

Course Outline and Detailed Syllabus for B. Tech. Mechanical Engineering
(5th Semester)

Semester-V

S. No	Course Code	Course Title	Hours Per Week			Total Contact Hours	Credits
			L	T	P		
1.	MEC301C	Heat and Mass Transfer	4	0	0	4	4
2.	MEC302C	Design of Machine Elements	3	0	0	3	3
3.	MEC303C	Manufacturing Processes	3	0	0	3	3
4.	MEC304C	Measurement & Instrumentation	3	0	0	3	3
5.	STA303C	Probability and Statistics	3	0	0	3	3
6.	ECE330C	Microcontrollers	3	0	0	3	3
7.	MEC310C	Heat Transfer Lab	0	0	2	2	1
8.	MEC311C	Manufacturing Processes Lab	0	0	2	2	1
9.	MEC312C	Project-I	0	0	2	30 (Total)	1
10.	-	Open Elective	-	-	-	-	-
Total Credits							22

MEC301C

Heat and Mass Transfer

4-0-0

Conduction: Basic laws of heat transfer, thermal conductance and resistance, combined heat transfer processes; Thermal conductivity of solids, liquids and gases. General heat conduction equation in Cartesian, cylindrical and spherical co-ordinate systems; One dimensional steady state heat conduction through composite walls. Variable thermal conductivity; Critical thickness of insulation. 1-D heat conduction with internal heat generation in plane wall, cylinder and sphere. Extended surfaces, Generalized equation for fins, Fin of uniform cross section: heat transfer rate, temperature distribution & fin efficiency for different conditions at fin tip. 1-D unsteady heat conduction; lumped heat capacity method, temperature-time response of thermocouples; Unsteady conduction with negligible surface resistance. Two dimensional (2D) steady heat conduction

Convection: Viscous flow, hydrodynamic and thermal boundary layers, Momentum and energy equations of the laminar boundary layer over a flat plate. Integral momentum analysis of the hydrodynamic boundary layer and thermal boundary layer for forced convection. Liquid metal heat transfer. Free convection heat transfer. Dimensional analysis applied to forced and free convection. Empirical equations for laminar and turbulent flows over surfaces of various geometries; simplified equations for air. Heat transfer during condensation, film condensation over a vertical surface. Phenomenon of boiling, Pool boiling over a heated nichrome wire.

Radiation: Introduction to thermal radiation, Plank's distribution law. Monochromatic and total emissive power, Emissivity, Stefan-Boltzmann law, Weins displacement law. Kirchoff's law; Proof of Kirchoff's law for monochromatic and total radiations. Solid angle, Intensity of radiation, Radiative heat exchange between two black surfaces, Shape factor, shape factor for simple geometries. Radiative heat exchange between non- black surfaces, Radiation shields. Radiation through gases and flames; Solar radiation

Heat Exchangers: Classification of heat exchangers and their temperature distributions; Overall heat transfer coefficient and fouling factors; Log mean temperature difference (LMTD). Heat exchanger effectiveness, NTU-method. Compact heat exchangers; Baffled shell and tube type heat exchangers. Heat exchangers design considerations. Heat Pipe

Mass Transfer: Introduction, diffusion and convective mass transfers, Ficks law of diffusion. Generalized equation of mass diffusion, steady state diffusion of gasses and liquids through solids, Isothermal evaporation of water into air. Convective mass transfers, mass transfer coefficients, analogy between momentum, heat and mass transfer.

Text Books:

1. Incropera F. P., Dewitt D. P., Fundamentals of Heat & Mass Transfer, *McGraw Hill Education (India)*.

Reference Books:

1. Cengel Y. A., Heat transfer: A Practical Approach, *McGraw Hill Education (India)*.
2. Holman J. P., Heat Transfer, *McGraw Hill Education (India)*.

MEC302C

Design of Machine Elements

3-0-0

Introduction to design: Various stages of design process, design tools and resources, standards and codes, safety, reliability and product liability, uncertainties in design, introduction to behavior of mechanical systems.

Failure prevention in mechanical components: Failures resulting from static loads, static strength, factor of safety, theories of failure for static loads, selection of failure theories, Introduction to fatigue in materials, various approaches to fatigue failure analysis and design, endurance limit and modifying factors, stress concentration and notch sensitivity, failure criteria for fluctuating loads.

Design of shafts: Shaft design for static and fatigue loads, shafts subjected to twisting and bending moments, deflection considerations, shaft materials, design of shaft components, keys and couplings.

Design of springs: Types of springs, stresses induced in helical springs, spring materials, design for static and fatigue loads, extension springs, torsion springs, spiral springs, leaf springs.

Design of permanent and temporary joints: Riveted joints, failures of riveted joints, design of riveted joints for boilers and pressure vessels, welded joints, welding symbols, butt and fillet welds, screwed joints, designation of screw threads, stresses induced in screw threads, bolt strength, design of cotter and knuckle joints.

