IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Mechanical Engineering Department

B. Tech, V Sem

Scheme

S. No.	Subject Code	Category	Subject Name	Maximum Marks Allotted					Total Marks	Contact Hours per week			Total Credits
				Theory			Practical						
				End Sem.	Mid Sem. Exam.	Quiz/ Assignment	End Sem	Term work / Lab Work & Sessional		L	T	P	
1.	PCC-ME09	PCC	Heat Transfer	60	25	15			100	2	1	-	3
2.	PCC-ME10	PCC	Machine Design 1	60	25	15			100	3	1	-	4
3.	PCC-ME11	PCC	Manufacturing Technology	60	25	15			100	3	-	-	3
4.	PCC-ME12	PCC	Mechanical Measurement & Control	60	25	15			100	2	1	-	3
5.	HSMC-HS05	HSMC	Humanities and Social Science Open Course-I	60	25	15			100	2	-	-	2
6.	IFC-CIOT01	IFC	Interdisciplinary Foundation Course-II	60	25	15			100	2	-	-	2
7.	LC-ME09(P)	LC	Heat Transfer Laboratory				60	40	100	-	-	2	1
8.	LC-ME10(P)	LC	Machine Design Laboratory				60	40	100	-	-	2	1
9.	LC-ME12 (P)	LC	Mechanical Measurement & Control Laboratory				60	40	100	-	-	2	1
10.	SBC-ME04 (P)	SBC	Software Lab-I				60	40	100	-	-	2	1
11.	MLC-MLC 03	MLC	Environmental Studies	-	-	-	-	-	-	1	0	0	Audit
Total Academic Engagements and Credits										12	3	10	21
Total				360	150	90	240	160	1000	12	3	10	21

*MST: Minimum of two mid semester tests to be conducted.

L: Lecture T: Tutorial P: Practical

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IPS Academy, Institute of Engineering & Science
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B. Tech, V Sem
Syllabus

PCC-ME09	Heat Transfer	2L : 1T : 0P (3 Hrs)	Credits: 03

Prerequisite(s): Thermodynamics

Course Objective's:
To understand the fundamentals of heat transfer mechanisms in fluids and solids and their applications in various heat transfer equipment in process industries.

Module 1 **(10 hrs)**

Introduction: Modes/laws of heat transfer, thermo-physical properties, Electrical Analogy in conduction, derivation of Generalized heat conduction equation in Cartesian coordinates, Generalized heat conduction equation in cylindrical and spherical co-ordinates. (no derivation).

One dimensional steady state heat conduction: Heat conduction through a plane wall, cylindrical wall and sphere. Heat conduction through a composite slab, cylinder and sphere, effect of variable thermal conductivity, critical radius of insulation, One dimensional steady state heat conduction with heat generation for plane wall, cylinder and sphere

Module 2 **(10 hrs)**

Extended Surfaces: Types and Applications of Fins, Heat transfer through extended surfaces, derivation of temperature distribution equations and heat transfer through fins of constant cross-sectional area, Effectiveness and efficiency of a fin, Errors in the measurement of temperature in a thermo-well.

Unsteady State Heat Conduction: System with negligible internal resistance, Biot and Fourier numbers. Lumped heat capacity method, use of Heisler charts.

Module 3 **(10 hrs)**

Convection: Local and average convective coefficient, Hydrodynamic and thermal boundary layer, Laminar and turbulent flow over a flat plate and through a duct, Friction factor, Drag and drag co-efficient.

Free and Forced Convection: Dimensional analysis in free and forced convection, physical significance of the dimensionless numbers related to free and forced convection, empirical correlations for free and forced convection for heat transfer in laminar and turbulent flow over a flat plate and through a duct.

Module 4 **(08 hrs)**

Radiation: Fundamental concepts, Black body radiation, Planck's distribution law, Wien's displacement law and the Stefan-Boltzmann law. Surface emission, radiative properties of a surface, the grey, black and real surface. Radiation shape factor, use of shape factor charts, Kirchhoff's law, Lambert's cosine law. Heat exchange between non-black bodies, heat exchange between two infinitely parallel planes and cylinders, Radiation shields, heat exchange by radiation, between two finite black/gray surfaces.

