

## MACHINE TOOLS AND METROLOGY

<b>VI Semester: ME</b>								
Course Code	Category	Hours / Week			Credits	Maximum Marks		
AME010	Core	L	T	P	C	CIA	SEE	Total
		3	1	-	4	30	70	100
<b>Contact Classes: 45</b>		<b>Tutorial Classes: 15</b>		<b>Practical Classes: Nil</b>			<b>Total Classes: 60</b>	

### OBJECTIVES:

**The course should enable the students to:**

- I. Visualize the generation of surface profiles using the relative motion between directrix and generatrix.
- II. Understand the basic mechanism involved in metal cutting processes using different cutting tools.
- III. Understand the measurement of different attributes of metal cutting using various measuring Instruments
- IV. Analyze surface topology, establish geometrical dimensioning and tolerances.

### COURSE OUTCOMES(COs):

1. Explain metal cutting principles, various materials used for metal cutting and types of lathes and operations performed on lathe.
2. Acquire the basic structure of various machine tool equipment commonly found in industry such as drilling machines, shaping machines, planning machines, etc.
3. Identify the fine finishing operations to obtain dimensional accuracy and surface finish
4. Apply the concept of system of limits and fits and design limit gauges.
5. Measure surface finish, perform alignment test of machine tools and write applications of coordinate measuring machines.

### COURSE LEARNING OUTCOMES (CLOs):

1. Understand the concepts various metals cutting machines like lathe describe various driving mechanisms of lathe.
2. Demonstrate knowledge with sketches the constructional features and describe the various operations related to the shaper and planer machines.
3. Explore knowledge & ability to describe the indexing mechanism for a milling machine and also calculate simple indexing values.
4. Derive the constructional features and the terminologies related to grinding, broaching and honing machines.
5. Discuss the nature of steady and unsteady processes under the influence of time.
6. Develop the fundamentals of casting and foundry and discuss metal cutting tool theory.
7. Determine simple numerical on related concepts discuss in detail various materials used for cutting tools.
8. Understand the various principles and applications of Non-traditional machining (NTM) processes. Look into the concepts related to NTM processes.
9. Knowledge to operate different machine tools with understanding of work holders and operating principles to produce different part features to the desired quality
10. Knowledge to identify the uncertainties in dimensional metrology and define the measurement standards.
11. Discuss the measure length and angles using line graduated instruments, i.e. Vernier calipers, micrometers, bevel protractor, sine bar and surface plates.
12. Develop measure dimensions of shafts, bearings and linear surfaces in metric and imperial units using

<p>calibers, micrometers, and scales.</p> <p>13. Understand Principles and gauges and their uses of measuring instruments.</p> <p>14. Introduction to Inspection of engineering parts with various precision instruments.</p> <p>15. Ability to use comparative length measuring instruments, i.e. dial indicator, to measure variations in the distance between two or more surfaces.</p> <p>16. Explore the use of appropriate method for determination of accuracy based on product function and manufacturing capability.</p>		
<b>UNIT-I</b>	<b>BASIC MECHANISM OF METAL CUTTING</b>	<b>Classes: 09</b>
<p>Elementary treatment of metal cutting theory, element of cutting process, geometry of single point tool and angles chip formation and types of chips, built up edge and its effects, chip breakers: Mechanics of orthogonal cutting, Merchant's force diagram, cutting forces, cutting speeds, feed, depth of cut, tool life, coolants, machinability, tool materials.</p>		
<b>UNIT-II</b>	<b>MACHINE TOOL-I</b>	<b>Classes: 09</b>
<p>Engine lathe, Principle, specification, types, work and tool holding devices, Automatic lathes, classification: Single spindle and multi-spindle automatic lathes and its tool layouts; Shaping, slotting and planning machines, Principles of working, specification, operations performed, Kinematic scheme.</p>		
<b>UNIT-III</b>	<b>MACHINE TOOL-II</b>	<b>Classes: 09</b>
<p>Milling machine, classifications, specifications, working principles of milling machines; Geometry of milling cutters, methods of indexing, kinematic scheme of milling machines. Drilling and boring machines, principles of working, specifications, types, operations performed, twist drill; Kinematics scheme of the drilling and boring machines.</p>		
<b>UNIT-IV</b>	<b>GEOMETRICAL DIMENSIONING AND TOLERANCES</b>	<b>Classes: 09</b>
<p>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; Linear Measurement: Slip gauges, dial indicator, micrometers; Measurement of angles and tapers: Bevel protractor, angle slip gauges, spirit levels, sine bar.</p>		
<b>UNIT-V</b>	<b>MEASURING INSTRUMENTS</b>	<b>Classes: 09</b>
<p>Optical measuring instruments: Tool maker's microscope and its uses, collimators, optical projector, interferometer; Screw thread measurement: Element of measurement, errors in screw threads, measurement of effective diameter, angle of thread and thread pitch, profile thread gauges; Surface roughness measurement: Numerical assessment of surface finish: CLA, R.M.S Values, Rz values, methods of measurement of surface finish: profilograph, talysurf - ISI symbol for indication of surface finish.</p>		
<b>Text Books:</b>		
<ol style="list-style-type: none"> <li>1. Dr. R. Kesavan, Dr. R. Kesavan, "Machine Tools" Laxmi publications, 2<sup>nd</sup> Edition, 2016.</li> <li>2. N. K Mehta, "Metal Cutting and Design of Cutting Tools, Jigs &amp; Fixtures", McGraw-Hill Education, 1st Edition, 2014.</li> <li>3. T. L. Chaudhary, "Metal Cutting and Mechanical Tool Engineering", Khanna Publishers, 5<sup>th</sup> Edition, 2013.</li> <li>4. R. K. Jain, Engineering Metrology, Khanna Publishers, 1<sup>st</sup> Edition, 2013.</li> </ol>		
<b>Reference Books:</b>		
<ol style="list-style-type: none"> <li>1. B.L. Juneja, G.S. Sekhon, Nitin Seth "Fundamentals of Metal Cutting and Machine Tools ", New Age Publishers, 2<sup>nd</sup> Edition, 2014.</li> <li>2. Geoffrey, "Fundamentals of metal machining and machine tools", Tata McGraw Hill Education, 1<sup>st</sup> Edition, 2013.</li> <li>3. R. S. Sirohi, H. C. Radha Krishna, "Mechanical Measurements", New Age Publishers, 3<sup>rd</sup> Edition, 2011.</li> </ol>		

4. M Mahajan "A Textbook of Metrology ", Dhanpatrai and Co, 2<sup>nd</sup> Edition, 2013.

**Web References:**

1. <https://www.ocw.mit.edu/courses/mechanical-engineering/>
2. <http://www.nptel.ac.in/courses/112106138>.