



INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)
Dundigal, Hyderabad-500043

MECHANICAL ENGINEERING

TUTORIAL QUESTION BANK

Course Title	PRECISION ENGINEERING				
Course Code	AME512				
Programme	B.Tech				
Semester	V	ME			
Course Type	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				

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).

COURSE OUTCOMES (COs):

CO 1	Describes the General concept of accuracy, dimensional wear of cutting tools, 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.
CO 2	Describes the Influence of static stiffness, thermal effects, compliance of work piece, Influence of vibration on accuracy.
CO 3	Describes Top down and bottom up approach, development of Nanotechnology, precision and micro-machining, Stereo microlithography.
CO 4	Describes Nano Measuring Systems such as mechanical measuring systems, optical measuring systems, electron beam measuring systems, pattern recognition and inspection systems.
CO 5	Describes various types of Lithography such as Photolithography, nano lithography, electron beam lithography, ion Beam lithography, optical lithography, LIGA process, dip pen lithography, deep UV.

COURSE LEARNING OUTCOMES (CLOs):

AME512.01	Describes the General concept of accuracy,
AME512.02	Describe dimensional wear of cutting tools, clamping errors & setting errors
AME512.03	Describes how to location of rectangular prism & cylinder.
AME512.04	Describes basic type of tests and measuring instruments used for testing machine tools.
AME512.05	Describes the Influence of static stiffness.
AME512.06	Describes thermal effects and methods of decreasing thermal effects,
AME512.07	Describes the compliance of work piece
AME512.08	Describes the Influence of vibration on accuracy.
AME512.09	Describes the importance of Top down and bottom up approach,
AME512.10	Explains the development of Nanotechnology, precision and micro-machining, Stereo microlithography.
AME512.11	Explains the development of precision and micro-machining.
AME512.12	Explains the development Stereo microlithography.
AME512.13	Classify the various Nano Measuring systems.
AME512.14	Discuss the various Mechanical measuring systems
AME512.15	Discuss the optical measuring systems, electron beam measuring system.
AME512.16	Discuss the pattern recognition and inspection systems.
AME512.17	Classify the various Lithography's.
AME512.18	Describe the importance of Nano lithography & electron beam lithography
AME512.19	Describe the importance of ion Beam lithography & optical lithography
AME512.20	Explain LIGA Process, Dip Pen Lithography & deep UV

