-II	ME	3	-	-	3	50	50	100	3
6.	PC	22ME66x	Online Courses – 22NP661-NPTEL, 22MC662-MOOC, 22SW663-SWAYAM	ME	2	-	-	2	50	-	50	-
7.	PW	22MEMP607	Mini Project	ME	-	-	4	2	50	50	100	3
8.	HS	22SK608	Pre placement training	T&P	-	-	2	1	50	-	50	-
L: Lecture, T-Tutorial, P-Practical/Drawing, CIE: Continuous Internal Evaluation, SEE: Semester End Examination				**Total**	**17**	**-**	**10**	**22**	**400**	**300**	**700**	**23**

22ME6PE4x - Professional Elective-II		22ME6OE5x - Open Elective-II		22ME66x - Online Courses	
22ME6PE41	Engineering Economics	22ME6OE51	Enterprise Resource Planning	22NP661	NPTEL
22ME6PE42	Operation Research	22ME6OE52	Product Design and Development	22MC662	MOOC
22ME6PE43	Non-Destructive Testing	22ME6OE53	Operation Research	22SW663	SWAYAM

Department: Mechanical Engineering   **Semester: VI**

PRODUCT DESIGN AND DEVELOPMENT

Subject Code: 22ME601   **L – T – P - C: 3-0-0-3**

Course Objectives:

Sl. No	Course Objectives
1	Competence with a set of tools and methods for product design and development.
2	Confidence in your own abilities to create a new product.
3	Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
4	Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective and enhance team working skills.

Unit	Description	Hours
I	**Introduction:** Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development. Development Processes and Organizations, the front-end process, adopting the generic product development process **Product Planning**: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources , and plan timing, complete pre project planning, reflect all the results and process	08
II	**Identifying Customer Needs**: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process	07
III	**Concept Generation:** The activity of concept generation, clarifies the problem, search externally, search internally, explore systematically, and reflect on the results and process. Concept Selection, Overview of methodology, concept screening and concept scoring	08
IV	**Concept Testing:** Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result, reflect on the results and the process. **Industrial Design:** Assessing the need and impact of industrial design, process, managing the industrial design process and assessing the quality of industrial design	08
V	**Design For Manufacturing And Economics:** Design for Manufacturing: Definition, estimation of manufacturing cost, reducing the cost of components, assembly, supporting production, impact of DFM on other factors. Product Development Economics: Elements of economic analysis, base case financial mode, Sensitive analysis, project trade-offs, influence of qualitative factors on project success, qualitative analysis.	09

Course Outcomes:

Course outcome	Descriptions
CO1	Understand the product design and development process
CO2	Apply creative thinking skills for idea generation
CO3	Translate conceptual ideas into products
CO4	Present ideas using various types of model.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Product Design and Development	Karl.T.Ulrich, Steven D Eppinger - Irwin	McGrawHill – 2012, Fifth Edition.
2	Product Design and Manufacturing	A C Chitale and R C Gupta	PH1, - 3rd Edition, 2003.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	New Product Development	Timjones Butterworth Heinmann	Oxford. UCI -1997
2	Product Design for Manufacture and Assembly	GeofferyBoothroyd	Peter Dewhurst and Winston Knight-2002

HEAT TRANSFER

Subject Code: 22ME602   **L – T – P - C: 3 – 0 – 2 – 4**

Course Objectives:

Sl. No	Course Objectives
1	To understand the fundamentals of heat transfer mechanisms insolids and their applications in various heat transfer equipment in process industries.
2	To understand the fundamentals of heat transfer mechanisms in fluidsand their applications in various heat transfer equipment in process industries.
3	To develop methodologies for solving a wide variety of practical engineering problems.
4	To impart knowledge on design of heat transfer equipment

