SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Teaching and Evaluation 2023-24 (As per NEP-2020)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

(Effective from the Academic year 2023-24)

III-SEMESTER SCHEME OF TEACHING & EVALUATION 2023-24

S. N.	Course Type	Course Code	Course Title	Teaching Hours/week			Examination				Credits
				Theory lectures	Tutorial	Practical/Drawi	Examination in Hours	CIA Marks	SEA Marks	Total Marks	
				L	T	P					
1	Ancient Science/Management/ Psychology	MEUCTE1	Statistical and Numerical Methods	3	1	-	03	40	60	100	4
2	Department Core	MEUCTT1	Engineering Thermodynamics	3	1	-	03	40	60	100	4
3	Department Core	MEUCTT2	Mechanics of Solids – I	2	1	-	03	40	60	100	3
4	Department Core	MEUCTT3	Manufacturing Processes	3	-	-	03	40	60	100	3
5	Open Elective	MEUCTO1	Introduction to Thermodynamics*	3	-	-	03	40	60	100	3
6	Department Elective	MEUCTP1	Material Science and Metallurgy	3	-	-	03	40	60	100	3
		MEUCTP2	Sustainable Energy Conversion								
7	Practical	MEUCLT1	Manufacturing Processes Lab	-	-	2	03	25	25	50	1
8	Practical	MEUCLT2	Computer Aided Machine Drawing	1	-	2	03	25	25	50	2
Total				**18**	**3**	**04**	**25**	**290**	**410**	**700**	**23**
*** Not for ME students**											

Credit Definition:

➢1-hour lecture **(L)** per week per semester = **1 Credit**

➢1-hour tutorial **(T)** per week per semester = **1 Credit**

➢2-hour Practical/Drawing**(P)** per week per semester = **1 Credit**

- **Four credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **30** hours of Teaching-Learning process.
- **One credit** courses are to be designed for **15** hours of Teaching-Learning process

Note: The above is applicable only to THEORY courses

CIA: Two internal Class Tests, each of 15 Marks. Assignment: 10 Marks

SEA: Semester End Assessment – 60 marks

List of Electives for ME Students:

1. **Green Buildings (CEUCTO1)**
2. **Engineering Materials (CHUCTO1)**
3. **Data Structure with C++ (CSUCTO1)**
4. **Data Communication (ECUCTO1)**
5. **Computer Organization and Architecture (ITUCTO1)**
6. **I.C. Engine (IPUCTO1)**

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUCTE1	**Statistical and Numerical Methods**	**3**	**1**	**-**	**40**	**60**	**4**

Course Objectives:

1 To impart knowledge on statistics and probability

2 To make students understand various sampling methods to analyse the data.

3 To enable students to apply NM techniques in solving polynomials and DEs.

UNIT-1 Introduction to Probability and Statistics

Theory of Probability – Mathematical and statistical definition of probability Sample space finite sample space sample point, Events Theorem of total probability. Sample and compound event. Conditional probability. Theorem of compound probability. Boy's theorem. Use of binomial theorem.

UNIT-2 Distribution and Sampling

Theoretically Distribution – Binomial Distribution Mean, Standard deviation and Pearson's β and γ coefficient. Poisson distribution, mean, variance normal Distribution.
Random and simple sampling – mean and standard deviation in simple sampling of attribute test of significance for large sample test of significance based on Chi square, T, F, and Z Distribution Degree of freedom and condition for applying

UNIT-3 Introduction to Numerical Methods

Approximation and errors in Computation Approximation and round-off errors, truncation errors and Taylor series, Determination of roots of polynomials and transcendental equations by Graphical methods and Bisection, Regular-false, secantand Newton-Raphson methods, solution of Linear simultaneous, linear algebraic equations by Gauss Elimination Gauss-Jordan and Gauss-Siedel iteration method.

UNIT-4 Numerical Techniques

Empirical Laws, Curve Fitting & Interpolation Curve fitting linear and non-linear regression analysis (Method of group average and least squares) finite differences, backward, forward and central difference relation and their use in Numerical differentiation and integration and their application in interpolation.

UNIT-5 Numerical Solutions to DEs

Numerical Solution of Ordinary Differential Equations Numerical Integration by Trapezoidal rule, Simpson's (1/3rd & 3/8th) rule and its error estimation. Multi Step Methods for differential equations.

TEXTBOOKS:

1 M. Ray, Statistical Methods, Ram Prasad Publications, 2021

2 S. C. Gupta and Kapoor, Fundamental of Mathematical Statistic, Sultan Chand Sons, 10th Edition, 2002

3 P.Kandasamy, K.Thilagavathy & K. Gunavathy, Numerical Methods, -S Chand& Co.,2nd Edition, 2003.

4 S.S.Sastry, Introductory Methods of Numerical Analysis-, PHI, 3rd Edition,2003

REFERENCE BOOKS:

1 P.C. Biswal, Probability and Statistics, PHI, 2nd Edition, 2008

2 James B. Scarborough, Numerical Methods Analysis-, Oxford & IBH Publishing, 6th Edition, 2002

3 Dr.B.S.Grewal, Numerical Methods in Engineering & Science, Khanna Publishers, 6th Edition, 2004.

WEB RESOURCES

1 https://ocw.mit.edu/courses/18-335j-introduction-to-numerical-methods-spring-2019/

2 https://www.sjsu.edu/me/docs/hsuChapter%2010%20Numerical%20solution%20methods.pdf

3 https://onlinecourses.nptel.ac.in/noc23_ma94/preview

Course Outcomes (COs): After completion of the course, the students will be able to	
CO1	Use statistical methods to solve engineering problems.
CO2	Apply distribution techniques in arriving at solutions to real-time problems
CO3	Use Numerical Methods to solve Linear and simultaneous equations.
CO4	Implement numerical integration and differentiation techniques in case studies
CO5	Solve differential and ordinary differential equations by NM techniques.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		2						2	2		3		
CO2	3	2		2						2	2		3		

CO3	3	2		2						2	2		3		
CO4	3	2		2						2	2		3		
CO5	3	2		2						2	2		3		

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUCTT1	**Engineering Thermodynamics**	**3**	**1**	**-**	**40**	**60**	**4**

Course Objectives:

1 To educate the basic concept of various forms of energy especially (heat and work)
2 Develop skills to formulate and analyze thermodynamic problems involving control volumes and control masses
3 To introduce the concepts of the steam table, Mollier diagrams to determine the properties of pure substances.
4 Make students understand various systems/processes involved in ideal gas and two-phase mixtures.
5 Familiarise the students with the procedure to analyse the working of different types of thermodynamic cycles and their performance

UNIT-1 Introduction to Thermodynamics

Thermodynamic System, Control Volume, Macroscopic Versus Microscopic Point of View, Properties, State, Processes and Cycles, Equality of Temperature and Zeroth Law of Thermodynamics. Work, Heat and their comparison.

UNIT-2 First Law of Thermodynamics

First law: for systems and control volumes, enthalpy, Applications of first law: closed and open systems, Steady flow energy equation, unsteady flow energy equation. Limitations of the first law of thermodynamics, concept of Heat Engine, heat pump/ refrigerators and Reservoirs, Kelvin-Planck and Clausius statements and their equivalence; reversible and irreversible processes; Causes of Irreversibility, Internal and External Irreversibility. Thermodynamic temperature scale

UNIT-3 Second Law of Thermodynamics

Clausius inequality and entropy: principle and evaluation, second law for closed and open systems; Availability and Exergy, Introduction to Third Law of Thermodynamics.

UNIT-4 Pure Substances

Pure Substances: P-V-T- surfaces, Phase Transformations, Triple Point and Critical Point of Pure Substances, State Properties during Change of Phase, Dryness Fraction. Property Diagrams, Steam Tables, Mollier Charts, Various Thermodynamic Processes and Energy Transfer, Measurement of Dryness Fraction.

