Department of Mechanical Engineering

CURRICULUM AND SYLLABUS

(2021-2025)

B. Tech. Automobile Engineering

Automobile Engineering

B. Tech (AU)

CURRICULUM AND SYLLABUS

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:

- To offer a platform to the students where they will be able to groom themselves technically as industry ready professionals.
- To develop research environment where students will be motivated to enhance their knowledge to undertake research in mechanical and allied engineering.
- To collaborate with industries, education institutes of excellence and aluminus to share and exchange latest technology and innovation.
- To design curriculum to motivate and sensitize students towards environmental issues and respect for human values and ethics.
- 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)

PEO01	To provide advanced knowledge for finding solutions of complex practical problems.
PEO02	To develop research acumen for designing a system with better efficiency and performance.
PEO03	To prepare students as experts with better communication skills, professional ethics and team spirit for working in multidisciplinary teams

PROGRAMME OUTCOMES (POs)

PO01	Engineering knowledge: Apply the knowledge of mathematics, science, engineering, fundamentals, and an engineering specialization to the solution of complex engineering problem.
PO02	Problem analysis: Identify, formulate, review, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO03	Design / development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO04	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.

PO05	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.
PO06	The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO07	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.
PO08	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO09	Individual and teamwork: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	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.
PO11	Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12	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

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO01	Implement the knowledge in industrial automation through specialization in CAD/CAM and Mechatronics.
PSO02	Develop cost effective and sustainable energy solutions for industry and society at large through specialization in Energy Technology.
PSO03	Implement the knowledge in improving industrial productivity through specialization in industrial and production engineering.

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

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	Enviornmental 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

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	AU3CO18	Manufacturing Processes- I	3	0	0	3
3	AU3CO19	Mechanics of Materials	4	0	0	4
4	AU3CO20	Engineering Thermodynamics	4	0	0	4
5	AU3CO21	Automotive Electrical and Electronics	3	0	2	4
6	AU3CO22	CAD LAB-I	0	0	2	1
7	AU3CO23	Materials and Material Testing Lab	0	0	2	1

8	AU3CO24	Python Programming for Automotive 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**			

SEMESTER – IV

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	AU3CO25	Manufacturing Processes- II	3	0	2	4
2	AU3CO26	Python Programming for Automotive Engineers- II	0	0	2	1
3	AU3CO27	Fluid Mechanics and Machinery	3	0	2	4
4	AU3CO28	Automotive Chassis & Transmission System	3	0	2	4
5	AU3CO29	CAD LAB-II	0	0	2	1
6	EN3HS04	Fundamentals of Management, Economics & Accountancy	3	0	0	3
7	AU3PC04	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**	**23**
		Total Contact Hours	**30**			

SEMESTER – V

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	AU3CO30	Automotive Engines	4	0	2	5
2	AU3CO31	Machine Design	4	0	0	4
3	AU3CO32	Hybrid Vehicles	4	0	0	4
4	AU3CO33	Theory of Machines	3	0	2	4
5	AU3CO34	Design and Simulation Lab -I	0	0	2	1
6		Program Elective - I	3	0	0	3
7		Program Elective - II	3	0	0	3
8		Open Elevtive I	3	0	0	3
		Total	**24**	**0**	**6**	**27**
		Total Contact Hours	**30**			

SEMESTER – VI

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	AU3CO35	Vehicle Dynamics	3	0	2	4
2	AU3CO36	MAT Lab for Electric vehicle	3	0	0	3
3	AU3CO37	Automotive Refrigeration & Air Conditioning	3	0	2	4
4	AU3CO38	Design and Simulation Lab -II	0	0	2	1
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	AU3PC05	Mini Project -II	0	0	4	2
9	EN3NG09	Soft Skills -III	2	0	0	2
		Total	**20**	**0**	**10**	**25**
		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 Elevtive III	3	0	0	3
4	AU3PC12	Project-1	0	0	8	4
5	AU3PC03	Industrial Training	0	2	0	2
6	EN3NG06	Open Learning Courses	1	0	0	1
		Total	**10**	**2**	**8**	**16**
		Total Contact Hours	**20**			

SEMESTER VIII

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	AU3PC13	Project-2	0	0	20	10
		Total	**0**	**0**	**20**	**10**
		Total Contact Hours	**20**			

Total Credits with NG Courses	**171**

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, Seminar	20	10-15% (16-24)
8	Non Grading	11	
		171	

Medi-Caps University Indore (M.P.)

B.Tech. (I year)

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	3	3

Course Learning Objectives (CLOs):

CLO01 To impart analytical ability of using concepts of matrices in various fields of engineering.

CLO02 To explain the concept of Differential Calculus.

CLO03 To discuss the concept of Integral Calculus and its applications.

CLO04 To impart analytical ability in solving Ordinary Differential Equations of first and Higher order.

CLO05 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

Basics of Complex number, Functions of complex variable: Analytic functions, Harmonic Conjugate 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, Higher Engineering Mathematics, S. Chand & Company Pvt LTD., New Delhi

REFERENCES

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Pub. Co. Ltd., New Delhi.
2. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons.
3. R.K. Jain and 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:

CO01 To illustrate the tools of matrices in solving the system of simultaneous equations,

CO02 To investigate the tools of differential calculus to relevant fields of engineering and can implement the concept of several variables.

CO03 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.

CO04 To solve Ordinary Differential Equations using different methods.

CO05 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):

CLO01 They will be able to understand the concept of Laser devices.

CLO02 An ability to understand the phenomena occurs in optical fibre.

CLO03 Students came to know about the optical phenomenon like Interference, diffraction, and polarization with their use in daily life.

CLO04 They will be able to learn about the quantum physics.

CLO05 They will be able to understand the concept of modern physics

CLO06 An ability to recognise the crystal structure and their basics.

CLO07 An ability to adapt the classical concept of oscillations.

CLO08 They will be able to use the acoustics nature in practical applications.

CLO09 Students learn the advanced concept of superconductivity.

Unit-I Laser 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:

CO01	Understand and analyse the different types of lasers and optical fibres, operation, and its characteristics
CO02	Understand and apply various phenomenon of Interference, diffraction and polarization and their applications.
CO03	Understand and apply the concept of Quantum Mechanics.
CO04	Understand and examine the crystal structures and acquire the basic knowledge of various semiconductor devices.
CO05	Evaluate and apply the applications of superconductivity in technology and real world.
CO06	Apply basic concepts of oscillations in harmonic oscillator and compound pendulum.
CO07	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

1. To determine the radius of curvature of plano convex lens using Newton's ring experiment.
2. To determine wavelength of spectral lines of mercury vapor lamp with the help of grating and spectrometer.
3. To determine the specific optical rotation of sugar solution by biquartz polarimeter.
4. To determine the wavelength of given sodium vapor lamp using Fresnel's Biprism.

Quantum Mechanics

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

Solid State Physics

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

Oscillations and Acoustics

1. To find the frequency of AC Mains using Melde's method in longitudinal and transverse arrangement.
2. 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):

CLO01 To learn the basics of semiconductor materials and their usage in variety of PN junction diodes and applications of diodes

CLO02 To study transistor in different modes of configuration and basic biasing techniques, FET.

CLO03 To study of the fundamental concepts and various types of analog communication systems

CLO04 To study of the concept of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.

CLO05 To learn about basic Measurement & Instrument components.

Unit-I SEMICONDUCTOR DIODE

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

Unit-II BIPOLAR JUNCTION TRANSISTOR

Construction and working of transistor, characteristics of transistor, transistor as an amplifier and switch, transistor configurations, transistor biasing and biasing methods, basic amplifier configurations, Basic principle and working of FET and MOSFET

Unit-III BASICS OF COMMUNICATION 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 DIGITAL SYSTEM

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 and products of sums, Karnaugh map Minimization, Logic gates: NOT, AND, OR, NAND, NOR, EX- OR and EX-NOR, half adder and full adder. Function and Structure of a Computer System, Von Neumann Architecture, and modern computers.

Unit-V ELECTRONICS MEASUREMENT

Introduction, Basics of Measurements, Ammeter, Voltmeter, multimeter, Signal Generators, Cathode Ray Oscilloscope: Block diagram of CRO, Construction of CRT, Deflection sensitivity and various controls, Measurement of voltage, current frequency and phase angle using CRO

TEXTBOOKS

1. Millman and Halkias: Integrated electronics, TMH.
2. D Roy 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. Andrew S. Tanenbaum, Structured Computer Organization, Upper Saddle River.

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:

CO01	Should have the knowledge of basic semiconductor materials and their usage in variety of PN junction diodes and applications of diodes
CO02	Should be able to understand the concept operation of transistors and its configuration.
CO03	Understand and identify the fundamental concepts and various components of analog communication systems
CO04	Should have the knowledge of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.
CO05	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)

CLO01 To impart knowledge of Environment and its basic components.

CLO02 To build basic understanding of various effects of human activities to the environment.

CLO03 To understand concepts of water pollution

CLO04 To understand function of solid waste management

CLO05 To learn concepts of disaster management

Unit-I Ecosystem 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:

CO01	Gain knowledge of Ecosystem & Biodiversity.
CO02	Develop basic understanding of air pollution and its control method
CO03	Develop basic understanding of water pollution and its control method
CO04	Gain knowledge of Solid waste management and its importance.
CO05	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):

CLO01 To familiarize with the construction of geometrical figures.

CLO02 To familiarize with the projection of 1D, 2D and 3D elements

CLO03 To familiarize with the projection and sectioning of solids.

CLO04 To familiarize with the Preparation and interpretation of building drawing.

CLO05 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:

CO01	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
CO02	Understand the projection of points, straight lines and have the ability to convert the practical problems into projections
CO03	To understand and apply concepts of the projection of simple planes & solids.
CO04	Understand and apply the concepts of Projection & Sections of solids & development of surfaces
CO05	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 geometry.

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

Course Learning Objectives (CLOs)

CLO01 Analyze Basics of Computers, programming environment and about different types of Programming languages.

CLO02 Application of various basic concepts required to create programs, use good problem-solving approach.

CLO03 Use different control structures for conditional programming.

CLO04 Use of Arrays and string in different problems and to apply different operations on arrays and strings

CLO05 Use the functions and procedures to solve different problems.

Unit-I Introduction 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-II Basics 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-V Functions

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

TEXTBOOKS

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:

CO01	Understand Basics of Computers and Programming languages.
CO02	Understand basic concepts of C programming language required to create programs.
CO03	Apply different types of control structures in problem solving.
CO04	Use of Arrays and string in different problems and also to apply different operations on arrays and strings.
CO05	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:
13. If per greater than or equal to 75 ➔ A grade
14. If per between 60-75 ➔ B grade
15. If per between 50-60 ➔ C grade
16. If per between 40-50 ➔ D grade
17. If per less than 40 ➔ Fail
18. Write a program for addition subtraction multiplication division using switch case.
19. Write a program to print table of any number.
20. Write a program to calculate factorial of any number.
21. Write a program to print series of alphabet.
22. Write a program to print Fibonacci series.
23. Write a program to check given number is perfect or not
24. Write a program to check given number is prime or not.
25. Write a program to check given number is Armstrong or not
26. Write a program to print number in word in between 1-5. Like (1 =one)
27. Write a program to check given char is vowel or consonant.
28. Write a program to print name of month according to number.
29. Write a program for convertor
30. For currency convertor
31. For temperature convertor
32. For weight convertor
33. For length convertor
34. For time convertor
35. For energy convertor
36. Write a program to print series of number from 1-100 without using loop.
37. Write a program to find maximum & minimum number from array.
38. Write a program to check how many numbers is prime & not prime in a list
39. Write a program to check how many digits at each index of array.
40. Write a program to check (search) given number is present or not present in list.
41. Write a program to arrange (sort) array elements in ascending or descending order.
42. Write a program to print a 2*2 matrix.

43. Write a program to find sum of two matrix.
44. Write a program to find multiplication of two matrix.
45. Write a program of string functions.
46. Write a function to find sum of two numbers.
47. Write a function to calculate factorial of any number.
48. Write a function for call by value to find sum of two numbers.
49. Write a function to pass an integer array as an arguments and find sum of array elements
50. Write a function to pass a char array as an argument and find length of string.
51. Write a recursive function to calculate factorial of any number.
52. 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):

CLO01 To give the knowledge of various building and general construction materials such as bricks, stones, timber, cement, steel and concrete & their properties and application.

CLO02 To provide basic understanding of the forces and its components, stresses, strains and the modulus of elasticity of the different construction materials.

CLO03 To understand the components of the building such as beams, columns, foundations, slabs and different types of soils and their bearing capacities.

CLO04 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.

CLO05 To understand various aspects of structural members and application of loads, shear force & bending moment in the field of civil engineering.

Unit I 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.

Unit II 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.

Unit III 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.

Unit IV 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.

Unit V 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.

TEXTBOOKS

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:

CO01	Students will be able to recognize the civil engineering works and conversant about different construction materials and their uses.
CO02	Student will be able to differentiate force, pressure and stresses.
CO03	Students will be able to know the different building component and its importance.
CO04	Students will be conversant about vertical and horizontal variation of different terrains.
CO05	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

SNo.	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			Total	
		L	T	P	Hours	Credit
EN3BS12	Engineering Mathematics-II	3	0	0	3	3

Course Learning Objectives (CLOs):

CLO01 To illustrate knowledge of Laplace Transform and investigate its application.

CLO02 To explain the concept of Fourier Series and Fourier Transform.

CLO03 To illustrate the concept of Partial Differential Equations.

CLO04 To impart the knowledge of Vector Calculus.

