INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

MECHANICAL ENGINEERING

COURSE DESCRIPTOR

Course Title	**PRECISION ENGINEERING**				
Course Code	AME512				
Programme	B.Tech				
Semester	V	ME			
Course Type	Professional Elective				
Regulation	IARE - R16				
Course Structure	**Theory**			**Practical**	
	Lectures	**Tutorials**	**Credits**	**Laboratory**	**Credits**
	3	1	3	-	-
Chief Coordinator	Mr. G. Sarat Raju, Assistant Professor				
Course Faculty	Mr. G. Sarat Raju, Assistant Professor				

I. COURSE OVERVIEW:

Precision engineering concerns the manufacture of items that have a wide range of sizes, from those that are as large as the satellite rocket launcher to ones that are as small as the microchip. The absolute dimensions of the size of precision-engineered products vary widely, but the reality is that the relative accuracies involved can be comparable. Precision engineering is therefore thought of as being heavily dependent on metrology parameters such as length and angle. Its objective in the widest sense is the manufacture of materials and components, the development of manufacturing processes, the design and the manufacture of high-precision machine tools measuring devices and their control systems.

II. COURSE PRE-REQUISITES:

Level	Course Code	Semester	Prerequisites	Credits
UG	AHS008	II	Modern Physics	3

III. MARKS DISTRIBUTION:

Subject	SEE Examination	CIA Examination	Total Marks
Precision Engineering	70 Marks	30 Marks	100

IV. DELIVERY / INSTRUCTIONAL METHODOLOGIES:

✘	Chalk & Talk	✔	Quiz	✔	Assignments	✘	MOOCs
✔	LCD / PPT	✔	Seminars	✘	Mini Project	✔	Videos
✘	Open Ended Experiments						

V. EVALUATION METHODOLOGY:

The course will be evaluated for a total of 100 marks, with 30 marks for Continuous Internal Assessment (CIA) and 70 marks for Semester End Examination (SEE). Out of 30 marks allotted for CIA during the semester, marks are awarded by taking average of two CIA examinations or the marks scored in the make-up examination.

Semester End Examination (SEE): The SEE is conducted for 70 marks of 3 hours duration. The syllabus for the theory courses is divided into five units and each unit carries equal weightage in terms of marks distribution. The question paper pattern is as follows. Two full questions with "either" or "choice" will be drawn from each unit. Each question carries 14 marks. There could be a maximum of two sub divisions in a question.

The emphasis on the questions is broadly based on the following criteria:

50 %	To test the objectiveness of the concept.
50 %	To test the analytical skill of the concept OR to test the application skill of the concept.

Continuous Internal Assessment (CIA):

CIA is conducted for a total of 30 marks (Table 1), with 25 marks for Continuous Internal Examination (CIE), 05 marks for Quiz/ Alternative Assessment Tool (AAT).

Table 1: Assessment pattern for CIA

Component	Theory		Total Marks
Type of Assessment	CIE Exam	Quiz / AAT	
CIA Marks	25	05	30

Continuous Internal Examination (CIE):

Two CIE exams shall be conducted at the end of the 8th and 16th week of the semester respectively. The CIE exam is conducted for 25 marks of 2 hours duration consisting of two parts. Part–A shall have five compulsory questions of one mark each. In part–B, four out of five questions have to be answered where, each question carries 5 marks. Marks are awarded by taking average of marks scored in two CIE exams.

Quiz / Alternative Assessment Tool (AAT):

Two Quiz exams shall be online examination consisting of 25 multiple choice questions and are be answered by choosing the correct answer from a given set of choices (commonly four). Marks shall be awarded considering the average of two quizzes for every course. The AAT may include seminars, assignments, term paper, open ended experiments, five minutes video and MOOCs.