UNIT-5 Thermodynamic Property Relations

Maxwell relations; Clausius-Clapeyron equation; Difference in heat capacities; Ratio of heat capacities; Joule-Thompson coefficient. Mixture of perfect gases

- Mole Fraction, Mass fraction, Dalton's and Amalgam's model - Calculation of C_p, C_v, R, u, h and s changes for gas mixtures. Gibbs and Helmholtz Functions.

TEXTBOOKS:

1 P.K. Nag, Engineering Thermodynamics, Tata McGraw-Hill, 6th Edition , 2022

2 Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, Wiley, 8thEdition,2012.

3 Y.A.Cengel and M.A.Boles, Thermodynamics: an Engineering Approach, McGraw Hill, 9th Edition, 2019

REFERENCE BOOKS:

1 Moran & Shapiro, Fundamentals of Engineering Thermodynamics, Willey, 8th Edition, 2014.

WEB RESOURCES

1 https://www2.engineering.com/Library/ArticlesPage/tabid/85/ArticleID/218/Thermodynamics.aspx

2 https://open.umn.edu/opentextbooks/textbooks/1252

3 https://www2.engineering.com/Library/ArticlesPage/tabid/85/ArticleID/218/Thermodynamics.aspx

4 https://onlinecourses.nptel.ac.in/noc23_me65/preview#:~:text=This%20course%20is%20on%20basic,pure%20substance%20and%20practical%20applications.

Course Outcomes (COs): After completion of the course, the students will be able to	
CO1	Explain the fundamentals of heat and work transfer
CO2	Apply the laws of thermodynamics to flow processes.
CO3	Implement the concept of second law and entropy of the various thermodynamics processes.
CO4	Determine properties of pure substances using the steam table and Mollier chart
CO5	Determine the non-reactive gas mixture properties through the relation between measurable properties and non-measurable entities.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2									2		3		
CO2	3	2									2		3		
CO3	3	2									2		3		
CO4	3	3		2							2		3		
CO5	3	3	2	2							2		3		

Guru Ghasidas Vishwavidyalaya
(A Central University)
Department of Mechanical Engineering

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUCTT2	**Mechanics of Solids – I**	**2**	**1**	**-**	**40**	**60**	**3**

Course Objectives:

1 To impart a fundamental understanding of the concepts of stress and strain by analysis of solids and structures.
2 To familiarize the concept of shear force and bending moment.
3 To make students understand and apply the relation between moment, slope & deflection.
4 To acquaint the combined effect of torsion and bending.
5 To study the strength of columns and the stress distribution in a cylinder.

UNIT-1 Introduction to Stress and Strain

Basic of Stress and strain, elastic constants, stress–strain diagram, Hooke's law, Poisson's ratio, shear stress, the stress in the components subjected to multi-axial forces, thermal stresses, statically indeterminate systems.

UNIT-2 Beams

Beams: Introduction of Beams, Various types of Beams, Various type of Supports, Reactions at supports, Shear force and bending moment at any section of a beam, Relation between Shear Force and Bending Moment, Point of contra-flexure.

Bending of beams: Bending of beams with symmetric section, boundary conditions, pure bending, and bending equation problems of simple bending.

UNIT-3 Deflection of Beam

Relation between slope deflection and radius of curvature, solution of beam deflection, problem by Macaulay's method, Direct integration method, Moment Area Method.

UNIT-4 Torsion

Deformation in the circular shaft due to torsion, basic assumptions, torsion equations, stresses in the elastic range, angular deflection, hollow & stepped circular shaft.

UNIT-5 Principal Stresses and Strain

Transformation of plane stresses, Principal stresses, Maximum shear stresses. Combined Loading: Components subjected to bending, torsion & axial loads.

Mohr's circle for plane stresses, Plain strain and its Mohr's circle representation, Principal strains, Maximum shear strain**.**

TEXTBOOKS:

1 S.P. Timoshenko & D.H. Young, Elements of Strength of Material, Affiliated East-West Press, 5th Edition, 2009.
2 Sadhu Singh, Strength of Materials, Khanna Book Publishing Company, 1st Edition, 2016
3 Crandall, Dahl & Lardnee, An Introduction of Mechanics of Solid, Tata McGraw Hill,2012.

REFERENCE BOOKS:

1 F.P. Beer & E.R. Johnson Jr., Mechanics of material, Tata McGraw Hill, 3rd Edition, 2021.
2 L.S. Srinath, Advance Mechanics of Solids, Tata McGraw Hill, 3rd Edition,2008
3 Egor P. Popov, Engineering Mechanics of solid, PHI, 2nd Edition, 2015
4 I. H. Shames, Introduction of Solid Mechanics, PHI, 3rd Edition,2000

WEB RESOURCES

1 https://www.vssut.ac.in/lecture_notes/lecture1423904647.pdf
2 https://onlinecourses.nptel.ac.in/noc22_ce46/preview
3 https://www.mae.cornell.edu/solid-mechanics

Course Outcomes (COs): After the completion of the course, the students will be able to	
CO1	Apply the principles of equilibrium, superposition, and compatibility to estimate the stress-strain behaviour of linear elastic solids under axial loading.
CO2	Construct a shear force and bending moment diagram to evaluate the deflection and stress distribution in beams of various cross-sections.
CO3	Determine the slope and curvature of the beam by various methods.
CO4	Analyze the behaviour of torsionally loaded members and evaluate the angle of twist.
CO5	Determine stresses at an inclined plane and construct the Mohr circle to predict the principal and maximum shear planes.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1										3		
CO2	3	2	1										3		
CO3	3	2	1	3									3		
CO4	3	2	1	3						2			3		
CO5	3	2	1	3						2			3		

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUCTT3	**Manufacturing Processes**	**3**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1 To impart knowledge on the casting processes and its related activities.

2 To familiarize with the metal forming process.

3 To explore the metal joining process and its defects.

4 To teach about powder metallurgy.

UNIT-1 Casting

Metal casting processes: Introduction to Metal casting - Pattern, core and Mould making - Moulding, sand properties and testing - Principles of gating and riser design

UNIT-2 Furnace

Melting furnaces - Casting processes - sand, die, gravity, centrifugal castings, shell mould and investment casting. Fettling and cleaning of casting - Inspection of casting and Casting defects.

UNIT-3 Metal Forming Process

Mechanics of forming processes and forming operations – rolling, forging, drawing, deep drawing, bending, extrusion, punching and blanking – high energy forming processes – defects in metal forming – Case studies.

UNIT-4 Metal Joining Process

Principles of welding – fusion, resistance and solid-state welding – soldering, brazing and adhesive bonding, arc welding, resistance welding, gas welding, thermit welding, ultrasonic welding, electron beam welding, laser beam welding and explosive welding – weld defects and inspection.

UNIT-5 Powder Metallurgy

Powder metallurgy – production of metal powders – characteristics of metal powders – compaction – sintering – applications.

