

GUJARAT TECHNOLOGICAL UNIVERSITY

MECHANICAL (PRODUCTION ENGINEERING) (28)

MACHINING SCIENCE

SUBJECT CODE: 2712802

SEMESTER: I

Type of course: MAJOR ELECTIVE - I

Prerequisite: Nil

Rationale: This course provides the knowledge and practice regarding different Mechanics of Metal Cutting & their effects. This course gives hands on practice of metal cutting principles and metal Cutting force also Economics of Cutting Forces. This course gives concept of Metal Surface Finish and Thermal aspect of Metal Cutting.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks						Total Marks
L	T	P		Theory Marks		Practical Marks				
			ESE (E)	PA (M)	PA (V)		PA (I)			
					ESE	OEP	PA	RP		
3	2	2	5	70	30	20	10	20	0	150

Content:

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	Introduction to Machining: Basic Mechanism involved.	2	4
2	Plastic Deformation: Tensile test; stress and strain; Mechanism of Plastic Deformation- slip, dislocation.	2	4
3	Chip Formation: Typical lathe tools; Orthogonal cutting; oblique cutting; Types of chips; Mechanism of built-up-edge formation.	2	4
4	Tool Geometry: Reference planes; Tools specification in ASA, ORS and NRS; conversation from ASA to ORS; Selection of tools angles; Multi-point cutting tools-geometry of peripheral milling cutters and twist drills.	4	8
5	Mechanics of Metal Cutting: Merchant's circle diagram- determination of cutting and thrust forces; Coefficient of friction; Stress, strain and strain rate; Measurement of shear angle - direct and indirect methods; Mohr's circle diagram; slip line field method; Thin zone model - Lee and Shaffer's relationship; Thick zone model - Okushima and Hitomi model(analysis) ; Friction in Metal cutting.	6	10
6	Mechanics of Oblique Cutting: Concept of rake angle measured in different planes; Shear angle; Velocity and force relationship.	3	6
7	Measurement of Cutting Forces: Cantilever beams, rings; Dynamometer requirement; turning, drilling milling and grinding.	3	6

8	Tool Wear and Tool Life: Mechanism of wear; Progressive tool wear; Flank wear; Crater wear; Model of diffusion wear; Tool life : Variables affecting tool life- Cutting conditions; tool geometry; Tool materials; work materials; Work materials; Cutting fluids; Determination of tool life equation; Mach inability.	6	12
9	Economics of Machining: Minimum production cost criterion; Maximum production rate criterion; maximum profit rate criterion; Restriction on cutting conditions	4	8
10	Abrasive Machining Processes: Introduction; Grinding: Characteristics of a grinding wheel; Specification of grinding wheels; Mechanics of grinding process; Chip length in horizontal surface grinding; External and internal cylindrical grinding; Specific energy in grinding; Wheel wear; Thermal analysis; Selection of grinding wheels; Honning and lapping operations.	6	12
11	Thermal Aspects of Machining: Regions of heat generation; Distribution of heat generated; Equations of flow due to conduction, transportation, heat absorbed and heat generated; Average shear plane temperature; Average chip-tool interface temperature Experimental determination of cutting temperature - tool-work thermocouple technique, infrared photographic technique	6	12
12	Surface Finish: Ideal and natural roughness; Surface finish during turning, milling and grinding. Topics of Term papers	4	8

Reference Books:

1. An introduction to the principles of Metal working - Rowe, Edward Arnold, 1968
2. Manufacturing properties of metals and Alloys - Alexander and Brewar, Van Nostrand.
3. Principle of metal cutting- Dr.A.Bhattacharya
4. Fundamental of machining and machine tools-geoffrey boothroyd-CRC Taylor & Francis
5. Manufacturing Engineering and Technology-serope kalakjian-Addison Wesley longman (Singapore) pvt.ltd.

Course Outcome:

After learning the course, the students would be able to perform following:

1. Cutting Force Analysis
2. Determination of tool wear and tool life
3. Experimental determination of cutting temperature
4. Measure and Predict the Surface Finish

List of Experiments:

- 1) A Force Analysis for Turning
- 2) Re - Sharpening Of Cutting Tools
- 3) To Study Tool Wear
- 4) To Study Design of Twist Drill
- 5) To Study Oblique Cutting & Force Analysis
- 6) To Study Grinding Force Analysis
- 7) Surface Analysis of Various Manufacturing Processes

Open Ended Problems:

1. Fabrication and Design evaluation using CAE tools for a 3-axis vertical milling machine for sculptured surface machining.
2. Finite element analysis and optimization of process parameters involved in single point and multi point machining process

Major Equipments:

1. Lathe Tool Dynamometer,
2. Drill Tool Dynamometer
3. Milling Tool Dynamometer
4. Grinding Wheel Dresser & Truing Panel,
5. Infrared Thermometer,
6. Tool-Work Thermocouple Test Rig