

ME3461 **THERMAL ENGINEERING LABORATORY** **L T P C**

COURSE OBJECTIVES

- 1 To study the valve and port timing diagram and performance characteristics of IC engines
- 2 To study the Performance of refrigeration cycle / components
- 3 To study the Performance and Energy Balance Test on a Steam Generator.

45

PART I IC ENGINES LABORATORY

List of Experiments

1. Valve Timing and Port Timing diagrams.
2. Actual p-v diagrams of IC engines.
3. Performance Test on four – stroke Diesel Engine.
4. Heat Balance Test on 4 – stroke Diesel Engine.
5. Morse Test on Multi-Cylinder Petrol Engine.
6. Retardation Test on a Diesel Engine.
7. Determination of p-θ diagram and heat release characteristics of an IC engine.
8. Determination of Flash Point and Fire Point of various fuels / lubricants
9. Performance test on a two stage Reciprocating Air compressor
10. Determination of COP of a Refrigeration system

15

PART II STEAM LABORATORY

List of Experiments:

1. Study of Steam Generators and Turbines.
2. Performance and Energy Balance Test on a Steam Generator.
3. Performance and Energy Balance Test on Steam Turbine.

TOTAL:60 PERIODS

OUTCOMES:

At the end of the course the students would be able to

1. Conduct tests to evaluate performance characteristics of IC engines
2. Conduct tests to evaluate the performance of refrigeration cycle
3. Conduct tests to evaluate Performance and Energy Balance on a Steam Generator.

CO	PO												PSO		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
1	2	2	1	1					1			1	1	1	1
2	2	2	1	1					1			1	1	1	1
3	2	2	1	1					1			1	1	1	1
Low (1) ; Medium (2) ; High (3)															

ME3591

DESIGN OF MACHINE ELEMENTS

L T P C
4 0 0 4

COURSE OBJECTIVES

- 1 To learn the various steps involved in the Design Process.
- 2 To Learn designing shafts and couplings for various applications.
- 3 To Learn the design of temporary and permanent Joints.
- 4 To Learn designing helical, leaf springs, flywheels, connecting rods and crank shafts for various applications.
- 5 To Learn designing and select sliding and rolling contact bearings, seals and gaskets.
(Use of PSG Design Data book is permitted)

UNIT – I FUNDAMENTAL CONCEPTS IN DESIGN 12

Introduction to the design process - factors influencing machine design, selection of materials based on mechanical properties - Preferred numbers- Direct, Bending and torsional loading- Modes of failure - Factor of safety – Combined loads – Principal stresses – Eccentric loading – curved beams – crane hook and 'C' frame- theories of failure – Design based on strength and stiffness – stress concentration – Fluctuating stresses – Endurance limit –Design for finite and infinite life under variable loading - Exposure to standards.

UNIT – II DESIGN OF SHAFTS AND COUPLINGS 12

Shafts and Axles - Design of solid and hollow shafts based on strength, rigidity and critical speed – Keys and splines – Rigid and flexible couplings.

UNIT – III DESIGN OF TEMPORARY AND PERMANENT JOINTS 12

Threaded fasteners - Bolted joints including eccentric loading, Knuckle joints, Cotter joints – Welded joints- Butt, Fillet and parallel transverse fillet welds – welded joints subjected to bending, torsional and eccentric loads, riveted joints for structures - theory of bonded joints.

UNIT – IV DESIGN OF ENERGY STORING ELEMENTS AND ENGINE COMPONENTS 12

Types of springs, design of helical and concentric springs–surge in springs, Design of laminated springs - rubber springs - Flywheels considering stresses in rims and arms for engines and punching machines-- Solid and Rimmed flywheels- connecting rods and crank shafts

UNIT – V DESIGN OF BEARINGS AND MISCELLANEOUS ELEMENTS 12

Sliding contact and rolling contact bearings - Hydrodynamic journal bearings, Sommerfeld Number, Raimondi & Boyd graphs, -- Selection of Rolling Contact bearings –Design of Seals and Gaskets.

TOTAL: 60 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Explain the design machine members subjected to static and variable loads.
2. Apply the concepts design to shafts, key and couplings.
3. Apply the concepts of design to bolted, Knuckle, Cotter, riveted and welded joints.
4. Apply the concept of design helical, leaf springs, flywheels, connecting rods and crank shafts.
5. Apply the concepts of design and select sliding and rolling contact bearings, seals and gaskets.

TEXT BOOKS:

1. Bhandari V B, "Design of Machine Elements", 4th Edition , Tata McGraw-Hill Book Co, 2016
2. Joseph Shigley, Richard G. Budynas and J. Keith Nisbett "Mechanical Engineering Design", 10th Edition, Tata McGraw-Hill , 2015.