TEXT BOOKS:

1 P.N. Rao, Manufacturing Technology, Vol.1, McGraw Hill Education, 4th Edition,2017.

2 S. Kalpakjian and S. R. Schmid, Manufacturing Engineering and Technology, Pearson publisher, 5th Edition,2018.

3 Ghosh, Manufacturing Science, East-West Press, 2ndEdition. 2010

REFERENCE BOOKS:

1 A. Mubeen and M. Pervez, Manufacturing Science, Publisher-Asian books, 1st Edition, 2012.

2 R. A. Lindberg, Processes and Materials of Manufacture, PHI learning Publication, 4th Edition, 1990

3 P. N. Rao, Manufacturing Technology-Foundry, Farming and Welding, McGraw Hill Education, 5th Edition, 2018.

WEB RESOURCES

1 https://archive.nptel.ac.in/courses/112/107/112107219/

2 https://onlinecourses.nptel.ac.in/noc23_me25/preview

3 https://www.coursera.org/courses?query=manufacturing%20process

4 https://alison.com/course/manufacturing-technologies

Course Outcomes (COs): After the completion of the course, students will be able to	
CO1	Select a suitable casting process for a specific application
CO2	Recommend a suitable metal forming process for a specific application.
CO3	Classify various metal joining processes and select a suitable process for a given application.
CO4	Identify the various defects in manufacturing processes.
CO5	Interpret the characteristics of metal powders and their production.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2								2			3		
CO2	3	2								2			3		
CO3	3	2								2			3		
CO4	3	2								2			3		
CO5	3	2								2			3		

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUCTO1	**Introduction to Thermodynamics**	**3**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1 To understand the basic laws of thermodynamics and heat transfer

2 To understand the principle of operation of thermal systems like I C Engine, boilers, turbines, condensers etc.

UNIT-1 Introduction

Fundamental Concepts System, surrounding and universe, Concept of continuum, Property, State, Path, process, Cyclic process, Energy and its form, Work and heat, Enthalpy.

UNIT-2 Laws of Thermodynamics

Laws of thermodynamics: Concepts of Temperature, Zeroth law. First law of thermodynamics. Concept of processes, Flow processes and control volume, Flow work, Steady flow energy equation, Mechanical work in a steady flow of process

Second law: Essence of second law, Thermal reservoir, Heat engines, COP of heat pump and refrigerator. Statements of second law, Carnot cycle, Concept of Entropy.

UNIT-3 Thermal Power Plant

Thermal Power Plant Layout; Rankine Cycle, Major components of thermal power plant, Condensers, Cooling Towers.

UNIT-4 Power Producing Machines

Internal combustion engines, basic cycles; Turbines: Basic cycle of turbines, Impulse and Reaction Turbines.

UNIT-5 Power Consuming Machines

Pumps, compressors; Basic of refrigeration cycles, Environmental- friendly refrigerants, and Air conditioners.

TEXT BOOKS:

1 P.K. Nag, Engineering Thermodynamics, Tata McGraw-Hill, 6th Edition , 2022

2 Sonntag, Borgnakke, Van Wylen, Fundamentals of Thermodynamics, Wiley, 8thEdition,2012.

3 Y.A.Cengel and M.A.Boles, Thermodynamics: an Engineering Approach, McGraw Hill, 9th Edition, 2019

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1 Moran & Shapiro, Fundamentals of Engineering Thermodynamics, Willey, 8th Edition, 2014.

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1 https://www2.engineering.com/Library/ArticlesPage/tabid/85/ArticleID/218/Thermodynamics.aspx
2 https://open.umn.edu/opentextbooks/textbooks/1252
3 https://www2.engineering.com/Library/ArticlesPage/tabid/85/ArticleID/218/Thermodynamics.aspx
4 https://onlinecourses.nptel.ac.in/noc23_me65/preview#:~:text=This%20course%20is%20on%20basic,pure%20substance%20and%20practical%20applications.

Course Outcomes (COs): After completion of the course, the students will be able to	
CO1	Explain the basic concepts of thermodynamics such as heat and work.
CO2	Describe the various laws of thermodynamics
CO3	Describe the working principle of thermal power plants and the associated parts.
CO4	Describe the various energy interactions between heat and work.
CO5	Explain the various thermal machines based on thermodynamics.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2									2		3		
CO2	3	2									2		3		
CO3	3	2									2		3		
CO4	3	2									2		3		
CO5	3	2									2		3		

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUCTP1	**Material Science and Metallurgy**	**3**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1 To impart the concept of crystal structure and deformation mechanism in crystalline materials.
2 To impart the understanding of structure-property-performance of materials.
3 To impart the knowledge of heat treatment processes to manipulate the material properties.
4 To teach the steps involved in powder metallurgy.

UNIT-1 Introduction

Structure and properties relationship of Engineering Materials, Classification of materials, Crystalline structure of solids: concepts of unit cell and space lattice, miller indices, crystal structure. Crystal structure of ferrous and non-ferrous metals, crystal imperfections. Plastic Deformation: Mechanisms of plastic deformation, role of dislocation, slip and twinning, strain hardening. Imperfections in Solids-Point defects, Dislocations, Interfacial Defects, Bulk defects.

UNIT-2 Phase Diagrams and Phase Transformations

Phase Diagrams, Phases, phase rules, concept of equilibrium, Phase diagram, lever rule, eutectic, eutectoid, peritectic and peritectoid systems, iron–carbon diagram. Transformation rate effects and TTT diagrams. Microstructure and property changes in iron-carbon system, Iron-Carbon (Fe-C or Fe-Fe3C) Diagram.

UNIT-3 Material Behaviour

Mechanical Behaviour of Materials-Elastic and plastic properties, Creep, Fatigue, Fracture, Heat treatment of steels.

UNIT-4 Material Properties

Thermal, Electrical, Magnetic, Optical Properties: Heat capacity, Thermal expansion, Thermal conductivity, Thermal stresses, Electrical conduction, Semi conductivity, Super conductivity, Electrical conduction in ionic ceramics and in polymers, Dielectric behaviour, Ferroelectricity, Piezoelectricity, Diamagnetism and paramagnetism, Ferromagnetism, Anti-ferromagnetism and ferrimagnetism.

UNIT-5 Powder Metallurgy

Characteristics of metal powder, Particle size, shape and size distribution, Characteristics of powder mass such as apparent density, tap density, flow rate, friction conditions. Properties of green compacts and sintered compacts. Machining, milling, atomization, electro-deposition, reduction from oxide,

production of alloy powders. Powder rolling, powder forging, powder extrusion and explosive forming technique.

TEXTBOOKS:

1 V.Raghavan, Material Science and Engineering, PHI, 6th Edition, 2018.
2 Callister W. D. Jr., Materials Science and Engineering an Introduction, Wiley, 9th Edition, 2013.
3 O P Khanna, Material Science and Metallurgy, Dhanpat Rai Publication, 4th Edition, 2011.

REFERENCE BOOKS:

4 R K Rajput, Engineering Materials And Metallurgy, S. Chand, 4th Edition, 2006
5 Sidney H Avner, Introduction to Physical Metallurgy, Mc Graw Hill, 2nd Edition, 2017.
6 Ahindra Ghosh, Textbook of Materials and Metallurgical Thermodynamics, PHI, 2nd Edition, 2008.

WEB RESOURCES

1 https://archive.nptel.ac.in/courses/113/102/113102080/
2 https://metall-mater-eng.com/index.php/home
3 https://www.iitb.ac.in/mems/en
4 https://www.iitkgp.ac.in/department/MT
5 https://www.birmingham.ac.uk/schools/metallurgy-materials/index.aspx

Course Outcomes (COs): After completion of the course, the students will be able to	
CO1	Describe the crystal system, crystal structure and deformation mechanisms of crystalline materials.
CO2	Paraphrase the phase diagrams in evaluating the microstructure-property relationship especially considering the case of Fe-C system.
CO3	Compare the mechanical behaviour of materials and utilise the microstructure outcome to evaluate the effect of heat treatment.
CO4	Characterize the different properties viz. Thermal, Electrical, Magnetic and Optical Properties of materials.
CO5	Explain the steps involved in the development of composite materials through the powder metallurgy route.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2							2			3		

CO2	3	2	2							2			3		
CO3	3	2	2							2			3		
CO4	3	2	2							2			3		
CO5	3	2	2							2			3		

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUCTP2	**Sustainable Energy Conversion**	**3**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1 To understand the different energy resources like conventional and non-conventional sources of energy.
2 To learn about energy conversion systems like bio-energy conversion, bio methanation technology, Thermochemical Conversion, gasification, pyrolysis etc.
3 To know about various sustainable energies.