TUTORIAL QUESTION BANK

MODULE- I				
ACCURACY AND ALIGNMNET TEST				
Part - A (Short Answer Questions)				
S No	QUESTIONS	Blooms Taxonomy Level	Course Outcomes	Course Learning Outcomes (CLOs)
1	What is the term precision?	Remember	CO 1	AME512.01
2	Write briefly the dimensional wear of cutting tools.	Understand	CO 1	AME512.01
3	What is the use of NC systems?	Understand	CO 1	AME512.01
4	Differentiate between accuracy and precision.	Remember	CO 1	AME512.01
5	What is the spindle rotation error?	Understand	CO 1	AME512.01
6	Write the term alignment tests?	Remember	CO 1	AME512.01
7	What is the use of measuring instruments?	Understand	CO 1	AME512.02
8	Name the errors of cylindrical form.	Remember	CO 1	AME512.02
9	What is the use of test methods?	Remember	CO 1	AME512.02
10	How do measure the displacement accuracy?	Understand	CO 1	AME512.02
11	What is the ring gauge center method?	Remember	CO 1	AME512.02
12	What is the plug gauge center method?	Understand	CO 1	AME512.03
13	Define the term straightness.	Remember	CO 1	AME512.03
14	Define the term parallelism.	Remember	CO 1	AME512.03
15	Define the term squareness.	Understand	CO 1	AME512.03
16	Define the term circularity.	Remember	CO 1	AME512.03
17	Why is alignment necessary for machine tools?.	Understand	CO 1	AME512.04
18	What is the cumulative error?	Remember	CO 1	AME512.04
19	Define the term wear of cutting tools.	Remember	CO 1	AME512.04
20	Differentiate between the clamping errors and setting errors.	Understand	CO 1	AME512.04
Part - B (Long Answer Questions)				
1	Explain spindle rotation accuracy.	Remember	CO 1	AME512.01
2	What are the test methods for radial spindle rotation error?	Remember	CO 1	AME512.01
3	Explain various types of errors that are occur with spindle rotation with sketches.	Understand	CO 1	AME512.01
4	How spindle rotation error is important for machine tools?	Understand	CO 1	AME512.02
5	What is the influence of displacement accuracy on machined work pieces in machine tools.	Remember	CO 1	AME512.02
6	Explain spindle rotation error.	Understand	CO 1	AME512.03
7	What are the basic components of displacement error?	Remember	CO 1	AME512.03
8	Write about clamping errors.	Remember	CO 1	AME512.03
9	Explain setting errors with neat sketches.	Understand	CO 1	AME512.03
10	How can you measure straightness?	Remember	CO 1	AME512.03
11	What are the different methods to check flatness?	Understand	CO 1	AME512.03
12	Write about different alignment test.	Remember	CO 1	AME512.03
13	What are the two major specifications for evaluating positioning accuracy of NC machine tools?	Remember	CO 1	AME512.03
14	Write briefly different parallelism checking methods.	Understand	CO 1	AME512.03
15	Explain the NMTBA specification in NC system.	Remember	CO 1	AME512.03
16	Explain the VDI specification in NC system	Understand	CO 1	AME512.03
17	What is the importance of periodic errors in NC system?	Remember	CO 1	AME512.04
18	Explain the errors occurred in NC systems due to velocity lags.	Understand	CO 1	AME512.04
19	Explain the measuring instruments used in testing machine tools and their applications.	Remember	CO 1	AME512.04
20	What is the influence of spindle rotation error in the boring operation?	Remember	CO 1	AME512.04
Part - C (Problem Solving and Critical Thinking Questions)				
1	How alignment tests are performed and write important parameters to conduct alignment tests?	Understand	CO 1	AME512.01
2	Explain the NMTBA specification in NC system.	Remember	CO 1	AME512.01
3	Explain the VDI specification in NC system	Remember	CO 1	AME512.02
4	What is the importance of periodic errors in NC system?	Remember	CO 1	AME512.02

5	Explain the errors occurred in NC systems due to velocity lags.	Remember	CO 1	AME512.02
6	How can measure the spindle rotation errors	Understand	CO 1	AME512.03
7	What is the influence of spindle rotation on accuracy?	Remember	CO 1	AME512.03
8	What is the importance of alignment tests?	Understand	CO 1	AME512.03
9	What are the different errors that occur in NC machine tool system?	Remember	CO 1	AME512.04
10	What are the effects on dimensions due to wear of cutting tools?	Remember	CO 1	AME512.04

MODULE-II

INFLUENCE OF STATIC STIFFNESS, THERMAL EFFECTS

Part – A (Short Answer Questions)

1	What is static stiffness?	Remember	CO 2	AME512.05
2	Write the formula overall stiffness of lathe.	Understand	CO 2	AME512.05
3	Name the errors occurred due to variation of cutting force.	Remember	CO 2	AME512.05
4	Write the formula compliance of work piece.	Understand	CO 2	AME512.05
5	Draw the schematic diagram of work piece before clamping and after clamping.	Remember	CO 2	AME512.05
6	How do measure setting errors of work piece held in vice.	Understand	CO 2	AME512.05
7	Discuss the inaccuracies caused due to thermal effects.	Remember	CO 2	AME512.06
8	Draw the graph between dimensional wear and length of tool travel.	Remember	CO 2	AME512.06
9	Discuss briefly distribution of axial setting error of work piece held in collets.	Understand	CO 2	AME512.06
10	Write the formula for tool growth	Understand	CO 2	AME512.06
11	What is nominal differential expansion?	Remember	CO 2	AME512.07
12	How can you calculate thermal bending in case of single-slided clamping?	Understand	CO 2	AME512.07
13	What is MWTF system?	Remember	CO 2	AME512.05
14	Write an empirical expression for force normal to machined surface.	Remember	CO 2	AME512.07
15	What are sources the of forced vibrations in machine tools?	Understand	CO 2	AME512.07
16	Write the formula to find contact deformation.	Remember	CO 2	AME512.08
17	Draw the deflection curve along the length of work piece turned between centers.	Understand	CO 2	AME512.08
18	What is temperature variation error?	Remember	CO 2	AME512.08
19	How can calculate thermal error index?	Understand	CO 2	AME512.08
20	Draw the deflection curve caused by changing depth of cut.	Remember	CO 2	AME512.08