Unit	Description	Hrs
I	**Introductory concepts and definitions:** Modes of heat transfer, basic laws of governing conduction, convection and radiation heat transfer, Thermal conductivity, convective heat transfer coefficient, radiation heat transfer, combined heat transfer mechanism, boundary conditions of 1st, 2nd, 3rd kind **Steady state Conduction** Derivation of general three-dimensional conduction equation in Cartesian coordinate, special cases, Derivation for heat flow and temperature distribution for One dimensional conduction equation in rectangular, cylindrical and spherical coordinates for plane and composite walls. contact resistance theory between the two walls, Electrical resistance concept Numerical problems Critical thickness of insulation without heat generation,	**09**
II	**Fins:** Heat transfer in extended surfaces of uniform cross section without heat generation, very long fin and short fin with insulated tip (derivation of short fin without insulated tip and fin between two heat sources are EXCLUDED) & Fin efficiency and effectiveness.	**09**
III	**Heat exchangers:** classification of heat exchanger, overall heat transfer coefficient, fouling and fouling factor, LMTD, effectiveness NTU methods analysis of heat exchangers, Numerical Problems. **Concepts and basic relations in boundary layers**: Flow over a body, velocity boundary layer, critical Reynolds number, general expressions for drag coefficient and drag force, Thermal boundary layer, general expression for local heat transfer coefficient, average heat transfer coefficient, Nusselts number.	**09**
IV	**Free convection** Application of dimensional analysis for free convection-Physical significance of Grasshoff number,Prandtl, Nusselt numbers. Use of correlations free convection to vertical and horizontal plates, vertical & horizontal cylinders, (inclined plates, sphere and enclosed spaces EXCLUDED) Numerical Problems **Forced natural convection**: Application of dimensional analysis for forced convection, physical significance of Reynolds number, Flow inside a duct, velocity	**09**

	boundary layer, hydrodynamic entrance length and hydro dynamically developed flow, Numerical Problems.	
V	**Radiation heat transfer:** Thermal radiation, definitions of various terms used in radiation heat transfer, Stefan Boltzmann law, Kirchoff's Law, Planck's law and Wien's displacement law, Radiation heat exchange between two parallel infinite black surfaces. Simple Numerical problems.	**09**

LAB CONTENT

Sl. No	Experiment Description
1	Determination of Thermal conductivity of insulating powder.
2	Determination of Thermal conductivity of Metal Rod
3	Determination of Thermal conductivity of Composite wall
4	Determination of thermal conductivity of liquid.
5	Determination of heat transfer co efficient in natural convection
6	Determination of heat transfer co efficient in forced convection
7	Determination of Efficiency of Pin-fin in natural convection
8	Determination of efficiency of Pin-fin in forced convection.
9	Determination of emissivity of test surface
10	Determination of Stefan Boltzmann constant

Course Outcomes:

Course outcome	Descriptions
CO1	Understand the basic laws of heat transfer. Analyze problems and develop solutions for steady state heat conduction in simple geometries.
CO2	Understand the fundamentals of convective heat transfer process. Evaluate heat transfer coefficients for natural convection and forced convection inside ducts.
CO3	Analyze heat exchanger performance by using the method of log mean temperature difference and effectiveness.
CO4	Analyze radiation heat transfer between black body surfaces and gray body surfaces.

Course Articulation Matrix

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

CO4	2	3	2	2					1				

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Heat and Mass Transfer- A basic Approach,	Ozisik,	Tata Mc Graw Hill-2002

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Heat Transfer, A practical approach,	Yunus and Cenegel	Tata Mc Graw Hill, 2nd Edition, 2002
2	Heat and Mass Transfer,	P.K Nag,	Tata Mc Graw Hill, 3rd edition 2011

DESIGN OF MACHINE ELEMENTS

Subject Code: 22ME603   **L – T – P - C: 3 – 0 – 2 – 4**

Course Objectives:

Sl. No	Course Objectives
1	Recognize and define the terminology involved in the design of m/c components like flexible m/c elements (springs, belts, chains, wire ropes etc.), transmission components like spur gear, helical gears, bevel gears, worm gears etc. & other miscellaneous components like power absorbing machines like clutches, brakes etc., bearings (journal bearing, antifriction bearings)
2	To understand the concept of uniaxial, biaxial and triaxial state of stress in a loaded machine component and apply them for practical situations
3	To acquire knowledge of basic concepts of failure theories and use those for designing components subjected to static, impact and fatigue loads
4	To understand & apply the basic design concepts for designing machine components used for mechanical power transmission and mechanical fastening elements.