VI. HOW PROGRAM OUTCOMES ARE ASSESSED:

Program Outcomes (POs)		Strength	Proficiency assessed by
PO 1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.	3	Presentation on real-world problems
PO 2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences	2	Seminar
PO 4	**Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.	1	Term Paper

3 = High; 2 = Medium; 1 = Low

VII. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:

Program Specific Outcomes (PSOs)		Strength	Proficiency assessed by
PSO 1	**Professional Skills:** To produce engineering professional capable of synthesizing and analyzing mechanical systems including allied engineering streams.	1	Seminar
PSO 2	**Software Engineering Practices:** An ability to adopt and integrate current technologies in the design and manufacturing domain to enhance the employability.	-	-
PSO 3	**Successful Career and Entrepreneurship:** To build the nation, by imparting technological inputs and managerial skills to become technocrats.	-	-

3 = High; 2 = Medium; 1 = Low

VIII. COURSE OBJECTIVES :

The course should enable the students to:	
I	Understand the BIS code fits and tolerances for geometrical dimensioning and tolerance (GD & T).
II	Understand the principal application of different measuring instruments.
III	Summarize the application of latest manufacturing techniques (Nano).

IX. COURSE OUTCOMES (COs):

COs	Course Outcome	CLOs	Course Learning Outcome
CO 1	Describes the General concept of accuracy, dimensional wear of cutting tools, location of rectangular prism alignment tests.	CLO 1	Describes the General concept of accuracy.
		CLO 2	Describe dimensional wear of cutting tools, clamping errors & setting errors.
		CLO 3	Describes how to location of rectangular prism &cylinder.
		CLO 4	Describes basic type of tests and measuring instruments used for testing machine tools.
CO 2	Understand the Influence of static stiffness, thermal effects, compliance of work piece, Influence of vibration on accuracy.	CLO 5	Describes the Influence of static stiffness.
		CLO 6	Describes thermal effects and methods of decreasing thermal effects,
		CLO 7	Describes the compliance of work piece
		CLO 8	Describes the Influence of vibration on accuracy.
CO 3	Explains Top down and bottom up approach, development of Nanotechnology, precision and micro-machining, Stereo microlithography.	CLO 9	Describes the importance of Top down and bottom up approach,
		CLO 10	Explains the development of Nanotechnology, precision and micro-machining, Stereo microlithography.
		CLO 11	Explains the development of precision and micro-machining.
		CLO 12	Explains the development Stereo microlithography.
CO 4	Describes Nano Measuring Systems such as mechanical measuring systems, optical measuring systems.	CLO 13	Classify the various Nano Measuring systems.
		CLO 14	Discuss the various Mechanical measuring systems
		CLO 15	Discuss the optical measuring systems, electron beam measuring system.
		CLO 16	Discuss the pattern recognition and inspection systems.
CO 5	Explores various types of Lithography ,ion Beam lithography, optical lithography, LIGA process, dip pen lithography, deep UV.	CLO 17	Classify the various Lithographies.
		CLO 18	Describe the importance of Nano lithography & electron beam lithography
		CLO 19	Describe the importance of ion Beam lithography & optical lithography
		CLO 20	Explain LIGA Process, Dip Pen Lithography & deep UV.

X. COURSE LEARNING OUTCOMES (CLOs):

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
AME512.01	CLO 1	Describes the General concept of accuracy.	PO 1	3
AME512.02	CLO 2	Describe dimensional wear of cutting tools, clamping errors & setting errors.	PO 2	1
AME512.03	CLO 3	Describes how to location of rectangular prism &cylinder.	PO 1	3
AME512.04	CLO 4	Describes basic type of tests and measuring instruments used for testing machine tools.	PO 1	3
AME512.05	CLO 5	Describes the Influence of static stiffness.	PO 2	1
AME512.06	CLO 6	Describes thermal effects and methods of decreasing thermal effects,	PO 2	1
AME512.07	CLO 7	Describes the compliance of work piece	PO 2	1
AME512.08	CLO 8	Describes the Influence of vibration on accuracy.	PO 2	1
AME512.09	CLO 9	Describes the importance of Top down and bottom up approach,	PO 4	1
AME512.10	CLO 10	Explains the development of Nanotechnology,	PO 4	1

