2023-24

MECHANICAL ENGINEERING

NON-CONVENTIONAL MACHINING METHODS

PREPARED BY

Mr. Abhishek Sharma

Techno India NJR Institute of Technology, Udaipur

Session 2023-24

6ME5-12

NON CONVENTIONAL MACHINING METHODS

Abhishek Sharma
(Assistant Professor)
Department of Mechanical

Syllabus

RAJASTHAN TECHNICAL UNIVERSITY, KOTA

Syllabus

3rd Year - VI Semester: B.Tech. : Mechanical Engineering

6ME5-12: NON CONVENTIONAL MACHINING METHODS

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**

3L+0T+0P **End Term Exam: 3 Hours**

SN	Contents	Hours
1	Introduction: Objective, scope and outcome of the course.	1
2	Introduction and classification of advanced machining process, consideration in process selection, difference between traditional and non-traditional process, Hybrid process.	4
	Abrasive finishing processes: AFM, MAF (for Plain and cylindrical surfaces).	4
3	Mechanical advanced machining process: Introduction, Mechanics of metal removal, process principle, Advantages, disadvantages and applications of AJM, USM, WJC.	6
4	Thermo electric advanced machining process: Introduction, Principle, process parameters, advantages, disadvantages and applications about EDM, EDG,	4
	LBM, PAM, EBM	6
5	Electrochemical and chemical advanced machining process: ECM, ECG, ESD, Chemical machining,	6
	Anode shape prediction and tool design for ECM process. Tool (cathode) design for ECM Process.	4
6	Introduction to Micro and nanomachining,	5
	TOTAL	**40**

COs And POs Mapping

Non-Conventional Machining Methods Year of study: 2022-23															
Course Outcome	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2	2	2	2	0	0	0	0	0	0	0	3	2	2
CO2	2	2	2	2	1	0	0	0	0	0	0	0	2	1	2
CO3	3	2	2	3	2	0	0	0	0	0	0	0	2	2	1
C04	2	1	1	1	0	0	0	0	1	0	0	0	2	1	1
C05	3	1	1	1	1	0	0	0	0	1	0	0	2	1	1
Average	2.60	1.60	1.60	1.80	1.20	0.00	0.00	0.00	0.20	0.20	0.00	0.00	2.20	1.40	1.40

Subject Overview: Non-Conventional Machining Methods

Subject Name: Non-Conventional Machining Methods

Offered in: Mechanical Engineering, Six Semester

Subject Description:

Non-Conventional Machining Methods is a course offered in the Mechanical Engineering curriculum during the sixth semester. This subject focuses on introducing students to advanced machining processes that deviate from traditional methods. It covers various non-traditional machining techniques, their classifications, and considerations for process selection. The subject also explores hybrid processes that combine different machining methods.

Course Outline:

Introduction:

Objective, scope, and outcome of the course.

Introduction and Classification of Advanced Machining Processes:

Differentiating traditional and non-traditional machining processes. Classification of advanced machining processes. Considerations in process selection. Hybrid processes. Abrasive Finishing Processes:

Abrasive Flow Machining (AFM) for plain and cylindrical surfaces.

Magnetic Abrasive Finishing (MAF) for plain and cylindrical surfaces.

Mechanical Advanced Machining Processes:

Introduction to mechanical advanced machining processes.

Mechanics of metal removal in advanced machining.

Process principles and applications of:

Abrasive Jet Machining (AJM).

Ultrasonic Machining (USM).

Water Jet Cutting (WJC).

Advantages and disadvantages of these processes.

Thermo-Electric Advanced Machining Processes:

Introduction to thermo-electric advanced machining processes.

Principles and applications of:

Electrical Discharge Machining (EDM).

Electro-Discharge Grinding (EDG).

Laser Beam Machining (LBM).

Plasma Arc Machining (PAM).

Electron Beam Machining (EBM).

Process parameters, advantages, and disadvantages of these techniques.

Electrochemical and Chemical Advanced Machining Processes:

Electrochemical Machining (ECM) and Electrochemical Grinding (ECG).

Electrostream Drilling (ESD).

Chemical Machining (CM).

Anode shape prediction and tool design for ECM process.

