Mechanical Engineering

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Teaching Scheme

Course Code	Course Name	Lecture hours	Tutorial hours	Practical hours	Credit
ME 3001	Heat and Mass Transfer	3	1	2	5
ME 3002	Advanced Manufacturing Processes	2	1	3	4
ME 3003	Introduction to Tribology	3	1	0	4
ME 3004	Introduction to Machine Design	3	0	0	3
ME 3005	Dynamics and Vibration	3	1	0	4
ME 3501	Lab Oriented Project/Study Oriented Project & Costing	0	0	3	2
	Total	**14**	**4**	**11**	**22**

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<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 3001</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Heat and Mass Transfer</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>2</td><td>5</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Introduction, Modes of heat transfer: Conduction, Convection, Radiation, Material properties of importance in heat transfer, Thermal conductivity, Specific heat capacity.
Conduction: One Dimensional steady-state conduction through homogeneous and composite plane walls, One-dimensional steady-state conduction through cylinders and spheres, Critical thickness of insulation, Heat transfer from fins of uniform cross section, Heat conduction in bodies with heat sources, Transient heat conduction, Lumped system analysis, Numerical methods in heat conduction.
Convection: Free and Forced, Fundamentals, Velocity and thermal boundary layer, Conservation equations for mass, momentum and energy, solution of boundary layer equations. Non-dimensional numbers, Laminar and turbulent flows, External forced convection: Drag and heat transfer, parallel flow over flat plates, flow across cylinders and spheres, Internal forced convection: Mean velocity and mean temperature, entrance region, constant heat flux and temperature condition in pipe flow, HagenPoiseuille flow, Turbulent flow and heat transfer, Natural/free convection: Equation of motion of Grashof number, natural convection over surfaces and inside enclosures
Thermal Radiation, Kirchoffs law; Plancks distribution law, Wiens displacement law. Stefan-Boltzmanns relation, Configuration factors, Radiant interchange between black and grey surfaces, Radiation shielding solar radiation.
Heat exchanger, Combined heat transfer analysis, overall heat transfer co-efficient, Types of heat exchangers, LMTD and NTU methods of heat exchanger design, Simple heat exchanger calculations.
Boiling and condensation, Boiling heat transfer: pool boiling and flow boiling, Condensation heat transfer, film condensation
Mass Transfer, Introduction, analogy between heat and mass transfer, mass diffusion, Ficks Law, boundary conditions, Steady mass diffusion through a wall, cylinder and sphere, Transient mass diffusion, mass transfer in a moving medium, diffusion of vapor through a stationary gas: Stefan Flow.
Laboratory Experiments:
1.Heat Conduction and Convection Through Extended Surface
2.Unsteady State Heat Transfer
3.Heat Transfer in Natural Convection
4.Laws of Radiant Heat Transfer and Radiant Heat Exchange
5.Dropwise and Filmwise Condensation
6.Heat Transfer Through Lagged Piple
7.Critical Heat Flux
8.Parallel and Counterflow Heat Exchanger
9.Diffusion in Liquids and Gases</td></tr>
</table>

VI	Text/References	1. Holman JP and Bhattacharya S, Heat Transfer, 10th Edition, McGraw Hill Education. 2. Incropera, F.P. and DeWitt, D.P., Principles of Heat and Mass Transfer, 7th Edition, Wiley publications. 3. Nag, P.K. (2002). Heat and Mass Transfer, TMH. 4. Thirumaleshwar, M. (2006). Fundamentals of Heat and Mass Transfer, Pearson education. 5. Ghoshdastidar, P.S. (2004). Heat Transfer. Oxford University Press. 6. Arora, Domkundwar, S. and Domkundwar, A. (1988). A Course in Heat & Mass Transfer, Dhanpat Rai & Co. 7. Incropera, F.P. and DeWitt, D.P. (2002). Fundamentals of Heat and Mass Transfer, John Willy & Sons, New York, NY. 8. John R.Howell& Richrd O Buckius, Fundamentals of Engg. Thermodynamics, McGraw Hill International. 9. Holman, J.P. (1997). Heat Transfer, 9th edition, McGraw-Hill. 10. Mills, A.F. (1999). Basic Heat and Mass Transfer. Prentice-Hall.

