MEDI-CAPS UNIVERSITY

Knowledge is Power

Department of Mechanical Engineering

CURRICULUM AND SYLLABUS

(2021-2025)

B. Tech. Mechanical Engineering

Mechanical Engineering

B.Tech.(ME)

CURRICULUMANDSYLLABUS

Vision Statement of University

Be an internationally acclaimed University recognised for its excellent teaching, research, innovation, outreach and creating top class technocrats and professionals who can serve the mankind as multi skilled global citizen.

Mission Statement of University

- Establish state-of-the-art facilities for world class education and research.
- Conduct scholarly research and creative endeavours that impact quality of life.
- Attract quality staff and students to cater for diverse needs and preferences and widen participation.
- Build a foundation for students to be successful at all levels through high-quality, innovative programs.
- Collaborate with institute, industry, and society to address current issues through research and align curriculum.
- Involve in societal outreach programs to identify concerns and provide sustainable ethical solutions.
- Encourage life-long learning and team-based problem solving through an enabling environment.

Vision of the Department:

To develop engineers of par excellence to meet the ever-changing requirements of industries, motivated towards innovation, entrepreneurship and research in mechanical and allied engineering along with strong human values and ethics for the benefit of society and nation at large.

Mission of the Department:

1. To offer a platform to the students where they will be able to groom themselves technically as industry ready professionals.
2. To develop research environment where students will be motivated to enhance their knowledge to undertake research in mechanical and allied engineering.
3. To collaborate with industries, education institutes of excellence and aluminus to share and exchange latest technology and innovation.
4. To design curriculum to motivate and sensitize students towards environmental issues and respect for human values and ethics.
5. To develop conducive academic environment in the department to attract qualified faculties members from all around the country.

Department of Mechanical Engineering

Program Education Objectives (PEOs)

PEO_{01} To provide advanced knowledge for finding solutions of complex practical problems.

PEO_{02} To develop research acumen for designing a system with better efficiency and performance.

PEO_{03} To prepare students as experts with better communication skills, professional ethics and team spirit for working in multidisciplinary teams

Department of Mechanical Engineering

PROGRAMMEOUTCOMES(POs)

PO_{01} **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO_{02} **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO_{03} **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate considerate on for the public health and safety, and the cultural, societal, and environmental considerations.

PO_{04} **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO_{05} **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO_{06} **The engineer and society**: Apply reasoning in formed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO_{07} **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO_{08} **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO_{09} **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multi disciplinary settings.

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

PO_{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 multi disciplinary environments.

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

Department of Mechanical Engineering

PROGRAMMESPECIFICOUTCOMES(PSOs)

PSO_{01} Implement the knowledge in industrial automation through specialization in CAD/CAM and Mechatronics.

PSO_{02} Develop cost effective and sustainable energy solutions for industry and society at large through specialization in Energy Technology.

PSO_{03} Implement the knowledge in improving industrial productivity through specialization in industrial and production engineering.

Semester I

S.No.	Course Code	Course Name	L	T	P	Credits
1	EN3BS11	Engineering Mathematics-I	3	0	0	3
2	EN3BS13	Engineering Physics	3	0	2	4
3	EN3ES17	Basic Electrical Engineering	3	0	2	4
4	EN3NG01	Environmental Science*	2	0	0	2
5	EN3ES19	Engineering Graphics	2	0	2	3
6	EN3ES21	Programming-I	0	0	4	2
7	EN3ES01	Basic Civil Engineering	3	0	2	4
		Total	**16**	**0**	**12**	**20**
		Total Contact Hours	**28**			

Semester II

S.No.	Course Code	Course Name	L	T	P	Credits
1	EN3BS12	Engineering Mathematics-II	3	0	0	3
2	EN3BS14	Engineering Chemistry	2	0	2	3
3	EN3ES18	Basic Mechanical Engineering	3	0	2	4
4	EN3ES22	Programming-II	0	0	4	2
5	EN3HS02	Communication Skills	2	0	2	3
6	EN3ES16	Basic Electronics Engineering	3	0	2	4
7	EN3ES20	Engineering Workshop - I	0	0	2	1
8	EN3HS01	History of Science & Technology	2	0	0	2
		Total	**15**	**0**	**14**	**22**
		Total Contact Hours	**29**			

SEMESTER – III

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	EN3BS15	Engineering Mathematics -III	3	0	0	3
2	ME3CO18	Manufacturing Processes - I	3	0	0	3
3	ME3CO19	Mechanics of Materials	4	0	0	4
4	ME3CO20	Engineering Thermodynamics	4	0	0	4
5	ME3CO21	Sensors and Control	3	0	2	4
6	ME3CO22	CAD LAB-I	0	0	2	1
7	ME3CO23	Materials and Material Testing Lab	0	0	2	1
8	ME3CO24	Python Programming for Mechanical Engineers -I	0	0	2	1
9	EN3ES25	Engineering Materials	3	0	0	3
10	EN3NG03	Soft Skills -I	2	0	0	2
		Total	**22**	**0**	**8**	**24**
		Total Contact Hours	**30**			

SEMESTER – IV

Sr. No.	Course Code	Course Name	L	T	P	Credits
1	ME3CO25	Manufacturing Processes- II	3	0	2	4
2	ME3CO26	Python Programming for Mechanical Engineers -II	0	0	2	1
3	ME3CO27	Fluid Mechanics and Machinery	3	0	2	4
4	ME3CO28	Kinematics of Machines	3	0	2	4
5	ME3CO29	CAD LAB-II	0	0	2	1
6	EN3HS04	Fundamentals of Management, Economics & Accountancy	3	0	0	3
7	ME3PC04	Mini Project -I	0	0	4	2
8	EN3NG02	Universal Human Values & Professional Ethics	2	0	0	2
9	EN3NG04	Soft Skills -II	2	0	0	2
		Total	**16**	**0**	**14**	**19**
		Total Contact Hours	**30**			

SEMESTER – V

Sr. No.	Course Code	Course Name	L	T	P	Credits
1	ME3CO30	Industrial Engineering & Operations Research	3	0	0	3
2	ME3CO31	Data Science for Mechanical Engineers	2	0	2	3
3	ME3CO32	Heat & Mass Transfer	4	0	0	4
4	ME3CO33	Design and Simulation Lab -I	0	0	2	1
5	ME3CO34	Dynamics of Machine	4	0	2	5
6	ME3CO35	Thermal Lab	0	0	2	1
7		Program Elective - I	3	0	0	3
8		Program Elective - II	3	0	0	3
9		Open Elective I	3	0	0	3
		Total	**22**	**0**	**8**	**26**
		Total Contact Hours	**30**			

SEMESTER – VI

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	ME3CO36	Computer Integrated Manufacturing	4	0	0	4
2	ME3CO37	Refrigeration & Air Conditioning	3	0	2	4
3	ME3CO38	Design and Simulation Lab -II	0	0	2	1
4	ME3CO39	Machine Design	4	0	0	4
5		Program Elective - III	3	0	0	3
6		Program Elective - IV	3	0	0	3
7		Open Elective II	3	0	0	3
8	ME3PC05	Mini Project -II	0	0	4	2
9	EN3NG10/EN3NG11/EN3NG12/EN3NG13/EN3NG14	Sports/Club Activities/NSS/NCC/Yoga	0	0	2	1
		Total	**20**	**0**	**10**	**24**
		Total Contact Hours	**30**			

SEMESTER – VII

Sr. No.	Course Code	Course Name	L	T	P	Credits
1		Program Elective - V	3	0	0	3
2		Program Elective - VI	3	0	0	3
3		Open Elective- III	3	0	0	3
4	ME3PC06	Minor Project	0	0	8	4
5	ME3PC03	Industrial Training	0	2	0	2
6	EN3NG06	Open Learning courses	1	0	0	1
10	EN3NG10/EN3NG11/EN3NG12/EN3NG13/EN3NG14	Sports/Club Activities/NSS/NCC/Yoga	0	0	2	1
		Total	**10**	**2**	**8**	**15**
		Total Contact Hours	**20**			

SEMESTER VIII

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	ME3PC07	Major Project	0	0	20	10
		Total	**0**	**0**	**20**	**10**
		Total Contact Hours	**20**			

Summary of Credits

S.NO	Course Work	Total Credits (CS)	Credits as per Modal scheme (176)
1	Basic Sciences (BS)	16	10-15% (16-24)
2	Engineering Sciences (ES)	27	15-20% (24-32)
3	Humanities and Social Sciences (HS)	8	5-10% (8-16)
4	Core (CO)	62	30-40% (48-64)
5	Program Electives (EL)	18	10-15% (16-24)
6	Open Electives (OE)	9	5-10% (8-16)
7	Project Work, Industrial Training (PC)	20	10-15% (16-24)
8	Non Grading (NG)	11	
		171	

Batch 2021-2025
Scheme (2021-25 Batch)

SEMESTER I

SNo.	Course Code	Courses	L	T	P	Credit
1	EN3BS11	Engineering Mathematics-I	3	0	0	3
2	EN3BS13	Engineering Physics	3	0	2	4
3	EN3ES17	Basic Electrical Engineering	3	0	2	4
4	EN3NG01	Environmental Science*	2	0	0	2
5	EN3ES19	Engineering Graphics	2	0	2	3
6	EN3ES21	Programming-I	0	0	4	2
7	EN3ES01	Basic Civil Engineering	3	0	2	4
		Total	**16**	**0**	**12**	**22**
		Total Contact Hours	**28**			

* Non-gradial Courses

Course Code	Course Name	Hours per Week				
		L	T	P	Credits	
EN3BS11	Engineering Mathematics-I	3	0	0	3	

Course Learning Objectives (CLOs):

CLO_{01} To impart analytical ability of using concepts of matrices in various fields of engineering.

CLO_{02} To explain the concept of Differential Calculus.

CLO_{03} To discuss the concept of Integral Calculus and its applications.

CLO_{04} To impart analytical ability in solving Ordinary Differential Equations of first and Higher order.

CLO_{05} To impart basics of complex number and variables including concepts of analytical functions.

Unit-I- Matrices and Linear Systems

Rank and Nullity of a Matrix by reducing it into Echelon and Normal Forms, Solution of Simultaneous equations by elementary transformation methods, Consistency and Inconsistency of Equations, Eigen Values and Eigen Vectors.

Unit-II- Differential Calculus

Introduction to limit continuity, differentiability, Rolle's theorem, Mean value theorem, Taylors and Maclaurin's series expansions. Functions of Several variables, Partial differentiation, Euler's Theorem, Total Derivative, Maxima and Minima of function of two variables.

Unit-III- Integral Calculus

Definite Integral as a limit of sum and its application in summation of series, Beta and Gamma functions (Definitions, Relation between Beta and Gamma functions without proof, Duplication formula without proof). Multiple Integral (Double and Triple Integrals), Change the Order of Integration, Applications of Multiple Integral in Area, Volume.

Unit-IV- Ordinary Differential Equations

First order differential equations (Separable, Exact, Homogeneous, Linear), Linear differential Equations of second and higher order with constant coefficients**,** Homogeneous linear differential equations, Simultaneous linear differential equations**.**

Unit-V-Complex Variable

BasicsofComplexnumber,Functionsofcomplexvariable:Analyticfunctions,HarmonicConjugate functions, Cauchy-Riemann Equations, Complex Line Integral, Cauchy's Theorem, Cauchy's Integral Formula.

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, New Delhi.
2. H.K. Dass,*HigherEngineeringMathematics,S.Chand&CompanyPvtLTD.,NewDelhi*

References:

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Pub.Co.Ltd., NewDelhi.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley& Sons.
3. R.K. Jainand S.K.Iyengar, Advanced Engineering Mathematics, Narosa Pub. House, New-Delhi.

Web Source:

1. http://nptel.ac.in/courses/111108066/
2. http://nptel.ac.in/courses/111104085/
3. https://swayam.gov.in/courses/public
4. http://nptel.ac.in/course.ph

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} To illustrate the tools of matrices in solving the system of simultaneous equations,

CO_{02} To investigate the tools of differential calculus to relevant fields of engineering and can implement the concept of several variables.

CO_{03} To relate the integral calculus to relevant fields of engineering and can translate the concept of multiple integrals in finding area of regions and volume of solids.

CO_{04} To solve Ordinary Differential Equations using different methods.

CO_{05} To relate the knowledge of complex number and categorize it in solving functions of several complex numbers.

Course Code	Course Name	Hours per Week			
		L	T	P	Credits
EN3BS13	Engineering Physics	3	0	2	4

Course Learning Objectives (CLOs):

CLO_{01} They will be able to understand the concept of Laser devices.

CLO_{02} An ability to understand the phenomena occurs in optical fibre.

CLO_{03} Students came to know about the optical phenomenon like Interference, diffraction, and polarization with their use in daily life.

CLO_{04} They will be able to learn about the quantum physics.

CLO_{05} They will be able to understand the concept of modern physics

CLO_{06} An ability to recognise the crystal structure and their basics.

CLO_{07} An ability to adapt the classical concept of oscillations.

CLO_{08} They will be able to use the acoustics nature in practical applications.

CLO_{09} Students learn the advanced concept of the superconductivity.

Unit-ILaser and Fibre Optics

Lasers: Properties of lasers, Spontaneous and Stimulated emission of radiation, Einstein's A & B co-efficient, Population inversion, Components of Laser, Ruby Laser, He-Ne Laser, Engineering applications of lasers. Fibre Optics: Fundamental idea about optical fibre, propagation of light through optical fibre acceptance angle, numerical aperture, fractional refractive index changes, V number, Classification of fibre, Engineering applications of fibre.

Unit-II Wave Optics

Interference: Fresnel's biprism experiment, Newton's ring experiment. Diffraction of light: Fraunhofer diffraction for single slit, N-slits diffraction (grating), Missing orders and Rayleigh criterion of Resolution. Polarization: General concept of Polarization, double refraction, Engineering Applications of Polarization.

Unit-III Quantum mechanics

Limitations of Classical Mechanics, De-Broglie hypothesis for matter waves, Phase and group velocity, wave packet, Heisenberg's uncertainty principle, Compton scattering, wave function, Schrodinger's Time dependent and time independent wave equation, Particle in a box problem.

Unit-IV Solid State Physics

Crystal Physics: Unit cell, Crystal System, Types of Unit cell: Simple cubic, Face centered cubic, Body centered cubic Crystal, Number of atoms per unit cell, Packing fraction in different cubical lattices, Miller indices. Band theory of solids: Free Electron model, Band Model, Fermi level for Intrinsic and Extrinsic Semiconductors, Hall effect. Superconductivity: Zero resistance, persistent currents, superconducting transition temperature (Tc), Meissner effect, Type-I and Type-II superconductors, Engineering applications of superconductivity.

Unit- V Oscillations and acoustics

Oscillations: Concept of Simple, Periodic & harmonic Oscillation with illustrations; Differential equation of harmonic oscillator; Kinetic and potential energy of Harmonic Oscillator, compound

pendulum. Acoustics: Introduction, Reverberation, Sabine's Formula, Eyring's Formula, Absorption Coefficient, Conditions for good acoustical design, Production and detection of ultrasonic waves and their applications.

Textbooks:

1. A Text book of Optics, N. Subramanyam and Brij Lal, S. Chand , New Delhi, 2010 .
2. Engineering Physics, H. K. Malik and A. K. Singh, Tata McGraw Hill New Delhi, 2010
3. Concepts of Modern Physics A. Beiser, Tata McGraw Hill New Delhi.
4. Engineering Physics, Gaur and Gupta, Dhanpat Rai Publications.

References:

1. An Introduction to Lasers- Theory and Applications. Dr. M N. Avadhanulu, Dr. R. S. Hemne S. Chand Publications.
2. Optics, A. Ghatak: 4th Edition, Tata McGraw-Hill, New Delhi 2009.
3. An Introduction to Fiber Optics, Ghatak and Thiagarajan, Cambridge University Press.
4. Solid State Physics by Kittel, Wiley India
5. A Text book of Physics – N. Gupta & S.K. Tiwary, Dhanpat Rai & Co., Delhi
6. Quantum Mechanics by Ghatak &Loknathan, Macmillian India Ltd-new Delhi Revised Edition 2019.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01}	Understand and analyse the different types of lasers and optical fibres, operation, and its characteristics.
CO_{02}	Understand and apply various phenomenon of Interference, diffraction and polarization and their applications.
CO_{03}	Understand and apply the concept of Quantum Mechanics.
CO_{04}	Understand and examine the crystal structures and acquire the basic knowledge of various semiconductor devices.
CO_{05}	Evaluate and apply the applications of superconductivity in technology and real world.
CO_{06}	Apply basic concepts of oscillations in harmonic oscillator and compound pendulum.
CO_{07}	To analyse and design acoustics applications.

List of Practical's

List of suggestive core experiments (Any 10 experiments from the list of 16)

Laser and Fiber Optics

1. To measure the beam divergence and beam waist of laser beam.
2. To measure the numerical aperture of an optical fiber by scanning method.
3. To find the thickness of thin wire using laser.
4. To study the working of laser using PhET simulation module.
5. To establish a fiber optic analog link and study of bending loss in optical fiber.

Wave Optics

6. To determine the radius of curvature of plano convex lens using Newton's ring experiment.
7. To determine wavelength of spectral lines of mercury vapor lamp with the help of grating an spectrometer.
8. To determine the specific optical rotation of sugar solution by biquartz polarimeter.

9. To determine the wavelength of given sodium vapor lamp using Fresnel's Biprism.

Quantum Mechanics

10. Determination of Planck's constant (h) using light emitting diode (LED) of various colors.
11. To study black body Radiation by PhET Simulation.

Solid State Physics

12. To study the Hall Effect experiment and calculate the charge carrier concentration (density) of given semiconductor diode.
13. To determine the energy band gap of semiconductor diode.
14. To study V-I characteristics of semiconductor diode and Zener diode.

Oscillations and Acoustics

15. To find the frequency of AC Mains using Melde's method in longitudinal and transverse arrangement.
16. To determine the value of acceleration due to gravity (g) using compound pendulum

Course Code	Course Name	Hours per Week			
		L	T	P	Credits
EN3ES16	Basic Electronics Engineering	3	0	2	4

Course Learning Objectives (CLOs):

CLO_{01} To learn the basics of semiconductor materials and their usage in variety of PN junction diodes and applications of diodes

CLO_{02} To study transistor in different modes of configuration and basic biasing techniques, FET.

CLO_{03} To study of the fundamental concepts and various types of analog communication systems

CLO_{04} To study of the concept of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.

CLO_{05} To learn about basic Measurement & Instrument components.

Unit-I SEMICONDUCTORDIODE

Semiconductor basics, PN Junction diode construction & working, Volt-amp characteristics, Diode current equation, Halfwave rectifier, Full wave rectifier: Bridge and center tapped rectifier, Clipper and Clamper. Zener diode and Zener diode-based voltage regulator, LED

Unit-II BIPOLARJUNCTION TRANSISTOR

Construction and working of transistor, characteristics of transistor, transistor as an amplifier and switch, transistor configurations, transistorbiasingandbiasingmethods,basicamplifierconfigurations,Basic principle and working of FET and MOSFET

Unit-III BASICS OFCOMMUNICATION SYSTEMS

Block schematic of communication system, Simplex and duplex systems, Modes of communication: Broadcast and point to point communication, Necessity of modulation, Classification of modulation: Amplitude, phase, frequency modulation, sampling theorem and pulse amplitude modulation.

Unit-IV DIGITALSYSTEM

Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes –Binary, BCD, Excess 3, Gray, Boolean theorems, Minterms and Maxterms, Sum of products andproductsofsums,KarnaughmapMinimization,Logicgates:NOT,AND,OR,NAND,NOR,EX-OR and

EX-NOR, half adder and full adder. Function and Structure of a Computer System, VonNeumann Architecture, and modern computers.

Unit-V ELECTRONICSMEASUREMENT

Introduction,BasicsofMeasurements,Ammeter,Voltmeter,multimeter,SignalGenerators,Cathode Ray Oscilloscope: Block diagram of CRO, Construction of CRT, Deflection sensitivityandvarious controls,Measurement ofvoltage, currentfrequencyandphaseangleusingCRO

Textbooks:

1. MillmanandHalkias: Integrated electronics, TMH.
2. Droy Choudhury, Digital Electronics, Vol-I&II, TMH Publication.
3. A.K. Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai.
4. Simon Haykins, Communication System, John Willy.
5. AndrewS. Tanenbaum, StructuredComputerOrganization,UpperSaddleRiver.

References:

1. Sedra and Smith: Microelectronics, Oxford Press.
2. Millman and Taub, Pulse, Digital and Switching Waveforms, MGM.
3. A.Anand Kumar: Digital Circuits, PHI.
4. Salivahanan: Electronic Circuits Analysis and Design, TMH
5. Boylestad and Nashelsky: Electronic Devices and Circuit Theory, Pearson Education.
6. B.P.Lathi, Modern Digital & Analog Communication System, TMH

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} Should have the knowledge of basic semiconductor materials and their usage in variety of PN junction diodes and applications of diodes

CO_{02} Should be able to understand the concept operation of transistors and its configuration.

CO_{03} Understand and identify the fundamental concepts and various components of analog communication systems

CO_{04} Should have the knowledge of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.

CO_{05} Should have understood the basics of Measurement & Instrument components.

List of Experiments:

1. To verify V-I characteristic of semiconductor & Zener diode.
2. To verify input and output waveform of half wave rectifier.
3. To verify input and output waveform of full wave rectifier.
4. To verify Input and output characteristic of BJT in CB and CE configurations.
5. Implementation of basic logic gates using Universal gates (NAND, NOR).
6. To verify half adder & full adder.
7. Study of computer system structure and main peripheral devices.
8. Study of Frequency Division Multiplexing with sinusoidal inputs / audio inputs.
9. Study of CRO and its demonstration kit.
10. Study of voltmeter and multimeter.

Course Code	Course Name	Hours per Week			
		L	T	P	Credits
EN3NG01	Environmental Science	2	0	0	2

Course Learning Objectives (CLOs):

CLO_{01} To impart knowledge of Environment and its basic components.

CLO_{02} To build basic understanding of various effects of human activities to the environment.

CLO_{03} To understand concepts of water pollution

CLO_{04} To understand function of solid waste management

CLO_{05} To learn concepts of disaster management

Unit-IEcosystem and Biodiversity

Concept of Ecosystem, Food Chains, Food Webs, Energy flow in an ecosystem.

Biodiversity**:** Introduction,Types, Significance and Conservation.

Unit-II Air Pollution

Causes, Effects and Control of Air Pollution, Greenhouse Effect - Climate changes and Global warming, Ozone layer depletion, Acid Rain.

Case studies on recent cases of air pollution and management.

Unit-III Water Pollution

Causes, Effects and Control of Water Pollution, DO, BOD and COD, Water sampling, Municipal water treatment.

Unit-IV Solid Waste Management

Introduction, Types of solid waste, Harmful effects of solid waste, Methods to manage and modern techniques for solid waste management.

Unit-V Disaster Management

Concept of Disaster, Types of Disaster, Pre-disaster risk and vulnerability reduction, Post disaster recovery and rehabilitation.

Case studies on recent disasters and management.

Textbooks:

1. Preeti Jain, S.L.Garg, K.G.Garg, Energy, Environment, Ecology and Society, Variety Publication.
2. Surinder Deswal, Environmental Science, Dhanpat Rai & Co. publication.
3. R. Rajgopalan , Environmental Studies, Oxford IBH Publication.

References:

1. G. M. Masters, Introduction to Environmental Science and Engineering, Pearson Education Pvt. Ltd.
2. K. De, Environmental Chemistry, New Age International.
3. Daniel D. Chiras, Environmental Science, Jones & Bartlett Ltd.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} Gain knowledge of Ecosystem & Biodiversity.

CO_{02} Develop basic understanding of air pollution and its control method

CO_{03} Develop basic understanding of water pollution and its control method

CO_{04} Gain knowledge of Solid waste management and its importance.

CO_{05} Gain knowledge of Disaster Management.

Course Code	Course Name	Total Hours per week			Total	
		L	T	P	Hours	Credits
EN3ES19	**Engineering Graphics**	**2**	**0**	**2**	**4**	**3**

Course Learning Objectives (CLOs):

CLO_{01} To familiarize with the construction of geometrical figures.
CLO_{02} To familiarize with the projection of 1D, 2D and 3D elements
CLO_{03} To familiarize with the projection and sectioning of solids.
CLO_{04} To familiarize with the Preparation and interpretation of building drawing.
CLO_{05} To familiarize with the Upgraded Drawing Software and their use.

Unit -I
Drawing scales: Engineering scale, graphical scale, plain scale, diagonal scale, scale of chord.
Orthographic Projections: Reference planes, types of orthographic projections–First angle projections, Third angle projections.

Unit-II
Projections of points: Including points in all four quadrants
Projections of lines: Line parallel to reference plane, perpendicular to reference plane, inclined to one reference plane, inclined to both reference planes, traces of line.

Unit-III
Projections of Planes: Projections of Planes in different Positions, Auxiliary planes, Auxiliary Vertical Plane (AVP), Auxiliary Inclined Plane (AIP)
Projection of Solids: Classification of solid. Projections in simple and complex positions of the axis of the solid.

Unit-IV
Sections of Solids: Sectional views and true shape of the section.
Isometric Projections: Isometric view, Isometric scale to draw Isometric projection, non-Isometric lines, construction of isometric view from given orthographic views and to construct Isometric view of a Pyramid, Cone, Sphere.

Unit V
Computer Aided Drawing (CAD): Introduction to AutoCAD **,**2D & 3D Basics, Modify & Draw Commands Using AutoCAD, Points, Lines planes and Solids and their projections.

Textbooks:

1. N.D. Bhatt, Elementary Engineering Drawing, Chartor Publishing House.
2. D. N. Johle, Engineering Drawing, Tata McGraw-Hill Publishing Co.Ltd.
3. P.S. Gill, Engineering Graphics, S.K. Kataria andSons.
4. Warren J. Luzzader, Fundamentals of Engineering Drawing, Prentice Hall of India, New Delhi.
5. F. E. Giesecke, A. Mitchell & others, Principles of Engineering Graphics, Maxwell McMillan Publishing.
6. K.C. John, Engineering Graphics for Degree, PHI Learning Pvt. Ltd.

Reference Books

1. Engineering Drawing- Basant Agarwal, TMH
2. D. M. Kulkarni, A. P. Rastogi, and A. K. Sarkar (2009), Engineering Graphics with AutoCAD, PHI Learning Private Limited, New Delhi
3. Venugopal (2010), Engineering Drawing and Graphics, 2nd edition, New Age Publications, New Delhi.
4. Trymbaka Murthy (2007), Computer Aided Engineering Drawing, I.K. International Publishers, New Delhi.
5. R.B. Choudary (2005), Engineering graphics with Auto CAD, Anuradha Publishers, New Delhi

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} Familiarize with different drawing equipment's and technical standards and Know purpose, procedures, materials and conventional symbols used. Create and read an engineering drawing using standard views and have ability to Convert pictorial (3D) drawings to orthographic (2-D) drawings and vice versa

CO_{02} Understand the projection of points, straight lines and have the ability to convert the practical problems in to projections

CO_{03} To understand and apply concepts of the projection of simple planes & solids.

CO_{04} Understand and apply the concepts of Projection & Sections of solids & development of surfaces

CO_{05} Convert simple 2D orthographic projections into 3D isometric projections with the help of auto cad commands

List of Experiments

Preparation of drawing sheets containing the drawings for topics covered in theory.

List of Drawing Sheets (Manual)

1. Orthographic Projections
2. Projections of points & Projections of straight lines
3. Projections of planes & Projections of solids
4. Projections of sections of solids & isometric projections
5. Drawing scales

List of CAD Sheets

1. To study about special features, advantages and applications of CAD in detail.
2. To study and practice basic draw commands, modifying commands exist in the CAD.
3. To construct a diagonal scale.
4. To draw orthographic projection of given pictorial views.
5. To construct the isometric views of given geometries.

