GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Engineering

Level: PG

Branch: Production

Course / Subject Code: ME01000571

Course / Subject Name: Metal Cutting Technology

w. e. f. Academic Year:	2024-25
Semester:	1
Category of the Course:	

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.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT level
1	Performance on Cutting Force measurement.	Evaluate
2	Determination of tool wear and tool life.	Analyze
3	Experimental determination of cutting temperature.	Evaluate
4	Analysis on cutting parameter optimization for economics of machining.	Analyze
5	Measure and Predict the Surface Finish.	Application

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE (E)	PA / CA (M)	PA/CA (I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1.	Cutting Tool Geometry: Reference planes; Tools specification in ASA, ORS and NRS; conversation from ASA to ORS; Selection of tools angles; Multipoint cutting tools-geometry of peripheral milling cutters and twist drills.	2	5
2.	Machining: Basic Mechanism involved. Tensile test; stress and strain;	2	5

	Mechanism of Plastic Deformation- slip, dislocation. Typical lathe tools; Orthogonal cutting; oblique cutting; Types of chips; Mechanism of built-up-edge formation.		
3.	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.	8	20
4.	Mechanics of Oblique Cutting: Concept of rake angle measured in different planes; Shear angle; Velocity and force relationship. Measurement of Cutting Forces: Cantilever beams, rings; Dynamometer requirement; turning, drilling milling and grinding.	6	15
5.	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; 6 14 Work materials; Cutting fluids; Determination of tool life equation; Mach inability.	6	15
6.	Economics of Machining: Minimum production cost criterion; Maximum production rate criterion; maximum profit rate criterion; Restriction on cutting conditions, Machining Costs, Water base cutting fluids, stepless speed change, tool and work material, Adaptive control: Data banks vs. Adaptive control, Automatic Adaptive control, Manual Adaptive control.	4	10
7.	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; Honing and lapping operations.	6	15
8.	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	4	10
9.	Surface Finish: Ideal and natural roughness; Measurement and Specification, Primary cutting edge Finish, Fracture roughness, The built up edge, Influence of Sulfur, Lead and coldwork. Secondary cutting edge finish, Geometrical contribution to roughness, System Stability: Static deflection effect, Dynamic Instability effect, Self exited vibrations, Variable deformed chip thickness effect.	4	5
	Total	**42**	**100**

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Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
10	**15**	**20**	**25**	**25**	**5**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) 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. Fundamental of machining and machine tools-Geoffrey Boothroyd-CRC Taylor & Francis
4. Metal Cutting Principles, Milton Shaw, CBS Publishers and Distributors. 1992 Indian print.
5. Principle of metal cutting- Dr. A. Bhattacharya
6. Manufacturing Engineering and Technology-serope kalakjian-Addison Wesley longman (Singapore) pvt. ltd.

(b) Open-source software and website:

1.
2.

Suggested Course Practical List:

1. Performance on cutting force and Analysis for Turning
2. Study on Re - Sharpening Of Cutting Tools
3. Performance on Tool Wear measurement
4. To Study Design of Twist Drill
5. To Study Oblique Cutting & Force Analysis of economics of machining
6. To Study Grinding Force Analysis
7. Performance on Surface Analysis of Various Manufacturing Processes
8. Research review on cutting force measurement and optimization
9. Research review on Cutting parameter optimization for economics of metal cutting

List of Laboratory/Learning Resources Required:

1. Lathe and Drill machine
2. Lathe and Drill Tool Dynamometer
3. Milling Tool Dynamometer

4. Grinding Wheel Dresser & Truing Panel,
5. Temperature measurement devices during machining
6. Tool-Work Thermocouple Test Ri
7. Surface measuring equipment

Suggested Project List:

Suggested Activities for Students: If any

CO- PO Mapping:

Semester 1	**Unconventional Manufacturing Technology (Course Code:)**		
	POs		
Course Outcomes	PO1	PO2	PO3
CO1			
CO2			
CO3			
CO4			
CO5			

*Legend: '**3**' for high, '**2**' for medium, '**1**' for low and '**-**' for no correlation of each CO with PO.*

Any Other:

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