CLO Code	CLO's	At the end of the course, the student will have the ability to:	PO's Mapped	Strength of Mapping
		precision and micro-machining, Stereo microlithography.		
AME512.11	CLO 11	Explains the development of precision and micro-machining.	PO 2	1
AME512.12	CLO 12	Explains the development Stereo microlithography.	PO 2	1
AME512.13	CLO 13	Classify the various Nano Measuring systems.	PO 4	1
AME512.14	CLO 14	Discuss the various Mechanical measuring systems	PO 2	1
AME512.15	CLO 15	Discuss the optical measuring systems, electron beam measuring system.	PO 2	1
AME512.16	CLO 16	Discuss the pattern recognition and inspection systems.	PO 1, PO 4	3
AME512.17	CLO 17	Classify the various Lithographies.	PO 1, PO 2	1
AME512.18	CLO 18	Describe the importance of Nano lithography & electron beam lithography	PO 1, PO 4	3
AME512.19	CLO 19	Describe the importance of ion Beam lithography & optical lithography	PO 1, PO 2	1
AME512.20	CLO 20	Explain LIGA Process, Dip Pen Lithography & deep UV.	PO 1, PO 4	3

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

Course Outcomes (COs)	Program Outcomes (POs)			
	PO 1	PO 2	PO 4	PSO1
CO 1	3	1		1
CO 2		1		
CO 3		1	1	
CO 4	3	1	1	1
CO 5	3	1		1

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XII. MAPPING COURSE LEARNING OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 1	3												1		
CLO 2		1													
CLO 3	3												1		

Course Learning Outcomes (CLOs)	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO 4	3												1		
CLO 5		1													
CLO 6		1													
CLO 7		1													
CLO 8		1													
CLO 9				1											
CLO 10				1											
CLO 11		1											1		
CLO 12		1											1		
CLO 13				1											
CLO 14		1													
CLO 15		1													
CLO 16	3			1									1		
CLO 17	3	1											1		
CLO 18	3			1									1		
CLO 19	3	1											1		
CLO 20	3			1									1		

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XIII. ASSESSMENT METHODOLOGIES – DIRECT

CIE Exams	PO1, PO2, PO4,PSO1	SEE Exams	PO1, PO2, PO4,PSO1	Assignments	PO1,PO2, PO4,PSO1	Seminars	PO1, PO2, PO4,PSO1
Laboratory Practices	-	Student Viva	-	Mini Project	-	Certification	-
Term Paper	PO1, PO2, PO4,PSO1						

XIV. ASSESSMENT METHODOLOGIES – INDIRECT

✔	Early Semester Feedback	✔	End Semester OBE Feedback
✘	Assessment of Mini Projects by Experts		

XV. SYLLABUS

Unit-I	ACCURACY AND ALIGNMNET TEST
Accuracy and alignment tests: General concept of accuracy, Spindle rotation accuracy, test methods, displacement accuracy, dimensional wear of cutting tools, accuracy of NC systems, clamping errors, setting errors, location of rectangular prism, cylinder, basic type of tests, measuring instruments used for testing machine tools, alignment tests, straightness, flatness, parallelism, squareness, Circularity, cylindricity.	
Unit-II	**INFLUENCE OF STATIC STIFFNESS,THERMAL EFFECTS**
Influence of static stiffness, thermal effects: Static stiffness, nature of deformation in a machine tool, overall stiffness of a lathe, compliance of work piece, errors due to the variation of the cutting force and total compliance, accuracies due to thermal effects, methods of decreasing thermal effects-Influence of vibration on accuracy.	
Unit-III	**INFLUENCE OF STATIC STIFFNESS,THERMAL EFFECTS**
Top down and bottom up approach, development of Nanotechnology, precision and micro-machining, diamond turning of parts to nanometer accuracy. Stereo microlithography, machining of micro-sized components, mirror grinding of ceramics, ultra precision block gauges.	
Unit -IV	**PRECISION MACHINING**
In-process measurement of position of processing point, post process and online measurement of dimensional features, mechanical measuring systems, optical measuring systems, electron beam measuring systems, pattern recognition and inspection systems.	
Unit -V	**LITHOGRAPHY**
Nano Lithography: Photolithography, nano lithography, photolithography, electron beam lithography, ion Beam lithography, optical lithography, LIGA process, dip pen lithography, deep UV.	
Text Books:	
1. Murthy.R.L, ―Precision Engineering in Manufacturing‖, New Age International, New Delhi, 2005. 2. Norio Taniguchi, ―Nanotechnology‖, Oxford university press, Cambridge, 1996.	
Reference Books:	
1. Lee Tong Hong, ―Precision Motion control, Design and Implementation‖, Springer Verlag, U.K., 2001. 2. Liangchi Zhang, ―Precision Machining of Advanced Materials‖, Trans Tech Publications Ltd., Switzerland, 1st Edition, 2001. 3. Hiromu Nakazawa, ―Principles of Precision Engineering‖, Oxford university press, 1st Edition, 1994.	