Part - B (Long Answer Questions)

1	Explain nature of deformation in a machine tool.	Understand	CO 2	AME512.05
2	Derive an expression for overall stiffness of a lathe.	Understand	CO 2	AME512.05
3	What are the errors occurred due to variation of cutting force?	Remember	CO 2	AME512.05
4	Explain briefly different methods to decrease thermal effects.	Understand	CO 2	AME512.05
5	How vibrations effect the waviness?	Understand	CO 2	AME512.05
6	What are the different methods of decreasing thermal effects?	Remember	CO 1	AME512.06
7	Write about compliance of work piece.	Understand	CO 2	AME512.06
8	What is the significance of forced vibration in various machine tools?	Remember	CO 2	AME512.06
9	How dimensional wear of cutting tools effects the accuracy?	Understand	CO 2	AME512.06
10	What are the errors occurred due to variation of total compliance?	Remember	CO 2	AME512.07
11	Explain deformation of slender members between two rigid members	Understand	CO 2	AME512.07
12	What are the errors due to compliance while machining on milling machines?	Remember	CO 2	AME512.07
13	Explain force deformation directions while machining various operations.	Understand	CO 2	AME512.07
14	What are thermal deformations in machine tools?	Remember	CO 2	AME512.07
15	How stabilization of temperature taking place in machine tools?	Remember	CO 2	AME512.08
16	How deflection calculations being done in multi tool machining?	Understand	CO 2	AME512.08
17	How do you distinguish horizontal and vertical vibrations in micromachining?	Understand	CO 2	AME512.08
18	Classify thermal effects in micromachining.	Remember	CO 2	AME512.08
19	What is thermal rigidity? How does it effects thermal inaccuracies?	Remember	CO 2	AME512.08
20	Write indirect assessment methods for thermal effects.	Understand	CO 2	AME512.08

Part - C (Problem Solving and Critical Thinking Questions)

1	Possibility of interfacing drastically reduces the thermal effects Explain with an example	Remember	CO 2	AME512.05
2	Illustrate horizontal and vertical vibrations occurring in micromachining.	Remember	CO 2	AME512.05
3	Find deformation of slender members between two rigid members.	Understand	CO 2	AME512.05
4	How over all stiffness effects the accuracy in a lathe machine?	Remember	CO 2	AME512.06
5	What is the impact of vibrations on the waviness?	Understand	CO 2	AME512.06
6	What are different deformations contributing to compliance in a machine tool?	Remember	CO 2	AME512.06

7	How surface finish is effected by forced vibrations by a single point cutting tool?	Understand	CO 2	AME512.07
8	What is the method to stabilize the temperature?	Remember	CO 2	AME512.07
9	How thermal rigidity effects the thermal inaccuracies in the machining process?	Understand	CO 2	AME512.08
10	How heat is carried away with in a machine?	Remember	CO 2	AME512.08

MODULE –III

PRECISION MACHINING

Part - A (Short Answer Questions)

1	Differentiate top down and bottom up approach.	Remember	CO 3	AME512.09
2	List different micro-machining methods.	Understand	CO 3	AME512.09
3	What is stereo lithography?	Remember	CO 3	AME512.09
4	What is meant by top down approach?	Understand	CO 3	AME512.09
5	What is meant by bottom up approach?	Remember	CO 3	AME512.09
6	What is micromachining process?	Remember	CO 3	AME512.10
7	Define micro cracking.	Understand	CO 3	AME512.10
8	What is micro fracturing?	Remember	CO 3	AME512.10
9	Why diamond turning is necessary?	Understand	CO 3	AME512.10
10	Where precision machining is used?	Remember	CO 3	AME512.10