CLO05 To discuss numerical methods and to outline its application in solving algebraic, transcendental equations and system of linear equations.

Unit I Laplace Transform

Introduction of Laplace Transform, Laplace Transform of elementary functions, properties of Laplace Transform, Inverse Laplace transform and its properties, Convolution theorem, Applications of Laplace Transform to solve the Ordinary Differential Equation, Laplace transform of Unit step function and Impulse function.

Unit II Fourier Series and Fourier Transform

Introduction of Fourier series, Fourier series for Discontinuous functions, Fourier series for Even and Odd function, Half range series, Fourier Transform, Sine and Cosine Transform.

Unit III Partial Differential Equations

Definition, Formulation, Solution of Partial Differential Equations (By Direct Integration Method and Lagrange's Method), Non-Linear Partial Differential Equations of First order {Standard form I, II, III & IV), Charpit's method. Partial Differential Equations with Constant Coefficients (Higher Orders Homogeneous), Method of Separation of Variables.

Unit IV Vector Calculus

Scalar and Vector fields, Vector Differentiation, Laplacian operator, Gradient, Divergence and Curl, Line and surface integrals, Green's theorem, Gauss Divergence theorem, Stoke's theorem.

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 Gauss Elimination, Gauss Jordan, Jacobi's and Gauss-Siedel Iterative methods.

TEXTBOOKS

1. B.S. Grewal, Higher Engineering Mathematics, Edition-43, Khanna Publishers, New Delhi.
2. H. K. Dass, Higher Engineering Mathematics,S. Chand & Company Pvt LTD., New Delhi

REFERENCES

1. B.V. Ramana, Higher Engineering Mathematics, Tata McGraw Hill Publishing Company Ltd., New Delhi.
2. Shanti Narayan, A textbook of Vector Calculus, S. Chand & Co., New Delhi.
3. Erwin Kreyszig, Advanced Engineering Mathematics, John Wiley & Sons 1999.

WEB SOURCE:

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 the 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):

CLO01 To gain fundamental knowledge of the principles related to, so as to meet the challenging requirements of students in chemistry studies.

CLO02 To attain awareness in students about current & new issues in the fields of chemistry.

CLO03 To make students understand about the present needs without compromising on the ability of future generations to meet their own needs for proper engineering, relevant education efficient management of resources.

CLO04 To increase curiosity and give them awareness about practical knowledge of various laboratory 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

1. Preeti Jain, S L Garg, Engineering Chemisty, 4th edition, Variety Publication.
2. Shashi Chawla, Engineering Chemistry, 11th edition, Dhanpat RaiPublications.

REFERENCE BOOKS

1. P C Jain, Monika Jain, Engineering Chemistry, Dhanpat RaiPublications.
2. S. S.Dara, A Text Book of Engineering Chemistry, S. Chand & Company.

Course Outcomes (COs):

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

CO01	To Understand the lubricants, their mechanism and practically analyze the properties of lubricants.
CO02	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.
CO03	Will get familiarised with new engineering materials and their commercial applications.
CO04	Will get knowledge of using instrumental techniques and their applications for determination of chemical structure of any compound.
CO05	Identify various types of corrosion and methods to protect the metallic structures from corrosive environment.

List of Practicals:

Volumetric Analysis:

1. To determine Hardness of given water sample by Complexometric titration.
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 CuSO4 solution by Iodometric titration using Starch as internal indicator.
5. To determine Chloride content of water sample by Mohr's method (Argentometric titration).

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 Closecup apparatus.
5. To determine Steam emulsification number of givenlubricant.
6. To determine Aniline point of given oilsample.
7. To determine Cloud and Pour point of given lubricatingsample.
8. To study rate of change of viscosity with temperature of the given lubricating oil by meansof 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:

1. Variation of cell potential in Zn/Zn2+//Cu2+/Cu with change in concentration of electrolytes (CuSO4 or ZnSO4) at room temperature.

Kinetics:

1. 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):

CLO01 To understand the properties of materials and their behavior with variation in temperature and Load. To understand different measuring instruments used in engineering applications.

CLO02 To understand the basic laws of thermodynamics and their applications in engineering, refrigeration cycles and properties of refrigerants.

CLO03 To understand Construction and Working of I. C. Engines.

CLO04 To understand Construction and Working of Steam Generators

CLO05 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 Axis theorems.

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:

CO01	Students will be able to understand the engineering materials, their properties, Iron-Carbon Diagram and Stress-Strain Curve, Measuring Equipment's and Testing Machines.
CO02	Student will be thorough with the basic laws of thermodynamics and their applications in engineering also know about Refrigeration cycles and properties of refrigerants.
CO03	Students will be able to understand the construction and working of I.C. Engines.
CO04	Students will be able to understand the construction and working of Steam Generators
CO05	Students will be able to determine the Centroid & Moment of Inertia of areas/composite sections.

LIST OF EXPERIMENTS

1. Measurements using Vernier caliper & 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 engines.
7. Study of 4-stroke petrol and diesel engines.
8. Study of different types of boilers.
9. Study of different types of boilers mounting & accessories.
10. To find the centroid of different plane laminas.

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

Course Learning Objectives (CLOs):

CLO01 Understand Pointer variables. Declaring and dereferencing pointer variables. Pointer Arithmetic. Accessing arrays, strings through pointers.

CLO02 Declaration and use structures, perform operations on structures, passing structures as function arguments. type defining structures.

CLO03 Use Function declaration, function definition, function call, Passing arguments to a function, by value, by reference. Scope of variable names, creation of header files

CLO04 Use calloc, malloc, realloc dynamic memory.

CLO05 Apply Input-output using files in C, Opening, closing and reading from files. Programming for command line arguments.

CLO06 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.

TEXTBOOKS

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:

CO01	Apply Pointers, Pointer Arithmetic and Accessing arrays, strings through pointers.
CO02	Use different user defined data types like structures, union and num.
CO03	Understand and Use of dynamic memory allocation and preprocessor directives.
CO04	Use the concepts of file handing.
CO05	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.
30. Creating a new file
31. Opening an existing file
32. Closing a file
33. Reading from and writing information to a file
34. Program to count number of words, number of character and number of lines from a given text file.
35. Program in C to delete a specific line from a file.
36. Write a program in C to append multiple lines at the end of a text file.
37. Write a program in C to copy a file in another name.
38. Write a program in C to merge two files and write it in a new file.
39. Write a program in C to encrypt a text file.
40. Write a program in C to decrypt a previously encrypted file.
41. Write a program in C to remove a file from the disk.
42. Write a program to draw a circle and fill blue color in it.
43. Write a program to draw a rectangle with diagonal and fill different colors in both halves.
44. Write a program to move a circle using suitable animations.
45. Write a program to implement traffic signal.
46. 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):

CLO01 To develop, enhance and demonstrate LSRW Skills.

CLO02 To enable students to acquire oral presentation skills.

CLO03 To prepare students to become more confident and active participants in all aspects of their undergraduate programs

CLO04 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, note making, 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, right words 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.

TEXTBOOKS

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, New Delhi.

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:

CO01	The students will be able to enhance confidence in their ability to read, comprehend, organize, and retain written and oral information.
CO02	The students will be able to distinguish between general and technical communication and understand its importance
CO03	The students will be able to improve upon their language skills, communication skills, group discussion, and personality development and confidence level.
CO04	The students will be able to bridge the language gap which is vital to their success
CO05	Students will be able to communicate effectively.

List of Experiments (if applicable):

1. JAM
2. Debates
3. Role plays
4. GDs
5. Extempore
6. Story writing
7. Picture description
8. Symposium
9. Oral presentation
10. Phonetics practice
11. 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):

CLO01 To learn the basics of semiconductor materials and their usage in variety of PN junction diodes and applications of diodes

CLO02 To study transistor in different modes of configuration and basic biasing techniques, FET.

CLO03 To study of the fundamental concepts and various types of analog communication systems

CLO04 To study of the concept of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.

CLO05 To learn about basic Measurement & Instrument components.

Unit-I SEMICONDUCTOR DIODE

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

Unit-II BIPOLAR JUNCTION TRANSISTOR

Construction and working of transistor, characteristics of transistor, transistor as an amplifier and switch, transistor configurations, transistor biasing and biasing methods, basic amplifier configurations, Basic principle and working of FET and MOSFET

Unit-III BASICS OF COMMUNICATION 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 DIGITAL SYSTEM

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 and products of sums, Karnaugh map Minimization, Logic gates: NOT, AND, OR, NAND, NOR, EX- OR and EX-NOR, half adder and full adder. Function and Structure of a Computer System, Von Neumann Architecture, and modern computers.

Unit-V ELECTRONICS MEASUREMENT

Introduction, Basics of Measurements, Ammeter, Voltmeter, multimeter, Signal Generators, Cathode Ray Oscilloscope: Block diagram of CRO, Construction of CRT, Deflection sensitivity and various controls, Measurement of voltage, current frequency and phase angle using CRO

Textbooks:

1. Millman and Halkias: Integrated electronics, TMH.
2. D Roy 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. Andrew S. Tanenbaum, Structured Computer Organization, Upper Saddle River.

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:

CO01	Should have the knowledge of basic semiconductor materials and their usage in variety of PN junction diodes and applications of diodes
CO02	Should be able to understand the concept operation of transistors and its configuration.
CO03	Understand and identify the fundamental concepts and various components of analog communication systems
CO04	Should have the knowledge of number systems and Boolean Algebra, minimization, Logic gates and other Combinational circuits and their designing.
CO05	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	Total Hours per week			Total	
		L	T	P	Hours	Credits
EN3ES20	Engineering Workshop -I	0	0	2	2	1

Course Learning Objectives (CLOs):

CLO01 Familiar with Lathe, Drilling, Milling and shaping machines.

CLO02 The basic law of physics and their utilization in engineering.

CLO03 To understand different primary manufacturing process.

CLO04 To understand different metal joining process.

CLO05 To identify different tools used in basic manufacturing process.

Unit-I Introduction and Demonstration: - Introduction to various shops / sections and workshop 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.

Black Smithy 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:

CO01	Understand the engineering materials, their properties, and their utilization in manufacturing tool and other equipment's.
CO02	Understand the primary manufacturing process.
CO03	Understand the basic operation involve in casting.
CO04	Understand the basic process of forging.
CO05	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):

CLO01 To know the historical perspective of science and technology in India, its roots and its role.

CLO02 To know how research and development field is progressing in India.

CLO03 To know what the policies and plans were proposed after independence to be technologically sound.

CLO04 To Know what the developments were done in major areas of science & technology.

CLO05 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 Research and Development (R&D) in India

Science and Technology Education, Research activities and promotion of technology development, Technology mission, Programs aimed at technological self-reliance, activities of council of scientific and industrial research (CSIR).

Unit-III Policies and Plans after Independence

Nehru's vision of science for independent India, Science and technology developments in the new era, science and technology developments during the Five-Year Plan Periods and science and technology policy resolutions.

Unit-IV Science and Technological Developments in Major Areas

Space – Objectives of space programs, Geostationary Satellite Services – INSAT system and INSAT services remote sensing applications, Launch Vehicle Technology. Ocean Development. Objectives of ocean development, marine research. Biotechnology - Applications of biotechnology in medicine, agriculture, food, and fuel. Energy – Research and development in the field of nonconventional energy resources, India's nuclear energy program.

Unit-V Nexus between Technologies

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

TEXTBOOKS

1. K. Rajaram, Science and Technology in India, Published and Distributed by Spectrum Books (P) Ltd., New Delhi.
2. M. Srinivasan, Management of Science and Technology (Problems & Prospects), East- West Press (P) Ltd., New Delhi.
3. G.R. Kohili, The Role and Impact of Science and Technology in the Development of India, Surjeet Publications.
4. Government of India, Five Year Plans, Planning Commission, New Delhi.
5. K.D. Sharma, and M.A. Qureshi, Science, Technology and Development, Sterling Publications (P) Ltd., New Delhi.

REFERENCES

1. Suvobrata Sarkar , History of Science, Technology, Environment, and Medicine in India, Published by Routledge India.
2. Sabareesh P.A. , A Brief History Of Science In India. Published by 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:

CO01	Student will be aware about the ancient India & the existence of science & technology in that era & how it is reciprocated.
CO02	Student will be aware about the upliftment done in the field of R & D after independence.
CO03	Student will come to know about the plans and policies that brought about radical changes for the growth of science in India.
CO04	Student will come to know about the major areas of the applied science and their existence. And can set the relationship between the technologies.
CO05	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	AU3CO18	Manufacturing Processes- I	3	0	0	3
3	AU3CO19	Mechanics of Materials	4	0	0	4
4	AU3CO20	Engineering Thermodynamics	4	0	0	4
5	AU3CO21	Automotive Electrical and Electronics	3	0	2	4
6	AU3CO22	CAD LAB-I	0	0	2	1
7	AU3CO23	Materials and Material Testing Lab	0	0	2	1
8	AU3CO24	Python Programming for Automotive 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**			

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

Course Learning Objectives (CLOs):

CLO01 To understand the structure, function and characteristics of computer system

CLO02 To understand the design of the various functional units and components of computers

CLO03 To identify the elements of modern instructions sets and their impact on processor design.

CLO04 To explain the function of each element of a memory hierarchy

CLO05 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, Trapezoidal 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: Probability Distribution:

Discrete Distribution: Binomial, Poisson Distribution with mean variance, Moment generating function.

Continuous Distribution: Normal and 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.

TEXTBOOKS

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:

CO01 Student will understand the Evolution of Computers and Computer Generations, Measuring Computer, Technology Trends, Measuring Computer Performance, MIPS.