UNIT-1 Energy resources

Conventional and non-conventional sources of energy, basics of solar, wind, bio, hydro, tidal, ocean, thermal and other renewable energy sources.

UNIT-2 Energy conversion systems

Conversion routes, direct and indirect ways of energy conversion, electricity generation, distribution and use, basics of solar thermal conversion, technology of selective coating, fundamentals of flat plate collector and evacuated collector,

UNIT-3 Wind and PV System

Basics of wind energy conversion, wind machine, wind electric generator, wind pump, basics of photovoltaic conversion technology and PV systems.

UNIT-4 Chemical Energy System

Bio-methanation technology, thermochemical conversion through pyrolysis, gasification and esterification, bio-oil, application of ocean thermal gradient and geothermal gradient for power generation.

UNIT-5 Hydro and Fuel Cell System

Basics of hydropower, tidal and wave power, basics of hydrogen fuel, fundamentals of fuel cells, basics of fusion power.

TEXTBOOKS:

1 Rao Ashok, “Sustainable Energy Conversion for Electricity and Coproducts: Principles, Technologies and Equipment”, Wiley, 1st Edition, 2015.

REFERENCE BOOKS:

1 Capareda Sergio, Introduction to Biomass Energy Conversions, CRC Press, 1st Edition, 2013.

2 D. Mukherjee, Fundamentals of Renewable Energy Systems, New Age Publication, 1st Edition, 2004.

3 Mehmet Kanoglu, Yunus A. Çengel, John M. Cimbala, Fundamentals and Applications of Renewable Energy, Mc Graw Hill, 1st Edition, 2020.

WEB RESOURCES

1 https://www.cambridge.org/highereducation/books/sustainable-energy/4056BC60E0BC9FBEDA07671340BC19EB#overview

2 https://ncert.nic.in/ncerts/l/jesc114.pdf

3 https://www.uobabylon.edu.iq/eprints/publication_4_10679_78.pdf

4 https://www.uobabylon.edu.iq/eprints/publication_4_10679_78.pdf

Course Outcomes (COs): After completion of the course, the students will be able to	
CO1	Explain the availability of various energy sources.
CO2	Describe the possible ways of converting one form of energy into another.
CO3	Discuss the merits and application of Wind power and Photovoltaic cells.
CO4	Paraphrase the energy generation through the chemical process
CO5	Outline the working of other power generation processes like hydro, tidal, and fuel cell.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2							2		2	2		
CO2	3	2	2							2		2	2		
CO3	3	2	2			2				2		2	2		
CO4	3	2	2			2				2		2	2		
CO5	3	2	2			2				2		2	2		

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUCLT1	**Manufacturing Process Lab**	**-**	**-**	**2**	**25**	**25**	**1**

LIST OF EXPERIMENTS

1 Study the working of the lathe machine and its operations

2 Perform operations on the given workpiece:

i) Plain turning,
ii) Eccentric turning,
iii) Step turning,
iv) Taper turning,
v) Thread cutting (external & internal),
vi) Drilling,
vii) Boring,
viii) Knurling,
ix) Chamfering

3 Study of furnaces, Casting process, moulding sand and patterns

4 Study of Wooden Patterns:

i) Single-piece pattern,
ii) Split pattern,
iii) Match plate pattern,
iv) Loose piece pattern,
v) Sweep pattern,
vi) Skeleton pattern.
vii) Making of core.

5 Sand Casting:

i)Sand preparation and testing: - Specimen preparation, Permeability, Clay content, Grain fineness number, Green compression test, Green shear strength, Dry strength, hardness. Types of sand.
ii) Mould making: Familiarization with moulding tools, Preparation of green sand mould using split pattern (using any type of pattern), gating system, core making.
iii) Melting furnace, pouring of hot metals in the mould for obtaining of different engineering shapes & surfaces.

6 Study of Welding tools and operation of Welding Machines.

7 Joining of metals:
i) Welding: - Edge preparation for butt joint (V, J) and welding practice by SMAW, welding practice on T/butt joint using MIG/GTAW welding.
ii) Soldering & brazing: Familiarization with soldering and brazing tools & practice.

WEB RESOURCES

1 http://vlabs.iitkgp.ac.in/psac/newlabs2020/vlabiitkgpAM/#

2 http://www.nitttrkol.ac.in/vlab-me-mtl-exp-1.php#top

Course Outcomes (COs): **After completion of the course, the students will be able to**	
CO1	Perform the operations in lathe and make the desired product with specified dimensions.
CO2	Assess the properties of moulding sand and demonstrate the casting and related practices.
CO3	Evaluate the effect of welding, soldering and brazing process parameters.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	3	2
CO3	3	2	2	3	-	-	-	-	3	2	-	-	3	3	3

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUCLT2	Computer-Aided Machine Drawing	1	-	2	25	25	2

LIST OF EXERCISE

1 Study of Limits, Fits, and Tolerances and its application in Machine Drawing.
2 Study of various types of Keys (Parallel key, Taper key, Feather Key, Gib-head key, and Woodruff key) used in the assembly of Machine Elements
3 Study of various forms of Threads (ISO Metric -Internal & External, BSW -internal & External, Square and ACME) and their standards.
4 Study various types of Fasteners like Hexagonal-headed bolt and nut with washer, square-headed bolt and nut with washer.
5 Simple assembly of stud bolts with nut and lock nut.
6 Prepare the assembly drawing from the given part drawing for the following machine components by performing manually and using standard commercial 2D / 3D CAD software
   (i) Joints: Cotter joint (socket and spigot), knuckle joint (pin joint) for two rods.
   (ii) Coupling: Split Muff coupling, Protected type flanged coupling, pin (bush) type flexible coupling, and universal coupling (Hooks' Joint)
   (iii) Engine parts: Piston, connecting rod, stuffing box, multi-plate clutch
   (iv) Other machine components: Plummer block (Pedestal Bearing), Screw jack (Bottle type), tailstock of lathe, Machine vice

TEXT BOOKS:

1 K.R. Gopala Krishna, Machine Drawing, Subhash Publication,32nd Edition, 2005
2 N.D.Bhat and V.M. Panchal Machine Drawing, Charotar Publishing House, 49th Edition, 2014.

REFERENCE BOOKS

1 S. Trymbaka Murthy, A Text Book of Computer Aided Machine Drawing, CBS Publishers, 2nd Edition, 2008.
2 P.S. Gill, Engineering drawing, KATSON BOOKS, 11th Edition, 2013.
3 N. Siddeshwar, P. Kanniah, V.V.S. Sastri, Machine Drawing, Tata McGraw Hill, 2017

WEB RESOURCES

1 https://archive.nptel.ac.in/courses/112/102/112102304/
2 https://www.youtube.com/playlist?list=PLGiGNMkNq6QsSHEfUC1ekc2Pz2qfy1OKb
3 https://nptel.ac.in/courses/112104031

Note 50% of assembly drawings must be done manually and the remaining 50% must be done using any CAD software. The above tasks can be performed manually and using standard commercial 2D / 3D CAD software

Course Outcomes (COs): After completion of the course, the students will be able to	
CO1	Use industry-standard engineering drawing practices, symbols, and conventions.
CO2	Apply limits and tolerances to assemblies and choose appropriate fits for given assemblies.
CO3	Demonstrate the importance of linking functional and visualization aspects in the preparation of the part drawings
CO4	Create assembly drawings that depict the arrangement and relationships of individual components within a machine or mechanical system.
CO5	Demonstrate proficiency in using computer-aided design (CAD) software to create detailed and accurate machine drawings.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3									3			3		1
CO2	2		2							3			3	2	
CO3	3	2											3		2
CO4	3												3	1	
CO5	3				3					3			3		2

SCHOOL OF STUDIES OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of Teaching and Evaluation 2023-24 (As per NEP-2020)

Choice Based Credit System (CBCS) and Outcome Based Education (OBE)