Unit	Description	Hours
I	**Introduction:** Materials and their properties, design considerations, manufacturing considerations, codes and standards, limits, fits and tolerances for manufacture, stress-strain diagrams, mechanical behavior of metals, Stress analysis under bi-axial and tri-axial stress state with combined shear, Principal stresses and related problems, analysis of beams with straight and curved cross section. Design for static strength: Static loads and factor of safety,	**09**
II	**Design for fatigue strength**: Introduction, S-N Diagram, low cycle fatigue, high cycle fatigue, and endurance limit. Modifying factors, size effect, surface effect, stress concentration effect, fluctuating stresses, fatigue strength under fluctuating stresses, Goodman and Soderberg relationship for design, stress due to combined loading, cumulative fatigue damage, problems. Impact loading: Derivation of Instantaneous stress due to axial, bending and torsion loading, effect of Inertia, problems	**09**
III	**Design of Transmission Shafts:** Simple torsion equation, design for strength and rigidity under steady loading, ASME & BIS codes for design of transmission shafting, Shafts under fluctuating loads & combined loads, Design of rigid flanged coupling & bushed pin type flexible coupling, design of keys, splined shafts **Power screws & Fasteners:** Mechanics of power screws, stresses in power screws, efficiency and self-locking. Cotter and Knuckle joints: Cotter and Knuckle joints. Bolted joints: Types of Keys, stresses in keys, pins and retainers, Threaded fasteners and their terminology,	**09**

| IV | **Hydrodynamic and Hydrostatic Bearings:-** Introduction, The Reynolds Equation, Thrust Slider, Journal Slider Bearings, Squeeze Film Bearings, Hydrostatic Bearings Rolling Element Bearings:- Introduction, Historic Overview, Bearing types-Ball bearings- Roller bearings. Static Load Distribution | **09** |
| V | **Spur Gear, Helical, Bevel and Worm Gears**:- Introduction, Types of Gear, Gear Geometry, Gear Ratio, Contact ratio, Tooth thickness, backlash, interference, Gear Materials, Load acting on gear tooth, Bending stresses on gear tooth, gear design based on static beam strength, wear load considerations
Helical, Bevel and Worm Gears:- Introduction, Helical gears- Helical gear relationships, Pitches of Helical gears, Equivalent Number of Teeth and Pressure Angle, Helical Tooth Proportions, Loads and Stresses Bevel Gear Geometry and forces, ASME Design. Worm Gears:- Tooth Geometry, Forces on Worm Gears | **09** |

Lab content

Sl no	Experiment Descriptions
1	Determination of Natural Frequency, logarithmic decrement, Damping ratio and damping coefficient in a single degree of freedom vibrating systems (longitudinal and torsional)
2	Balancing of Rotating masses
3	Determination of critical speed of a rotating shaft
4	Determination of Fringe constant of Photo elastic material using. a. Circular disc subjected to diametral compression
5	Determination of equilibrium speed, sensitiveness, power and effort of Porter/Proell /Hartnell Governor
6	Determination of Pressure distribution in Journal bearing.
7	Determination of Principal Stresses and strains in a member subjected to combined loading using Strain rosettes.
8	Determination of stresses in curved beam using strain gauge
9	Experiment on Gyroscope.

Course Outcomes:

Course outcome	Descriptions
CO1	Define and explain the terminology associated with material properties and material behavior under the action of static, impact and fatigue loads.[BL1]
CO2	Understand and explain the essential principles of uniaxial, biaxial and tri-axial state of stresses in a loaded machine component and find the resultant stresses.[BL2]
CO3	Analyze and Evaluate the working of transmission gears, flexible drives and support systems, power absorbing machines [BL3,BL4]
CO4	Design the transmission system axles, power-screws, couplings, fastenings like riveted and support system required for the same [BL5, BL6]

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Machine Design	V.B. Bhandary	TATA Mcgraw Hill Publication
2			

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Machine Design	Sharma & Agarwal,	SK Kataria & Sons Publications, New Delhi.
2			

Department: Mechanical Engineering   **Semester: VI**

ENGINEERING ECONOMICS

Subject Code: **22ME6PE41**   **L – T – P - C: 3 – 0 – 0 – 3**

Course Objectives:

Sl.No	Course Objective
1	To perform, evaluate present worth, future worth and annual worth analyses on economic alternatives
2	To determine the total cost incurred before and after manufacturing a component
3	To evaluate benefit/cost, life cycle and breakeven analyses on economic alternatives
4	To learn replacement analysis, depreciation, break even analysis on different alternatives with case studies.

