

MOHAMMED SATHAK A J COLLEGE OF ENGINEERING

Siruseri IT park, OMR, Chennai - 603103

LESSON PLAN

Department of Mechanical Engineering

Name of the Subject	METROLOGY AND MEASUREMENTS	Name of the handling Faculty	Mr.Muhammad Irfan A A
Subject Code	ME3592	Year / Sem	III/V
Acad Year	2023-24	Batch	2021-25

Course Objective

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.

Course Outcome

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

- CO1-Discuss the concepts of measurements to apply in various metrological instruments.
- CO2-Apply the principle and applications of linear and angular measuring instruments, assembly and transmission elements.
- CO3-Apply the tolerance symbols and tolerance analysis for industrial applications.
- CO4-Apply the principles and methods of form and surface metrology.
- CO5-Apply the advances in measurements for quality control in manufacturing Industries.

Lesson Plan

Sl. No.	Topic(s)	T / R*	Periods Required	Mode of Teaching (BB/ PPT / NPTEL/ MOOC / etc)	Blooms Level (L1-L6)	CO	PO
		Book					

UNIT I BASICS OF METROLOGY

1	Measurement – Need, Process, Role in quality control	R1	1	BB	L1	CO1	PO1
2	Factors affecting measurement - SWIPE	R1	1	BB	L2	CO1	PO1
3	Errors in Measurements – Types – Control	R1	1	BB	L2	CO1	PO1
4	Measurement uncertainty – Types, Estimation	R1	1	BB	L1	CO1	PO1
5	Problems on Estimation of Uncertainty	R1	1	BB	L3	CO1	PO1,PO2
6	Statistical analysis of measurement data	R1	1	BB	L2	CO1	PO1,PO2
7	Measurement system analysis	R1	1	BB	L2	CO1	PO1
8	Calibration of measuring instruments, Principle of air gauging	R1	1	BB	L2	CO1	PO1
9	ISO standards	R1	1	BB	L1	CO1	PO1

Suggested Activity: Assignment

Evaluation method: Internal Assessment Test

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

10	Linear Measuring Instruments – Vernier caliper, Micrometer	R1	1	BB	L1	CO2	PO1
11	Vernier height gauge, Depth Micrometer, Bore gauge	R1	1	BB	L2	CO2	PO1, PO2
12	Telescoping gauge; Gauge blocks – Use and precautions	R1	1	BB	L2	CO2	PO1
13	Comparators – Working and advantages; Opto-mechanical measurements using measuring microscope and Profile projector	R1	1	BB	L3	CO2	PO1
14	Angular measuring instruments – Bevel protractor, Clinometer, Angle gauges	R1	1	BB	L2	CO2	PO1, PO2
15	Precision level, Sine bar, Autocollimator, Angle dekkor, Alignment telescope	R1	1	BB	L3	CO2	PO1, PO2
16	Measurement of Screw threads - Single element measurements – Pitch Diameter, Lead, Pitch	R1	1	BB	L2	CO2	PO1, PO2
17	Measurement of Gears – purpose – Analytical measurement – Runout, Pitch variation, Tooth profile, Tooth thickness, Lead	R1	1	BB	L2	CO2	PO1, PO2
18	Functional checking – Rolling gear test.	R1	1	BB	L3	CO2	PO1

Suggested Activity: Quiz

Evaluation method: Internal Assessment Test

UNIT III TOLERANCE ANALYSIS

19	Tolerancing– Interchangeability	R1	1	BB	L2	CO3	PO1
20	Selective assembly, Tolerance representation, Terminology	R1	1	BB	L2	CO3	PO1
21	Limits and Fits	R1	1	BB	L2	CO3	PO1, PO2
22	Problems (using tables IS919)	R1	1	BB	L3	CO3	PO1,PO2, PO3
23	Design of Limit gauges, Problems	R1	1	BB	L3	CO3	PO1,PO2, PO3
24	Tolerance analysis in manufacturing	R1	1	BB	L2	CO3	PO1, PO2
25	Process capability	R1	1	BB	L2	CO3	PO1
26	tolerance stackup	R1	1	BB	L2	CO3	PO1
27	tolerance charting	R1	1	BB	L2	CO3	PO1, PO2

Suggested Activity: Tutorial

Evaluation method: Internal Assessment Test

UNIT IV METROLOGY OF SURFACES

28	Fundamentals of GD & T	R1	1	BB	L2	CO4	PO1
29	Conventional vs Geometric tolerance	R1	1	BB	L2	CO4	PO1
30	Datums, Inspection of geometric deviations like straightness, flatness, roundness deviations	R1	2	BB	L2	CO4	PO1, PO2
31	Simple problems	R1	1	BB	L3	CO4	PO1, PO2
32	Measurement of Surface finish	R1	1	BB	L3	CO4	PO1, PO2
33	Functionality of surfaces, Parameters, Comparative, Stylus based	R1	1	BB	L2	CO4	PO1, PO2
34	Optical Measurement techniques, Filters	R1	1	BB	L2	CO4	PO1, PO2