11	Write most significant advantage of mirror grinding in ceramics	Remember	CO 3	AME512.10
12	What does infiltration mean in grinding ceramics?	Understand	CO 3	AME512.10
13	What is the built mass in mirrors?	Remember	CO 3	AME512.11
14	What is stereo lithography?	Understand	CO 3	AME512.11
15	What is meant by top down approach?	Remember	CO 3	AME512.11
16	Define micro cracking.	Remember	CO 3	AME512.12
17	What is micro fracturing?	Understand	CO 3	AME512.12
18	Differentiate top down and bottom up approach.	Remember	CO 3	AME512.12
19	List different micro-machining methods.	Understand	CO 3	AME512.12
20	Where precision machining is used?	Remember	CO 3	AME512.12

Part – B (Long Answer Questions)

1	How Nano materials are synthesized?	Remember	CO 3	AME512.09
2	Write different micro-machining methods with sketches?	Understand	CO 3	AME512.09
3	Explain top down approach in manufacturing of nano materials.	Remember	CO 3	AME512.09
4	Explain bottom up approach in manufacturing of nano materials.	Understand	CO 3	AME512.09
5	Explain constrained surface technique in micro-stereo lithography.	Remember	CO 3	AME512.09
6	Write about free surface technique in micro-stereo lithography.	Remember	CO 3	AME512.09
7	Explain the processing of grinding wheel conditioning in diamond micro machining	Understand	CO 3	AME512.10
8	‘Feed rate per revolution is directly proportional to tool nose radius’. How this parameter effects the surface roughness in diamond turning?	Remember	CO 3	AME512.10
9	What are the challenges in diamond machining of brittle materials?	Understand	CO 3	AME512.10
10	How brittle to ductile transition taking place in diamond machining?	Remember	CO 3	AME512.10

11	Explain micro fracturing.	Remember	CO 3	AME512.10
12	Why micro sized block gauges are used in multiple combinations?	Understand	CO 3	AME512.11
13	How the block gauge step size is chosen in micro sized block gauges?	Remember	CO 3	AME512.11
14	How to calibrate the coefficient of thermal expansion in micro sized gauges?	Understand	CO 3	AME512.11
15	What is gauge interferometer in micro sized components?	Remember	CO 3	AME512.11
16	How to measure and remove burrs from a micro sized components?	Remember	CO 3	AME512.12
17	Write about double phased interferometer.	Understand	CO 3	AME512.12
18	What is thermal stabilization time of micro sized components?	Remember	CO 3	AME512.12
19	Explain plasma etching in mirror grinding process.	Understand	CO 3	AME512.12
20	How to measure damage penetration limit?	Remember	CO 3	AME512.12

Part – C (Problem Solving and Critical Thinking)

1	‘The micro chambers and channels used in inkjet printers are produced by one of the micro machining processes’ discuss briefly.	Understand	CO 3	AME512.09
2	Explain why bulk micro machining is widely used to make micro sized components	Remember	CO 3	AME512.09
3	What is the deposition processes used in surface micro machining process?	Remember	CO 3	AME512.09

4	What is gauge interferometer in micro sized components?	Understand	CO 3	AME512.10
5	Explain plasma etching in mirror grinding process.	Remember	CO 3	AME512.10
6	Differentiate between the top down and bottom up approach.	Understand	CO 3	AME512.10
7	How do estimate thermal stabilization time of micro sized components?	Remember	CO 3	AME512.11
8	What is the method for calibration of the coefficient of thermal expansion in micro sized gauges?	Remember	CO 3	AME512.11
9	What is the importance of plasma etching in the process of mirror grinding?	Understand	CO 3	AME512.12
10	How material is transformed from brittle to ductile in the diamond machining ?	Remember	CO 3	AME512.12

MODULE –IV

NANO MEASURING SYSTEMS

Part – A (Short Answer Questions)