Unit	Description	Hours
I	**Introduction:** Principles of Engineering Economy, Engineering Decision- Makers, Engineering and Economics, Decision Makers and Decision making, Problems solving, Intuition and Analysis, Tactics and Strategy. **Interest and Interest Factors:** Interest rate, simple interest, Compound interest, Cash-flow diagrams, Exercises and Discussion	**08**
II	**Present Worth Comparisons**: Condition for present worth comparisons, Basic present worth comparisons, present worth equivalence, Net Present worth, Assets with unequal lives, Infinite lives, Future worth comparisons, Pay-back comparisons, Exercises, Discussions and problems.	**08**
III	**Equivalent Annual Worth Comparisons**: Equivalent Annual Worth Comparison methods, Situations for Equivalent Annual Worth Comparison, Consideration of asset life, Comparison of asset with equal and unequal lives, Use of shrinking fund method, Annuity contract for guaranteed income, exercises, problems	**08**
IV	**Replacement Analysis**: Introduction, Reasons for replacement, Individual Replacement of machinery or equipment with/without value of money, Group Replacement Policies, Problems **Break Even Analysis** : Basic concepts, Assumptions of BEA, Graphical methods of reducing BEP, Profit-Volume ratio, Problems on BEP	**08**
V	**Depreciation and Taxes**: Causes of depreciation, basic methods of computing depreciation charges, Definition and types of taxes with examples . **Estimating and Costing**: Components of costs such as Direct Material Cost, Direct Labor Cost, Fixed Over-Heads, Factor Cost, Administrative Over-Heads, Selling price, Estimation for simple components.	**08**

Question paper Pattern:

Two questions to be set from each unit and students has to answer any one question from each unit. Totally 5Qs need to be answered

Course outcome	Description
CO1	Understand, explain problem solving and decision-making process in Engineering Economy
CO2	Apply Engineering Economy tools to compare alternative proposals
CO3	Apply economic principles to prices and quantities in competitive supply and demand for goods and for money.
CO4	To learn replacement analysis, depreciation, break even analysis on different alternatives with case studies

Course Articulation Matrix

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

Text Books:

Sl No	Title	Author	Volume and Year of Edition
1	Engineering Economy	Riggs J.L	McGraw Hill, 2002
2	Engineering Economy	Thuesen H.G	PHI,2002

Reference Books:

Sl No	Title	Author	Volume and Year of Edition
1	Engineering Economy	Tara Chand	Nem Chand and brothers' publisher,2016.
2	Industrial Engineering and Management	O.P Khanna	Dhanpat rai & sons,2018.
3	Financial management	I M Pandey,	Vikas publishing house,2020.
4	Engineering Economy	Paul Degarmo	Macmillan Publishing Co,2001

Department: Mechanical Engineering   **Semester: VI**

OPERATIONS RESEARCH

Subject Code: 22ME6PE42

Course Objectives: **L – T – P - C: 3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	To develop the students with the knowledge based on models for problem solving and decision making situations in organizations.
2	To develop mathematical model for interactive decision making situations, where competitors are involved under conditions conflict.
3	Construct the required activities in an efficient manner so as to complete it on or before as specified time limit and at minimum cost.
4	To make the student analyse the real time problems as operational research models and decide upon optimal solution.

Unit	Description	Hours
I	**Introduction of OR**, Definition of OR, Scope of OR, Application areas of OR, Phases of OR, Characteristics and limitations of OR, Linear Programing Problems (LPP) by graphical methods. **Simplex Methods**: Standard form of an LPP, Slack & Surplus Variables, Artificial variable or Big M Method	**08**
II	**Transportation Problems:** Formulation of transportation problems, types, initial basic feasible solution using Penalty methods and optimal solution by MODI method, Degeneracy in transportation problems, Applications of Transportation problems, Concept for maximization cases. **Assignment problems**: Formation, Types, solution by Hungarian Method, Unbalanced problems, Comparison b/w Transportation &Assignment problems Application to maximization cases.	**08**
III	**Travelling salesman Problems**: Problems faced by travelling salesmen's and routing of machine operations by operators. **GAME THEORY:** Formation of games, types, solution of games with saddle point, Graphical method of solving mixed strategy games, Dominance and Modified Dominance rule for solving mixed strategy games.	**08**
IV	**SEQUENCING:** Basic assumptions, sequencing 'N' jobs on single machine using priority rules, sequencing using Johnson's rule-'N' jobs on 2 machines, "n; jobs on 3 machines. **PERT and CPM** Techniques: introduction, network construction – rules, Fulkerson's rule numbering the events, AON and AOA diagrams, definitions, different floats.	**08**
V	**Critical path method** to find the expected completion time of a project, **PERT methods** for finding expected during of an activity and project, determining the probability of completing a project, predicting a project, predicting the completion time of project; Procedure for crashing of simple projects, Simple projects.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Identify and develop operational research models from the verbal description of the real system.
CO2	Understand the mathematical tools that are needed to solve optimization problems.
CO3	Use mathematical tools to solve the proposed models.
CO4	Develop are port that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	**Operations Research**	Kalavathy S	Vikas Publishing House Pvt Ltd (Publisher), 2016, Edition4, ISBN-139789325963474
2	**Operations Research**	Prem Kumar Gupta, Ds Hira	S Chand & Company Pvt Ltd (Publisher), 2016, Edition7, ISBN-139788121902816

