SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

FACULTY OF ENGINEERING & TECHONOLOGY

ORDINANCE No. V-2 (B5)

RELATING TO COURSE CURRICULUM & SYLLABUS OF UG PROGRAM

BACHELOR OF TECHNOLOGY (B.Tech.) ME

(Effective from the Session – 2025-26)

Apporved by the Academic Council of the Meeting held on 06 May 2025

Apporved by the Executive Council of the Meeting held on 28 June 2025

(Er. Sachin Kumar) (Er. G.S. Kesharwani) (Er. K K Sharma) (Dr. Sanjeev Kumar)

Faculty of Engineering & Technology
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FACULTY OF ENGINEERING AND TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
(As per NEP 2020 and AICTE Guidelines)
B.Tech 2nd Year/3rd Semester (Mechanical Engineering)
w.e.f. academic Session 2026-27

SEMESTER III

S. No	Course Code	Course Title	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	UME-301	Engineering Mechanics	ES	4	0	0	20	10	30	-	70	-	100	3
2	UME- 302	Thermodynamics	ES	4	0	0	20	10	30	-	70	-	100	3
3	UME-303	Metallurgy & Materials Science	ES	4	0	0	20	10	30	-	70	-	100	3
4	UAS-301// UOE- 3**	Science based Open Elective/ Mathematics III	ES/BS	4	0	0	20	10	30	-	70	-	100	3
5	UAS-304/ UAS-405	Soft Skill*/ Environmental Science*	AEC	4	0	0	20	10	30	-	70	-	100	3
6	UME-351	Engineering. Mechanics Lab	ES	0	0	4	-	-		15	-	35	50	2
7	UME-352	Thermodynamics Lab	ES	0	0	4	-	-	-	15	-	35	50	2
8	UCC-351	Internship Assessment/ Mini Project		-	-	-	-	-	-	100			100	2
9	UVA-301/ UVA-302	The Art of Being Happy/ Disaster Management & Preparedness	VAC-1/ VAC-2	0	0	4	-	-	-	15	-	35	50	2
	TOTAL												750	23

***Compulsory Qualifying Audit Course**

Abbreviation Used:

BS: Basic Science Course

ES: Engineering Science Course

HS: Humanities and Social Sciences including Management Course

AU: Audit Course

*May be offered through NPTEL.

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STUDY & EVALUATION SCHEME
(As per NEP 2020 and AICTE Guidelines)
B.Tech 2nd Year/4th Semester (Mechanical Engineering)
w.e.f. academic Session 2026-27

SEMESTER IV

S. No.	Course Code	Course Title	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	UME-401	Applied Thermodynamics	ES	4	0	0	20	10	30	-	70	-	100	3
2	UME-402	Fluid Mechanics& Fluid Machines	ES	4	0	0	20	10	30	-	70	-	100	3
3	UME-403	Strength of Materials	ES	4	0	0	20	10	30	-	70	-	100	3
4	UOE- 4**/ UAS-403	Science based Open Elective / Mathematics III	ES/BS	4	0	0	20	10	30	-	70	-	100	3
5	UME-404	Measurements & Metrology	ES	4	0	0	20	10	30	-	70	-	100	3
6	UHU-405/ UAS-404	Soft Skills*/ Environmental Science*	AEC	4	0	0	20	10	30	-	70	-	100	3
7	UME-452	Fluid Mechanics& Fluid Machines lab	ES	0	0	4	-	-	-	15	-	35	50	2
8	UME-454	Measurement & Metrology Lab	ES	0	0	4	-	-	-	15	-	35	50	2
9	UVA-402/ UVA-401	Disaster Management & Preparedness /The Art of Being Happy	VAC-1/ VAC-2	0	0	4	-	-	-	15	-	35	50	2
	TOTAL												750	22

***May be offered through NPTEL.**

***Compulsory Qualifying Audit Course**

Summer Internship (4-6 weeks) during summer break after Semester-IV and same will be assessed/ evaluated in the Semester-V

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UME- 301	ENGINEERING MECHANICS	4L:0T:2P	3 credits

Objectives:

- To understand the nature of forces, law of motion, free body diagram, and friction force developed on body.
- To understand the concept of centre of gravity of different geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads
- To calculate the Moment of Inertia of different shapes like circular ring, disc, cylinder, sphere and cone.

UNIT-I: **(8 hours)**

Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium.

Friction: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction.

UNIT-II: **(8 hours)**

Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.

Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.

UNIT-III: **(8 hours)**

Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies, moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.

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UNIT-IV: **(10 hours)**

Kinematics of rigid body: Introduction, plane motion of rigid body, velocity and acceleration under translational and rotational motion, relative velocity.

Kinetics of rigid bodies: Introduction, force, mass and acceleration, work and energy, impulse and momentum, D'Alembert's principle and dynamic equilibrium.

UNIT-V: **(6 hours)**

Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy.

Text / References:

- J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
- M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media,1986.
- Beer, F.P and Johnston Jr. E.R., "Vector Mechanics for Engineers (In SI Units): Statics and Dynamics", 8th Edition, Tata McGraw-Hill Publishing company, New Delhi (2004).
- Vela Murali, "Engineering Mechanics", Oxford University Press (2010).

Course Outcomes:

After completing this course, the students should be able to understand the

- Proficient Analysis of Two-Dimensional Force Systems:
- Comprehensive Understanding of Friction in Equilibrium Systems:
- Expertise in Beam and Truss Analysis:
- Advanced Calculation of Centroid and Moment of Inertia:
- Thorough Understanding of Kinematics, Kinetics, and Stress-Strain Relationships:

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UME- 302	Thermodynamics	4L:0T:2P	3 credits

Objectives:

- To learn about law's of thermodynamics, work and heat interactions, and balance of energy between system and its surroundings.
- To learn about application of 2nd law to various energy conversion devices.
- To learn about the Available and unavailable energy and the relationship between the pressure, volume, temperature, enthalpy, and entropy.
- To understand the term pure substances in brief.
- To understand about the 2stroke, 4 stroke petrol & diesel engine and efficiency of cycle.

Syllabus:

UNIT-I **(8)**

Introduction- Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Macroscopic and Microscopic view points, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Exact & Inexact Differentials, Cycle Reversibility Quasi – static Process, Irreversible Process, Causes of Irreversibility Energy and its forms, Work and heat (sign convention), Gas laws, Ideal gas, Real gas, Law of corresponding states, Property of mixture of gases, electrical, magnetic, gravitational, spring and shaft work.

Zeroth law of thermodynamics: Concept of Temperature and its' measurement, Temperature scales. First law of thermodynamics: First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume. Limitations of first law of thermodynamics, PMM-I. Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc.

UNIT-II **(8)**

Second law of thermodynamics: Thermal reservoirs, Energy conversion, Heat engines, Efficiency, Reversed heat engine, Heat pump, Refrigerator, Coefficient of Performance, Kelvin

Planck and Clausius statement of second law of thermodynamics, Equivalence of the two statements. Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it's corollaries, Thermodynamic Temperature Scale, PMM-II. Entropy: Clausius inequality, Concept of Entropy, Entropy change of pure substance in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law of thermodynamics.

UNIT-III **(5)**

Availability and Irreversibility: Available and unavailable energy, Availability and Irreversibility, Helmholtz & Gibb's function. ***Thermodynamic relations:*** Conditions for exact differentials. Maxwell relations, Clapeyron equation, Joule-Thompson coefficient and Inversion curve.

UNIT-IV **(10)**

Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts- Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.

UNIT-V **(9)**

Introduction of IC engine. Classificiaction and parts of IC engine. Two stroke and four stroke diesel and petrol engine. Air standard cycle (Otto, Diesel cycle & Dual Cycle). Efficiency of Otto, Diesel cycle

Outcomes:

- After completing this course, the students will be able to apply energy balance to systems and control volumes, in situations involving heat and work interactions.
- The students will be able to understand the principle of the increase of entropy, isentropic efficiency for compressors, turbines, and nozzles.
- Students can evaluate changes in thermodynamic properties of substances.

DEAN

UME- 303	Metallurgy &Materials Science	4L:0T:0P	3 credits

Objectives:

- Understand the fundamental concepts of the crystallography of metals and alloys, including the determination of grain size and its effect on material properties.
- Learn how to construct and interpret phase diagrams and understand the phase transformations in binary systems.
- Gain an in-depth understanding of the iron-carbon phase diagram and the heat treatment processes applied to steels.
- Understand the structure and properties of different types of cast irons and non-ferrous metals and their alloys.
- Explore the classification, structure, properties, and applications of ceramics, polymers, and composites.

Syllabus:

UNIT – I **(08)**

Structure of Metals: Crystallography, Miller's indices, Packing Efficiency, Density calculations. Grains and Grain Boundaries. Effect of grain size on the properties. Determination of grain size by different methods. Constitution of Alloys: Necessity of alloying, Types of solid solutions, Hume - Rothery rules, Intermediate alloy phases.

UNIT –II **(08)**

Phase Diagrams: Construction and interpretation of phase diagrams, Phase rule. Lever rule. Binary phase Diagrams, Isomorphous, Eutectic and Eutectoid transformations with examples.

UNIT –III **(08)**

Engineering Materials –I STEELS: Iron-Carbon Phase Diagram and Heat Treatment: Study of Fe-Fe_3C phase diagram. Construction of TTT diagrams. Annealing, Normalizing, Hardening and Tempering of steels, Hardenability. Alloy steels.

UNIT –IV **(08)**

Engineering Materials –II: CAST IRONS: Structure and properties of White Cast iron, Malleable Cast iron, Grey cast iron. Engineering Materials-III: Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminium and its alloys, Al-Cu phase diagram, Titanium and its alloys.

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- The students will be able to differentiate 2 stroke, 4 stroke and understand the function of diesel and petrol engine.
- The students will be able to use the Mollier's chart.
- Students can evaluate the relationship of units.

Text Books:

- Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
- Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
- Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
- Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd.
- Thermodynamics- An Engineering Approach by Cengel, MCGRAW HILL INDIA.
- Engineering Thermodynamics by Onkar Singh, New Age International.
- Engineering Thermodynamics by CP Arora.
- Engineering Thermodynamics by Rogers, Pearson. 11. Fundamentals of Engineering Thermodynamics by Moran, Shapiro, Boettner, & Bailey, John Wiley.

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UNIT – V **(08)**

Engineering Materials –IV: Ceramics, Polymers and Composites: Crystalline ceramics, glasses, cermets: structure, properties and applications. Classification, properties and applications of composites. Classification, Properties and applications of Polymers.

Outcomes:

- Students will be able to explain the structure of metals and the importance of grain size, calculate packing efficiency and density, and describe the necessity and types of alloying along with Hume-Rothery rules and intermediate alloy phases.
- Students will be able to construct and analyze phase diagrams using the phase rule and lever rule, and describe isomorphous, eutectic, and eutectoid transformations with practical examples.
- Students will be able to interpret the Fe-Fe3C phase diagram, construct TTT diagrams, and describe the processes of annealing, normalizing, hardening, tempering, and the concept of hardenability in steels, including the role of alloy steels.
- Students will be able to describe the structure and properties of white, malleable, and grey cast irons, and explain the structure, properties, and applications of copper, aluminium, and titanium alloys, along with the Al-Cu phase diagram.
- Students will be able to classify and describe the properties and applications of crystalline ceramics, glasses, cermets, polymers, and composite materials.

TEXT BOOKS:

- Material Science and Metallurgy/ Kodgire
- Essentials of Materials Science and engineering / Donald R.Askeland / Thomson.

REFERENCES:

- Introduction to Physical Metallurgy / Sidney H. Avner.
- Materials Science and engineering / William and callister.
- Elements of Material science / V. Rahghavan
- Engineering Material and Metallurgy – Er Amandeep Singh Wadhva
- Materials Science for Engineering Students- Traugott Fischer 2009 Edition.

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UOE-305	Open Elective	HOUR	CREDITS
	Sensor & Instrumentation	4L:0T:0P	3

Objective:

- To understand the definition, classification, and selection criteria of sensors, and their applications.
- To explore different methods for measuring temperature and to understand the application of proximity sensors as accelerometers and vibration sensors, as well as the concept of thermal imaging.
- To gain proficiency in graphical programming techniques for virtual instrumentation, understand data types, and learn the advantages of virtual instrumentation in industrial applications.
- To comprehend the basic block diagram of data acquisition systems, differentiate between analog and digital IO, and understand the operation of counters and timers.
- To explore the structure and components of smart sensors, and understand their characteristics such as self-calibration, self-testing, and self-communication.

Syllabus:

Unit- I: **(08 Hours)**

Sensors & Transducer: Definition, Classification & selection of sensors, Measurement of displacement using Potentiometer, LVDT & Optical Encoder, Measurement of force using strain gauge, Measurement of pressure using LVDT based diaphragm & piezoelectric sensor.

Unit-II: **(08 Hours)**

Measurement of temperature using Thermistor, Thermocouple & RTD, Concept of thermal imaging, Measurement of position using Hall effect sensors, Proximity sensors: Inductive & Capacitive, Use of proximity sensor as accelerometer and vibration sensor, Flow Sensors: Ultrasonic & Laser, Level Sensors: Ultrasonic & Capacitive.

Unit -III: **(08 Hours)**

Virtual Instrumentation: Graphical programming techniques, Data types, Advantage of Virtual Instrumentation techniques, Concept of WHILE & FOR loops, Arrays, Clusters & graphs, Structures: Case, Sequence & Formula nodes, Need of software based instruments for industrial automation.

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Unit-IV: **(08 Hours)**

Data Acquisition Methods: Basic block diagram, Analog and Digital IO, Counters, Timers, Types of ADC: successive approximation and sigma-delta, Types of DAC: Weighted Resistor and R-2R Ladder type, Use of Data Sockets for Networked Communication.

Unit V: **(08 Hours)**

Intelligent Sensors: General Structure of smart sensors & its components, Characteristic of smart sensors: Self calibration, Self-testing & self-communicating, Application of smart sensors: Automatic robot control & automobile engine control.

Text Books:

1. DVS Murthy, Transducers and Instrumentation, PHI 2nd Edition 2013
2. D Patranabis, Sensors and Transducers, PHI 2nd Edition 2013.
3. S. Gupta, J.P. Gupta / PC interfacing for Data Acquisition & Process Control, 2nd ED / Instrument Society of America, 1994.
4. Gary Johnson / Lab VIEW Graphical Programing II Edition / McGraw Hill 1997.

Reference Books:

1. Arun K. Ghosh, Introduction to measurements and Instrumentation, PHI, 4th Edition 2012.
2. A.D. Helfrick and W.D. cooper, Modern Electronic Instrumentation & Measurement Techniques, PHI, 2001
3. Hermann K.P. Neubert, "Instrument Transducers" 2nd Edition 2012, Oxford University Press

Course Outcomes:

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

CO 1: Apply the use of sensors for measurement of displacement, force and pressure.

CO2: Employ commonly used sensors in industry for measurement of temperature, position, acelerometer, vibration sensor, flow and level.

CO3: Demonstrate the use of virtual instrumentation in automation industries.

CO4: Identify and use data acquisition methods.

CO5: Comprehend intelligent instrumentation in industrial automation.