1	What is the basic concept of pattern recognition system?	Remember	CO 4	AME512.13
2	Write the basic principle of electron beam lithography.	Understand	CO 4	AME512.13
3	What are mechanical measuring systems?	Remember	CO 4	AME512.13
4	Write the basic principle of laser interferometer	Understand	CO 4	AME512.13
5	Name different measurement methods in production process.	Remember	CO 4	AME512.14
6	What is purpose of scanning electron micro scope?	Remember	CO 4	AME512.14
7	What is purpose of transmission electron micro scope?	Understand	CO 4	AME512.14
8	Where Nano positioning and Nano measuring Machine is used?	Remember	CO 4	AME512.14
9	Write the applications of Nano positioning and Nano measuring Machine .	Understand	CO 4	AME512.14
10	What is the measuring range and resolution of Nano measuring Machine?	Remember	CO 4	AME512.15
11	Sketch the Laser interferometer for figure measurement.	Remember	CO 4	AME512.15
12	What is image processing?	Understand	CO 4	AME512.15
13	What do you mean by Touch Probe?	Remember	CO 4	AME512.15
14	Define nano tweezers.	Understand	CO 4	AME512.16
15	Define emitance.	Remember	CO 4	AME512.16
16	What is energy spread?	Understand	CO 4	AME512.16
17	What is the basic concept of pattern recognition system?	Remember	CO 4	AME512.16
18	Write the basic principle of electron beam lithography.	Understand	CO 4	AME512.16
19	What are mechanical measuring systems?	Remember	CO 4	AME512.16
20	Write the basic principle of laser interferometer	Remember	CO 4	AME512.16

Part – B (Long Answer Questions)

1	Explain different measurement methods in production processes.	Remember	CO 4	AME512.13
2	What are the features of mechanical measuring systems?	Understand	CO 4	AME512.13
3	Explain vertical resolution of profile instrument.	Remember	CO 4	AME512.13
4	Explain horizontal resolution of profile instrument.	Understand	CO 4	AME512.13
5	Write about post process and on machine measurement of dimensional features.	Remember	CO 4	AME512.13
6	How laser interferometer works?	Remember	CO 4	AME512.14
7	Explain optical figure measuring instruments.	Understand	CO 4	AME512.14
8	How can measure surface roughness by optical measuring instruments?	Remember	CO 4	AME512.14
9	Write about scanning electron microscopy.	Understand	CO 4	AME512.14
10	Explain transmission electron microscope.	Remember	CO 4	AME512.14
11	Drawn and explain block diagram of image processing unit.	Remember	CO 4	AME512.14
12	Write different industrial applications of pattern recognition.	Understand	CO 4	AME512.14
13	Explain wafer inspection systems.	Remember	CO 4	AME512.15
14	Describe pattern distortion and overlay	Understand	CO 4	AME512.15
15	Is atom holography necessary for nano instrumentation Explain.	Remember	CO 4	AME512.15
16	What are the susceptibility parameters of nano instrumentation?	Understand	CO 4	AME512.15
17	Explain different measurement methods in production processes.	Remember	CO 4	AME512.16
18	What are the features of mechanical measuring systems?	Remember	CO 4	AME512.16
19	Explain vertical resolution of profile instrument.	Understand	CO 4	AME512.16
20	Explain horizontal resolution of profile instrument.	Remember	CO 4	AME512.16

Part – C (Problem Solving and Critical Thinking)

1	The linear collider is used to measure beam size in electron beam measuring systems. What will be the minimum number of locations that it should be used?	Remember	CO 4	AME512.13
2	What are the features of mechanical measuring systems?	Understand	CO 4	AME512.14
3	Explain vertical resolution of profile instrument.	Remember	CO 4	AME512.14

4	Is atom holography necessary for nano instrumentation Explain.	Understand	CO 4	AME512.15
5	Explain horizontal resolution of profile instrument.	Remember	CO 4	AME512.16
6	What is the working principle of transition electron microscope?	Remember	CO 4	
7	What is the working principle of scanning electron microscopy?	Understand	CO 4	
8	Compare the SEM and TEM.	Remember	CO 4	
9	In nano instrumentation how susceptibility parameters are varying?	Understand	CO 4	
10	Discuss the horizontal resolution and vertical resolution in profile instrument.	Remember	CO 4	

MODULE -V

LITHOGRAPHY

Part - A (Short Answer Questions)