Course Code	Course Name	Total Hours per week			Total	
		L	T	P	Hours	Credits
EN3ES21	Programming-I	0	0	4	**4**	**2**

Course Learning Objectives (CLOs):

CLO_{01} Analyse Basics of Computers, programming environment and about different types of Programming languages.

CLO_{02}Application of various basic concepts required to create programs, use good problem solving approach.

CLO_{03} Use different control structures for conditional programming.

CLO_{04} Use of Arrays and string in different problems and also to apply different operations on arrays and strings

CLO_{05} Use the functions and procedures to solve different problems..

Unit-IIntroduction to Computer and Problem Solving Methodology

Computer System, Computing Environments, Software, Types of Software and Features of Software. Design Tools (Algorithm, Flow-Chart, Pseudo-Code).Types and Generations of Programming Languages. Compiler, Interpreter, Linker, Loader, Execution of Program. Develop an Algorithm for Simple Problems.

Unit-IIBasics of Language

Character set, Identifier, Keywords, Constants, Data Types, Preprocessor Directives, Variables and Declaration, White Space and Escape Sequence, Operators and Expressions, Type Conversions, Operator Precedence and Associativity, Expression Evaluation, Input and Output Functions. Computational Problems Solving Based on above Constructs.

Unit-III Control Statements

Selection (If, Else), Conditional Operator, Iteration (For, While, Do-While), Branching (Switch, Break, Continue, Goto), Nesting of Control Statements. Problem Solving Based on Control Statements.

Unit-IV Arrays and Strings

Defining an Array, One Dimensional Array, Two Dimensional Array, Multi-Dimensional Array. Basic Array Operations and Matrix Manipulation Operations (Addition, Subtraction, and Multiplication).Problem Solving Based on Array.

Strings Definition, String Operations and String Functions. Problem Solving Based on Strings.

Unit-VFunctions

Introduction, Functions Declaration, Definition, Calling, Return Statement, Parameter Passing (By Value), Recursion, Library Functions. Problem Solving Based on Functions.

Text Books:

1. Herbert Schildt, C: The complete Reference, Fourth Edition, Mc-GrawHill.
2. R. Sethi, Programming Language Concepts and Constructs, Pearson Education.

3. V. Rajaraman, Computer Programming in 'C',PHI.
4. M. Sprankle, Programming and Problem Solving, Pearson Education.
5. R.G. Dromey, How to solve it by Computer, Pearson Education.
6. E. Balguruswamy, Programming in ANSI C by, Tata Mc-GrawHill.
7. Yashavant Kanetkar, Let Us C, BPB.
8. E.Balagurusamy, Fundamentals of Computers, TMH.

References:

1. Kernighan and Ritchie , The 'C' programming language, PHI
2. Programming With C, Schaum Series.
3. A. N. Kamthane, Programming with ANSI and Turbo C, Pearson Education.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} Understand Basics of Computers and Programming languages.

CO_{02} Understand basic concepts of C programming language required to create programs.

CO_{03} Apply different types of control structures in problem solving.

CO_{04} Use of Arrays and string in different problems and also to apply different operations on arrays and strings.

CO_{05} Apply and use the functions and procedures to solve different problems.

List of Practical

1. Write a program to print hello user on output screen.

2. Write a program to perform arithmetic operation on two numbers.

3. Write a program to find sum of individual digits of any three digits number.

4. Write a program to print any three digit number in reverse order.

5. Write a program to swap any two numbers using third variable and without using third variable.

6. Write a program to check given number is even or odd.

7. Write a program to check given char is vowel or consonant.

8. Write a program to check given number is positive or negative.

9. Write a program to check given year is leap year or not.

10. Write a program to check given number in range of 100-200 or not.

11. Write a program to check given number is palindrome or not.

12. Write a program to print grade of student on the basis of percentage:

a. If per greater than or equal to 75 ➔ A grade
b. If per between 60-75 ➔ B grade
c. If per between 50-60 ➔ C grade
d. If per between 40-50 ➔ D grade
e. If per less than 40 ➔ Fail

13. Write a program for addition subtraction multiplication division using switch case.

14. Write a program to print table of any number.
15. Write a program to calculate factorial of any number.
16. Write a program to print series of alphabet.
17. Write a program to print Fibonacci series.
18. Write a program to check given number is perfect or not
19. Write a program to check given number is prime or not.
20. Write a program to check given number is Armstrong or not
21. Write a program to print number in word in between 1-5. Like (1 =one)
22. Write a program to check given char is vowel or consonant.
23. Write a program to print name of month according to number.
24. Write a program for convertor

a. For currency convertor
b. For temperature convertor
c. For weight convertor
d. For length convertor
e. For time convertor
f. For energy convertor

25. Write a program to print series of number from 1-100 without using loop.
26. Write a program to find maximum & minimum number from array.
27. Write a program to check how many numbers is prime & not prime in a list
28. Write a program to check how many digits at each index of array.
29. Write a program to check (search) given number is present or not present in list.
30. Write a program to arrange (sort) array elements in ascending or descending order.
31. Write a program to print a 2*2 matrix.
32. Write a program to find sum of two matrix.
33. Write a program to find multiplication of two matrix.
34. Write a program of string functions.
35. Write a function to find sum of two numbers.
36. Write a function to calculate factorial of any number.
37. Write a function for call by value to find sum of two numbers.

38. Write a function to pass an integer array as an arguments and find sum of array elements

39. Write a function to pass a char array as an argument and find length of string.

40. Write a recursive function to calculate factorial of any number.

41. Write a program to find the no of char no of word and no of lines from given text input.

Course Code	Course Name	Hours per Week			
		L	T	P	Credits
EN3ES01	Basic Civil Engineering	3	0	2	4

Course Learning Objectives (CLOs):

CLO_{01} To give the knowledge of various building and general construction materials such as bricks, stones, timber, cement, steel and concrete & their properties and application.

CLO_{02} To provide basic understanding of the forces and its components, stresses, strains and the modulus of elasticity of the different construction materials.

CLO_{03} To understand the components of the building such as beams, columns, foundations, slabs and different types of soils and their bearing capacities.

CLO_{04} To provide basic knowledge about principles of surveying for a location, and its application in execution of engineering projects, various instruments used for surveying such as chains, tapes, compass, theodolite and auto level.

CLO_{05} To understand various aspects of structural members and application of loads, shear force & bending moment in the field of civil engineering.

UnitI Building Construction Material

Role of Civil Engineer in the construction of buildings, dams, expressways, and infrastructure projects for 21st century. Importance of an inter- disciplinary approach in engineering Building Materials: Bricks composition, classifications, properties and uses. Stone classification of rocks, quarrying, and Dressing properties uses. Timber properties uses plywood. Cement: grades, types, properties, uses. Steel: types, mild steel, medium steel, hard steel, properties, uses, market forms. Concrete: grade designation, properties, uses.

UnitII Surveying and levelling

Surveying-classification, general principles of surveying–Basic terms and definitions of chain, Chain survey, Compass survey and Levelling, Uses of surveying, Contours their characteristics and uses.

UnitIII Building Components

Site selection, General Classification and building components. Soils: types and bearing capacity of soils, Foundation: functions and classifications. Flooring: requirements and selection types, Roof - types and requirements.

UnitIV Forces & Properties of Material

Forces and its components, Resolution and summation of forces, Lami's Theorem, Stress, Strain types, Hook's law, Three moduli of elasticity, poisons ratio, relationship, factor of safety.

UnitV Shear force and Bending moment

Introduction of shear force and bending moment and their sign conventions, Types of loads, Types of beams, Types of supports; Shear force and bending moment diagrams for simply supported, overhang and cantilever beams subjected to any combination of point loads, uniformly distributed load and point moment; Relationship between load, shear force and bending moment.

Text Books

1. S.C. Rangwala, Building materials, Charotar Publishing House, Pvt. Limited.
2. S.Ramamrutham , Basic Civil Engineering and Engineering Mechanics, Dhanpat Rai.
3. K.K.Dwivedi& K.K. Shukla, Basic Civil Engineering & Engineering Mechanics, Dhanpat Rai & Co.(Revised).

References

1. I.K.V.B. Raju and P.T. Ravichandran, Basics of Civil Engineering, Ayyappa Publications, Chennai.
2. S.Gopi, Basic Civil Engineering, Pearson Publishers.
3. M.S. Palanichamy, Basic Civil Engineering, Tata Mc Graw Hill

Course Outcomes (COs):
After completion of this course the students shall be able to:

CO_{01} Students will be able to recognize the civil engineering works and conversant about different construction materials and their uses.
CO_{02} Student will be able to differentiate force, pressure and stresses.
CO_{03} Students will be able to know the different building component and its importance.
CO_{04} Students will be conversant about vertical and horizontal variation of different terrains.
CO_{05} Students will be able to apply the theoretical knowledge about structural elements in practical manner.

List of Experiments

1. To determine particle size distribution & fineness modulus of coarse and fine aggregates.
2. To determine standard consistency of cement paste. -
3. To determine initial and final setting times for cement by using Vicat's apparatus.
4. To determine the workability of fresh concrete of given proportion by slump cone test.
5. To determine the area of land by chain surveying.
6. To perform traverse surveying with prismatic compass check for local attraction and determine corrected bearing and to balance the traversing by Bowditch'srule.
7. To perform levelling by height of Instrument method.
8. To perform levelling by rise and Fall method.
9. To perform Plane Table Surveying work by (A) Radiation method and (.B) Intersection methods.
10. To measure horizontal and vertical angle sin the field by using Theodolite.

SEMESTER II

Sr. No.	Course Code	Courses	L	T	P	Credit
1	EN3BS12	Engineering Mathematics-II	3	0	0	3
2	EN3BS14	Engineering Chemistry	2	0	2	3
3	EN3ES18	Basic Mechanical Engineering	3	0	2	4
4	EN3ES22	Programming-II	0	0	4	2
5	EN3HS02	Communication Skills	2	0	2	3
6	EN3ES16	Basic Electronics Engineering	3	0	2	4
7	EN3ES20	Engineering Workshop – I	0	0	2	1
8	EN3HS01	History of Science and Technology	2	0	0	2
		Total	**15**	**0**	**14**	**22**
		Total Contact Hours	**29**			

Course Code	Course Name	Hours per Week				
		L	T	P	Credits	
EN3BS12	Engineering Mathematics-II	3	0	0	3	3

Course Learning Objectives (CLOs):

CLO_{01} To illustrate knowledge of Laplace Transform and investigate its application.

CLO_{02} To explain the concept of Fourier Series and Fourier Transform.

CLO_{03} To illustrate the concept of Partial Differential Equations.

CLO_{04} To impart the knowledge of Vector Calculus.

CLO_{05} To discuss numerical methods and to outline its application in solving algebraic, transcendental equations and system of linear equations.

UnitILaplaceTransform

Introduction of Laplace Transform, Laplace Transform of elementary functions, properties ofLaplace Transform, Inverse Laplace transform and its properties, Convolutiontheorem,ApplicationsofLaplaceTransformtosolvetheOrdinaryDifferentialEquation,Laplacetransformof Unit step function andImpulsefunction.

UnitIIFourierSeries andFourierTransform

Introduction of Fourier series, Fourier series for Discontinuous functions, Fourier series for EvenandOdd function,Half rangeseries,FourierTransform, Sineand Cosine Transform.

UnitIIIPartialDifferentialEquations

Definition,Formulation,SolutionofPartialDifferentialEquations(ByDirectIntegrationMethodandLagrange'sMethod),Non-LinearPartialDifferentialEquationsofFirstorder{StandardformI,II,III&IV),Charpit'smethod.Partial DifferentialEquationswithConstantCoefficients(HigherOrdersHomogeneous),Method of Separation of Variables.

Unit-IV-Vector Calculus

Scalar and Vector fields, Vector Differentiation, Laplacian operator, Gradient, Divergence andCurl,Lineandsurfaceintegrals,Green'stheorem,GaussDivergencetheorem,Stoke'stheorem.

Unit-V-Numerical Analysis

Errors and Approximations, Solution of Algebraic and Transcendental Equations (Regula Falsi,Newton-Raphson and Iterative methods), Solution of Simultaneous linear equations by GaussElimination,Gauss Jordan,Jacobi's and Gauss-SiedelIterativemethods.

Textbooks:

1. B.S.Grewal,*HigherEngineeringMathematics*,Edition-43,KhannaPublishers,NewDelhi.
2. H.K.Dass,*HigherEngineeringMathematics,S.Chand&CompanyPvtLTD.,NewDelhi*

References:

1. B.V.Ramana,HigherEngineeringMathematics,TataMcGrawHillPublishingCompanyLtd.,New Delhi.
2. ShantiNarayan,AtextbookofVectorCalculus, S.Chand&Co.,NewDelhi.
3. ErwinKreyszig,Advanced EngineeringMathematics,John Wiley& Sons1999.

WebSource:

1. nptel.ac.in/*courses*/*111103021*/15
2. nptel.ac.in/courses/111105035/22
3. https://swayam.gov.in/courses/public
4. http://nptel.ac.in/course.php

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO1-To impact mathematical models involving ordinary and partial differential equations with given boundary condition which is helpful in all engineering and research work.

CO2-To examine the general mathematical concepts required for the field regarding Laplace and Fourier Transform.

CO3-To compare and contrast importance of partial differential equations in physical problems.

CO4-To prioritize derivatives of vector- point functions, gradient functions, evaluate integral of functions over curves, surfaces and domains in two and three dimensional.

CO5-To examine numerical techniques and investigate its application in solving algebraic and transcendental equations.

Course Code	Course Name	Hours per Week			
		L	T	P	Credits
EN3BS14	Engineering Chemistry	2	0	2	3

Course Learning Objectives (CLOs):

CLO[01] To gain fundamental knowledge of the principles related to, so as to meet the challenging requirements of students in chemistry studies.

CLO[02] To attain awareness in students about current & new issues in the fields of chemistry.

CLO[03] To make students understand about the present needs without compromising on theability of future generations to meet their own needs for proper engineering, relevanteducation efficient management of resources.

CLO[04] To increase curiosity and give them awareness about practical knowledge of variouslaboratory methods among the students regarding the course.

Unit-I Lubricants

Introduction, Classification of lubricants, Mechanism of lubrication, Properties and Testing of lubricating oils (Flash and Fire point, Cloud and Pour point, Viscosity and Viscosity Index, Neutralization number, Saponification Number, Steam Emulsification Number, Aniline Point, Iodine Value), Numerical problems based on testing methods.

Unit -II Polymer

Introduction and Classification of polymer, Preparation, Properties andUses of the following- Polythene, PVC, Teflon, Nylon 66, Bakelite, Silicone resin, Natural and Synthetic Rubber, Vulcanization of Rubber, Biopolymers, Biodegradable polymers.

Unit -III New Engineering Materials

Introduction, Properties and Applications of - Superconductors, Optical Fiber, Fullerenes, Graphene, Carbon nanotubes, Nanowires.

Unit -IV Instrumental Techniques in Chemical Analysis

Spectroscopy, Electromagnetic spectrum, Beer &Lambert's Law and its limitations, Principle, Instrumentation and Applications of-UV-Visible Spectroscopy, IR Spectroscopy, Gas Chromatography.

Unit- V Electrochemistry

Concept of Enthalpy, Entropy and Free energy, EMF, Applications of EMF measurements, Corrosion- Definition, Types, Causes and Protection from corrosion.

TextBooks:

TextBooks:

1. Preeti Jain, Anjali Soni, Jeetendra Bhawsar, A text book of Engineering Chemistry, 1st edition, Manthan Publication
2. Preeti Jain, S L Garg, Engineering Chemisty, 4th edition, Variety Publication

3. Shashi Chawla, Engineering Chemistry, 11th edition, DhanpatRaiPublications

References:

1. P C Jain ,MonkaJain, Engineering Chemistry, Dhanpat RaiPublications.
2. S. S.Dara, A Text Book of Engineering Chemistry, S. Chand & Company.
3. B.Joseph, Environmental Studies, Tata McGrawHill.
4. A.K. De, Environmental Chemistry, New AgeInternational.
5. Shashi Chawla, Engineering Chemistry, Dhanpat RaiPublications.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO[01] To Understand the lubricants, their mechanism and practically analyze the properties oflubricants.
CO[02] Will acquire betterment in lifestyle by understanding the need of bio polymers in the current scenario and replacing synthetic polymers with its bio-polymer substitute.
CO[03] Will get familiarised with new engineering materials and their commercial applications.
CO[04] Will get knowledge of using instrumental techniques and their applications for determination of chemical structure of any compound.
CO[05] Identify various types of corrosion and methods to protect the metallic structures fromcorrosive environment.

List of Practicals:

Volumetric Analysis:

1.To determine Hardness of given water sample by Complexometrictitration.
2.To determine total and mixed Alkalinity of given water sample using phenolphthalein and methyl orange as indicator.
3.To determine strength of unknown FAS solution by Redox titration using N- Phenyl anthranilic acid as internal indicator.
4.To determine strength of unknown $CuSO_4$ solution by Iodometric titration using Starch as internal indicator.
5.To determine Chloride content of water sample by Mohr's method (Argentometrictitration).

Fuel Testing:

1.Todeterminemoisturecontentingivensampleofcoalbyproximateanalysis.
2.Todeterminevolatilecontentingivensampleofcoalbyproximateanalysis.
3.Todetermineashcontentingivensampleofcoalbyproximateanalysis.
4.To determine percentage carbon content of coal by proximate analysis.

Lubricant Testing:

1. To determine penetration number of grease by Cone Penetrometerapparatus.
2. To determine flash and fire point of given oil sample by Cleveland's open cup apparatus.
3. To determine flash point of given oil sample by Penskey Marten's close cup apparatus.
4. To determine flash point of given oil sample by Abel's Close-up apparatus.
5. To determine Steam emulsification number of given lubricant.
6. To determine Aniline point of given oil sample.
7. To determine Cloud and Pour point of given lubricating sample.
8. To study rate of change of viscosity with temperature of the given lubricating oil by means of Redwood Viscometerno.1
9. To study rate of change of viscosity with temperature of the given lubricating oil by means of Redwood Viscometer no.2.

Electrochemistry:

Variation of cell potential in $Zn/Zn^{2+}//Cu^{2+}/Cu$ with change in concentration of electrolytes ($CuSO_4$ or $ZnSO_4$) at room temperature.

Kinetics:

Effect of concentration and temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid.

Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hours	**Credits**
EN3ES18	**Basic Mechanical Engineering**	**3**	**0**	**2**	**5**	**4**

Course Learning Objectives (CLOs):

CLO_{01} To understand the properties of materials and their behavior with variation in temperature and Load. To understand different measuring instruments used in engineering applications.

CLO_{02} To understand the basic laws of thermodynamics and their applications in engineering, refrigeration cycles and properties of refrigerants.

CLO_{03} To understand Construction and Working of I. C. Engines.

CLO_{04} To understand Construction and Working of Steam Generators

CLO_{05} To understand the concepts of Centroid & Moment of Inertia and of plane areas and different theorems of moment of Inertia

Unit-I Materials & their mechanical properties

Classification of Engineering material and their mechanical properties, Composition of cast iron and carbon steels and their application. Stress-strain diagram, Hooks law and modulus of elasticity. Tensile, shear, hardness, and fatigue testing of materials.

Unit-II-Thermodynamics

Thermodynamic properties and systems, First of thermodynamics, thermal processes at constant pressure, volume. Second law of thermodynamic, enthalpy, entropy, heat engine, heat pump, refrigerator and their numerical.

Unit-III- I.C. Engines

Description and working of four stroke petrol engines, two stroke petrol engines, four stroke diesel engines and two stroke diesel engines, and its efficiency relative merits and demerits.

Unit-IV-Steam generators

Definition, Classification, general study of Cochran, Lancashire and Locomotive boilers, boilers mountings and accessories. Steam properties and boiler performance. Draught Classification, Calculation of Chimney height, boiler efficiency and numerical. Unit V: Centroid & Moment of Inertia Location of centroid and Moment of Inertia of plane areas, Perpendicular Axis and Parallel Axistheorems.

Unit V Centroid & Moment of Inertia

Location of centroid and Moment of Inertia of plane areas, Perpendicular Axis and Parallel Axis theorems.

Textbooks:

1. R.K. Rajput, Basic Mechanical Engineering, Laxmi Publication.
2. P.K. Nag, Engineering Thermodynamics, McGraw Hill.
3. R.K. Bansal, Engineering Mechanics, Laxmi publications.

References:

1. Anand K Bewoor, Vinay A Kulkarni, Ist edition, Metrology & Measurement, McGraw Hill.
2. Cengel and Boles, Thermodynamic, An Engineering Approach in S.I Unit, McGraw Hill.
3. S.S. Bhavikatti and K.G.Rajashekarappa, Engineering Mechanics, New age international limited.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} Students will be able to understand the engineering materials, their properties, Iron-Carbon Diagram and Stress-Strain Curve, Measuring Equipment's and Testing Machines.

CO_{02} Student will be thorough with the basic laws of thermodynamics and their applications in engineering also know about Refrigeration cycles and properties of refrigerants.

CO_{03} Students will be able to understand the construction and working of I.C. Engines .

CO_{04} Students will be able to understand the construction and working of Steam Generators

CO_{05} Students will be able to determine the Centroid & Moment of Inertia of areas/composite sections.

List of Experiments

1. Measurements using Vernier calliper& micrometer.
2. Measurements using dial gauges and combination set.
3. Measurements using slip gauges & sine-bar.
4. Tensile Testing of standard mild steel specimen on UTM.
5. To determine the hardness number by using Brinell Hardness Testing Machine.
6. Study of 2-stroke petrol and diesel engine.
7. Study of 4-stroke petrol and diesel engine.
8. Study of different type of boilers.
9. Study of different type of boilers mounting & accessories.
10. To find the centroid of different plane laminas.

Course Code	Course Name	Hours per Week			Total	
		L	T	P	Hours	**Credits**
EN3ES22	Programming-II	0	0	4	**4**	**2**

Course Learning Objectives (CLOs):

CLO_{01} Understand Pointer variables. Declaring and dereferencing pointer variables. Pointer Arithmetic. Accessing arrays, strings through pointers.

CLO_{02} Declaration and use structures, perform operations on structures, passing structures as function arguments. type defining structures.

CLO_{03} Use Function declaration, function definition, function call, Passing arguments to a function, by value, by reference. Scope of variable names, creation of header files

CLO_{04} Use calloc, malloc, realloc dynamic memory.

CLO_{05}Apply Input-output using files in C, Opening, closing and reading from files. Programming for command line arguments.

CLO_{06} Apply graphics functions to create pictorial representation and animations

Unit-I Pointers

Introduction to Pointers (Declaration and Initialization), Double Pointer, Pointers and Array, Pointers and Functions, Operations on Pointers.

Unit-II User Defined Data Types

Defining a Structure, Declaration of Structure Variables, Initialization of Structure Variables, Accessing Structure Members, Storage of Structures in Memory Array within a Structure, Array of Structure, Pointer Structure, Passing Structure to a Function, Structure within a Structure. Define Union, Structure versus Union, Working with Union, Initializing Union, Enumerated Data Type.

Unit-III Pre-processor and Memory Allocation

Pre-processor Directives, Macro and Macro Expansions, File Inclusions, Conditional Compilation, Stringification (#) and Token Passing Operator (##), Type Def, Command Line Argument, Dynamic Memory Allocation. malloc(), calloc(), realloc(), free(), Core Dump, Memory Leak, Dynamic 1D and 2D Arrays. Header Files and Their Creations.

Unit-IV File Handling

File Concept, File Pointer and File Handling Operations Using files in C, Buffer and Streams, Working with Text Files and Binary Files, File Operations using std. Library and System Calls, File Management I/O Functions, Random Access Files.

Unit-V Graphics Programming

C Header Files for handling graphics and initializing graphics mode, Understand Coordinate system, Function to Draw Lines,Circle, Arc, Ellipse, pieslice, sector, Rectangle, Bar, 3-D Bars & Polygon, Color Spraying: filling Ellipse, polygons and flooding the fills, Filling Styles and Patterns, Understand Animation, Function to create Animation, Traffic Light and Moving Car Simulation.

Text Books:

1. Herbert Schildt, C: The complete Reference, Fourth Edition, Mc-Graw Hill.
2. R. Sethi, Programming Language Concepts and Constructs, Pearson Education.
3. V. Rajaraman, Computer Programming in ‘C’, PHI.
4. M. Sprankle, Programming and Problem Solving, Pearson Education.
5. R.G. Dromey, How to solve it by Computer, Pearson Education.

6. E. Balguruswamy, Programming in ANSI C by, Tata Mc-Graw Hill.
7. Yashavant Kanetkar, Let Us C, BPB.
8. E. Balagurusamy, Fundamentals of Computers, TMH.
9. AL Stevens, C Database Development, MIS Press.

References:

1. Kernighan and Ritchie, The 'C' programming language, PHI.
2. Programming With C, Schaum Series.
3. A. N. Kamthane, Programming with ANSI and Turbo C, Pearson Education.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} Apply Pointers, Pointer Arithmetic and Accessing arrays, strings through pointers.
CO_{02} Use different user defined data types like structures, union and enum.
CO_{03} Understand and Use of dynamic memory allocation and preprocessor directives.
CO_{04} Use the concepts of file handing.
CO_{05} Use Graphics programming to draw and use different shapes.

List of Practical

1. Program to create, initialize, assign and access a pointer variable.
2. Program to swap two numbers using pointers.
3. Program to change the value of constant integer using pointers.
4. Program to print a string using pointer.
5. Program to count vowels and consonants in a string using pointer.
6. Program to find sum of elements of array using pointer.
7. Program to swap two numbers using pointers.
8. Compare strings using pointer
9. Find smallest number in array using pointer.
10. Find largest element in array using pointer.
11. Find sum of all matrix elements using pointer.
12. Program to create a pointer array store elements in it and display.
13. Program to demonstrate function pointers.
14. Program to perform Addition Subtraction Multiplication Division using array of function pointers.
15. Program to display details of student two (Name, roll no, marks) using structure.
16. Program to display details of employee using array of structure.
17. Program to access member of structures using pointers.
18. Program for passing structure to a function.
19. Program for returning a structure from a function.
20. Program to display details of student two (Name, roll no, marks) with the help of union.
21. Program to demonstrate the memory allocation in structure and union.
22. Program to demonstrate malloc and calloc.
23. Program to allocate memory of array at run time.
24. Program to print the day of week.

25. Program to print month of a year.
26. Program to calculate area of circle using macro.
27. Program to calculate area of circle using macro function.
28. Program to create a header file and use it in a program.
29. Program to demonstrate file operation.

a. Creating a new file
b. Opening an existing file
c. Closing a file
d. Reading from and writing information to a file

30. Program to count number of words, number of character and number of lines from a given text file.
31. Program in C to delete a specific line from a file.
32. Write a program in C to append multiple lines at the end of a text file.
33. Write a program in C to copy a file in another name.
34. Write a program in C to merge two files and write it in a new file.
35. Write a program in C to encrypt a text file.
36. Write a program in C to decrypt a previously encrypted file.
37. Write a program in C to remove a file from the disk.
38. Write a program to draw a circle and fill blue color in it.
39. Write a program to draw a rectangle with diagonal and fill different colors in both halves.
40. Write a program to move a circle using suitable annimations.
41. Write a program to implement traffic signal.

Write a pogram to simulate a moving car. Draw car using simple shapes like line, circle and polygon.

Course Code	Course Name	Hours per Week			
		L	T	P	Credits
EN3HS02	COMMUNICATION SKILLS	2	0	2	3

Course Learning Objectives (CLOs):

CLO_{01} To develop, enhance and demonstrate LSRW Skills.

