INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad - 500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTION FORM

Course Title	**ENGINEERING METROLOGY**			
Course Code	**A50318**			
Course Structure	**Lectures**	**Tutorials**	**Practicals**	**Credits**
	4	1	-	4
Course Coordinator	Mr V. Mahidhar Reddy, Assistant Professor.			
Team of Instructors	Mr. M.Sunil Kumar, Mr. V. Mahidhar Reddy Assistant Professor			

I. COURSE OVERVIEW

The Knowledge of Engineering Metrology and its practical applications is of vital importance in the modern competitive industrial environment. The most important factor in achieving quality and reliability in service of any product in its dimensional control. Hence to meet with increasing exacting demands of industry for mechanisms and assemblies the functioning of which must meet the stringent design requirement, closer attention must be paid to science of precision measurement.

II. PREREQUISITE(S)

Level	Credits	Periods	Prerequisite
UG	4	4	Mathematics, Physics, Mechanics.

III. MARKS DISTRIBUTION

Sessional Marks	University End Exam Marks	Total Marks
There shall be 2 midterm examinations. Each midterm examination consists of subjective type and Objective type tests. The subjective test is for 10 marks, with duration of 1 hour. Subjective test of each midterm exam shall contain 4 questions. The student has to answer 2 questions, each carrying 5 marks. The objective type test is for 10 marks with duration of 20minutes. It consists of 10 Multiple choice and 10 objective type questions. The student has to answer all the questions and each carries half mark. First midterm examination shall be conducted for the first 2 ½ units of syllabus and second midterm examination shall be conducted for the remaining 2 ½ units. Five marks are earmarked for assignments. There shall be two assignments in every theory course. Marks shall be awarded considering the average of two assignments in each course reason whatsoever, will get zero marks(s).	75	100

IV. EVALUATION SCHEME

S.No	Component	Duration	Marks
1	I Mid examination	90 minutes	20
2	I Assignment	--	05
3	II Mid examination	90 minutes	20
4	II Assignment	--	05
5	External examination	3 hours	75

V. COURSE OBJECTIVES

I. **Understanding** the type of inspection procedure which will be applied for given process for the manufactured parts for given product to satisfy the functional requirement.
II. **Demonstration** of suitable instruments and inspection process that has to adopt to satisfy the requirement of assembly.
III. **Familiarize** with different type of instruments to support for the production and manufacturing fields as managers to lead the industrial organizations.
IV. **Enhance** the knowledge to apply scientific methods of inspection to improve the quality and to save the materials to grow in their professional carriers
V. To serve as a link to several other subjects in the background of Mechanical Engineer.

VI. COURSE OUTCOMES

After completing this course the student must demonstrate the knowledge and ability to:

1. **Analyze** the importance of Measuring Instruments.
2. **Illustrates** the categories of different types of instruments used in checking quality control department.
3. **Understands** the basic concepts of Measurement, true values of manufacturing dimensional accuracy for clear understanding the functional requirement.
4. **Recall** the defective parts for checking error free products.
5. **Compare** different types of process of measurement..
6. **Classify** various needs of measuring system for the manufacturing process.
7. **State** the importance of Quality Checking Department in manufacturing environment.
8. **Organize** various system models.
9. **Compare** new ideas in view of further development of the product design from time to time.
10. **Decision** making, ability to communicate in written, oral forms before starting the production
11. **State** the importance of alternative corrections to suit the functional requirement of the product.

VII. HOW PROGRAM OUTCOMES ARE ASSESSED

Program outcomes		Level	Proficiency assessed by
PO1	Capability to apply the knowledge of mathematics, science and engineering in the field of mechanical engineering.	H	Assignments and Tutorials
PO2	An ability to analyze complex engineering problems to arrive at relevant conclusion using knowledge of mathematics, science and engineering.	H	Tutorials
PO3	Competence to design a system, component or process to meet societal needs within realistic constraints.	S	Exams
PO4	To design and conduct research oriented experiments as well as to analyze and implement data using research methodologies.	S	Mini Projects
PO5	An ability to formulate solve complex engineering problem using modern engineering and information Technology tools.	H	Assignments, Exams
PO6	To utilize the engineering practices, techniques, skills to meet needs of the health, safety, legal, cultural and societal issues.	N	Assigning Mini Projects
PO7	To understand impact of engineering solutions in the societal context and demonstrate the knowledge for sustainable development.	S	Assignments
PO8	An understanding and implementation of professional and ethical responsibilities.	H	------

PO9	To function as an effective individual and as a member or leader in multi disciplinary environment and adopt in diverse teams.	S	Assignments, Tutorials and Exams
PO10	An ability to assimilate, comprehend, communicate, give & receive instructions to present effectively with engineering community and society.	S	-----
PO11	An ability to provide leadership in managing complex engineering projects at multidisciplinary environment and to become a Technocrat.	H	Mini Projects
PO12	Recognition of the need and an ability to engage in lifelong learning to keep abreast with technological changes.	S	------

