K.S. SCHOOL OF ENGINEERING AND MANAGEMENT, BANGALORE - 560109

DEPARTMENT OF MECHANICAL ENGINEERING

CO-PO Mapping

Course: Machining Science and Metrology			
Type: Core		Course Code: BME402	
No of Hours per week			
Theory (Lecture Class)	Practical/Field Work/Allied Activities	Total/Week	Total teaching hours
03	02	04	50
Marks			
Internal Assessment	Examination	Total	Credits
50	50	100	3

Pre-Requisite: The student should have basic knowledge of machine tools.

Aim/Objective of the Course:

1. To enrich the knowledge pertaining to relative motion and mechanics required for various machine tools.
2. To introduce students to different machine tools to produce components having different shapes and sizes.
3. To develop the knowledge on mechanics of machining process and effect of various parameters on machining.
4. To understand the basic principles of measurements
5. To enrich the knowledge pertaining to gauge, comparator and angular measurement.

Course Learning Outcomes:

After completing the course, the students will be able to,

CO1	**Analyze** various cutting parameters in metal cutting.	**Applying (K3)**
CO2	**Understand** the construction of machines & machine tools and **compute** the machining time of various operations.	**Applying (K3)**
CO3	**Understand** the concept of Temperature in Metal Cutting, forms of wear in metal cutting and Cutting fluids and find the tool life	**Applying (K3)**
CO4	**Understand** the objectives of metrology, methods of measurement, standards of measurement & various measurement parameters. Explain tolerance, limits of size, fits, geometric and position tolerances, gauges and their design **construct** the height using slip gauges to measure the unknown angles	**Applying (K3)**
CO5	**Understand** the working principle of different types of comparators, gauges and **construct** the angle gauges to angular Measurements	**Applying (K3)**

Detailed Syllabus:

Module-1 **Introduction to Metal cutting:** Orthogonal and oblique cutting. Classification of cutting tools: single, and multipoint; tool signature for single point cutting tool. Mechanics of orthogonal cutting; chip formation, shear angle and its significance, Merchant circle diagram. Numerical problems. Cutting tool materials and applications. **Introduction to basic metal cutting machine tools: Lathe-** Parts of lathe machine, accessories of lathe Machine and various operations carried out on lathe. Kinematics of lathe. Turret and Capstan lathe. **Laboratory Experiments:** 1. To study the tool geometry of a single point turning tool (SPTT) in the American Standards Association (ASA) system. 2. Preparation of one model on lathe involving - Plain turning, Facing, Knurling, Drilling, Boring, Internal Thread cuts and Eccentric turning. 3. Preparation of One model on lathe involving - Plain turning, Facing , Taper turning, Step turning, Thread cutting, Facing, Knurling, Drilling, Boring, Internal Thread cutting and Eccentric turning.	CO1 08 hrs PO1 PO2 PO3 PO7 PO12

LO: After competing this unit the student will be able to 1. Explain the tool geometry 2. Explain the different cutting methods and chip formation 3. Do the different lathe operations	
Module- 2 **Milling Machines:** up milling & down milling, classification of milling machines, constructional features (Column and Knee and vertical milling machine), milling cutter nomenclature, various milling operations, calculation of machining time. **Indexing:** Need of indexing Simple, compound and differential indexing calculations. Simple numerical on indexing. **Shaping, Slotting and Planning Machines Tools:** Driving mechanisms of Shaper, Slotter and Planer. Operations done on Shaper, Planer & Slotter Difference between shaping and planning operations. **Drilling Machines:** Constructional features (Radial & Bench drilling Machines), operations, types of drill & drill bit nomenclature. Calculation of machining time. **Grinding**: Grinding operation, classification of grinding processes: cylindrical, surface &centerless grinding **Laboratory Experiments:** 1. Cutting of Gear Teeth using Milling Machine. 2. One Job, Cutting of V Groove/ dovetail / Rectangular groove using a shaper. 3. Simple operations and One Job on the drilling and grinding machine. **LO: After competing this unit the student will be able to** 1. Explain all the conventional machining process. 2. Do the different milling, shaping operations 3. Do the different drilling, grinding operations	CO2 08 hrs PO1 PO2 PO3 PO4 PO5 PO6 PO12
Module 3: **Thermal aspects, Tool wear, and Machinability** **Temperature in Metal Cutting**: Heat generation in metal cutting; temperature distribution in metal cutting, effect of cutting speed on temperatures, measurement of cutting temperatures Tool life and tool Wear: progressive tool wear; **Forms of wear in metal cutting:** crater wear, flank wear, tool-life criteria, cutting tool materials: basic requirements of tool materials, major classes of tool materials: high-speed steel, cemented carbide, ceramics, CBN and diamond, tool coatings; the work material and its machinability **Cutting fluids:** Action of coolants and application of cutting fluids **Laboratory Experiments:** 1. Demonstration / Experiment on tool wears and tool life on anyone conventional machining process. 2. Analysis of chip formation and chip reduction coefficient in turning of mild steel by HSS tool with different depth of cut, speed, and feed rate. **LO: After competing this unit the student will be able to** 1. Explain the concept temperature distribution, wear in the tool and tool life. 2. Calculate tool life.	CO3 08 hrs PO1 PO2 PO3 PO5 PO7 PO12
Module 4: **Introduction:** Introduction to metrology & measurements, definition, objectives and classification of metrology, standards of length- wave length standard, sub division of standards, numerical problems on length calibration. **Line & End Standards:** Line and end standard, slip gauges, wringing phenomena, numerical problems on slip gauges. **Systems of Limits, Fits & Tolerance:** Definition of tolerance, tolerance specification in assembly, principle of interchangeability and selective assembly, limits of size, Indian standards, concepts of limits of size and tolerances, cost v/s tolerances, compound tolerances, accumulation of tolerances,	CO4 08 hrs PO1 PO2 PO3 PO4 PO5 PO12