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UAS-304	Mandatory Course-I	HOUR	CREDITS
	Environmental Science	4L:0T:0P	3

OBJECTIVES

To enable the students

- To gain knowledge on the importance of environmental education and ecosystem.
- To acquire knowledge about environmental pollution- sources, effects and control measures of environmental pollution.
- To understand the treatment of wastewater and solid waste management.
- To acquire knowledge with respect to biodiversity, its threats and its conservation and appreciate the concept of interdependence.
- To be aware of the national and international concern for environment for protecting the environment

SYLLABUS

UNIT-I **10**

Nature of Environment Introduction to Environmental Science - Definition and scope and need for public awareness Ecosystems Concept, structure and functions, restoration of damaged ecosystems Biodiversity, Definition, description at national and global level, threats and conservation Natural Resources - Renewable and non-renewable and their equitable use for sustainability, Material cycles – carbon, nitrogen and sulphur cycle. Conventional and Non-conventional Energy Sources – fossil fuel-based, hydroelectric, wind, -nuclear and solar energy, biomass, biodiesel, hydrogen as an alternative fuel

UNIT-II **8**

Impact of Human Activity on Environment Human Population and Environment – Population growth, population explosion and migration; Impact of farming, housing, mining, transportation and industrial growth Social Issues Related to Environment– Sustainable development, urban problems (related to water and energy conservation and waste management), resettlement and rehabilitation Environmental ethics.

UNIT-II **10**

Environmental Changes and Human Health Environmental Pollution–Definition, causes and effects, control measures for water, air, soil, marine, land, noise, thermal pollution, Climate change– Greenhouse effect and global warming, acid rain, ozone layer formation and depletion

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Impact on human health – water and air borne diseases, diseases induced by residual impurities in drinking water (fluoride and arsenic); Toxic wastes and carcinogens; Nuclear hazards.

UNIT-II **4**

Environmental Protection through Assessment and Education Indicators and Impact Assessment – Bio-indicators, Natural disasters and disaster management, Impact assessment through inventorying and monitoring.

UNIT-II **8**

Environmental Protection– Role of individuals, organizations and government in pollution control Laws, Conventions and Treaties– National legislation, issues in the enforcement of environmental legislation, initiatives by non- governmental organizations, global efforts in environmental protection Environmental education–women and value education.

Course Learning Outcomes (CLO):

- Master core concepts and methods from ecological and physical sciences and their application in environmental problem solving.
- Master core concepts and methods from economic, political, and social analysis as they pertain to the design and evaluation of environmental policies and institutions.
- Appreciate the ethical, cross-cultural, and historical context of environmental issues and the links between human and natural systems.
- Understand the transnational character of environmental problems and ways of addressing them, including interactions across local to global scales.

Text Book:

1. Environmental Studies, J Krishnawamy, R J Ranjit Daniels, Wiley India.

Reference Books:

1. Environmental Science, Bernard J. Nebel, Richard T. Right, 9780132854467, Prentice Hall Professional 1993.
2. Environment and Ecology, R K Khandal, 978-81-265-4277-2, Wiley India.
3. Environmental Science, 8th Ed ISV, Botkin and Keller, 9788126534142, Wiley India.
4. Environmental Studies, R Rajagopalan, 978-0195673937, Oxford University Press.
5. Textbook of Environmental Science and Technology, M.Anjireddy, BS Publications.

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6. Environmental Studies, Soli. J Arceivala, Shyam, R Asolekar, 9781259006050, McGrawHill India, 2012.
7. Environmental Studies, D.L. Manjunath, 9788131709122 Pearson Education India, 2007.
8. Textbook of Environment Ecology , Singh, Acme Learning.
9. Perspective in Environmental Studies, Kaushik, New Age International.
10. Environmental Studies, B. Joseph, 2nd Ed, 978-0070648134, Tata McGraw Hill.

~~UME-351~~	~~LAB~~	~~HOUR~~	~~CREDITS~~

UME-351	LAB	HOUR	CREDITS
	ENGINEERING MECHANICS LAB	0L:0T:4P	2

OBJECTIVES:

1. To understand the vectorial and scalar representation of forces and moments
2. To describe static equilibrium of particles and rigid bodies both in two dimensions and also in three dimensions
3. To analyze the properties of surfaces & solids in relation to moment of inertia.
4. To illustrate the laws of motion, kinematics of motion and their interrelationship.
5. To comprehend the effect of Friction on general plane motion

List of Experiments: (At least 6 of the followings)

1. To verify the law of parallelogram of forces.
2. To study the equilibrium of a body under three forces
3. To determine the coefficient of friction of a flat surface.
4. To determine the deflection of beam (simple supported beam)
5. Experiment based on analysis of truss.
6. To conduct the tensile/ compression test and determine the ultimate tensile strength, percentage elongation for a mild steel specimen.
7. To conduct the Impact-tests (Izod / Charpy) on Impact testing machine to find the Impact Strength of the specimen.

Course Learning Outcomes (CLO):

1. Ability to install strain gages on several metallic (steel and aluminum) structural components and systems, and collect data from the strain gages
2. Ability to perform column buckling tests using wood specimens
3. Ability to perform aggregate analysis, prepare and test concrete cylinders and a reinforced concrete beam
4. Ability to design and conduct an experiment
5. Ability to compare experimental results to the theoretical results and write technical reports
6. Ability to work in a team

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Text books/ Reference books: As per recommendation of concern instructor/ supervisor.

UME-352	LAB	HOUR	CREDITS
	THERMODYNAMICS LAB	0L:0T:4P	2

Objectives:

- To understand the construction, working, and applications of fire tube boilers & water tube boilers
- To study the internal combustion (I.C.) engine, its classification, and the functions of its components
- To understand the construction, working principles, and performance characteristics of a two-stroke & four-stroke petrol engine.
- To understand the construction, working principles, and performance characteristics of a two-stroke & four-stroke diesel engine
- To prepare a heat balance sheet for a diesel & petrol engine test rig.

List of Experiments: (At least 6 of the followings)

1) Study of Fire Tube boiler.
2) Study of Water Tube boiler.
3) Study the I.C. Engine, classification and their parts.
4) Study and working of Two stroke petrol Engine.
5) Study and working of Two stroke Diesel Engine.
6) 4. Study and working of Four stroke petrol Engine.
7) Study and working of Four stroke Diesel Engine.
8) 5. Study the Indicated H.P. of I.C. Engine by Morse Test.
9) Prepare the heat balance sheet for Diesel Engine test rig.
10) Prepare the heat balance sheet for Petrol Engine test rig.

Course Outcomes:

- Students will be able to understand the different components and their functions in a fire & water tube boiler.
- Students will explore his Knowledge of the operational cycle and combustion process in two-stroke & four -stroke petrol engines.
- Enhance his Ability to measure and calculate the indicated horsepower of an I.C. engine.

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FOURTH SEMESTER

UME- 401	**Applied Thermodynamics**	**4L:0T:0P**	**3 credits**

Objectives:

- To learn about gas vapour cycles
- To understand about the properties of dry and wet air and the principles of psychrometry
- To learn about gas dynamics of air flow and steam through nozzles
- To learn the about reciprocating compressors with and without intercooling

Syllabus:

UNIT-I **(8)**

Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium and equilibrium composition calculations of free energy.

UNIT-II **(12)**

Vapor power cycles Rankine cycle with superheat, reheat and regeneration, Super-critical and ultra super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles- Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression refrigeration cycles, refrigerants and their properties.

UNIT-III **(4)**

Properties of dry and wet air, use of pschyrometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.

UNIT-IV **(8)**

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, supersaturation- compressible flow in diffusers, efficiency of nozzle and diffuser.

UNIT-V **(8)**

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors. Analysis of steam turbines, velocity and pressure compounding of steam turbines

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Outcomes:

- After completing this course, the students will get a good understanding of various practicalpower cycles and heat cycles.
- They will be able to analyze energy conversion in various thermal devices such as combustors, air coolers, nozzles, diffusers, steam turbines and reciprocating compressors
- They will be able to understand phenomena occurring in high speed compressible flows

Text Books:

- Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
- Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
- Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
- Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd.
- Thermodynamics – J.P.Holman / McGrawHill.
- Engineering Thermodynamics – Jones & Dugan.
- Engineering Thermodynamics/P.Chattopadhyay/Oxford Higher Education/Revised First Edition.
- Thermodynamics & Heat Engines – Yadav – Central Book Depot, Allahabad.

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UME- 402	Fluid Mechanics & Fluid Machines	4L:0T:0P	3 credits

Objectives:

- Understand the fundamental properties of fluids and their dimensions, including mass density, specific volume, specific gravity, viscosity, compressibility, and surface tension.
- Describe fluid kinematics, including streamlines, path lines, and streak lines, and classify flows based on steadiness, uniformity, and nature (laminar/turbulent, rotational/irrotational).
- Explain boundary layer concepts, including definition, thickness, and characteristics for laminar and turbulent flows, and understand boundary layer transition and separation.
- Describe the basics of turbo machinery, including hydrodynamic forces on vanes and velocity diagrams, and understand the principles and classifications of hydraulic turbines.
- Classify centrifugal and reciprocating pumps based on their working principles and understand specific characteristics such as barometric head, efficiencies, and performance curves.

Syllabus:

UNIT-I **(6)**

Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, vapour pressure and their influence on fluid motion- atmospheric, gauge and vacuum pressures – measurement of pressure- Piezometer, U-tube and differential manometers.

UNIT-II **(8)**

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 stream line, momentum equation and its application on force on pipe bend.

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UNIT-III **(10)**

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 equationMinor losses in pipes- pipes in series and pipes in parallel- total energy linehydraulic gradient line. Measurement of flow: pitot tube, venturimeter, and orifice meter, Flow nozzle

Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.

UNIT-IV **(10)**

Basics of turbo machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes.

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-V **(6)**

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

Reciprocating pumps : Working, Discharge, slip, indicator diagrams

Course Outcomes:

Upon completion of this course, students will be able to

- Apply various pressure measurement techniques such as piezometer, U-tube manometer, and differential manometer to measure atmospheric, gauge, and vacuum pressures.
- Apply the equation of continuity for both one-dimensional and three-dimensional flows, and analyze fluid dynamics using Euler's and Bernoulli's equations along streamlines.
- Apply the Darcy-Weisbach equation for closed conduit flow and analyze minor losses in pipes, as well as determine the total energy line and hydraulic gradient line. Understand

measurement techniques using pitot tube, venturimeter, and orifice meter.

- Analyze the performance of hydraulic turbines using geometric similarity and specific quantities, interpret characteristic curves, and discuss turbine governing mechanisms and issues like cavitation and water hammer.
- Describe the working principles of centrifugal and reciprocating pumps, analyze pump performance using specific speed and characteristic curves, and discuss factors affecting pump efficiency and operation.

Text Books :

1. Hydraulics, fluid mechanics and Hydraulic machinery MODI and SETH.
2. Fluid Mechanics and Hydraulic Machines by Rajput.

References :

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. Fluid Mechanics and Machinery by D. Rama Durgaiah, New Age International.
3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.

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UME- 403	Strength of Material	4L:0T:0P	3 credits

Objectives:

- Understand the concepts of elasticity and plasticity, including types of stresses and strains, Hooke's law, stress-strain diagrams, and factors influencing material behavior under different loading conditions.
- Define beams and their types, and explain shear force and bending moment concepts. Develop shear force and bending moment diagrams for different types of beams under various loading conditions.
- Explain the theory of simple bending, derive bending equations, and determine bending stresses. Understand shear stress distribution across various beam sections and calculate shear stresses for different types of cross-sectional shapes.
- Introduce principal stresses and strains, and explain their determination using analytical and graphical methods. Describe various theories of failure, including Maximum Principal Stress Theory, Maximum Principal Strain Theory, and Von Mises Theory.
- Discuss the theory of pure torsion and its assumptions. Derive equations for torsional stress, polar section modulus, and power transmission in shafts. Explain combined bending and torsion effects and their implications on shaft design.

Syllabus:

UNIT – I **(06)**

Simple Stresses & Strains : Elasticity and plasticity – Types of stresses & strains–Hooke's law– stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Elastic moduli & the relationship between them – Bars of varying section – compositebars. Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

UNIT – II **(10)**

Shear Force and Bending Moment : Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l., uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

UNIT – III **(08)**

Flexural Stresses : Theory of simple bending, Assumptions, Derivation of bending equation: M/I = f/y = E/R Neutral axis, Determination bending stresses, section modulus of rectangular and circular sections (Solid and Hollow), I, and T sections, composite beam Shear Stresses: Derivation of formula, Shear stress distribution across various beams sections like rectangular, circular, triangular, I, T angle sections.

UNIT-IV **(08)**

Principal Stresses and Strains: Introduction, Stresses on an inclined section of a bar under axial loading, compound stresses, Normal and tangential stresses on an inclined plane for biaxial stresses, Two perpendicular normal stresses accompanied by a state of simple shear, Mohr's circle of stresses – Principal stresses and strains – Analytical and graphical solutions.

Theories of Failure: Introduction, Various theories of failure, Maximum Principal Stress Theory, Maximum Principal Strain Theory, Strain Energy and Shear Strain Energy Theory (Von Mises Theory).

UNIT – V **(08)**

Torsion of Circular Shafts : Theory of pure torsion – Derivation of Torsion /L Assumptions made in the theory of pure torsionθequations : T/J = q/r = N – Torsional moment of resistance, Polar section modulus, Power transmitted by shafts, Combined bending and torsion and end thrust, Design of shafts according to theories of failure.

Thin Cylinders : Thin seamless cylindrical shells, Derivation of formula for longitudinal and circumferential stresses, hoop, longitudinal and Volumetric strains, changes in dia, and volume of thin cylinders, Thin spherical shells.

Outcomes:

After completing this course, the students should be able to

- Calculate stress and strain in materials, interpret stress-strain diagrams for mild steel, and apply concepts of working stress and factor of safety in engineering design. Understand the effects of temperature on material behavior and calculate strain energy and resilience under various loading conditions.
- Construct shear force and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to point loads, uniformly distributed loads (UDL) and

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uniformly varying loads. Analyze the relationship between shear force, bending moment, and loading rates along the length of a beam.

- Calculate bending stresses using the bending equation and determine section modulus for rectangular, circular, I, T, angle, and channel sections. Analyze shear stress distribution and calculate shear stresses across different beam sections to understand their structural behavior.
- Construct Mohr's circle of stresses and determine principal stresses and strains for complex loading conditions. Evaluate different failure theories and apply them to analyze material failure under various stress states and loading conditions.
- Calculate torsional stresses in circular shafts and determine the power transmitted by shafts under torsional loading. Design shafts considering combined bending and torsion effects using theories of failure. Analyze stress and strain in thin cylindrical and spherical shells and determine changes in diameter and volume under internal pressure.

TEXT BOOKS :

- Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
- R. Subramanian, Strength of Materials, Oxford University Press, 2007.
- Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata Mc Graw Hill Publishing Co. Ltd., New Delhi 2005.
- Solid Mechanics, by Popov.
- Strength of Materials – Ryder. G.H.; Macmillan Long Man Pub.
- Strength of Materials – W.A. Nash, TMH.

REFERENCES :

- Strength of Materials by R.K Rajput, S.Chand & Company Ltd.Analysis of structures by Vazirani and Ratwani.
- Mechanics of Structures Vol –I by H.J.Shah and S.B.Junnarkar, Charotar Publishing House Pvt. Ltd.
- Strength of Materials by D.S Prakash Rao, Universities Press Pvt. Ltd.
- Strength of Materials by S.S.Rattan, Tata McGraw Hill Education Pvt. Ltd.
- Fundamentals of Solid Mechancis by M.L.Gambhir, PHI Learning Pvt. Ltd.