CLO_{02} To enable students to acquire oral presentation skills.

CLO_{03} To prepare students to become more confident and active participants in all aspects of their undergraduate programs

CLO_{04} To enable students with good vocabulary, grammar and writing skills.

CLO5 To enable students to distinguish between general and technical communication and understand its importance

Unit-I

Grammar and Vocabulary Development: Applied Grammar and usage, Parts of Speech, Articles, Tenses, Subject-Verb Agreement, Prepositions, Active and Passive Voice, Clauses, modals, Reported Speech: Direct and Indirect, Sentence Structure, Punctuations, common errors.

Unit-II

Using Dictionaries and Thesaurus, Synonyms, Antonyms, Homophones, One Word Substitution, Affixation: Prefixes & Suffixes, Basic Grammar & Vocabulary Practice, Synonyms, Antonyms, Analogies, Sentence Completion, Correctly Spelt Words, Idioms, Proverbs, and Derivation from root words, Jargon, Scientific Jargon, Vocabulary Practice.

Unit-III

Developing Reading and Listening Skills: Reading Comprehension, Process, Active & Passive Reading, Reading Speed Strategies, Benefits of effective reading, notemaking, note - taking, Reading comprehension of technical material and SQ3R reading technique. Listening Skills: Meaning, process hearing and listening, types, barriers, importance.

Unit-IV

Developing Writing Skills: Planning, Drafting & Editing, Writing with style, rightwords selection, writing effective sentences, developing logical paragraphs, art of condensation, précis, essay, technical definition and technical description. Formal and Informal Letters: Letter to the Editors, Municipal corporation, Bank Managers etc.

Unit-V

Speaking Skills Oral Presentation: Preparation, Delivery using Audio – Visual Aids with stress on body language and voice modulations. (Topics to be selected by the Instructor.) Phonetic Symbols, Pronunciations.

Text Books:

1. P.C,Wren and N.D.V. Prasada Rao, High School English Grammar &Composition, S Chand and Co Pvt Ltd.
2. S. Kumar and P. Lata, English for Effective Communication, Oxford UP, NewDelhi.
3. A.J. Thompson and A. V. Martinet, A Practical English Grammar,Oxford UP, New Delhi.
4. U. S. Rai and S.M, Rai, Effective Communication, Himalaya Publishing House.

References:

1. A.C. Gimson, An introduction to the Pronunciation of English, ELBS.
2. S. Greenbaum, Thw Oxford English Grammer, Oxford University Press.
3. K.Mohan and M. Raman, Effective English Communication, Tata Mc-Graw Hill.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} The students will be able to enhance confidence in their ability to read, comprehend, organize, and retain written and oral information.

CO_{02} The students will be able to distinguish between general and technical communication and understand its importance

CO_{03} The students will be able to improve upon their language skills, communication skills, group discussion, and personality development and confidence level.

CO_{04} The students will be able to bridge the language gap which is vital to their success

CO_{05} Students will be able to communicate effectively.

List of Experiments (if applicable): List of Practicals:

- JAM
- Debates
- Role plays
- GDs
- Extempore
- Story writing
- Picture description
- Symposium
- Oral presentation
- Phonetics practice
- Book Reviews

Course Code	Course Name	Hours per Week			
		L	T	P	Credits
EN3ES16	Basic Electronics Engineering	3	0	2	5

Course Learning Objectives (CLOs):

CLO_{01} To learn the basics of semiconductor materials and their usage in variety of PN junction diodes and applications of diodes

CLO_{02} To study transistor in different modes of configuration and basic biasing techniques, FET.

CLO_{03} To study of the fundamental concepts and various types of analog communication systems

CLO_{04} To study of the concept of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.

CLO_{05} To learn about basic Measurement & Instrument components.

Unit-I SEMI CONDUCTOR DIODE
Semiconductor basics, PN Junction diode construction & working, Volt-amp characteristics, Diode current equation, Halfwave rectifier, Full wave rectifier: Bridge and center tapped rectifier, Clipperand Clamper. Zener diode and Zener diode-based voltage regulator, LED.

Unit-II BIPOLARJUNCTION TRANSISTOR
Construction and working of transistor, characteristics of transistor, transistor as an amplifier andswitch,transistorconfigurations,transistorbiasingandbiasingmethods,basicamplifierconfigurations,Basic principle and working of FET and MOSFET

Unit-III BASICS OFCOMMUNICATION SYSTEMS
Blockschematicofcommunicationsystem,Simplexandduplexsystems,Modesofcommunication:Broadcastandpointtopointcommunication,Necessityofmodulation,Classification of modulation: Amplitude, phase, frequency modulation, sampling theorem andpulseamplitudemodulation.

Unit-IV DIGITALSYSTEM
Number Systems – Decimal, Binary, Octal, Hexadecimal, 1‘s and 2‘s complements, Codes –Binary, BCD, Excess 3, Gray, Boolean theorems, Minterms and Maxterms, Sum of products andproductsofsums,KarnaughmapMinimization,Logicgates:NOT,AND,OR,NAND,NOR,EX-OR and EX-NOR, half adder and full adder. Function and Structure of a Computer System, VonNeumannArchitecture,and modern computers.

Unit-V ELECTRONICSMEASUREMENT
Introduction,BasicsofMeasurements,Ammeter,Voltmeter,multimeter,SignalGenerators,Cathode Ray Oscilloscope: Block diagram of CRO, Construction of CRT, Deflection sensitivityandvarious controls,Measurement ofvoltage, currentfrequencyandphaseangleusingCRO

Textbooks:
6. MillmanandHalkias: Integratedelectronics,TMH.

7. DRoyChoudhury, Digital Electronics, Vol-I&II, TMHPublication.
8. A.K.Sawhney,ACourseinElectricalandElectronicMeasurementsand Instrumentation,DhanpatRai.
9. SimonHaykins,CommunicationSystem,JohnWilly.
10. AndrewS.Tanenbaum,StructuredComputerOrganization,UpperSaddleRiver.

References:

7. Sedra and Smith: Microelectronics, Oxford Press.
8. Millman and Taub, Pulse, Digital and Switching Waveforms, MGM.
9. A.Anand Kumar: Digital Circuits, PHI.
10. Salivahanan: Electronic Circuits Analysis and Design, TMH
11. Boylestad and Nashelsky: Electronic Devices and Circuit Theory, Pearson Education.
12. B.P.Lathi, Modern Digital & Analog Communication System, TMH

Course Outcomes (COs):
After completion of this course the students shall be able to:

CO_{01} Should have the knowledge of basic semiconductor materials and their usage in variety of PN junction diodes and applications of diodes

CO_{02} Should be able to understand the concept operation of transistors and its configuration.

CO_{03} Understand and identify the fundamental concepts and various components of analog communication systems

CO_{04} Should have the knowledge of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.

CO_{05} Should have understood the basics of Measurement & Instrument components.

ListofExperiments:

11. To verify V-I characteristic of semiconductor & Zener diode.
12. To verify input and output waveform of half wave rectifier.
13. To verify input and output waveform of full wave rectifier.
14. To verify Input and output characteristic of BJT in CB and CE configurations.
15. Implementation of basic logic gates using Universal gates (NAND, NOR).
16. To verify half adder & full adder.
17. Study of computer system structure and main peripheral devices.
18. Study of Frequency Division Multiplexing with sinusoidal inputs / audio inputs.
19. Study of CRO and its demonstration kit.
    10 Study of voltmeter and multimeter.

Course Code	Course Name	Total Hours per week			Total	
		L	T	P	Hours	Credits
EN3ES20	**Engineering Workshop -I**	**0**	**0**	**2**	**2**	**1**

Course Learning Objectives (CLOs):

CLO_{01} To familiar with Lathe, Drilling, Milling and shaping machines.

CLO_{02} The basic law of physics and their utilization in engineering.

CLO_{03} To understand different primary manufacturing process.

CLO_{04} To understand different metal joining process.

CLO_{05} To identify different tools used in basic manufacturing process.

Unit-IIntroduction and Demonstration: - Introduction to various shops / sections andworkshop layouts. Safety norms to be followed in a workshop.
Carpentry Shop: Introduction of Tools & operations, Types of woods & their applications, Types of Carpentry tools and their uses, Carpentry Joints, carpentry operations such as marking, sawing, planning, chiseling, grooving, boring, joining, types of woods and carpentry hardware.

Unit-II Fitting Shop: Introduction of Tools & operations, Types of Marking tools & their uses, Types of fitting cutting tool & their uses, fitting operations such as chipping, filing, scraping, grinding, sawing, marking, drilling, tapping

Unit-III Foundry Shop: Pattern Making: Study of Pattern materials, pattern allowances and types of patterns. Core box and core print. Use and care of tools used for making wooden patterns.
Molding: Properties of good mould & Core sand, Composition of Green, Dry and Loam sand. Methods used to prepare simple green sand mould using single piece and split patterns.
BlackSmithy Shop: Use of various smithy tools. Forging operations: Upsetting, drawing down, Fullering Swaging and Cutting down.

Unit-IV: Welding Shop: Study and use of tools used for Brazing, Soldering, Gas & Arc welding. Preparing Lap & Butt joints using gas and arc welding methods, Study of TIG & MIG welding processes. Safety precautions.

Unit V: Machine Shop: Study of machine tools in particular Lathe machine (different parts, different operations, study of cutting tools). Demonstration of different operations on Lathe machine, Practice of Facing, Plane Turning, step turning, taper turning, knurling, and parting. Demonstration and applications of drilling machine, Demonstration of CNC Machines

Textbooks:

1. B.S. Raghuwanshi, Workshop Technology Vol. I & II, Dhanpath Rai & Sons.
2. R.S. Khurmi, Workshop Technology, S. Chand and Co.
3. S.K. Hajra Choudhary, A.K. Hajra Choudhary and Nirjhar Roy, Elements of Workshop Technology, vol. I Media promoters and Publishers Pvt. Ltd
4. R.K. Bansal, Engineering Mechanics, Laxmi publications.

Reference Books:

1. W. A.J. Chapman, Workshop Technology, 1998, Part -1, 1st South Asian Edition, Viva Book Pvt. Ltd.
2. P.N. Rao, 2009, Manufacturing Technology, Vol.1, 3rd Ed., Tata McGraw Hill Publishing Company.
3. Dr. S.K. Sinha , CNC programming — Golgotia publication.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} Understand the engineering materials, their properties, and their utilization in manufacturing tool and other equipment's.

CO_{02} Understand the primary manufacturing process.

CO_{03} Understand the basic operation involve in casting.

CO_{04} Understand the basic process of forging.

CO_{05} Basic knowledge of simple cutting, holding. Marking and striking tool.

Course Code	Course Name	Hours per Week			
		L	T	P	Credits
EN3HS01	History of Science and Technology	2	0	0	2

Course Learning Objectives (CLOs):

CLO_{01} To know the historical perspective of science and technology in India, its roots and its role.

CLO_{02} To know how research and development field is progressing in India.

CLO_{03} To know what were the policies and plans are proposed after independence to be technologically sound.

CLO_{04} To Know what were the developments done in major areas of science & technology.

CLO_{05} To know the relationship between the technologies.

Unit-I-Historical Perspective

Nature of science and technology, Roots of science and technology in India, Role of Science and Scientists in society, Science and Faith.

Unit-II

ScienceandTechnologyEducation,Researchactivitiesandpromotionoftechnologydevelopment, Technology mission, Programs aimed at technological self-reliance, activitiesofcouncil of scientificand industrial research(CSIR).

Unit-III

Nehru'svisionofscienceforindependentIndia,Scienceandtechnologydevelopmentsinthenewera,scienceandtechnologydevelopmentsduringtheFive-YearPlanPeriodsandscienceandtechnology policyresolutions.

Unit -IV-ScienceandTechnologicalDevelopmentsinMajorAreas

Space–Objectivesofspaceprograms,GeostationarySatelliteServices–INSATsystemandINSATservicesremotesensingapplications,LaunchVehicleTechnology.Ocean Development.Objectivesofoceandevelopment,marineresearch.Biotechnology-Applicationsofbiotechnology in medicine, agriculture, food, and fuel. Energy – Research and developmentin thefield ofnonconventionalenergyresources,India'snuclearenergyprogram.

Unit-V-NexusbetweenTechnologies

Transfer of Technology – Types, Methods, Mechanisms, Process, Channels and Techniques,Appropriate technology, Technology assessment, Technological forecasting, Technologicalinnovationsand barriers oftechnological change.

Textbooks:

1. K.Rajaram,ScienceandTechnologyinIndia,PublishedandDistributedbySpectrumBooks(P) Ltd., New Delhi.
2. M.Srinivasan,ManagementofScienceandTechnology(Problems&Prospects),East-West Press (P) Ltd., New Delhi.
3. G.R.Kohili,TheRole andImpactofScience andTechnologyinthe DevelopmentofIndia,SurjeetPublications.
4. Governmentof India,FiveYearPlans,PlanningCommission,NewDelhi.
5. K.D.Sharma,andM.A.Qureshi,Science,TechnologyandDevelopment,SterlingPublications(P) Ltd., New Delhi.

References:

1. Suvobrata Sarkar , History of Science, Technology, Environment, and Medicinein India, Publishedby Routledge India.
2. Sabareesh P.A. , A Brief History Of Science In India. Publishedby Garuda rakashan.
3. G. Kuppuram, K. Kumudamani, History of Science and Technology in India, Published by Sundeep Prakashan.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} Student will be aware about the ancient India & the existence of science & technology in that era & how it is reciprocated.

CO_{02} Student will be aware about the upliftment done in the field of R & D after independence.

CO_{03} Student will come to know about the plans and policies that brought about radical changes for the growth of science in India.

CO_{04} Student will come to know about the major areas of the applied science and their existence. And can set the relationship between the technologies.

CO_{05} Students will understand the need of technology transfer, its types and processes.

SEMESTER – III

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	EN3BS15	Engineering Mathematics -III	3	0	0	3
2	ME3CO18	Manufacturing Processes - I	3	0	0	3
3	ME3CO19	Mechanics of Materials	4	0	0	4
4	ME3CO20	Engineering Thermodynamics	4	0	0	4
5	ME3CO21	Sensors and Control	3	0	2	4
6	ME3CO22	CAD LAB-I	0	0	2	1
7	ME3CO23	Materials and Material Testing Lab	0	0	2	1
8	ME3CO24	Python Programming for Mechanical Engineers -I	0	0	2	1
9	EN3ES25	Engineering Materials	3	0	0	3
10	EN3NG03	Soft Skills -I	2	0	0	2
		Total	**22**	**0**	**8**	**26**
		Total Contact Hours	**30**			

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EN3BS15	Engineering Mathematics-III	3	0	0	3

Course Learning Objectives (CLOs):

CLO[01] To understand the structure, function and characteristics of computer system
CLO[02] To understand the design of the various functional units and components of computers
CLO[03] To identify the elements of modern instructions sets and their impact on processor design.
CLO[04] To explain the function of each element of a memory hierarchy
CLO[05] To identify and compare different methods for computer I/O.

Unit I: Numerical Interpolation techniques:
Difference Operators, Interpolation (Newton Forward and Backward Formulae), Central Interpolation Formulae (Gauss, Bessel's and Sterling's formula), Lagrange's and Divided Difference formulae, Numerical Differentiation.

Unit-IINumerical Differentiation and integration:
Numerical Integration (Simpson's, Weddle's, Trapezodal rules), Numerical Solution of Ordinary Differential Equations (Taylor's Series, Picard's, Euler's Modified, Runge-Kutta, Milne's Predictor and Corrector methods)

Unit III: ProbabilityDistribution:
DiscreteDistribution:Binomial, PoissonDistributionwithmean variance, Moment generating function.
ContinuousDistribution:Normaland Exponential Distribution with mean variance, moment generating function.

Unit IV: Curve fitting,Correlation, Regression:
Curve fitting (Method of Least Square), linear and nonlinear curves,Correlation, Karl Pearson's Coefficient of Correlation, Spearman's Rank Correlation Coefficient, Linear Regression, Regression coefficients,Properties of regression curve.

Unit V: Testing of Hypothesis:
Introduction to testing of hypothesis, Statistical assumptions, Level of significance, Confidence level, Type I Error, Type II error, Critical value, Power of the test, sampling distribution, Chi-Square test,small sample test – t test for one and two sample mean, F test, Large Sample test ,Z test for equality of single mean, equality of two sample.

Text Books

1. Higher Engineering Mathematics, B .V. Ramana, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2006.

2. Probability and Statistics, Ravichandran, Wiley India.

Reference Books

1. Sheldon M. Ross, “Introduction to Probability Models”, Elsevier Publication, Academic Press, UK
2. Numerical Methods for Scientific and Engineering Computation, M .K. Jain, Iyengar and R. K. Jain, New Age International Publication.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO[01] Student will understand the Evolution of Computers and Computer Generations, Measuring Computer, Technology Trends, Measuring Computer Performance, MIPS.

CO[02] Students will learn about Fundamental concepts of– Execution of a complete instruction Design of Basic computer, addressing modes, Instruction formats, stack organization.

CO[03] Students will be able solve questions on Number systems, Arithmetic operations on binary numbers, Floating Point Representation.

CO[04] Students will able to understand basics of Storing data and Program in Memory, Memory Hierarchy in a Computer, Semiconductor RAMs–ROMs, Cache memories, and virtual memory.

CO[05] Students will able to understand pipelining, vector processing, Multiprocessor Architecture organization, Performance, characteristics of Multiprocessors

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3CO18	Manufacturing Processes -I	3	0	0	3

COURSE LEARNING OBJECTIVES (CLOS):

CLO 01 To understand the basic knowledge of moulding.
CLO 02 To understand the operation for manufacturing of any product by sand casting.
CLO 03 To understand basic knowledge of forging and sheet metal operation.
CLO 04 To understand the basic knowledge of various types of welding operation.
CLO 05 To understand the basic knowledge of Powder metallurgy processes.

UNIT-I MOULDING:

Introduction of moulding, Moulding sand: types, properties and its constituents, testing of moulding sand, Pattern: types allowances, Pattern design, Cores, Core Prints, Core boxes. moulding and core making machines, use of chaplets, CO2 - Process, fluid sand process, shell moulding, cold curing process, hot-box method, high pressure and flask less moulding, Design of metal moulds, Die Design for die Casting.

UNIT II CASTING

Introduction of casting and its types. Solidification of casting, types of gating systems, Pouring time and temperature. Design criteria of pouring basin, screw, runner, gate and riser design, gating ratio, chill and its uses. Selection of melting furnaces, Crucible furnaces, Electric furnaces, Induction furnace. Casting defects, Causes and remedies.

UNIT-III FORGING

Classification of forging processes - forging processes - forging defects and inspection. Rolling: Classification of rolling processes - rolling mill - rolling of bars and shapes.
Extrusion: Classification of extrusion drawing of rods, wires and tubes.
Sheet Metal Working: Sheet metal forming methods: Shearing, Blanking, Bending, Stretch Forming, deep forming. Spinning: Spinning processes. Load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes

UNIT-IV WELDING

Welding: Principle, classification, advantages, limitations and applications, Tungsten Inert Gas welding, Metal Inert Gas welding, Electro - slag welding, Electro - Gas Welding, Explosive Welding, Ultrasonic Welding, Electron Bean Welding, Laser Beam Welding, Friction Welding, Cold Welding, Thermit Welding, Codification of Electrodes, Welding Defects-causes and remedies.

UNIT- V POWDER METALLURGY

Definition, advantages, limitations and applications, Powder metallurgy processes and operations, Compaction – Sintering and Finishing – Design considerations for powder metallurgy and Process

capability – Shaping of ceramics –Forming and shaping of glass – Design considerations for ceramics and glass – Processing of superconductors.

TEXT BOOKS

1. Rao P.N., "Manufacturing Technology", Vol. 1, Tata McGraw Hill.
2. Sharma P.C., "A Text Book of Production Engineering", Vol.1, S. Chand Publication,NewDelhi.
3. Hajra Choudhry, Elements of Workshop Technology, Vol I & II Media Promoters

REFERENCE BOOKS

1. Production Technology by HMT, Tata Mcgraw Hills
2. Chapman W.A.J, Workshop Technology , Volume II , Oxford and IVH PublishingCompany Ltd
3. Lindberg RA , Processes and Materials of M<anufacture, Prentice Hall Publications.

COURSE OUTCOMES (COS):
After completion of this course the students shall be able to:

CO 01 Students will have understood all types of moulding processes.
CO 02 Students will understand all types of sand-casting methods.
CO 03 Students will understand basic knowledge of forging and sheet metal operation.
CO 04 Students will understand the various types of welding operation.
CO 05 Students will be able to understand the Powder metallurgy processes.

Course Code	Course Name	Hours per Week			Total	Total
		L	**T**	**P**	**Hrs.**	Credits
ME3CO19	Mechanics of Materials	4	0	0	4	4

Course Learning Objectives (CLOs):

CLO_{01}	To understand basic concepts of stress, strain and compound stresses
CLO_{02}	To understand the Shear Force & Banding Moment concept
CLO_{03}	To understand the bending and shear stress.
CLO_{04}	To understand the concept of deflection of beams subjected to different types of loading.
CLO_{05}	To understand the basic concepts of torsion of shafts

UNIT I

Stress and Strain:

Stress, strain and its types, stresses in members of a structure, axial loading, normal stress, shear stress, analysis of simple structures, stepped rods, members in series and parallel: stress strain diagram, Hooke's law, modulus of elasticity, elastic and plastic behaviour of materials, deformation under axial loading ,statically indeterminate problems, stress due to temperature, Poisson's ratio, Bulk modulus, shear strain, relation among elastic constants, residual stress, fibre reinforced composite materials, strain energy under axial loads and stresses due to impact of falling weights.

UNIT II

Principle stress and Strain:

Principle stresses, Principle Planes, Mohr's circle and its application to two- and three-dimensional analysis, stresses in thin-walled pressure vessels, wire winding

UNIT III

Shear force and BM diagram:

Freebody diagrams, Types of support reactions, types of loads , shear force and BM diagram, relationship between load, shear force and bending moment

Shear and Bending Stresses**:** Pure bending, symmetric member, deformation and stress, bending in beams of composite sections, eccentric axial loading, shear stresses in beams, strain energy in bending, Deflection of beams, equation of elastic curve, Macaulay's method and Area moment method for deflection of beams.

UNIT IV

Torsion in shafts

Torsion Equation , stresses in a circular shaft, deformation in circular shaft, angle of twist, stepped-hollow Shaft, thin walled-hollow transmission shafts. Strain Energy in shafts

UNIT V

Columns and struts : Stability of structures, Euler's formula for columns with different end conditions, Rankin's formula.

TEXT BOOKS

1. Beer FP, Johnson ER, DewolfJT : Mechanics of Materials; TMH
2. Rattan; Strength of materials; TMH
3. Nash William; Schaum's Outline Series; Strength of Materials; TMH.
4. Negi ; strength of materials; TMH

REFERENCE BOOKS:

1. Singh Arbind K; Mechanics of Solids; PHI
2. Sadhu Singh; Strength of Materials; Khanna Pub.
3. Kamal K and Ghai RC; Advanced Mechanics of Materials; Khanna Pub.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01}	Evaluate the strength of various structural elements internal forces such as compression, tension, shear etc & to evaluate the behavior and strength of structural elements under the action of compound stresses.
CO_{02}	Plot the variation of shear force and bending moments over the beams under different types of loads.
CO_{03}	Analyze the different methods of unsymmetrical bending analysis and concept of shear center
CO_{04}	Evaluate force, stress and displacement in beams using Double Integration & Macaulay's method
CO_{05}	Understand the basic concept of analysis and design of members subjected to torsion.

Course Code	Course Name	Hours per Week			Total	Total
		L	**T**	**P**	**Hrs.**	Credits
ME3CO20	Engineering Thermodynamics	4	0	0	4	4

Unit- I

LAWS OF THERMODYNAMICS:

Applications of first law and SFEE in calculation of heat and work in various processes. Applications of second law, calculation of entropy in various processes, performance of thermal machines. Availability, reversibility and irreversibility, Clausius inequality, Carnot's theorem, Third Law

Unit- II

PROPERTIES OF PURE SUBSTANCES :

Phase transformation of water and applications, P-v, T-q, T-v charts, Calorimetry, Use of steam tables and Mollier Chart.

Unit- III

VAPOUR CYCLES :

Vapor Power Cycles, Carnot cycle, Rankine cycle, Comparison of Carnot cycle and Rankine cycle, Efficiency of Rankine cycle, Relative efficiency, Effect of superheat, boiler and condenser pressure on performance of Rankine cycle. Reheat & Regenerative cycle, Binary Vapor Cycle.

Unit-IV

BOILERS, STEAM CONDENSERS AND COOLING TOWERS:

Classification of high-pressure boilers, Performance evaluation of boilers; Equivalent evaporation, Boiler efficiency by direct and indirect method Energy balance. Introduction, types of condensers, back pressure and its effect on plant performance air leakage and its effect on performance of condensers, various types of cooling towers, design of cooling towers.

Unit- V

RECIPROCATING AIR COMPRESSORS AND NOZZLES :

Working of reciprocating compressor, work input for single stage compression, effect of clearance, volumetric efficiency, isentropic isothermal and mechanical efficiency, multi stage compression, inter cooling, condition for minimum work input. Types of nozzles, Stagnation and Critical properties, Velocity of sound in perfect gas.

Text Books:

1. P.K.Nag; Engineering Thermodynamics; TMH
2. B K Sarkar;Thermal Engineering; TMH
3. R K Rajput; Thermal Engineering; Laxmi Publicaions

Reference Books:

1. Van GJ; Thermodynamics; Willey Publication
2. Cengel Y; Thermodynamics; TMH
3. Moran & Shapiro; Engineering Thermodynamics, Willey Publication

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3CO21	Sensors and Controls	3	0	2	4

Unit-I: Introduction

Description of measuring devices and dynamic characteristics, active and passive sensors and transducers, classifications. Control system components, modeling of a linear dynamic systems, concept of transfer function, open and closed loop systems.

Unit-II: Sensors

Position sensors, velocity sensors, acceleration sensors, force and pressure sensors, light & infrared sensors, proximity sensors, strain gauge, LVDT, RVDT,

Unit-III: Advanced Sensors

Gas sensors and acoustic sensors. automobile sensors (airflow sensor, engine speed sensor, spark knock sensor, coolant sensor, fuel, voltage sensor, camshaft position sensor, throttle position), home appliance sensors (temperature sensors, IR sensors, ultrasonic sensors, hall effect sensor, LDR, UV).

Unit-IV: Feedback systems

Closed loop system components, error detector, digital actuator, block diagram of op-amp, ideal op-amp characteristics, Inverting and non-inverting, Adder, subtracter, integrators and differentiators, comparator,

Unit-V: Sensor based Control

Types of controllers, electrical, pneumatic and hydraulic prime movers and associated control hardware, closed loop control of microcomputer-based drives. Relay control systems and PLC systems and programming, control including sequence control. Sensor based control of various actuators.

Text-Books:

1. D. Patranabis, Sensors and Actuators, PHI.
2. J.Vetelino, A. Reghu, Introduction to Sensors, CRC Press.
3. Ramakant A. Gaikwad, OP- Amp and linear Integrated circuits, Pearson.

Reference Books: -

1. Hermann K.P. Neubert, Instrument Transducers, Oxford University press.
2. R. Sinclair, Sensors and Transducers, Elsevier.
3. B.C. Kuo, Automatic contro systems, PHI.

List of experiments:

1. Displacement measurement using LVDT.
2. Temperature measurement using resistance temperature detector.
3. To perform the characteristics of a Thermistor

4. To perform the characteristics of a Thermocouple
5. Temperature measurement using strain gage.
6. To perform the characteristics of the optical transducers.
7. To perform the characteristics of a DC Tachometer
8. To perform the characteristics of a Proximity sensor for Speed Measurement
9. To realize inverting and noninverting amplifier using Op-amp.
10. To realize adder, subtracter, integrator and differentiator circuits using Op-amp.