12/07/25

IPS Academy, Institute of Engineering & Science
(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)
Mechanical Engineering Department
B. Tech, V Sem

Module 5 **(08 hrs)**

Heat Exchangers: Heat exchangers classification, overall heat transfer coefficient, heat exchanger analysis, use of log mean temperature difference (LMTD) for parallel and counter flow heat exchangers, LMTD correction factor, fouling factor, The effectiveness-NTU method for parallel and counter flow heat exchangers. Design considerations of heat exchanger, compact heat exchangers.

Course Outcome:

After completion of the course student will be able:

1. Explain various modes of heat transfer and Determine thermal conductivity of different materials.
2. Analyse the phenomenon of heat transfer through extended surface and to describe unsteady state conduction.
3. Evaluate heat transfer coefficient for free and forced convection & apply the concept of dimensional analysis.
4. Study different types of heat exchanger and Evaluate their performance characteristics.
5. Explain the concept of thermal radiation and Examine the phenomenon of boiling and condensation.

List of Text Books

1. R.C. Sachdeva: Fundamentals of Engineering Heat and Mass Transfer, Wiley Eastern Ltd. (I), 2010.
2. S. P Sukhatme, A Text Book of Heat Transfer, University Press, 4th Edition, 2005.
3. Domkudwar,Heat and Mass Transfer,Dhanpat Rai & Co. 2010
4. R K Rajput, Heat & Mass Transfer, S Chand Publication, 5th Edition 2012.
5. D. S Kumar, Heat & Mass Transfer, S. K. Kataria & Sons, 2012.

List of Reference Book

1. Incropera and Dewitt: Fundamentals of Heat and Mass Transfer, John Wiley and Sons, NY, 7th Edition, 2011.
2. Frank Kreith: Principles of Heat Transfer, Cengage Learning, 7th Edition 2011.
3. Yunus A. Cengel, Heat Transfer: A Practical Approach, McGraw-Hill Higher Education, 2002.
4. J.P. Holman: Heat Transfer; McGraw-Hill, 1996.

List of Data Book

5. Kothandaraman. C. P, Subramanyan, S, "Heat and Mass Transfer Data Book", New Age International, 7th edition, 2010.
6. Khurmi. R. S, "Steam Tables", S. Chand Publishers, 2012.

12/01/25

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IPS Academy, Institute of Engineering & Science

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Mechanical Engineering Department

B. Tech, V Sem

PCC – ME10	Machine Design I	3L: 1T: 0P (4 hrs.)	Credits: 04

Pre-requisite(s):
Basic concepts of Engineering Mechanics

Course Objective:

1. To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.
2. To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.
3. To understand procedure of machine design and develop an ability to apply it for simple component design by using design data hand book.
4. To determine forces on transmission shaft and design of transmission shaft.
5. To determine the endurance strength and design of components subjected to fluctuating loads.

Module 1: **(10Hrs)**

Stress Concentration and Fatigue: causes of stress concentration, stress concentration in tension, bending and torsion; reduction of stress concentration, theoretical stress concentration factor, notch sensitivity, fatigue stress concentration factor, cyclic loading, endurance limit, S-N Curve, loading factor, size factor, surface factor. Design consideration for fatigue, Goodman and modified Goodman's diagram, Soderberg equation, Gerber parabola, design for finite life, cumulative fatigue damage factor.

Module 2: **(10 Hrs)**

Design of Belts, Rope and chain Drive: Types of belts and their selection criteria, types of ropes and chains and design criteria for their selections for various applications, matched sets of belts, calculations of different tensions, lengths, sections, materials, etc.

Module 3:

Design of shaft under combined bending, twisting and axial loading; shock and fatigue factors, design for rigidity; Design of shaft subjected to dynamic load; Design of keys and shaft couplings.

Module 4: **(12 Hrs)**

Design of Spring: helical compression and tension springs, consideration of dimensional and functional constraints, leaf springs and torsion springs; fatigue loading of springs, surge in spring; special springs, Power Screws: design of power screw and power nut, differential and compound screw, design of simple screw jack.