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	**Operations Research Theory & Applications**	JK Sharma	Laxmi Publications (P) Ltd (Publisher), 2016, Edition6, ISBN-z39789385935145
2	**Operations Research Theory Methods & Applications**	SD Sharma	Kedar Nath Ram Nath (Publisher), 2017, Edition18, ISBN-139789380803388

Department: Mechanical Engineering   **Semester: VI**

NON DESTRUCTIVE TESTING

Subject Code: 22ME6PE43   **L – T – P - C: 3 – 0 – 0 – 3**

Course Objectives:

Sl. No	Course Objectives
1	To introduce the basic principles, techniques, equipment, applications and limitations of Non Destructive Testing (NDT) methods such as Visual, Penetrant Testing, Magnetic Particle Testing, Ultrasonic Testing, Radiography, Eddy Current.
2	To enable selection of appropriate NDT methods.
3	To identify advantages and limitations of NDT methods.
4	To make aware the developments and future trends in NDT.

Unit	Description	Hours
I	**Introduction:** Need for Inspection, comparison between destructive and non-destructive tests, Merits and Demerits of Non-destructive Testing, selection of NDT methods. Visual Inspection Bore scopes, types of bore scopes, Application of visual Inspection.	08
II	**Liquid Dye Penetrant Inspection (LPI):** Introduction, Principles, Characteristics of penetrants, Inspection Procedure, Penetrant testing materials, methods and its Applications. **Magnetic Particle Inspection (MPI):** Basic definitions and principles, Magnetization methods, Procedure, Characteristics of Magnetic particles, Applications, Advantages and Limitations.	08
III	**Radiography:** Introduction, Uses and limitations of radiography, Basic Principles of radiography, X-ray radiography, Advantages and Limitations, Applications, Inspection Techniques, Single wall single image, double wall single image technique, double wall double image technique **Eddy current Inspection (ECT):** Introduction and principles, elements of a typical inspection system, operating variables, Inspection coils, Applications, Advantages and Limitations.	08
IV	**Ultrasonic Testing (UT):** Introduction, basic equipment's, variables in ultrasonic inspection, General Characteristics of Ultrasonic waves, wave propagations, Attenuation of ultrasonic beams, Inspection methods, Transducer elements, Search units, Couplants, Detection of Flaws, Applications, Advantages and Limitations.	08
V	**Other NDT Methods:** Acoustic Emission Testing (AET), Basic principle of AET, Characteristics of AET with other inspection methods, Optical Holography, principle, Applications, Advantages and Limitations of Optical Holography, Helium Leak detector, Probe technique, Envelope vacuum technique, Envelope pressure technique, Bubble testing.	08

Course Outcomes:

Course outcome	Descriptions
CO1	Apply the Knowledge of various NDT inspection methods with specific applications.
CO2	Make use of Liquid Dye Penetrate Inspection (LPI) Magnetic Particle Inspection (MPI) techniques for Inspection of defective components.
CO3	Identify the techniques of Radiography method, Eddy Current Testing (ECT) and Ultrasonic method of NDT for the testing, analysis and evaluation of the defects in the components.
CO4	Utilize the Acoustic, Helium Leak test and other leak testing's to achieve realistic analysis rather than mere testing for defects with conventional NDT Methods.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Non-Destructive Testing	Barry Hull and Veron John	Palgrave Macmillan, 22 January 1990
2	Metals hand book for non-destructive evaluation & quality control	American society of Metals	V0lume - 17, Metals Park, Ohio, USA, 2000