CO02 Students will learn about Fundamental concepts of– Execution of a complete instruction Design of Basic computer, addressing modes, Instruction formats, stack organization.

CO03 Students will be able solve questions on Number systems, Arithmetic operations on binary numbers, Floating Point Representation.

CO04 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.

CO05 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
AU3CO18	Manufacturing Processes I	3	0	0	3

Course Learning Objectives (CLOs):

CLO1 To Understand Moulding and Casting Processes.

CLO2 To Analyze and Mitigate Casting and Welding Defects.

CLO3 To Master Forging, Rolling, and Extrusion Techniques

CLO4 To Apply Advanced Welding Techniques

CLO5 To Understand Powder Metallurgy and Material Shaping

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.

TEXTBOOKS

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:

CO01 Understand the fundamental principles and applications of moulding and casting processes, including design considerations and defect prevention.

CO02 Analyze and develop the Metal Forming Processes and apply various metal forming techniques, such as forging, rolling, and extrusion, to industrial scenarios.

CO03 Apply Advanced Welding Methods to Gain proficiency in advanced welding techniques, understanding their applications, advantages, and limitations.

CO04 Understand Powder Metallurgy and Material Shaping including the design considerations for ceramics, glass, and superconductors.

CO05 Identify and Resolve Manufacturing Defects and implement appropriate solutions to improve product quality.

Course Code	Course Name	Hours per Week			Total	Total
		L	T	P	Hrs.	Credits
AU3CO19	Mechanics of Materials	4	0	0	4	4

Course Learning Objectives (CLOs):

CLO1 Understand Stress and Strain Relationships

CLO2 Analyze Principal Stresses and Strains

CLO3 Construct and Interpret Shear Force and Bending Moment Diagrams

CLO4 Apply Torsion Theory to Shafts

CLO5 Evaluate the Stability of Columns and Struts

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 behavior 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 Principal stress and Strain:

Principle stresses, Principal 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.

TEXTBOOKS

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:

CO01 Understand the Fundamentals of Stress and Strain to gain a solid understanding of stress, strain, and their applications in analyzing the behavior of materials under different loading conditions.

CO02 Analyze Principal Stresses and Strains to develop the ability to calculate and interpret principal stresses and strains in materials and apply these concepts to real-world engineering problems.

CO03 Create Shear Force and Bending Moment Diagrams to Learn to construct and analyze shear force and bending moment diagrams for various types of beams and loading conditions.

CO04 Apply Torsion Theory to Shafts to acquire the knowledge to analyze torsion in shafts, including calculating stresses, deformations, and the angle of twist for different shaft configurations.

CO05 Evaluate Column Stability to Understand the principles of column stability and be able to apply Euler's and Rankin's formulas to assess the stability of columns and struts under various end conditions.

Course Code	Course Name	Hours per Week			Total	Tota Credits
		L	T	P	Hrs.	
AU3CO20	Engineering Thermodynamics	4	0	0	4	4

Course Learning Objectives (CLOs):

CLO1 Understand and Apply the Laws of Thermodynamics

CLO2Analyze Properties of Pure Substances

CLO3Evaluate Vapor Power Cycles

CLO4Understand Boiler, Condenser, and Cooling Tower Operations

CLO5Analyze Reciprocating Air Compressors and Nozzles

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.

TEXTBOOKS

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 Outcomes (COs):

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

CO01 Apply the Laws of Thermodynamics and develop the ability to apply the first and second laws of thermodynamics to analyze heat, work, and entropy changes in various engineering processes.

CO02Analyze Thermodynamic Properties of Pure Substances toGain proficiency in using phase diagrams, steam tables, and Mollier charts to evaluate the properties of pure substances and their phase transformations.

CO03Evaluate Vapor Power Cycles to understand and analyze the performance of vapor power cycles, including the Carnot and Rankine cycles, and assess the effects of various parameters on cycle efficiency.

CO04Understand Boiler and Cooling Tower Operations: Learn to evaluate the performance of boilers, condensers, and cooling towers, and understand their role and efficiency in thermal power plants.

CO05 Analyze Reciprocating Compressors and Nozzles to acquire knowledge of the operation and efficiency of reciprocating air compressors and the design and application of nozzles in engineering systems.

Course Code	Course Name	Hours per Week			Total	Total
		L	T	P	Hrs.	Credits
AU3CO21	Automotive Electrical and Electronics	3	0	2	5	4

Course Learning Objectives (CLOs):

CLO1 Understand Battery Technology and Maintenance

CLO2 Analyze Starting and Charging Systems

CLO3 Understand Lighting Systems and Vehicle Accessories

CLO4 Apply Knowledge of Sensors and Actuators

CLO5 Understand Electronic Fuel Injection and Ignition Systems

Unit I

Batteries: Principles and construction of lead-acid battery. Characteristics of battery, rating capacity and efficiency of batteries. Various tests on battery condition, charging methods. Constructional aspect of alkaline battery, Battery Maintenance

Unit II

Starting, Charging Systems: Condition at starting. Series motor and its characteristics.

Principle & construction of starter motor, Starter Switches. Charging System: Generation of electricity (DC and AC), Voltage & current regulation techniques. types.

Unit III

Lighting Systems & Accessories: Insulated & earth return systems. Positive &negative earth systems. Details of head light & side light. Headlight dazzling & preventive methods.

Electrical fuel-pump, Speedometer, Fuel, oil & temperature gauges, Horn, Wiper system, Trafficator.

Unit IV

Sensors and Actuators: Basic sensor arrangement, Types of sensors such as-Oxygen sensors, Crank angle position sensors-Fuel metering/vehicle speed sensor and detonation sensor-Altitude sensor, flow sensor. Throttle position sensors. Solenoids, stepper motors, and relays. Vehicle control systems: Anti-locking braking system, steer by wire, cruise control system.

Unit V

Electronic Fuel Injection and Ignition Systems: Introduction, feedback carburetor systems. Throttle body injection and multi-port or point fuel injection., fuel injection systems, Injection system controls. Advantages of electronic ignition systems: Types of solid-state ignition systems and their principle of operation, Contact less electronic ignition system, and electronic spark timing control.

TEXTBOOKS:

1. Kholi. P.L., Automotive Electrical Equipment, Tata McGraw-Hill Co. Ltd. NewDelhi, 1975.

2. Crouse. W.H., Automobile Electrical Equipment, McGraw Hill Book Co Inc., NewYork, 1980.

3. Automotive Handbook, Robert Bosch, Bently Publishers, 1997.

REFERENCE BOOKS:

1. Judge. A.W., Modern Electrical Equipment of Automobiles, Chapman & Hall,London, 1992.

2. Young. A.P., & Griffiths. L., Automobile Electrical Equipment, English Language Book Society & New Press, 1990.

3. Robert N Brady Automotive Computers and digital Instrumentation reston Book,Prentice Hall, Eagle Wood Cliffs, New Jersy, 1988.

WEB SOURCES:

1. http://fmcet.in/AUTO/AT6502_uw.pdf

2.http://npkauto.com/wpcontent/uploads/notes/third/6g/autotronics/CHAPTER%20NO%201%20AUTOMOTIVE%20ELECTRONIC%20COMPONENTS.pdf

Course Outcomes (COs):

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

CO01 Understand Battery Technology and Maintenance to gain knowledge of the principles, construction, and maintenance of lead-acid and alkaline batteries, including battery testing, rating, capacity, and charging methods.

CO02 Analyze Starting and Charging Systems to Learn the operation and characteristics of starting and charging systems in vehicles, including the generation of electricity and voltage regulation techniques.

CO03 Understand Lighting Systems and Vehicle Accessories to develop an understanding of vehicle lighting systems, including headlight configurations, as well as the functioning of various vehicle accessories like fuel pumps, speedometers, and wipers.

CO04 Apply Knowledge of Sensors and Actuators to acquire knowledge of various sensors and actuators used in vehicles, including their types, functions, and roles in vehicle control systems like ABS, cruise control, and steer-by-wire systems.

CO05 Understand Electronic Fuel Injection and Ignition Systems to gain insights into the operation and advantages of electronic fuel injection and ignition systems, including solid-state ignition and electronic spark timing control systems.

List of Practicals :

1. Study of batteries and battery maintenance.
2. Study of starting systems.
3. Study of Charging Systems.
4. Study of various current and Voltage regulation systems.
5. Study of various ignition systems.
6. Study of automobile electrical wiring.
7. Study of Antilock Braking System.
8. Study of dash-board indicators.
9. Study of automotive sensors.
10. Study of electronic fuel injection systems.
11. Study of lighting systems

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3CO22	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 Sources Rendering Concepts, Working Drawings from 3D Models Creating Multiple Viewports, 2D Views from 3D Solids.

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

Individual Projects:

Shift Lever

Form Roll Leaver

Nut, bolt & washer assembly

Knuckle Joint Assembly

Cotter Joint

Universal Joint

Solid muff coupling

Bush Type Coupling

Crosshead

Cam shaft

Connecting rod

Piston

Piston and connecting rod

Plumber block

Bush Bearing

Journal Bearing

TEXTBOOKS

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 by Cheryl R. Shrock, Steve Heather

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3CO23	MATERIALS AND MATERIAL TESTING LAB	0	0	2	1

List of 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).

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

Course Learning Objectives (CLOs)

CLO1 Understand Atomic and Crystal Structures.

CLO2 Analyze Material Behavior and Mechanical Properties

CLO3 Interpret Phase Diagrams and Heat Treatment Processes

CLO4 Evaluate Metallic Materials and Their Applications

CLO5 Understand Non-Metallic Materials and Their Properties

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.

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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 Outcomes (COs):

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

CO01 Understand the Fundamental Structure of Materials

CO02 Analyze Material Behavior and Mechanical Properties

CO03 Interpret Phase Diagrams and Apply Heat Treatment Processes

CO04 Characterize and Select Metallic Materials for Engineering Applications

CO05 Evaluate Properties and Applications of Non-Metallic Materials

Course Code	Course Name	Hours per Week			Total	Total
		L	T	P	Hrs.	Credits
AU3CO24	Python Programming for Automotive Engineering-I	0	0	2	2	1

Unit-I Introduction:

Introduction to Python and its history, how python is different from other programming languages and similarities. Application and uses. Python Installation, Installing the Anaconda, Python IDE, Toolbars, working area, sub menus, working modes.

Unit-II Basic constructs of Python:.

Variables in python Input and Output in Python, Basic commands. 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.

Unit-III Conditional Statement and Looping in python :

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-IV 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.

Unit-V 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.

TEXTBOOK

1. Dr. R. Nageswara Rao, Core Python Programming, dreamtech press.

2. Paul Barry, Head First Python, O'REILLY.

REFERENCE BOOK

1. Mark Luiz, Learning Python, O'REILLY.

2. Jamie Chan, Learn Python in One Day, LCF Publishing.

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. Prepare a program for dictionary consisting of various key elements and perform various operations in it.
15. Write a program using normal function and lambda function.
16. Write a program with Class name Phone and add the various parameter of class.
17. Write a class program using a constructor.
18. Write a program using inheritance.
19. Write a program using Numpy to demonstrate array creation techniques.
20. Write a program on football data using Numpy , Panda and Seaborn libraries.

Medi-Caps University, Indore

Scheme of B. Tech. -Automobile Engineering

For the candidates admitted in session 2021 - 2025

SEMESTER – IV

Sr. No.	Course Code	Course Name	L	T	P	Credits
1	AU3CO25	Manufacturing Processes- II	3	0	2	4
2	AU3CO26	Python Programming for Automotive Engineers- II	0	0	2	1
3	AU3CO27	Fluid Mechanics and Machinery	3	0	2	4
4	AU3CO28	Automotive Chassis & Transmission System	3	0	2	4
5	AU3CO29	CAD LAB-II	0	0	2	1
6	EN3HS04	Fundamentals of Management, Economics & Accountancy	3	0	0	3
7	AU3PC04	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**			

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
AU3CO25	Manufacturing Processes- II	3	0	2	3

Course Learning Objectives (CLOs):

CLO1 Understand the Mechanics of Metal Cutting

CLO2 Gain Proficiency in Lathe, Shaper, and Planer Machines:

CLO3 Explore Milling, Drilling, and Broaching Machines

CLO4 Learn Abrasive Machining Processes

CLO5 Introduction to CNC and Non-Traditional Machining Processes

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

Course Outcomes (COs):

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

CO01 Apply Metal Cutting Mechanics

CO02 Operate Lathe, Shaper, and Planer Machines

CO03 Select and Use Milling, Drilling, and Broaching Machines

CO04 Implement Abrasive Machining Techniques

CO05 Program and Operate CNC and Non-Traditional Machining Processes

LIST OF PRACTICALS:

1. To perform various operations on the lathe machine tool according to given drawing.

2. To perform various shaping operation to cut a groove on mild steel specimen 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 radial drilling machine.

5. To perform a finishing operation on surface grinder.

6. To make a job on 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.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
AU3CO26	Python Programming for Automotive Engineers- II	0	0	2	2

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.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
AU3CO27	Fluid Mechanics and Machinery	3	0	2	4

Course Learning Objectives (CLOs):

CLO1 Understand Fluid Properties and Hydrostatics

CLO2 Analyze Fluid Flow Kinematics and Dynamics

CLO3 Study the Operation and Efficiency of Hydraulic Turbines

CLO4 Explore the Working Principles of Hydraulic Pumps

CLO5 Apply Dimensional Analysis and Similarity Laws

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.