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UME- 404	Measurement & Metrology	4L:0T:0P	3 credits

Objectives:

- To educate students on different measurement systems and on common types of errors
- To introduce different types of sensors, transducers and strain gauges used for measurement.
- To give knowledge about thermocouples, thermometers and flow meters used for measurements
- To introduce measuring equipments used for linear and angular measurements.
- To familiarize students with surface roughness measurements on machine components Course

Syllabus

UNIT-I **(08)**

Mechanical Measurements Introduction: Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error, statistical analysis of errors.

Sensors and Transducers: Types of sensors, types of transducers and their characteristics. Signal transmission and processing: Devices and systems. Signal Display & Recording evices

UNIT-II **(08)**

Time related measurements: Counters, stroboscope, frequency measurement by direct comparison. Measurement of displacement Measurement of pressure: Gravitational, directing acting, elastic and indirect type pressure transducers. Measurement of very low pressures. **Strain measurement:** Types of strain gauges and their working, strain gauge circuits, temperature compensation. Strain rosettes, calibration. **Measurements of force and torque:** Different types of load cells, elastic transducers, pneumalic & hydraulic systems. **Temperature measurement:** Thermometers, bimetallic thermocouples, thermistors and pyrometers. **Vibration:** Seismic instruments, vibration pickups and decibel meters, vibrometers, accelerometers.

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Unit-III: **(08)**

Metrology Metrology and Inspection: Standards of linear measurement, line and end standards. Limit fits and tolerances. Interchangeability and standardization. Linear and angular measurements devices and systems Comparators: Sigma, Johansson's Microkrator. Limit gauges' classification, Taylor's Principle of Gauge Design.

Unit-IV **(08)**

Measurement of geometric forms like straightness, flatness, roundness. Tool maker's microscope, profile project autocollimator. Interferometry: principle and use of interferometry, optical flat. Measurement of screw threads and gears. Surface texture: quantitative evaluation of surface roughness and its measurement. Measurement and Inspection: Dimensional inspection – Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection.

Outcomes of the subject/course

- Students will be able to work in Quality control and quality assurances divisions in industries
- Students will be able to design a sensors and transducers used for stress analysis.
- Students will be able to design a measuring equipments for the measurement of temperature and flow.
- Students will be able to maintain quality in engineering products.

References

1. Beckwith Thomas G., Mechanical Measurements, Narosa Publishing House, N. Delhi.
2. Doeblein E.O., "Measurement Systems, Application Design", McGraw Hill, 1990.
3. Kumar D.S., "Mechanical Measurements and Control", Metropolitan, N. Delhi.
4. Hume K.J., "Engineering Metrology", MacDonald and Co. 1963
5. Gupta, I.C., "Engineering Metrology", Dhanpat Rai & Sons, New Delhi, 1994
6. Sirohi, "Mechanical Measurement" New Age Publishers
7. Jain, R.K., "Engineering Metrology" Khanna Publishers

Manoj Kapil

UME- 452	Fluid Mechanics& Fluid Machines	0L:0T:4P	2 credits

Objectives:

- To experimentally validate Bernoulli's theorem by demonstrating the relationship between pressure, velocity, and elevation in a flowing fluid.
- To study the force exerted by a fluid jet on stationary and moving vanes and to understand the principles of momentum transfer.
- To calibrate a Venturimeter, orifice meter and determine its coefficient of discharge.
- To evaluate the performance characteristics of a Pelton wheel, Kaplan & Francis turbine.
- To assess the performance characteristics of a single stage centrifugal pump.

List of Experiments: (At least 8 of the following)

1) Verification of Bernoulli's Theorems
2) Impact of jets on Vanes.
3) Calibration of Venturimeter.
4) Calibration of Orifice meter.
5) Performance Test on Pelton Wheel.
6) Performance Test on Francis Turbine.
7) Performance Test on Kaplan Turbine.
8) Performance Test on Single Stage Centrifugal Pump.
9) Performance Test on Multi Stage Centrifugal Pump.
10) Performance Test on Reciprocating Pump.
11) Determination of friction factor for a given pipe line.
12) Determination of loss of head due to sudden contraction in a pipeline.

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Course Outcomes:

After completion of this Students will be able to

- Measure and analyze pressure variations in fluid flow, enhancing understanding of energy conservation in fluid systems.

- Calculate the impact force of a jet on different vane shapes, improving understanding of momentum transfer in fluid dynamics.
- Perform accurate flow rate measurements and calibrate flow measuring devices effectively.
- Measure flow rates using an orifice meter and analyze the relationship between flow rate and pressure drop.
- Measure and analyze the efficiency and power output, improving understanding of reaction turbine operation.
- Measure and interpret the performance data of Kaplan turbines, enhancing knowledge of adjustable blade turbines.

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UME- 454	Measurement & Metrology Lab	0L:0T:4P	2 credits

Objectives:

- To understand the construction, working principles, and applications of Vernier calipers, and micrometer.
- To measure the effective diameter of a screw thread using the 3 wire method.
- To measure angles using a sine bar and slip gauges and to study the application and types of limit gauges.
- To understand the construction and working of dial indicators.
- To understand the principles and applications of strain gauges in measuring strain.
- To study the torsional strength of a rod using a torsion testing machine.
- To understand the principles and procedures of impact testing using Charpy and Izod methods.

List of Experiments: (At least 8 of the following)

1) Study & working of simple measuring instruments- Vernier calipers, and micrometer.
2) Measurement of effective diameter of a screw thread using 3 wire method.
3) Measurement of angle using sinebar & slip gauges. Study of limit gauges.
4) Study & angular measurement using level protector
5) Study of dial indicator & its constructional details.
6) Study and understanding of limits, fits & tolerances
7) Study of Pressure & Temperature measuring equipment.
8) Study of Strain gauge measurement.
9) Flow measurement experiment
10) Strength testing of a given mild steel specimen on UTM machine.
11) Torsion testing of a rod on torsion testing machine.
12) Impact testing on impact testing machine like Charpy, Izod or both.

Course Outcomes:

The students who have undergone the course will be able to

- Accurately measure dimensions and rotational speeds using vernier calipers, and micrometers.

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- Measure angles precisely using sine bars and slip gauges and understanding the use of limit gauges in quality control.
- Perform impact tests and analyze the impact resistance of materials using charpy and izod testing machines.
- Conduct torsion tests and evaluate the torsional properties of materials.
- Perform tensile strength tests and analyze the mechanical properties of mild steel using a UTM.
- Perform experiments to measure the flow of fluids.
- Understand of how limits, fits, and tolerances affect the assembly and function of mechanical components.

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SWAMI VIVEKANAND
SUBHARTI UNIVERSITY, MEERUT

EVALUATION SCHEME & SYLLABUS

B.TECH.

(MECHANICAL ENGINEERING)

W.E.F. SESSION 2023-24

FACULTY OF ENGINEERING & TECHNOLOGY
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(Er. A.K. Sharma) (Er. Sachin Kumar) (Er. G.S. Keotharwal) (Dr. Sajeev Kumar)

FACULTY OF ENGINEERING & TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
B. Tech. 3rd Year/ 5th (Mechanical Engineering)
w.e.f Academic Session 2025-26

SEMESTER V

S. No	Course Code	Course Title	Course Type	Periods			Evaluation Scheme				End semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	KME-501	Heat & Mass Transfer	PC	3	1	0	20	10	30	-	70	-	100	4
2	KME-502	Kinematics & Theory of Machines	PC	3	1	0	20	10	30	-	70	-	100	4
3	KME-511-S to KME-514-S	Department Electrive – I *(Bucket of 4 courses from SWAYAM)	PE	3	1	0	20	10	30	-	70	-	100	4
4	KME-521 to KME-524	Departmental Elective-II	PE	3	1	0	20	10	30	-	70	-	100	4
5	KMC-501/ KMC-502	Constitution of India / Essence of Indian Traditional Knowledge	MC	3	1	0	20	10	30	-	70	-	100	0
6	KME-551	Heat & Mass Transfer Lab	PC	0	0	4	-	-		15	-	35	50	2
7	KME-552	Kinematics & Theory of Machines Lab	PC	0	0	4	-	-	-	15	-	35	50	2
8	KME-554	Welding Technology Lab	PC	0	0	4	-	-	-	15	-	35	50	2
9	KCC-551	Internship Assessment/ Mini Project		-	-	-	-	-	-	100			100	2
			TOTAL										**750**	**24**

#The Mini Project and internship (4 weeks) conducted during summer break after IV semester and will be assessed during V semester.

*** Will be offered through SWAYAM-NPTEL.**

Abbreviation Used:
PC: Professional Core Course
PE: Professional Elective Course
MC: Mandatory Course

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FACULTY OF ENGINEERING & TECHNOLOGY
SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
STUDY & EVALUATION SCHEME
B.Tech. 3rd Year/ 6th (Mechanical Engineering)
w.e.f Academic Session 2025-26

SEMESTER VI														
S. No.	Course Code	Course Title	Course Type	Periods			Evaluation Scheme				End semester		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1.	KME 601	Refrigeration and Air conditioning	PC	3	1	0	20	10	30	-	70	-	100	4
2.	KME-602	Design of Machine Elements	PC	3	1	0	20	10	30	-	70	-	100	4
3	KME-603	Robotics and Mechatronics System	PC	3	1	0	20	10	30	-	70	-	100	4
4	KME-611-S to KME-614-S	Departmental Elective-III * (Bucket of 4 courses from SWAYAM)	PE	3	1	0	20	10	30	-	70	-	100	4
5	KOE-6**	Open Elective I (Idea to Business Model)	PE	3	0	0	20	10	30	-	70	-	100	3
6	KMC-601/ KMC-602	Essence of Indian Traditional Knowledge / Constitution of India	MC	3	1	0	20	10	30	-	70	-	100	0
7	KME-651	3D Printing Lab	PC	0	0	4	-	-		15	-	35	50	2
8	KME-652	Robotics and Mechatronics System Lab	PC	0	0	4	-	-		15	-	35	50	2
9	KME 653	Project –I	PROJ	0	0	4	-	-	-	50	-	100	150	2
			TOTAL										850	25

*** Will be offered through SWAYAM-NPTEL.**

Abbreviation Used:

PC: Professional Core Course

PE: Professional Elective Course

MC: Mandatory Course

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Departmental Elective-I

* A bucket of four (04) courses should be prepared based on the courses offered by SWAYAM in the respective session.

1. KME-511-S Additive Manufacturing ,
2. KME-512-S Advanced Welding Technology ,
3. KME-513-S Manufacturing Processes & Technology,
4. KME-514-S Finite Element Methods

Departmental Elective-II

1. KME-521 Computer Integrated Manufacturing
2. KME -522 Internal combustion engine
3. KME -523 Green Manufacturing
4. KME -524 Industrial Engineering

Departmental Elective-III

* A bucket of four (04) courses should be prepared based on the courses offered by SWAYAM in the respective session.

1. KME-611–S Composite materials
2. KME-612–S Machine Tool and Die Engineering
3. KME-613–S 3D Printing
4. KME-614-S Precision Manufacturing

Open Elective-I

Separate list is attached (common to all branches)

KOE-601 – Idea to Business Model

KOE-602 – Quality Control and Reliability

KOE-603 – Embedded Systems

KOE-604 – Introduction to MEMS (Micro-Electro-Mechanical Systems)

KOE-605 – Object-Oriented Programming

KOE-606 – Computer-Based Numerical Techniques

KOE-607 – GIS & Remote Sensing

KOE-608 – Basics of Database Management Systems

KOE-609 – Software Project Management

KOE-610 – Understanding the Human Being Comprehensively – Human Aspirations and Its Fulfillment

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Course Code	Definitions
BSC	Basic Science Courses
ESC	Engineering Science Courses
HSMC	Humanities and Social Sciences including Management courses
PCC	Professional core courses
PEC	Professional Elective Course
OEC	Open Elective Course
MC	Mandatory courses
PROJ	Project
CCA	Continuation Comprehensive Assessment
ESE	End Semester Examination

OPEN ELECTIVE COURSES (OEC)
[MECHANICAL ENGINEERING]

S. No	Code No.	Subject
01	BME-001	Nano Technology & Surface Engineering
02	BME -002	Soft Skills and Interpersonal Communication
03	BME- 003	ICT for Development
04	BME -004	Human Resource Developments and Organizational Behavior
05	BME -005	Cyber Law and Ethics
06	BME -006	Introductions to Philosophical Thoughts
07	BME -007	Comparative Study of Literature
08	BME -008	Indian Music Systems
09	BME- 009	Histories of Science & Engineering
10	BME- 010	Introductions to Art and Aesthetics

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HUMANITIES, SOCIAL SCIENCE INCLUDING MANAGEMENT COURSES (HSMC)

S.No	Subject Code	Subject Name
1	BHU-501/BHU-601/BHU-701	Humanities, Social Science including Management Courses
2	BHU-502/BHU-602/BHU-702	Foundational Course in Humanities (Development of Societies/Philosophy)
3	BHU-503/BHU-603/BHU-703	Education, Technology and Society
4	BHU-504/BHU-604/BHU-704	History of Science and Technology in India
5	BHU-505/BHU-605/BHU-705	Nyaya Logic Epistemology
6	BHU-506/BHU-606/BHU-706	Political and Economic Thought for a Humane Society
7	BHU-507/BHU-607/BHU-707	State, Nation Building and Politics in India
8	BHU-508/BHU-608/BHU-708	Psychological Process
9	BHU-509/BHU-609/BHU-709	Positive Psychology
10	BHU-510/BHU-610/BHU-710	Application of Psychology
11	BHU-511/BHU-611/BHU-711	Sociology, Society and Culture
12	BHU-512/BHU-612/BHU-712	Epochal Shift
13	BHU-513/BHU-613/BHU-713	Values and Ethics
14	BHU-514/BHU-614/BHU-714	Ethics and Holistic Life
15	BHU-515/BHU-615/BHU-715	Folk and Vernacular Expressive Tradition and Popular Culture
16	BHU-516/BHU-616/BHU-716	Universal Human Conduct
17	BHU-517/BHU-617/BHU-717	Gender Culture and Development
18	BHU-518/BHU-618/BHU-718	Introduction to Women's and Gender Studies
19	BHU-519/BHU-619/BHU-719	Advance Course in Peace Research
20	BHU-520/BHU-620/BHU-720	Contemporary India in Globalized Era: Challenges of Democracy and Development
21	BHU-521/BHU-621/BHU-721	Making Indian Culture: Epistemic Traditions, Literature and Performative Arts
22	BHU-522/BHU-622/BHU-722	Universal Human Values 2: Understanding Harmony
23	BHU-523/BHU-623/BHU-723	Human Relations at Work
24	BHU-524/BHU-624/BHU-724	Sanskrit Bhasa
25	BHU-525/BHU-625/BHU-725	Language and Communication
26	BHU-526/BHU-626/BHU-726	Language and Linguistics
27	BHU-527/BHU-627/BHU-727	Understanding Society and Culture through Literature
28	BHU-528/BHU-628/BHU-728	Fundamentals of Linguistics
29	BHU-529/BHU-629/BHU-729	Elements of Literature
30	BHU-530/BHU-630/BHU-730	Humanities and Multiple Dimensions of Ecology
31	BHU-531/BHU-631/BHU-731	Film Appreciation
32	BHU-532/BHU-632/BHU-732	Law and Engineering

KME-501	Heat & Mass Transfer	3L:1T:2P	4 credits

Objectives:

- Understand the basic principles of heat transfer, including conduction, convection, and radiation, and the formulation of heat conduction equations in various coordinate systems.
- Analyze steady-state and transient heat conduction problems, including the use of fins, thermal resistance, and critical insulation radius.
- Study forced and natural convection mechanisms, boundary layer concepts, and empirical heat transfer correlations in different flow geometries.
- Explain the fundamentals of thermal radiation, radiation properties, and combined modes of heat transfer in engineering systems.
- Evaluate and design heat exchangers and apply basic mass transfer principles, including diffusion laws and convective mass transfer analogies.