MEDI-CAPS UNIVERSITY

Knowledge is Power

मेडी-केप्स विश्वविद्यालय, इंदौर

Medi-Caps University, Indore

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3CO22	CAD LAB-1	0	0	2	1

Part-A: Introduction to Machine Drawing

- Conventional representation of Machine Components
- Sectional views of Machine Components
- Dimensioning of Machine Components
- Surface finish, GD & T symbols

Part-B: Application of Computer Aided Drafting

- Getting familiar with Drafting ,Draw Toolbar , Hatching & Gradient
- Modify Toolbar, Array Tool ,Status Bar toggle keys , Object Properties, Important drawing Tools , Dimension Toolbar , Isometric Drafting ,Creating Multileader, Geometric Drawing & Tolerances, Text, Table
- Managing Drawing with layers ,Parametric Drawing , External References, Layout Printing & Plotting

Part-C: Introduction to the 3D Modeling Workspace

- Basic 3D Viewing Tools ,3D Navigation Tools Introduction to the User Coordinate System (UCS)
- Working with Solid Primitives, Solid Primitive Types ,Working with the User Coordinate System
- Extruded Solids and Surfaces ,Swept Solids and Surfaces , Revolved Solids and Surfaces, Lofted Solids and Surfaces, NURBS Surfaces
- 3D Modify Commands, Editing Components of Solids, Editing Faces of Solids Fillets and Chamfers, Creating a Shell ,Imprinting Edges of Solids, Slicing a Solid along a Plane
- Converting Objects to Surfaces, Converting Objects to Solids,

Part-D: Refining the View

- Working with Sections, Working with Cameras, Managing Views in 3D
- Creating Visual Styles, Working with Materials Specifying Light SourcesRendering Concepts, Working Drawings from 3D ModelsCreating Multiple Viewports, 2D Views from 3D Solids.

Part-E: Drawing Practice: 2D & 3D

Individual Projects:

1. Shift Lever
2. Form Roll Leaver
3. Nut, bolt & washer assembly
4. Knuckle Joint Assembly
5. Cotter Joint
6. Universal Joint
7. Solid muff coupling
8. Bush Type Coupling
9. Crosshead
10. Cam shaft
11. Connecting rod
12. Piston
13. Piston and connecting rod
14. Plumber block
15. Bush Bearing
16. Journal Bearing

Text Books:

1. AutoCAD 2021 For Beginners. By Cadfolks
2. Mastering AutoCAD 2019 and AutoCAD LT 2019 By George Omura
3. Discovering AutoCAD 2020 By Mark Dix

Reference Books:

1. AutoCAD 2020 A Project-Based Tutorial By Tutorial books
2. AutoCAD Exercises for Beginners: Designers WorkBook for Practice ByShameer S.A.

3. Beginning AutoCAD® 2022 Exercise Workbook: For Windows® Kindle Edition by Cheryl R. Shrock, Steve Heather

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3CO23	MATERIALS AND MATERIAL TESTING LAB	0	0	2	1

List of Experiment

Experiments

1. Preparation of specimen for Metallographic examination of different engineering materials for analysis of microstructures of plain carbon steel, tool steel, gray C.I, SG iron, Brass, Bronze & Composites.
2. Study of determination of structures of simple crystals by x-ray diffraction. and microscope.
3. Brinell, Rockwell and Vickers's Hardness tests on untreated and heat treated specimens.
4. Tensile and compression tests of steel, aluminum and cast iron specimens using Universal Testing Machine.
5. To conduct Shear test on Mild steel and Cast Iron using Universal Testing Machine.
6. Bending Test on steel and wood specimens.
7. Izod and Charpy Tests on Mild steel and C.I Specimen
8. Impact test by falling dart method on PVC pipe.
9. To study the wear and fracture characteristics of ferrous and non-ferrous materials under different parameters.
10. Fatigue Test (demonstration only).

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Course Code	Course Name	Hours per Week			Total	Total
		L	**T**	**P**	**Hrs.**	Credits
EN3ES25	Engineering Material	3	0	0	3	3

UNIT I: STRUCTURES:

Atomic structure and bonding in materials. Crystal structure of materials, crystal systems, unit cells and space lattices, miller indices of planes and directions, packing geometry in metallic, ionic and covalent solids. Imperfections in crystalline solids and their effect various properties.

UNIT II MATERIAL BEHAVIOR &MECHANICAL PROPERTIES:

Elasticity in metals, mechanism of plastic deformation, strengthening mechanisms, stress-strain diagrams of metallic, ceramic and polymeric materials. Ductile to brittle transition, creep failure mechanism, fatigue mechanism. Mechanical properties of material.

UNIT III PHASE DIAGRAMS & HEAT TREATMENT:

Introduction - Solid solutions, Hume-Rothery rules for solid solutions, Phase rules , Phase diagrams - Binary phase diagrams - tie line and lever rule; Iron-Iron carbide metastable diagram, development of micro-structures in iron-carbon alloys. Isothermal transformation diagrams, TTT curves, various heat treatment processes.

UNIT IV METALLIC MATERIALS:

Stainless and tool steels, HSLA, Maraging steels, TRIP steel – Cast Irons, Properties and applications of - Cu and its alloys, Al and its alloys, Age hardening, Ti and its alloys, Ni-based alloys- super alloys.

UNIT V NON METALLIC MATERIALS:

Introduction, properties Types and applications of Polymers , Composites and its types , and Ceramics - advanced structure ceramics, Shape memory alloy, Nano-materials - its important properties at nanoscale and applications-carbon nano-tubes.

TEXTBOOKS:

1. Raghavan V; Material Science and Engineering, PHI Publication.

2. W.D. Callister, Jr., Materials Science and Engineering: An Introduction, Wiley & Sons

3. Krishnan K. Chawla, Composite materials, Science and Engineering Springer.

REFERENCE BOOKS:

1. J.C. Anderson, K.D. Leaver, P. Leavers and R.D. Rawlings, (2003), Materials Science for Engineers, 5th edition, Tata McGraw Hill Publishers.

2. William F. Smith and Javad Hashemi (2004), Foundations of Materials Science and Engineering 4th ed., Mc Graw Hill.

3. Sidney H Avner, (2005) "Introduction to Physical Metallurgy, Tata McGraw Hill Publishing Company Limited.

4. Lawrence E.Murr (2000), Failure analysis, Marcel Dekker Inc. Publications.

5. Askeland; The science and engineering of material, Cengage learning.

Course Code	Course Name	Hours per Week			Total	Total
		L	T	P	Hrs.	Credits
ME3CO24	Python for Mechanical Engineering	0	0	2	2	1

Unit-I Introduction:
Introduction to Python difference and similarity from other programming languages, Python Installation, Installing the Anaconda, Python IDE, Toolbars, working area, sub menus, working modes. Variables in python Input and Output in Python, Basic commands.

Unit-II Basic constructs with Conditional Statement and Looping in Python:.
Tokens Basic program structure-quotation and indentation, Operator, Basic data types and In-built objects. Basics Expressions, Assignment Statement, Arithmetic Operators, Operator Precedence, Boolean Expression. If-else, for loop, while loop, break, pass, continue, creating Functions, functions with arguments, returning values from functions, lambda expressions, recursion, global and local variables, Importing other modules/packages and using their functions

Unit-III : Object Oriented Programming in Python:
Class and Object. Defining variables and functions inside class. Creating objects, Inheritance, Multiple and Multi Level Inheritance, Function overriding, the concept of composing objects of a different class in an object, problems on object composition. Encapsulation, Polymorphism, Constructors __init__, __del__.

Unit-IV Libraries in Python : Use of libraries in python like NumPy, Panda etc., Arrays, Matrices in python. Matplotlib library for plotting the data, Figures and axes Subplots, Grid Spaces, Contour Plots, Surface Plots, Polar Plots and Seaborn.

Unit-V Application of python in mechanical engineering problems
Problem based on shear force and bending moment, problem based on efficiency of ic engine, pv graph plotting, analysis of various fluid mechanical properties, tolerance measurement.

Text Book:
1. Dr.R.Nageswara Rao, Core Python Programming, dreamtech press.
2. Paul Barry, Head First Python, O'REILLY.
3. James Payne, "Beginning Python: Using Python 2.6 and Python 3.1", Wrox Publication

4.Magnus Lie Hetland, “Beginning Python from Novice to Professional”, Second Edition”, Apress Publication.

Reference Book:

1. Mark Luiz, Learning Python, O’REILLY.
2. Jamie Chan, Learn Python in One Day, LCF Publishing.
3.Wesley J Chun, “Core Python Applications Programming”, Third Edition, Pearson Publication.
4. E. Balaguruswamy,” Introduction to Computing and Problem Solving using Python” McGraw Hill Education IndiaPvt., Ltd.

Web Resources:

1, https://www.edx.org/course/introduction-to-python-absolute-beginner-3.
2, https://onlinecourses.nptel.ac.in/noc19_cs40.

List of Experiments

1. Write a program to print hello user on the output screen.
2. Write a program using various operators.
3. Write a program to perform arithmetic operations on two numbers.
4. Write a program stating which number is greater using conditional statements.
5. Write a program to check weather a number is even or odd
6. Write a program by the use of for loop and nested for loop.
7. Print the table of 2 using a while loop.
8. Write a program to reverse an integer.
9. Write a program to determine whether a number is palindrome or not.
10. Write a program using strings and extract the individual character.
11. Write a program using various functions of strings in it.
12. Write a program using tuples and perform various functions of tuples in it.
13. Write a program using list and perform various functions of list in it.
14. Write a program using normal function and lambda function.
15. Write a program with Class name Phone and add the various parameter of class.
16. Write a program using inheritance.
17. Formulate a plan for the delivery of two sets of important products A and B. Each box of Product A weighs 20 kg and occupies 0.45m^3. Each box of Product B weighs 30 kg and occupies 0.35m^3. The profit for transporting Product A is $ 4.10. The profit for transporting Product B is $ 5.40. The truck has the capacity to transport 2 tons and the space of 30m^3. Knowing that the carrier wants to transport as many products as possible and obtain the highest possible profit, use linear programming, and solve the problem using python.
18. Calculate the efficiency of otto cycle and plot its pv diagram using following data : Initial pressure and temperature are 1atm and 500K respectively. Maximum temperature is 2300k, gamma is 1.4, bore 100cm, stroke length 100cm,
19. Would a tank of radius = 5 m, and height = 10 m be overfilled if the flow rate of water is 15 cubic m/min within two hours? Do the analysis using python.

20. Write a program for analysis of SF and BM on a simply supported beam carrying udl of 500N/m for a span of 5m at a distance of 2.5m from the left support. The total length of the beam is 10m.

Medi-Caps University, Indore
Scheme of B. Tech. -Mechanical Engineering
For the candidates admitted in session 2021 - 2025

SEMESTER – IV

Sr. No.	Course Code	Course Name	L	T	P	Credits
1	ME3CO25	Manufacturing Processes- II	3	0	2	4
2	ME3CO26	Python Programming for Mechanical Engineers-II	0	0	2	1
3	ME3CO27	Fluid Mechanics and Machinery	3	0	2	4
4	ME3CO28	Kinematics of Machines	3	0	2	4
5	ME3CO29	CAD LAB-II	0	0	2	1
6	EN3HS04	Fundamentals of Management, Economics & Accountancy	3	0	0	3
7	ME3PC04	Mini Project –I	0	0	4	2
8	EN3NG02	Universal Human Values & Professional Ethics	2	0	0	2
9	EN3NG04	Soft Skills –II	2	0	0	2
		Total	**16**	**0**	**14**	**19**
		Total Contact Hours	**30**			

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Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO25	Manufacturing Processes- II	3	0	2	4

UNIT I MECHANICS OF METAL CUTTING:
Fundamentals of machining, Machinability, mechanics of metal cutting, orthogonal vs oblique cutting, mechanics of chip formations, types of chips, tools geometry, Merchant's force circle diagram, cutting forces, power required, shear zone, chip thickness measurement, strain rates, tool signature and nomenclature, tool life and wear, speed, feed, depth of cut, machining time.

UNIT II LATHE, SHAPERS & PLANER MACHINE:
Lathe Machine: Introduction, type, specification, components & accessories for various operations on lathes, taper turning methods, methods of thread production, capstan & turret lathes.
Shapers and Planer Machine: Introduction, operations, specifications, parts, quick returns mechanism.

UNIT III MILLING, DRILLING, BROACHING MACHINE & WORK HOLDING:
Milling: Introduction, classifications and specifications of milling machines, milling cutter, up & down milling, determination of maximum chip thickness, power required.
Drilling: Introduction, calculation of drilling time, working principle of radial and universal drilling machines.
Broaching: Principle, Types of broaches and broaching machines.
Work holding device: Introduction & working principle of jigs and fixtures.

UNIT IV ABRASIVE MACHINING PROCESSES:
Grinding : Specification and selection, wheel turning and dressing, types of grinding processes-surface grinding, cylindrical grinding, centre-less grinding, internal grinding- honing, lapping, supper finishing.

UNIT V CNC AND NON-TRADITIONAL MACHINING PROCESSES:
Introduction to NC/CNC machines: offset setting, G-code, M-code, and CNC part programming.
Non-traditional Machining Processes: Introduction, working principle, process characteristics & applications of - Electrical discharge machining (EDM), Electro chemical machining (ECM) Abrasive jet machining (AJM), Water jet machining (WJM), Ultrasonic machining (UJM), Electron beam machining (EBM), Laser beam machining (LBM).

TEXTBOOKS:

1. S. Kapakjian and S.R. Schmid, (2010), Manufacturing Engineering and Technology, 6th Edition, Pearson Education (Singapore) Pvt. Ltd.
2. P. N. Rao, (2009), Manufacturing Technology, Vol. 2, 2nd ed., Tata McGraw Hill Publications.
3. P.C. Sharma, (2000), Text book of Production Technology, S.Chand& Company Ltd, New Delhi.

REFERENCE BOOKS:

1. Lindberg RA; Processes and Materials of Manufacturing; PHI.
2. Raghuvanshi;BS; Work shop technology Vol-I, II; Dhanpat Rai Delhi
3. Alciatori DG, Histand MB; Introduction to Mechatronics and Measurement system; TMH

LIST OF PRACTICAL:

1. To perform various operations on the lathe machine tool according to given drawing.
2. To perform various shaping operations to cut a groove on mild steel specimens according to the given specification.
3. To perform plane milling operation on the given specimen (mild steel) for spur gear cutting.
4. To make a job on a radial drilling machine.
5. To perform a finishing operation on a surface grinder.
6. To make a job on a CNC turning and milling machine according to the given specification.
7. Industrial visit for the students on metal forming processes.
8. Industrial visit for the students on metal casting processes.

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Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO26	Python Programming for Mechanical Engineers-II	0	0	2	1

UNIT-I PROGRAMS ON MECHANICS & MACHINE DESIGN -I
Projectile Motion, Failure theory plot, Shear force, Bending Moment analysis,
Unit-II PROGRAMS ON MECHANICS & MACHINE DESIGN -II
Kinematic Analysis, Fatigue Criteria, Simple spring Mass system, SciPy Odeint,
Unit-III PROGRAMS ON THERMAL ENGINEERING-I:
Streamlines of fluid flow, Otto Cycle and Diesel Cycle Analysis,
Unit-IV PROGRAMS ON THERMAL ENGINEERING-II
One dimensional heat equation, Two dimensional heat equation, flow pressure distribution
Unit-V ADDITIONAL ENGINEERING PROBLEMS:
Newton Raphson method, Linear Differential Problem, Data Interpretation, Data Filter Application

LIST OF EXPERIMENTS:

1. To make a program for projectile motion and plot on graph.
2. To draw Von Mises plot and locate stress points on it.
3. To draw Shear force diagram and Bending Moment diagram for given load conditions.
4. To perform kinematic analysis using python.
5. To draw streamlines for given velocity.
6. To perform analysis of Otto cycle using python.
7. To perform analysis of Diesel cycle using python.
8. To solve one dimensional heat equation using python.
9. To solve a mathematical problem by Newton Raphson Method using Python.
10. To solve linear programming problems using python.

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Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO27	Fluid Mechanics and Machinery	3	0	2	4

UNIT-I FLUID PROPERTIES AND HYDROSTATICS:
Introduction, Fluid Properties- mass density, weight density, viscosity, specific gravity, specific volume, Newton's law of viscosity, Hydrostatic forces on plane – inclined and curved surfaces – buoyancy – centre of buoyancy – metacentre.

UNIT-II KINEMATICS AND DYNAMICS OF FLOW:
KINEMATICS: Types of flow-ideal & real, steady & unsteady, uniform & non uniform, one, two, and three-dimensional flow, path lines, streak-lines, streamlines; continuity equation for one- and three-dimensional flow, rotational & irrotational flow, velocity potential, stream function, Vortex Flow.
DYNAMICS: Euler's equation of motion along a streamline and derivation of Bernoulli's equation, application of Bernoulli's equation, linear momentum equation for steady flow. The moment of momentum equation, forces on fixed and moving vans and other applications. Head Losses in pipes

UNIT III HYDRAULIC TURBINES:
Hydraulic Turbines, classification, Hydraulic, volumetric, mechanical and overall efficiencies, Pelton and Francis Turbines, their velocity triangles, calculation of power and efficiency, draft tube and its applications.

UNIT IV HYDRAULIC PUMPS:
Centrifugal pumps, classification, advantage over reciprocating type, definition of manometric head, gross head, static head, vector diagram and work done. Main and operating characteristics of the machines, cavitations, priming of pumps.

UNITV- DIMENSIONAL ANALYSIS:
Dimensional analysis, dimensional homogeneity, use of Buckingham-pi theorem, calculation of dimensionless numbers, similarity laws.

TEXT BOOKS
1. M. M. Rathore, Thermal Engineering, TMH
2. R.K. Bansal, Fluid Mechanics & Fluid Machines, Lakshmi Pub.
3. Congel; Fluid Mechanics; TMH

REFERENCE BOOKS
1. B.K. Venkanna, Turbomachinery, PHI
2. K.L. Kumar, Fluid Mechanics, S. Chand Pub.
3. White; Fluid Mechanics; TMH

LIST OF PRACTICAL:
1. To Verify Bernoulli's Theorem.
2. Determination of meta-centric height
3. Calibration of Orifice meter and Venturi meter and Rotameter.
4. To determine the local point pressure with the help of pitot tube
5. Determination of Friction Factor of a pipe (Major Losses)and fittings (Minor Losses).
6. Reynolds experiment for demonstration of streamline& turbulent flow

7. Verification of Impulse momentum principle.
8. To conducts an experiment on Pelton turbine test rig.
9. To conducts an experiment on Francis's turbine test rig.
10. To study the effect of a draft tube on reaction turbines.
11. To conduct a test on Centrifugal Pump and plot its characteristics.

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Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO28	KINEMATICS OF MACHINES	3	0	2	4

UNIT-I MECHANISMS AND MACHINES:
Rigid and resistant body, Definitions and classification of Kinematic Links, Kinematic pairs, Chains, Mechanism and machine., Degrees of freedom: Kinematic pairs and mechanism, Gruebler's & Kutzback's Criterion for planer mechanisms, Kinematic inversion, Different Inversions of Four bar chain, Single Slider and Double slider-crank chain. Different lower paired mechanisms: Kinematic analyses of Straight-line mechanisms, Approximate and Exact Mechanisms, Davi's and Ackermann Steering Mechanisms, Pantograph Mechanisms, Quick Return Mechanisms- Slotted Lever and Whitworth's type.

UNIT II VELOCITY AND ACCELERATION ANALYSIS IN MECHANISMS:
Displacement of a rigid body -Combination of rotation and translation, Relative displacement of two points on a rigid body, Pure rotation of a rigid body- Angular velocity of link , Kinematic Analysis of Mechanisms :Graphical Methods of Velocity Analysis of Planer Mechanisms: Relative Velocity Method up to four links, Instantaneous Centre of Rotation Method:Properties of instantaneous centers, Aronhold- Kennedy Theorem of three centers, Velocity determination in simple four bar and slider crank mechanisms, Acceleration Analysis of Planer Mechanisms: Concepts of Radial and Tangential acceleration, Coriolis Component of acceleration. Klein's Construction for velocity and acceleration of Slider Crank mechanism.

UNIT-III CAMS AND FOLLOWERS:
Classification of Cams and Followers, Terminologies of Cams, Displacement, velocity, and accelerations of followers for standard motions – Uniform motion, Parabolic, SHM and Cycloidal. Cam profile generation.

UNIT-IV GEARS AND GEAR TRAINS:
Classification of gears, Law of gearing, Spur Gears : Terminology, Velocity of sliding, Tooth profiles-Cycloidal and Involute and their comparison, Concept of path of contact, arc of contact and contact ratio and their relationship for spur gear pair, Concepts of Interference and Undercutting, Minimum number of teeth to avoid interference between. Gear Trains: Spur Geared trains: Simple, Compound, Reverted and Epi-Cyclic - Velocity ratio.

UNIT- V GYROSCOPE:
Concepts of Gyro-couple and Gyro-reaction Couples. Evaluation of gyroscopic couple. Evaluation of gyro-reaction couples and their effects in different machines – Boat, Aeroplane, Two wheeler and Four wheeler, Stabilization of naval ship using Gyroscopic effect.

TEXT BOOKS:
1. Rattan S.S.; Theory of machines; Mc-Graw Hills Publications.
2. Ambekar A. G.; Mechanism and Machine Theory; PHI. Eastern Economy Edition.
3. Khurmi R. S. and Gupta J. K., Theory of Machines, S. Chand & Co.

REFERENCE BOOKS:
1. Bevan T., "Theory of Machines: A text book for engineering students", CBS, New Delhi.
2. Jagdish Lal; Theory of Machines; Metropolitan Book Co; Delhi
3. Ghosh, A, and Malik, A. K. "Theory of Mechanisms and Machines", East West Press Pvt. Ltd.

LIST OF PRACTICALS:

1. To determine the degree of freedom of different kinematic pairs
2. To verify the principle of Pantograph apparatus.
3. To verify the principle of Watt's and Peaucellier's Straight line mechanisms.
4. To determine the cutting ratios in Whitworth and SlottedLever Quick Return Mechanisms
5. To verify the torques due to Coriolis component of acceleration.
6. To draw the cam profile of a given cam.
7. To identify different types of gears and their nomenclature on tooth profile.
8. To verify the velocity ratio and the holding torque in an epi-cyclic gear train.
9. To verify the applied gyroscopic couple using motorized gyroscopic apparatus.
10. To determine slip and creep and power loss in flat belt drive.

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ME3CO29	CAD LAB-II	0	0	2	1

Part-A: Part modeling and assembly Introduction to CAD part modeling and analysis

- Using the interface
- Selecting and Editing
- Sketcher geometry
- Creating datum Features: Planes and Axes
- Creating extrudes, Revolves and Ribs
- Creating sweeps and blends
- Creating holes, shells and drafts, Creating rounds, chamfers
- Copy and mirror tools
- Creating patterns
- Assembling with constraints
- Exploding assemblies
- Application of mechanisms to assemblies
- Creating animation clips of various assemblies and models
- Using layers
- Managing design intent

- **Part-B: Surface modeling**
- Surface modeling overview
- Advance selection
- Basic Surfacing tools
- Helical Sweep
- Creating and editing solids using quilts

- **Part-C Sheet Metal Design**
- Introduction to Sheet Metal design process
- Sheet Metal model fundamentals
- Creating primary and secondary Sheetmetal, Wall features
- Modifying Sheet Metal models
- Sheet Metal Bends
- Setting the Sheetmetal environment

- **Part-D Detailing of Drawings**
- Introduction to drawings
- Creating new drawings and views
- Adding details to drawings
- Adding notes to drawings
- Adding tolerance and symbols
- Using layers in drawings
- Creating reports (BOM)

Part-E Introduction of manufacturing

- Introduction to manufacturing using CAM Software
- Create CNC part program using CAM Software

- Computer assist part programming Practice

Team Projects:

1. Cylinder Vertical Steam Engine with single valve
2. Petrol vapour carburetor
3. 2-stroke engine
4. Triple cylinder oscillating steam engine
5. Cylinder horizontal steam engine with Crosshead trunk guide
6. Working model of a fire engine.
7. Cylinder steam engine to the bernay design.
8. Carburetor
9. Model of a gas fired quarry typehunslet loco
10. Vertical Boiler
11. Horizontal Boiler
12. Wobler Engine
13. Wagon
14. Side lever Engine
15. Tractor Engine

Text Books:

1. Creo Parametric 8.0: A Power Guide for Beginners and Intermediate Users Kindle Edition by CADArtifex , John Willis , Sandeep Dogra.
2. Designing with Creo Parametric 8.0 Published August 27, 2021 By Michael J. Rider Ph.D.
3. Creo 8.0 Mechanism Design Published August 19, 2021 By Roger Toogood Ph.D.

Reference Books:

1. Creo Parametric 8.0 Advanced Tutorial Published August 27, 2021 By Roger Toogood Ph.D.
2. Creo Parametric 8.0 Tutorial Published August 18, 2021 By Roger Toogood Ph.D.
3. Creo Parametric 9.0 Advanced Tutorial Available August 18, 2022 By Roger Toogood Ph.D.

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Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EN3HS04	Fundamentals of Management, Economics & Accountancy	3	0	0	3

UNIT I CONCEPTS OF MANAGEMENT:
Definition, characteristics and importance of management; Management: Science or Art,Difference between Management and Administration, Levels of management, Functions ofManagement, Managerial Roles, Managerial skills and competencies; Decision Making:Definition, process and types; Decision making under certainty, uncertainty and risk; Cross cultural issues in management and challenges.

UNIT II FUNDAMENTALS OF MARKETING AND HUMAN RESOURCE MANAGEMENT:
Introduction to Marketing: Definition, importance, function and scope of marketing, Coreconcepts of marketing, Marketing concepts and orientations, Marketing environment, Marketing-mix, Holistic marketing concept, Customer Relationship Management (CRM).Introduction to Human Resource Management (HRM): Nature, Scope, Objectives andFunctions; Role of HR manager, Process and need for Human Resource Planning, Humanresource policies, Changing role of Human Resource in India, Globalization and its impact onHuman Resource.

UNIT III FUNDAMENTALS OF ECONOMICS:
Definition, nature, scope and significance; Difference between microandmacro economics; Time value of money, Law of diminishing marginal utility; Theory ofDemand and Supply, Price elasticity of demand; Meaning and types of costs, Law of variableproportions; Types of market structure; National income and related aggregates; Meaning andtypes of Inflation; Meaning and phases of business cycle.

UNIT IV BASIC ACCOUNTING PRINCIPLES:
Accounting Principles and Procedure, Double entry system, Journal, Ledger, Trail Balance, CashBook; Preparation of Trading, Profit and Loss Account; Balance sheet; Cost Accounting:Introduction, Classification of costs, Methods and Techniques of costing, Cost sheet andpreparation of cost sheet; Breakeven Analysis: Meaning and its application.

UNITV FUNDAMENTALS OF FINANCIAL MANAGEMENT:
Introduction of Business Finance: Meaning, Definition of Financial Management, Goals ofFinancial Management (Profit Maximization and Wealth Maximization), Modern approaches toFinancial Management — (Investment Decision, Financing Decision and Dividend PolicyDecisions).