XVI. COURSE PLAN:

The course plan is meant as a guideline. Probably there may be changes.

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
1	Describe the General concept of accuracy,	CLO 1	T2:2.3
2	Describe dimensional wear of cutting tools, clamping errors & setting errors	CLO 2	R1:2.6
3	Describes how to location of rectangular prism &cylinder.	CLO 3	T1:2.6
4	Describes basic type of tests used for testing machine tools.	CLO 4	T2:2.7 R1:2.18
5	Describes basic type of measuring instruments used for testing machine tools.	CLO 4	T2:2.22
6	Describes the Influence of static stiffness.	CLO 5	T2:2.25
7	Describe the thermal effects and methods of decreasing thermal effects,	CLO 6	T2:2.26 R1:2.55
8	Describe the methods of decreasing thermal effects,	CLO 6	T2:2.16 R1:2.61
9	Describes the compliance of work piece	CLO 7	T2:2.30 R1:2.58
10	Describe the Influence of vibration on accuracy.	CLO 8	T2:3.6 R1:4.29
11	Describe the importance of Top down and bottom up approach.	CLO 9	T2:3.14 R1:4.31
12	Explain the development of Nanotechnology.	CLO 10	T2:3.14 R1:4.33
13	Explain precision machining.	CLO 11	R1:4.36
14	Explain micro-machining, Stereo microlithography	CLO 11	T2:3.18 R1:4.64
15	Explain Stereo microlithography	CLO 12	T2:3.22
16	Classify the various Nano Measuring systems Explain In-process measurement of position of processing point.	CLO 13	T2:3.28 R1:4.67
17	Explain post process measurement of position of processing point.	CLO 13	T2:4.2
18	Explain online measurement of dimensional features.	CLO 13	T2:4.3 R1:4.71
19	Describe mechanical measuring systems,	CLO 14	T1:4.8 R2:4.68
20-21	Explain optical measuring systems,	CLO 15	T2:4.15 R1:5.74
22	Describe electron beam measuring systems,	CLO 15	T1:4.12 R2:5.75
23-24	Understand the pattern recognition and inspection systems	CLO 16	T1:4.8 R1:5.72
25	Classify the various Lithographies.	CLO 17	T1:5.8 R1:5.73
26-27	Describe the importance of Nano lithography.	CLO 18	T1:5.14 R1:6.78
28	Describe electron beam measuring systems,	CLO 15	T2:5.19 R1:6.81
29-30	Understand the pattern recognition and inspection systems	CLO 16	T1:6.4 R2:6.8

Lecture No	Topics to be covered	Course Learning Outcomes (CLOs)	Reference
31	Describe the importance of Nano lithography.	CLO 18	T2:7.7 R1:7.74
32-33	Describe the importance of electron beam lithography	CLO 18	T1:7.12 R2:8.75
34	Describe the importance of ion Beam lithography	CLO 19	T1:7.8 R1:8.72
35	Describe the importance of optical lithography	CLO 19	T1:8.8 R1:8.73
36	Explain LIGA Process.	CLO 20	T1:9.14 R1:10.78
37-38	Explain Dip Pen Lithography	CLO 20	T2:9.19 R1:10.814
39-40	Explain deep UV process	CLO 20	T1:10.4 R2:11.68
41-43	Describe the importance of Nano lithography.	CLO 18	T2:10.7 R1:12.74
44-45	Describe the importance of electron beam lithography	CLO 18	T1:11.12 R2:12.75

XVII. GAPS IN THE SYLLABUS-TO MEET INDUSTRY / PROFESSION REQUIREMENTS:

S No	Description	Proposed Actions	Relevance With POs	Relevance With PSOs
1	To improve standards and analyze the concepts.	Seminars	PO 1	PSO 1
2	To understand the technology of thermo-electric refrigeration, solar powered refrigeration, etc.	Seminars / NPTEL	PO 4	PSO 1
3	Encourage students to solve real time applications and prepare towards competitive examinations.	NPTEL	PO 2	PSO 1

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