TEXTBOOKS

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

Course Outcomes (COs):

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

CO01 Apply Fluid Properties and Hydrostatic Principles

CO02 Analyze and Solve Fluid Flow Problems

CO03 Evaluate the Performance of Hydraulic Turbines

CO04 Understand and Operate Hydraulic Pumps

CO05 Utilize Dimensional Analysis in Fluid Mechanics

LIST OF PRACTICALS

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.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
AU3CO28	Automotive Chassis & Transmission System	3	0	2	4

Course Learning Objectives (CLOs):

CLO1 Understand the Operation and Maintenance of Clutches and Gearboxes:

CLO2 Explore Hydrostatic, Hydrodynamic, and Electric Drive Systems:

CLO3 Familiarize with Drive Line and Automatic Transmission Systems:

CLO4 Analyze Chassis, Frame, and Steering Systems:

CLO5 Learn Suspension and Braking Systems:

UNIT I CLUTCH AND GEAR BOX:

Constructional details, calculation of torque capacity,Operation of different types of clutches, Dry and Wet type of clutch, Friction lining materials, Over-running clutch,clutch maintenance, Different types of gear boxes,determination of gear ratios for vehicles, Performance characteristics in different speeds,need for double declutching and working of synchronizing unit, Power and economy modes in gearbox, Transfer box, Transaxles, Overdrives, Gear shifting mechanisms, Gear box maintenance.

UNIT III HYDROSTATIC DRIVE, HYDRODYNAMIC DRIVE AND ELECTRIC DRIVE:

Hydrostatic drive – principle, types, advantages, limitations – Comparison of hydrostatic drive with hydrodynamic drive - Construction and working of typical Janny hydrostatic drive. Electric drive, Principle of early and modified Ward Leonard Control system, Advantage & limitations, Performance characteristics, Study of drive system in an electric and hybrid vehicle, Principle, construction and working of fluid coupling, torque converter, Torque capacity, Performance characteristics, Reduction of drag torque, Free wheel.

UNIT III DRIVE LINE AND AUTOMATIC TRANSMISSION APPLICATIONS:

Propeller Shaft, U Joint, Front and Rear Drive, Differential, Fluid coupling, Chevrolet "Turbo glide" Transmission, Power glide Transmission Toyota "ECT-i" Automatic Transmission with Intelligent Electronic controls system, Hydraulic Actuation system.

Axles, Wheels and Tire: Construction of Drive Axles, Types of Loads acting on drive axles, Full - Floating, Three-Quarter Floating and Semi-Floating Axles, Axle Housings and Types, Types and Constructional Details of Different Types of Wheels and Rims, Different Types of Tires and their constructional details.

UNIT IV CHASSIS, FRAME AND STEERING SYSTEM:

Definition of Chassis, Types of Chassis layout, with reference to Power Plant location and drive, various types of frames, Loads acting on vehicle frame, Constructional details and materials for frames, testing of frames.

Types of Front and Stub Axles, Front Wheel Geometry, Condition for True Rolling Motion of Wheels during Steering, Steering Linkages, Different Types of Steering Gears, Slip Angle, Over-Steer and Under-Steer, Reversible and Irreversible Steering, Power-Assisted Steering.

UNIT V SUSPENSION AND BRAKING SYSTEM:

Need for Suspension System, Construction, working and characteristics of different types of Suspension system, Pneumatic and Hydro-elastic Suspension Systems, Independent Suspension System, Shock Absorbers.

Theory of Automobile Braking, Stopping Distance Time and Braking Efficiency, Effect of Weight Transfer during Braking, Construction, working and characteristics of different types of Braking system, Retarders, Anti-Lock Braking System.

TEXT BOOKS

1. Crouse. W.H., Anglin., D.L., Automotive Transmission and Power Trains construct, McGraw-Hill.
2. Kirpal Singh, Automobile Engineering, Standard Publishers Distributors.
3. R.K. Rajput, A Text-Book of Automobile Engineering, Laxmi Publications Private Limited.
4. N.K. Giri, Automotive Mechanics, Khanna Publishers.
5. Judge. A. W., Modern Transmission systems, Chapman and Hall Ltd.

REFERENCE BOOKS

1. Heinz Heisler, Advanced Vehicle Technology, Butterworth Heinemann, 2002.
2. Hydrostatic Transmission for vehicle applications, I. Mech E. Conference, 1981-88.
3. Heldt. P.M, Torque converters, Chilton Book Co., 1992.
4. Newton Steeds and Garrot, Motor Vehicles, Bunenvonhs.
5. A.W. Judge, Mechanism of the Car, Chapman and Halls Ltd.
6. J.G. Giles, Steering, Suspension and tyres, Wife Book Co

Course Outcomes (COs):

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

CO01 Apply Knowledge of Clutch and Gearbox Mechanisms:

CO02 Evaluate Hydrostatic, Hydrodynamic, and Electric Drive Systems:

CO03 Analyze and Maintain Drive Line and Automatic Transmission Systems:

CO04 Design and Assess Vehicle Chassis and Steering Systems:

CO05 Understand and Implement Suspension and Braking Systems:

WEB SOURCES:

1. http://164.100.133.129:81/eCONTENT/Uploads/MAS-5%20Manual%20and%20Automatic%20Transmissions.pdf

LIST OF PRACTICALS:

1. Study of transmission of front and rear engine vehicles.
2. Study of front and rear-wheel-drive vehicle.
3. Study of various gear boxes and pre-synchronization systems.
4. Study of fluid couplings, hydrodynamic drives and torque converters.
5. Study of different types of clutch.
6. Study the various types of gear used in automotive application.
7. Study of various components of Chassis and different types of Frames and trouble shooting.
8. Study and Construction of Front Axle.
9. Study and measure various angles of steering geometry and different types of steering linkages.
10. Study and Construction of Rigid Axle Suspension system and Independent Suspension system.
11. Study and Construction of various types of Brakes.
12. Study and Construction of Wheel and Tyres

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
AU3CO29	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:

Cylinder Vertical Steam Engine with single valve

Petrol vapour carburetor

2-stroke engine

Triple cylinder oscillating steam engine

Cylinder horizontal steam engine with Crosshead trunk guide

Working model of a fire engine.

Cylinder steam engine to the bernay design.

Carburetor

Model of a gas fired quarry typehunslet loco

Vertical Boiler

Horizontal Boiler

Wobler Engine

Wagon

Side lever Engine

Tractor Engine

TEXTBOOKS

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.

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

Course Learning Objectives (CLOs):

CLO1 Understand the Core Concepts of Management

CLO2 Gain Knowledge in Marketing and Human Resource Management

CLO3 Develop an Understanding of Economic Principles

CLO4 Learn Basic Accounting Principles and Procedures

CLO5 Explore the Fundamentals of Financial Management

UNIT I CONCEPTS OF MANAGEMENT:

Definition, characteristics and importance of management; Management: Science or Art, Difference between Management and Administration, Levels of management, Functions of Management, 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 and Functions; Role of HR manager, Process and need for Human Resource Planning, Human resource 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 microand macro 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).

TEXTBOOKS

1. R. D. Agarwal, Organization and Management, McGraw Hill Education.

2. P. C. Tripathy and P. N. Reddy, Fundamentals of Management, Economics and Accountancy Tata McGraw Hill

3. Kotler Philip and Keller Kevin Lane, marketing Management Pearson

REFERENCE BOOKS

1. Peter F Drucker, The Practice of Management McGraw Hill

2. Harold Koontz, Essentials for Management, Tata McGraw Hill

3. M Y Khan and P K Jain, Management Accounting Tata McGraw Hill

Course Outcomes (COs):

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

CO01 Apply Management Concepts in Decision-Making:

CO02 Analyze Marketing and Human Resource Strategies:

CO03 Utilize Economic Principles in Business Contexts:

CO04 Prepare and Interpret Financial Statements:

CO05 Implement Financial Management Strategies:

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
AU3PC04	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 perthe prescribed module.

5. A complete Assembly and Details drawings of the project should be submitted along with a detailedproject report, where applicable.

6. A Detailed Background / field / literature survey, related to the topic must be made and presented inthe report.

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

Course Learning Objectives (CLOs):

CLO1Understand the Need and Process for Value Education

CLO2 Explore Harmony within the Individual

CLO3 Understand Harmony in Relationships and Society

CLO4 Comprehend Harmony in Nature and Existence

CLO5 Apply Holistic Understanding to Professional Ethics

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 eaning of 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, Sahastitvaas comprehensive Human Goals, Visualizing a universal harmonious order in society Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)-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 :as mutually enriching institutions and organizations.

TEXTBOOKS

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, Small is Beautiful: a study of economics as if people mattered, Blond &Briggs, Britain.
3. SussanGeorge,1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, Limits to Growth–Club of Rome's report, Universe Books.
5. A Nagraj, 1998, Jeevan Vidya Ek Parichay, Divya Path Sansthan, Amarkantak.
6. PL Dhar, RRGaur,1990, Science and Humanism, Commonwealth Publishers.
7. A N Tripathy, 2003, Human Values, New Age International Publishers. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen (Vaidik) Krishi Tantra Shodh, Amravati.
8. EG Seebauer & RobertL.Berry,2000, Fundamentals of Ethics for Scientists & Engineers,

Course Outcomes (COs):

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

CO01 Articulate the Importance of Value Education:

CO02 Foster Inner Harmony:

CO03 Promote Harmonious Relationships and Societal Order:

CO04 Demonstrate Understanding of Harmony in Nature:

CO05 Apply Ethical Principles in Professional Life:

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

Course Learning Objectives (CLOs):

CLO1 Enhance Professionalism and Body Language Skills

CLO2 Develop Interpersonal and Team Building Skills

CLO3 Strengthen Time Management and Goal Setting Abilities

CLO4 Cultivate Creativity and Presentation Skills

CLO5 Practice Everyday Communication and Problem-Solving

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 group activity session.

UNIT II Team Building:

To make every student intermingle within a team and contribute to the team's success. To make them understand the importance of working as a team. Importance of complimentary 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.

TEXTBOOKS:

1. "Body Language: How to Read Others' Thoughts by Their Gestures" by Allan Pease
2. "The 7 Habits of Highly Effective People" by Stephen R. Covey
3. "Interpersonal Communication: Everyday Encounters" by Julia T. Wood

REFERENCES:

1. "Emotional Intelligence: Why It Can Matter More Than IQ" by Daniel Goleman
2. "Creative Confidence: Unleashing the Creative Potential Within Us All" by Tom Kelley and David Kelley
3. "The Goal: A Process of Ongoing Improvement" by Eliyahu M. Goldratt

WEB LINKS:

1. https://www.mindtools.com/pages/main/newMN_HTE.htm
2. https://owl.purdue.edu/owl/subject_specific_writing/professional_technical_writing/index.html

Course Outcomes (COs):

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

CO01Demonstrate Professionalism and Effective Body Language

CO02 Exhibit Strong Interpersonal and Teamwork Skills

CO03Apply Time Management Techniques and Achieve Goals

CO04 Deliver Creative and Engaging Presentations

CO05 Communicate Effectively in Everyday Situations

SEMESTER – V

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	AU3CO30	Automotive Engines	4	0	2	5
2	AU3CO31	Machine Design	4	0	0	4
3	AU3CO32	Hybrid Vehicles	4	0	0	4
4	AU3CO33	Theory of Machines	3	0	2	4
5	AU3CO34	Design and Simulation Lab -I	0	0	2	1
6		Program Elective - I	3	0	0	3
7		Program Elective - II	3	0	0	3
8		Open Elevtive I	3	0	0	3
		Total	24	0	6	27
		Total Contact Hours	30			

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3CO30	Automotive Engines	4	0	2	5

Course Learning Objectives (CLOs):

CLO01 Students will be familiar with engine operation and fuel supply system for SI and CI engine.

CLO02 Student will be able to explain the need and requirement of cooling & lubrication system.

CLO03 Students will be able to explain the combustion phenomenon in IC engine and combustion chamber design.

CLO04 Student will know the various latest technologies and different parameters used for identifying engine performance and their measurements.

CLO05 Students will be able to interpret Dynamic analysis of reciprocating engine and balancing of inertia forces.

UNIT I INTRODUCTION OF IC ENGINES

Constructional details of 4-stroke and 2-stroke engines. Working principle, Otto, Diesel cycle, valve and port timing diagrams and actual indicator diagram. Fuel Systems in SI Engine :Carburettor working principle. Fuel feed systems, Mechanical and electrical pumps. LPG and CNG fuel systems. MPFI systems.CI Engine Fuel System; Requirements of Air and solid injection systems and their types, Jerk and distributor type Pumps. Pressure waves, Injection lag, Unit injectorFuel injection nozzles and types, CRDI systems for diesel.

UNIT II COOLING AND LUBRICATION SYSTEMS

Need for cooling, types of cooling systems- air and liquid cooling systems. Thermo-syphon and forced circulation and pressurized cooling systems. Properties of coolants. Requirements of lubrication systems. Types-mist, pressure feed, dry and wet sump systems. Properties of lubricants.

UNITIII COMBUSTION AND COMBUSTION CHAMBERS

Combustion in IC engines, stages of combustion, flame propagation, rate of pressure rise, abnormal combustion, knocks. Effect of engine variables and knock. Combustion chambers, Different types, Factor controlling combustion chamber design.

UNIT IV SUPERCHARGING & TURBO CHARGING AND TYPES OF SCAVENGING

Necessity and limitation, Charge cooling, Types of supercharging and turbo charging, relative merits, Matching of turbocharger. Theoretical scavenging methods. Scavenging pumps. Performance Characteristics and Testing ;Variables affecting engine performance. Methods to improve engine performance. Heat balance. Performance Maps and Drivability Diagnosis. Engine power and efficiency.