Module 5: **(08 Hrs)**

Clutches: Materials for friction surface, uniform pressure and uniform wear theories, Design of friction clutches: Disk, plate clutches, cone & centrifugal clutches.

12/07/25

MECHANICAL ENGG. DEPTT. HOD

IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Mechanical Engineering Department

B. Tech, V Sem

Course Outcome:

After completion of the course student will be able:

1. Understand component behavior subjected to loads and identify the failure criteria.
2. Understand the basic concept of shaft.
3. Designs of springs subjected to loads and identify the failure criteria.
4. Understand the basic concepts of Clutches and their design.
5. Design of Journal Bearing with their life.

List of Text Books :

1. "Machine Design", "S.Chand Publication", "Edition 2019".
2. "Design of Machine elements", "Khanna Publication", "Edition 2017".

List of Reference Books:

1. "Machine Design", "TMH", "Edition 2018".
2. "Machine Design", "Cengage Learning", "Edition 2016".
3. "Design of Machine elements", "PHI", "Edition 2018".
4. "Machine Design", "Khanna Publication", "Edition 2018".
5. "Design of Machine Elements", "TMH", "Edition 2018".
6. "Machine Design", "Kataria & Sons", "Edition 2018".
7. "Machine Design", "CBS Publication", "Edition 2017".

12/07/25

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Mechanical Engineering Department

B. Tech, V Sem

PCC-ME11	Manufacturing Technology	3L: 0T:0P (3 Hrs)	Credits: 03

Pre-requisite(s): Knowledge of Manufacturing Process

Course Objective's:

1. To Know the basic operations on various types of machine
2. To understand the various plastic moulding and extrusion processes
3. To Know the various non-conventional manufacturing processes
4. To understand the NC,CNC & DNC machine
5. To understand Industry 4.0 and it's benefits

Course Content:

Module 1: **(10 Hrs)**

Theory of Metal Cutting: Analysis of Machining processes, introduction, tool geometry, tool materials, wear characteristics, cutting forces, cutting fluids, failure of cutting tools, broaching operation, types of broaching machines, design of broaching tools, centre less grinding, thread chaser, thread grinding boring, super finishing processes like honing, lapping, electro polishing and buffing.

Module 2: **(08 Hrs)**

Plastic Moulding & Extrusion: Plastics, composition of plastic materials, moulding method-injection moulding, compression moulding, transfer moulding, extrusion moulding, calendaring, blow moulding, laminating and reinforcing, welding of plastics. Extrusion, principles, hot and cold extrusion processes, tube extrusion, sawing, power hacksaw, band saw, circular saw

Module 3: **(10 Hrs)**

Non-Conventional Machining: Non-conventional machining processes, introduction, abrasive jet machining, ultrasonic machining, electrochemical machining, electro discharge machining, electron beam machining, laser beam machining, plasma arc machining, non destructive testing of machined surfaces and tools

Module 4: **(10 Hrs)**

NC, CNC & DNC: Introduction to numerical control machining, NC Machine tools, NC tooling, part programming, functions, coordinate systems, CNC types function and advantage, DNC types function and advantage. Introduction to FMS and Machining center

Module 5: **(10 Hrs)**

Industry 4.0: Introduction, evolution, Drivers, Goals, and Benefits of Industry 4.0, Pillars of Industry 4.0, Comparison of Traditional v/s Smart Manufacturing, Enabling Technologies of Industry 4.0, Implementation Roadmap for Industry 4.0;Sustainability and Green Manufacturing, Real-world examples (Tesla, Siemens, Bosch), Industry 5.0, Human-Centric Manufacturing.