UNIT-I: **(8 hours)**

Introduction to Heat Transfer: Introduction of thermodynamics and Heat Transfer, Modes of Heat Transfer: Conduction, convection and radiation, Effect of temperature on thermal conductivity of different types of materials, Introduction to combined heat transfer mechanism, General differential heat conduction equation in the rectangular, cylindrical and spherical coordinate systems, Initial and system boundary conditions.

Steady State one□dimensional Heat conduction: Simple and Composite Systems in rectangular, cylindrical and spherical coordinates with and without energy generation, Concept of thermal resistance, Analogy between heat and electricity flow, Thermal contact resistance and over□all heat transfer coefficient, Critical radius of insulation for cylindrical, and spherical bodies.

UNIT□2 **(6 hours)**

Fins: Heat transfer through extended surfaces and its classification, Fins of uniform cross□sectional area, Error in measurement of temperature of thermometer wells.

Transient heat conduction: Lumped capacitance method, Time constant, Unsteady state heat conduction in one dimension only, Heisler charts and their applications.

UNIT□3 **(10 hours)**

Forced Convection: Basic concepts: Hydrodynamic boundary layer, Thermal boundary layer, Approximate integral boundary layer analysis, Analogy between momentum and heat transfer in turbulent flow over a flat surface, Mixed boundary layer, Flow over a flat plate, Flow across a single cylinder and a sphere, Flow inside ducts,

Natural Convection: Physical mechanism of natural convection, Buoyant force, Empirical heat transfer relations for natural convection over vertical planes and cylinders, horizontal plates, cylinders and sphere, combined free and forced convection, Effect of turbulence.

UNIT□4 **(8 hours)**

Radiations: Basic concepts of radiation, Radiation properties of surfaces, Black body radiation Planck's law, Wein's displacement law, Stefan□Boltzmann law, Kirchhoff's law, Gray body, Shape factor, Black□body radiation, Radiation exchange between diffuse non□black bodies in an enclosure, Radiation shields, Radiation combined with conduction and convection; Absorption and emission in gaseous medium; Solar radiation; Greenhouse effect, Radiation network analysis.

UNIT□5 **(7 hours)**

Heat Exchanger: Different types of heat exchangers, Fouling factors, Overall heat transfer coefficient, Logarithmic mean temperature difference (LMTD) method, Effectiveness□number of transfer unit (NTU) method and Compact Heat Exchangers.

Introduction to Mass Transfer: Introduction of Fick's law of diffusion, Steady state equimolar counter diffusion, Steady state diffusion through a stagnant gas film, Heat and Mass Transfer Analogy □Convective Mass Transfer Correlations.

Text / References:

1. Fundamentals of Heat and Mass Transfer, by Incroperra& DeWitt, John Wiley and Sons
2. Heat and Mass Transfer by Cengel, McGraw□Hill
3. Heat Transfer by J.P. Holman, McGraw□Hill
4. Heat and Mass Transfer by Rudramoorthy and Mayilsamy, Pearson Education
5. Heat Transfer by Ghoshdastidar, Oxford University Press
6. A text book on Heat Transfer, by Sukhatme, University Press.
7. Heat Transfer by Venkateshan, Ane Books Pvt Ltd
8. Schaum's outline of Heat Transfer by Pitts & Sisson McGraw□Hill
9. Heat and Mass Transfer by R Yadav, Central Publishing House

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COURSE OUTCOMES:

After completing this course, the students should be able to understand the

- CO 1: Explain the fundamental modes of heat transfer and derive governing equations in different coordinate systems.
- CO 2: Analyze one-dimensional steady and unsteady heat conduction problems with and without internal heat generation.
- CO 3: Evaluate convective heat transfer in forced and natural convection systems using boundary layer theory and empirical correlations.
- CO 4: Apply radiation heat transfer principles to compute heat exchange between surfaces and in combined heat transfer systems.
- CO 5: Design and analyze heat exchangers and apply mass transfer principles to engineering problems involving diffusion and convection.

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KME-502	Kinematics & Theory of Machines	4L:0T:2P	4 credits

Objectives:

- Understand basic kinematic concepts, classifications, and commonly used mechanisms.
- Analyze displacement, velocity, and acceleration in simple mechanisms using graphical and analytical methods.
- Study different types of cams and followers, their motion profiles, and cam design.
- Learn gear terminology, profiles, and kinematics of various gear trains.
- Understand friction in mechanical systems and analyze the working of friction-based elements like clutches, brakes, and drives.

SYLLABUS:

UNIT-I: **(8 hours)**

Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains-Limitpositions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms.

UNIT-II: **(8 hours)**

Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics-Coincident points- Coriolis component of acceleration- introduction to linkage synthesis-three position graphical synthesis for motion and path generation

UNIT-III: **(8 hours)**

Classification of cams and followers, Terminology and definitions, Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions, derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.

UNIT-IV: **(8 hours)**

Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

UNIT-V: **(8 hours)**

Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication-frictionclutches- belt and rope drives- friction in brakes.

Text Books:

- Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005. CleghornW.L. ,
- Mechanisms of Machines, Oxford University Press, 2005.
- Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill, 2009. Ghosh A. and Mallick A.K.,
- Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

COURSE OUTCOMES:

CO 1: Identify and classify mechanisms, apply Grashof's law, and analyze basic kinematic chains and inversions.

CO 2: Perform velocity and acceleration analysis of mechanisms using graphical and analytical approaches.

CO 3: Design cam profiles for specified follower motions using graphical and analytical techniques.

CO 4: Analyze gear profiles and gear train kinematics for power transmission applications.

CO 5: Evaluate the effects of friction and design components like clutches, brakes, and belt drives.

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Subject Code	Departmental Elective	HOUR	CREDITS
KME-521	Computer Integrated Manufacturing	3L:T:0P	4

Course Objectives:

- To introduce the fundamentals of Computer Integrated Manufacturing (CIM), its components, automation strategies, and the role of computers in modern manufacturing.
- To develop an understanding of computer graphics principles and geometric modeling techniques used in CAD/CAM systems.
- To provide knowledge of Computer Aided Manufacturing (CAM), CNC machine tools, tooling systems, and part programming methods.
- To explore the concepts of Group Technology, Flexible Manufacturing Systems (FMS), robotics, and their integration in advanced manufacturing environments.
- To understand data and information management in CIM, material handling systems, and rapid prototyping technologies with their industrial applications.

UNIT- 1 **(7)**

Introduction to Computer Integrated Manufacturing (CIM): Introduction to CAD, CAM, CIM, Automated Manufacturing system; Need of automation, Basic elements of automation, Levels of automation, Automation Strategies, Advantages & disadvantages of automation, Historical development and future trends. Computer Integrated Manufacturing, Computers in manufacturing industries.

Unit -2 **(7)**

Principles of Computer Graphics:

Point plotting, drawing of lines, Bresenham's circle algorithm.

Transformation in Graphics:

2D transformations – rotation, scaling, translation, mirror, reflection, shear – homogeneous transformations – concatenation, 3D transformations.

Curves: Introduction to Hermite cubic splines, Bezier curves, B□spline curves, NURBS

Surface Modeling: Polygon surfaces, Quadric surfaces, Superquadric surfaces and blobby objects

Solid modeling: Boolean set operations, Primitive instancing, Sweep representation, Boundadry representation, Constructive solid geometry,

Unit -3 **(8)**

Computer Aided Manufacturing:

NC in CAM – Principal types of CNC machine tools and their construction

features – tooling for CNC – ISO designation for tooling – CNC operating system

Programming for CNC machining – coordinate systems – manual part programming – computer assisted part programming.

Unit -4 **(12)**

Group Technology: Group technology, Cellular Manufacturing, CAPP – Variant and Generative systems□ Concurrent Engineering and Design for Manufacturing.

Flexible Manufacturing System: characteristics – economics and technological justification – planning, installation, operation and evaluation issues – role of group technology and JIT in FMS – typical case studies future prospects, Industry 4.0.

Robotics: Classification and specification – drive and controls – sensors □ end effectors □ grippers□ tool handling and work handling – machine vision – robot programming concepts – case studies in assembly. Introduction to Programmable logical controller

Unit – 5 **(6)**

Data and information in CIM: Management information system in CIM environment, MRP – MRP II – ERP □ Capacity planning.

Material handling in CIM environment: Types – AGVS – AS/RS – Swarf handling and disposal of wastes – single and mixed mode assembly lines – quantitative analysis of assembly systems.

Rapid prototyping: Need for rapid prototyping, Basic principles and advantages of RP, General features and classifications of different RP techniques with examples.

Course Outcomes (COs):

CO1: Explain the fundamentals and components of Computer Integrated Manufacturing (CIM), including automation strategies and their impact on modern manufacturing systems.

CO2: Apply principles of computer graphics and geometric modeling to perform 2D and 3D transformations, and represent curves and surfaces in CAD applications.

CO3: Describe the structure and functioning of CNC machines, tooling systems, and develop basic CNC part programs using manual and computer-assisted methods.

CO4: Analyze the concepts of Group Technology, Flexible Manufacturing Systems, robotics, and programmable logic controllers in the context of Industry 4.0.

CO5: Demonstrate an understanding of data management, material handling systems, and rapid prototyping techniques in a CIM environment.

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Books and References

1. Mikell P. Groover – Automation, Production Systems and Computer Integrated Manufacturing, Second edition, Prentice Hall of India.

2. Ibrahim Zeid – CAD/CAM theory and Practice, Tata McGraw Hill Publishing Co. Ltd. Company Ltd. New Delhi

3. Yoram Koren Computer control of machine tools McGraw – Hill

4. Hearn & Baker, Computer Graphics, Prentice Hall of India

5. Sunil Kumar Srivastava, Computer Aided Design: A Basic and Mathematical Approach, I.K. International Publishing House

6. P. Radhakrishnan – CAD/CAM/CIM, New Age International (P) Ltd., New Delhi

DEAN

Subject Code	Departmental Elective	HOUR	CREDITS
KME-522	Internal Combustion Engine	3L:T:0P	4

Course Objectives:

- To introduce the fundamentals of internal combustion (IC) engines, including classification, working principles, valve mechanisms, and performance testing methods.
- To understand the combustion process in SI and CI engines, factors influencing combustion, and the design considerations of combustion chambers.
- To explore various fuel supply systems like carburetors, fuel injection in SI and CI engines, and the principles and effects of turbocharging.
- To study engine emissions, their environmental impact, and the technologies used for emission control such as catalytic converters, SCR, and DOC.
- To examine engine cooling and lubrication systems, ignition systems, and recent advancements in IC engine technologies such as GDI and lean burn engines.

UNIT- 1 **(9)**

Introduction to I.C Engines: Engine classification and basic terminology, Two and four stroke engines, SI and CI engines, Valve timing diagram, Valve mechanism□ Push rod type, Overhead type (SOHC,DOHC). Thermodynamic analysis of Air standard cycles: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycles Fuel air cycle, factors affecting the fuel air cycle, Actual cycle. Testing and Performance: Performance parameters, Basic measurements, Blow by measurement, Testing of SI and CI engines.

UNIT -2 **(7)**

Combustion: Stages of Combustion in SI & CI engine, Factors affecting combustion, Flame speed, Ignition Delay, Abnormal combustion and its control.

Combustion chamber: Squish, Swirl & tumble, Combustion chamber design for SI & CI engine & factors affecting it.

UNIT -3 **(8)**

Carburetion, Mixture requirements, Carburetors and fuel injection system in SI Engine, MPFI, Scavenging in 2 Stroke engines. Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, Fuel injectors, Injection timings. Turbocharging & its types□ Variable Geometry Turbocharger, Waste Gate Turbocharger, Effect of turbocharging on power & emission.

UNIT -4 **(12)**

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Engine Emission and Control: Pollutant □ Sources and types – Effect on environment and human health □ formation of NOx □ Hydrocarbon Emission Mechanism □ Carbon Monoxide Formation □ Particulate emissions □ Methods of controlling Emissions □ Catalytic converters and Particulate Traps □ Selective Catalytic Reduction(SCR) □ Diesel Oxidation Catalyst (DOC).

UNIT – 5 **(6)**

Engine Cooling and Lubrication: Different cooling systems, Radiators and cooling fans, Engine friction, Lubrication principle, Type of lubrication, Lubrication oils, Crankcase ventilation.

Ignition System in SI Engine: Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug, Electronic ignition.

Recent trends in IC engine: Lean burn engine, Stratified charge spark ignition engine, Homogeneous charge spark ignition engine, GDI.

Course Outcomes (COs):

CO	CO Statement	Bloom's Level
CO1	To understand the basic classification, working principles, valve mechanisms, and thermodynamic cycles of IC engines.	K1, K2
CO2	To analyze fuel-air cycles and evaluate engine performance through testing methods.	K4, K5
CO3	To describe the combustion process in SI and CI engines, and analyze combustion chamber design and factors influencing combustion.	K2, K4
CO4	To explain and compare fuel supply systems including carburetors, MPFI, and fuel injection in SI and CI engines.	K2, K3
CO5	To analyze engine emissions, their effects on health and the environment, and propose appropriate emission control technologies.	K4, K5
CO6	To understand engine cooling, lubrication, ignition systems, and evaluate recent advancements in IC engine technology.	K2, K5

K1 – Remembering, **K2** – Understanding, **K3** – Applying, **K4** – Analyzing, **K5** – Evaluating, **K6** – Creating *(Not typically applicable unless design/project-based)*

Text Books

1. A Course in International Combustion Engines, by Mathur& Sharma, DhanpatRai& Sons.
2. I.C Engine, by Ganeshan, Tata McGraw Hill Publishers.

Reference Books

1. I.C Engine Analysis & Practice by E.F Obert.
2. Internal Combustion Engine Fundamentals, by John B. Heywood, Tata Mcgraw Hill Publishers.
3. Engine Emission, by B. B. Pundir, Narosa Publication.

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4. Engineering Fundamentals of Internal Combustion Engines by W. W. Pulkrabek, Pearson Education
5. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing Co
6. Fundamentals of Internal Combustion Engines by H N. Gupta, Prentice Hall of India

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4. Engineering Fundamentals of Internal Combustion Engines by W.W. Pulkrabek, Pearson Education.
5. Fundamentals of Internal Combustion Engine by Gill, Smith, Ziurs, Oxford & IBH Publishing CO.
6. Fundamentals of Internal Combustion Engines by H.N. Gupta, Prentice Hall of India.