Text Books:

1. Budynas R. G., Nisbett J. K., Shigley's Mechanical Engineering Design, *McGraw Hill Education (India)*.

Reference Books:

1. Mott R. L., Machine Elements in Mechanical design, *Prentice-Hall Inc, New Jersey*.
2. Spotts M. F., Design of Machine Elements, *Prentice-Hall Inc, New Jersey*.
3. Bhandari V. B., Design of Machine Elements, *McGraw Hill Education (India)*.
4. Sharma P. C., Aggarwal D. K., A Textbook of Machine Design, *S. K. Kataria and Sons India*.

MEC303C

Manufacturing Processes

3-0-0

Introduction to Foundry and Casting: Metal Casting Processes: Patterns, Types of patterns, allowances and material used for patterns, moulding materials, moulding sands, Moulding sands; properties and sand testing: Grain fineness, moisture content, clay content and permeability test. Core materials and core making. Moulding practices: Green, dry and loam sand moulding, shell moulding; permanent moulding; carbon dioxide moulding. Gating and Rising design fundamentals, casting defects.

Metal Forming (Bulk Deformation): Metal working, Elastic and plastic deformation, Concept of strain hardening, Hot and cold working, Rolling, Principle and operations, Roll pass sequence, Forging, Forging operations, extrusion, Wire and tube drawing processes. Forging: Method of forging, Forging hammers and presses, Principle of forging tool design.

Sheet Metal Forming and Powder Metallurgy: Cold working processes: Shearing, Drawing Squeezing, Blanking, Piercing, deep drawing, Spinning, Bending, Coining and embossing, Metal working defects, cold heading, Riveting, Thread rolling bending and forming operation. Powder Metallurgy: Sintering, Impregnation and Infiltration.

Metal Joining Processes: Principle of welding, soldering, Brazing and adhesive bonding. Classification of welding and allied processes. Capabilities and applications; welding parameters, Gas welding and gas cutting, Arc welding, Power sources and consumables, Resistance welding: Spot, Projection and seam welding process, TIG, MIG, friction and explosive welding. Defects of welding and remedial actions.

Jigs and Fixtures: Definition, Differences between Jigs and Fixtures, Its usefulness in mass production, design principles, 3-2-1 location principle and its application to short and long cylinders, types of locators, concept of work piece control, geo metric control, dimensional control and mechanical control, Clamps, jig bushes, Jigs and fixtures for various machining operations.

Text Book:

1. Kalpakjian S., Schmid S. R., Manufacturing Engineering and Technology, *Pearson publication.*

Reference Books:

1. Rao P. N., Manufacturing Technology: Volume-II, *McGraw Hill Education (India).*
2. Jain R. K., Production Technology, *Khanna publishers.*

MEC304C

Measurement and Instrumentation

3-0-0

Introduction: Types of applications of Measurement Instrumentation: Monitoring of processes and operation, control of processes and operation, experimental engineering analyses, computer aided machines and processes.

Configuration, functional description, and performance of measuring instruments: Functional elements, Active and passive transducers, Analog and digital modes of operation, Input-output configuration of measuring instruments and instrument systems, Generalized performance characteristics of instruments, Static and Dynamic characteristics.

Motion and dimensional measurement: Fundamental standards, Relative and absolute motion devices, relative displacement, Resistive potentiometers, bridge circuit, LVDT, Variable inductance and variable capacitance pick-ups, Piezoelectric transducers, fiber optic displacement transducer, Resistance strain gage, Relative velocity-translational and rotational, Mechanical revolution counters and timers, stroboscopic method, Moving coil and moving magnet pickups, DC and AC tachometers, Eddy current drag-cup tachometer, Acceleration measurement.

Force, torque and shaft power measurement: Standards and calibration, Basic methods of force measurement, Elastic force transducers, Strain gauge transducers, Piezoelectric, Hydraulic and pneumatic load cells, Cantilever beam transducer, etc.; Torque measurements on rotating shafts; Shaft power measurements: Dynamometers – Absorption, driving and transmission type, reaction forces in shaft bearings, eddy current brake dynamometer.

Pressure, Flow and Temperature Measurement: Standards and Calibration, Methods of pressure measurement, Instruments for high, mid and low pressure measurement; Sound level meter, Microphones; Flow measurement: Orifice meters, Venturimeter, Pitot tube, Flow nozzle, rotameter, Positive displacement flow meter, turbine flow meter, ultrasonic flow meters; Temperature sensing techniques: liquid-in-glass and bimetallic thermometers, Pressure thermometers, electrical resistance thermometers, Thermistors, Thermocouples, etc.

Text Books:

1. Doebelin E.O., Measurement systems, *McGraw Hill Education (India)*.
2. Thomas G. Beckwith, Roy D. Marangoni, John H. Lienhard, Mechanical Measurements, *Pearson publication*.

Reference Books:

1. Nakra B. C., Instrumentation, Measurements & Analysis, *McGraw Hill Education (India)*.
2. Bolton W., Instrumentation and control systems, *Newnes Publications*.
3. Hollman J. P., Experimental Methods for Engineers, *McGraw Hill Education (India)*.