UNIT V DYNAMIC ANALYSIS OF RECIPROCATING ENGINES

Force analysis of different components of IC Engines, Turning moment diagrams, Coefficient of fluctuation of- Energy and Speed, Flywheel and its applications. Balancing of Inertia Forces and Moments in Engines Balancing of rotating masses and reciprocating masses in single and multi-cylinder (inline engine, Radial Engine V-twin engines), Concept of firing order, Lanchester technique of engine balancing.

TEXTBOOKS

1. Internal Combustion Engines by V. Ganesan, 2012, Tata Mc Graw Hill.
2. Internal Combustion Engines Ramalingam K.K., Sci-Tech Publications, 2005.
3. Internal Combustion Engines ,Mathur and Sharma , Dhanpat Rai and Sons 2010.
4. Ambekar, A.G.; Mechanism and Machine Theory; PHI
5. Rattan S.S.; Theory of machines; TMH

REFERENCE BOOKS

1. Heldt.P.M, High Speed Combustion Engines, Oxford IBH Publishing Co., Calcutta, 1985.
2. Obert.E.F, International Combustion Engines Analysis and Pratice, International Text Book Co., Scranton, Pennsylvania, 1988.
3. Automotive Engines (McGraw-Hill International Editions: Automotive Technology Series) Paperback – International Edition, September 1, 1994 by William H. Crouse and Donald Anglin.
4. Ellinger.H.E, Automotive Engines, Prentice Hall Publishers, 1992
5. Maleev.V.M, Diesel Engine Operation and Maintenance, McGraw Hill, 1974.
6. Dicksee.C.B, Diesel Engines, Blackie & Son Ltd., London, 1964.
7. Advanced Engine Technology by Heisler, SAE Publication.
8. Edward F. Obert Internal Combustion Engines.
9. H.N. Gupta Fundamentals of Internal Combustion Engines by, PHI.
10. John B. Heywood, “Fundamentals of Internal Combustion Engines”.
11. Ghosh and Mallik; Theory of Mechanisms and Machines; Affiliated East-West Press, Delhi
12. Norton R.L.; Kinematics and Dynamics of machinery; TMH

LIST OF PRACTICALS:

1. To identify the major components of different automobile engines.
2. To study the fuel supply system of petrol & diesel engines and represent the same in sketches.
3. To study the engine lubrication system circuits.
4. To study the engine cooling system with neat sketches.

5. To study of Electronic Fuel Injection (EFI) system with neat sketches.
6. To perform the Morse Test on I.C. engine.
7. To perform the Heat Balance Test on petrol / diesel engine.
8. To study the performance characteristics of petrol / diesel engine by using an engine test rig.
9. To perform dynamic balancing of unbalanced rotating shaft.
10. To study the balancing of reciprocating masses in an reciprocating engine

Course Outcomes (COs)

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

CO01	Understand the basics of I. C. Engines, parts, construction and fuel supply system for different types of engines
CO02	Understand the concept and requirement of cooling & lubrication system.
CO03	Understand the concept of phenomenon of SI & CI engine combustion and types of combustion chamber.
CO04	Understand modern technologies of engine development and testing of an I. C. Engines.
CO05	Understand concepts balancing of inertia forces and dynamic analysis of engines.

Course Code	Course Name	Hours per Week	Total

		L	T	P	Credits
AU3CO31	Machine Design	4	0	0	4

Course Learning Objectives (CLOs):

CLO1 Students will be able to design the objects against the static & fluctuating loads.

CLO2 Student will be able to design the key and couplings

CLO3 Students will be able to design the different types of shafts

CLO4 Student will be able to design different types of springs

CLO5 Students will be able to design different types of belt, rope and chain drives.

Unit I

Design against Static & Fluctuating loads: Types of static loads, Theories of failure , design under static load, 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, Soderberg, Goodman & Gerber criteria.

Unit II

Keys & Couplings: Keys; Types and selection, design of square and flat keys, splines. Selection of couplings, design of rigid coupling: Muff coupling, Clamp coupling and Flange coupling, Flexible couplings: Bushed pin flexible coupling.

Unit III

Shafts: Cause of failure in shaft, materials for shaft, stress in shaft and design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments.

Unit IV

Mechanical Spring: Types, nomenclature of helical springs, spring materials, types of ends, design of helical springs subjected to static load. Leaf springs: types, classification, nomenclature and design.

Unit V

Belt Rope and Chain drives: Design of belt drives, Flat & V-belt drives, Condition for Transmission of max. Power, Selection of belt, design of rope drives and design of chain drives with sprockets.

TEXTBOOKS

1. Design of Machine Elements by V. B. Bhandari, TMH Publishing Co. Ltd., New Delhi
2. Machine Design by Shigley, McGraw hill
3. Sharma P C and Aggarwal D K, “Machine Design”, Kataria Publishers.

REFERENCE BOOKS:

1. Machine Design by Norton, Prentice Hall
2. Machine Design by Spots, Prentice hall

WEB SOURCES:

1. http://nptel.ac.in/downloads/112105125/
2. http://www.svecw.edu.in/Docs%5CMEDMMLnotes2013.pdf

Suggested Practicals

1. To study and draw the methods of reducing stress concentration.
2. Design and drawing of different types of keys.
3. Design and drawing of Muff coupling.
4. Design and drawing of Clamp coupling.
5. Design and drawing of Flange coupling.
6. Design of shafts subjected to combined twisting and bending moments & drawing of bending and twisting moment diagrams.
7. Design and drawing of different types of springs.
8. Design and drawing of different types of chains.
9. Design and drawing of different types of belts.
10. Design and drawing of different types of wire ropes.

Course Outcomes (COs):

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

CO1	Design the objects against the static & fluctuating loads.
CO2	Design different kinds of keys and couplings.
CO3	Design the different kinds of shaft.
CO4	Design the different types of springs
CO5	Design different types of belt, rope and chain drives.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits

AU3C032	Hybrid Vehicles	4	0	0	4

Course Learning Objectives (CLOs):

CLO1 Explain the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.

CLO2 Explain energy storage in electric and hybrid electric vehicle.

CLO3 Discuss different energy storage technologies used for hybrid electric vehicles and their control.

CLO4 To understand electric propulsion for EV and HEV.

CLO5 Explain different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components.

Unit I

Electric And Hybrid Electric Vehicles: Configuration of Electric Vehicles, Performance of Electric Vehicles, Traction motor characteristics, Tractive effort and Transmission requirement, Vehicle performance, Tractive effort in normal driving, Energy consumption Concept of Hybrid Electric Drive Trains, Architecture of Hybrid Electric Drive Trains, Series Hybrid Electric Drive Trains, Parallel hybrid electric drive trains.

Unit II

Energy Storage for EV & HEV: Energy storage requirements, Battery parameters, Types of Batteries, Modelling of Battery, Fuel Cell basic principle and operation, Types of Fuel Cells, Super Capacitors.

Unit III

Electronic Converter For Battery Charging: Charging methods for battery, Termination methods, charging from grid, The Z - converter, Isolated bidirectional DC - DC converter, Design of Z - converter for battery charging, High -frequency transformer based isolated charger topology.

Unit IV

Electric Propulsion: EV consideration, DC motor drives and speed control, Induction motor drives, Permanent Magnet Motor Drives, BLDC motor, Switch Reluctance Motor Drive for Electric Vehicles, Configuration and control of Drives.

Unit V

Design of Electric & Hybrid Electric Vehicles: Series Hybrid Electric Drive Train Design: Operating patterns, control strategies, Sizing of major components, power rating of traction motor, power rating of engine /generator.

TEXTBOOKS

1. M. Ehsani, Y. Gao, S. Gay and Ali Emadi, Modern Electric, Hybrid Electric, and Fuel Cell.
2. Vehicles: Fundamentals, Theory, and Design, CRC Press
3. Iqbal Husain, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press

REFERENCE BOOKS:

1. C.C. Chan and K.T. Chau, Modern Electric Vehicle Technology, OXFORD University Press
2. Chris Mi, M. AbulMasrur, David WenzhongGao, Hybrid Electric Vehicles Principles and Applications with Practical Perspectives, Wiley Publication
3. Sheldon S. Williamson, Energy Management Strategies for Electric and Plug - in Hybrid Electric Vehicles, Springer

Course Outcomes (COs)

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

CO1	Students will be able to understand the basics of electric and hybrid electric vehicles, their architecture, technologies and fundamentals.
CO2	Student will become well conversant with different energy storage technologies used for hybrid electric vehicles and their control.
CO3	Students will different configurations of electric vehicles and its components, hybrid vehicle configuration by different techniques, sizing of components.
CO4	Students will be able to understand the basics of different charging methods of electric and hybrid electric vehicles.
CO5	Students will be able to explain design of electric and hybrid electric vehicle.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits

AU3C033	Theory of Machines	3	0	2	4

Course Learning Objectives (CLOs)

CLO1	Understand the fundamental principles and concepts of theory of machines, including kinematics and dynamics of mechanisms.
CLO2	Develop the ability to analyze and solve problems related to the motion and forces in machine systems.
CLO3	Acquire knowledge of various mechanisms and their applications in engineering systems
CLO4	Develop skills to design and evaluate machine components, such as gears, cams, and linkages.
CLO5	Develop skills to design and evaluate machine components, such as gears, cams, and linkages.

UNIT I MECHANISMS AND MACHINES

Rigid and resistant body, Definitions and classification of Links, Kinematic pairs, Chains and Mechanism, Difference between mechanism and machine., Degrees of freedom : for a pair and mechanism, Gruebler's & Kutzback's Criterion for planer mechanisms, Inconsistencies in Gruebler's criteria, Equivalent linkages, Kinematic inversion, Different Inversions of Four bar chain, Slider crank chain and Double slider-crank chain. Number Synthesis of mechanism, Different lower paired mechanisms: Kinematic analyses of- Straight line mechanisms: Approximate and Exact Mechanisms, Davi's and Ackermann Steering Mechanisms, Hooke's Joint- Single and Double type , Pantograph Mechanisms, Quick Return Mechanisms- Slotted Lever and Whitworth's type.

UNIT II VELOCITY AND ACCELERATION ANALYSIS IN MECHANISMS

Concepts of planer motion of body as a point and as a rigid body, 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- Velocity Diagrams of Mechanisms upto six links, Instantaneous Centre of Rotation Method : Properties of instantaneous centers, Aronhold- Kennedy Theorem of three centers, Velocity determination in mechanisms upto six links, Acceleration Analysis of Planer Mechanisms: Concepts of Radial and Tangential acceleration, Coriolis Component of acceleration, Acceleration Diagrams of different mechanisms. 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, Analysis for cams with specific contours, circular arc and tangent cams.

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 and Pinion and between Rack and Pinion, Terminologies of Helical, Spiral, Worm and Worm gear and Bevel gears. Gear Trains: Spur Geared trains: Simple, Compound, Reverted and Epi-Cyclic - Velocity ratio and Torque calculations in gear trains, Introduction to Automobile Differential Gear Box.

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.

TEXTBOOKS

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. Bansal R.K., Theory of Machines

6. Sharma and Purohit; `Theory of Machines

7. Khurmi R.S. and Gupta J K; Theory of Machines ; S.Chand& Co.

REFERENCES 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 rdEdition, 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 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 Slider Lever 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 study different types of gears.
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.

Course Outcomes:

CO1	Students will be able to analyze and predict the motion characteristics of mechanisms using principles of kinematics, such as displacement, velocity, and acceleration analysis.
CO2	Students will be able to apply dynamic analysis techniques to determine the forces and torques involved in machine systems, considering factors such as inertia, friction, and external loads.
CO3	Students will gain an understanding of different types of mechanisms and their applications, such as gears, belts, and linkages, and will be able to select and design appropriate mechanisms for specific engineering tasks.
CO4	Students will be able to design and evaluate machine components, such as gears, cams, and bearings, considering factors such as load capacity, reliability, and efficiency.
CO5	Students will develop problem-solving skills by applying theoretical concepts to real-world engineering problems, demonstrating the ability to analyze and propose solutions for various machine system challenges.

Course Code	Course Name	Hours per Week	Total

		L	T	P	Credits
AU3C034	Design & Simulation Lab	0	0	2	1

Course Learning Objectives(CLOs)

CLO1	To acquire knowledge about stress analysis at different objects
CLO2	To acquire knowledge about Thermal analysis at different objects
CLO3	To acquire knowledge about vibrational analysis at different objects

Introduction of FEA and ANSYS

Study of a FEA package and applying it on various problems

STRUCTURAL ANALYSIS

Stress analysis of a plate with a circular hole

Stress analysis of rectangular L bracket

Stress analysis of an axis-symmetric component

Stress Analysis on Cantilever Beam Subjected To single point load and UDL

Stress analysis of simply supported beam Subjected To single point load and UDL

Stress analysis of fixed beam Subjected To single point load and UDL

Truss subjected to transverse load

Analysis of a bicycle frame

Application of Joints and springs in ANSYS

THERMAL ANALYSIS

Thermal stress analysis of a 2D component

Conductive heat transfer analysis of a 2D component

Convective heat transfer analysis of a 2D component

Thermal analysis of Melting Using Element Death -it is subject to convection heating which will cause the block to "melt"

VIBRATIONAL ANALYSIS

Model frequency analysis of 2D component

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, Dream tech Press

Course Outcomes:

CO1	Students will be able to perform stress analysis at different objects
CO2	Students will be able to perform Thermal analysis at different objects
CO3	Students will be able to perform vibrational analysis at different objects

Course Code	Course Name	Hours per Week	

		L	T	P	Total Credits
AU3EL01	Program Elective-I Finite Element Methods	3	0	0	3

Course Learning Objectives (CLOs)

CLO1Student should identify and compare the outputs of different methods to solve governing equation of a process.