(Effective from the Academic year 2023-24)

IV-SEMESTER SCHEME OF TEACHING & EVALUATION 2023-24

S. N.	Course Type	Course Code	Course Title	Teaching Hours/ week			Examination				Credits
				Theory lectures	Tutorial	Practical /Drawin	Examination in Hours	CIA Marks	SEA Marks	Total Marks	
				L	T	P					
1	Department Core	MEUDTT1	Fluid Mechanics and Hydraulic Machinery	3	1	-	03	40	60	100	4
2	Department Core	MEUDTT2	Mechanics of Solids – II	2	1	-	03	40	60	100	3
3	Department Core	MEUDTT3	Kinematics of Machines	2	1	-	03	40	60	100	3
4	Department Core	MEUDTT4	CAD/CAM	3	-	-	03	40	60	100	3
5	Open elective/Institute Core	MEUDTO1	Introduction to Fluid Mechanics*	3	-	-	03	40	60	100	3
6	Department Elective	MEUDTP1	Industrial Engineering and Economics	3	-	-	03	40	60	100	3
		MEUDTP2	Introduction to Composites								
7	Practical	MEUDLT1	FMHM Lab	-	-	2	03	25	25	50	1
8	Practical	MEUDLT2	CAD/CAM Lab	-	-	2	03	25	25	50	1
9	Practical	MEUDLT3	Mechanics of Solids Lab	-	-	2	03	25	25	50	1
10	Project	MEUDPV1	Mini Project	-	-	2	03	25	25	50	1
Total				**16**	**3**	**08**	**30**	**340**	**460**	**800**	**23**
*** Not for ME students**											

Credit Definition:

➢1-hour lecture **(L)** per week per semester = **1 Credit**

➢1-hour tutorial **(T)** per week per semester = **1 Credit**

➢2-hour Practical/Drawing**(P)** per week per semester = **1 Credit**

- **Four credit** courses are to be designed for **50** hours of Teaching-Learning process.
- **Three credit** courses are to be designed for **40** hours of Teaching-Learning process.
- **Two credit** courses are to be designed for **30** hours of Teaching-Learning process.
- **One credit** courses are to be designed for **15** hours of Teaching-Learning process

Note: The above is applicable only to THEORY courses

CIA: Two internal Class Tests, each of 15 Marks. Assignment: 10 Marks

SEA: Semester End Assessment – 60 marks

List of Open Electives for ME department students

1. **Remote Sensing (CEUDTO1)**
2. **Energy and Environment Engineering (CHUDTO1)**
3. **Introduction to Information Science (CSUDTO1)**
4. **Introduction to Electronic Devices and Circuits (ECUDTO1)**
5. **Fundamentals of Python Programming (ITUDTO1)**
6. **Automobile Engineering (IPUDTO1)**

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDTT1	**Fluid Mechanics and Fluid Machinery**	**3**	**1**	**-**	**40**	**60**	**4**

Course Objectives: The student shall

1 Learn about various properties of fluids and pressure measurement

2 Understand basic principles of fluid motion

3 Understand boundary layer concepts and flow through pipes

4 Learn the construction and working of hydraulic turbines

5 Learn the construction and working of centrifugal and reciprocating pumps

UNIT-1 **Fluid Statics**

Fluid Statics: Dimensions and units: physical properties of fluids- specific gravity, viscosity, and surface tension - vapor pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

UNIT-2 **Fluid Kinematics and Dynamics**

Fluid Kinematics: Stream line, path line and streak lines and stream tube, classification of flows- steady & unsteady, uniform & non-uniform, laminar & turbulent, rotational & irrotational flows-equation of continuity for one dimensional flow and three-dimensional flows.

Fluid Dynamics: Surface and body forces –Euler's and Bernoulli's equations for flow along a streamline, momentum equation and its application on force on pipe bend.

UNIT-3 **Boundary Layer and Flow through Pipes**

Boundary Layer Concepts: Definition, thicknesses, characteristics along thin plate, laminar and turbulent boundary layers (No derivation) boundary layer in transition, separation of boundary layer, submerged objects – drag and lift.

Closed Conduit Flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel- total energy line- hydraulic gradient line. Measurement of flow: Pitot tube, venturi meter, and orifice meter, Flow nozzle

UNIT-4 **Hydraulic Turbines**

Dimensional Analysis: Buckingham's pi-theorem

Hydraulic Turbines: Classification of turbines, Heads and efficiencies, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-

working proportions, work done, efficiencies, hydraulic design –draft tube theory- functions and efficiency.

Performance Of Hydraulic Turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer.

UNIT-5 **Centrifugal and Reciprocating Pumps**

Centrifugal Pumps: Classification, working, work done – barometric head-losses and efficiencies specific speed- performance characteristic curves, NPSH.

Reciprocating Pumps: Working, Discharge, slip, indicator diagrams.

TEXT BOOKS:

1 S K Som & G. Biswas, Introduction to Fluid Mechanics & Fluid Machines, McGraw Hill, 3rd Edition, 2017

2 Yunus A Cengel, Fluid Mechanics-Fundamentals and Applications, McGraw Hill, 4th Edition, 2019

REFERENCE BOOKS:

1 R.W. Fox and T. McDonnald, Introduction to Fluid Mechanics, WILEY, 10th Edition, 2021

2 F.M. White, Fluid Mechanics, McGraw Hill, 9th Edition, 2022

3 P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics Including Hydraulics Machines, SBH, 22nd Edition, 2019

WEB RESOURCES

1 https://nptel.ac.in/courses/112104118

2 https://onlinecourses.nptel.ac.in/noc21_me75/preview

3 https://edurev.in/courses/24694_Fluid-Mechanics-and-Hydraulic-Machines

Course Outcomes (COs): After the course completion, student shall be able to	
CO1	explain the effect of fluid properties on a flow system
CO2	identify type of fluid flow patterns and describe continuity equation
CO3	demonstrate boundary layer concepts
CO4	describe the construction and working of hydraulic turbines
CO5	describe the construction and working of hydraulic pumps

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3		
CO2	3	3	1	-	-	-	-	-	-	-	-	-	3		
CO3	3	3	1	-	-	-	-	-	-	-	-	-	3		
CO4	3	3	1	-	-	-	-	-	-	-	-	1	3		
CO5	3	3	1	-	-	-	-	-	-	-	-	1	3		

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDTT2	**Mechanics of Solids – II**	**2**	**1**	**-**	**40**	**60**	**3**

Course Objectives: The student shall

1 Learn various energy methods for the analysis of mechanical structures

2 Understand the concept of various types of beams and their deflection modes on loading

3 Familiarize with the deflection behavior and failure characteristics of curved beam components subjected to different types of loading conditions

4 Learn the effect of unsymmetric loading on Columns and beams

5 Describe the concept and methods involved in the calculation of stresses in pressure vessels

UNIT-1 **Introduction to Energy Methods**

Energy Methods: Introduction, Strain energy, Elastic strain energy in tension, compression, bending and torsion. Impact loading in tension and bending.

Theorem of Castigliano and its applications, Reciprocal relations, Maxwell - Betti theorem.

UNIT-2 **Deflection of Beams**

Fixed Beams: Fixed beams subjected to different types of loads and couples, Calculations of fixing moments and reactions at supports and deflection. Effect of sinking of support.

Continuous beams: Continuous beams subjected to different type of loads and couples, beams with overhang, beams with one end fixed, Clapeyron's theorem. Effect of sinking of supports.

UNIT-3 **Bending of Curved Beams**

Bending of curved bars: Bending of curved bars in the plane of loading, Winkler- Bach theory, crane hooks, chain links, bending of circular bars subjected to symmetric loading, bending of circular rings, stresses in circular rings.

UNIT-4 **Eccentric Loaded Structures**

Unsymmetrical Bending: Introduction to unsymmetrical bending, Stresses and deflection in unsymmetric bending, Shear center for angle, Channel and I-sections.