definition of fits, types of fits and their designation. **Laboratory Experiments:** 1. Cutting force measurement with dynamometers (Demonstration) for turning, drilling, grinding operations. **LO: After competing this unit the student will be able to** 1. Differentiate different standards 2. Explain the concept of measurement using different standards 3. Explain the concept of Limits fits and gauges	
Module 5: **Gauges:** Classification of gauges, Taylor's principle, design of GO, NO GO gauges, wear allowance on gauges, types of gauges- plain plug gauges, ring gauges, snap gauge, limit gauge, simple problems. **Comparators:** Introduction to comparators, classification, characteristics, systems of displacement amplification in mechanical comparators, Reed type, Sigma comparator, Zeiss ultra-optimeter, Solex air gauge, ultrasonic gauges, LVDT. **Angular Measurements:** Bevel protractor, sine bar, angular gauges, numerical on building of angles. **Laboratory Experiments:** 1. Experiment on anyone advanced machining process 2. Demonstration/Experimentation of simple programming of CNC machine operations. **LO: After competing this unit the student will be able to** 1. Understand the different types of gauges and comparators 2. Understand the programming of CNC lathe and milling.	CO5 08 hrs PO1 PO2 PO3 PO4 PO5 PO12
Practical/Field Work Content 1. Machine shop lab and industrial visit to one of the well-known industries.	
Textbooks: 1. Manufacturing Process II by Kestoor Praveen 2. Manufacturing Process by A C Niranjan 3. Rao P. N., Manufacturing Technology II, Tata McGraw Hill.	
Reference Books: 1. Shaw, M C, (2014), Metal Cutting Principles, Oxford University Press. 2. McGeough, J A, (1988), Advanced Methods of Machining, Springer. 3. Boothroyd, G., and Knight, W. A., Fundamentals of Machining and Machine Tools, CRC Press. 4. Chattopadhyay, A B, (2013), Machining and Machine Tools, Wiley India. 5. Mikell P. Groover, (2019), Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Publications. 6. Mechanical Measurements Beckwith Marangoni and Lienhard Pearson Education 6th Ed.,	
Useful Websites: 1. V. K. Jain, Advanced Machining Processes, NPTEL Course Department of Mechanical Engineering, IIT Kanpur, Link: http://nptel.ac.in/courses/112104028/. 2. U. S. Dixit, Mechanics of Machining, NPTEL Course Department of Mechanical Engineering Guwahati, Link: http://nptel.ac.in/courses/112103248/. 3. A. B. Chattopadhyay, Manufacturing Processes II, NPTEL Course of Department of Mechanical Engineering, IIT Kharagpur, https://nptel.ac.in/courses/112/105/112105126/	
Useful Journals: 1. https://www.sciencedirect.com/journal/journal-of-manufacturing-processes 2. https://www.scimagojr.com/journalsearch.php?q=27677&tip=sid&clean=0	
Teaching and Learning Methods: 1. Lecture class : 40 hrs 2. Practical classes : 03 hrs	

Assessment:

Type of test/examination: Written examination

Continuous Internal Evaluation(CIE) : 50 marks (Average of two tests will be considered)

Semester End Exam(SEE) : 100 marks (students have to answer all main questions) which will be reduced to 50 Marks.

Test duration: 1 :30 hrs

Examination duration: 3 hrs

CO to PO Mapping

PO1: Science and engineering Knowledge **PO2:** Problem Analysis **PO3:** Design & Development **PO4:** Investigations of Complex Problems **PO5:** Modern Tool Usage **PO6:** Engineer & Society	**PO7:** Environment and Society **PO8:** Ethics **PO9:** Individual & Team Work **PO10:** Communication **PO11:** Project Mngmt & Finance **PO12:** Life long Learning

PSO1: Ability to apply concept of mechanical engineering to design a system, a component or a process/system to address a real-world challenges.

PSO2: Ability to develop effective communication, team work, entrepreneurial and computational skills

CO	PO	PO1	PO2	PO3	PO 4	PO5	PO6	PO 7	PO8	PO9	PO10	PO1 1	PO12	PS O1	PS O 2
18 ME34	K-level														
CO1	K2	3	3	2	-	-	-	1	-	-	-	-	1	3	1
CO2	K3	3	3	3	2	1	1	-	-	-	-	-	1	3	1
CO3	K2	3	2	2	-	1	-	1	-	-	-	-	1	3	1
CO4	K3	3	3	3	2	1	-	-	-	-	-	-	1	3	1
CO5	K2	3	3	3	2	2	1	-	-	-	-	-	1	3	1

Course In charge **Head of the Department** **Principal**