12/07/25

MECHANICAL ENGG. DEPTT. HOD IPSA IES, INDORE

IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Mechanical Engineering Department

B. Tech, V Sem

Course Outcomes:

After completion of the course student will be able:

1. Understand the function and operations of different types of machine
2. Understand the various plastic moulding and extrusion processes
3. Have the knowledge of various non-conventional manufacturing processes
4. Have the knowledge of NC,CNC & DNC
5. Compare traditional and smart manufacturing processes

Text Books:

1. R. K. Jain, Production Technology, Khanna Publishes:2019
2. Chapman W.A.-"Workshop Technology, Vol. II, III, & I", Edward Arnold Pub. Ltd. London 1995
3. Hajra Chaudhary S.K.- Elements of Workshop Technology, Vol. I& II, 2008.
4. Rao P.N., Manufacturing Technology, Tata McGraw Hill2013

Reference Books:

1 HMT Hand book- Production Technology;2008

2 Roy A. & Linberg- "Processes and materials of manufacturing", 1990.

3 Campbell J.S.: Principles of manufacturing Materials and Processes, McGraw-Hill, 1984

4 Philip F Ostwald; Manufacturing Process & systems : John Wiley;2000

12/01/25

MECHANICAL ENGG. DEPTT. HOD IPSA/ES, INDORE

IPS Academy, Institute of Engineering & Science
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Mechanical Engineering Department
B. Tech, V Sem

PCC – ME12	Mechanical Measurement & Control	2L: 1T: 0P (3 Hrs)	Credits: 03

Pre-requisite(s):
Nil

Course Objective's:
The main objective of this course is to make students familiar with the mechanical measuring systems, and the standard measurement methods. It further aims to make them to understand the basic measurement systems in the real time engineering applications.

Course Content:

Module 1: **(10 Hrs)**
Basic Concepts of Measurement: General measurement system; Experimental test plan: variables, parameters, noise and interference, replication and repetition; Calibration: Static calibration, dynamic calibration, static sensitivity, range, accuracy, precision and bias errors, sequential and random tests; Presenting data: Rectangular coordinate format, semi-log, full-log formats. Measurement System Behavior: General model for a dynamic measurement system and its special cases: zero order, first order, and second order system, determination of time constant and settling time, phase linearity.

Module 2: **(09 Hrs)**
Statistics: Least square regression analysis and data outlier detection; Normal distribution and concept of standard deviation of the mean in finite data set, Uncertainty Analysis: Measurement errors; error sources: calibration, data acquisition, data reduction; Design stage uncertainty analysis; combining elemental errors; Bias & Precision errors; Error propagation, Higher order uncertainty analysis.

Module 3: **(10 Hrs)**
Temperature Measurement: Temperature standards, Temperature scales; Thermometry based on thermal expansion: Liquid in glass thermometers, Bimetallic Thermometers; Electrical resistance thermometry: Resistance Temperature Detectors, Thermistors; Thermoelectric Temperature Measurement: Temperature measurement with thermocouples, thermocouple standards. Pressure and Velocity Measurement: Relative pressure scales, pressure reference instruments, barometer, manometer, deadweight tester, pressure gauges and transducers, total and static pressure measurement in moving fluids Flow measurement: Pressure differential meters: Orifice meter, Venturi meter, roto-meter.

Module 4: **(09 Hrs)**
Strain Measurement: Stress and strain, resistance strain gauges, gauge factor, strain gauge electrical circuits, multiple gauge bridge, bridge constant, apparent strain and temperature compensation, bending compensation. Motion, Force and Torque Measurement: Displacement measurement: Potentiometers, Linear variable differential transformers, rotary variable differential transformer; Velocity measurement: moving coil transducers; angular velocity measurement: electromagnetic techniques, stroboscopic measurement; Force measurement: load cells, piezoelectric load cells; Torque measurement: measurement of torque on rotating shafts, Power estimation from rotational speed and torque.

12/07/25

MECHANICAL ENGG. DEPTT.

Module 5: **(10 Hrs)**

Introduction to control systems: Examples of control systems. Open loop and closed loop control, Mathematical modeling of dynamic systems: Transfer function, impulse response function, block diagram of closed loop system, block diagram reduction, Transient and steady state response analyses: First order systems, unit step and unit impulse response of first order systems, second order systems, unit step and unit impulse response of second order systems, transient response specifications, modeling of mechanical systems, modeling of electrical systems, signal flow graphs, modeling of fluid systems, liquid level systems, hydraulic systems, modeling of thermal systems.