Columns: Struts and Columns, Stability of columns, Euler's formula for different end conditions, Equivalent load, Eccentric loading, Rankine's formula.

UNIT-5 **Pressure Vessels**

Thin Pressure Vessel: Thin Pressure Vessels, Circumferential and longitudinal stresses in thin cylindrical shells and thin spherical shells under internal pressure.

Thick Pressure Vessel: Introduction, Lames Theorem, Thick Pressure vessels subjected to internal pressure, External Pressure & both, compound cylinders.

TEXT BOOKS:

1 J. M. Gere and S. P. Timoshenko, Mechanics of Materials, CBS publisher, 2nd Edition, 2023
2 Sadhu Singh, Strength of Materials, Khanna Book Publishing, 1st Edition, 2016
3 F.P. Beer & E.R. Johnson Jr., Mechanics of Material, PHI,

REFERENCE BOOKS:

1 Egor P. Popov, Engineering Mechanics of solids, PHI,
2 I. H. Shames, Introduction of solid mechanics

WEB RESOURCES

1 https://nptel.ac.in/courses/112107146
2 https://onlinecourses.nptel.ac.in/noc23_me140/preview
3 https://edurev.in/courses/25074_Strength-of-Material--ME-

Course Outcomes (COs):	
CO1	Determine the stored energy of the structures under varying load conditions.
CO2	Interpret different types of beams based on their characteristic features
CO3	Solve the problems associated with curved beams for varied application
CO4	Determine the response of unsymmetrical loading on beams and columns.
CO5	Determine the stress distribution on thin and thick vessels.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	2		-	-	-	-	-	2	-	-	3	-	-
CO2	3	2	2		-	-	-	-	-	2	-	1	3	-	-
CO3	3	2	2		-	-	-	-	-	2	-	-	3	-	-
CO4	3	2	2		-	-	-	-	-	2	-	1	3	-	-
CO5	3	2	2		-	-	-	-	-	2	-	1	3	-	-

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CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDTT3	Kinematics of Machinery	2	1	-	40	60	3

Course Objectives: The student shall

1 Understand the fundamentals of kinematics and the concept of machines, mechanisms, and related terminologies

2 Construct the velocity diagram for a given mechanism

3 Construct the acceleration diagram for a given mechanism

4 Classify, identify, and explain different types of gear and gear Trains

5 Classify cam mechanisms and design cam motion profiles

UNIT-1 **Mechanism and Machines**

Mechanism and Machines: Introduction and basic concepts, Mechanism and Machines, Links, kinematics pair, kinematics chain, degree of freedom & constrained motion, inversion of slider crank mechanism, four bar chain, mechanisms with lower pairs, pantograph

UNIT-2 **Velocity in Mechanism**

Velocity in Mechanism: Plane motion, absolute and relative motion, velocity of a point, velocity of a mechanism by relative velocity diagram

UNIT-3 **Acceleration in Mechanism**

Acceleration in Mechanism: Plane motion, absolute and relative motion and acceleration of a point, acceleration of a mechanism by relative acceleration diagram, Coriolis components.

UNIT-4 **Gear and Gear Train**

Gear and Gear Train: Classification of gears, spur, helical, bevel, worm gears, spur gear, conjugate action, law of gearing, involute and cycloidal tooth's profiles, interference and undercutting, contact ratio, gear train, simple, compound, and epicyclical gear trains.

UNIT-5 **Cams and Followers**

Cams and Followers: Classification of cam and follower, types of follower motion, uniform, simple harmonic, parabolic, cycloid, Cam's profile by graphical method.

TEXT BOOKS:

1 Amitabh Ghosh and Ashok Kumar Mallik, Theory of Mechanism and Machines, East West Press,3rd edition, 2008

2 S. S. Ratan, Theory of Machine, McGraw Hill Education India, 5th edition, 2018

REFERENCE BOOKS:

1 Thomas Beven, Theory of Machine, Pearson, 3rd edition, 2009

2 G.R. Pennock and J.E. Shigley, Theory Of Machine And Mechanisms, Oxford University Press, 4th Edition, 2014

WEB RESOURCES

1 https://archive.nptel.ac.in/courses/112/104/112104121/

2 https://archive.nptel.ac.in/courses/112/105/112105268/

3 https://edurev.in/courses/21055_Theory-Of-Machines

Course Outcomes (COs):	
CO1	Understand the basic concept of different machines and mechanisms
CO2	Calculate the velocity of a mechanism
CO3	Calculate the acceleration of a mechanism
CO4	Analyze different types of Gear and gear trains
CO5	Design various cam motion profiles and Classify cam-followers

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	1	2		1							1	1		
CO2	3	1	2		1								1		
CO3	2	1	2		1							1	1		
CO4	3	1	1		1							1	1		
CO5	3	1	1										1		

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDTT4	CAD/CAM	3	-	-	40	60	3

Course Objectives:

1 To provide the necessary theoretical background and the application of computer graphics

2 To impart the parametric fundamentals to create and manipulate geometric models using curves, surfaces and solids

3 To describe positions and orientation of primitives by operations like translations, reflections, and dilations on and off the coordinate plane

4 To summarize the basics of CAD/CAM software and CNC Technology

5 To impart knowledge on basics of NC part programming

UNIT-1 **Basics of CAD**

Basics of CAD: Basics fundamentals of Computer Graphics, Principle of computer graphics, Product life cycle, Concept of Computer Aided Design (CAD) and architecture, Hardware and software, Color management, Raster graphics, Graphics standard, Graphic primitives, lines, andCircle Drawing algorithms, Software documentations, CAD standards GKS, OpenGL, Data exchange standards- IGES, STEP, CALS etc, Communication standards. Standards for exchange images.

UNIT-2 **Geometric Modelling**

Geometric Modeling of Curves, Surface and Solid: Basics representation of curves, Parametric and nonparametric curves, Mathematical representation of curves, Hermite curves, Bezier curves and B-spline curves. Basic of Surface, Techniques of surface modelling, Plane surface, Rule surface, Surface of revolution and sweep, Coons and bi-cubic patches, concept of Bezier and B-spline surfaces. Basic concept of solid modelling technique, CSG and B-rep method for solid generation.

UNIT-3 **Computer Aided Design**

Computer Aided Design (CAD) methodology, Coordinate systems, Theory and applications, 2D and 3D geometric transformation, Homogeneous transformation, Concatenation, Assembly modelling, interferences of positions and orientation, tolerance analysis, mass property calculations, Visual realism- hidden line-surface-solid removal algorithms, shading, coloring, computer animation, Concurrent Engineering.

UNIT-4 **Basics of CAM**

Basics of CAM: Basic concept of numerical control (NC) System, NC coordinate system, NC motion control, Application of NC, concepts of computer numeric control (CNC) system, problems with conventional, NC and CNC.

UNIT-5 **Part Programming**

Part Programming: Introduction to NC part programming, manual part programming, Computer assisted part programming, Automatically Programming Tool (APT) language, statements and code of APT, programming methods, and advantages of CAD/CAM programming.