STA303C

Probability and Statistics

3-0-0

Statistics: Measures of central tendency and Measures of variations (Dispersions), Moments, Measures of Skewness and Kurtosis. Moment generating functions, problems.

Standard Distributions: Binomial, Poisson and Normal Distributions, Beta and Gamma Distribution, t Distribution, F-Distribution, Chi-square Distribution and their applications.

Method of Least Squares & Correlation: Methods of least squares, fitting of straight line and parabola of degree 'p'. Regression and Correlation. Multiple and Partial Correlation.

Probability: Random experiment, sample space, events, classical, statistical and axiomatic definitions of probability. Statements and proof of theorems on addition and multiplication of probabilities, problems.

Conditional Probability: Bayes theorem on conditional probability. Random variables, Derivation of formulae for mean, variance and moments of random variables for discrete and continuous cases. Laws of expectation problems.

Text Books/Reference Books:

1. Gupta S. C., Kapoor V. K., Fundamentals of Mathematical Statistics, *S. Chand & Sons*.
2. Brownlee, Statistical Theory and Methodology in Science & Engineering, *John Wiley & Sons*.
3. Walpole R. E., Introduction to Mathematical Statistics, *Macmillan publications*.
4. Meyer, Data Analysis for Scientists & Engineers, *John Wiley & Sons*.

ECE330C

Microcontrollers

3-0-0

Microcontroller Architecture: Overview of 8051 Microcontroller family: Architecture, basic assembly language programming concepts, The program Counter and ROM Spaces in the 8051, Data types, 8051 Flag Bits and PSW Register, 8051 Register Banks and Stack Instruction set, Loop and Jump Instructions, Call Instructions,

Timers: Time delay generations and calculations, I/O port programming Addressing Modes, accessing memory using various addressing modes, Arithmetic instructions and programs, Logical instructions, Single-bit instruction programming, Programming of 8051 Timers, Counter Programming.

Communication with 8051: Basics of Communication, Overview of RS-232, I²C Bus, UART, USB, 8051 connections to RS-232, 8051 serial communication programming, 8051 interrupts, Programming of timer interrupts, Programming of External hardware interrupts, Programming of the serial communication interrupts, Interrupt priority in the 8051.

Interfacing with 8051: Interfacing an LCD to the 8051, 8051 interfacing to ADC, Sensors, Interfacing a Stepper Motor, 8051 interfacing to the keyboard, Interfacing a DAC to the 8051, 8255 Interfacing with 8031/51, 8051/31 interfacing to external memory.

Data Converters: Data converter fundamentals, Digital-to-Analog Converter (DAC) Specifications, Analog-to-Digital Converter (ADC) Specifications, DAC architectures, ADC architectures

Text Books:

1. Raj Kamal, Embedded Systems, *TMH, 2004*.
2. M.A. Mazidi and J. G. Mazidi, The 8051 Microcontroller and Embedded Systems, *PHI, 2004*

Reference Books:

1. David E. Simon, An Embedded Software Primer, *Pearson Education, 1999*.
2. K.J. Ayala, The 8051 Microcontroller, *Penram International, 1991*.
3. Dr. Rajiv Kapadia, 8051 Microcontroller & Embedded Systems, *Jaico Press*
4. Dr. Prasad, Embedded Real Time System, *Wiley Dreamtech, 2004*.
5. Muhammad Ali Mazidi , The 8051 Microcontroller and Embedded Systems: Using Assembly and C – VTU, *Pearson publishers*.

MEC310C

Heat Transfer Lab

0-0-2

List of Experiments:

1. Determination of Fin efficiency and effectiveness of a pin fin in forced convection and natural convection
2. Determination of thermal conductivity of a plate by two slab guarded hot plate method
3. Determination of thermal conductivity of pipe insulation and insulation powder
4. Determination of thermal conductivity of a liquid by the guarded hot plate method
5. Determination of thermal conductivity of a good conductor of heat (metal rod)
6. Determination of overall resistance of a composite wall
7. Determination of heat transfer coefficient in forced convection through a horizontal tube
8. Determination of heat transfer coefficient for heat vertical cylinder in natural convection
9. Determination of LMTD and NTU in parallel flow and counter flow heat exchanger
10. Determination of Stefan Boltzmann's constant
11. Determination of Emissivity
12. Demonstration of heat pipe.

MEC311C

Manufacturing Processes Lab

0-0-2

List of Experiments:

1. Basic understanding of Different Manufacturing Processes: concepts, application, advantage and future aspects.
2. Hands on Exercise on Pattern Making.
3. Performance on Metal Casting of Simple component.
4. Study of SMAW/ MMAW process.
5. Making of Lap joints / T- Joints at different welding parameters.
6. Study of TIG / MIG welding processes.
7. Making of Butt joint at different welding parameter by TIG.
8. Making of Butt joint at different welding parameter by MIG.
9. Making of Butt joint (16 mm MS rod) by friction welding at different speed.
10. Design a Jig and Fixture for given component.