

JK Lakshmipat University Jaipur
INSTITUTE OF ENGINEERING AND TECHNOLOGY

End-Term Examination, April-May 2018
B. Tech. in Mechanical Engineering, Semester VI

Roll No.....

ME622: Non-Conventional Machining Processes

Time: 3 hours

Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type questions (10 questions @ 1 mark)

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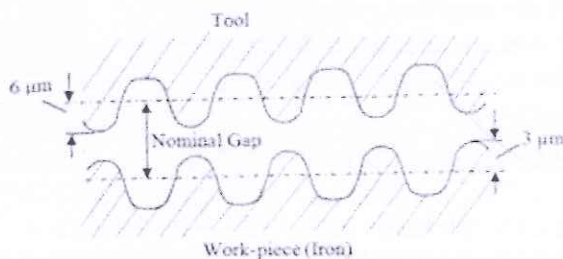
- i. In an ultrasonic machining (USM) process, the material removal rate (MRR) is plotted as a function of the feed force of the USM tool. With increasing feed force, the MRR exhibits the following behavior:
(A) Increases linearly (B) Decreases linearly
(C) Does not change (D) First increases and then decreases
- ii. The non-traditional machining process that essentially requires vacuum is
(A) Electron beam machining (B) Electro chemical machining
(C) Electro chemical discharge machining (D) Electro discharge machining
- iii. In which of the following processes, a nozzle is used?
(i) Plasma arc machining (ii) Ultrasonic Machining (iii) Abrasive jet machining
(A) i & ii (B) i & iii (C) ii & iii (D) i, ii & iii
- iv. In which of the following processes, the shape of tool is not same as that of cavity produced?
(A) Ultrasonic Machining (B) Electrical discharge Machining
(C) Plasma arc machining (D) Electrochemical Machining
- v. A resistance capacitance relaxation circuit is used in an electrical discharge machining process. The discharge voltage is 100 V. At a spark cycle time of 25 μ s the average power input required is 1 kW. The capacitance (in μ F) in the circuit is
(A) 2.5 (B) 5.0 (C) 7.5 (D) 10.0
- vi. In Electron beam machining, the order in which electrons passed after emitted by filament cathode
(A) diaphragm - anode -focusing lens - Deflector coil
(B) deflector - coil anode - diaphragm - focusing lens
(C) focusing lens - anode - diaphragm -Deflector coil
(D) Anode - Diaphragm - focusing lens - Deflector coil
- vii. During the electrochemical machining (ECM) of iron (atomic weight = 56, valency = 2) at current of 1000 A with 90% current efficiency, the material removal rate was observed to be 0.26 gm/s. If Titanium (atomic weight = 48, valency = 3) is machined by the ECM process at the current of 2000 A with 90% current efficiency, the expected material removal rate in gm/s will be
(A) 0.11 (B) 0.23 (C) 0.30 (D) 0.52

- viii In which of the following methods, an electrolyte is used?
 (A) Ultrasonic Machining (B) Electro-chemical Machining
 (C) Abrasive Jet Machining (D) Laser Beam Machining
- ix The primary mechanism of material removal in electrochemical machining (ECM) is
 (A) Chemical corrosion (B) Etching (C) Ionic dissolution (D) Spark erosion
- x Match the most suitable manufacturing processes for the following parts.
- | Parts | Manufacturing Processes |
|---------------------------------|-------------------------------|
| P. Computer chip | 1. Electrochemical Machining |
| Q. Metal forming dies and molds | 2. Ultrasonic Machining |
| R. Turbine blade | 3. Electrodischarge Machining |
| S. Glass | 4. Photochemical Machining |
- (A) P-4, Q-3, R-1, S-2 (B) P-4, Q-3, R-2, S-1 (C) P-3, Q-1, R-4, S-2 (D) P-1, Q-2, R-4, S-3

Q.1B Short answer type questions (4 questions @ 2.5 marks)

10

- a. Classify non-traditional machining processes based on major energy source employed
- b. List out the commonly used gases in LBM
- c. The surface irregularities of electrodes used in an electrochemical machining (ECM) process are $3\text{ }\mu\text{m}$ and $6\text{ }\mu\text{m}$ as shown in the figure. If the work-piece is of pure iron and 12V DC is applied between the electrodes, then find largest feed rate in mm/min.
 Conductivity of the electrolyte = $0.02\text{ ohm}^{-1}\text{mm}^{-1}$, Over-potential voltage = 1.5 V,
 Density of iron = 7860 kg/m^3 & Atomic weight of iron = 55.85 gm
 Assume the iron to be dissolved as Fe^{+2} and the Faraday constant to be 96500 Coulomb.



- d. Differentiate between chemical milling and chemical blanking
- Q.2A Compare non-traditional machining with conventional machining processes. 05
- Q.2B Draw schematic diagram of Abrasive Jet Machining (AJM). Explain its construction and working. 05
- Q.3A Explain the following parameters with respect to USM:
 i) Effect of amplitude and frequency of vibration.
 ii) Effect of grain diameter.
 iii) Effect of applied static load.
 iv) Effect of slurry. 10

OR

- Q.3B Find out the approximate time required to machine a hole of diameter equal to 6.0 mm in a tungsten carbide plate (flow strength of work material = $6.9 \times 10^9\text{ N/m}^2$) 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 oscillations is 25 μm and the frequency is equal to 25 kHz. The tool material is copper having flow strength = $1.5 \times 10^9\text{ N/m}^2$. The slurry contains one part of abrasives to one part of water. Take the values of

different constants as

$K_1 = 0.3$, $K_2 = 1.8 \times 10^{-6}$ and $K_3 = 0.6$ and abrasive slurry density = 3.8 g/cm^3 . Also calculate the ratio of the volume removed by throwing mechanism to the volume removed by hammering mechanism.

- Q.4 List and explain the variables used in AJM. 10
- Q.5A What is the principle of metal removal in EDM process? Describe the process with the help of sketch. 10

OR

- Q.5B 1. explain different elements of electrochemical machining process 5
2. Mention the best suited non-traditional machining processes for the following operations:
- i). For producing microholes
 - ii) For machining small holes
 - iii) For machining deep holes
 - iv) For producing shallow holes
 - v) For Threading operation
 - vi) For grinding operation
 - vii) For honing operation
 - viii) For Deburring operation
 - ix) For precision through cavities in work pieces
- Q.6A Explain with sketch the principle of working of electron beam machining (EBM) process 7
- Q.6B Differentiate between fludging and non-fludging electrolyte. 3
- Q.7A Explain the construction and working principle of Plasma Arc Machining (PAM) with neat sketch. 5
- Q.7B What are the application of PAM and also mention advantages and limitations? 5
- Q.8A Explain with sketch the mechanism of metal removal in Laser Beam Machining (LBM) 5
- Q.8B Explain advantages, limitations & applications of LBM. 5
- Q.9A Calculate the machining rate and electrode feed rate when iron is electrochemically machined, Using copper electrode and sodium chloride solution. The following data are given as:
- | | |
|---|---|
| Specific resistance of NaCl = 5 ohm cm, | Supply voltage = 18 V D.C, |
| Current = 5000 amp, | Tool work gap = 0.5 mm (constant), |
| Current efficiency = 100%, | Atomic wt. of Iron N = 56, |
| Valency of iron, n = 2 | Density, d = $7.87 \times 10^6 \text{ g/m}^3$ |
- Q.9A Discuss the factors to be considered for selection of Maskants and the types that are used in chemical machining. 5