Cathode design for ECM process.

Introduction to Micro and Nanomachining:

Overview of micro and nanomachining processes.

Importance and applications of micro and nanomachining.

This subject equips students with knowledge and understanding of advanced machining techniques that go beyond traditional methods. It enables them to evaluate and select suitable machining processes based on specific requirements. Students also gain insight into the emerging field of micro and nanomachining.

Last Year Question Paper.

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6E 7012

B.Tech. VI - Semester (Main&Back) Examination, April - 2019
Mechanical Engineering
6ME2A Newer Machining Methods

Time : 3 Hours **Maximum Marks : 80**
Min. Passing Marks : 26

Instructions to Candidates:

*Attempt any **Five questions**, selecting **One question from each unit**. All Questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly).*

Unit - I

1. a) Explain the principle of modern machining process. What are the factors to be considered while selecting a process? **(8)**

   b) Describe briefly Magnetic Abrasive Finishing (MAF) process for finishing internal surface of cylindrical surface/workpiece. **(8)**

(OR)

1. a) Make a comparison between traditional and non traditional machining process in terms of cost, application, scope, machine time and limitations. **(6)**

   b) A Hollow cylinder (inner dia. = 4 mm, outer dia. = 14 mm) requires improved surface finish on its outer and inner curved surfaces. Would you recommend AFM? Note that workpiece material is hardened steel and permissible dimensional change in its dia is 20µm. Draw the suggested tooling, if any. **(10)**

Unit - II

2. a) Describe in brief the process parameters, tool design and material removal rate analysis of Ultrasonic Machining Process. **(6)**

   b) During AJM, the mixing ratio used is 0.2. Calculate mass ratio if the ratio of density of abrasive and density of carrier gas is equal to 20. **(10)**

(OR)

2. Find out the approximation time required to machine a hole of diameter equal to 6.0 mm in a tungsten carbide plate (fracture hardness = $6900 N/mm^2 = 6.9\times10^9 N/m^2$) of thickness equal to one and half times of hole diameter. The mean abrasive grain size is 0.015 mm diameter. The feed force is equal to 3.5 N. The amplitude of tool oscillation is 25 μm and the frequency is equal to 25kHz. The tool material used is copper having fracture hardness equal to $1.5 \times 10^3 N/mm^2$. The slurry contains one part abrasive to one part of water. Take the values of different constants as $K_1 = 0.3$, $K_2 = 1.8 mm^2$, $K_3 = 0.6$ and abrasive density = $3.8 g/cm^3$.

   Also calculate the ratio of the volume removed by throwing mechanism to the volume removed by hammering mechanism. **(16)**

Unit - III

3. a) Explain the working principle of Laser Beam Machining. Also brief its process parameters. **(8)**

   b) Why EBM process is performed usually in vacuum chamber? Explain. **(8)**

(OR)

3. a) What are the requirements of tool materials for EDM? Name the common tool material. **(6)**

   b) A molybdenum surface has to be machined by chlorine atoms to from molybdenum trichloride. To get nascent chlorine, a generator is provided. The value of $p = 0.13 N/m^2$. Assuming the temperature of etchant to be 300K, estimate the machining rate. **(10)**

Unit - IV

4. a) What are the different functions of electrolyte in ECM? List the common electrolytes used in ECM. **(8)**

   b) Explain with sketch ECG operations. **(8)**

(OR)

4. a) Calculate the machining rate and the electrode feed rate when iron is electrochemically machined, using copper electrode and sodium chloride solution (specific resistance = 5.0 ohm cm). The power supply data of the ECM machine used are:

   Supply voltage 18V D.C., Current = 5000 amp.

   A 'tool-work' gap of 0.5 mm (constant) may be assumed. **(10)**

   b) Why surface finish obtained in case of chemical machining of alloys is poor? Explain in brief. **(6)**

Unit - V

5. Explain in detail the nanoscale cutting process. Also highlight the typical advantages, applications and limitations of the process. **(16)**

(OR)

5. a) What are the benefits and applications of laser Micromachining. **(8)**

   b) Explain the various applications of Nano-machining and Micro-machining in industry. **(8)**

6E 7012

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