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<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 3002</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Advanced Manufacturing Processes</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>2</td><td>1</td><td>3</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Introduction to Advanced Manufacturing Processes; Sustainable manufacturing; Unconventional machining processes and their comparative evaluation; Fundamentals of Additive manufacturing; Advanced analysis of steels and non-ferrous alloys; Advanced modeling tools for manufacturing; Foundations of industrial finite element codes for heat treatment, machining and forming processes. Simulation of different manufacturing processes with FE packages and their experimental validation. Plastics and Composite material manufacturing. Industry oriented project.
Laboratory Experiments:
1.Basic practical skills on mechanical machining, data acquisition, filtering and analysis skills.
2.Simulation of forming and machining processes using FE package DEFORM 3D and their experimental validation.
3.Use of ANSYS and MATLAB for analyzing and solving manufacturing problems.
4.Creating 3D models of components using different CAD software and building prototypes using 3D printing machine.
5.Experimental investigation of weld quality using TIG and MIG welding techniques.
6.Demonstration on Die-Sinking and Wire-cut EDM.
7.Demonstration on Electrochemical and Ultrasonic machining setup.
8.Composite manufacturing.</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. Ghosh and Mallik, Manufacturing Science, EWP Private Ltd.
2. Hassan Abdel, Gabad El Hoffy, Advanced Manufacturing Processes, McGraw Hill.
3. V.K.Jain, Advance Machining Processes, Allied Publisher Bombay.
4. Pandey P.C., Shan H.S., Modern Machining Processes, Tata McGraw-Hill Education.
5. Weller E.J., Non-traditional Machining Processes, Society of Manufacturing Engineers, Publications.
6. Stephen P. Campbell, The Science and Engineering of Micro-fabrication, Oxford University Press.
7. Gibson, Rosen, Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing. Springer, 2009.
8. Davim, J.P, Machining Composite Materials, Wiley-ISTE, 2009.
9. Fluhrer, J. SFTC Inc. DEFORM 3D User's Manual.
10. Works, M. Matlab User Manual Version r2015b. Math Works Incorporation, Natick, MA.</td></tr>
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<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 3003</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Introduction to Tribology</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>1</td><td>0</td><td>4</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Introduction: Defining Tribology, Tribology in Design - Mechanical design of oil seals and gasket - Tribological design of oil seals and gasket, Tribology in Industry (Maintenance), Defining Lubrication, Basic Modes of Lubrication, Properties of Lubricants, Lubricant Additives, Defining Bearing Terminology - Sliding contact bearings - Rolling contact bearings, Comparison between Sliding and Rolling Contact Bearings
Friction and Wear: Friction - Laws of friction - Friction classification - Causes of friction, Theories of Dry Friction, Friction Measurement, Stick-Slip Motion and Friction Instabilities, Wear - Wear classification - Wear between solids - Wear between solid and liquid - Factors affecting wear - Measurement of wear.Theories of Wear, Approaches to Friction Control and Wear Prevention, Boundary Lubrication, Bearing Materials and Bearing Construction
Lubrication of Bearings: Mechanics of Fluid Flow - Theory of hydrodynamic lubrication - Mechanism of pressure development in oil film. Two Dimensional Reynoldss Equation and its Limitations. Idealized Bearings, Infinitely Long Plane Fixed Sliders, Infinitely Long Plane Pivoted Sliders, Infinitely Long Journal Bearings, Infinitely Short Journal Bearings, Designing Journal Bearing - Sommerfeld number - Raimondi and Boyd method - Petroffs Solution - Parameters of bearing design - Unit pressure - Temperature rise - Length to diameter ratio - Radial clearance - Minimum oil-film thickness
Hydrodynamic Thrust Bearing: Introduction - Flat plate thrust bearing - Tilting pad thrust bearing, Pressure Equation - Flat plate thrust bearing - Tilting pad thrust bearing, Load - Flat plate thrust bearing - Tilting pad thrust bearing, Center of Pressure - Flat plate thrust bearing - Tilting pad thrust bearing, Friction - Flat plate thrust bearing - Tilting pad thrust bearing.
Hydrostatic and Squeeze Film Lubrication: Hydrostatic Lubrication - Basic concept - Advantages and limitations - Viscous flow through rectangular slot - Load carrying capacity and flow requirement - Energy losses - Optimum design. Squeeze Film Lubrication - Basic concept - Squeeze action between circular and rectangular plates - Squeeze action under variable and alternating loads.Application to journal bearings. Piston Pin Lubrications.