REFERENCES:

1. Ansel C Ugural, "Mechanical Design – An Integral Approach", 1st Edition, Tata McGraw-Hill Book Co, 2004.
2. Merhyle Franklin Spotts, Terry E. Shoup, and Lee EmreyHornberger, "Design of Machine Elements" 8th Edition, Printice Hall, 2004.
3. Robert C. Juvinall and Kurt M. Marshek, "Fundamentals of Machine component Design",6th Edition, Wiley, 2017.
4. Sundararajamoorthy T. V. and Shanmugam .N, "Machine Design", Anuradha Publications, Chennai, 2003.
5. Design of Machine Elements | SI Edition | Eighth Edition | By Pearson by M. F. Spotts, Terry E. Shoup, et al. | 25 March 2019

CO	PO												PSO		
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1	2	2	3					1	1			2	3	2	2
2	2	2	3					1	1			2	3	2	2
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4	2	2	3					1	1			2	3	2	2
5	2	2	3					1	1			2	3	2	2

Low (1) ; Medium (2) ; High (3)

ME3592

METROLOGY AND MEASUREMENTS

L T P C
3 0 0 3

COURSE OBJECTIVES

- 1 To learn basic concepts of the metrology and importance of measurements.
- 2 To teach measurement of linear and angular dimensions assembly and transmission elements.
- 3 To study the tolerance analysis in manufacturing.
- 4 To develop the fundamentals of GD & T and surface metrology.
- 5 To provide the knowledge of the advanced measurements for quality control in manufacturing industries.

UNIT – I BASICS OF METROLOGY

9

Measurement – Need, Process, Role in quality control; Factors affecting measurement - SWIPE; Errors in Measurements – Types – Control – Measurement uncertainty – Types, Estimation, Problems on Estimation of Uncertainty, Statistical analysis of measurement data, Measurement system analysis, Calibration of measuring instruments, Principle of air gauging- ISO standards.

UNIT – II MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS

9

Linear Measuring Instruments – Vernier caliper, Micrometer, Vernier height gauge, Depth Micrometer, Bore gauge, Telescoping gauge; Gauge blocks – Use and precautions, Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector - Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges, Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope. Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch. Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead – Functional checking – Rolling gear test.

UNIT – III TOLERANCE ANALYSIS

9

Tolerancing– Interchangeability, Selective assembly, Tolerance representation, Terminology, Limits and Fits, Problems (using tables IS919); Design of Limit gauges, Problems. Tolerance analysis in manufacturing, Process capability, tolerance stackup, tolerance charting.

UNIT – IV METROLOGY OF SURFACES

9

Fundamentals of GD & T- Conventional vs Geometric tolerance, Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations; Simple problems – Measurement of Surface finish – Functionality of surfaces, Parameters, Comparative, Stylus based and Optical Measurement techniques, Filters, Introduction to 3D surface metrology- Parameters.

UNIT – V ADVANCES IN METROLOGY

9

Lasers in metrology - Advantages of lasers – Laser scan micrometers; Laser interferometers – Applications – Straightness, Alignment; Ball bar tests, Computer Aided Metrology - Basic concept of CMM – Types of CMM – Constructional features – Probes – Accessories – Software – Applications – Multi-sensor CMMs.

Machine Vision - Basic concepts of Machine Vision System – Elements – Applications - On-line and in-process monitoring in production - Computed tomography – White light Scanners.

TOTAL: 45 PERIODS

OUTCOMES: At the end of the course the students would be able to

1. Discuss the concepts of measurements to apply in various metrological instruments.
2. Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.
3. Apply the tolerance symbols and tolerance analysis for industrial applications.
4. Apply the principles and methods of form and surface metrology.
5. Apply the advances in measurements for quality control in manufacturing Industries.

TEXT BOOKS:

1. Dotson Connie, "Dimensional Metrology", Cengage Learning, First edition, 2012.
2. Mark Curtis, Francis T. Farago, "Handbook of Dimensional Measurement", Industrial Press, Fifth edition, 2013.

REFERENCES:

1. AmmarGrous, J "Applied Metrology for Manufacturing Engineering", Wiley-ISTE, 2011.
2. Galyer, J.F.W. Charles Reginald Shotbolt, "Metrology for Engineers", Cengage Learning EMEA; 5th revised edition, 1990.
3. National Physical LaboratoryGuideNo. 40, No. 41, No. 42, No. 43, No. 80, No. 118, No. 130, No. 131. <http://www.npl.co.uk>.
4. Raghavendra N.V. and Krishnamurthy. L., Engineering Metrology and Measurements, Oxford University Press, 2013.
5. Venkateshan, S. P., "Mechanical Measurements", Second edition, John Wiley & Sons, 2015.