CLO2 Students must understand the different terminologies and features of finite element method.

CLO3 Students must understand when to distinguish a given domain as a one-dimensional problem and implement structural concepts.

CLO4 Students must understand when to distinguish a given domain as a two-dimensional problem and implement structural concepts.

CLO05 Students must understand the applications of Finite Element Method to different domains.

UNIT I Introduction to Finite Element Method: General description of Finite Element Method, Historical development, Comparison with classical methods, General procedure of FEM. General field problems, discrete and continuous models, Variational formulation in finite elements, Ritz method, Weighted residual methods, Galerkin, sub domain, method of least squares and collocation method, numerical problems.

UNIT-II Discretization and Interpolation Function: Discretization: Geometrical approximations, Simplification through symmetry, Element shapes and behavior, Choice of element types, size and number of elements, Element shape and distortion, Location of nodes, Node and Element numbering. Interpolation Function: Simplex, Complex and Multiplex elements, Selection of interpolation polynomials, Convergence requirements, Natural coordinate systems, Derivation of shape functions for various elements, Iso-parametric elements, Numerical Integration.

UNIT III Applications in structural: One dimensional elasticity, Castigliano's first theorem, Principle of minimum potential energy, Linear Spring, Elastic bar with constant and varying cross sections using linear and quadratic elements, Truss structures and Beams.

UNIT IV Applications in plane elasticity: Introduction to plane elasticity theory, Plane stress, Plane strain and axisymmetric problems, Finite Element formulations of plane elasticity problems using CST and four noded quadrilateral elements only.

UNIT V Applications in Heat Transfer and Fluid Mechanics: Finite Element formulation of One dimensional and Two-dimensional steady state heat conduction problems with convection Simplex elements only. Finite Element formulation of in viscid and incompressible flow, Potential function formulation, Stream function formulation.

TEXTBOOKS:

1. T.R.Chandrupatla and A.D.Belugundu, Introduction to Finite Elements in Engineering, PHI. 2. D.V. Hutton, Fundamentals of Finite Element Analysis, TMH.

3. D. L.Logan, A First Course in the Finite Element Method, Cengage Learning.

REFERENCE BOOKS

1 Klaus-Jurgen Bathe, Finite element procedures, PHI.

2. S.S. Rao, The Finite Element Method in Engineering, Elsevier.

3. C.Zienkiewicz, R.L.Taylor and J.Z. Zhu, The Finite Element Method: Its basis and fundamentals, Butterworth I leinmann.

Course Outcomes

CO1 Students will be able to implement the different mathematical approaches to formulate and solve a given problem other than finite element method.

CO2 Students will be able to design a given problem from the point of view of Finite Element Method.

CO3 Students will be able to formulate and implement structural analysis to a one-dimensional domain using Finite Element Modelling.

CO4 Students will be able to formulate and implement structural analysis to a two-dimensional domain using Finite Element Modelling.

CO5 Student will be able to formulate and apply the Finite Element Modelling to problems of other domains like- Heat transfer, Fluid flow and problems of dynamic nature.

Course Code	Course Name	Hours per Week			Total Credits
		L	T	P	
AU3EL02	Program Elective-I Measurement & Instrumentation	3	0	0	3

Course Learning Objectives (CLOs):

CLO1	Understand the fundamental principles and concepts of measurement and instrumentation, including various measurement techniques and instruments used in engineering.
CLO2	Develop the ability to select and use appropriate measurement instruments for different engineering applications.
CLO3	Acquire knowledge of different types of sensors and transducers used for measuring physical quantities.
CLO4	Gain practical skills in calibration, measurement accuracy, and uncertainty analysis.
CLO5	Enhance critical thinking and problem-solving abilities by analyzing and interpreting measurement data and making informed decisions based on the results.

Unit I

Introduction to generalized measurement system and their functional elements. Basic characteristics of measuring devices, Standards & Calibration. Accuracy, Precision, Sensitivity, Resolution, Linearity & Errors in measurement.

Unit II

Transducers, Stages & their classification, Resistive transducers, Strain gauges, Rosettes, Inductive transducers, Displacement measurement, LVDT.

Unit III

Applications Miscellaneous instruments in Industrial & Environmental Applications, Measurement of viscosity & flow, Transient Time & Doppler's flow meter, Measurement of liquid level, humidity, and hair hygrometers.

Unit IV

Control engineering applications, Introduction to type of control Systems, Open loop & close loop Control Systems; Examples & their block diagrams. Transfer function, Stability of Control System, Hurwitz Polynomial& Routh Hurwitz Criterion. Block diagram representation & reduction.

Unit V

Modes of Control & Controller Mechanism P, PI and PID Controller. Pneumatic & Hydraulic Controller, General Pr. of generating various Control Actions. Concept of Control Valves.

TEXTBOOKS:

1. Sawhney A. K, "A course in Electrical & Electronics Measurement & Instrumentation", Dhanpat Rai &Son"s.
2. B.C Nakra, KK Chaudhary."Instrumentation, Measurement & Analysis". TMH.
3. M Ogata, "Modern Control Engineering" PHI.

REFERENCE BOOKS:

1. H.S Kalsi, Electronic Instrumentation", TMH.
2. B.C Kuo, "Automatic Control System", Prentice Hall

Course Outcomes

CO1	Students will be able to apply the principles of measurement to select and use appropriate instruments for measuring physical quantities such as temperature, pressure, flow, and electrical signals.
CO2	Students will gain an understanding of different types of sensors and transducers and their working principles and will be able to select and implement suitable sensors for specific measurement tasks.
CO3	Students will develop practical skills in calibration techniques, measurement accuracy assessment, and uncertainty analysis, ensuring reliable and accurate measurement results.
CO4	Students will be able to design and implement measurement systems, including signal conditioning, data acquisition, and signal processing techniques.
CO5	Students will enhance their problem-solving abilities by analyzing measurement data, identifying sources of error, and making informed decisions based on the results, thereby improving the overall quality of engineering processes and systems.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3EL08	Program Elective-II Automotive Safety Systems	3	0	0	3

Course Learning Objectives (CLOs):

CLO1 To understand the fundamentals of vehicle safety systems.

CLO2 To understand the principle and concepts of automotive safety.

CLO3 To understand the construction and functioning of automotive safety systems.

CLO4 To understand the different types of automotive collision avoidance system.

CLO5 To understand the comfort and convenience system used in automobile.

UNIT I Introduction: Design of the body for safety, energy equation, engine location, deceleration of vehicle inside passenger compartment, deceleration on impact with stationary and movable obstacle, concept of crumple zone, safety sandwich construction.

UNIT II Safety Concepts: Active safety: driving safety, conditional safety, perceptibility safety, operating safety- passive safety: exterior safety, interior safety, deformation behavior of vehicle body, speed and acceleration characteristics of passenger compartment on impact.

UNIT III Safety Equipment's: Scat belt, regulations, automatic seat belt tightener system, collapsible steering column, Tiltable steering wheel, air bags, electronic system for activating air bags, bumper design for safety.

UNIT IV Collision Warning and Avoidance: Collision warning system, causes of rear end collision, frontal object detection, rear vehicle object detection system, object detection system with braking system interactions.

UNIT V Comfort and Convenience System: Steering and mirror adjustment, central locking system, Garage door opening system, tire pressure control system, rain sensor system, environment information system.

TEXTBOOKS

1. Bosch, Automotive Handbook, Robert Bosch publication.

2. UrichSeiffert and Lothar Wech, Automotive Safety I landbook, SAE publication.

3. George A. Peters and Barbara J. Peters, Automotive Vehicle Safety, CRC Press.

REFERENCES BOOKS

1. Powloski, Vehicle Body Engineering, Business books limited, London.

2. Ronald. K. Jurgen, Automotive Electronics Handbook, TMH.

3. U.Seiffcrt, and L.Wech, Automotive Safety hand Book, Society of Automotive Engineers (SAE).

Course Outcomes (COs):

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

CO1 Understand the fundamentals of vehicle safety systems.

CO2 Apply the principle and concepts of automotive safety in real time.

CO3 Work on the construction and functioning of automotive safety systems in automobiles.

CO4 Apply the knowledge of different types of automotive collision avoidance system.

CO5 Apply the knowledge of various comfort and convenience systems in automobiles

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3EL13	Program Elective-II Tractor & Farm Equipment	3	0	0	3

Course Learning Objectives (CLOs):

CLO1 To understand the fundamentals of farm and machinery equipments.

CLO2 To understand the fundamentals of hydraulic systems used in earth movers.

CLO3 To understand the working of tractor and various components used in it.

CLO4 To understand the maintenance management of earth moving equipments.

CLO5 To study various safety norms related to tractor and farm equipments.

Unit-I

Introduction: Fundamental of Soils and machinery; different equipments, purposes and operations; Systems of Earth Moving Equipments: Engine-all systems of engine and special features like automatic timer, turbochargers, after coolers; Transmission:- Basic types and planetary transmission constructional and working principles. Hydro shift automatic trans torque converters, retarders.

Unit-II

Hydraulics: Basic components of hydraulic systems like pumps (types); control valves, relief valves and hydraulic motors; hydraulic cylinders, circuits and controls valves.

Unit-III

Final Drive: Types of reductions, Structure and function suspensions like hydraulic suspension; brakes and steering: hydraulic power steering, main components and circuit; tire, brakes and components and functions. Tractor and components.

Unit-IV

Earth Moving Equipments Management: Earth moving equipments; maintenance; type of maintenance schedules; purpose and advantages, method of selection of equipments:-Selection of machines, basic rules of matching machine, selection of equipment including the nature of operation; selection- based on type of soil, based on haul distance and weather condition.

Unit-V

Safety Norms of Tractor &Farm Equipments: Safety Methods and attachment for earth moving equipments. Precautions to avoid accidents. Life safeguarding equipments & accessories

TEXTBOOKS

1. John B. Llzedaw et-al; Tractors and their power units

2. Donald R. Hum and LGV Garner; Farm machinery and mechanism

3. Jain S C, Farm Tractor: Maintenance and Repair, Standard Publishing House

REFERENCES BOOKS:

1. D N & S Mukesh Sharma , Farm Power And Machinery Management Vol. - 1 and II , Jain brothers
2. Ivan Gregg Morrison , Farm Tractor Maintenance, Jain Brothers

Course Outcomes (COs):

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

CO1 Understand the fundamentals of farm and machinery equipments.

CO2 Understand various types of hydraulic systems used in earth movers

CO3 Explain the working of tractor system and various components used in it

CO4 Understand the selection of equipment based on nature of operation

CO5 Understand various safety methods used while working on earth moving equipment.

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
OE00008	Open Elective Reliability and Maintenance	3	0	0	3

Course Learning Objectives (CLOs):

CLO1 To acquire awareness about Reliability & Maintenance Eng and its applications.

CLO2 To understand the importance of Maintenance management in organizations

CLO3 To acquire Knowledge of reliability and know about design and measures of reliability.

CLO4 To understand the concept of various probability distribution curves.

CLO5 To understand the different system reliability model and redundancy techniques.

Unit 1 Basic Concepts of Reliability: Probability distributions used in maintenance engineering, Binomial, Poisson, Exponential, Normal, Log-normal, Gamma and Weibull distribution; failure rate, hazard rate, failure modes, MTTR, MTBF, MTTF.

Unit 2 System Reliability Models: System reliability–n-component series systems, m- component, parallel systems and combined system; standby systems; K-out-of-m systems; redundancy techniques, in system design; event space, decomposition (Key Stone), cut and tie sets, Markov analysis, reliability and quality, unreliability, maintainability, availability.

Unit 3 Maintenance Concepts and Strategies: Introduction, maintenance functions and objectives, maintenance planning and scheduling, maintenance organization. General Introduction to Maintenance Types: Breakdown, emergency, corrective, predictive, and preventive; maintenance prevention; design-out maintenance, productive maintenance, shutdown maintenance and scheduled maintenance.

Unit 4 Condition Based Maintenance: Principles of CBM, pillars of condition monitoring, CBM implementation and benefits; condition monitoring techniques- visual monitoring, vibration monitoring, wear debris monitoring, corrosion monitoring, performance monitoring.

Unit 5 Reliability Centered Maintenance (RCM): Concept, methodology, benefits; Total Productive Maintenance: Evolution of TPM, TPM objectives, concept, pillars of TPM. Failure Modes and Effects Analysis (FMEA)/ Failure Modes, Effects and Criticality Analysis (FMECA): Overview, elements of

FMECA, applications and benefits, risk evaluation, risk priority numbers, criticality analysis, process FMEA, qualitative and quantitative approach to

FMECA; design FMEA and steps for carrying out design FMEA.

TEXTBOOKS

1. Ebeling CE; An Introduction To Reliability & Maintainability Engg; TMH

2. Srinath L.S; Reliability Engineering; East West Press.

3. Naikan; Reliability engg and life testing; PHI

4. Kapur KC and Lamberson LR; Reliability in Engineering Design; Wiley India

REFERENCE BOOKS

1. Maintenance Engineering by S. K. Shrivastava

2. Reliability & Maintenance Engineering by N.V.S. Raju.

Course Outcomes

CO1	Have understood the concept of Reliability Engineering.
CO2	Have understood the concept of MTTR, MTBF, MTTF.
CO3	Have understood the concept of design-out maintenance, productive maintenance, shutdown maintenance and scheduled maintenance.
CO4	Have understood the concept of CBM and condition based monitoring techniques
CO5	Have understood the concept of RCM, TPM, FMEA and application of these concepts in organizations.