TEXT BOOKS:
1. R. D. Agarwal, Organization and Management, McGraw Hill Education.
2. P. C. Tripathy and P. N. Reddy, Fundamentals of Management, Economics andAccountancyTata McGraw Hill
3. Kotler Philip and Keller Kevin Lane, marketing ManagementPearson

REFERENCE BOOKS:
1. Peter F Drucker, The Practice of ManagementMcGraw Hill
2. Harold Koontz, Essentials for Management, Tata McGraw Hill
3. M Y Khan and P K Jain,ManagementAccountingTata McGraw Hill

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Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3PC04	Mini Project -I	0	0	4	2

1. Mini Project can be an individual or a group activity depending on the depth and scope of the topic.
2. The project work can be any of the form given below :
a) Making physical working models, prototypes, scaled models, of a concept machine.
b) Making virtual / CAD models of a sufficiently complex machines / concepts.
c) Making study, modeling, analysis, programming and simulation of a system / machine /operation / process.
d) Making study / teaching modules of a sufficiently complex topic for pedagogy purposes.
3. Group formation, discussion with faculty advisor, formation of the Semester Mini Project statement,resource requirement, if any should be carried out in the earlier part of the Semester.
4. The students are expected to utilize the laboratory resources before or after their contact hours as per the prescribed module.
5. A complete Assembly and Details drawings of the project should be submitted along with a detailed project report, where applicable.
6. A Detailed Background / field / literature survey, related to the topic must be made and presented in the report.

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Medi-Caps University, Indore

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EN3NG02	Universal Human Values & Professional Ethics	2	0	0	2

UNIT-I

Introduction-Need,BasicGuidelines,ContentandProcessforValueEducation: Understanding the need, basic guidelines, content and process for Value Education, Self Exploration – what is it ?-its content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self - exploration, Continuous Happiness and Prosperity-A look at basic Human Aspirations, Right understanding, Relationship and Physical Facilities-the basic requirements for fulfilment of aspirations of every human being with their correct priority, Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario, Method to fulfil the above human aspirations: understanding and living in harmony at various levels.

UNIT-II

Understanding Harmony in the Human Being-Harmony in Myself:

Understanding human being as a co-existence of the sentient 'I' and the material 'Body', Understanding the needs of Self ('I') and 'Body'- Sukhand Suvidha, Understanding the Body as an instrument of 'I'(I being the doer, seer and enjoyer), Understanding the characteristics and activities of 'I' and harmony in 'I', Understanding the harmony of I with the Body: Sanyamand Swasthya; correct appraisal of Physical needs, meaning of Prosperity in detail, Programs to ensure Sanyam and Swasthya.

UNIT-III

Understanding Harmony in the Family and Society-Harmony in Human- Human Relationship:

Understanding harmony in the Family- the basic unit of human interaction, Understanding values in human -0/'[-789*-0o human relationship ;meaning of Nyayaand program for its fulfilment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship, Understanding them eaningof Vishwas; Difference between intention and competence, Understanding the meaning of Samman ,Difference between respect and differentiation ;the other salient value in relationship, Understanding the harmony in the society(society being an extension of family):Samadhan, Samridhi, Abhay, Sahastitvaascomprehensive Human Goals, Visualizing a universal harmonious order in societyUndivided Society (AkhandSamaj), Universal Order (SarvabhaumVyawastha)-from family to world family.

UNIT- IV

Understanding Harmony in the Nature and Existence-Whole existence as Co-existence:

Understanding the harmony in the Nature, Interconnectedness and mutual fulfilment among the four orders of nature –recyclability and self-regulation in nature, Understanding Existence as Concourse Code Course Name Hours per Week Total L T P Credits EN3MC15 Universal Human Values and Professional Ethics 2 0 0 0 existence(Sah-astitva) of mutually interacting units in all-pervasive space, Holistic perception of harmony at all levels of existence.

UNIT-V

Implications of the above Holistic Understanding of Harmony on Professional Ethics:

Natural acceptance of human values, Definitiveness of Ethical Human Conduct, Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order, Competence in Professional Ethics: a) Ability to utilize the professional competence for augmenting universal human order, b) Ability to identify

the scope and characteristics of people- friendly and eco-friendly production systems, technologies and management models, Case studies of typical holistictechnologies,managementmodelsandproductionsystems,Strategyfor transition from the present state to Universal Human Order: a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers, b) At the level of society :asmutually enriching institutions and organizations.

Text books:

1. R R Gaur, R Sangal, G P Bagaria, 2009, A Foundation Course in Human Values and Professional Ethics. References: 1. IvanIllich,1974,Energy& Equity, The Trinity Press, Worcester, and Harper Collins, USA
2. E.F.Schumacher,1973, Smallis Beautiful: a sudyof economics as if people mattered, Blond &Briggs, Britain.
2. SussanGeorge,1976,HowtheOtherHalfDies,PenguinPress.Reprinted 1986, 1991
3. Donella H .Meadows, DennisL. Meadows,JorgenRanders, WilliamW. BehrensIII, 1972, Limits to Growth–Club of Rome's report, UniverseBooks.
4. ANagraj, 1998, JeevanVidyaEkParichay, DivyaPathSansthan, Amarkantak.
5. PLDhar, RRGaur,1990,Science and Humanism,Commonwealth Publishers.
6. A NTripathy, 2003, Human Values, New Age International Publishers. SubhasPalekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) KrishiTantraShodh, Amravati.
7. EGSeebauer&RobertL.Berry,2000,FundamentalsofEthicsforScientists&Engineers,Oxford UniversityPress.
8. MGovindrajran,SNatrajan&V.S.SenthilKumar,EngineeringEthics(includingHumanValues),EasternEconomyEdition,PrenticeHallofIndia Ltd.
9. BP Banerjee,2005, Foundations of Ethics andManagement, Excel Books. BLBajpai,2004,IndianEthosandModernManagement,NewRoyal Book Co., Lucknow. Reprinted 2008.

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Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
EN3NG04	Soft Skills -II	2	0	0	2

UNIT I Body Language and professionalism:
To make participants aware of the importance of Body language trains them to project a better outlook of themselves. This helps in presenting themselves in Personal interview and Group discussions. Grooming and presenting oneself are the main focus. Interview dress code, facial expressions, body language, handshake etiquettes etc., are dealt in the session. Worksheets, anecdotes, videos and role-plays are some of the important components of the session. Interpersonal skills: Effective interpersonal skills are crucial to increase employment opportunities and to compete in the business environment. This session makes the participants understand different barriers to proper interpersonal communication and to tackle them head-on. Activities are an integral component of the session. Reporter: The aim of the session is to make every student ask rational questions and make diplomatic replies. The session is a press meet like a group activity session.

UNIT II Team Building:
To make every student intermingled within a team and contribute to the team's success. To make them understand the importance of working as a team. Importance of complementary skill sets, and synergy effects of a team are proved using real-life examples and classroom activities. Picture connector: To make the students participate in group interactions, create dialogue and present on the stage. Students link various pictures from newspaper to come up with a pictorial representation of a story or idea and narrate/present the same. Creativity and presentation skills are concentrated. Students also learn to connect various variables and come up with concrete ideas.

UNIT III Time and work:
Work with different efficiencies, Pipes and cisterns, Work equivalence, Division of wages Goal Setting: • To make students goal oriented and to help them realise and sketch their personal and professional goals. SMART goal technique for goal setting is taught and explained using examples. Students will be encouraged to set a personal and career goal based on the SMART technique. Tactics to deal with hurdles for attaining the goals are dealt. Famous goal setting success stories are shared to boost confidence.

UNIT IV Time Management:
To make students understand the value of time and effective management of their time. Paper tower activity helps students practically experience the importance of managing time and to improve at it. Time management grid helps students understand the importance of prioritizing. Tourism pitch: The session makes students present and promotes their choice of tourist spot or their favourite city in order to convince the client (trainer) to visit the city. Presentation skills are enhanced. Teamwork is practised during the preparation phase of the activity.

UNIT V Shopping role play:
To enable students to frame dialogues for their day-to-day life scenarios. A shopping scenario has to be mimicked by the students with impromptu conversation. This helps them in practising speaking in English in their daily conversations. Sample everyday conversations are presented for practical learning. Shipwreck: The main objective of this is to enhance the skill capacity of the students to think out of the box and try to enhance the cognitive thinking capability. Play teacher: The session makes students understand the different values and virtues like empathy- by which they will try to enact the scenario given to them try solving the problem like an adviser.

B.TECH ME SEMESTER – V

Sr. No.	Course Code	Course Name	L	T	P	Credits
1	ME3CO30	Industrial Engineering & Operations Research	3	0	0	3
2	ME3CO31	Data Science for Mechanical Engineers	2	0	2	3
3	ME3CO32	Heat & Mass Transfer	4	0	0	4
4	ME3CO33	Design and Simulation Lab -I	0	0	2	1
5	ME3CO34	Dynamics of Machine	4	0	2	5
6	ME3CO35	Thermal Lab	0	0	2	1
7		Program Elective - I	3	0	0	3
8		Program Elective - II	3	0	0	3
9		Open Elective I	3	0	0	3
		Total	**22**	**0**	**8**	**26**
		Total Contact Hours	**30**			

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO30	Industrial Engineering & Operation Research	3	0	0	3

Course Learning Objectives:

CLO1	To develop concepts related to principles of productivity & work study.
CLO2	To apply the concepts related to operational analysis & measuring work for designing the work systems.
CLO3	Review the emerging concepts and principles in work system design for productivity improvement.
CLO4	Develop the skills in the application of operations research models for complex decision making situations.
CLO5	To Implement the methodology and tools of operations research to assist decision - making.

UNIT –I: INTRODUCTION TO WORK STUDY

The basic procedure of work-study. Work study for establishing the standard time for a given activity. Method study, procedure for Method study, Principles of motion economy, Filming techniques and micro motion analysis, recording technique. Construction of process chart, Gantt chart, SIMO chart, string chart, Travel chart, Multiple activity chart, Sampling process, Critical examination analysis. Primary, secondary and tertiary stages, Search for alternatives. Steps involved in evaluation of alternatives

UNIT -II: INTRODUCTION TO WORK MEASUREMENT

Introduction to work measurement, objectives of work measurement, Techniques of work measurement. Basic procedure in time study, Advantages and limitations of time study, Time recording techniques in time study. Performance rating standard allowances, personal allowance, fatigue allowance, production delay allowance, Factors affecting the rating, Synthetic rating method

UNIT -III: INTRODUCTION TO OPERATIONS RESEARCH

Basics definition, scope, objectives, phases, models and limitations of Operations Research.Introduction to Linear Programming, Formulation of LPP, Graphical solution of LPP. Simplex Method, Artificial variables, Big-M method, two-phase method, degeneracy and unbound solutions.

UNIT- IV: TRANSPORTATION PROBLEM, ASSIGNMENT PROBLEM

Mathematical model, Balanced and unbalanced problems, Degeneracy, Optimality conditions, Methods to find starting solution and optimal solution. Assignment problem: Mathematical model, Balanced and unbalanced problems, Optimality conditions, Hungarian method. Two-person zero-sum games: Saddle points, Mixed strategies, Fundamental theorem, Computational methods using graphs and linear programming, Introduction to nonzero sum game.

UNIT- V :QUEUING THEORY, GAME THEORY

Basis of Queuing theory, elements of queuing theory, Kendall's Notation, Operating characteristics of a queuing system, Classification of Queuing models, Preliminary examples of M/M/1:∞/FCFAGame Theory: Introduction, Characteristics of Game Theory, Two Person, Zero sum games, Pure strategy. Dominance theory, Mixed strategies (2x2, mx2), Algebraic and graphical methods.

Text Books

[1]Operations Research: An Introduction by Hamdy Taha, Pearson.
[2]Operations Research by R. Paneerselvam, Prentice Hall of India Pvt. Ltd.
[3]Introduction to work study by ILO, 4th revised edition

Reference Books

[1]Operations Research by A. M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education Inc.
[2]Operations Research by P Mariappan, Pearson.
[3]Operations Research by H N Wagner, Prentice hall.

[4] Optimization in Operations Research by Ronald L. Rardin, Pearson Education Inc

Course Outcomes:

CO1	Students shall be able to apply selected industrial engineering techniques for enhancing productivity in an organization.
CO2	Students shall be able to manage projects & improve the performance of routine activities by application of appropriate industrial engineering tools.
CO3	Students shall be able to understand the basic concepts of different models of operations research and their applications.
CO4	Students shall be able to apply the models to incorporate rational decision making process in real life situations.
CO5	Students shall be able to analyze various modeling alternatives & select appropriate modeling techniques for a given situation

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO31	Data Science for Mechanical Engineers	2	0	2	3

Course Learning Objectives:

CLO1	To understand the fundamentals of data science and its relevance to mechanical engineering.
CLO2	To acquire skills in data preprocessing, exploration, and visualization.
CLO3	To apply statistical analysis techniques for data interpretation.
CLO4	To gain knowledge of machine learning algorithms and their application to mechanical engineering datasets.
CLO5	To develop practical expertise in implementing data science techniques for solving mechanical engineering problems.

Unit 1: Introduction to Data Science for Mechanical Engineering

Introduction to data science and its applications in mechanical engineering
Data acquisition and data pre-processing techniques
Exploratory data analysis and data visualization
Data quality assessment and cleaning

Unit 2: Statistical Analysis for Mechanical Engineering Data

Descriptive statistics and data summarization
Probability distributions and hypothesis testing
Statistical inference and confidence intervals
Analysis of variance (ANOVA) for experimental data

Unit 3: Data Visualization in Mechanical Engineering

Visualization techniques and best practices
Plotting libraries in Python (Matplotlib, Seaborn)
Interactive visualization using Plotly
Visualizing multidimensional data and correlation analysis

Unit 4: Machine Learning for Mechanical Engineering

Introduction to machine learning algorithms
Supervised learning: Regression and classification
Unsupervised learning: Clustering and dimensionality reduction
Evaluation and validation of machine learning models

Unit 5: Case Studies and Applications in Mechanical Engineering

Predictive maintenance and condition monitoring
Fault diagnosis and failure prediction
Optimization and design optimization using data-driven techniques
Decision support systems in mechanical engineering

Text Books:

1. "Python for Data Analysis" by Wes McKinney
2. "Introduction to Probability and Statistics for Engineers and Scientists" by Sheldon M. Ross
3. "Python Data Science Handbook" by Jake VanderPlas
4. "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow" by Aurélien Géron
5. Case studies and research papers related to data science applications in mechanical engineering

List of Practical:

1. Data Acquisition and Pre-processing Techniques:
a. Collect and pre-process sensor data from a mechanical system.
b. Perform feature extraction and selection on raw sensor data.
c. Handle missing data and outliers in a dataset.
2. Exploratory Data Analysis and Data Visualization:
a. Explore and visualize the relationships between different variables in a mechanical engineering dataset.
b. Create histograms, scatter plots, and box plots to understand the distribution and spread of data.
c. Use heatmaps and correlation matrices to identify correlations between variables.
3. Data Quality Assessment and Cleaning:
a. Evaluate the quality of a dataset by assessing missing values, duplicates, and inconsistencies.
b. Clean the dataset by imputing missing values, removing duplicates, and resolving inconsistencies.
4. Descriptive Statistics and Data Summarization:
a. Calculate and interpret descriptive statistics such as mean, median, and standard deviation for mechanical engineering data.
b. Summarize the data using measures of central tendency and variability.
5. Probability Distributions and Hypothesis Testing:
a. Fit probability distributions to mechanical engineering data and assess goodness of fit.
b. Perform hypothesis testing to compare means or proportions of different groups in a dataset.
6. Statistical Inference and Confidence Intervals:
a. Estimate population parameters and construct confidence intervals for mechanical engineering data.
b. Interpret confidence intervals in the context of mechanical engineering problems.
7. Analysis of Variance (ANOVA) for Experimental Data:
a. Conduct ANOVA to analyze the differences between multiple groups in experimental data.
b. Perform post-hoc tests to identify which groups differ significantly from each other.
8. Visualization Techniques and Best Practices:
a. Create effective visualizations for mechanical engineering data using appropriate chart types.
b. Apply best practices in data visualization, such as labeling axes, adding titles, and choosing appropriate color schemes.
9. Machine Learning Algorithms for Regression and Classification:
a. Apply regression algorithms to predict mechanical system performance based on input variables.
b. Use classification algorithms to classify mechanical components as healthy or faulty based on sensor data.
10. Unsupervised Learning: Clustering and Dimensionality Reduction:
a. Apply clustering algorithms to identify patterns or groups in mechanical engineering data.
b. Perform dimensionality reduction techniques such as Principal Component Analysis (PCA) to visualize high-dimensional data.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO32	***Heat and Mass Transfer***	4	0	0	4

Course Learning Objectives (CLOs):

CLO^{01}	To understand the phenomenon of heat transfer & different modes of heat transfer.
CLO^{02}	To understand the importance of extended surfaces & its applications.
CLO^{03}	Apply principles of heat and mass transfer to predict transfer coefficients.
CLO^{04}	Analyze working of various heat transfer equipment like heat exchanger.
CLO^{05}	To understand the various laws for Radiations heat transfer.

UNIT I CONDUCTION

Fourier heat conduction equation, its form in rectangular, cylindrical and spherical coordinates, thermal diffusivity, linear one-dimensional steady state conduction through a slab, tubes, spherical shells and composite structures, electrical analogies, critical-insulation-thickness for pipes, Lumped Parameter Analysis.

UNIT II CONVECTION

Introduction, free and forced convection; application of dimensional analysis of free and forced convection, empirical correlations for laminar and turbulent flow over flat plate and tubular geometry; calculation of convective heat transfer coefficient using data book, Thermal Boundary layer.

UNIT III EXTENDED SURFACES (FINS)

Heat transfer from a straight and annular fin for a uniform cross section; error in measurement of temperature in a thermometer well, fin efficiency, fin effectiveness, applications.

UNIT IV HEAT EXCHANGERS & MASS TRANSFER

Heat exchangers: Types- parallel flow, counter flow; evaporator and condensers, overall heat transfers coefficient, fouling factors, long-mean temperature difference (LMTD), method of heat exchanger analysis, effectiveness of heat exchanger, NTU method.

Mass transfer: Fick's law, equi-molar diffusion, diffusion coefficient, analogy with heat transfer, diffusion of vapour in a stationary medium

UNIT V THERMAL RADIATION

Nature of radiation, emissive power, absorption, transmission, reflection and emission of radiation, radiation from real surfaces; radiation heat exchange between black and gray surfaces, shape factor, radiation shields.

Text Books

1. S.P.Sukhatme, Heat and Mass Transfer, University Press Hyderabad
2. J.P.Holman, Heat Transfer, TMH
3. R. K. Rajput, Heat and Mass Transfer, S. Chand Pub.

Reference Books

1. Y Cengel, Heat and Mass Transfer, TMH
2. D.S.Kumar, Heat and Mass Transfer; S.K. Kataria and Sons.
3. P.K.Nag, Heat Transfer,TMH

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01}	Ability to understand and solve conduction heat transfer problems.
CO_{02}	Ability to design and analyze thermal heat transfer cooling systems by using principle of convection.
CO_{03}	Ability to understand the concept of natural convection and forced convection for different thermal system configurations.
CO_{04}	Ability to design and analyze the performance of heat exchangers and evaporators
CO_{05}	Ability to understand and solve radiation problems.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO33	***Design & Simulation Lab-I***	0	0	2	1

Introduction of FEA and ANSYS

Study of a FEA package and applying it on various problems

STRUCTURAL ANALYSIS

1. Stress analysis of a plate with a circular hole
2. Stress analysis of rectangular L bracket
3. Stress analysis of an axis-symmetric component
4. Stress Analysis on Cantilever Beam Subjected To single point load and UDL
5. Stress analysis of simply supported beam Subjected To single point load and UDL
6. Stress analysis of fixed beam Subjected To single point load and UDL
7. Truss subjected to transverse load
8. Analysis of a bicycle frame
9. Application of Joints and springs in ANSYS

THERMAL ANALYSIS

1. Thermal stress analysis of a 2D component
2. Conductive heat transfer analysis of a 2D component
3. Convective heat transfer analysis of a 2D component
4. Thermal analysis of Melting Using Element Death -it is subject to convection heating which will cause the block to "melt"

VIBRATIONAL ANALYSIS

1. Model frequency analysis of 2D component
2. Harmonic analysis of a 2D component

Textbooks:

1. P Seshu, Finite Element Analysis, PHI publications, Delhi
2. J N Reddy “An Introduction to finite element method” Tata Mc Graw Hill 3rd edition
3. Nitin S.Gokhale, “Practical Finite Element Analysis”, Finite To Infinite Publication
4. R C Hibbeler, “Structural Analysis by Pearson”, Pearson Education

Reference Books:

1. Finite Element Method with Applications in Engineering- Y M Desai, Pearson Publication
2. G. Ramamurty, Applied Finite Element Analysis, Dreamtech Press

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO34	**Dynamics of Machine**	4	0	2	5

UNIT I FORCE ANALYSIS IN MECHANISMS

Static force and Inertia force, D'Alembert's Principle, Static force analysis in mechanisms. Free body diagrams and equilibrium of two, three and four force members, superposition of forces and torques, Concept of dynamically equivalent system. Inertia force analysis using graphical approach - in four bar and slider crank mechanisms.

UNIT II DYNAMIC ANALYSIS OF RECIPROCATING ENGINES

Analytical expressions of displacement, velocity and acceleration of piston, Analytical expressions of Piston effort, Connecting rod force and turning moment in engines, Turning moment diagrams of Single Cylinder and Multi-cylinder Internal combustion engines, Double acting steam engines. Coefficient of fluctuation of Energy and Speed, Flywheel and it's applications in reciprocating engines and Punching and riveting Machine.

UNIT III GOVERNER MECHANISMS

Governors and its type, Types of governors, terminology of Centrifugal Governors, Different types of centrifugal Governors- Watt, Porter, Proell, Hartnell Hartung. Gravity and spring controlled Governor their performance characteristics. Different characteristics like - Stability. Isochronism and Hunting in Governors.

UNIT IV BALANCING OF INERTIA FORCES & MOMENTS

Balancing of rotating masses: Two Plane Balancing, Balancing of several masses rotating in different planes, Balancing of reciprocating masses in single cylinder IC engines, Multi-cylinder inline engine, Radial Engine V-twin engines, Concept of firing order and harmonic balancing in multi-cylinder engine.

UNIT V FUNDAMENTAL ASPECTS OF VIBRATION

Vibration, main causes, advantages and disadvantages; engineering applications of vibration and noise; classification of vibration, vector method of representing harmonic motion; characteristics of vibration, elements of vibratory system; lumped and distributed parameter systems.

Undamped Free Vibrations: Derivation of differential equation of motion: the energy method, the method based on Newton’s second law of motion, and Rayleigh’s method. Solution of differential equation of motion: Natural frequency of vibration. Systems involving angular oscillations: the compound pendulum.

Text Books

1. Rattan S.S.; Theory of machines; Mc-Graw Hills Publications.
2. Ambekar A.G.; Mechanism and Machine Theory; PHI. Eastern Economy Edition 2015
3. Rao, J.S., and Dukkipati, R.V.: “Mechanism and Machine Theory”, Wiley Eastern Ltd.
4. Jagdish Lal; Theory of Machines; Metropolitan Book Co; Delhi
5. Khurmi R.S. and Gupta J K; Theory of Machines ;S.Chand& Co.
6. Ambekar A.G.,’ Mechanical Vibrations and Noise Engineering; PHI

Reference Books

1. Bevan T., “Theory of Machines: A text book for engineering students”, 3 rd Edition, CBS, New Delhi.

2. Shigley, J.E. and Uicker, J.J. and Pennock, G. R.. “Theory of Machines and Mechanisms”, 3 rd Edition, Oxford University Press, 2005.
3. Ghosh, A, and Malick, A. K. “Theory of Mechanisms and Machines” 3 rd Edition, East West Press Pvt. Ltd., 2000

List of Experiments:

1. Determination of moment of inertia of flywheel by falling weight method.
2. To determine center of gravity of compound pendulum (Symmetrical and Unsymmetrical body).
3. Determination of center of percussion of long body.
4. Determination of radius of gyration of a bar using Bifilar suspension method.
5. To determine the performance characteristics of Watt, Porter and Proell Governor.
6. To determine the performance characteristics of Hartnell Governor.
7. To perform dynamic balancing of unbalanced rotating shaft.
8. To study the balancing of reciprocating masses in a reciprocating engine.
9. To determine the time period and natural frequency of undamped free vibration of equivalent spring mass system.
10. To study undamped torsional vibration of a single rotor with shaft.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3CO35	***Thermal Lab***	0	0	2	1

UNIT I

Experimental capabilities include study of steam generators and turbines, Performance and energy balance test on steam generators. Performance and energy balance test on steam turbines.

UNIT II

Experimental investigation of nozzle properties, jet velocity and nozzle efficiency

UNIT III

Demonstration of parts and working of compressor, Experimental investigation of compressor performance parameters

UNIT IV

Demonstration of cooling towers, Parts of cooling towers, heat exchangers, experimental investigation of performance parameters.

UNIT V

Demonstration of various condensers, Role of condensers in boiler performance.

Text Books:

1. P.K.Nag; Engineering Thermodynamics; TMH
2. B K Sarkar;Thermal Engineering; TMH
3. R K Rajput; Thermal Engineering; Laxmi Publicaions

Reference Books:

1. Van GJ; Thermodynamics; Willey Publication
2. Cengel Y; Thermodynamics; TMH
3. Moran & Shapiro; Engineering Thermodynamics, Willey Publication.

List of Experiments:

1. To determine engine performance parameters using four stroke diesel engine test rig.
2. To determine engine friction power by using Morse test using four stroke petrol engine test rig.
3. Performance test on reciprocating air compressor .
4. To determine dryness fraction of steam using separating and throttling calorimeter.
5. To determine the effectiveness of steam condenser.
6. To determine the effectiveness of parallel and counter flow heat exchanger.
7. To determine (a) exit velocity and Mach number maximum (b) discharge and efficiency of nozzle on convergent divergent nozzle test rig.
8. To determine the COP of vapour compressor and vapour absorption refrigeration cycle.
9. To Determination of thermal resistance of a composite slab.

10. To Determination of heat transfer through lagged pipe.
11. Determination of convective heat transfer coefficient in (a) natural convection process (b) forced convection process.
12. To determine the effect of thickness of insulation on heat transfer rate.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL05	***Finite Element Method***	3	0	0	3

UNIT I: INTRODUCTION

Mathematical Formulation of Engineering Problems, Types of Governing equations- Differential formulation, Energy –Integral formulation, Solution Methodologies-Analytical, Physical and Computational, Overview of approximate methods for the solution of the mathematical models- Rayleigh-Ritz method , Methods of Weighted Residuals (Galerkin, Least-squares & Collocation methods), Variation method, Finite Element Method- General description of Finite Element Method, History and Working of FEM Applications of FEM, Advantages and Limitations of FEM, FEA softwares.

UNIT II :FINITE ELEMENT MODELING

General procedure of FEM, Idealization- Mathematical Models, Implicit vs Explicit Models Various approaches in FEM- Direct Approach, Variational Approach, Energy Approach and Weighted Residual Approach, Discretization, Classification of Elements, Concept of Degree of Freedom, Boundary Conditions, Shape Function- Derivation of shape functions for various elements, Formulation of Finite element characteristic matrices and vectors, Compatibility conditions, Assembly and boundary considerations, Concept of Shape Functions.

UNIT III: STRUCTURAL ANALYSIS OF ONE-DIMENSIONAL PROBLEMS

Equilibrium of a cubical element subjected to three dimensional stresses-Concept of body and surface forces, Stress Strain relationship in three dimensional stresses, Plane Stresses and Strain.

Bar Element : Linear and Quadratic elements, Elemental stiffness matrix, Properties of global stiffness matrix; FE formulation using Potential Energy Approach, Element numbering and connectivity concept, half band width, structural and thermal strains, calculation of shape functions, elemental load vectors and stiffness matrices treatment for various boundary conditions- elimination and penalty approach.