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Subject Code	Departmental Elective	HOUR	CREDITS
KME-523	Green Manufacturing	3L:T:0P	4

Course Objectives:

- To introduce the basic concepts of production, sustainability, and manufacturing systems.
- To familiarize students with simulation techniques and statistical tools for sustainable manufacturing analysis.
- To explain the principles and procedures of Life Cycle Assessment (LCA) within a sustainability framework.
- To develop an understanding of green manufacturing metrics, indices, and system development.
- To explore renewable energy sources, green machining techniques, and their application in the Indian context.

UNIT- 1

Basics of Production, Sustainability and manufacturing, Introduction of simulation, Basic statistical concepts for sustainable manufacturing analysis **(7)**

Unit -2

Life cycle assessment, Life cycle assessment element, life cycle assessment procedure, Sustainability framework, Basic Modeling Concepts for Factory Simulation **(7)**

Unit -3

Green Manufacturing Modelling: Metrics for Green Manufacturing, Indices for Green Manufacturing, Developing Green Manufacturing System, Productivity and Sustainability **(8)**

Unit -4

Green Manufacturing Techniques, Renewable Sources of Energy, Renewable energy in India and Industrial Symbiosis, Various Instruments Used for Green Machining **(12)**

Unit – 5

Developing a Smart Factory, Demonstration on PLM Software, Sustainability and Green Manufacturing System **(6)**

Course Outcomes (COs):

CO1: Understand the fundamentals of production, sustainability, and simulation, and apply basic statistical tools for sustainable manufacturing analysis.

CO2: Analyze the life cycle assessment (LCA) methodology, including its procedures and elements, and apply basic modeling techniques for factory simulations within a sustainability framework.

CO3: Evaluate green manufacturing systems through metrics and indices, and correlate productivity with sustainability principles.

CO4: Explore and apply green manufacturing techniques, including renewable energy sources, industrial symbiosis, and advanced green machining tools, with a focus on the Indian industrial context.

CO5: Develop insights into smart factory systems and product lifecycle management (PLM) software for achieving an integrated sustainable and green manufacturing environment.

Reference books

1. **"Sustainable Manufacturing: Challenges, Solutions and Implementation Perspectives"** *Edited by Günther Seliger*,Springer, 2012.
2. **"Green Manufacturing: Fundamentals and Applications"**, *David A. Dornfeld,* Springer, 2013.
3. **"Sustainability in Manufacturing: Recovery of Resources in Product and Material Cycles"** *Edited by Günther Seliger,* Springer, 2007.
4. **"Energy Efficiency and Renewable Energy Handbook"**,*D. Yogi Goswami and Frank Kreith*, CRC Press, 2015.
5. **"Life Cycle Assessment: Theory and Practice"**, *Michael Z. Hauschild, Ralph K. Rosenbaum, and Stig Irving Olsen*, Springer, 2018.

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DEAN

Subject Code	Departmental Elective	HOUR	CREDITS
KME- 524	Industrial Engineering	3L:0T:0P	4

Objectives:

- To introduce the fundamentals of Industrial Engineering, including production systems, productivity, facility layout, material handling, and process planning.
- To develop an understanding of production planning and control techniques, forecasting models, scheduling strategies, and project management tools like CPM and PERT.
- To equip students with economic evaluation techniques, inventory control systems, and basic principles of queuing theory for effective decision-making.
- To impart knowledge of work system design principles, including work and motion studies, ergonomics, incentive systems, and product design methodologies.
- To enable students to apply operational analysis techniques such as linear programming, transportation and assignment models, and simulation for optimizing industrial operations.

Syllabus

UNIT-I

Overview of Industrial Engineering: **(08)**

Types of production systems, concept of productivity, productivity measurement in manufacturing and service organizations, operations strategies, liability and process design.

Facility location and layout:

Factors affecting facility location; principle of plant layout design, types of plant layout; computer aided layout design techniques; assembly line balancing; materials handling principles, types of material handling systems, methods of process planning, steps in process selection, production equipment and tooling selection, group technology, and flexible manufacturing.

UNIT-II

Production Planning and control: **(08)**

Forecasting techniques – causal and time series models, moving average, exponential smoothing, trend and seasonality; aggregate production planning; master production scheduling; materials requirement planning (MRP) and MRP-II; routing, scheduling and priority dispatching, concept of JIT manufacturing system.

Project Management:

Project network analysis, CPM, PERT and Project crashing.

Unit-III:

Engineering economy and Inventory control: **(08)**

Methods of depreciation; break□even analysis, techniques for evaluation of capital investments, financial statements, time□cost trade□off, resource levelling; Inventory functions, costs, classifications, deterministic inventory models, perpetual and periodic inventory control systems, ABC analysis, and VED analysis.

Queuing Theory:

Basis of Queuing theory, elements of queuing theory, Operating characteristics of a queuing system, Classification of Queuing models.

Unit-IV (08) **Work**

System Design:

Taylor's scientific management, Gilbreths's contributions; work study: method study, micro□motion study, principles of motion economy; work measurement –time study, work sampling, standard data, Predetermined motion time system (PMTS); ergonomics; job evaluation, merit rating, incentive schemes, and wage administration.

Product Design and Development:

Principles of product design, tolerance design; quality and cost considerations; product life cycle; standardization, simplification, diversification, value engineering and analysis, and concurrent engineering.

Unit-V: **(08)**

Operational Analysis:

Formulation of LPP, Graphical solution of LPP, Simplex Method, Sensitivity Analysis, degeneracy and unbound solutions. transportation and assignment models; Optimality test: the stepping stone method and MODI method, simulation.

Outcomes of the subject/course

CO1: Understand the key concepts of industrial engineering, including types of production systems, productivity measurement, and the principles of facility location, layout design, and material handling.

CO2: Apply production planning and control techniques, such as forecasting models, aggregate production planning, materials requirement planning (MRP), and scheduling methods in manufacturing and service operations.

CO3: Evaluate engineering economic concepts, such as depreciation, break-even analysis, capital investment evaluation, and inventory control systems, to make informed operational decisions.

CO4: Design efficient work systems through the application of scientific management, work study techniques, motion economy, ergonomics, and product design and development principles.

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CO5: Analyze and solve optimization problems using operational analysis methods, including linear programming, transportation and assignment models, sensitivity analysis, and simulation techniques.

References

Books and References:

1. Industrial Engineering and Production Management by Martand T Telsang S. Chand Publishing
2. Industrial Engineering and Production Management by M. Mahajan DhanpatRai& Co. (P) Limited
3. Industrial Engineering and Management by Ravi Shankar, Galgotia Publications Pvt Ltd
4. Production and Operations Management by Adam, B.E. & Ebert, R.J., PHI
5. Product Design and Manufacturing by Chitale A.V. and Gupta R.C., PHI
6. Operations Research Theory & Applications by J K Sharma, Macmillan India Ltd,
7. Production Systems Analysis and Control by J.L.Riggs, John Wiley & Sons
8. Automation, Production Systems & Computer Integrated Manufacturing by Groover, M.P. PHI
9. Operations Research, by A.M. Natarajan, P. Balasubramani, A. Tamilarasi, Pearson Education
10. Operations Research by P. K. Gupta and D. S. Hira, S. Chand & Co.

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DEI

Subject Code	Open Elective	HOUR	CREDITS
KMC-501	Constitution of India	3L:1T:0P	0

Objective:

- To provide an understanding of the historical background and the process of drafting the Indian Constitution.
- To explain the structure of Fundamental Rights, Directive Principles of State Policy, and Fundamental Duties.
- To introduce the three main organs of government – Legislature, Executive, and Judiciary – and their roles and powers.
- To provide insights into state legislative bodies and the structure and functioning of local self-governments.
- To explore the roles of constitutional bodies like the Election Commission, CAG, and welfare institutions for SC/ST/OBC and women.

Syllabus:

UNIT-I **(4 hours)**

History of Making of the Constitution:Indian History, Drafting Committee (Composition & Working), Preamble, The Union and its territory, Citizenship

UNIT-II **(4 hours)**

Contours of Constitutional Rights & Duties:

Fundamental Rights-Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties

UNIT-III **(4 hours)**

Organs of Governance:

Parliament-Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Vice president, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT-IV **(4 hours)**

State Legislation: Function and formation of state legislative, legislative council, Power of chief minister, union state relationship

Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, Panchayati Raj: Introduction, Block level: introduction. Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT-V

(4 hours)

Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners.State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women. Role and Functioning of Comptroller & Auditor general of India

Course Outcomes:

CO1: Students will be able to describe the evolution of the Constitution, the role of the Drafting Committee, and key features like the Preamble, Union, and Citizenship.

CO2: Students will be able to identify various fundamental rights and duties enshrined in the Constitution and analyze their implications in real-life contexts.

CO3: Students will be able to explain the functioning and interrelation of Parliament, President, Council of Ministers, and Judiciary, including their constitutional roles.

CO4: Students will be able to understand the significance of state and local governance, including the roles of elected officials in democratic decentralization.

CO5: Students will be able to evaluate the functions of constitutional authorities and their impact on democratic governance and social justice.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015

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SUBJECT CODE	LAB	HOUR	CREDITS
KME-551	Heat & Mass Transfer Lab	0L:0T:4P	2

OBJECTIVES:

1. To understand and analyze different modes of heat transfer including conduction, convection, and radiation through practical experiments.
2. To evaluate the performance and heat transfer characteristics of extended surfaces such as fins under various conditions.
3. To determine heat transfer coefficients in forced and free convection scenarios using standard apparatus.
4. To compare and analyze the effectiveness and LMTD of parallel and counter flow heat exchangers.
5. To gain practical exposure to thermal systems and applications through experiments and industrial visits, such as to a thermal power station.

List of Experiments: (At least 6 of the followings)

1. To determine total thermal resistance and thermal conductivity of composite wall.
2. To determine total thermal resistance and thermal conductivity of composite cylinder.
3. To determine critical heat flux in saturated pool boiling.
4. To find out the transfer co-efficient to vertical cylinder in natural convection.
5. To measure the temperature profiles of a pin fin heated at its bottom at natural and forced convection.
6. To determine the effectiveness and overall heat transfer co-efficient for parallel heat exchanger.
7. To determine the effectiveness and overall heat transfer co-efficient for counter flow heat exchanger.

Course Learning Outcomes (CLO):

1. Demonstrate a clear understanding of conduction, convection, and radiation through hands-on experiments.
2. Analyze and interpret the heat transfer behavior of fins under varying thermal conditions.
3. Accurately determine heat transfer coefficients in both forced and natural convection systems.
4. Evaluate and compare the performance of heat exchangers using LMTD and effectiveness methods.
5. Apply theoretical knowledge to real-world thermal systems through laboratory work and industrial exposure.

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Text books/ Reference books: As per recommendation of concern instructor/ supervisor.

SUBJECT CODE	LAB	HOUR	CREDITS
[illegible]-552	Kinematics & Theory of Machines Lab	0L:0T:4P	2

Objectives:

- To understand the fundamentals of kinematic links, pairs, chains, and various mechanisms including their practical applications.
- To analyze and interpret the working of quick return mechanisms, engine mechanisms, and different inversions of four-bar and slider crank mechanisms.
- To study various types of gears and gear profiles, and determine conditions for interference in gear systems.
- To explore the principles of gyroscopic effects, governor mechanisms, and perform related experiments to evaluate performance and stability.
- To conduct experiments on brakes, clutches, and balancing, as well as study longitudinal and transverse vibrations in mechanical systems.

List of Experiments: (At least 8 of the followings)

1. To study various types of kinematics links, pairs, chains & Mechanisms
2. To study Whitworth Quick Return Motion Mechanisms, Reciprocating Engine Mechanism, and Oscillating Engine Mechanism
3. To study of inversions of four bar linkage
4. To study of inversions of single/double slider crank mechanisms
5. To study various types of gear (Helical, cross helical, worm, bevel gear) and gear profile (involute and cycloidal) and condition for interference Helical, cross helical, worm, bevel gear
6. To compute the output velocity invarious gear trains
7. To study gyroscopic effects through models
8. To determine gyroscopic couple on Motorized Gyroscope
9. To study dead weight type governor to prepare performance characteristic curves, and to find stability & sensitivity
10. To perform the experiment for static / dynamic balancing
11. To perform experiment on brake
12. To perform experiment on clutch

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13. To perform the experiment for static / dynamic balancing.
14. To study of longitudinal vibration
15. To study of transverse vibration

Course Outcomes (CO):

CO1: Understand and identify various types of kinematic links, pairs, chains, and mechanisms through hands-on models.

CO2: Analyze and compare the motion characteristics of quick return, engine, and slider-crank mechanisms via practical demonstrations.

CO3: Compute velocity ratios in different gear trains and study gear profiles to understand interference conditions.

CO4: Demonstrate and evaluate gyroscopic effects, governor performance, and balancing techniques using experimental setups.

CO5: Perform experiments on brakes, clutches, and vibrations to study their working principles and mechanical behavior.

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DEAN

SIXTH SEMESTER

KME	Refrigeration and Air Conditioning	3L:1T:0P	4 credits

Objectiv

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- Anal

sic concepts, significance, and future prospects of RAC technologies.
d knowledge about the construction, components, and working principles of RAC
dents with different types of refrigeration and air-conditioning systems along with their
tions.
cal skills to apply thermodynamic laws in evaluating RAC processes.
s to calculate performance indicators such as the Coefficient of Performance (COP) for
stems.
uence of key operating parameters on the efficiency and performance of RAC systems.

SYLL

UNIT-

Refrig (8)
troduction to refrigeration system, Methods of refrigeration, Unit of refrigeration,
refriger
t. Carnot refrigeration cycle, Refrigerator and Heat Pump, C.O.P.
Air R
n **cycle:** Open and closed air refrigeration cycles, Reversed air Carnot cycle, Bell
Colem
sed Joule air refrigeration cycle, Need of Aircraft refrigeration, Classification of aircraft
refrige

UNIT-

Vapou (12)
ssion **System:** Reversed vapour Carnot cycle, limitation of Reversed vapour Carnot cycle,
Simpl
mpression cycle, Analysis of vapour compression cycle, Use of T□S and P□H charts,
Effect
suction and discharge pressures on C.O.P, Effect of sub cooling of condensate &
superh
rigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle,
Multis
n: Multistage vapour compression system requirement, Different configuration of multi
pressu
emoval of flash gas, Intercooling, Multi evaporator system, Cascade system.

UNIT- (8)

Vapour Absorption system; Working Principal of vapour absorption refrigeration system, Comparison between absorption & compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature – concentration diagram & Enthalpy – concentration diagram , Adiabatic mixing of two streams, Ammonia – Water vapour absorption system, Lithium□ Bromide water vapour absorption system, Comparison, Three fluid system.

Refrigerants: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants, and Environment friendly refrigerants, Anti□freeze solution, Phase changing materials, Ozone layer depletion and global warming considerations of refrigerants, Selection of refrigerants, Future Refrigerants like Hydrofluoro□Olefines

UNIT-IV **(8)**

Air Conditioning: Introduction to air conditioning, Psychrometric properties and their definitions, Psychrometric chart, Different Psychrometric processes, Air Washers, Cooling towers & humidifying efficiency, Thermal analysis of human body, Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration & ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP).

Window air Conditioner, Simple air conditioning system, Air conditioning system with ventilation.

UNIT-V **(8)**

Refrigeration System Equipment: Compressors, Condensers, Expansion Devices and Evaporators, Elementary knowledge of transmission and distribution of air through ducts and fans,

Application: Food preservation, Transport refrigeration, Cold storage, Refrigerates Freezers, Ice plant, Water coolers, Comfort and Industrial air conditioning Refrigeration.