Elasto-hydrodynamic Lubrication: Principles and Applications, Pressure viscosity term in Reynoldss equation, Hertzs Theory, Ertel-Grubin equation, Lubrication of spheres, Gear teeth bearings, Rolling element bearings.
Gas (Air-) Lubricated Bearings: Introduction, Merits, Demerits and Applications, Tilting pad bearings, Magnetic recording discs with flying head, Hydrostatic bearings with air lubrication, Hydrodynamic bearings with air lubrication, Thrust bearings with air lubrication.
Tribological Aspects of Rolling Motion: The mechanics of tyre-road interactions, Road grip and rolling resistance, Tribological aspects of wheel on rail contact. Finite Bearings: Hydrostatic bearings, Hydrodynamic bearings, Thrust oil bearings, Porous Bearings, Foil bearings, Heat in bearings.</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4"></td></tr>
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<table>
<tr><td>I</td><td>Course Code</td><td colspan="4">ME 3004</td></tr>
<tr><td>II</td><td>Course Title</td><td colspan="4">Introduction to Machine Design</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">Credit Structure</td><td>L</td><td>T</td><td>P</td><td>C</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td></tr>
<tr><td>IV</td><td>Prerequisite(If any for the student)</td><td colspan="4">Nil</td></tr>
<tr><td>V</td><td>Course Content</td><td colspan="4">Fundamentals of machine design: Design philosophy, Engineering Materials, Brief overview of design and manufacturing
Stresses in machine elements: Simple stresses, Compound stresses in machine parts, Strain analysis
Design for Strength: Design for static loading, Stress Concentration, Design for dynamic loading, Low and high cycle fatigue
Fasteners: Types of fasteners: Pins and keys, Cotter and knuckle joint, Threaded Fasteners, Design of bolted joints
Couplings: Introduction, types and uses, Design procedures for rigid and flexible rubber-bushed couplings
Power Screws: Power Screw drives and their efficiency, Design of power screws
Design of Springs: Introduction to Design of Helical Springs, Design of Helical Springs for Variable Load, Design of Leaf Springs
Design of Shaft: Shaft and its design based on strength, Design of shaft for variable load and based on stiffness
Thin and thick cylinders: Thin Cylinders, Thick cylinders- Stresses due to internal and external pressures, Design principles for thick cylinders
Design of Permanent Joints: Riveted Joints Types and Uses, Design of Riveted Joints, Welded Joints Types and Uses, Design of Welded Joints, Design of Adhesive Joints
Design of Joints for Special Loading: Design of Eccentrically Loaded Bolted/Riveted Joints, Design of Eccentrically Loaded Welded Joints, Design of Joints with Variable Loading
Design of brakes: Design of shoe brakes, Design of Band and Disc Brakes
Belt drives: Introduction to Belt drives, Design of Flat Belt drives, Design of V- Belt drives
Brief overview of bearings: Fluid Film bearings, Rolling contact bearings</td></tr>
<tr><td>VI</td><td>Text/References</td><td colspan="4">1. Design of Machine Elements by Bhandari V. B., Third Edition, McGraw Hill Education, 2010.
2. Shigleys Mechanical Engineering Design by Budynas R. G., and Nisbett J. K., Tenth Edition, McGraw Hill Education, 2016.
3. Machine Design An Integrated Approach by Norton R. L., Fifth Edition, Pearson India, 2013.
4. Design of Machine Elements by Spotts M. F., Shoup T. E., and Hornberger L. E., Eigth Edition, Pearson India, 2003.
5. A Textbook of Machine Design by Kurmi R. S., and Gupta J. K., S. Chand Publishers, 2005.</td></tr>
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I	Course Code	**ME 3005**			
II	Course Title	**Dynamics and Vibrations**			
III	Credit Structure	L	T	P	C
		3	1	0	4
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	Newtonian dynamics of a particle, systems of particles and of a rigid body; Force, torque, impulse, momentum, angular momentum, energy, and vibrations; Two-dimensional rigid-body kinematics including motion relative to a moving frame; Brief introduction to three dimensional rigid-body dynamics; Single degree of freedom system; Free and forced vibrations (harmonic and general), types of damping; Duhamels integration; Two degree of freedom system; Modal analysis, diagonalisation, eigensystem, response calculations for general excitation, proportional damping; Principle of virtual work, Lagranges equations.			
VI	Text/References	1. Principles of Dynamics by Greenwood D. T., 2nd Edition, Prentice Hall, 1987 2. Classical Mechanics by Goldstein H., Addison-Wesley, 1980. 3. Dynamics of Multibody Systems by Roberson R. E., and Schwertassek R., Spinger-Verlag, 1988.			

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I	Course Code	**ME 3501**			
II	Course Title	**Lab Oriented Project/Study Oriented Project**			
III	Credit Structure	L	T	P	C
		0	0	3	2
IV	Prerequisite(If any for the student)	Nil			
V	Course Content	This course involves projects leading to laboratory/theoretical investigation or laboratory development in the students discipline or interdisciplinary areas. These projects must conclude with project reports.			
VI	Text/References				