VIII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED

Program Specific Outcomes		Level	Proficiency Assessed by
PSO 1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	H	Lectures, Assignments
PSO 2	**Design/ Analysis:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	S	Projects
PSO 3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become Technocrats.	H	Guest Lectures

N - None **S - Supportive** **H – Highly Related**

IX. SYLLABUS

UNIT-I

Systems of limits and fits:

Introduction, normal size, tolerance limits, deviations, allowance, fits and their types – unilateral and bilateral tolerance system, hole and shaft basis systems – interchangeability, and selective assembly. Indian standard Institution system, International Standard system for plain and screwed work.

UNIT-II

LINEAR MEASUREMENT :

Length standard, line and end standard, slip gauges – calibration of the slipgauges, Dial indicator, micrometers

MEASUREMENT OF ANGLES AND TAPERS :

Different methods – Bevel protractor – angle slip gauges – spirit levels – sine bar – Sine plate used to determine the tapers.

LIMIT GAUGES :

Taylors principle – Design of go and No go gauges, plug ring, snap, gap, taper, profile and position gauges.

UNIT-III

OPTICAL MEASURING INSTRUMENTS :

Tool maker's microscope and its uses – collimators, optical projector – optical flats and their uses, interferometer.

FLAT SURFACE MEASUREMENT :

Measurement of flat surfaces – instruments used – straight edges – surface plates – optical flat and auto collimator.

UNIT-IV

SURFACE ROUGHNESS MEASUREMENT :

Differences between surface roughness and surface waviness-Numerical assessment of surface finish – CLA,R, R.M.S Val ues – Rz values, Ra value, Methods of measurement of surface finish-profilograph. Talysurf, ISI symbols for indication of surface finish.

UNIT-V

MEASUREMENT THROUGH COMPARATORS :

Comparators – Mechanical, Electrical and Electronic Comparators, pneumatic comparators and their uses in mass production.

SCREW THREAD MEASUREMENT :

Element of measurement – errors in screw threads – measurement of effective diameter, angle of thread and thread pitch, profile thread gauges.

MACHINE TOOL ALIGNMENT TESTS :

Requirements of Machine Tool Alignment Tests, Alignment tests on lathe, milling, drilling machine tools.. Preparation of acceptance charts.

GEAR MEASUREMENT:

Gear measuring instruments, Gear tooth profile measurement. Measurement of diameter, pitch pressure angle and tooth thickness.

Coordinate Measuring Machines : Types of CMM, Role of CMM, and Applications of CMM.

TEXT BOOKS:

1. Engineering Metrology / R.K. Jain / Khanna Publishers
2. Engineering Metrology / I C Gupta./ Danpath Rai

REFERENCE BOOKS:

1. Dimensional Metrology/Connie Dotson/Cengage Learning.
2. BIS standards on Limits & Fits, Surface Finish, Machine Tool Alignment etc.
3. Fundamentals of Dimensional Metrology / Connie Dotson / Thomson /4th Edition. R4. Engineering Metrology/Kenneth John Hume/McDonald.
4. Engineering Metrology/D.M. Anthony/Pergamon Press.
5. Principles of Engineering Metrology/Rega Rajendra/Jaico Publications.

X. COURSE PLAN:

The course plan is meant as a guideline. There may probably be changes.

Lecture No.	Course Learning Outcomes	Topics to be covered	Reference
1-2	**Define** the nomenclature of the tolerances and its importance for the operator before manufacture.	**UNIT-I** **Systems of limits and fits:** Introduction, normal size, tolerance limits,	T2
3	**Describe** differences between allowance and deviations	deviations, allowance	T2
4	**Illustrate** various types of fits for industrial applications	Fits and their types	T1, T2
5	**Categorize and Describe** the system of tolerances for different types of fits	Unilateral and bilateral tolerance system	T2
6-7	**Analyze** the basic system of approach for the easy manufacturing system for achieving suitable assembly	Hole and shaft basis systems	T1, T2
8	**Illustrate** various types of assemblies using in the manufacturing system	Interchangeability, and selective assembly	T2
9	**Illustrate** various types of standards of fits	Indian standard Institution system	T2