UNIT IV: STRUCTURAL ANALYSIS OF TWO-DIMENSIONAL PROBLEMS

Plane stress and strain, Modeling using constant strain triangle (CST) element, Shape functions for CST, concept of Jacobian, calculation of stiffness matrices and load vectors using potential energy approach, Modeling using linear quad element, Shape function, Iso-parametric representation, Jacobian matrix, strain-displacement matrix, stress-strain relationship matrix, force vector, Axi-symmetric Solids subjected to axi-symmetric loading : Axi-symmetric formulation in cylindrical coordinates , Finite Element modeling, using triangular elements, shape functions, concept of stress-displacement relations and jacobian, element stiffness matrix, body and traction force vectors, temperature load vector.

UNIT V: FEA IN OTHER DOMAINS

Finite Element formulation of One- dimensional steady state Heat conduction and Convection, Hemholz equation, Concept of conductivity matrix, Heat Load Matrix, Finite Element formulation of invisicid and incompressible flow Potential function formulation, Stream function formulation. FEA in dynamic problems- single degree of freedom vibrating systems. Formulation, consistent and lumped mass matrices for 1-D and 2-D element, Solution of Eigen-value 1-D problems.

Text Books

1. T. R. Chandrupatla and A. D. Belugundu, Introdution to Finite Elements in Engineering, Prentice Hall.
2. ChennakesavaR.Alavala, Finite Element Method, Prentice Hall.
3. Y.M.Desai, T.I.Eldho, A.H.Shah, Finite Element Method, Pearson

Reference Books

1. G Laxmi Narasaiah, Finite Element Analysis, B.S.Publications
2. U.S.Dixit, Finite Element Methods for Engineers, Cengage Learning
3. S.S.Rao, The Finite Element Method in Engineering, Butterworth-Heinemann Elsevier

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL11	**Hydraulic and Pneumatic Control**	3	0	0	3

UNIT I: INTRODUCTION TO HYDRAULIC & PNEUMATIC SYSTEMS

Global fluid power Scenario, Basic system of Hydraulics-Major advantages and disadvantages, Comparison among Electrical, Hydraulics and Pneumatics System, Principles of Hydraulic Fluid power, Hydraulic Symbols, Electrical Elements used in hydraulic circuits. Basic Requirements for Pneumatic System, Basic Symbols of Pneumatic Systems, Applications of Pneumatics. Electrical elements used in Pneumatic System.

UNIT II: FLUID DYNAMICS

Fluid flow-Types of fluid flows-Continuity equation-Bernoulli's theorem-Venturi meter– Construction, principle of working, Coefficient of discharge, Discharge through venture meter.- Orifice meter-Pitot tube – Construction, Principle of working,- hydraulic coefficients -Numerical on Bernoulli's theorem, venturi meter, orifice meter.

UNIT III: HYDRAULIC SYSTEMS

Classification of hydraulic pumps, Gear Pumps, Vane Pumps, Piston Pumps, Axial piston pumps, Hydraulic motors, Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Accumulators, Heating & cooling devices, Hoses. Types of Hydraulic Actuators, Selection criterion of Actuators, Linear and Rotary Actuators, Hydrostatic Transmission Systems.

UNIT IV: PNEUMATIC SYSTEMS

General layout of pneumatic system-Advantages of pneumatic systems, Components of pneumatic system- Compressor – Reciprocating.-construction and working of FRL unit- working and symbols of-Control Valves – Pressure regulating valves, Flow Control valves, Direction Control Valves.-Actuators - Cylinders- single acting and double acting - Air motors,- piston motor-unit- - Pneumatic Symbols- ports and positions.

UNIT V : AUTOMATION & SIMULATION OF HYDRAULICS AND PNEUMATICS

Case study of Automation using Hydraulics and pneumatics. Introduction to software of hydraulic and Pneumatic system, Circuit designing in software, Simulation in software, Simulation with actual component using software like automation in industry.

Text Books

1. T. R. Chandrupatla and A. D. Belugundu, Introdution to Finite Elements in Engineering, Prentice Hall.
2. ChennakesavaR.Alavala, Finite Element Method, Prentice Hall.
3. Y.M.Desai, T.I.Eldho, A.H.Shah, Finite Element Method, Pearson

Reference Books

1. G Laxmi Narasaiah, Finite Element Analysis, B.S.Publications
2. U.S.Dixit, Finite Element Methods for Engineers, Cengage Learning
3. S.S.Rao, The Finite Element Method in Engineering, Butterworth-Heinemann Elsevier

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL17	**Advance Metrology**	3	0	0	3

Course Learning Objectives:

CLO1	To understand the principle of linear and angular measuring instruments and apply the acquired knowledge for the accurate and precise measurement of a given quantity.
CLO2	To understand High precision measurements such as Automated visual inspection in manufacturing, contact and non – contact type inspection methods
CLO3	To understand the principle of Laser Interferometer, Alignment Telescope, laser scanners for accurate and precise measurement.
CLO4	To understand the advances in Metrology such as use of CMM, Machine Vision System for Metrology etc.
CLO5	To understand the concept of Normalization, Grey scale correlation – Reflectance map concepts; surface roughness and texture characterization – photogrammetry

UNIT I DIMENSIONAL & FORM MEASUREMENTS

Principles of dimensional and form measurements - standards - measurement errors - uncertainty in measurements - some typical examples of linear and angular measurements - introduction to geometric dimensioning and tolerancing (GD&T) - measurement and evaluation of form tolerances.

UNIT II COMPUTER AIDED INSPECTION

High precision measurements – interfacing – software metrology – Automated visual inspection in manufacturing, contact and non – contact type inspection methods, Electrical field techniques, radiation techniques, ultrasonic – Atomic Force Microscopes (AFM), Talysurf instruments.

UNIT III LASER METROLOGY

Laser Interferometer, Alignment Telescope, laser scanners. On-line and in – process measurements – diameter, surface roughness, Micro holes, surface topography measurements, straightness and flatness measurement, speckle measurements.

UNIT IV COORDINATE MEASURING MACHINE

CMM Types, Applications – Non-contact CMM using Electro optical sensors for dimensional metrology – Non-contact sensors for surface finish measurements – Measurements / programming with CNC CMM – Performance evaluations – Measurement integration.

UNIT V EDGE DETECTION TECHNIQUE

Normalization, Grey scale correlation – Reflectance map concepts; surface roughness and texture characterization – photogrammetry. Application of Machine Vision in inspection – Measurement of length, diameters, Surface roughness – automated visual inspection – 3D and dynamic feature extraction. On-line Quality control: On-line feedback quality control variable characteristics – control with measurement interval, one unit, and multiple units control systems for lot and batch production.

Text Books

1. Marshall A. D. and Martin R. R. – 'Computer Vision, Models and Inspection' – World Scientific – 1998
2. NelloZuech – 'Understanding and Applying Machine Vision' – Marcel Dekker – 2000 – 2nd Edition

Reference Books

1. John A. Bosch, Giddings, and Lewis Dayton – 'Coordinate Measuring Machines and Systems' – Marcel Dekker – 1999
2. ASTE – 'Handbook on Industrial Metrology' – Prentice Hall – 1992

Course Outcomes:

CO1	Students shall be able to understand the principle of linear and angular measuring instruments and apply the acquired knowledge for the accurate and precise measurement of a given quantity.
CO2	Students shall be able to understand High precision measurements such as Automated visual inspection in manufacturing, contact and non – contact type inspection methods
CO3	Students shall be able to understand the principle of Laser Interferometer, Alignment Telescope, laser scanners for accurate and precise measurement.
CO4	Students shall be able to understand the advances in Metrology such as use of CMM, Machine Vision System for Metrology etc.
CO5	Students shall be able to understand the concept of Normalization, Grey scale correlation – Reflectance map concepts; surface roughness and texture characterization – photogrammetry

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL23	***Fundamental of Artificial Intelligence***	3	0	0	3

Course Learning Objectives:

CLO1	Understand the foundational concepts and principles of artificial intelligence (AI), including machine learning, natural language processing, and computer vision.
CLO2	Acquire knowledge of different AI techniques and algorithms used in problem-solving and decision-making tasks.
CLO3	Develop the ability to critically analyze AI applications and assess their ethical and societal implications.
CLO4	Gain practical experience in implementing AI algorithms and models using programming languages and tools commonly used in the field.
CLO5	Foster the skills necessary for effectively communicating AI concepts and results to both technical and non-technical audiences.

UNIT I INTRODUCTION

Definition – Future of Artificial Intelligence, Production systems- its types & Characteristics Characteristics of Intelligent Agents. Typical Intelligent Agents

UNIT II PROBLEM SOLVING METHODS

Problem solving Methods – Search Strategies- Uninformed – Informed – Heuristics – Local Search Algorithms and Optimization Problems – Searching with Partial Observations – Constraint Satisfaction Problems – Constraint Propagation – Backtracking Search – Game Playing – Optimal

UNIT III KNOWLEDGE REPRESENTATION

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining-Backward Chaining – Resolution – Knowledge Representation – Ontological Engineering-Categories and Objects – Events – Mental Events and Mental Objects – Reasoning Systems for Categories – Reasoning with Default Information.

UNIT IV SOFTWARE AGENTS

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems.

UNIT V APPLICATIONS

AI applications – Language Models – Information Retrieval- Information Extraction – Natural Language Processing – Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving.

Text Books

1. S. Russell and P. Norvig, “Artificial Intelligence: A Modern Approach‖, Prentice Hall, Third Edition, 2009.

2. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011.
3. M. Tim Jones, —Artificial Intelligence: A Systems Approach (Computer Science) ‖, Jones and Bartlett Publishers, Inc.First Edition, 2008
4. Nils J. Nilsson, —The Quest for Artificial Intelligence‖, Cambridge University Press, 2009

Reference Books

1. William F. Clocksin and Christopher S. Mellish, ‖ Programming in Prolog: Using the ISO Standard‖, Fifth Edition, Springer, 2003.
2. Gerhard Weiss, —Multi Agent Systems‖, Second Edition, MIT Press, 2013.
3. David L. Poole and Alan K. Mackworth, —Artificial Intelligence: Foundations of Computational Agents‖, Cambridge University Press, 2010.

Course Outcomes:

CO1	Demonstrate a comprehensive understanding of the fundamental principles and concepts of artificial intelligence, including the various subfields and techniques within the discipline.
CO2	Apply AI algorithms and models to solve real-world problems in different domains, demonstrating proficiency in implementing machine learning, natural language processing, and computer vision techniques.
CO3	Evaluate and critically analyze AI applications, considering ethical considerations, privacy concerns, and potential biases, and make informeddecisions about their use.
CO4	Utilize programming languages and tools relevant to AI, such as Python and TensorFlow, to develop and implement AI algorithms and models.
CO5	Communicate effectively about AI concepts, methods, and results through oral presentations, technical reports, and documentation, catering to both technical and non-technical audiences.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL06	*Computer Graphics & Product Modeling*	3	0	0	3

Course Learning Objectives (CLOs):

CLO_{01}	To familiarize with the basics of Components of Computer Graphics.
CLO_{02}	To familiarize with the basics of 3D elements of Computer Graphics.
CLO_{03}	To familiarize with 3D Solid Modeling.
CLO_{04}	To familiarize with the Preparation of New Product Development.
CLO_{05}	To familiarize with the designing and development of a new product.

UNIT I INTRODUCTION TO COMPUTER GRAPHICS

Historical evolution, issues and challenges, graphics pipeline, hardware and software basics; line and circle drawing algorithms, , Object representation – boundary representation, splines- cubic, Bezier, B-spline and NURBS, space partitioning

UNIT II MODELLING TRANSFORMATIONS

Matrix representation, homogeneous coordinate system, composition, 3D transformations; Illumination and shading – background, simple lighting model, shading models, intensity representation, color models, texture synthesis.

UNIT III 3D GRAPHICS

Polygon Surfaces-Polygon mesh representations, Quadric and Super quadric surfaces and blobby objects; Solid Modelling-Solid entities, Fundamentals of Solid Modelling-Set theory, regularized set operations; Half spaces, Boundary representation, Constructive solid geometry, Sweep representation, Colour models. Application Commands for3D Solid Modelling Software like Solid works /Autodesk Inventor/ PTC Creo / Catia (Any one) etc.

UNIT IV MANAGING PRODUCT DEVELOPMENT

Introduction; Business Models for New Products; Managing Product Development; Understanding Customer Needs- Identifying New Product Opportunities, Market Research for New Product Development. Introduction to Product Life Cycle Management and related software.

UNIT V ORGANIZING PRODUCT DEVELOPMENT

Product Architecture, Design for manufacturing and Prototyping; Organizing for Product Development; Developing Services and Product Service Systems; New Product Strategy- Building Markets and Creating Demand for New Products; Intellectual Property Issues in Product Development; New Product Business Plans – Strategy Consulting for New Products; Design Thinking for New Products- Designing Products for Emerging Markets; Design Thinking for New Products.

Text Books

1. Samit Bhattacharya. (2015). Computer Graphics. Oxford University Press.
2. Hearn, D. & Baker, M. P. (2003). Computer Graphics with OpenGL, (3rd ed), Pearson.

Reference Books

1. Drew Boyd & Jacob Goldenberg (2013) Inside the Box: The Creative Method that Works for Everyone
2. Joseph V. Sinfield, Edward Calder, Bernard McConnell, and Steve Colson (2012) How to Identify New Business Models, MIT Sloan Management Review Vol. 53, No.2.
3. Chun-Che Huang (2000) Overview of Modular Product Development, Proc. National Science Council ROC(A) Vol. 24, No. 3, pp. 149-165
4. Marc H. Meyer and Arthur DeTore (1999) Product Development for Services, The Academy of Management Executive, Vol. 13, No. 3, Themes: Teams and New Product Development (Aug., 1999), pp. 64-76

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01}	Understand the components of a computer graphics with object representation and to develop algorithms for graphics system components.
CO_{02}	Understand the basic principles of 3- dimensional computer graphics and express the 3D model with illumination and shading effects.
CO_{03}	Develop a 3D solid model using 3D Solid Modeling Software.
CO_{04}	Identify the customer needs in order to develop a business model for a new product.
CO_{05}	Develop strategy for designing and development of a new product.

MEDI-CAPS
UNIVERSITY

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL12	***Computational Fluid Dynamics***	3	0	0	3

UNIT I INTRODUCTION TO CFD

CFD as third dimension of engineering supplementing theory and experiment, Steps in CFD solution procedure, strengths and weakness of CFD, Flow modelling using control volume - finite and infinitesimal control volumes, Concept of substantial derivative, divergence of velocity, Basic governing equations in integral and differential forms – conservation of mass, momentum and energy (No derivations), Physical interpretation of governing equations, Navier-Stoke‘s model and Euler‘s model of equations.

UNIT II BASIC DISCRETIZATION TECHNIQUES

Introduction to grid generation (Types of grids such as structured, unstructured, hybrid, multiblock, Cartesian, body fitted and polyhedral etc.), Need to discretize the domain and governing equations, Finite difference approximation using Taylor series, for first order (Forward Difference Approximation, Backward Difference Approximation, Central difference Approximation) and second order (based on 3 node, 4 node and 5 node points),explicit and Implicit approaches applied to 1D transient conduction equation, Couette flow equation using FTCS and Crank Nicholson‘s Method, Stability Criteria concept and physical interpretation, Thomas Tri-diagonal matrix solver.

UNIT III 3D TWO DIMENSIONAL STEADY & UNSTEADY HEAT CONDUCTION

Solution of two dimensional steady and unsteady heat conduction equation with Dirichlet, Neumann, robbins and mixed boundary condition – solution by Explicit and Alternating Direction Implicit method (ADI Method), Approach for irregular boundary for 2D heat conduction problems.

UNIT IV APPLICATION OF NUMERICAL METHODS TO CONVECTION

Diffusion System Convection: first order wave equation solution with upwind, Lax–Wendroff, Mac Cormack scheme, Stability Criteria concept and physical interpretation Convection –Diffusion: 1D and 2D steady Convection Diffusion system – Central difference approach, Peclet Number, stability criteria, upwind difference approach, 1 D transient convection-diffusion system.

UNIT V ORGANIZING PRODUCT DEVELOPMENT

Solution of Navier-Stoke‘s equation for incompressible flow using SIMPLE algorithms and its variation (SIMPLER), Application to flow through pipe, Introduction to finite volume method. Introduction to any CFD tool, steps in pre-processing, geometry creation, mesh generation, selection of physics and material properties, specifying boundary condition, Physical Boundary condition types such as no slip, free slip, rotating wall, symmetry and periodic, wall roughness, initializing and solution control for the solver, Residuals, analyzing the plots of various parameters (Scalar and Vector contours such as streamlines, velocity vector plots and animation). Introduction to turbulence models. Reynolds Averaged Navier-Stokes equations (RANS), k-ϵ , k-ω . Simple problems like flow inside a 2-D square lid driven cavity flow through the nozzle.

Text Books

1. John D Anderson: Computational Fluid Dynamics- The Basics with Applications, McGraw Hill.
2. J. Tu, G.-H. Yeoh and C. Liu: Computational Fluid Dynamics: A practical approach, Elsevier.
3. W. Date: Introduction to Computational Fluid Dynamics, Cambridge University Press, India.

4. P. S. Ghoshdastidar: Computer Simulation of Fluid flow and heat transfer, Tata McGraw-Hill.

Reference Books

1. Bates, Computational Fluid Dynamics, Wiley India.
2. C. Hirsch: Numerical Simulation of internal and external flows Vol. 1, John Wiley.
3. Tannehill, Anderson, and Pletcher: Computational Fluid Mechanics and Heat transfer, CRC Press.
4. J. H. Ferziger and M. Peric: Computational Methods for Fluid Dynamics, 3rd Edition, Springer.
5. Zikanov, Essential Computational Fluid Dynamics, Wiley India.
6. Batchelor, An Introduction to fluid Dymanics, Cambridge Uni. Press, India.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL18	Production Planning & Control	3	0	0	3

UNIT I INTRODUCTION

Objectives and benefits of planning and control-Functions of production control, Types of production, job, batch and continuous, Product development and design, Marketing aspect, Functional aspects, Operational aspect, Durability and dependability aspect aesthetic aspect, Profit consideration, Standardization, Simplification.

UNIT II PROCESS DESIGN

Systems approach to process planning and design, linkage between product planning and process planning, distinction between process planning and facilities planning, types of process design, process design procedure. Break even analysis-Economics of a new design.

UNIT III FORECASTING

Characteristics of demand over time, forecasting qualitative model: Delphi, naive quantitative models: simple average, simple moving average, weighted moving average, exponential smoothing, smoothing coefficient selection, adaptive exponential smoothing, incorporating trend and seasonal components, linear regression, selection of forecasting models.

UNIT IV PRODUCTION SCHEDULING

Production Control Systems, Loading and scheduling, Master Scheduling, Scheduling rules, Gantt charts-Perpetual loading, Basic scheduling problems, Line of balance, Flow production scheduling, Batch production scheduling, Product sequencing, Production Control systems, Periodic batch control, Routing, Loading, Scheduling, forward and backward, Dispatching, priority rules, Sequencing, Johnson's algorithm for n jobs and two machines, Gantt's chart, Bar chart, Flow process chart.

UNIT V WORK STUDY

Method study, basic procedure, Selection-Recording of process, Critical analysis, Development, Implementation, Micro motion and memo motion study, work measurement, Techniques of work measurement, Time study, Production study, Work sampling, Synthesis from standard data, Predetermined motion time standards.

Text Books

1. V. Thomas , B. William, D Clay, "Manufacturing Planning and Control Systems" Galgotia Publications, New Delhi.
2. W.J. Stevensons, Operations Management, Mc-Graw Hills.
3. M.Telsang, Industrial Engineering and Production Management, S. Chand Publications.

Reference Books

1. Introduction to Work Study by ILO.
2. S.N. Chapman, Fundamentals of Production Planning and Control, Pearson
3. L. C. Jhamb, Production Planning and Control, Everest Publishing House

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL24	*Cyber Physical Production Systems*	3	0	0	3

Course Learning Objectives:

CLO1	Understand the key principles and concepts of cyber-physical systems (CPS) and their application in the context of production systems.
CLO2	Analyze the benefits and challenges associated with the integration of cyber and physical components in production processes.
CLO3	Gain knowledge of communication networks, sensors, actuators, and control systems used in cyber-physical production systems (CPPS).
CLO4	Design and develop architectures for effective integration and interoperability of cyber and physical components in production systems.
CLO5	Apply modeling and simulation techniques to analyze and optimize the performance of cyber-physical production systems.
CLO6	Identify and assess the security risks and vulnerabilities specific to cyber-physical production systems and implement appropriate security measures.

UNIT I INTRODUCTION

Cyber-Physical System, Key Features of CPS, Application Domains of CPS, Basic principles of design and validation of CPS, Challenges in CPS.

UNIT II CPS PLATFORM COMPONENTS

CPS HW platforms, Processors, Sensors and Actuators, CPS Network - Wireless, CAN, Automotive Ethernet, Scheduling Real Time CPS tasks, Synchronous Model and Asynchronous Model.

UNIT III SYNCHRONOUS & ASYNCHRONOUS MODEL

Reactive Components, Components Properties, Components Composing, Synchronous Designs and Circuits, Asynchronous Processes and operations, Design Primitives in Asynchronous Process, Coordination Protocols in Asynchronous Process, Leader Election, Reliable Transmission.

UNIT IV SECURITY OF CYBER-PHYSICAL SYSTEMS

Introduction to CPS Securities, Basic Techniques in CPS Securities, Cyber Security Requirements, Attack Model and Countermeasures, Advanced Techniques in CPS Securities.

UNIT V CPS APPLICATION

Health care and Medical Cyber-Physical Systems, Smart grid and Energy CyberPhysical Systems, WSN based Cyber-Physical Systems, Smart Cities.

Text Books

1. E. A. Lee and S. A. Seshia, “Introduction to Embedded Systems: A Cyber-Physical Systems Approach”, 2011.

2. R. Alur, “Principles of Cyber-Physical Systems,” MIT Press, 2015.
3. Raj Rajkumar, Dionisio de Niz and Mark Klein, “Cyber-Physical Systems”, Addison-Wesley, 2017

Reference Books

1. Rajeev Alur, “Principles of Cyber-Physical Systems”, MIT Press, 2015
2. Fei Hu, “Cyber-Physical Systems”, CRC Press 2013

Course Outcomes (COs):

CO1	Explain the fundamental principles and concepts of cyber-physical systems (CPS) and their relevance to production systems.
CO2	Evaluate the advantages and challenges associated with integrating cyber and physical components in production processes.
CO3	Demonstrate an understanding of communication networks, sensors, actuators, and control systems used in cyber-physical production systems (CPPS).
CO4	Design architectures that enable seamless integration and interoperability between cyber and physical components in production systems.
CO5	Apply modeling and simulation techniques to analyze and optimize the performance of cyber-physical production systems.
CO6	Identify and assess security risks and vulnerabilities specific to cyber-physical production systems and develop appropriate security measures.

SEMESTER – VI (ME)

Sr. No.	Subject Code	Courses	L	T	P	Credit
1	ME3CO36	Computer Integrated Manufacturing	4	0	0	4
2	ME3CO37	Refrigeration & Air Conditioning	3	0	2	4
3	ME3CO38	Design and Simulation Lab -II	0	0	2	1
4	ME3CO39	Machine Design	4	0	0	4
5		Program Elective - III	3	0	0	3
6		Program Elective - IV	3	0	0	3
8		Open Elective -II	3	0	0	3
9	ME3PC05	Mini Project -II	0	0	4	2
10	EN3NG05	Soft Skills -III	2	0	0	2
		Total	22	0	8	26
		Total Contact Hours	30			

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3CO36	Computer Integrated Manufacturing	4	0	0	4

Course Learning Objective:

CLO01 : To Develop an ability to apply knowledge of fundamentals of Production system to modern manufacturing organisation

CLO 02 : To understand the life of product cycle and management. To study various ways of employing computer in different aspect of engineering

CLO 03 : To understand and apply NC, CNC machine and its part programming fundamentals

CLO 04 : To understand various Group technology concept and part coding system and its application

CLO 05 : To understand different types of Rapid prototyping methodology

Unit I Introduction

Information requirements of mfg organizations; business forecasting and aggregate production plan; MPS, MRP and shop floor/ Production Activity Control (PAC); Mfg as a system, productivity and wealth creation; production processes on volume-variety axes; importance of batch and job shop production; CIM definition and CIM wheel, evolution and benefits.

Unit II Product Life Cycle (PLC)

Design for mfg (DFM) and concurrent engg; product design in conventional and CIM environment; terms like CAD, CAE, CAM, CAP, CAPP, CATD and CAQ.

Unit III Numeric control and part programming

Principles of NC machines, CNC, DNC; NC modes of point to point, -line and 2D, 3D contouring; NC part programming; ISO standard for coding, preparatory functions(G)- motion, dwell, unit, preset, cutter compensation, coordinate and plane selection groups; miscellaneous (M) codes; CLDATA and tool path simulation; ISO codes for turning tools and holders; ATC, modular work holding and pallets; time and power estimation in milling, drilling and turning; adaptive control, sequence control and PLC; simple part programming examples.

Unit IV Group Technology

Importance of batch and job shop production; merits of converting zigzag process layout flow to smooth flow in cellular layout, Production Flow Analysis (PFA) and clustering methods; concept of part families and coding; hierarchical, attribute and hybrid coding; OPITZ, MICLASS and DCLASS coding; FMS; material handling; robots, AGV and their programming; agile mfg; Computer Aided Process Planning (CAPP), variant/ retrieval and generative approach

Unit V Rapid Prototyping

Introduction, basic concepts, Need - Development of Rapid Prototyping systems, Rapid Prototyping process chain - Impact of Rapid Prototyping on Product Development –Digital prototyping - Virtual prototyping- Rapid Tooling - Benefits-Applications. Stereolithography (SLA), Solid Ground Curing (SGC), Fused deposition Modeling (FDM), Laminated object manufacturing (LOM), Selective Laser Sintering (SLS), Powder based 3DP systems.

Text Books:

1. S.Kant Vajpay; Principles of CIM; PHI
2. PN Rao CAD/CAM;TMH
3. MP Groover ; Automation, Production Systems & CIM; P.H.I.

Reference Books:

1. PN Rao , NK Tiwari , TK Kundra ; Computer Aided Manufacturing; TMH
2. A Alavudeen, N Venkteshwarn; Computer Integrated Mfg; PHI
3. P Radhakrishnan, S Subramanian and V Raju ; CAD/CAM/CIM; New age Pub

Course Outcomes (COs):

CO01: To understand Manufacturing and CIM Concept, Product Life Cycle (PLC) Management
CO02: To understand Numeric control technique and Part programming fundamentals ,Group Technology and various Rapid, Prototyping methods
CO 03: To analyze the part drawing for CNC Part programming
CO 04: To apply the concept of Part Programming fundamental to generate the Part Program for various machining operations
CO 05: To create work part on CNC machine by Part programming concepts

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3CO37	Refrigeration and Air Conditioning	3	1	2	5

Course Learning Objective:

CLO 01: Define the fundamental principles of thermodynamics and heat transfer as they apply to refrigeration and air conditioning systems. Identify and explain the basic components of a refrigeration cycle.

CLO 02: Analyze and design simple refrigeration and air conditioning systems based on given specifications.

CLO 03: Evaluate the performance of different refrigerants and select appropriate ones based on specific applications.

CLO 04: Describe the function and operation of key components in refrigeration and air conditioning systems, such as compressors, condensers, evaporators, and expansion devices. Analyze the impact of various components on the overall system efficiency.

CLO 05: Demonstrate the ability to install, commission, and troubleshoot common issues in refrigeration and air conditioning systems. Develop preventive maintenance strategies to ensure the longevity and efficiency of these systems.

UNIT -1 Introduction & Air Refrigeration cycles

Different methods of refrigeration, EER, COP, Tonne of refrigeration, Carnot air cycle, Joule's cycle or Bell Coleman cycle, Boot-strap cycle, Reduced ambient cycle and Regenerative cooling cycle.