TEXT BOOKS:

1 Ibrahim Zeid, CAD/CAM Theory and Practice, McGraw Hill Publications, 2nd Edition, 2009

2 Milkell P. Groover and Emory W. Zimmer, CAD/CAM, Pearson Education, 1st Edition, 2003

REFERENCE BOOKS:

1 P. N. Rao, CAD/CAM Principle & Applications, McGraw Hill Publications, 3rd Edition, 2017

2 T. Jeyapoovan, Robert Quesada, Computer Numeric Control, Pearson Education,

3 Amitabh Ghosh and Ashok Kumar Mallik, Theory of Mechanism and Machines, East West Press,3rd edition, 2008

WEB RESOURCES

1 https://archive.nptel.ac.in/courses/112/102/112102101/

2 https://onlinecourses.swayam2.ac.in/nou22_me08/preview

3 http://www.nptelvideos.com/course.php?id=782

Course Outcomes (COs):	
CO1	Explain the core concepts and standards of computer-aided graphics
CO2	Describe the representation of curves, surface and solid modelling techniques for real-time applications
CO3	Apply geometric techniques to transform 2D and 3D entities
CO4	Explain the working principles of NC and CNC machines
CO5	Apply various programming methods for computer-assisted manufacturing

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CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3									2			3		
CO2	3	2	2		2								3		
CO3	3	2											3		
CO4	3									2		3	3		
CO5	3	2	2		3					2			3		

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDTP1	**Industrial Engineering and Economics**	**3**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1 Understand the essential principles and decision making tools of Engineering Economics (EC) for circulating Economics Production and Consumption

2 Perceive the thoughts and methods of micro EC, especially calculating the inflation rate, replacement of equipments, and depreciation value

3 Aware about the history & development of industrial engineering and architectures of productivity

4 Understand the process and application of method and work study

5 Familiarize from the different wage & incentives schemes

UNIT-1 **Basic Economics**

Basic Economics-Introduction to Economics, Type of Economics, Theory of Economics, Principles of Economics and its scope, Law of supply and demand and its type and features, Economic efficiency.
Cost and Decision-Costs, Element of costs-fixed-variable and others, Capital, Assets and its Type, Role of Engineers in Decision Making, Decision Tree and Sequential Investment Decisions, Decision Making Techniques, Cash Flow Diagram

UNIT-2 **Basic Methodologies of Engineering Economic Analysis**

Basic Methodologies of Engineering Economic Analysis-Introduction to Time Value of Money, Simple Interest, Compound Interest, Nominal Interest rate. Measuring Inflation, equivalence calculation under Inflation, assets replacement and its policy, Comparative Analysis of Alternatives and its methods for analysis, Depreciation- Introduction and its types and methods, value analysis

UNIT-3 **Introduction History & Development of Industrial Engineering**

Introduction history & development of industrial engineering: F.W.Taylor and Frank & Lillian Gilberth their contribution industrial engineering.
Productivity: Productivity definition; means of increasing productivity; productivity vs production, Productivity index and its types, numerical.

UNIT-4 **Method Study**

Method Study: Definition & basic procedure, selection of jobs, recording technique; and Principle of motion economy.

Work Measurement: Definition, objectives, application, time study equipment, performance rating; allowances; number of cycle to be studied; determination of standard time, numerical

UNIT-5 **Wages and Incentives**

Wage & Incentives: Characteristics of a good wage or incentive systems, method of wage payment. Concept of wage incentive schemes; financial & non-financial; Taylor differential piece rate, Halsey premium plane, Merric's multiple piece rate system. Ergonomics, work space dimension, design of work place, environmental stresses & impacts on human work.

TEXT BOOKS:

1 Dharmaraj, E.. Engineering Economics. Mumbai, IN: Himalaya Publishing House, 2009. ProQuest ebrary. Web. 9 November 2016.

2 Malakooti, B. (2013). Operations and Production systems with multiple objectives. John Wiley & Sons.ISBN 978-1-118-58537-5.

REFERENCE BOOKS:

1 Morris, W. Thomas. (1960). Engineering economy: the analysis of management decisions. Homewood, Ill.: R. D. Irwin

2 Krugman, Paul; Wells, Robin (2012). Economics (3rd ed.).Worth Publishers. p. 2. ISBN 978-1464128738.

3 Badiru, A. (Ed.) (2005). Handbook of industrial and systems engineering. CRC Press. ISBN 0-8493-2719-9.

WEB RESOURCES

1 https://onlinecourses.nptel.ac.in/noc22_me04/preview

2 https://archive.nptel.ac.in/noc/courses/noc18/SEM1/noc18-me35/

Course Outcomes (COs):	
CO1	Relate the essential principles and decision making tools of EC for attaining Economics Production and Consumption practices
CO2	Apply the thoughts and methods of micro EC for attaining the production economics
CO3	Describe the history & development of industrial engineering and apply the concept of productivity for economic production
CO4	Explore the methods and work study tools for economic production
CO5	Implement the wage & Incentives schemes for economic production

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CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1	-	-	3	3	-	2	-	3	1	1	2	3
CO2	3	3	3	-	1	3	3	-	2	-	3	1	1	2	3
CO3	3	-	-	-	-	-	3	-		-	3	-	-	1	3
CO4	3	3	3	1	1	3	3	-	2	-	3	1	1	2	3
CO5	3	3	3	1	1	3	3	-	3	-	3	1	1	2	3

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDTP2	**Introduction to Composites**	**3**	**-**	**-**	**40**	**60**	**3**

Course Objectives:

1 To introduce the concept of composite materials and deliver the properties of composite materials.

2 To elaborate the role of constituent elements of the composite materials

3 To familiarize the students with various types of composite materials

4 To make students conversant with the making of polymer matrix composite materials

5 To create awareness about the mechanical testing methods of composites.

UNIT-1 Introduction

Classifications of Engineering Materials, Concept of composite materials, Matrix materials, Functions of a Matrix, Desired Properties of a Matrix, Functions of Reinforcement and desired properties of the reinforcement.

UNIT-2 Matrix and Reinforcement

Matrix: Role and Selection of Matrix material, Polymer (Thermosets and Thermoplastics), Metal, Ceramic etc. as matrix material.

Types of Reinforcements/Fibers: Role and Selection of reinforcement materials, Types of fibers, Glass fibers, Carbon fibers, Aramid fibers, Metal fibres, Whiskers, Flakes etc.,

UNIT-3 Various types of Composites

Classification based on Matrix Material: Polymer matrix composites (PMC), Carbon matrix Composites or Carbon-Carbon Composites, Metal matrix composites (MMC), Ceramic matrix composites (CMC);

Classification based on reinforcements: Fiber Reinforced Composites, Fiber Reinforced Polymer (FRP) Composites, Laminar Composites, Particulate Composites, Comparison with Metals, Advantages & limitations of Composites

UNIT-4 Fabrication of Polymer Matrix Composites

Manufacturing Processes like Hand Lay-up, filament welding, compression moulding, resin-transfer method, and Pultrusion. Vacuum Bag Manufacturing Techniques: Tooling and Specialty materials, Release agents, Peel plies, release films and fabrics, Bleeder and breather plies, bagging films.

UNIT-5 Testing of Composites

Mechanical properties of fibers, Reinforcements. Mechanical testing of composites, tensile testing, Compressive testing, Inter-laminar shear testing, and Fracture testing.

TEXTBOOKS:

1 K.K.Chawla, Composite Materials, Springer, 3rd Edition, 2012
2 Ronald F. Gibson, Principles of Composite Material Mechanics, CRC Press, 2011
3 Bhargava, A. K. Engineering Materials: Polymers, Ceramics and Composites, Prentice Hall India, 2nd Edition, 2012

REFERENCE BOOKS:

1 K.K. Chawla, Ceramic Matrix Composites, Kluwer Academic Publishers, 2003
2 N. Chawla, K.K. Chawla, Metal Matrix Composites, Springer-Verlag, 2006
3 C. Seferis, L. Nicolais, (Eds.) The Role of the Polymeric Matrix in the Processing and Structural Properties of Composite Materials, Plenum Press, New York 1983.

WEB RESOURCES

1 https://www.intechopen.com/chapters/71222
2 https://compositeskn.org/KPC/A100
3 https://archive.nptel.ac.in/courses/112/104/112104229/

Course Outcomes (COs): At the end of the course, the student will be able to	
CO1	Describe the evolution of composite materials.
CO2	Describe the constituents of composite materials.
CO3	Classify the types of composite materials.
CO4	Describe the manufacturing of polymer matrix composite materials.
CO5	Determine the strength characteristics of composite materials.