1	Define electron beam lithography.	Understand	CO 5	AME512.17
2	Write the concept of dip pen lithography.	Remember	CO 5	AME512.17
3	Draw the schematic diagram of photo lithographic process.	Understand	CO 5	AME512.17
4	Draw schematic diagram of ion beam lithography.	Understand	CO 5	AME512.17
5	What is the meaning of LIGA?	Understand	CO 5	AME512.17
6	What is the importance X-ray lithography?	Remember	CO 5	AME512.18
7	Write advantages of X-ray lithography?	Understand	CO 5	AME512.18
8	Write disadvantages of X-ray lithography?	Remember	CO 5	AME512.18
9	Write shortly on nano lithography.	Understand	CO 5	AME512.18
10	What are advantages of LIGA?	Remember	CO 5	AME512.18
11	Write applications of LIGA.	Understand	CO 5	AME512.19
12	What is deep UV?	Understand	CO 5	AME512.19
13	Write the applications of photo lithography.	Remember	CO 5	AME512.19
14	What is depth of focus?	Understand	CO 5	AME512.19
15	Define alignment marks.	Remember	CO 5	AME512.19
16	Explain with examples schematics.	Understand	CO 5	AME512.20
17	Write the disadvantages of EUV lithography.	Understand	CO 5	AME512.20
18	What are the disadvantages of X-ray lithography?	Remember	CO 5	AME512.20
19	Explain the problems with partial field chips.	Understand	CO 5	AME512.20
20	What is focus exposure matrix?	Remember	CO 5	AME512.20

Part - B (Long Answer Questions)

1	What are the parameters that influence the resolution of DPN?	Understand	CO 5	AME512.17
2	What are the steps to be followed in photo lithography?	Remember	CO 5	AME512.17
3	Explain ion beam lithography with neat sketch.	Remember	CO 5	AME512.17
4	What are the applications of DPN?	Understand	CO 5	AME512.17
5	Explain optical lithography with neat sketch.	Remember	CO 5	AME512.18
6	How ion beam lithography is different from the other lithography?	Understand	CO 5	AME512.18
7	What is the basic principle of optical lithography? Explain with sketch.	Understand	CO 5	AME512.18
8	Write about deep ultra violet lithography.	Remember	CO 5	AME512.18
9	What is the procedure for LIGA process?	Remember	CO 5	AME512.18
10	Mass separator is a setup that allows only required amount of ions with affixed mass charge .Explain.	Understand	CO 5	AME512.18
11	Mention few methods to reduce the spot size of the beam in ion beam system.	Understand	CO 5	AME512.19
12	Describe briefly the basic lithography process	Remember	CO 5	AME512.19
13	Differentiate light field and dark field in the lithography?	Remember	CO 5	AME512.19
14	What is numerical aperture in lithographic modeling?	Understand	CO 5	AME512.19
15	What is resolution enhancement technique in lithography?	Remember	CO 5	AME512.19
16	What are uses of anti-reflective coating in lithography?	Understand	CO 5	AME512.20
17	What are partial fields and full fields?	Understand	CO 5	AME512.20
18	Explain the problem with partial field chips.	Remember	CO 5	AME512.20
19	Describe EUV and X- ray lithography.	Remember	CO 5	AME512.20
20	Describe the optical proximity correction in optical lithography.	Understand	CO 5	AME512.20

Part – C (Problem Solving and Critical Thinking)

1	Why optical lithography is so important in the field of lithography	Understand	CO 5	AME512.17
2	Mention few methods to reduce the spot size of the beam in ion beam system.	Remember	CO 5	AME512.17
3	Mass separator is a setup that allows only required amount of ions with affixed	Remember	CO 5	AME512.17

	mass charge .Explain.			
4	Describe briefly the basic lithography process.	Understand	CO 5	AME512.18
5	Differentiate light field and dark field in the lithography.	Remember	CO 5	AME512.18
6	Differentiate between the partial fields and full fields.	Understand	CO 5	AME512.18
7	What is the importance of optical proximity correction in optical lithography.	Remember	CO 5	AME512.19
8	How do resolution enhancement techniques in lithography?	Remember	CO 5	AME512.19
9	What is the importance of optical lithography?	Understand	CO 5	AME512.20
10	What are the advantages and disadvantages of optical lithography?	Remember	CO 5	AME512.20

Prepared by:

Mr. G Sarat Raju , Assistant Professor

HOD, ME