UNIT-2 VCR Cycles

Carnot cycle with vapor as a refrigerant, Rankine cycle with p-v and T-s diagram, p-h diagram, sub-cooling and super heating, effects of condenser and evaporator pressure on COP, Liquid suction heat exchanger, Actual VCR cycle on T-s and p-h diagram. . Refrigerants: nomenclature & classification, desirable properties, common refrigeration, Environment friendly refrigerants.

UNIT-3 Vapor Absorption System & Multi Pressure system

Vapour absorption system: Theoretical and practical systems such as aqua-ammonia, Electrolux & other systems.

Removal of flash gas, Multiple expansion & compression with flash inter cooling; Low temperature refrigeration: Production of low temperatures, Cascade system

UNIT-4 Psychrometry and Comfort Air Conditioning

Air properties, Psychrometric chart, Psychrometric processes: Sensible heating and cooling, Evaporative cooling, Cooling and dehumidification, Heating and humidification, Mixing of air stream, Sensible heat factor. Comfort Air Conditioning; Mechanism of Body Heat Loss, Unit of Metabolic Heat Generation, Effective Temperature, Comfort Chart & Thermal Sensation.

UNIT-5 Air Conditioning system and Air Conditioning Loads

Air conditioning system & its Types, Air conditioning loads: calculation of summer & winter air conditioning load, bypass factor of coil, calculation of supply air rate & its condition, room sensible heat factor, grand sensible heat factor, effective sensible heat factor, dehumidified air quantity. Problems on cooling load calculation.

Text Books:

1. C.P. Arora, Refrigeration and Air conditioning, Tata McGraw-Hill Publisher, Company, New Delhi, 4e, 2006
2. Edward G. Pita, Air Conditioning Principles and systems, Parson Education Pte. Ltd., Indian Branch, 482 F.I.F. Patparganj.
3. W.F. Stoecker, Refrigeration and Air conditioning, McGraw-Hill Book Company, 1e, 1985.
4. Manohar Prasad, Refrigeration & Air Conditioning, New Age International (P) Limited, Publishers, 7/30 A, Daryaganj, New Delhi -10002.
5. PL Balani, Refrigeration & Air conditioning, Khanna Publishers, 2-B Nath Market, Nai Sadak, Delhi - 110006

List of Practical's:-

Determination of COP of three fluid ELECTROLUX absorption refrigeration systems.
Study of various components and working of simple vapor compression cycle refrigeration trainer.
Determination of COP of simple vapor compression cycle refrigeration system on the trainer.
Study of various components and working of thermoelectric based refrigeration system on TCL hot & cold water dispenser.
Study of various components and working of air conditioning system on re-circulated type trainer.
Plotting the change in the psychometric properties of air under sensible heating, sensible cooling and heating with humidification; on re-circulated type air conditioning trainer
Study the various components and working of window air conditioning system.
Study the various components and working of three fluid ELECTROLUX absorption refrigeration systems.
Study of Steam Jet Refrigeration system.
Study of Domestic Refrigerator.

Course Outcomes (COs):

CO 01: Apply thermodynamic principles to analyze and optimize the performance of refrigeration and air conditioning systems. Design efficient systems that meet specific cooling requirements.

CO 02: Integrate and troubleshoot various components within a refrigeration and air conditioning system. Develop the ability to modify existing systems to meet new requirements.

CO 03: Adhere to safety guidelines and regulations in the design, installation, and maintenance of refrigeration and air conditioning systems.

CO 04: Communicate effectively, both orally and in writing, about technical concepts related to refrigeration and air conditioning.

CO 05: Demonstrate the ability to stay current with advancements in refrigeration and air conditioning technology.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3CO38	Design and Simulation Lab -II	0	0	2	1

Course Objectives:

CLO 01 : To Understand the Basics of Simulation:

CLO 02 : Learn to navigate and utilize key features of simulation software effectively.
CLO 03 : Analyze and interpret simulation results, including statistical analysis of data.
CLO 04 : Understand the trade-offs involved in optimization processes.
CLO 05 : Develop project management skills in the context of simulation studies.

Study of a FEA, Application of FEA in Simulation Based Software
Introduction to CFD Basics:
CFD Case Study-1
CFD Case Study-2
Various Problems need to be solved by CFD Software
Analysis of laminar fluid flow in straight pipe in Ansys workbench fluent
Analysis of turbulent fluid flow in straight pipe in Ansys workbench fluent
Analysis of fluid flow in helical pipe in Ansys workbench fluent
Analysis of fluid flow in straight pipe in Ansys workbench CFX
Analysis of flow in venturi meter for Pressure gradient and velocity Gradient
Analysis of 3-D Airfoil wing and calculate the coefficient of drag and coefficient of lift
Analysis of various Car Bodies for the Lift and Drag Force
Analysis of Ceiling fan air thrown in a Room
Analysis of Centrifugal Pump water Throw
Analysis of any one hydraulic turbine

Text Books:
1. Introduction to Computational Fluid Dynamics- Anil W. Date, Cambridge University Press
2. Finite Element Analysis - P Seshu, PHI publications, Delhi
3. Introduction to Computational Fluid Dynamics: Development, Application and Analysis- Atul Sharma, Wiley

References:
1. Finite Element Method in Machine Design"- V.Ramamurti, Norosa Publishing House
2. An Introduction to Computational Fluid Dynamics: The Finite Volume Method- H. Versteeg, Pearson
3. Applied Computational Fluid Dynamics- S. C. Gupta, Wiley publication
4. Introduction to Finite Element Analysis- Tirupathi R. Chandrupatla & Ashok D Belegundu, Pearson Publication

Course Outcomes:

CO 01 : Develop mathematical models for simulating real-world systems.

CO 02 : Demonstrate proficiency in using simulation tools to model and analyze complex systems.

CO 03 : Analyze simulation data, draw conclusions based on the results.

CO 04 : Work effectively in teams to design, implement, and analyze simulation studies.

CO 05 : Communicate simulation results, insights, and recommendations through reports and presentations.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3CO39	Machine Design	4	0	0	4

Course Learning Objective:

CLO1: Define and explain the fundamental principles of machine design, including statics, dynamics, and materials.

CLO2: Analyze forces and moments acting on machine components and structures.
CLO3: Understand the properties of materials commonly used in machine design.
CLO4: Select appropriate materials based on mechanical, thermal, and environmental considerations.
CLO5: Identify and analyze different machine elements, such as gears, bearings, shafts, and springs.
CLO6: Apply theories and equations to design machine components that meet specified criteria.

Unit I
Design against Static & Fluctuating loads: Types of loads, design under static and fluctuating loads, Stress concentration and its effect on ductile and brittle materials, stress concentration factor for various geometries, cyclic stresses, notch sensitivity, design for finite and infinite life, Theories of failures : Soderberg, Goodman & Gerber criteria.

Unit II
Design of Bolted, Riveted and welded Joint (elaborative)

Unit III
Shafts: design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments.
Design of Spur Gear: Force analysis of gear tooth, modes of failure, beam strength, Lewis equation, form factor, formative gear and virtual number of teeth; Gear materials; Surface
strength and wear of teeth; strength against wear; Design of straight tooth spur Gears.

Unit IV
Design of Brakes
Brakes: Various types of Brakes, band brakes. Self-energizing condition of brakes, Design of shoe brakes Internal & external expanding.
Design of Clutches
Clutches: Various types of clutches in use, Design of friction clutches, single disc. multidisc, Cone & Centrifugal, Torque transmitting capacity.

Design of Leaf and helical springs subjected to static load

Unit V

Journal Bearing: Types of lubrication, viscosity, hydrodynamic theory, design factors, temperature and viscosity considerations heat dissipation and thermal equilibrium, boundary lubrication, dimensionless numbers, Design of journal bearings,
Rolling-element Bearings: Types of rolling contact bearing, bearing friction and power loss, bearing life; Radial, thrust & axial loads; Static & dynamic load capacities; Selection of ball and roller bearings.

Text Books:

1. J.E.Shigley, Machine Design, TMH
2. V. B.Bhandari, Design of Machine Elments, TMH
3. P.C.Sharma and D.K.Agrawal, Design of Machine Elements, S. K. Kataria & Sons Pub.

Reference Books:

1. Hall and Somani, Machine Design, Schaum Series, TMH
2. A. Mubeen, Machine Design, Khanna Pub.
3. R.Norton, Design Of Machinery, TMH

List of Practicals

1. Design of Journal bearing.
2. Design and drawing of Roller bearing.
3. Design and drawing of Spur Gears.
4. Design and drawing of Flat & V-belt drives.
5. Design and drawing of helical springs.
6. Design and drawing of Cylinder head and Piston.
7. Design and drawing of Shafts.
8. Design and drawing of Single plate/Multiplate clutch.
9. Design and drawing of Centrifugal Clutch.
10. Design and drawing of Shoe Brakes.

Course Outcomes:

CO 01 : Demonstrate knowledge of materials, stress analysis, and loading conditions.
CO 02 : Perform preliminary calculations for mechanical components, considering factors such as loads, stresses, and material properties.
CO 03 : design key machine elements such as shafts, bearings, gears, and springs.
CO 04 : strategies to prevent failures through proper design considerations.
CO 05 : Develop strategies for predictive and preventive maintenance.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3EL10	Product Design and Development	3	0	0	3

Course Learning Objective:

CLO 01 : To Confidence to create new product based on mechanical design engineering.

CLO 02. Students will have knowledge of all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.

CLO 03. Students will have ability to solve open-ended problem belongs to design engineering that meet the requirements.

CLO 04 Students will have ability to understand contemporary issues and their impact on provided solution.

Unit- I: Design Fundamentals:

The importance of engineering design – types of design –the design process – relevance of product lifecycle issues in design –designing to codes and standards- societal considerations in engineering design –generic product development process – various phases of product development-planning for products –establishing markets- market segments- relevance of market research.

Unit – II: Customer oriented design & Societal Considerations :

Identification of customer needs- customer requirements- Quality Function Deployment Product Design Specifications- Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics - Ethical conflicts – Environment responsible design-future trends in interaction of engineering with society.

Unit – III: Material selection processing and Design:

Material Selection Process – Economics – Cost Vs Performance – Weighted property Index – Value Analysis – Role of Processing in Design – Classification of Manufacturing Process – Design for Manufacture – Design for Assembly –Designing for castings, Forging, Metal Forming, Machining and Welding – Residual Stresses – Fatigue, Fracture and Failure.

Unit- IV: Design Methods:

creativity and problem solving- creative thinking methods- generating design concepts - systematic methods for designing –functional decomposition – physical decomposition – functional representation – morphological methods-TRIZ- axiomatic design. Decision making theory- utility theory –decision trees – concept evaluation methods.

Unit- V: Industrial Design concepts:

human factors design –user friendly design – design for serviceability – design for environment – prototyping and testing – cost evaluation –categories of cost –overhead costs – activity based costing – methods of developing cost estimates – manufacturing cost –value analysis in costing

Text Books:

Product Design, by Kevin Otto, Kristin wood, Pearson Education Inc.

Product design and development, by K.T. Ulrich and S.D. Eppinger, Tata McGraw Hill.

Product Development, by Chitale & Gupta, Tata McGraw Hill.

Reference Books:

The Mechanical Process Design, by David Ullman, McGrawhill Inc
Engineering Design Process, by Yousef Haik, T M MShahin, Cengage Learning
Product design & process Engineering by Niebel & deeper, McGraw hill
Value Management by Heller, Addison Wasley
New Product Development Timjones. Butterworth Heinmann, Oxford.

Course Outcome:

CO 01. Confidence to create new product based on mechanical design engineering.

CO 02. Students will have knowledge of all mechanical aspects of product design by incorporating concept, creativity, structural, manufacturing, esthetic etc.

CO 03. Students will have ability to solve open-ended problem belongs to design engineering that meet the requirements.

CO 04. Students will have ability to understand contemporary issues and their impact on provided solution.

Course Code	Course Name	Hours per Week			Total	Total
		L	T	P	Hrs.	Credits
ME3EL25	Additive manufacturing	3	0	0	3	3

Course Objective

CLO 01: Students undergoing this course are expected to know the principles, methods, applications, possibilities/limitations as well as environmental impact of additive manufacturing technologies.

CLO 02: Students undergoing this course are expected to be familiar with the characteristics of various materials that are used in additive manufacturing.

Unit I

Introduction: Overview, History, Classification , Subtractive vs Additive Manufacturing, AM vs Reverse Engineering, AM technology in product development, Materials for AM , Tooling , Application Domain

Unit II

Liquid based and Solid Based AM Systems: Classification – Liquid based system – Stereolithography – Principle, process, advantages and applications – Solid based system – Fused Deposition Modeling – Principle, process, advantages and applications, Laminated Object Manufacturing.

Unit III

Powder based AM Systems: Selective Laser Sintering – Principles of SLS process – advantages and limitations, Direct Metal Laser Sintering - Principles of DMLS process – advantages and limitations, 3D Printing - Principles – advantages and limitations, Selective Laser Melting - Laser Engineered Net Shaping – Electron Beam Melting.

Unit-IV

Direct Energy Deposition: Electron Beam Freedom Fabrication Principles – advantages and limitations, Wire-Laser AM - Principles – advantages and limitations, Wire Arc Additive Manufacturing (WAAM) - Principles – advantages and limitations

Unit-V

Post-processing, Defects, Inspection and Future Prospects: Various in-situ and ex-situ techniques – Heat Treatment – Types of post-machining operations – Defects and Inspections – Upcoming AM Techniques including Friction Stir Additive Manufacturing (FSAM) – Hybrid Additive- Subtractive Manufacturing.

Course Outcomes:

The expected outcome of the course is trained student who will be able innovating new processes, can select right process for the right component and can provide basic scientific understanding of this emerging technology. Course outcomes are furnished point wise.

CO 01: Describe the differences and of the application of a range of additive manufacturing processes.
CO 02: Select and use correct CAD formats in the manufacturing of a 3D printed part.
CO 03: Understand the operating principles, capabilities and limitations of liquid and solid based additive manufacturing system, including fused deposition modelling and stereo-lithography.
CO 04: Appraise operating principles, capabilities and limitations of powder-based additive manufacturing system, including 3D printing and laser sintering.
CO 05: Describe important process parameters for bio-manufacturing and determine an appropriate technique for efficient bio-manufacturing.

Text Books:

Ian Gibson, David W. Rosen and Brent Stucker, Additive manufacturing technologies: rapid prototyping to direct digital manufacturing, Springer, 2010

C.K. Chua, K.F. Leong and C.S. Lim, Rapid prototyping: Principles and applications, 3rd Edition, World Scientific, 2010

Reference Books:

Andreas Gebhardt, Understanding additive manufacturing: rapid prototyping, rapid tooling, rapid manufacturing, Hanser Publishers, 2011

L. Lu, J. Fuh and Y. S. Wong, Laser-induced materials and processes for rapid prototyping, Kluwer Academic Press, 2001

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3EL19	Program Elective Operations Management	3	0	0	3

Course Learning Objectives (CLOs):

CLO01	To familiarize with the concept of Production and operations management, product and process
CLO02	Gain the knowledge of system design.
CLO03	Understand about service operations and quality management tools.
CLO04	Apply the concepts of forecasting, line balancing, facility location and layout.
CLO05	Apply the concepts of project management, MRP and product structure.

Unit I

Introduction: Operations Management: Introduction and overview, Operations Management Strategy framework, Responsibilities of operation manager Understanding similarities and difference among goods and services, Historical evolution of operations management-Changes & Challenges.

Unit II

Product Development: Operations strategy, Product Strategy and integrated product development, Process Strategy, Systematic approach to capacity planning, Capacity Decisions, Facilities Location Strategies, BPO, DFM, DFE, 3'S

Unit III

System Design: Facilities Layout and Material Handling Strategy, Group Technology, Flexible manufacturing system, Assembly line balancing, Project Management-CPM PERT, Line of Balance (LOB). Traditional v/s Concurrent Design, form & functional design, simplification & standardization

Unit IV

Planning and Managing Operations: Purchasing, vendor selection and material management, Just-in-Time Systems, MPS. Materials Requirement Planning, MRP II and ERP Aggregate Operations Planning, Product structure tree,

Unit V

Advance Operation Management: Service Operations Management, Lean systems, Constraint management – TOC, Computer integrated manufacturing, Analytical tools for decision support system (DSS) for operations management, Kanban and CONWIP, shop floor controls, Kaizen.

Text Books:

Chary S N , Production and Operations Management, Tata Mc Graw Hill
Chase, Jacobs and Aquilano, Operations Management for Competitive advantages, Tata Mc Graw Hill
Everett Adam, Ronald J Ebert, Production and Operations Management Prentice Hall

Reference Books:

Joseph G. Monks, Operations Management Theory and Problems, Mc. Graw Hill .
William J Stevenson, Operations Management Concepts, McGraw Hill
Norman Gaither, Greg. Frazier , Operation Management, Thomson

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO01 Understanding of Production and operations management, product and process.

CO02 Understanding of System design and its concepts.

CO03 Understanding of Quality and service management

CO04 Ability to apply knowledge of forecasting, line balancing, facility location and layout

CO05 Ability to apply knowledge of Apply the concepts of project management, MRP and product.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
ME3EL20	Program Elective Lean Manufacturing	3	0	0	3

CLO 01 : Understand the principle and concepts of Lean Manufacturing

CLO 02 : Explore and understand the various secondary tools used in lean manufacturing

CLO 03 : Explore various tools and techniques used in TQM for process improvement

CLO 04 : Learn how to implement TPM strategies to improve Equipments reliability and minimize downtime.

CLO 05 : Understand the fundamental principles and concepts of Design of Experiments (DOE)

Unit-1 Introduction Lean Manufacturing: Introduction, Definitions of Lean manufacturing, explaining basic concepts. Overview of historical development. Management theory. 5-S, Workplace organization, Total Productive Maintenance, Process mapping/ Value stream mapping, Work cell.

Unit-2 Secondary Tools of Lean manufacturing: Objective and benefits of Secondary lean tool, Cause and Effect diagram, Pareto chart, Spider chart, Poka yoke, Kanban, Automation, Single minute exchange of die (SMED), Design for manufacturing and assembly, Just in time (JIT), Visual workplace, OEE

Unit-3 TQM Tools And Techniques: The seven traditional tools of quality, New management tools, and Six sigma: Concepts, methodology, applications to manufacturing, service sector including IT, Bench marking, Reason to bench mark, Bench marking process, FMEA, Stages, and Types. Quality circles ,Quality Function Deployment (QFD), Taguchi quality loss function, TPM ,Concepts, improvement needs, Cost of Quality , Performance measures

Unit-4 Total Productive Maintenance: Objectives and functions, Tero technology, Reliability Centered Maintenance (RCM), maintainability prediction, availability and system effectiveness, maintenance costs, maintenance organization. Minimal repair, maintenance types, balancing PM and breakdown maintenance, Primary and secondary tool for TPM, Case studies related to TPM.

Unit-5 Design of Experiments: Introduction , Methods, Taguchi approach, Achieving robustdesign, Steps in experimental design Designing for Quality: Introduction to Concurrent Engineering, Quality Function Deployment (QFD) and Failure Mode and Effect Analysis (FMEA), Concept, Methodology and

Application (with case studies). Quality in Service Sectors: Characteristics of Service Sectors, Quality Dimensions in Service Sectors, Measuring Quality in Different Service Sectors.

Text Books:

1. Mitra A., “Fundamentals of Quality Control and Improvement”, PHI, 2nd Ed., 1998.
2. J Evans and W Linsay, The Management and Control of Quality, 6'th Edition, Thomson, 2005

Reference Books:

1. Besterfield, D H et al., “Total Quality Management”, 3rd Edition, Pearson Education, 2008.
2. Dale H.Besterfiled, “Total Quality Management”, Pearson Education Asia List of Open Source Software/learning website:1. www.nptel.ac.in/

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO 01 : Learn the core concepts of Lean like 5-S, Workplace organization, Total Productive Maintenance, Process mapping/ Value stream mapping.

CO 02 : Enhance problem-solving skills using secondary tools of lean manufacturing like Cause and Effect diagram, Pareto chart, Poka yoke, Kanban, Automation, Single minute exchange of die (SMED), Just in time (JIT), Visual workplace, OEE

CO03 : Develop problem-solving skill by applying TQM methodologies in real-world scenarios.

CO 04 : Develop problem-solving skill by applying TPM methodologies in real-world scenarios.

CO 05 : Develop problem-solving skill by identifying and addressing sources of variation in experiments.

Course Code	Course Name	Hours per Week			Total	Credits
		L	T	P		
RA3EL27	Machine Learning in Manufacturing	3	0	0	3	3

COURSE OBJECTIVES

CLO 01. To understand pattern classification algorithms to classify multivariate data

CLO 02. To understand the Implementation of genetic algorithms

CLO 03. To gain knowledge about Q-Learning

CLO 04. To create new machine learning techniques

Unit I

Introduction Machine Learning: What is machine learning; varieties of machine learning, learning input/output functions, bia, sample application. Boolean functions and their classes, CNF, DNF, decision lists. Version spaces for learning, version graphs, learning search of a version space, candidate elimination methods.

Unit II

Neural Networks and Genetic Algorithms: Neural Network Representation Problems Perceptions Multilayer Networks and Back Propagation Algorithms – Advanced Topics – Genetic Algorithms Hypothesis Space Search– Genetic Programming – Models of Evolutions and Learning

Unit III

Computational Learning: Statistical Learning, background and general method, learning belief networks, nearest neighbour. Decision-trees, supervised learning of uni-variance decision trees, network equivalent of decision trees, over fitting and evaluation.

Unit IV

Instant based Learning: Inductive Logic Programming, notation and definitions, introducing recursive programs, inductive logic programming vs decision tree induction.

Unit V

Advanced Learning: Computational learning theory, fundamental theorem, Vapnik Chernonenkis dimension, linear dichotomies and capacity. Unsupervised learning, clustering methods based on Euclidian distance and probabilities, hierarchical clustering methods. Introduction to reinforcement and explanation-based learning.

COURSE OUTCOMES

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

CO 01. Develop and apply pattern classification algorithms to classify multivariate data.

CO 02. Develop and apply regression algorithms for finding relationships between data variables.
CO 03. Develop and apply reinforcement learning algorithms for learning to control complex systems.
CO 04. Write scientific reports on computational machine learning methods, results and conclusions

Text Books:

Introduction to Machine learning, Nils J.Nilsson
Introduction to Machine Learning with Python A guide for data scientists, Andreas, C. Muller & Sarah Guido, O'Reilly
Tom M. Mitchell, “Machine Learning”, McGraw-Hill, 2010
Bishop, Christopher. Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995

Reference Books:

Ethem Alpaydin, (2004) “Introduction to Machine Learning (Adaptive Computation and Machine Learning)”, The MIT Press
T. Astie, R. Tibshirani, J. H. Friedman, “The Elements of Statistical Learning”, Springer (2nd ed.), 2009.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
	Open Elective -I				
OE00085	Innovation and Entrepreneurship	3	0	0	3

Unit 1:

Introduction to Technological Innovation:

Basic Concepts and Definitions, Technology, Technology Management, Invention, Innovation, The Concept of Technological Innovation, Innovation Posture, Propensity and Performance, Innovation Measurement, Competitiveness, A Historical and Socio-Technical Perspective on Innovation, Common Frameworks and Typologies, to Characterize Innovations.

Unit 2:

Managing for Innovation:

Key Issues in Innovation Management, Innovation and Competitive Advantage, Types of Innovation, The Importance of Incremental Innovation, Innovation as a Knowledge-based Process, The Challenge of Discontinuous Innovation, Christensen's Disruptive Innovation Theory.

Innovation as a Management Process:

Innovation as a Core Business Process, Evolving Models of the Process, Consequences of Partial Understanding of the Innovation Process, Successful Innovation and Successful Innovators, Roadmaps for Success, Key Contextual Influences.

Unit 3:

Creating and starting the Venture:

Sources of new Idea, methods of generating ideas, creative problem solving, opportunity recognition, product planning and development, opportunity recognition.

Customer and Solution:

Understand who is the customer, who is the consumer, what are the market types, Identify customer segments and niche, Identify jobs, pains, gains, and early adopters, and use them to craft your value proposition, establish your venture's unique value proposition and competitive advantage.

Business Model:

Basics of Business Model and Lean Approach, Introduction to the Lean Canvas and understand the various components, Sketch a business model for your venture using the Lean Canvas, Identify the riskiest assumptions of your model.

Unit 4:

Validation:

Refine your value proposition using the Blue Ocean Strategy, Build Solution Demo and conduct Solution Interviews, Fine-tune your canvas based on research and customer feedback

Exploring Ways to Increase Revenue:

Understand the cycle of customer acquisition, activation, retention, revenue generation, and referrals to attract new customers, Identify primary and secondary revenue streams, Identify new markets and new customer segments, Explore licensing and franchising options for expansion

Unit 5:

Marketing and Sales:

Positioning and branding – Getting the word out about your new product/service, Identify the channels available to reach your potential customers, Make a Sales Plan using the Funnel approach.

Creating a Branding and Channel Strategy:

Define a positioning statement, Create a public image and presence for your business, Select a brand name, logo, social media handles, and mobile app names for your venture, Create online public profiles, Select the right channels for your venture using the Bull's-eye Framework.

Text Books:

Joe Tidd, John R. Bessant, (2018) Managing Innovation: Integrating Technological, Market and Organizational Change, 6th Edition, Wiley.

Ravichandran M. & Prasanna N., (2022), "Innovative Entrepreneurship", Notion Press; 1st edition.

Elias G. Carayannis, Elpida T. Samara, Yannis L. Bakouros,(2015). Innovation and Entrepreneurship Theory, Policy and Practice, Springer International Publishing Switzerland.

Reference Books:

Martha Corrales-Estrada,(2019) "Innovation and Entrepreneurship: A New Mindset for Emerging Markets", Emerald Publishing Limited.

Eric Ries, (2017). "The startup way: how modern companies use entrepreneurial management to transform culture and drive long-term growth", New York: Currency.

Matt Ridle, (2020), "How Innovation Works: And Why It Flourishes in Freedom", Harper.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
	Open Elective -II				
OE00036	Renewable Sources of Energy	3	0	0	3

Unit-I

Introduction: Causes of Energy Scarcity, Solution to Energy Scarcity, Factors Affecting Energy Resource Development, Energy Resources and Classification, Renewable Energy – Worldwide Renewable Energy Availability, Renewable Energy in India.

Unit-II

Solar Energy: Energy from Sun, Types of Solar Collectors, Material Aspects of Solar Collectors, Concentrating Collectors, Parabolic Dish , Solar Water Heating Systems, Applications of Solar Water Heating Systems, Active Solar Space Cooling, Solar Air Heating, Solar Dryers, Crop Drying, Solar Cookers, Solar pond. Solar Cells: Components of Solar Cell System

Unit-III

Wind Energy: Windmills, Wind Turbines, Wind Resources, Wind Turbine Site Selection. Geothermal Energy: Geothermal Systems, Classifications, Geothermal Resource Utilization Geothermal Based Electric Power Generation

Solid waste and Agricultural Refuse: Waste Recovery Management Scheme, Advantages and Disadvantages of Waste Recycling, Sources and Types of Waste,Recycling of Plastics.

Unit-IV

Biomass Energy:Biomass Production, Energy Plantation,Biomass Gasification, Updraft and Downdraft Gasifiers, Fluidized Bed Gasification, Use of Biomass Gasifier.

Biogas Energy: Introduction, Biogas and its Composition, Anaerobic Digestion, Biogas Production, Benefits of Biogas,

Unit-V

Ocean Thermal Energy: Introduction,Principles of Ocean Thermal Energy Conversion (OTEC), Ocean Thermal Energy Conversion plants,

Tidal Energy: Introduction, Tidal Energy Resource, Tidal Energy Availability, Tidal Power Generation in India

Text Books

Kothari, Singal&Rajan; Renewable Energy Sources and Emerging Technologies, PHI

B.H Khan, Non Conventional Energy, TMH.