Reference Books:

Sl. No	Text Book title	Author	Volume and Year of Edition
1	Practical Non Destructive Testing,	Baldev Raj, T. Jayakumar and M. Thavasimuthu	Woodhead Publisher, 2002
2	Non-Destructive test and Evaluation of Materials	J. Prasad and C. G. Krishnadas Nair	Tata McGraw Hill, 2008

Department: Mechanical Engineering   **Semester: VI**

ENTERPRISE RESOURCE PLANNING

    Subject Code: 22ME6OE51

    Course Objectives: **L – T – P - C: 3 – 0 – 0 – 3**

Sl. No	Course Objectives
	To provide the students with the knowledge of
1	Evolution of ERP and overview of ERP.
2	ERP related technologies, Data warehousing and Data mining.
3	Various ERP packages and package developing company`s.
4	ERP Implementation Life Cycle in industries

Unit	Description	Hours
I	INTRODUCTION TO ERP: Introduction, Evolution of ERP, What is ERP, Reasons for the growth of the ERP market, The advantages of ERP, Why do ERP Implementations Fail? ENTERPRISE – AN OVERVIEW: Introduction, Integrated Management Information, Business modelling, Integrated Data Model.	**08**
II	ERP AND RELATED TECHNOLOGIES: Introduction, Business Process Reengineering, Management Information System, Data Warehousing, Data Mining, On-line Analytical Processing, Supply Chain Management.	**08**
III	BENEFITS OF ERP: Introduction, Reduction of Lead time, On-time shipment, Reduction in Cycle Time, Improved Resource Utilisation, Better Customer Satisfaction, Improved Suppler Performance, Increased Flexibility, Reduced Quality Costs, Improved Information Accuracy and Decision – making capability.ERP MODULES: Introduction, Finance, Plant Maintenance, Quality Management, Materials Management.	**08**
IV	ERP PACKAGES: Overview of ERP Software Introduction, SAP AG, Baan Company, Oracle Corporation, PeopleSoft, JD Edwards World Solutions Company, System Software Associates, Inc. QAD.	**08**
V	ERP Implementation Life Cycle: Pre-Evaluations Screening, Package Evaluation, Project Planning Phase, Gap Analysis, Reengineering, Configuration, Implementation of Team Training, Testing, Going Live, end user Training, Post Implementation VENDOR, CONSULTANTS AND USERS: Introduction, In-house implementation – Pros and Cons, Vendors, Consultants, End-users.	**08**

    Course Outcomes:

Course outcome	Descriptions
	At the end of the course, the student will be able to
CO1	Make use of ERP software, and its role in integrating business functions.
CO2	Analyze the strategic options for ERP identification and adoption.
CO3	Design the ERP implementation strategies.
CO4	Create reengineered business processes for successful ERP implementation.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Enterprise Resource Planning	Alexis Leon Tata	McGraw Hill Publishing Company Ltd 1999
2	Enterprise Resource Planning Concept and Practice	Vinod Kumar Garg and Venkitakrishnan	Prentice Hall, India 2nd Edition Reference Books

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Manufacturing Planning & Controls	Thomas Volloman, et,al	Manufacturing Planning & Controls Thomas Volloman, et,al

Department: Mechanical Engineering   **Semester: 6th**

PRODUCT DESIGN AND DEVELOPMENT

Subject Code: 22ME6OE52

Course Objectives: **L – T – P - C: 3 – 0 – 0 – 3**

Sl. No	Course Objectives
1	Competence with a set of tools and methods for product design and development.
2	Confidence in your own abilities to create a new product.
3	Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
4	Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective and enhance team working skills.