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3						2						3		
CO2	3												3		
CO3	3												3		
CO4	3		3				2			3			3		2
CO5	3	3	2	2	2					3			3		2

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDLT1	**Fluid Mechanics and Fluid Machinery Lab**	**-**	**-**	**2**	**25**	**25**	**1**

LIST OF EXPERIMENTS

1 Metacentric height: Determination of metacentric height
2 Bernoulli's apparatus: Determination of total head and verifying Bernoulli's principle
3 Venturimeter: Determination of coefficient of discharge of venturimeter
4 Orifice meter: Determination of coefficient of discharge of an orifice
5 Pipe friction apparatus: Determination of frictional losses
6 Reynolds apparatus: Laminar and Turbulent flow
7 Pelton Wheel turbine: Characteristics of impulse turbine
8 Francis turbine: Characteristics of medium head reaction turbine
9 Kaplan turbine: Characteristics of low head reaction turbine
10 Centrifugal pump: Characteristics of centrifugal pump

WEB RESOURCES

1 https://www.youtube.com/watch?v=2Iv4QSkXADM
2 https://fmc-nitk.vlabs.ac.in/
3 https://me.iitp.ac.in/Virtual-Fluid-Laboratory/

Course Outcomes (COs):	
CO1	Analyze data using fluid mechanics principles and experimentation methods
CO2	Apply Bernoulli's principle in determining the coefficient of discharge of various flow meters
CO3	Compute the friction factor for fluid flow through set of pipes
CO4	Analyse the performance characteristics of hydraulic turbines
CO5	Analyse the performance characteristics of hydraulic pumps

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	1	3	3	3

CO2	3	2	-	-	-	-	-	-	-	-	-	1	3	3	3
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
CO5	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDLT3	**CAD/CAM Lab**	**-**	**-**	**2**	**25**	**25**	**1**

LIST OF EXPERIMENTS

I **Creation of 3D assembly model of the following machine elements using 3D Modelling Software**

1 Introduction of 3D Modelling software
2 Flange Coupling
3 Plummer Block
4 Screw Jack
5 Safety Valves
6 Connecting Rod
7 Piston
8 Crankshaft

II **Manual Part Programming**

(i) Part Programming - CNC Machining Centre
- Linear cutting
- Circular cutting
- Cutter radius compensation
- Canned cycle operations

(ii) Part Programming – CNC Turning Centre
- Straight, Taper and Radius Turning
- Thread Cutting
- Rough and Finish Turning Cycle
- Drilling and Tapping Cycle

WEB RESOURCES

1 https://fab-coep.vlabs.ac.in/List%20of%20experiments.html
2 http://vlabs.iitkgp.ac.in/cim/
3 http://vlabs.iitkgp.ernet.in/vlabs/rtvlab1/cadprg.html

Course Outcomes (COs):	
CO1	Apply modelling software to develop 3D models of machine components
CO2	Prepare CNC part programming to perform machining in CNC Lathe
CO3	Prepare CNC part programming to perform machining in CNC Milling
CO4	Describe the role of CNC control in modern manufacturing systems

CO5	Demonstrate the importance of Modelling and Machining through product development

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2		3					3		3	3	2	2
CO2	3	2	2		3								3	2	2
CO3	3	2	2		3								3	2	2
CO4	3												3	2	2
CO4	3	2	2	2	3					3		3	3	2	2

Guru Ghasidas Vishwavidyalaya
(A Central University)
Department of Mechanical Engineering

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDLT2	**Mechanics of Solids Lab**	**-**	**-**	**2**	**25**	**25**	**1**

LIST OF EXPERIMENTS

1 To study the Universal Testing Machine
2 To perform the Tensile Test of Mild Steel on U.T.M and To Draw Stress–Strain Curve
3 To study the Impact Testing Machine and test specimen of Izod and Charpy
4 To determine Izod and Charpy Value of the given mild steel specimen
5 To study the Torsion Testing Machine
6 To determine ultimate shear stress and modulus of rigidity under Torsion
7 To study the Rockwell Hardness Testing Machine and to determine the Rockwell Hardness of thegiven material
8 To study the Brinell Hardness Machine and to determine the Brinell hardness of the given material
9 To study the Vickers Hardness Machine and to conduct a hardness test on the machine

WEB RESOURCES

1 https://sm-nitk.vlabs.ac.in/List%20of%20experiments.html
2 https://rtlabs.nitk.ac.in/?q=page/strength-materials-lab
3 https://mrmsmtbs-iitk.vlabs.ac.in/List%20of%20experiments.html

Course Outcomes (COs):	
CO1	remember properties of material, stress, thermal stress and various mechanical components
CO2	understand how different components will fail under different types of load
CO3	understand the deflection/deformation behaviour due to different loading condition
CO4	apply concepts of stress, strain, principle stress in 1D, and 2D objects

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3
CO2	2	1	-	-	-	-	-	-	-	-	-	-	3	3	2
CO3	3	2	2	3	-	-	-	-	3	2	-	-	3	3	3
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3

CODE	COURSE NAME	HOURS PER WEEK			CIA	SEA	CREDIT
		L	T	P			
MEUDTT1	**Introduction to Fluid Mechanics**	**3**	**-**	**-**	**40**	**60**	**3**

Course Objectives: The student shall

1 To familiarize with the properties of fluids and the applications of fluid mechanics

2 To formulate and analyze problems related to calculation of forces in fluid structure interaction

3 To understand the concept of fluid measurement, types of flows and dimensional analysis

4 To understand boundary layer concepts

UNIT-1 **Fundamentals**

Fundamentals of Fluid Mechanics: Introduction; Applications; Concept of fluid; Difference between solids, liquids and gases; Concept of continuum; Ideal and real fluids; Fluid properties

UNIT-2 **Fluid Statics**

Fluid Statics: Concept of static fluid pressure; Pascal's law and its engineering applications; Hydrostatic paradox; Pressure distribution in a liquids

UNIT-3 **Fluid Kinematics**

Fluid Kinematics: Classification of fluid flows; Lagrangian and Euler flow descriptions; Velocity and acceleration of fluid particle; Local and convective acceleration; Normal and tangential acceleration; Flow rate and discharge mean velocity; One dimensional continuity equation; Continuity equation

UNIT-4 **Fluid Dynamics**

Fluid Dynamics: Euler's equation of motion; Bernoulli's equation using principle of conservation of energy; equation of motion and its applications to steady state ideal and real fluid flows

UNIT-5 **Fluid Devices**

Fluid devices; Conversion of mechanical to fluid energy - applications

TEXT BOOKS:

1 Yunus A Cengel, Fluid Mechanics-Fundamentals and Applications, McGraw Hill, 4th Edition, 2019

REFERENCE BOOKS:

1 F.M. White, Fluid Mechanics, McGraw Hill, 9th Edition, 2022

2 P.N. Modi and S.M. Seth, Hydraulics and Fluid Mechanics Including Hydraulics Machines, SBH, 22nd Edition, 2019

WEB RESOURCES

1 https://nptel.ac.in/courses/112104118

2 https://onlinecourses.nptel.ac.in/noc21_me75/preview

3 https://edurev.in/courses/24694_Fluid-Mechanics-and-Hydraulic-Machines

Course Outcomes (COs): After the course completion, student shall be able to	
CO1	Understand the concept of fluids and their properties
CO2	Distinguish various types of flows and learn flow measurement methods
CO3	Apply the concept to solve the problems related to fluid statics
CO4	Apply concepts to solve problems on fluid kinematics
CO5	Demonstrate working principle of various fluid-based devices

CO	PO												PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	3	2	1										2	1	1
CO2	3	2	2										3	1	1
CO3	3	2	2										3	1	1
CO4	3	2	1										2	1	1
CO5	3	2	1										2	1	1