35	Introduction to 3D surface metrology- Parameters	R1	1	BB	L2	CO4	PO1			
Suggested Activity: Assignment										
Evaluation method: Internal Assessment Test										
UNIT V ADVANCES IN METROLOGY										
36	Lasers in metrology - Advantages of lasers	R4	1	BB	L2	CO5	PO1, PO2, P06			
37	Laser scan micrometers; Laser interferometers	R4	1	BB	L3	CO5	PO1, PO2, P06			
38	Applications – Straightness, Alignment, Ball bar tests	R4	1	BB	L2	CO5	PO1			
39	Computer Aided Metrology	R4	1	BB	L2	CO5	PO1			
40	Basic concept of CMM, Types of CMM	R4	1	BB	L2	CO5	PO1			
41	Constructional features – Probes – Accessories – Software – Applications, Multi- sensor CMMs	R4	1	BB	L2	CO5	PO1, PO2, P06			
42	Machine Vision - Basic concepts of Machine Vision System	R4	1	BB	L3	CO5	PO1, PO2, P06			
43	Elements – Applications - On-line and in- process monitoring in production	R4	1	BB	L3	CO5	PO1			
44	Computed tomography – White light Scanners	R4	1	BB	L3	CO5	PO1			
Suggested Activity: Seminar										
Evaluation method: Internal Assessment Test										
Content Beyond the Syllabus Planned										
1	Measurement of Force									
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.									
Reference Books										
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									
Website / URL References										
1	https://nptel.ac.in/courses/112104250									
2	https://nptel.ac.in/courses/112106139									
3	https://nptel.ac.in/courses/112106179									
4	https://nptel.ac.in/courses/112106138									
Blooms Level										
Level 1 (L1) : Remembering		Lower Order Thinking	Fixed Hour Exams	Level 4 (L4) : Analysing					Higher Order Thinking	Projects / Mini Projects
Level 2 (L2) : Understanding				Level 5 (L5) : Evaluating						
Level 3 (L3) : Applying				Level 6 (L6) : Creating						
Mapping syllabus with Bloom’s Taxonomy LOT and HOT										
Unit No	Unit Name	L1	L2	L3	L4	L5	L6	LOT	HOT	Total
Unit 1	BASICS OF METROLOGY	3	5	1	0	0	0	9	0	9
Unit 2	MEASUREMENT OF LINEAR, ANGULAR DIMENSIONS, ASSEMBLY AND TRANSMISSION ELEMENTS	1	5	3	0	0	0	9	0	9

Unit 3	TOLERANCE ANALYSIS	0	7	2	0	0	0	9	0	9
Unit 4	METROLOGY OF SURFACES	0	7	2	0	0	0	9	0	9
Unit 5	ADVANCES IN METROLOGY	0	5	4	0	0	0	9	0	9
Total		4	29	12	0	0	0	45	0	45
Total Percentage		8.88889	64.44444	26.66667	0	0	0	100	0	100

CO PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2												
CO2	3	2												
CO3	3	2	2										1	
CO4	3	2											1	
CO5	3	2				2							1	2
Avg	3	2	2			2							1	2

Justification for CO-PO mapping

CO1	PO1: Applying the knowledge of maths / science agreed strongly PO9: Function effectively as an individual, and as a member or leader agreed lowerly													
CO2	PO1: Applying the knowledge of maths / science agreed strongly PO2: Identifying and formulating the complex engineering problems agreed moderately PO9: Function effectively as an individual, and as a member or leader agreed lowerly													
CO3	PO1: Applying the knowledge of maths / science agreed strongly PO2: Identifying and formulating the complex engineering problems agreed moderately PO6: Applying the knowledge to the society in safe and healthy way agreed moderately PO9: Function effectively as an individual, and as a member or leader agreed moderately													
CO4	PO1: Applying the knowledge of maths / science agreed strongly PO2: Identifying and formulating the complex engineering problems agreed moderately PO6: Applying the knowledge to the society in safe and healthy way agreed moderately PO9: Function effectively as an individual, and as a member or leader agreed moderately													
CO5	PO1: Applying the knowledge of maths / science agreed strongly PO2: Identifying and formulating the complex engineering problems agreed moderately PO6: Applying the knowledge to the society in safe and healthy way agreed moderately PO9: Function effectively as an individual, and as a member or leader agreed moderately													
3	High level				2	Moderate level				1	Low level			

Name & Sign of Faculty Incharge : Mr.Muhammad Irfan

Name & Sign of Subject Expert : Dr.S.Prasath

Head of the Department : Dr.M.Shunmugasundaram