Sukhatme and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.

Reference Books

K. Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.

C.S.Solanki, Solar Photovoltaics: Fundamental, technologies and Application, PHI

A.Tasneem and SA Abbasi; Renewable Energy Sources; PHI Learning.

SEMESTER – VII

Sr.No.	Course Code	Course Name	L	T	P	Credits
1		Program Elective - V	3	0	0	3
2		Program Elective - VI	3	0	0	3
3		Open Elevtive III	3	0	0	3
4	ME3PC12	Project-1	0	0	8	4
5	ME3PC03	Industrial Training	0	2	0	2
6	EN3NG06	Open Learning courses	1	0	0	1
		Total	**10**	**2**	**8**	**16**
		Total Contact Hours	**20**			

Course Code	Course Name	Hours per Week			Total	Total
		L	T	P	Hrs.	Credits
ME3EL09	Tool Design	3	0	0	3	3

Course Learning Objectives:

CLO01 To understand the design principles of Jigs and Fixtures for different operations

CLO02 To understand the design principles of Press Tools and Dies for sheet working

CLO03 To understand the design intricacies of Dies and Punches for Forging process

CLO04 To understand the design factors for cutting and mounting elements for single and Multi-point cutting tools

CLO05 To understand the principles of Gage design for various applications.

Unit I

Introduction: Tool Design & its objectives, Tool designer's responsibilities, Guidelines of economical tool design

Design of Jigs and Fixtures: Difference between Jigs and fixtures, Principles of Design of Jigs and Fixtures, Design procedure of Jig and Fixture, Principles of Location- Basic principles of location & types of locators, Principles of clamping, Types of Clamping devices, Design of Drill Jigs, Milling fixtures, Turning fixtures.

Unit II

Press Tool Die Design: Introduction to press operations, Presses and their classification, Types of dies- cutting and forming dies, simple, compound and progressive dies, Punching Die Design- calculation of forces on punch and die during piercing, calculation of press power, concept of center of pressure, Blanking Die design- types of dies, calculation of forces on punch and die during blanking Design of drawing Die. Design of Bending Die

Unit III

Design of Forging Die: Drop v/s Press forging, Types of Forging Machines, Types of forging Dies- Open and Closed, Simple and Multi-Impression Dies, Forging design factors, Determination of

stock size, Die design for machine Forging, Selection of forging equipments, Manufacture of forging die

Unit-IV

Design of Cutting tools: Introduction to cutting tools, Solid v/s Tipped tools, Parts of cutting tool- cutting element and mounting or clamping element, Design factors for cutting element, Design factors for mounting element, Design of Single point tool, Design of milling cutters- peripheral and face cutters, Broach Design

Unit-V

Gage Design: Difference between instrument and gage, Classification of gages, Gaging principles, Gauge wear allowance Design of limit gauges- factors to be considered in gauge design- Limit gauge tolerances and Taylor's principle, Computer applications in tool design-computer aided design and simulation, Collaborative Engineering.

Text Books:

1. **Sharma P.C. , A text book of Production Engineering, S.Chand and Co., 2009**
2. **Nee John G. William Dufraine, John W. Evans Mark Hill, Fundamentals of Tool Design, Society of Manufacturing Engineers, Sixth Edition.**
3. **Jain K.C., Chitle A.K., Text book of Production Engineering, PHI Learning Pvt. Ltd., Second Edition**

Reference Books:

1. **K. Venkataraman, Design of Jigs, Fixtures and Press Tools, John Wiley and Sons Ltd., First Edition**
2. **Suchy Ivana, Handbook of Die Design, McGraw Hills, Second Edition**

Course Outcomes:

CO01 Students will be able to design the jigs and fixtures for different processes

CO02 Students will be able to evaluate loads for various sheet working operations and design punch and dies accordingly.

CO03 Students will be able to evaluate the forging loads for various components and design punch and die accordingly.

CO04 Students will be able to evaluate cutting loads and design the cutting tools and holding elements for different configurations accordingly.

CO05 Students will be able to assess the measurement requirement and design the gages.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL22	Industrial Revolution 4.0	3	0	0	3

Course Learning Objectives:

CLO1 To comprehend the fundamental concepts and principles of Industrial revolution 4.0.

CLO2 To explore the integration of robotics and automation with advanced technologies in the context of Industrial revolution 4.0.

CLO3 To understand the role of cyber-physical systems, IoT, and cloud computing in Industrial revolution 4.0.

CLO4 To understand the role of digital twin and cyber security in Industrial revolution 4.0.

CLO5 To analyze and evaluate the impact of Industrial revolution 4.0on industrial sectors and future trends.

Unit 1: Introduction to Industrial revolution 4.0

Evolution of industrial revolutions: From Industry 1.0 to Industry 4.0, Key concepts and principles of Industry 4.0, Smart factories and cyber-physical systems , Impact of Industry 4.0 on robotics and automation

Unit 2: Advanced Technologies in Industrial revolution 4.0

Internet of Things (IoT) and its applications in industrial settings, Cloud computing and its role in Industry 4.0, Big data analytics for smart manufacturing , Artificial Intelligence and machine learning in Industry 4.0

Unit 3: Robotics and Automation in Industrial revolution 4.0

Collaborative robotics and human-robot interaction, Industrial automation systems and control, Sensing and perception technologies in smart factories, Robotic process automation (RPA) and intelligent automation

Unit 4: Digital Twin and Cybersecurity in Industrial revolution 4.0

Digital Twin technology and its applications, Virtual and augmented reality in manufacturing, Data security and privacy in Industry 4.0, Cybersecurity challenges and solutions in smart factories

Unit 5: Applications and Future Trends in Industrial revolution 4.0

Smart logistics and supply chain management, Predictive maintenance and condition monitoring, Smart energy management and sustainable manufacturing.

Textbooks:

1. "Industry 4.0: The Industrial Internet of Things" by Alasdair Gilchrist
2. "Robotics and Automation in the Industry 4.0 Era" by Pedro Neto and Anibal Reñones

Reference Books:

1. "Digital Twin Technologies and Smart Cities" by QuangVinh Nguyen et al.
2. "Smart Manufacturing: Innovation and Transformation" by Hui-Ming Wee and Kuan Yew Wong

Course Outcomes:

CO1 Understand the concepts of all technologies used to support industry 4.0 environments.

CO2 Understand the role and application of cyber-physical systems, the Internet of Things (IoT), cloud computing, and big data analytics, Digital twin and cyber security in Industry 4.0.

CO3 Apply the knowledge of AI, ML, IOT, could computing, CPS, Big data, Robots, sensors and cyber security to design and implement solutions within the context of Industry 4.0.

CO4 Explore applications and challenges of Industry 4.0 in areas such as smart logistics, supply chain management, predictive maintenance, condition monitoring, smart energy management, sustainable manufacturing, digital twin and cyber security.

CO5 Analyze and evaluate the impact of Industry 4.0 on Automotive sector, and identify future trends in the field.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL29	Artificial Intelligence in Manufacturing	3	0	0	3

Course Objectives

CLO1 Understand the potential and applications of artificial intelligence in modern manufacturing industries.

CLO2 Equip students with the necessary tools and software for developing AI applications in the manufacturing domain.

CLO3 Grasp the core concepts of Artificial Intelligence, Machine Learning, Inference Engines, Speech Recognition, Computer Vision, Natural Language Understanding, Robotics, and Human-Computer Interaction.

CLO4 Unify concepts from human cognition, AI, Machine Learning, and data engineering to design and implement intelligent systems.

CLO5 Demonstrate hands-on knowledge and skills with advanced AI tools through real-world problem-solving projects in manufacturing engineering.

Unit I: Introduction to Artificial Intelligence (AI)

Definitions of intelligence and artificial intelligence - Human mental capabilities: association, stereotyping, reasoning and vision - Artificial intelligence: components, scope and application areas.

Unit II: AI Languages

Features of PROLOG, PROLOG Data Types, Structure of PROLOG, Programming in Prolog.

Unit III: Expert Systems

Knowledge-based or expert systems: definition, structure, characterization and justification - Knowledge sources - Expert - Knowledge acquisition and representation - Knowledge base - Interference strategies: forward and backward chaining.

Unit IV: Expert Systems Tools and Applications

Expert system languages - Expert system shells: typical examples of shells - CLIPS programming -Expert system software for manufacturing applications in CAD, CAPP, MRP, adaptive control, robotics, process control, fault diagnosis, failure analysis, process selection, group technology, etc.

Unit V: Artificial Neural Networks, Fuzzy Logic and Genetic Algorithms

Concepts of artificial neural networks, fuzzy logic and genetic algorithms - Manufacturing applications of neural networks, fuzzy logic and genetic algorithms - Case studies of typical applications in tool selection, process selection, part classification, inventory control, process planning, etc.

Textbooks

1) Clocksin, W. F. and C. S. Mellish, Programming in PROLOG, Narosa Publishing House, New Delhi.

2) Giarratano, J. C. and G. D. Riley, Expert Systems - Principles and Programming, Cengage Learning, New Delhi.

3) Padhy, N. P., Artificial Intelligence and Intelligent Systems, Oxford University Press, New Delhi.

Reference Books

1) Rajasekaran, S. and G. A. Vijaya Lakshmi Pai, Neural Networks, Fuzzy Logic and Genetic Algorithms, PHI Learning Private Limited, New Delhi.

2) Artificial Intelligence: A Modern Approach, Second Edition, Russell, S. and Norvig, P., Pearson Education (2009).

3) Machine Learning, First Edition, Dutt, S., Chandramouli, S. and Das, A.K. Pearson Education (2018).

Course Outcomes

CO1 This course systematically introduces the aspects of artificial intelligence, in the context of manufacturing engineering, which has very good potential in modern industries.

CO2 The students will become familiar with the tools required for creating artificial intelligence applications in the manufacturing domain.

CO3 Understand the fundamentals of Artificial Intelligence, Machine Learning, Inference Engines, Speech, Vision, Natural Language Understanding, Robotics, and Human Computer Interaction.

CO4 Unify the knowledge of human cognition, AI, Machine Learning and data engineering for designing systems.

CO5 Demonstrate hands-on knowledge of state-of-the-art AI tools for real-world problem-solving.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
ME3EL21	Project Management	3	0	0	3

Course objectives

CLO 1 Understand the Fundamentals of Project Management

CLO 2 Master Network Analysis Techniques

CLO 3 Develop Skills in Project Duration and Control

CLO 4 Explore Project Organization and Leadership

CLO 5 Apply Strategic Planning and Project Appraisal Techniques

Unit I: Concepts of project management: Meaning, definition and characteristics of a project, technical and socio-cultural dimensions; project life cycle phases, project planning and graphic presentation; work breakdown structure, manageable tasks; size of network; blow down NW; identity and logic dummy activity; Fulkerson rule for numbering NW; time-scaled NW

Unit II: NW analysis: PERT network; mean time and variances; probability to complete PERT project in specified time; CPM network; Event Occurrence Time (EOT); activity start/ finish times; forward and reverse path calculations, concept and calculation of floats; resource allocation and critical-chain; overview of MS-project-2000.

Unit III: Project duration and control: Importance and options to accelerate project completion; time cost trade off; fixed variable and total costs; use of floats and cost optimization; project performance measures; project monitoring info and reports; project control process; Gant chart and control chart; cost-schedule S-graph; planned cost of work schedule (PV), budgeted/ earned cost of work completed (EV) and actual cost of work completed (AC); schedule and cost variances (SV, CV) forecasting final project costs.

Unit IV: Project organization, culture and leadership: projects within functional organization; dedicated project/ task-force teams; staff, matrix and network organization; choosing appropriate project organization; Organization culture; ten characteristics; cultural dimensions supportive to projects; social

network and management by wandering around (MBWA); different traits of a manager and leader; managing project teams; five stage team development model; shared vision; conflicts; rewards; rejuvenating project teams; project stakeholders; concept of project partnering.

Unit V: Strategic planning and project appraisal: Capital allocation key criteria; Porters competitive strategy model; BCG matrix; Strategic Position Action Evaluation (SPACE); time value of money; cash flows; payback period; IRR; cost of capital; NPV; social cost benefit analysis; UNIDO approach; project risks and financing.

References books:

1. Prasana Chandra: Projects: planning Implementation control; TMH.
2. Gray Clifford F And Larson EW; Project The managerial Process; TMH
3. Panneerselven and Serthil kumar; Project management, PHI
4. Burke; Project Management-Planning and control technics; Wiley India
5. Kamaraju R; Essentials of Project Management; PHI Learning

Textbooks:

1. Jack R. Meredith, Project Management: a managerial approach, Wiley.
2. Choudhary; Project Management; TMH
3. Srinath LS; PERT And CPM Principles and Appl; East West Press
4. Richman L; Project Management: Step by Step; PHI Learning
5. United Nations Industrial Development Organization, Guide to practical project appraisal - social benefit cost analysis in developing countries, oxford & ibh

Course Outcome:

CO 1 Define the characteristics of a project and recall the key components of network analysis techniques such as PERT and CPM.

CO 2 Interpret the significance of critical path analysis in project scheduling.

CO 3 Apply time-cost trade-off techniques to accelerate project completion and Utilize project performance measures to control schedule and cost.

CO 4 Analyze different project organizational structures and their suitability.

CO 5 Construct financial evaluations including NPV, IRR, and payback period for project appraisal.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
OE00084	Startup Creation through Experiential Learning	3	0	0	3

Course Learning Objectives (CLOs):

CLO_{01} To understand concepts of entrepreneurial thinking, opportunity evaluation and market type.

CLO_{02} To understand the concepts of value proposition canvas, lean canvas and refining the business model.

CLO_{03} To understand the concepts of minimum viable product and prototype.

CLO_{04} To understand the concepts of market validation and sustainability.

CLO_{05} To understand the concepts of financial feasibility and funding options in early stage startups.

Unit I: Problem Identification and Opportunity Discovery

Conduct Opportunity Discovery, Problem Validation, Sharpen their Problem Pitch

Customer and Markets**:** Identify the Market Type, Explore Market Segment, Determine Market Positioning, Create the Customer Persona

Unit II: Sustainable Differentiation Strategy

Craft your core value proposition; create a Sustainable Differentiation Strategy, Analyze Competition.

Competitive Advantage: Identify competitors, Identify critical product features, Conduct feature ranking and estimate a product road-map

Unit III: Business Model

Build and test a business model, Pivot or Persevere, Identify the riskiest assumptions in the business model.

Competitive Advantage: Build your prototype, Test with early adopters, Conduct Customer Interviews; Refine the Prototype, Build Minimum Viable Product.

Unit IV: Business model sustainability

Ascertain Costs, Arrive at appropriate pricing strategy, Financial Projections, Key Financial Metrics.

Go To market Strategy: Identify the appropriate channels, Build Strategic partnerships, Create Digital Marketing Plan, Devise a Market penetration strategy.

Unit V: Managing growth and Targeting Scale

Devise a Growth Plan, Structure the Scaling Strategy, Customer acquisition; enhancing productivity, Process improvements, Operational excellence, manage money

Funding Strategy: Create Sources and uses of Funds Statement, Map the Start-up Lifecycle to Funding Options; Valuation, Create the Pitch Deck

Text Books:

1. Elias G. Carayannis, Elpida T. Samara, Yannis L. Bakouros, (2015). Innovation and Entrepreneurship Theory, Policy and Practice, Springer International Publishing Switzerland.
2. Hisrich, Robert. Michael Peters and Dean Shepherd, Mathew. (2014). Entrepreneurship. New Delhi: Tata McGraw-Hill Education.
3. Poornima M., (2014), Entrepreneurship Development and Small Enterprise, Pearson Education.

Reference Books:

4. Martha Corrales-Estrada,(2019), "Innovation and Entrepreneurship: A New Mindset for Emerging Markets", Emerald Publishing Limited.
5. Eric Ries, (2017). "The startup way: how modern companies use entrepreneurial management to transform culture and drive long-term growth", New York: Currency.
6. Howard H Frederick; Donald F Kuratko; Allan O'Connor, (2016). "Entrepreneurship: theory, process, practice", South Melbourne, Victoria: Cengage Learning.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO_{01} To understand concepts of entrepreneurial thinking, opportunity evaluation and market type.

CO_{02} To understand the concepts of value proposition canvas, lean canvas and business model.

CO_{03} To understand the concepts of minimum viable product and prototype.

CO_{04} To understand the concepts of market validation and sustainability.

CO_{05} To understand the concepts of financial feasibility and funding options in early stage startups.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
OE00047	Advance Machining Processes	3	0	0	3

Course Learning Objectives (CLOs):

CLO01: To develop the ability to understand the need of modern machining processes and their classification. Also the mechanical type advance machining processes

CLO02: To be able to understand the various Chemical and Electrochemical Type advance Machining Processes

CLO03: To be able to understand Thermal Type advance Machining Processes

CLO04: To be able to understand various Hybrid advance Machining Processes

CLO05: To be able to understand different types of Hybrid Finishing Processes.

Unit I

Mechanical Type Processes : Limitations of conventional machining process, classification of advance machining processes, Classification of mechanical type processes : Principle and mechanics of metal removal, calculation of MRR , process parameters and their effect on MRR , machine setup , advantages limitations and applications of - abrasive jet machining (AJM), ultrasonic machining (USM), water jet machining (WJM), recent developments in all the processes.

Unit II

Chemical and Electrochemical Type Processes : Principle and mechanics of metal removal, calculation of MRR , process parameters and their effect on MRR , machine setup , advantages limitations and applications of - chemical machining (CHM), maskants and its type, methods of applying maskants, Electrochemical machining[ECM], electrolyte flow design in ECM.

Unit III

Thermal Processes : Principle and mechanics of metal removal, calculation of MRR , process parameters and their effect on MRR , machine setup , advantages limitations and applications of - electric discharge machining(EDM), different circuits of pulsating dc supply, wire-cut EDM, transferred and non transferred arc type plasma arc machining (PAM), Electron beam machining(EBM) and Laser Beam machining (LBM).

Unit IV

Hybrid Processes: Principle and mechanics of metal removal, advantages, disadvantages and limitations of – abrasive electro-discharge machining (AEDM), ultra sonic assisted EDM (EDMUS), laser assisted ECM (ECML) , ultra sonic assisted ECM (USECM)

Unit V

Hybrid Finishing Processes: Working principle, applications, advantages and limitations of - electrochemical grinding (ECG), electro-discharge grinding (EDG), electrochemical de-burring (ECD), electrochemical honing (ECH), magnetic abrasive finishing (MAF),

Text Books :

1. P.C. Pandey and H.S.Shan, “Modern Machining processes”, McGraw Hill Education
2. M.K.Singh, “Unconventional Manufacturing Processes” New Age International
3. Hassan Abdel-Gawad El-Hofy, “advance Machining processes”, McGraw Hill

Reference Books :

1. G.F. Benedict, Marcel Dekker,Nontraditional Manufacturing Processes", Inc. New York.
2. Vijay.K. Jain, “advance Machining Processes” Allied Publishers.
3. Amitabha Ghosh and Asok Kumar Mallick, “Manufacturing Science”, East West Press.

Course Outcomes (COs):

After completion of this course the students shall be able to:

CO01: understand the need of modern machining processes and their classification and various types of mechanical type advance machining processes.

CO02: understand the various Chemical and Electrochemical type and Thermal Type advance Machining Processes

CO03: understand the various Hybrid advance Machining Processes and Hybrid Finishing Processes.

CO04: apply the knowledge of conventional and advance machining processes to make hybrid machining processes

CO05: analyze the benefit of advance machining processes over to Conventional machining processes

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
OE00048	**Supply Chain Management**	3	0	0	3

Course Learning Objectives:

1. Understand the fundamentals of supply chain management: Students will gain a comprehensive understanding of the key principles, concepts, and components that form the foundation of supply chain management.
2. Analyze supply chain networks and design strategies: Students will learn how to evaluate existing supply chain networks, identify inefficiencies, and develop effective strategies to optimize the flow of goods and services.
3. Implement logistics and transportation strategies: Students will explore different transportation modes and logistics strategies to develop efficient and cost-effective distribution channels and enhance overall supply chain performance.
4. Utilize technology and data analytics in supply chain management: Students will become proficient in using modern technologies and data analytics tools to improve supply chain visibility, track performance metrics, and make data-driven decisions.

Unit I

Introduction &Building a Strategic Framework to Analyze Supply Chains

An Introduction, Strategic view of supply chains, Evolution of Supply Chain Management (SCM),Importance of the supply chain, Decision phases in a supply chain, Process views of supply chain, Enablers of supply chain performance, Supply chain strategy and performance measures–competitive and supply chain strategies – customer service and cost trade –offs, Achieving strategic fit,

Unit II

Designing the Supply Chain Network:

Designing distribution networks and applications to e-business, network design in the supply chain, network design in an uncertain environment

Unit III

Supply Chain distribution and integration and Risk pooling

Supply chain integration, Warehouse Management Systems, Storage Systems, Material Handling Requirements, Distribution Strategies – Traditional Retail, Direct Shipping, Cross-docking, Cross-dock Operations, Distribution Strategies: Pool Distribution, Transshipment, Milk-Run Systems, Classic Techniques of Risk Management, Pooling based on Location, Product, lead Time and capacity.

Unit IV

Supplier Relationship Management: Integrating Suppliers into the e-Value Chain

Defining Purchasing and Supplier Relationship Management, Components of SRM, The Internet-Driven SRM Environment, e-SRM Structural Overview, e-SRM Services Functions, e-SRM Processing, e-SRM Technology Services, Anatomy of The e-SRM Marketplace Exchange Environment, Implementing e-SRM

Unit V

Transportation, Supplier Selection and Packaging

Transportation – Drivers, Modes, Measures, Sourcing decision in supply chain, Using Total Cost to Score and Assess Suppliers, 3PL and 4PL, Supplier selection- Auctions and negotiations, Contracts, Risk Sharing, and Supply Chain Performance. Packaging- Design considerations, Material and Cost. Packaging as Unitisation. Consumer and Industrial Packaging.

Reference books:

1. Bowersox Donald J, Logistics Management – The Integrated Supply Chain Process, Tata McGraw Hill,2010
2. Vinod V. Sople, Logistics Management-The Supply Chain Imperative, Pearson. 2012.

3. Coyle et al., The Management of Business Logistics, Thomson Learning, 7th Edition, 2004.

4. Leenders, Johnson, Flyn, Fearon, Purchasing and supply management, Tata McGraw Hill,

2010..

Text books:

1.Ronald H. Ballou and Samir K. Srivastava, Business Logistics and Supply Chain Management,

Pearson education,Fifth Edition

2. Sunil Chopra and Peter Meindl, Supply Chain Management-Strategy Planning and Operation,

PHI Learning / Pearson Education, 2007.

3. Mohanty R.P and Deshmukh S.G, Supply chain theories and practices, Biztantra publications,2007.

Course Outcomes:

1. Demonstrate a comprehensive understanding of supply chain management principles and practices, enabling effective problem-solving and decision-making within complex supply chain environments.
2. Design and optimize supply chain networks by identifying critical bottlenecks, selecting appropriate transportation modes, and implementing efficient distribution strategies.
3. Analyze supply chain risks and develop risk mitigation strategies to enhance resilience and responsiveness in the face of disruptions or unforeseen events.
4. Utilize technology and data analytics tools to improve supply chain visibility, performance monitoring, and collaboration among supply chain partners, leading to enhanced efficiency and customer satisfaction.

Course Code	Course Name	Hours Per Week			Total Credits
		L	T	P	
ME3PC12	Project-I	0	0	8	4

1. Project-I can be an individual or a group activity depending on the depth and scope of the topic.
2. The project work can be any of the form given below:

a) Making physical working models, prototypes, and scaled models of a concept machine.
b) Making virtual / CAD models of a sufficiently complex machines / concepts.
c) Making study, modeling, analysis, programming and simulation of a system / machine /operation / process.
d) Making study / teaching modules of a sufficiently complex topic for pedagogy purposes.

3. Group formation, discussion with faculty advisor, formation of the Semester Mini Project statement, resource requirement, if any should be carried out in the earlier part of the semester.
4. The students are expected to utilize the laboratory resources before or after their contact hours as per the prescribed module.
5. A complete Assembly and Details drawings of the project should be submitted along with a Detailed project report, where applicable.
6. A Detailed Background / field / literature survey, related to the topic must be made and presented in the report.

Course Code	Course Name	Hours Per Week			Total Credits
		L	T	P	
ME3PC03	Industrial Training	0	2	0	2

Industrial Training is a structured program that integrates academic learning with practical industrial experience. It is designed to bridge the gap between theoretical knowledge gained in the classroom and real-world applications in the industry. This program is essential for students in engineering, technology, and related fields as it provides hands-on experience and exposure to actual working environments.

Objectives of Industrial Training:

1. **Skill Development:** Enhance practical skills and technical knowledge that are crucial for industry-specific tasks.
2. **Workplace Experience:** Provide firsthand experience of the professional work environment, including workplace culture, practices, and expectations.
3. **Application of Knowledge:** Enable students to apply academic concepts and theories to real-world industrial problems and projects.
4. **Professional Networking:** Offer opportunities to build connections with industry professionals, which can be valuable for future career prospects.
5. **Career Insight:** Help students gain insights into potential career paths and make informed decisions about their professional future.

Key Components of Industrial Training:

1. **Orientation:** Introduction to the company, its operations, safety protocols, and expectations during the training period.
2. **Hands-on Projects:** Participation in live projects and tasks relevant to the student's field of study, under the guidance of experienced professionals.
3. **Mentorship:** Regular interaction with mentors and supervisors who provide guidance, feedback, and support throughout the training.
4. **Evaluation:** Continuous assessment of the student's performance through reports, presentations, and evaluations by industry mentors.
5. **Reflection:** Opportunities for students to reflect on their experiences, challenges faced, and lessons learned during the training.

Course Code	Course Name	Hours Per Week			Total Credits
		L	T	P	
EN3NG06	Open learning Courses	1	0	0	1

Open Learning Courses are educational programs designed to be accessible to a broad audience, often offered online and available to anyone with an internet connection. These courses aim to make education more inclusive and flexible, allowing learners to study at their own pace and according to their own schedules.

Objectives of Open Learning Courses:

1. **Accessibility:** Provide educational opportunities to learners regardless of their geographical location, financial situation, or prior educational background.
2. **Flexibility:** Allow learners to study at their own pace and on their own schedule, accommodating diverse learning styles and life commitments.
3. **Lifelong Learning:** Encourage continuous personal and professional development by providing access to a wide range of subjects and skill sets.
4. **Inclusivity:** Promote equal access to high-quality education for all, reducing barriers related to cost, location, and time.

SEMESTER VIII

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	ME3PC13	Project-2	0	0	20	10
		Total	**0**	**0**	**20**	**10**
		Total Contact Hours	**20**			

1. Project-II can be an individual or a group activity depending on the depth and scope of the topic.

2. The project work can be any of the form given below:

a) Making physical working models, prototypes, and scaled models of a concept machine.

b) Making virtual / CAD models of a sufficiently complex machines / concepts.

c) Making study, modeling, analysis, programming and simulation of a system / machine /operation / process.

d) Making study / teaching modules of a sufficiently complex topic for pedagogy purposes.

3. Group formation, discussion with faculty advisor, formation of the Semester Mini Project statement, resource requirement, if any should be carried out in the earlier part of the semester.

4. The students are expected to utilize the laboratory resources before or after their contact hours as per the prescribed module.

5. A complete Assembly and Details drawings of the project should be submitted along with a Detailed project report, where applicable.

6. A Detailed Background / field / literature survey, related to the topic must be made and presented in the report.