C O	PO												PSO		
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2	3	2	2	2					1			1	3	2	1
3	3	2	2	2					1			1	3	2	1
4	3	2	2	2					1			1	3	2	1
5	3	2	2	2					1			1	3	2	1

Low (1) ; Medium (2) ; High (3)

ME3581**METROLOGY AND DYNAMICS LABORATORY**

L	T	P	C
0	0	4	2

COURSE OBJECTIVES

- 1 To study the different measurement equipment and use of this industry for quality inspection.
- 2 To supplements the principles learnt in dynamics of machinery.
- 3 To understand how certain measuring devices are used for dynamic testing.

UNIT - I METROLOGY**30****LIST OF EXPERIMENTS**

1. Calibration and use of linear measuring instruments – Vernier caliper, micrometer, Vernier height gauge, depth micrometer, bore gauge, telescopic gauge, Comparators.
2. Measurement of angles using bevel protractor, sine bar, autocollimator, precision level.
3. Measurement of assembly and transmission elements - screw thread parameters – Screw thread Micrometers, Three wire method, Toolmaker's microscope.
4. Measurement of gear parameters – Micrometers, Vernier caliper, Gear tester.
5. Measurement of features in a prismatic component using Coordinate Measuring Machine (CMM), Programming of CNC Coordinate Measuring Machines for repeated measurements of identical components.
6. Non-contact (Optical) measurement using Measuring microscope / Profile projector and Video measurement system.
7. Surface metrology - Measurement of form parameters – Straightness, Flatness, Roundness, Cylindricity, Perpendicularity, Runout, Concentricity – in the given component using Roundness tester.
8. Measurement of Surface finish in components manufactured using various processes (turning, milling, grinding, etc.,) using stylus based instruments.

UNIT – II DYNAMICS LABORATORY**30****List of Experiments:**

1. Study of gear parameters.
2. Epicycle gear Train.
3. Determination of moment of inertia of flywheel and axle system.
4. Determination of mass moment of inertia of a body about its axis of symmetry.
5. Undamped free vibrations of a single degree freedom spring-mass system.
6. Torsional Vibration (Undamped) of single rotor shaft system.
7. Dynamic analysis of cam mechanism.
8. Experiment on Watts Governor.
9. Experiment on Porter Governor.
10. Experiment on Proell Governor.
11. Experiment on motorized gyroscope.
12. Determination of critical speed of shafts.

TOTAL:60 PERIODS**OUTCOMES:** At the end of the course the students would be able to

1. The students able to measure the gear tooth dimensions, angle using sine bar, straightness.
2. Determine mass moment of inertia of mechanical element, governor effort and range of sensitivity.
3. Determine the natural frequency and damping coefficient, critical speeds of shafts,

CO	PO												PSO		
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1		2	2	3		2	2		1	2	2		3	2	2
2		2	2	3		2	2		1	2	2		2	2	2
3		2	2	3		2	2		1	2	2		3	2	2
Avg	-	2	2	3	-	2	2	-	1	2	2	-	2.6	2	2
Low (1) ; Medium (2) ; High (3)															

ME3691**HEAT AND MASS TRANSFER****L T P C**
3 1 0 4**COURSE OBJECTIVES**

- 1 To Learn the principal mechanism of heat transfer under steady state and transient conditions.
- 2 To learn the fundamental concept and principles in convective heat transfer.
- 3 To learn the theory of phase change heat transfer and design of heat exchangers.
- 4 To study the fundamental concept and principles in radiation heat transfer.
- 5 To develop the basic concept and diffusion, convective di mass transfer.

UNIT – I CONDUCTION**12**

General Differential equation – Cartesian, Cylindrical and Spherical Coordinates – One Dimensional Steady State Heat Conduction — plane and Composite Systems – Conduction with Internal Heat Generation – Extended Surfaces – Unsteady Heat Conduction – Lumped Analysis – Semi Infinite and Infinite Solids –Use of Heisler's charts – Methods of enhanced thermal conduction

UNIT – II CONVECTION**12**

Conservation Equations, Boundary Layer Concept – Forced Convection: External Flow – Flow over Plates, Cylinders Spheres and Bank of tubes. Internal Flow – Entrance effects. Free Convection – Flow over Vertical Plate, Horizontal Plate, Inclined Plate, Cylinders and Spheres. Mixed Convection.

UNIT – III PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS**12**

Nusselt's theory of condensation- Regimes of Pool boiling and Flow boiling - Correlations in boiling and condensation. Heat Exchanger Types – TEMA Standards - Overall Heat Transfer Coefficient – Fouling Factors. LMTD and NTU methods. Fundamentals of Heat Pipes and its applications.