10	**Illustrate** various types of standards of fits	International Standard system for plain and screwed work	T1
11-12	**Analyze** the effect of tolerances for getting different types of fits and limitations	Problems	T2
13-14	**Describe** the length and end standards	**UNIT-II LINEAR MEASUREMENT :** Length standard, line and end standard,	T1, T2
15-16	**Compare** the dimension accuracy	Slip gauges – calibration of the slip gauges	T2
17	**Compare** the dimension accuracy	Dial indicator, micrometers	T1, T2
18-19	**Categorize and Describe** Taper angles for different products.	**MEASUREMENT OF ANGLES AND TAPERS :** Different methods – Bevel protractor – angle slip gauges	T2
20	**Compare** the geometry for different applications	Spirit levels, sine bar	T1, T2
21	**Evaluate** the angles of parts	Sine plate used to determine the tapers	T1
22-23	**Categorize and Describe** limit gauges	**LIMIT GAUGES :** Taylors principle – Design of go and No go gauges	T1
24	**Categorize and Describe** tapers	Plug, ring, snap, gap, taper	T1, T2
25-26	**Evaluate** profiles of gauges	Profile and position gauges	T1
27-28	**Describe** the operation of tool maker's microscope	**UNIT-III OPTICAL MEASURING INSTRUMENTS:** Tool maker's microscope and its uses	T2
29	**Evaluate** the surface texture	Collimators	T2
30	**Compare** the geometry accuracy of the component	Optical projector	T1, T2
31-32	**Evaluate** the surface texture	Optical flats and their uses	T1, T2
33-34	**Evaluate** the surface texture	Interferometer	T2, T1
35	**Evaluate** the unit content	Revision of the unit.	T2, T1
36-38	**Define** Measurement of flat surfaces	**FLAT SURFACE MEASUREMENT :** Measurement of flat surfaces	T1, T2
39-40	**Categorize and Describe** flat surface measurement instruments	Instruments used – straight edges, surface plates	T2, T1
41	**Evaluate** the surface texture	Optical flat	T1, T2
42	**Compare** the surface texture	Auto collimator	T2, T1
43	**Evaluate** the highlights of the unit content	Overview of the unit	T1, T2
44	**Describe** the operation of Surface Roughness Measurement	**UNIT-IV: SURFACE ROUGHNESS MEASUREMENT :** Differences between surface roughness and surface waviness	T2, T1
45	**Analyze** assessment of surface finish	Numerical assessment of surface finish, CLA	T1, T2
46	**Classify** R.M.S Values	R.M.S Values – Rz values, Ra value	T1, T2
47	**Calculate** the Ra Value	Ra Value- Methods of measurement of surface finish	T1, T2
48	**Evaluate** the surface texture	Profilograph	T2, T1
49	**Evaluate** the surface texture	Talysurf, ISI symbols for indication of surface finish.	T2
50-51	**Categorize and, Evaluate** the geometry of surface texture	**UNIT-V MEASUREMENT THROUGH COMPARATORS :** Comparators – Mechanical, Electrical and Electronic Comparators	T2
52	**Describe and Evaluate** the surface texture	Pneumatic comparators and their uses in mass production.	T1
53-54	**Define and Describe** the measuring of screw thread	**SCREW THREAD MEASUREMENT :** Element of measurement – errors in screw	T1

		threads	
55	**Evaluate** the screw thread profile	Measurement of effective diameter	T2
56	**Evaluate** the screw thread profile	Angle of thread and thread pitch	T2
57	**Evaluate** the screw thread profile	Profile thread gauges	T1
58-59	**Describe and Evaluate** machine tool specifications	**MACHINE TOOL ALIGNMENT TESTS :** Requirements of Machine Tool Alignment Tests	T2
60-62	**Describe and Evaluate** machine tool specifications	Alignment tests on lathe, milling, drilling machine tools	T2
63	**Analysis** of specifications of the reports	Preparation of acceptance charts.	T2
64	**Categorize and Describe** the measuring instruments for gears	**GEAR MEASUREMENT:** Gear measuring instruments	T1, T2
65	**Evaluate** gear tooth profile	Gear tooth profile measurement	T1, T2
66	**Define** gear diameter	Measurement of diameter	T1, T2
67	**Evaluate** gear parameters	Pitch pressure angle and tooth thickness.	T1, T2
68	**Categorize and Describe** coordinate measuring machines	**Coordinate Measuring Machines** : Types of CMM	T1, T2
69	**Discuss and Define** the role and applications of CMM	Role of CMM and Applications of CMM	T1, T2
70	**Evaluate** unit content highlights	Unit revision	T1, T2

XI. MAPPING COURSE OBJECTIVES LEADING TO THE ACHIEVEMENT OF THE PROGRAM OUTCOMES

Course Objectives	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
I	H				S			H					S		
II					S						H				S
III	H		S				S					H		H	
IV		S									H				S
V						S			H				H		
VI				H				S			S			H	S

N = None **S = Supportive** **H = Highly related**

XII. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF TSHE PROGRAM OUTCOMES:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
1	H				S										S
2		H									S		S		
3		H			S										
4	S										H			H	
5											H	S			S
6					S										
7		S									H		S		
8					H							S			

9			H						S					H	
10		H									S				S
11	H											S	S		
12					H		S								
13		H		S										H	
14	H					S							S		
15		H			S										S
16			H								S				

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Prepared by:

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