OUTCOMES:

CO1: Understand the basics concepts of Refrigeration & Air□Conditioning and its future prospects.

CO2: Explain the construction and working of various components in Refrigeration & Air□Conditioning systems.

CO3: Understand the different types of RAC systems with their respective applications.

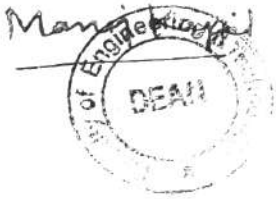
CO4: Apply the basic laws to the thermodynamic analysis of different processes involved in Refrigeration and Air□Conditioning.

CO5: Apply the basic concepts to calculate the COP and other performance parameters for different RAC systems

CO6: effects of performance parameters on COP.

Refere

1. Ref
2. Ref... d Air conditioning by C.P Arora, McGraw□Hill
3. Ref... d Air conditioning, by Manohar Prasad, New Age International (P) Ltd. Pub.
4. Prin... d Air conditioning by R.C. Arora, PHI
5. Re... rigeration by Roy J. Dossat. Pearson Education
6. Ref... d Air conditioning by Stoecker& Jones. McGraw□Hill
7. Th... d Air conditioning by Arora&Domkundwar. DhanpatRai
... ment Engineering. By Kuhen, Ramsey &Thelked



KME-602	Design of Machine Elements	3L:1T:0P	4 credits

Objectives:

- Understand the fundamental principles of mechanical design, material selection, and stress analysis for static and fluctuating loads.
- Develop the ability to design and analyze various types of riveted joints and shafts under different loading conditions.
- Gain knowledge of the types, selection, and design considerations of sliding and rolling contact bearings.
- Learn the design principles, terminology, and analysis methods for spur, helical, bevel, and worm gears based on standard practices.
- Acquire the skills to design essential IC engine components such as cylinders, pistons, piston rings, and gudgeon pins with appropriate material and performance considerations.

Syllabus:

(6)

UNIT-I

Introduction

Definition, Design requirements of machine elements, Design procedure, Standards in design, Standards designation of carbon & alloy steels, Selection of preferred sizes, Selection of materials for static and fatigue loads, Design against Static Load

Design against Fluctuating Loads

Cyclic stresses, Fatigue and endurance limit, Stress concentration factor, Stress concentration factor for various machine parts, Design for finite & infinite life, Soderberg, Goodman, Gerber criteria

(8)

UNIT-II

Riveted Joints

Riveting methods, materials, Types of rivet heads, Types of riveted joints, Caulking and Fullering, Failure of riveted joint, Efficiency of riveted joint, Design of boiler joints, Eccentric loaded riveted joint

Shafts

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity, Keys, Types of keys, Selection of square and flat keys, Strength of sunk key

(10)

UNIT-III

Sliding Contact Bearing

Types, of bearing, Plain journal bearing, Hydrodynamic lubrication, Properties and materials, Lubrication, Hydrodynamic journal bearing, Heat generation, Design of journal bearing. **Rolling bearing** Advantages, Disadvantages, Types of ball bearing, Thrust ball bearing, Types of roller bearing, Selection of ball bearing, Bearing life, Selection of roller bearings, Dynamic equivalent load for roller bearing under constant and variable loading, Reliability of Bearing.

UNIT-

Spur G

(10)

Tooth system of gear teeth, contact ratio, Standard proportions of gear systems, Interference in involute gears, Backlash, Selection of gear materials, Gear manufacturing methods, Design considerations, Beam strength of gear tooth, Dynamic tooth load, Wear strength of gear tooth, Failure of gear tooth, Design of spur gears based on AGMA and Indian standards.

Helical Terminology, Proportions for helical gears, Force components on a tooth of helical gear, Virtual number of teeth, Beam strength and wear strength of helical gears, Dynamic load on helical gears, Design of helical gears.

Introduction, Classification and Applications of Bevel & Worm Gears

UNIT-

IC E

(6)

Selection of IC engine, General design considerations, Design of Cylinder and cylinder head; Design of piston ring and gudgeon pin.

Note: ***book is allowed in the examination***

Cour

Upon successful completion of this course, students will be able to

CO1: Apply fundamentals of machine design, including material selection, stress analysis under static and dynamic conditions, and relevant design standards.

CO2: Design and analyze riveted joints and shafts subjected to various types of mechanical loads, including combined loading conditions.

CO Describe the types, functions, and design methodologies of sliding and rolling contact bearings, including lubrication and load considerations.

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CO4: Apply design principles to spur and helical gears, considering strength, wear, and dynamic loads as per standard gear design practices.

CO5: Design critical IC engine components such as cylinders, pistons, and connecting parts, considering mechanical stresses and thermal conditions.

Text Books:

1. Design of Machine Elements□V.B. Bhandari, McGraw Hill Co.
2. Design of Machine Elements, Sharma and Purohit, PHI.

Reference Books:

1. Mechanical Engineering Design, 9e – Joseph E. Shigely, McGraw Hill Education.
2. Machine Design□Maleev and Hartman, CBS Publishers.
3. Design of Machine Design□M.F. Spott, Pearson Education.
4. Elements of Machine Component Design, Juvinal&Marshek, John Wiley & Sons.
5. Machine design, Robert L. Norton, Pearson Education
6. Theory & Problem of Machine Design (Schaum's Outline Series) Hall, Holowenko, Laughlin, Tata McGraw Hill Co.
7. Machine Design□Sharma and Agrawal, S.K. Kataria& Sons.
8. Machine Design, U C Jindal, Pearson Education.

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03	Robotics and Mechatronics System	3L:1T:0P	4 credits

Obj

- e the foundational concepts, evolution, and applications of Robotics and Mechatronics us domains.
- an understanding of robot anatomy, kinematics, dynamics, and motion planning using l modeling techniques.
- the working principles and selection criteria of actuators, sensors, and control systems tic and mechatronic applications.
- nowledge on the design and integration of mechatronic systems using microcontrollers, stems, DAQ, and PLCs.
- ze students with recent advancements, tools, and ethical considerations in modern luding AI, machine learning, and collaborative robots.

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Intr

botics and Mechatronics: **(06)**

pe of Robotics and Mechatronics, Evolution and Applications in Industry, Medical, ice Sectors, Elements of a Mechatronic System, Introduction to Robotic System tors, Sensors, Controllers, Types of Robots: Serial, Parallel, Mobile, Humanoid, ial Robot Configurations and End Effectors

and Dynamics: **(08)**

d Coordinate Systems, Forward and Inverse Kinematics of Robotic Arms, Denavit–arameters, Jacobian and Singularities,Dynamics of Robotic Manipulators: Newton- n Approaches, Trajectory Planning and Motion Control

and Control Systems: **(08)**

Motors (DC, Servo, Stepper), Pneumatic and Hydraulic Drives, Sensors: Position, ximity, Vision Sensors, Feedback Devices and Signal Conditioning, Basics of Control onics, PID Control and its Application in Robotics, Introduction to Intelligent ogic, Neural Networks)

(10)

Mechatronics System Design and Integration: Key Elements of Mechatronic Design, Microcontrollers and Embedded Systems in Mechatronics, Data Acquisition Systems (DAQ) Interfacing Sensors and Actuators with Microcontrollers ,PLCs and their Applications in Automation, Case Studies: Mechatronic Products (e.g., Automatic Washing Machine, Smart Camera System)

(08)

UNIT – V

Recent Trends and Applications in Robotics and Mechatronics: Introduction to AI and Machine Learning in Robotics, Human-Robot Interaction (HRI), Robot Operating System (ROS) and Simulation Tools, Autonomous Mobile Robots and Drones ,Collaborative Robots (Cobots) and Industry 4.0, Ethical and Safety Issues in Robotics

Outcomes:

After completing this course, the students should be able to

CO1: Explain the fundamental concepts, scope, and real-world applications of Robotics and Mechatronics systems in various sectors.

CO2: Analyze the kinematics and dynamics of robotic systems using mathematical models and apply trajectory planning techniques.

CO3: Identify and describe the function of various actuators, sensors, and control systems, including intelligent controllers used in robotic systems.

CO4: Design and integrate mechatronic systems using microcontrollers, embedded systems, data acquisition systems, and PLCs.

CO5: Evaluate emerging technologies and applications in Robotics and Mechatronics, including AI integration, collaborative robots, and ethical considerations.

Reference Books:

1. Robert J. Schilling, *"Fundamentals of Robotics: Analysis and Control"*, Pearson.
2. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, *"Robotics: Control, Sensing, Vision, and Intelligence"*, McGraw-Hill.
3. Devdas Shetty & Richard Kolk, *"Mechatronics System Design"*, Cengage Learning.
4. Mikell P. Groover – *Industrial Robotics: Technology, Programming, and Applications*, McGraw-Hill Education.

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Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering,
cation.

ty & Richard A. Kolk – *Mechatronics System Design*, Cengage Learning.

– *Introduction to Robotics: Mechanics and Control*, Pearson.

de Silva – *Mechatronics: An Integrated Approach*, CRC Press.

unt – *Mechatronics with Experiments*, Wiley.

& Ben Betlem – *Advanced Mechatronics: Monitoring and Control of Signals and*
ntice Hall.

Kuo – *Automatic Control Systems*, Wiley.

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KME-651	3D Printing Lab	0L:0T:4P	2credits

Objectives:

CO1 Understand different methods of 3D Printing.

CO2 Gain knowledge about simulation of FDM process.

CO3 Estimate time and material required for manufacturing a 3D component

CO4 To understand the various software tools, process and techniques for digital manufacturing

CO5 To apply these techniques into various applications.

CO6 To gain knowledge and skills related to 3D printing technologies.

List of Experiments: (At least 8 of the followings)

1. 3D Modelling of a single component.
2. Assembly of CAD modelled Components
3. Exercise on CAD Data Exchange.
4. Generation of .stl files.
5. Identification of a product for Additive Manufacturing and its process plan.
6. Printing of identified product on an available AM machine.
7. Post processing of additively manufactured product.
8. Inspection and defect analysis of the additively manufactured product.
9. Comparison of Additively manufactured product with conventional manufactured counterpart.

Outcomes:

After completing the course, the student will be able to

- Explain different types of 3d Printing techniques
- Identify parameters for powder binding and jetting process
- Determine effective use of ABS material for 3D Printing
- Apply principles of mathematics to evaluate the volume of material require.

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KM	Robotics and Mechatronics System Lab	0L:0T:4P	2credits

Obje

CO1 : of fluid power and Mechatronics and primary actuating systems.

CO2 : kills in Programmable logic controllers

CO3 : matics and hydraulics and apply them to real life problems.

CO4 : able sensor and image processing technique for Mechatronics systems

CO5 : ate circuits to automate and control the hydraulic, pneumatic and electric actuators.

CO6 : odel of pneumatic and hydraulic circuits by using simulation software

List

(At least 8 of the followings)

1. S: ver Symbols.
2. P: ic Circuits.
3. P: Material Handling System.
4. P: cuit using Relay, Limit Switch and solenoid Valves.
5. I: cuit for an Automation of Double Acting Cylinder by using proximity Sensors and

Ca: ence A+B+ C+ A- B- C

6. I: cuit using proximity Sensors.
7. P: matic Logic circuits
8. I: matic circuit for Material Handling system
9. C: ot.
10. : for pick and place application.
11. : embly of PLC controlled based mobile robot.
12. : erfacing of sensors.

C

A: rse, the student will be able to

: n algebra for logic design of pneumatic circuits.

: n algebra for logic design for hydraulic circuits.

: rcuits for industrial applications.

: circuits for multiple cylinder applications.

: ation circuits with PLC for industrial problems.

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SWAMI VIVEKANAND
SUBHARTI UNIVERSITY, MEERUT

EVALUATION SCHEME & SYLLABUS

B.TECH.

(MECHANICAL ENGINEERING)

W.E.F. SESSION 2026-27

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FACULTY OF ENGINEERING & TECHNOLOGY
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SUBHARTI INSTITUTE OF TECHNOLOGY AND ENGINEERING

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT

STUDY & EVALUATION SCHEME

B.Tech. 4thYear/7th Semester (Mechanical Engg.)

w.e.f Academic Session 2026-27

SEMESTER VII														
S. No	Course Code	Course Title	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	KME-701	Automation in Manufacturing	PCC-14	3	0	0	20	10	30	-	70	-	100	3
2	KME-(711–712)	Elective III	PEC-3	3	0	0	20	10	30	-	70	-	100	3
3	KME-(721 – 723)	Elective-IV	PEC-4	3	0	0	20	10	30	-	70	-	100	3
4	KME-001-003	Open Elective-I	OEC-1	3	0	0	20	10	30	-	70	-	100	3
5	KME-751	Mechanical Engineering Laboratory III (Manufacturing)	PCC-15	0	0	3	-	-	-	15	-	35	50	1.5
5	KME-752	Internship Assessment / Mini Project		-	-	-	-	-	-	100	-	-	100	2
6	KME-752	Project-III	PROJ	0	0	10	-	-	-	100	-	150	250	5
	TOTAL												700	20.5

B.Tech.4thYear/8th Semester (Mechanical Engg.)

w.e.f academic Session 2026-27

SEMESTER VIII														
S. No.	Course Code	Course Title	Course Type	Periods			CCA				ESE		Total	Credit
				L	T	P	CT	TA	Total	PS	TE	PE		
1	KME-(811–812)	Elective-V	PEC-5	3	0	0	20	10	30	-	70	-	100	3
2	KME-(821–823)	Elective VI	PEC-6	3	0	0	20	10	30	-	70	-	100	3
3	KME-(004-006)	Open Elective-II	OEC-2	3	0	0	20	10	30	-	70	-	100	3
4	KME-(007-010)	Open Elective-III	OEC-3	3	0	0	20	10	30	-	70	-	100	3
5	KME-851	Project-IV	PROJ	0	0	12	-	-	-	100	-	200	300	6
	TOTAL													

B.Tech. (Mechanical Engineering) TOTAL CREDITS – 161.5

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PROFESSIONAL CORE COURSES (PCC)

[MECHANICAL ENGINEERING]

Sr. No	Course Code	Course Title
1	KME-701	Automation in Manufacturing
2	KME-751	Mechanical Engineering Laboratory III (Manufacturing)

PROFESSIONAL ELECTIVE COURSES (PEC)

[MECHANICAL ENGINEERING]

S. No.	Course Code	Course Title
1	KME-711	Refrigeration and Air Conditioning
2	KME- 712	Finite element analysis
3	KME- 721	Power plant engineering
4	KME- 722	Gas Dynamics and Jet Propulsion
5	KME- 723	Process Planning and Cost Estimation
6	KME-811	Principles of Management
7	KME-812	Automobile Engineering
8	KME-821	Design of Transmission Systems
9	KME-822	Total Quality Management
10	KME-823	Energy Conservation and Management

OPEN ELECTIVE COURSES (OEC)

[MECHANICAL ENGINEERING]

S. No	Code No.	Subject
01	KME-001	Nano Technology & Surface Engineering
02	KME -002	Soft Skills and Interpersonal Communication
03	KME- 003	ICT for Development
04	KME -004	Human Resource Developments and Organizational Behavior
05	KME -005	Cyber Law and Ethics
06	KME -006	Introductions to Philosophical Thoughts
07	KME -007	Comparative Study of Literature
08	KME -008	Indian Music Systems
09	KME- 009	Histories of Science & Engineering
10	KME- 010	Introductions to Art and Aesthetics

B.TECH. (MECHANICAL ENGINEERING)

SEVENTH SEMESTER

KME-701	Automation in manufacturing	3L:0T:0P	3 credits

Objectives:

To understand the importance of automation in the of field machine tool basedmanufacturing

To get the knowledge of various elements of manufacturing automation – CAD/CAM, sensors, pneumatics, hydraulics and CNC

To understand the basics of product design and the role of manufacturing automation

Course Contents:

Introduction: Why automation, Current trends, CAD, CAM, CIM; Rigid automation: Parthandling, Machine tools. Flexible automation: Computer control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphics Software and Data Base, Geometric modeling for downstream applications and analysis methods; Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC-Adaptive Control

Low cost automation: Mechanical & Electro mechanical Systems, Pneumatics and Hydraulics, Illustrative Examples and case studies

Introduction to Modeling and Simulation: Product design, process route modeling, Optimization techniques, Case studies & industrial applications.