Course Outcomes:

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

1. Apply the concept of measurement system and its application in engineering fields.
2. Illustrate types of errors and uncertainty in measurements using statistical analysis of data.
3. Interpret the types of temperature, pressure and flow measuring devices and explain different measuring instruments.
4. Apply the principle of measurement for various physical quantities like strain, motion, force, torque, displacement, and velocity along with its applications.
5. Explain various types of control system and its modeling.

Text Book & References:

1. Nakra and Chowdhry; Measurement and Control; TMH
2. Figiola RS & Beasley DE; Theory and Design for Mechanical Measurements; 3e John Wiley
3. Katsuhiko Ogata; Modern Control Engineering, 4e Pearson Education, New Delhi
4. Gopal; Control Systems Principles and Design; Tata McGraw Hill, New Delhi.
5. Backwith and Buck; Mechanical Measurements. 6. Swahney; Metrology and Instrumentation;

12/01/25

MECHANICAL ENGG. DEPTT. HOD IPSA/ES, INDORE

IPS Academy, Institute of Engineering & Science

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Mechanical Engineering Department

B. Tech, V Sem

LC-ME09	Heat Transfer Laboratory	0L : 0T : 2P (2 Hrs)	Credits: 01

List of Experiment

1. Determination of thermal conductivity of a metal rod.
2. Determination of thermal conductivity of insulating powder.
3. Determination of thermal conductivity of a given liquid.
4. Determination of thermal resistance of composite slab.
5. Determination of heat transfer coefficient in natural convection.
6. Determination of heat transfer coefficient in forced convection for flow through cylinder.
7. Determination of critical heat flux.
8. Determination of emissivity of given surface.
9. Determination of Stefan Boltzmann constant.
10. Determination of effectiveness of heat exchanger (shell and tube type, plate type).
11. Heat Pipe Demonstration Apparatus.

12/07/25

MECHANICAL ENGG. DEPTT. HOD IPSA/ES, IMKOM

IPS Academy, Institute of Engineering & Science

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Mechanical Engineering Department

B. Tech, V Sem

LC – ME10	Machine Design Laboratory	0L: 0T: 2P (2 hrs.)	Credits: 01

List of Experiment:

1. Design considerations for fatigue.
2. Design criteria and procedure for springs.
3. Design of shaft.
4. Design of keys.
5. Design of couplings.
6. Design of leaf spring for a given load.
7. Design of power screw and nut.
8. Design of Centrifugal clutch.
9. Design of disc brake.
10. Design considerations for roller bearings.

12/01/25

MECHANICAL ENGG. DEPTT. HOD IPSA ITS, INDORE

IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Mechanical Engineering Department

B. Tech, V Sem

LC – ME12	Mechanical Measurement & Control Laboratory I	0L: 0T: 2P (2 Hrs)	Credits: 01

List of Experiment (Expandable):

1. Study of various temperature measuring devices; thermo couple, RTD, gas thermo meters.
2. Measuring velocity of fluid flow by Ventura meter/ orifice meter/ pitot-tube.
3. Measuring torque and power generated by a prime mover by using pony brake dynamometer.
4. Study of various pressure measuring devices like manometers, mercury in glass pressure gauge.
5. To develop a measuring device for fluid level measurement

12/01/25

MECHANICAL ENGG. DEPTT. HOD IPS-IES, INDORE

IPS Academy, Institute of Engineering & Science

(A UGC Autonomous Institute, Affiliated to RGPV, Bhopal)

Mechanical Engineering Department

B. Tech, V Sem

SBC-ME04	Software Lab - I	0L: 0T:2P (2 Hrs)	Credits: 01

1. To create 2D drawing of any IC engine component on AutoCAD.
2. To create 2D and 3D model of any machine element on CAD software Solidworks.
3. To create 3D model of any machine component using 2D drawing.
4. To make Assembly of a spur gear mechanism.
5. To perform Structural analysis of a cantilever beam using Ansys software.
6. To perform Thermal analysis of a plate using Ansys software.
7. To design and print a small keychain or gear using 3D printer.

12/01/25

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