SEMESTER – VI

Sr.No.	Course Code	Course Name	L	T	P	Credits
1	AU3CO35	Vehicle Dynamics	3	0	2	4
2	AU3CO36	MAT Lab for Electric vehicle	3	0	0	3
3	AU3CO37	Automotive Refrigeration & Air Conditioning	3	0	2	4
4	AU3CO38	Design and Simulation Lab -II	0	0	2	1
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	AU3PC05	Mini Project -II	0	0	4	2
9	EN3NG09	Soft Skills -III	2	0	0	2
		Total	20	0	10	25
		Total Contact Hours	**30**			

Course Code	Course Name	Hours Per Week			Total Hrs.	Total Credits
		L	T	P		
AU3CO35	Vehicle Dynamics	3	0	2	5	4

Course Learning Objectives (CLOs)

In this course students will learn:

CLO 01 To explain the traction and brake, ride, and handling dynamics theory, as well as theory and design of vehicle control system

CLO 02 To explain tyre dynamics and analyze the forces and moments acting on tires.

CLO 03 To explain the suspension geometry and analyze the suspension dynamics.

CLO 04 To understand the rollover of a vehicle and its causes and effects.

CLO 05 To explain the motorcycle dynamics and overall stability.

UNIT I INTRODUCTION TO VEHICLE DYNAMICS

Longitudinal Dynamics; Vehicle Load Distribution – Acceleration and Braking - Brake Force Distribution, Braking Efficiency and Braking Distance - Longitudinal dynamics of a Tractor-Semi Trailer. Lateral Dynamics: Bicycle Model - Stability and Steering Conditions – Under-steer Gradient and State Space Approach - Handling Response of Vehicle - Immure Plot for Lateral Transient Response - Parameters affecting vehicle handling characteristics. Vertical Dynamics; Rollover Prevention - Half Car Model - Quarter Car Model.

UNIT II TIRE AND TIRE DYNAMICS

Tire Mechanics – An Introduction Mechanical Properties of Rubber - Slip, Grip and Rolling Resistance - Tire Construction and Force Development - Contact Patch and Contact Pressure Distribution. A Simple Tire Model Lateral Force Generation - Ply Steer and Conicity - Tire Models – Magic Formula - Classification of Tire Models and Combined Slip.

UNIT III SUSPENSIONS

Suspension Kinematics, Suspension types, Solid Axles, Independent Suspensions, Anti-Squat and Anti-Pitch Suspension Geometry, Anti-Dive Suspension Geometry, Roll Centre Analysis, Suspension Dynamics, Multi-body vibration, Body and Wheel hop modes, Invariant points, Controllable Suspension Elements: Active, Semi-Active. Choice of suspension spring rate, Calculation of effective spring rate, Vehicle suspension in fore and apt directions.

UNIT IV ROLLOVER

Quasi-Static Rollover of a Rigid Vehicle, Quasi-Static Rollover of a Suspended Vehicle, Transient Rollover.

UNIT V MOTORCYCLE DYNAMICS

Kinematic structure of motorcycle, geometry of motorcycles, importance of trail, Resistance forces acting on motorcycle (tyre rolling resistance, aerodynamic resistance forces, resistant force caused by slope), Location & height of motorcycle's centre of gravity (C.G), Moments of inertia on Motorcycle. Introduction to Front & Rear suspensions of Motorcycle.

TEXTBOOKS

1. Pacejka, Hans. Tire and vehicle dynamics. Elsevier, 2012.

2. Wong, Jo Yung. Theory of ground vehicles. John Wiley & Sons, 2001.

3. Moore, Desmond F. "The friction of pneumatic tyres." (1975).

4. Jazar, Reza N. Vehicle dynamics: theory and application. Springer, 2008

5. Gillespie, Thomas D. Fundamentals of vehicle dynamics, SAE USA 1992.

REFERENCE BOOKS:

1. Rajesh Rajamani, Vehicle Dynamics & control, Springer.

2. R.V. Dukkipati, Vehicle dynamics, Narsova Publications.

3. Milliken W F and Milliken D L, Race car Vehicle Dynamics, SAE.

LIST OF EXPERIMENTS:

1. Experimental study of mechanism for air flow over different geometry of vehicles.
2. Experimental studies of measurements of drag and lift coefficient for different geometry vehicles using wind tunnel apparatus.
3. To study the effect of tire pressure and temperature on the performance of the tire.
4. To simulate and study a quarter car model using MBD software.
5. To simulate and understand behaviours of sprung / unsprung mass & lumped mass system MBD software.
6. Finding the stiffness of the tire with variation of air pressure.
7. To simulate and study the effect of different conditions on vehicle loading.
8. Study of latest technologies available nowadays in vehicles helping to maintain stability of the vehicle on the road.
9. Study geometry of motorcycles as well as various types of forces faced by the motorcycle & its rider.
10. Study the location & height of the Centre of gravity (C.G) of a motorcycle.

COURSE OUTCOMES (COs):

CO 01 Students will be able to explain the traction and brake, ride, and handling dynamics theory, as well as theory and design of vehicle control system.

CO 02 Students will be able to explain tyre dynamics and analyze the forces and moments acting on tires.

CO 03 Students will be able to explain the suspension geometry and analyze the suspension dynamics.

CO 04 Students will be able to understand the rollover of a vehicle and its causes and effects.

CO 05 Students will be able to explain the motorcycle dynamics and overall stability.

Course Code	Course Name	Hours Per Week			Total Hrs.	Total Credits
		L	T	P		
AU3CO36	MATLAB for Electric Vehicle	3	0	0	3	3

Course Learning Objectives (CLO)

In this course students will learn:

CLO 01 To understand the basics of MATLAB and its application in Electric Vehicles.

CLO 02 To perform modelling and simulation of Electric Vehicles using MATLAB.

CLO 03 To apply the knowledge of MATLAB for power electronics circuits and generate algorithms for motor control.

CLO 04 To apply the knowledge of MATLAB for smart charging of EV and simulations for power grid integration.

CLO 05 To apply the concepts of MATLAB on real-world electric vehicle problems.

UNIT IINTRODUCTION TO EV & MATLAB BASICS:

Introduction to electric vehicle technology, Components of an electric vehicle, Types of electric vehicles (BEVs, PHEVs, HEVs), Introduction to MATLAB environment, Basic MATLAB commands and syntax, Data types, variables, and arrays, MATLAB plotting and visualization for electric vehicle data.

UNIT II MODELLING AND SIMULATION OF EV

Electric Vehicle Dynamics: Modeling electric vehicle dynamics, Simulation of vehicle motion, Vehicle modeling using MATLAB Simulink. Battery modelling and management: Overview of battery technologies, Battery modeling techniques, Battery management systems (BMS) in MATLAB.

UNIT III POWER ELECTRONICS & MOTOR CONTROL

Introduction to power electronics, Power electronics applications in electric vehicles, MATLAB simulations for power electronics circuits. Electric motor types and characteristics, Motor control strategies, Implementing motor control algorithms in MATLAB.

UNIT IV CHARGING INFRASTRUCTURE & GRID INTEGRATION:

Charging infrastructure overview, Charging station modeling, Smart charging algorithms using MATLAB, Integration of electric vehicles with the power grid. Impact on the grid and grid support functions, MATLAB simulations for grid integration scenarios.

UNIT V LATEST TRENDS IN MATLAB FOR EV:

Vehicle-to-Grid (V2G) technology, Autonomous electric vehicles, Emerging trends and technologies in electric vehicles. Applying MATLAB to solve a real-world electric vehicle problem.

TEXTBOOKS

1. “MATLAB for Engineers”Holly Moore, Pearson, 5th Edition, 2017.
2. "MATLAB: A Practical Introduction to Programming and Problem Solving"by Stormy Attaway, Butterworth-Heinemann, 5th Edition, 2018.
3. REFERENCE BOOKS
4. "MATLAB for Control Engineers" by Katsuhiko Ogata, Pearson Publication, 1st edition, 2007
5. "Electric and Hybrid Vehicles: Design Fundamentals" by Iqbal Husain, CRC press, 2nd edition, 2010.

Course Outcomes (COs):

CO 01 Students will be able to understand the basics of MATLAB and its application in Electric Vehicles.

CO 02 Students will be able to perform modelling and simulation of Electric Vehicles using MATLAB.

CO 03 Students will be able to apply the knowledge of MATLAB for power electronics circuits and generate algorithms for motor control.

CO 04 Students will be able to apply the knowledge of MATLAB for smart charging of EV and simulations for power grid integration.

CO 05 Students will be able to apply the concepts of MATLAB on real-world electric vehicle problem.

Course Code	Course Name	Hours Per Week			Total Hrs.	Total Credits
AU3CO37	Automotive Refrigeration & Air Conditioning	L	T	P		
		3	0	2	5	4

Course Learning Objectives (CLOs)

In this course students will learn:

CLO 01 To understand the Principles of Automotive Air Conditioning.

CLO 02 To analyze and Design Automotive AC Systems

CLO 03 To master Diagnostic and Troubleshooting Techniques

CLO 04 To get Specialized Knowledge for refrigeration requirements for Diverse Vehicles.

CLO 05 To Adapt to Environmental Regulations while using AC in vehicles

UNIT I INTRODUCTION TO AIR CONDITIONING & REFRIGERATION

Methods of refrigeration. vapour compression refrigeration system, vapour absorption refrigeration system, applications of refrigeration & air conditioning, Automobile air conditioning, air conditioning for passengers, isolated vehicles, refrigerated transport vehicles, applications related with very low temperatures. Importance of Refrigerant; Classification, properties, selection criteria, commonly used refrigerants, alternative refrigerants, eco-friendly refrigerants, applications of refrigerants, refrigerants used in automobile air conditioning.

UNIT II STUDY OF PSYCHOMETRIC CHARTS

Psychometric properties, tables/charts, psychometric processes, comfort charts, factors affecting comfort, effective temperature, ventilation requirements. Air Conditioning Systems; Classification, layouts, central / unitary air conditioning systems. System components like compressor, evaporator, condenser, expansion devices, Receiver dryer, fan blowers, heating system etc. Switch and electrical wiring circuit.

UNIT III LOAD CALCULATIONS & ANALYSIS

Design considerations for achieving desired inside/room conditions with respect to prevailing outside/environment conditions. Factors affecting/contributing towards the load on refrigeration & air conditioning systems. Cooling & heating load calculations. Load calculations for automobiles. Effect of air conditioning load on engine performance in terms of loss of available Peak Torque/Power and Fuel consumption.

UNIT IV AIR DISTRIBUTION SYSTEMS

Air Distribution Systems: Distribution ducting, sizing, supply / return ducts, type of grills, diffusers, ventilation, air noise level, layout of duct systems for automobiles and their impact on load calculation. Air Routing & Temperature Control; Objectives of the dashboard re-circulating unit, automatic temperature control, controlling flow, control of air handling systems & air flow through – evaporator care.

UNIT V AIR CONDITIONING SERVICE

Air Conditioning Service: Air conditioner maintenance & service - removing & replacing Components. Compressor service. Testing, Diagnosis & troubleshooting of air conditioning systems. Refrigerant gas charging procedure &. Servicing of heater system. Air Conditioning Control; Common controls such as thermostats, humidistat, control dampers, pressure cut-outs, and relays.

TEXTBOOKS

1. "Automotive Air-Conditioning", by Crouse & Anglin – Mc Graw Hill Pub.
2. "Automotive Air-Conditioning", by Paul Weiser – Reston Publishing Co.
3. "Automatic Heating & Air Conditioning Systems" – Mitchell Information Services.
4. "Air Conditioning", by Paul Lang, C.B.S. Publisher & Distributor, Delhi.
5. Principles of Refrigeration by Roy J. Dossat – Pearson Publication.

REFERENCE BOOKS

1. "Modern Air Conditioning", by Harris.
2. "Automobile Engg", by Anil Chhikara - Satya Prakashan.
3. "American Society of Heating, Refrigeration & Air Conditioning –Fundamentals", ASHRAE Handbook – 1985.

LIST OF EXPERIMENTS:

1. General Study of vapor compression refrigeration system.
2. General Study of Ice Plants.
3. General Study and working of cold storage.
4. General Study Trane Air Condition (Package Type).
5. General Study of Electrolux Refrigeration.
6. General Study One tone Thermax refrigeration unit.
7. General Study of Water cooler.
8. General Study of Psychrometers (Absorption type).
9. General Study of Leak Detectors (Halide Torch).
10. General Study and working of Gas Charging Rig.
11. General Study of window Air Conditioner.
12. General Study and working of Vapor Compression Air Conditioning Test rig.
13. Experimentation on Cold Storage of Calculate COP & Heat Loss.
14. Experimentation on Vapor Compression Air Conditioning test rig.

15. Changing of Refrigerant by using Gas Charging Kit.

Course Outcomes (COs):

CO 01 Demonstrate understanding of the fundamental principles of automotive air conditioning

CO 02 Analyze automotive air conditioning requirements for efficient AC systems.

CO 03 Develop proficiency in diagnosing issues in automotive AC systems

CO 04 Gain knowledge about refrigeration systems in diverse type of vehicles

CO05 Assess the environmental impact of automotive refrigerants

Course Code	Course Name	Hours Per Week			Total Hrs.	Total Credits
AU3CO38	Design and Simulation Lab -II	L	T	P		
		0	0	2	2	2

Course Learning Objectives (CLOs)

In this course students will learn:

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.