Unit	Description	Hours
I	**Introduction:** Characteristics of successful product development, Design and development of products, duration and cost of product development, the challenges of product development. Development Processes and Organizations, the front-end process, adopting the generic product development process,	**08**
II	**Product Planning**: The product planning process, identify opportunities. Evaluate and prioritize projects, allocate resources , and plan timing, complete pre project planning, reflect all the results and process	**07**
III	**Identifying Customer Needs**: Gather raw data from customers, interpret raw data in terms of customer needs, organize the needs into a hierarchy, establish the relative importance of the needs and reflect on the results and the process	**08**
IV	**Concept Generation:** The activity of concept generation, clarifies the problem, search externally, search internally, explore systematically, and reflect on the results and process. Concept Selection, Overview of methodology, concept screening and concept scoring	**08**
V	**Concept Testing:** Define the purpose of concept test, choose a survey population, choose a survey format, communicate the concept, measure customer response, interpret the result,reflect on the results and the process. **Industrial Design:** Assessing the need and impact of industrial design, process, managing the industrial design process and assessing the quality of industrial design	**09**

Course Outcomes:

Course outcome	Descriptions
CO1	Understand the product design and development process
CO2	Apply creative thinking skills for idea generation
CO3	Translate conceptual ideas into products
CO4	Present ideas using various types of model.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Product Design and Development	Karl.T.Ulrich, Steven D Eppinger - Irwin	McGrawHill – 2012, Fifth Edition.
2	Product Design and Manufacturing	A C Chitale and R C Gupta	PH1, - 3rd Edition, 2003.

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	New Product Development	Timjones Butterworth Heinmann	Oxford. UCI -1997
2	Product Design for Manufacture and Assembly	GeofferyBoothroyd	Peter Dewhurst and Winston Knight-2002

Department: Mechanical Engineering   Semester: 6th

OPERATIONS RESEARCH

Subject Code: 22ME6OE53   **L – T – P - C: 3 – 0 – 0 – 3**
Course Objectives:

Sl. No	Course Objectives
1	To equip the students with the knowledge based on OR models for problem solving and decision making situations in organizations.
2	To develop mathematical model for interactive decision making situations, where competitors are involved under conditions of conflict.
3	To design and develop Operations Research Models for real life problems.
4	To construct the network activities in an efficient manner.

Unit	Description	Hours
I	**Introduction of OR**, Definition of OR, Scope of OR, Application areas of OR, Phases of OR, Characteristics and limitations of OR, Linear Programing Problems (LPP) by graphical methods. **Simplex Methods**: Standard form of an LPP, Slack & Surplus Variables, Artificial variable or Big M Method	**08**
II	**Transportation Problems:** Formulation of transportation problems, types, initial basic feasible solution using Penalty methods and optimal solution by MODI method, Degeneracy in transportation problems, Applications of Transportation problems, Concept for maximization cases. **Assignment problems**: Formation, Types, solution by Hungarian Method, Unbalanced problems, Comparison b/w Transportation &Assignment problems Application to maximization cases.	**08**
III	**Travelling salesmanProblems**: Problems faced by travelling salesmen's and routing of machine operations by operators. **GAME THEORY:** Formation of games, types, solution of games with saddle point, Graphical method of solving mixed strategy games, Dominance and Modified Dominance rule for solving mixed strategy games.	**08**
IV	**SEQUENCING:** Basic assumptions, sequencing 'N' jobs on single machine using priority rules, sequencing using Johnson's rule-'N' jobs on 2 machines, "n; jobs on 3 machines. **PERT and CPM** Techniques: introduction, network construction – rules, Fulkerson's rule numbering the events, AON and AOA diagrams, definitions, different floats.	**08**
V	**Critical path method** to find the expected completion time of a project, **PERTmethods** for finding expected during of an activity and project, determining the probability of completing a project, predicting a project, predicting the completion time of project; Procedure for crashing of simple projects, Simple projects.	**08**

Course Outcomes:

Course outcome	Descriptions
CO1	Identify and develop operational research models from the verbal description of the real system.
CO2	Understand the mathematical tools that are needed to solve optimization problems.
CO3	Use mathematical tools to solve the proposed models.
CO4	Develop a report that describes the model and the solving technique, analyse the results and propose recommendations in language understandable to the decision-making processes in Management Engineering.

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	**Operations Research**	Kalavathy S	Vikas Publishing House Pvt Ltd (Publisher), 2016, Edition4, ISBN-139789325963474
2	**Operations Research**	Prem Kumar Gupta, Ds Hira	S Chand & Company Pvt Ltd (Publisher), 2016, Edition7, ISBN-139788121902816

Reference Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	**Operations Research Theory & Applications**	JK Sharma	Laxmi Publications (P) Ltd (Publisher), 2016, Edition6, ISBN-z39789385935145
2	**Operations Research Theory Methods & Applications**	SD Sharma	KedarNath Ram Nath (Publisher), 2017, Edition18, ISBN-139789380803388

Department: Mechanical Engineering   **Semester: VI**

MINI PROJECT

Subject Code: 22MEMP607   **L – T – P - C: 0 – 0 – 4 – 2**

- ➢ Students are encouraged to carry out mini project focusing on societal needs and fabricate them with minimum cost.