Course Outcomes:

Upon completion of this course, the students will get a comprehensive picture of computer based automation of manufacturing operations

Text Books:

(i) Mikell P. Groover, Automation, Production Systems, and Computer-integrated Manufacturing, prentice Hall

SeropeKalpakjian and Steven R. Schmid, Manufacturing – Engineering and Technology 7th edition,Pearson

YoramKoren, Computer control of manufacturing system, 1st edition Ibrahim Zeid , CAD/CAM : Theory & Practice, 2nd edition.

UVA-302/ UVA- 401	Introduction to Artificial Intelligence for Engineers	4L:0T:0P	2 credits

Objectives

- Introduce fundamental concepts of Artificial Intelligence.
- Develop basic understanding of machine learning and data analysis.
- Familiarize students with AI tools and engineering applications.
- Enable students to solve simple engineering problems using AI concepts.
- Create awareness about ethical and societal impacts of AI.

Unit 1: Fundamentals of Artificial Intelligence

Introduction to AI, History and evolution of AI, AI vs Machine Learning vs Deep Learning, Characteristics and importance of AI, Applications of AI in daily life and industry, Future trends in AI

Unit 2: Data and Machine Learning Basics

Introduction to data and datasets, Types of data, Data preprocessing basics, Introduction to Machine Learning, Supervised learning, Unsupervised learning, Introduction to prediction and classification, Simple engineering examples

Unit 3: AI Tools and Technologies

Introduction to Python for AI, Google Colab/Jupyter Notebook, AI libraries overview, Introduction to sensors and IoT data, Cloud AI platforms, Introduction to Generative AI and Chatbots, Human-AI interaction

Unit 4: Engineering Applications of AI

Smart manufacturing, Robotics and automation, Smart energy systems, Smart transportation, Healthcare systems, Environmental monitoring, Smart agriculture, Quality control and inspection, Predictive maintenance, Cyber-physical systems, Industry 4.0 concepts

Case Studies:

- AI-enabled smart factory
- AI-based traffic management
- AI in renewable energy systems
- AI-powered defect detection

Unit 5: Ethics, Challenges, and Future of AI

Ethical AI, Data privacy and security, Bias in AI systems, Social impact of AI, AI and employment, Sustainable AI, Future engineering opportunities with AI

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Nanotechnology and Surface Engineering (KME-001)

KME-001	Nanotechnology and Surface Engineering	4L:0T:0P	4 credits

Course Outcome:

After learning the course the students should be able:

CO	CO Statement	Bloom's Level
CO1	To define and understand the fundamental concepts of nanoscience, atomic structure, carbon nanomaterials, and size-dependent effects.	K1, K2
CO2	To identify and classify various types of nanostructures and explain the properties and applications of nanomaterials in various fields.	K2, K3
CO3	To explain and apply various synthesis methods for the preparation of nanomaterials.	K2, K3
CO4	To understand different bonding mechanisms in nanostructures and analyze surface interactions such as Brownian motion and surface free energy.	K2, K4
CO5	To describe and evaluate advanced characterization techniques for nanomaterials including diffraction, imaging, and spectroscopy methods.	K2, K5
CO6	To analyze and interpret data obtained from nanomaterial characterization tools to assess structure, composition, and properties for research and industrial applications.	K4, K5

Bloom's Levels Key: K1 – **Remembering,** K2 – **Understanding,** K3 – **Applying,** K4 – **Analyzing,** K5 – **Evaluating,** K6 – **Creating.**

Syllabus

Unit I

Background to Nanoscience: Defination of Nano, Scientific revolution-Atomic Structure and atomic size, emergence and challengs of nanoscience and nanotechnology, carbon age-new form of carbon (CNT to Graphene), influence of nano over micro/macro, size effects and crystals, large surface to volume ration, surface effects on the properties.

Unit II

Types of nanostructure and properties of nanomaterials: One dimensional, Two dimensional and Three dimensional nanostructured materials, Quantum Dots shell structures, metal oxides, semiconductors, composites, mechanical-physical-chemical properties. Application of Nanomaterial: Ferroelectric materials, coating, molecular electronics and nanoelectronics, biological and environmental, membrane based application, polymer based application.

Unit III

Synthesis and preparation of Nanomaterials: Synthesis of bulk nanostructured materials - Metal processing- bulk and nano composite materials - Grinding - high energy ball milling – injection moulding, extrusion - melt quenching and annealing.

Unit IV

Structure: Bonding in Nanostructures Atomic bonding in solids: Metallic, Ionic, Covalent, Co ordination/dative bonds; Vander Waals interactions/Electrostatic interactions - Hydrogen bonding hydrophobic interactions. Theories of bonding: VB theory, VSPR theory, Hybrization, MO theory, Contact angle. Brownian motion and Brownian Flocculation. Surface free energy.

Unit V

Nanomaterials Characterization Techniques: Diffraction analyses: X-ray diffraction, powder diffraction, lattice parameters, structure analyses, strain analyses, phase identification, particle size analyses using - Scherer`s formula - X-ray photoelectron spectroscopy (XPS)- Auger electron spectroscopy (AES).

Surface Imaging: Scanning Electron Microscope (SEM) – Field Emission Scanning Electron Microscope (FESEM)-Atomic Force Microscopy (AFM), Transmission Electron Microscopy (TEM).

Spectroscopic techniques: Infra red spectroscopy (IR) – Rotational & Vibrational - UV-visible - Raman Spectroscopy- Photoluminescence (PL)– Cathod eluminescence (CL), Differential Scanning Calorimeter (DSC), Differential Thermal Analyzer (DTA), Thermo gravimetric Analysis (TGA), X-ray Photoelectron Spectroscopy (XPS).

References:

1). Chemistry of nanomaterials: Synthesis, properties and applications by CNR Rao et.al.

2). Nanoparticles: From theory to applications – G. Schmidt, Wiley Weinheim 2004.

3). Instrument E L Principe, P Gnauck and P Hoffrogge, Microscopy and Microanalysis (2005), 11: 830- 831, Cambridge University Press.

4). Processing & properties of structural naonmaterials - Leon L. Shaw, Nanochemistry: A Chemical Approach to Nanomaterials, Royal Society of Chemistry, Cambridge UK 2005.

5). A.W. Adamson and A.P.Gast, Physical Chemistry of surfaces, Wiley Interscience, NY 2004.

6). P.C Hiemen and R.Rajgopalam, Principle of colloid and surface Chemistry, NY Marcel Dekker, 1997.

7). D.J.Shaw, Colloid and surface chemistry, Butterworth Heineman, Oxford,1992.

8). M. J. Rosen, Surfactant and Interfacial phenomena, Wiley Inter Science Publication, NY 2004.

9). W. Gaddand, D. Brenner, S. Lysherski and G. J. Infrate (Eds), Handbook of nanoscience, Engg. and Technology, CRC Press, 2002.

10). G. Cao, Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, 2004.

11). J. George, Preparation of thin films, Marcel Dekker, InC., New York, 2005.

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12) Ghuzang G.Cao, Naostructures and Nanomaterials: Synthesis, properties and applications, Imperical College Press, 2004

13). Zhong Lin Wang, Hand Book of Nanophase & Nanostructured materials (Vol. I & II), Springer, 2002.

14). B.D. Cullity, Elements of X-ray diffraction, Addison Wesley, 1977

15). S.M. Sze, Semiconductor Devices – Physics and Technology, Wiley, 1985.

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Human Resource Development and Organizational Behavior (KME–004)

Course Objectives

- To understand the fundamentals of **Human Resource Development (HRD).**
- To develop insight into **individual and group behavior** in organizations.
- To enhance managerial effectiveness through **motivation, leadership, and communication.**
- To build awareness about **organizational culture, change, and development.**

UNIT–I: Introduction to Human Resource Development

Concept of Human Resource Development (HRD), Evolution of HRD, HRD framework, Role and significance of HRD in organizations, HRD vs HRM, Challenges of HRD in modern organizations.

UNIT–II: Individual Behavior and Personality

Concept of organizational behavior, Nature and scope of OB, Factors influencing individual behavior, Personality: meaning, determinants and types, Theories of personality, Perception: meaning and process, Learning and its theories, Attitudes and values.

UNIT–III: Motivation and Leadership

Motivation: concept and importance, Theories of motivation – Maslow, Herzberg, McGregor, Vroom, Leadership: concept and functions, Leadership styles, Trait and behavioral theories, Situational leadership, Power and politics in organizations.

UNIT–IV: Group Behavior and Communication

Group behavior: types of groups, Group dynamics, Team building, Conflict: meaning, causes and types, Conflict management techniques, Communication: process, barriers to communication, Effective communication, Emotional intelligence.

UNIT–V: Organizational Culture, Change and Development

Organizational culture: concept, types and functions, Organizational climate, Organizational change: nature and causes, Resistance to change, Managing change, Organizational development (OD): concept, objectives and interventions, Stress management.

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Course Outcomes with Bloom's Taxonomy Levels

CO No.	Course Outcome (Students will be able to…)	Bloom's Level
CO1	Define and explain the fundamental concepts of Human Resource Development and Organizational Behavior.	K1 – Remember
CO2	Describe and interpret individual behavior, personality, perception, learning, attitudes, and values in organizations.	K2 – Understand
CO3	Apply motivation and leadership theories to analyze workplace behavior and managerial situations.	K3 – Apply
CO4	Analyze group behavior, communication processes, and conflict situations in organizational settings.	K4 – Analyze
CO5	Evaluate organizational culture, leadership styles, and change management practices for organizational effectiveness.	K5 – Evaluate
CO6	Design and propose suitable HRD and Organizational Development interventions for improving organizational performance.	K6 – Create

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BME- (711-712)	ELECTIVE –III	3L:0T:0P	3 credits

KME- 711 (Refrigeration and air Conditioning)

CONTENT

Objectives:

To familiarize with the terminology associated with refrigeration systems and airconditioning 2. To understand basic refrigeration processes

To understand the basics of psychrometry and practice of applied psychrometrics

To acquire the skills required to model, analyse and design different refrigeration as well asair conditioning processes and components

Course Content:

UNIT 1:

Introduction to Refrigeration and Air Conditioning: Basic principles of refrigeration and air conditioning, History and development of refrigeration.Applications in different industries (e.g., food preservation, HVAC).

Basic Thermodynamics of Refrigeration: Laws of thermodynamics and their relevance to refrigeration, Properties of refrigerants, Thermodynamic cycles (e.g., Rankine cycle, vapor compression cycle).

Components of Refrigeration Systems: Compressor, condenser, expansion valve, evaporator, Types of refrigerants used in different systems.

UNIT 2:

Vapor Compression Refrigeration System: Working principle of vapor compression cycle, Types of compressors: reciprocating, rotary, screw, and centrifugal, Types of condensers and evaporators.

Refrigeration System Design: Selection of refrigerants based on application, Calculation of system performance. Factors affecting refrigeration capacity (ambient temperature, pressure, etc.).

Types of Refrigeration Systems: Domestic, commercial, and industrial refrigeration systems, Freezer and cold storage systems, Air conditioning and heat pump systems.

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UNIT 3:

Air Conditioning Systems: Basic Principles of Air Conditioning, Air conditioning systems: working principle, Sensible and latent heat, Psychrometric chart and its application.

Components of Air Conditioning Systems: Compressor, condenser, expansion valve, evaporator in air conditioning, Types of air conditioning systems: window, split, and central air conditioning.

Types of Air Conditioning Systems: Comfort air conditioning vs. industrial air conditioning, Cooling load calculation (sensible and latent load).

UNIT 4:

Heat Transfer and System Efficiency: Heat Transfer Mechanisms, Conduction, convection, and radiation, Heat exchangers in refrigeration and air conditioning.

Performance and Efficiency of Refrigeration and Air Conditioning Systems: Coefficient of performance (COP) for refrigeration and air conditioning, Energy efficiency and environmental impact, Performance testing and maintenance of systems.

Alternative Refrigerants and Environmental Concerns: CFC, HCFC, HFC, and natural refrigerants, Global warming potential (GWP) and ozone depletion potential (ODP).

UNIT 5:

Maintenance and Troubleshooting: Maintenance of Refrigeration and Air Conditioning Systems: **Routine maintenance procedures: cleaning, lubrication, inspection, Refrigerant handling and leak detection, Maintenance of compressors, evaporators, condensers, and expansion valves.**

Troubleshooting Techniques: Diagnosing common problems in refrigeration and air conditioning systems, Performance issues: low cooling, high power consumption, noise, etc, Troubleshooting compressor and refrigeration cycle issues.

Safety in Refrigeration and Air Conditioning: Handling hazardous refrigerants and oils, Electrical safety, pressure vessel safety, Use of personal protective equipment (PPE).

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Course Outcomes:

A student who has done the course will have a good understanding of the working principles of refrigeration and air-conditioning systems.

CO	Course Outcome (Description)	Bloom's Taxonomy Level (K1 to K6)
CO1	Understand the basic principles and laws of refrigeration and air conditioning systems, including thermodynamics and components.	K1 (Knowledge)
CO2	Apply the principles of vapor compression cycle, refrigeration system design, and refrigerant selection in practical scenarios.	K3 (Application)
CO3	Analyze the operation of various types of air conditioning systems, including window, split, and central systems.	K4 (Analysis)
CO4	Evaluate the efficiency of refrigeration and air conditioning systems, considering environmental impact and energy consumption.	K5 (Evaluation)
CO5	Design and calculate cooling loads for air conditioning systems based on real-world applications.	K6 (Synthesis)
CO6	Perform maintenance and troubleshooting of refrigeration and air conditioning systems, ensuring safety and reliability.	K3 (Application)

Explanation of K1 to K6 Levels:

- **K1 (Knowledge)**: Recall basic facts, terms, concepts, and definitions related to refrigeration and air conditioning.
- **K2 (Comprehension)**: Understand the meaning of concepts and principles, and explain them.
- **K3 (Application)**: Use acquired knowledge to solve practical problems or carry out tasks in real-world scenarios.
- **K4 (Analysis)**: Break down complex information into components, identify relationships, and draw conclusions.
- **K5 (Evaluation)**: Assess, judge, and make decisions about systems or processes based on criteria, including performance and efficiency.
- **K6 (Synthesis)**: Combine knowledge to design, create, or plan systems or solutions, integrating multiple concepts.

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Text Books:

Gosney, W.B, Principles of Refrigeration, Cambridge University Press, 1982.