LIST OF EXPERIMENTS:

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

TEXTBOOKS

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

REFERENCE BOOKS:

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 (COs):

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 Hrs.	Total Credits
AU3EL08	Mechanical Vibrations	L	T	P		
		3	0	0	3	3

Course Learning Objectives (CLOs)

In this course students will learn:

CLO 01 Understand fundamentals of vibrations

CLO 02 Understand the fundamentals of different types of damping

CLO 03 Analyse the performance of harmonically excited vibrations

CLO 04 Apply the governing equations of multi-degree of freedom systems

CLO 05 Understand the principle of vibration measuring instruments

UNIT I BASICS OF VIBRATION

Basic concepts of vibrations, causes and effects of vibrations. Classification of Vibrations, Vibration parameters- spring, mass, damper. Degree of freedom, static equilibrium position.

UNIT II FREE VIBRATION SYSTEM

Undamped Single Degree of Freedom Vibration System Longitudinal, transverse, torsional vibratory systems. Formulation of differential equations by various principles. Effect of spring inertia on natural frequency. Damped single degree of freedom vibration system Viscous damped system-under damped, critically damped, over damped systems Logarithmic decrement. Coulomb's damping.

Unit III FREE AND FORCED VIBRATION SYSTEM

Free Single Degree of Freedom Vibration System Conversion of multi –springs, multi masses, multi dampers into a single spring mass and damper with linear or rotational co-ordinate system. Forced single degree of freedom vibration system. Analysis of linear and torsional systems subjected to harmonic force and harmonic motion excitation (excluding elastic damper). Force and motion Transmissibility.

UNIT IV VIBRATION MEASURING INSTRUMENTS

Principle of seismic instruments, Vibrometer, accelerometer, sensors used in measurement. Introduction to FFT analyser. Introduction to condition Monitoring and Fault diagnosis.

UNIT V MULTI DEGREE OF FREEDOM VIBRATION SYSTEMS

Lagrange Method, Exact and approximate solution methods.

TEXTBOOKS

1. G. K. Grover, Mechanical Vibrations, Nem Chand & Bros, Eighth Edition, 2009.
2. Graham Kelly, Fundamentals of Mechanical Vibration, Tata McGraw Hill, 2000.
3. P. L. Ballaney, Theory of Machines, Khanna Publishers, Delhi.
4. S. S. Rao, Mechanical Vibrations, Pearson Education, Fourth edition, 2009.
5. P.Srinivasan, Mechanical Vibration Analysis, Tata McGraw Hill, 1982.
6. Den, Chambil, Hinckle, Mechanical Vibrations.

REFERENCE BOOKS

1. J.P. Den Hartog, Mechanical Vibrations, McGraw hill Book Company Inc.
2. Leonard Meirovitch, Elements of Vibration Analysis, Tata McGraw Hill, Special Indian Edition, 2007.
3. Grahm Kelly, Mechanical Vibrations, Schaum's outline series, Tata McGraw Hill, Special Edition, 2007.
4. William Seto, Mechanical Vibrations, Schaum's outline series-McGraw Hill.
5. J.S. Rao, K. Gupta, Theory and Practice of mechanical vibrations, New Age International Publication.
6. W.T. Thomson, Theory of vibrations with applications, CBS Publishers, Delhi, 2003.

Course Outcomes (COs):

CO 01 Understand the features of various elements used to model a vibrating body.

CO 02 Form governing equations from a model of a vibrating body.

CO 03 Calculate the stiffness and damping coefficient of the isolation system

CO 04 Understand the principle of vibration measuring instruments

CO 05 Understand various condition monitoring techniques for machines

Course Code	Course Name	Hours Per Week			Total Hrs.	Total Credits
		L	T	P		
AU3EL16	Production Planning & Control	3	0	0	3	3

Course Learning Objectives (CLOs)

In this course students will learn:

CLO01 To gain an understanding and appreciation of the principles and applications relevant to the planning, design, and operations of manufacturing/service firms.

CLO02 To develop skills necessary to effectively analyze and synthesize the many interrelationships inherent in complex production planning systems.

CLO03 To gain some ability to recognize situations in a production system environment that suggests the use of certain quantitative methods to assist in decision making on operations management and strategy.

CLO04 To understand how industrial engineering are used in managing operations

CLO05 To understand the managerial responsibility for Operations, even when production is outsourced, or performed in regions far from corporate headquarters.

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.

TEXTBOOKS

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 OUTCOMES (COs):

CO01 Apply knowledge of mathematics, science, and engineering

CO02 Design and conduct experiments, as well as to analyse and interpret data

CO03 Design a system, component, or process to meet desired needs

CO04 Function on multi-disciplinary teams

CO05 Identify, formulate, and solve engineering problems.

Course Code	Course Name	Hours per Week			Total Hrs.	Total Credits
		L	T	P		
OE00085	Innovation and Entrepreneurship	3	0	0	3	3

Course Learning Objectives (CLOs)

In this course students will learn:

CLO01 Students will be able to understand the concepts and definitions of innovation.

CLO02 Students will be able to understand the importance of innovation and sources of innovation.

CLO03 Students will be able to understand the methods of generating ideas and create the business model.

CLO04 Students will be able to understand the concept of Blue Ocean Strategy and identify primary and secondary revenue streams.

CLO05 Students will be able to understand the concept of positioning and branding.

UNIT IINTRODUCTION 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 II 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 III 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 IV 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 V 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.

TEXTBOOKS

1. Joe Tidd, John R. Bessant, (2018) Managing Innovation: Integrating Technological, Market and Organizational Change, 6th Edition, Wiley.
2. Ravichandran M. & Prasanna N., (2022), "Innovative Entrepreneurship", Notion Press; 1st edition.
3. Elias G. Carayannis, Elpida T. Samara, Yannis L. Bakouros,(2015). Innovation and Entrepreneurship Theory, Policy and Practice, Springer International Publishing Switzerland.

REFERENCE BOOKS

1. Martha Corrales-Estrada,(2019) "Innovation and Entrepreneurship: A New Mindset for Emerging Markets", Emerald Publishing Limited.
2. Eric Ries, (2017). "The startup way: how modern companies use entrepreneurial management to transform culture and drive long-term growth", New York: Currency.
3. Matt Ridle, (2020), "How Innovation Works: And Why It Flourishes in Freedom", Harper.

Course Outcomes (COs):

CO01 To understand the concepts of and definitions of innovation.

CO02 To understand the importance of innovation and sources of innovation.

CO03 To understand the methods of generating ideas and create the business model.

CO04 To understand the concept of Blue Ocean Strategy and identify primary and secondary revenue streams.

CO05 To understand the concept of positioning and branding.

Course Code	Course Name	Hours per Week			Total Hrs.	Total Credits
		L	T	P		
OE00036	Renewable Sources of Energy	3	0	0	3	3

Course Learning Objectives (CLOs)

In this course students will learn:

CLO01 To understand the concept of Energy Scarcity and its solution using renewable energy.

CLO02 To understand working and construction of solar cookers, solar dryers, Solar WHS and solar collectors.

CLO03 To understand methods by which wind and geothermal energy can be used.

CLO04 To understand various methods of using biomass for energy production and construction of biogas plants.

CLO05 To understand Different energy conversion methods of using OTEC and Wind Energy.

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

TEXTBOOKS

1. Kothari, Singal&Rajan; Renewable Energy Sources and Emerging Technologies, PHI
2. B.H Khan, Non Conventional Energy, TMH.
3. Sukhatme and Nayak, Solar Energy, Principles of Thermal Collection and Storage, TMH.

REFERENCE BOOKS

1. K. Rao, Energy Resources, Conventional & Non-Conventional, BSP Publication.
2. C.S.Solanki, Solar Photovoltaics: Fundamental, technologies and Application, PHI
3. A.Tasneem and SA Abbasi; Renewable Energy Sources; PHI Learning.

Course Outcomes (COs)

CO01	Distinguish between various approaches of using solar Energy
CO02	Have basic knowledge of construction and working of Solar cookers and solar dryers and develop ability to choose the right device as per requirement.
CO03	Basic understanding of construction and working of different types of solar collectors and analysis their characteristics, merits and demerits
CO04	Analyze and Understand construction and working of different types of solar water heating systems
CO05	Elementary knowledge of design and working of photovoltaic technology and equipment related to it.

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	AU3PC12	Project-1	0	0	8	4
5	AU3PC03	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 Credits
		L	T	P	
AU3EL11	Program Elective VI-1 Two & Three-Wheeler Technology	3	0	0	3

Course Learning Objectives (CLOs)

In this course students will learn:

CLO1 Understand the Development and Classification of Two & Three-Wheeler Vehicles:

CLO2 Learn Transmission Systems in Two & Three-Wheelers:

CLO3 Comprehend Suspension and Steering Systems:

CLO4 Understand Instrumentation and Controls:

CLO5 Explore Electrical Systems and Instruments:

Unit I

Introduction: Development and history of two & three-wheeler vehicles. Classification & layouts of two wheelers (motorcycles, scooters, mopeds) and Three-wheeler vehicles (by applications – passengers & goods carriage, capacity etc.). Study of technical specification of Two & Three-wheeler vehicles.

Unit II

Transmission Systems: Clutch – special requirements, different types used in two & three wheelers. Need of primary reduction, selection of transmission - gear box, gear shift mechanism, Chain OR belt drive system for transmission of torque to drive wheels, automatic transmission (Continuously Variable Transmission - CVT, Epicyclic gear train), arrangement of final drive & differential for three-Wheeler.

Unit III

Suspension & Steering: Front suspension system – shock absorber construction and working principle. Rear suspension system – Mono type suspension. Steering Handlebar on two-wheeler / three-wheeler vehicles.

Unit IV

Instrumentation & Controls: Two-wheeler / three-wheeler panel meters & controls. All types Switches, Indicators, warnings indicators / buzzers & actuating levers on steering handle bar. Starting / Ignition and steering lock key switch on Steering Handle Shaft.

Unit V

Electrical Systems & Instruments: Battery specifications, charging system, Lighting (front & rear), Ignition key switch, Horn, Side Signalling, Instruments & Indicators.

TEXTBOOKS

1. Newton Steed, "The Motor Vehicle", McGraw Hill Book Co. Ltd., New Delhi
2. Siegfried Herrmann, "The Motor Vehicle", Asia Publishing House, Bombay.
3. "Two stroke Motor Cycles", Staff & Motor Cycles, London llefe Books.
4. G.B.S. Narang, "Automobile Engineering", 5th Edition, Khanna Publishers, Delhi.
5. Service Manuals of Manufacturers of Indian Two & Three wheelers.

REFERENCE BOOKS

1. Service Manual, Jeep Utility Vehicles, Villys Motors, Ioc., USA.
2. Irving. P. E., “Motor Cycle Engineering”, Temple Press Book, London – 1992.
3. “The Cycle Motor Manual”, - Temple Press Limited, London – 1990.
4. Raymond Broad Lambretta, “A Practical Guide to maintenance and repair”, S. Chand & Co., New Delhi – 1987

Course Outcomes (COs)

CO01 Identify and Classify Two & Three-Wheeler Vehicles

CO02 Analyze and Select Appropriate Transmission Systems

CO03 Evaluate Suspension and Steering Systems

CO04 Operate and Diagnose Instrumentation and Control Systems

CO05 Assess and Maintain Electrical Systems in Vehicles

Course Code	Course Name	Hours per Week			Total
		L	T	P	Credits
AU3EL10	Program Elective VII-1 Earth Moving Equipments	3	0	0	3

Course Learning Objectives (CLOs)

In this course students will learn:

CLO1 Understand the Types and Applications of Earth Moving Equipment:

CLO2 Comprehend the Components and Operations of Under Carriage and Suspension Systems:

CLO3 Learn Brakes and Hydraulic Systems:

CLO4 Develop Skills for Equipment Selection:

CLO5 Calculate Operating Capacity and Productivity:

Unit I

Equipments And Operations: Different types of earth moving equipment and their applications. Dozers, loaders, shovels, excavators, scrapers, motor graders, rollers, compactors, tractors and attachments, Types of soil.

Unit II

Under Carriage And Suspension: Tyre and tracked vehicles, advantages and disadvantages, under carriage components like, tracks, roller frames, drive sprockets, track rollers, track chains and track shoes, rubber spring suspension and air spring suspension

Unit III

Brakes And Hydraulics: Brakes: types of brakes; disc brake, engine brakes , Basic components of hydraulic systems, pumps (types of pumps), control valves, flow control valves, directional control valves and pressure control valves, hydraulic motors and hydraulic cylinders. Depth and draft control systems.

Unit IV

Methods Of Selection OfEquipments: Selection of machines, basic rules of equipment including the nature of operation, selection based on type of soil, selection based on haul distance, selection based on weather condition.

Unit V

Calculation Of Operating Capacity: Methods of calculating operating capacity, calculation of productivity of EMEs

TEXTBOOKS

1. Diesel equipment: volume I and II by Erich J.schulz
2. Construction equipment and its management By S.C. Sharma
3. Farm machinery and mechanism by Donald R. hunt and L. W.garner

REFERENCE BOOKS

1. Theory of ground vehicles by J.Y.Wong john wiley and sons
2. Moving the earth by Herbert Nicholas
3. On and with the earth by Jagman Singh, W.Newman and Co. Kolkata

Course Outcomes (COs)

CO01 Identify and Explain Different Types of Earth Moving Equipment

CO02 Analyze Under Carriage and Suspension Systems

CO03 Evaluate Braking and Hydraulic Systems

CO04 Apply Equipment Selection Criteria

CO05 Calculate and Optimize Equipment Productivity

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	
AU3PC12	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	
AU3PC03	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	AU3PC13	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.