- ➢ Using locally available materials for the purpose of demonstration of the concepts involved.

- ➢ Mini projects could be selected to be from purely mechanical engineering or interdisciplinary based on electromechanical, microprocessor-based prototype models etc.

- ➢ Option is also available for taking up small reconditioning projects pertaining to any of the laboratories of the department (typically adaptive design or development design projects)

Course Articulation Matrix

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

Department: Humanities and Sciences   **Semester: VI**

PRE-PLACEMENT TRAINING (Python for Mechanical Engineering)

Subject Code: **22SK608-ME**   **L – T – P - C: 0 – 0 – 2 – 1**

Sl. No	This course will enable the students to
1	To build real-world applications using the Python programming language and students can learn easily to meet the industry requirements
2	Hands on sessions and exclusive interactive sessions are provided to extend the learning the basics and updateskills as per the current situation
3	To update the skill with good candidature and take up the projects of your choice in your domains
4	To build resume suits to Industry 4.0, Python programming plays a vital role as it links to Machine Learning and Data Analysis requires for any companies for building top notch careers

Course Objectives:

COURSE TOPICS: The course has 28 lecture hours in 5 Units. 2- Lecture hours per week of 1-hour duration.

Unit	Description	Hrs
I	**Introduction to Python** ➢ Importance of Python for ME ➢ Installing of Python: - IDLE - Anaconda - Pip ➢ Jupiter Notebook: - Overview- Create Folder- Save ➢ Programming Methodology: - Methodology- Variables- First Program- Execution ➢ Data Types: - Integer- Float-Strings Python Programming:- Boolean- Hands on ➢ Type Conversions: - To String- To Float- To Integer- Hands on ➢ Input Statements: - Program - Execution	6
II	**Functions and Flow control:** ➢ If, Else, Elif Statements: - Syntax - Program - Execution - Hands on ➢ While loop, Break, Continue Statements: - Syntax - Program - Execution - Hands on ➢ Functions and For Loop:- Syntax - Program - Execution - Hands on ➢ List: - Syntax - Program - Execution -Hands on ➢ Slicing and Comprehensions:- Syntax –Program –Execution - Hands on ➢ Dictionaries:- Syntax – Program – Execution - Hands on	6

III	**Libraries:** ➢Numpy:- Definition - Examples - Hands on ➢ Pandas: - Definition - Examples - Hands on ➢Matplotlib:- Definition - Examples	4
IV	**Programming on domain specific** ➢ Mechanics of Materials ➢ Machine Design ➢ Fluid Mechanics ➢ Theory of Machines ➢ Manufacturing	6
V	**Advanced Programming** ➢ Project 1 ➢ Project 2	6

Course Outcomes:

Course Outcome	At the end of the course students will be able to
CO1	Learn Python programming is a mandatory skill for the engineering jobs roles forMechanical engineers.
CO2	Develops skills for aerospace engineers like Computer Aided Drawing, Modelling, FE Analysis, ThermalSimulation, Aero modelling and Simulation, Robotics,
CO3	Also builds skill on CFD modelling and simulations, Automation,Reliability Engineer
CO4	To build students resume suits to Industry 4.0, Python programming plays a vital role as it links to Machine Learning and Data Analysis requires for any companies for building

Course Articulation Matrix

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

Text Books:

Sl No	Text Book title	Author	Volume and Year of Edition
1	Let Us C by YashavantKanetkar	YashavantKanetkar	☐ ISBN-10: 8183331637 ☐ ISBN-13: 978-8183331630
2	**Python Crash Course" by Eric Matthes**	Eric Matthes	**ISBN-10: 1593276036**

Reference Books:

Sl No	Reference Book title	Author	Volume and Year of Edition
1	The C Programming Language by Brian W. Kernighan and Dennis M. Ritchie	Dennis M. Ritchie	☐ ISBN-10: 0131103628 ☐ ISBN-13: 978-0131103627
2	**Python Crash Course" by Eric Matthes**	Eric Matthes	**ISBN-10: 1593276036** **ISBN-13: 978-1593276034**