Stoecker, W.F. and Jones, J.W., Refrigeration and Air conditioning, Tata McGraw Hill,1986.

Arora, C.P., Refrigeration and Air conditioning, Tata McGraw Hill, 2nd Edition, 2000.

Kuehn, T.H., Ramsey, J.W. and Threlkeld, J.L., Thermal Environmental Engineering, 3rd Edition, Prentice Hall, 1998.

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KME- 712 (Finite Element Analysis)

CONTENT

Objectives:

To illustrate the principle of mathematical modeling of engineering problems To introduce the basics and application of Finite Element Method

Contents:

Historical Background, Mathematical modeling of field problems in engineering, governing equations, discrete and continuous models, boundary and initial value problems, Weighted Residual Methods, Variational formulation of boundary value problems, Ritz technique, Basic concept of Finite Element Method.

One dimensional second order equation, discretization, linear and higher order elements, derivation of shape functions, Stiffness matrix and force vectors, assembly of elemental matrices, solution of problems from solid mechanics and heat transfer, longitudinal vibrationand mode shapes, fourth order beam equation, transverse deflections and natural frequencies.

Two dimensional equations, variational formulation, finite element formulation, triangular elements- shape functions, elemental matrices and RHS vectors; application to thermal problems, torsion of non-circular shafts, quadrilateral and higher order elements. Plane stresses and plane strain problems, body forces and thermal loads, plate and shell elements.

Natural coordinate systems, isoparametric elements and shape functions, numerical integration and application to plane stress problems, matrix solution techniques, solution of dynamic problems, and introduction to FE software.

Course Outcomes:

Upon completion of the course, students will understand the FEM formulation and its application to simple structural and thermal problems

Text Books:

Reddy J.N., An Introduction to Finite Element Method, 3rd ed., Tata McGraw Hill, 2005.

Seshu P., Text Book of Finite Element Analysis, Prentice Hall, New Delhi, 2007.

Rao S.S., The Finite Element Method in Engineering, 3rd ed., Butterworth Heinemann, 2004.

Chandraputla&Belegundu, Introduction to Finite Elements in Engineering, 3rd ed., Prentice Hall,1990.

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KME- (721-722)	ELECTIVE –IV	3L:0T:0P	3 credits

KME- 721 (Power Plant Engineering)

Objectives:

To provide an overview of power plants and the associated energy conversion issues

Contents:

Coal based thermal power plants, basic Rankine cycle and its modifications, layout of modern coal power plant, super critical boilers, FBC boilers, turbines, condensers, steam andheating rates, subsystems of thermal power plants, fuel and ash handling, draught system, feed water treatment, binary cycles and cogeneration systems

Gas turbine and combined cycle power plants, Brayton cycle analysis and optimization, components of gas turbine power plants, combined cycle power plants, Integrated Gasifierbased Combined Cycle (IGCC) systems.

Basics of nuclear energy conversion, Layout and subsystems of nuclear power plants, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANDU Reactor, Pressurized Heavy Water Reactor (PHWR), Fast Breeder Reactors (FBR), gas cooled and liquid metal cooled reactors, safety measures for nuclear power plants.

Hydroelectric power plants, classification, typical layout and components, principles of wind, tidal, solar PV and solar thermal, geothermal, biogas and fuel cell power systems

Energy, economic and environmental issues, power tariffs, load distribution parameters, load curve, capital and operating cost of different power plants, pollution control technologies including waste disposal options for coal and nuclear plants.

Course Outcomes:

Upon completion of the course, the students can understand the principles of operation for different power plants and their economics.

Text Books:

Nag P.K., Power Plant Engineering, 3rd ed., Tata McGraw Hill, 2008.El Wakil M.M., Power Plant Technology, Tata McGraw Hill, 2010.

Elliot T.C., Chen K and Swanekamp R.C., Power Plant Engineering, 2nd ed., McGraw Hill, 1998

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KME- 722 (Gas Dynamics and Jet Propulsion)

Objectives:

To understand the features of compressible isentropic flows and irreversibilities likeshocks.

To provide a basic knowledge of jet and rocket propulsion technologies.

Contents:

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers, subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights

Course Outcomes:

Upon completion of this course, the students will be able to apply gas dynamics principles to jet and space propulsion systems

Text Books:

Ahmed F. El-Sayed, Aircraft Prpoulsion and Gas Turbine Engines, CRC Press, 2008.

H.S. Mukunda, "Understanding Aerospace Chemical Propulsion", Interline Publishing,2004.

Hill P. and Peterson C., Mechanics & Thermodynamics of Propulsion, Addison Wesley,1992.

Zucrow N. J., Aircraft and Missile Propulsion, Vol.I& II, John Wiley, 1975.

Sutton G.P., Rocket Propulsion Elements, John Wiley, New York, 1986.

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KME-751	Mechanical Engineering Laboratory III (Manufacturing)	0L:0T:3P	1.5 credits

Objectives:

To provide an understanding of advanced manufacturing methods. To get an idea of the dimensional & form accuracy of products

Contents:

About 12 experiments will be carried out as listed below.

Taper turning and external thread cutting using lathe Contour milling using vertical milling machine

Spur gear cutting in milling machine

Measurement of cutting forces in Milling/ Turning process

CNC part programming

Drilling of a small hole using wire EDM

Microprocessor controlled pick & place robotUse of Tool Maker's Microscope

Comparator and sine bar

Surface finish measurement equipment

Bore diameter measurement using micrometer and telescopic gaugeUse of Autocollimator

Course Outcomes:

Upon completion of this course, students will be able to perform some advanced manufacturing operations and also be able to evaluate the accuracy & tolerance of components produced

KME- 752	**Project- III**	**0L:0T:10P**	**5 credits**

Objectives:

It is intended to start the project work early in the seventh semester and carry out both design and fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried outin the eighth semester

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B.TECH. (MECHANICAL ENGINEERING)

EIGHT SEMESTER

BME- (811-812)	**ELECTIVE –V**	**3L:0T:0P**	**3 credits**

BME- 811 (Principles of Management)

Objectives:

To understand the principles of management and their application to the functioning of an organization

Contents:

Definition of management, science or art, manager vs entrepreneur; Types of managers-managerial roles and skills; Evolution of management- scientific, human relations, system and contingency approaches; Types of Business Organizations, sole proprietorship, partnership, company, public and private enterprises; Organization culture and environment; Current trends and issues in management.

Nature and purpose of Planning, types of Planning, objectives, setting objectives, policies, Strategic Management, Planning Tools and Techniques, Decision making steps & processes.

Nature and purpose of Organizing, formal and informal organization, organization structure, types, line and staff authority, departmentalization, delegation of authority, centralization and decentralization, job design, human resource management, HR planning, Recruitment selection, Training & Development, Performance Management, Career planning and Management.

Directing, individual and group behavior, motivation, motivation theories, motivational techniques, job satisfaction, job enrichment, leadership, types & theories of leadership, effective communication.

Controlling, system and process of controlling, budgetary and non-budgetary control techniques, use of computers and IT in management control, productivity problems and management, control and performance, direct and preventive control, reporting.

Course Outcomes:

Upon completion of this course, the students will get a clear understanding of management functions in an organization

Text Books:

Robins S.P. and Couiter M., Management, Prentice Hall India, 10th ed., 2009.

Stoner JAF, Freeman RE and Gilbert DR, Management, 6th ed., Pearson Education, 2004.

Tripathy PC & Reddy PN, Principles of Management, Tata McGraw Hill, 1999

DEAN

BME- 812 (Automobile Engineering)

Objectives:

To understand the construction and working principle of various parts of an automobile

Contents:

Types of automobiles, vehicle construction and layouts, chassis, frame and body, vehicle aerodynamics, IC engines- components, function and materials, variable valve timing (VVT). Engine auxiliary systems, electronic injection for SI and CI engines, unit injector system, rotary distributor type and common rail direct injection system, transistor based coil ignition

Capacitive discharge ignition systems, turbo chargers (WGT, VGT), engine emission controlby 3-way catalytic converter system, Emission norms (Euro & BS).

Transmission systems, clutch types & construction, gear boxes- manual and automatic gearshift mechanisms, over drive, transfer box, flywheel, torque converter, propeller shaft, slip joints, universal joints, differential and rear axle, Hotchkiss drive and Torque tube drive.

Steering geometry and types of steering gear box, power steering, types of front axle, and types of suspension systems, pneumatic and hydraulic braking systems, antilock braking system (ABS), electronic brake force distribution (EBD) and traction control.

Alternative energy sources, natural gas, LPG, biodiesel, bio-ethanol, gasohol and hydrogenfuels in automobiles, modifications needed, performance, combustion & emission characteristics of alternative fuels in SI and CI engines, Electric and Hybrid vehicles, application of Fuel Cells

Course Outcomes:

Upon completion of this course, students will understand the function of each automobile component and also have a clear idea about the overall vehicle performance.

Text books:

Kirpal Singh, Automobile Engineering, 7th ed., Standard Publishers, New Delhi, 1997.

Jain K.K. and Asthana R.B., Automobile Engineering, Tata McGraw Hill, New Delhi, 2002

Heitner J., Automotive Mechanics, 2nd ed., East-West Press, 1999.

Heisler H., Advanced Engine Technology, SAE International Publ., USA, 1998

BME- (821-823)	ELECTIVE –VI	3L:0T:0P	3 credits

BME- 821 (Design of Transmission Systems)

Objectives:

To learn about the design procedures for mechanical power transmission components

Contents:

Flexible transmission elements- design of flat belts & pulleys, selection of V-belts and pulleys, selection of hoisting wire ropes and pulleys, design of chains and sprockets

Gear transmission- speed ratios and number of teeth, force analysis, tooth stresses, dynamic effects, fatigue strength, factor safety, gear materials; Design of straight tooth spur gear and parallel axis helical gears based on strength and wear considerations, pressure angle in the normal and transverse plane; equivalent number of teeth and forces for helical gears.

Straight bevel gear- tooth terminology, tooth forces and stresses, equivalent number of teeth. Estimating the dimensions of a pair of straight bevel gears; Worm gear, merits & demerits, terminology, thermal capacity, materials, forces & stresses, efficiency, estimating the size of worm gear pair. Cross helical gears, terminology, helix angles, sizing of a pair of helical gears.

Gear box- geometric progression, standard step ratio; Ray diagram, kinematics layout; Design of sliding mesh gear box- Design of multi-seed gear box for machine tool applications; constant mesh gear box, speed reducer unit; Variable speed gear box; Fluid couplings, Torque converters for automotive applications.

Cam design, types: pressure angle and undercutting base circle determination, forces and surface stresses; Design of plate clutches, axial clutches, cone clutches, internal expanding rim clutches; Electromagnetic clutches; Band and Block brakes, external shoe brakes, internal expanding shoe brake.

Course Outcomes:

Upon completing this course the students will be able to design transmission systems forengines and machines.

Text Books:

Shigley J., Mischke C., Budynas R. and Nisbett K., Mechanical Engineering Design, 8th ed., Tata McGraw Hill, 2010.

Jindal U.C., Machine Design: Design of Transmission System, Dorling Kindersley, 2010.Maitra G. and Prasad L., Handbook of Mechanical Design, 2nd ed., Tata McGraw Hill, 2001

BME- 822 (Total Quality Management)

Objectives:

To facilitate the understanding of total quality management principles and processes

Contents:

Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

TQM principles; leadership, strategic quality planning; Quality councils- employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCE cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types.

TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, improvement needs, performance measures.

Quality systems, need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation,; Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Course Outcomes:

Upon completion of this course, the students will be able to use the tools and techniques ofTQM in manufacturing and service sectors.

Text Books:

Besterfield D.H. et al., Total qualityManagement, 3rd ed., Pearson Education Asia, 2006. Evans J.R. and Lindsay W.M., The management and Control of Quality, 8th ed., first Indian edition, Cengage Learning, 2012.

Janakiraman B. and Gopal R.K., Total Quality Management, Prentice Hall India, 2006.

Suganthi L. and Samuel A., Total Quality Management, Prentice Hall India, 2006.

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BME- 823 (Energy Conservation and Management)

Content

Objectives:

To understand the energy data from industries and carry out energy audit for energy savings

Contents:

Introduction to energy & power scenario of world, National Energy consumption data, and environmental aspects associated with energy utilization; Energy Auditing- need, types, methodology and barriers, role of energy managers, instruments of energy auditing.

Components of EB billing, HT and LT supply, transformers, cable sizing; Concept of capacitors, power factor improvement, harmonics; Electric motors- motor efficiency computation, energy efficient motors; Illumination- Lux, Lumens, types of lighting, efficacy, LED lighting and scope of energy conservation in lighting.

Thermal systems, Boilers, Furnaces and Thermic Fluid heaters- efficiency computation and energy conservation measures; Steam distribution and usage, steam traps, condensate recovery, flash steam utilization; Insulation & Refractories.

Energy conservation in major utilities; pumps, fans, blowers, compressed air systems, Refrigeration& Air Conditioning systems, Cooling Towers, DG sets.

Energy Economics- discount period, payback period, internal rate of return, net present value; Life Cycle costing- ESCO concept.

Course Outcomes:

Upon completion of this course, the students will be able to perform of energy auditing for the energy consumption of industries.

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Text Books:

Witte L.C., Schmidt P.S. and Brown D.R., Industrial Energy Management and Utilization, Hemisphere Publ., Washington, 1988..

Callaghn P.W., Design and Management for Energy Conservation, Pergamon Press, Oxford, 1981.

Murphy W.R. and McKay G., Energy Management, Butterworths, London, 1987.

Energy Manager Training Manual, Bureau of Energy Efficiency (BEE) under Ministry ofPower, GOI, 2004 (available at www.energymanager training.com).

BME- (004-006)	OPEN ELECTIVE –IV	3L:0T:0P	3 credits

BME- 004: Human Resource Developments and Organizational Behavior

Introduction: HR Role and Functions, Concept and Significance of HR, Changing role of HR managers - HR functions and Global Environment, role of a HR Manager.

Human Resources Planning: HR Planning and Recruitment: Planning Process - planning at different levels - Job Analysis - Recruitment and selection processes - Restructuring strategies - Recruitment-Sources of Recruitment-Selection Process Placement and Induction-Retention of Employees

Training and Development : need for skill up gradation - Assessment of training needs - Retraining and Redeployment methods and techniques of training employees and executives - performance appraisal systems.

Performance Management System: Definition, Concepts and Ethics-Different methods of Performance Appraisal- Rating Errors-Competency management. Industrial Relations: Factors influencing industrial relations - State Interventions and Legal Framework - Role of Trade unions -Collective Bargaining - Workers' participation in management.

BOOK:

1. Gary Dessler, Human Resource Management - (8th ed.,) Pearson Education, Delhi

2. Decenzo & Robbins, Personnel / Human Resource Management, 3rd ed., John Wiley &Sons (Pvt.) Ltd. 3. Biswajeet Patanayak, Human Resource Management, PHI, New Delhi 4. Luis R. Gomez, Mejia, Balkin and Cardy, Managing Human Resources PHI, New Delhi.

BME- 851	Project- IV	0L:0T:12P	6 credits

It is intended to start the project work early in the seventh semester and carry out both designand fabrication of a mechanical device whose working can be demonstrated. The design is expected to be completed in the seventh semester and the fabrication and demonstration will be carried out in the eighth semester.

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