



Name :

Roll No. :

Invigilator's Signature :

CS/M.Tech (MTI)/SEM-2/MTI-204/2010

2010

NON-CONVENTIONAL PRODUCTION PROCESSES

Time Allotted : 3 Hours

Full Marks : 70

The figures in the margin indicate full marks.

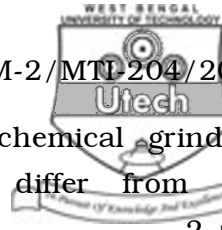
*Candidates are required to give their answers in their own words
as far as practicable.*

Answer any five questions. $5 \times 14 = 70$

1. a) Name the important factors that should be considered during the selection of a non-conventional production process for a given job. 2
- b) Classify non-conventional production processes on the basis of the type of energy employed, mechanism of material removal, transfer media and energy sources used.
- c) Discuss the mechanism of material removal for abrasive jet machining.
- d) In an abrasive jet machining process the diameter of the nozzle is 2.0 mm and jet velocity is 300 m/s. Find the volumetric flow rate (cm^3/s) of the carrier gas and abrasive mixture. 4



2. a) State the difference between water jet machining process and abrasive water jet machining process in terms of working principles, applications, limitations and merit of the processes. 4
- b) Derive an equation suggested by Shaw to obtain volumetric material removal rate (consider both throwing and hammering mechanisms) for ultrasonic machining process. 10
3. a) How is plasma produced ? Explain what is meant by non-transferred and transferred mode of plasma arc. 2 + 3
- b) Explain the working principle of electromagnetic forming process. 3
- c) State the role of charged capacitor in electrohydraulic forming process. 3
- d) In a certain electrochemical dissolution process of iron, a metal removal rate of $2 \text{ cm}^3/\text{min}$ was desired. Determine the current required for the process. Assume atomic weight of iron = 56 gm, valence at which dissolution occurs = 2, density of iron = 7.8 gm/cm^3 . 3



4. a) Discuss electrochemistry of electrochemical grinding (ECG) process. How does ECG differ from the conventional grinding process ? 2 + 2
- b) Illustrate the process of fabrication of carbon nanotube by laser evaporation method. 3
- c) A square through hole of 7 mm × 7 mm has to be drilled in a 7 mm thick tungsten carbide sheet. The slurry is made of 1 part of 20-μ-radius boron carbide grains mixed with $1\frac{1}{2}$ parts of water. The feed force is 5N. The tool oscillates with an amplitude of 0.025 mm at 30 kHz. Assuming that only 10% of the pulses are effective, calculate the time required to complete the job. 7
5. a) Explain how would you make use of Faraday's law of electrolysis for computing the material removal rate during electrochemical machining. 3
- b) State how "selective dissolution" and "spordiak breakdown" of the anodic film adversely affect the surface finish by electrochemical machining process. 4
- c) Geometry of the workpiece surface with a single curvature is given by the equation, $y = 10 + 0.20x - 0.05x^2$ where x and y are in cm. The other details are as follows : Applied voltage = 10V, over-potential = 0.7V, feed (f) = 0.75 mm/min, work material = Copper ($A = 63.57$ gm, $Z = 1$, density = 8.96 g/cm³, $K = 0.2$ /ohm-cm). Determine the equation of required tool surface geometry and write the assumptions, if any. 7



6. a) State various advantages for using laser as cutting tool. 2
- b) Distinguish between solid state laser and gas laser. 4
- c) "Machining by laser is a high speed ablation process." Justify the statement. 3
- d) A laser beam with a power intensity of $1 \times 10^5 \text{ W/mm}^2$ falls on a stainless steel sheet. Find out the time required for stainless surface to reach the melting temperature assuming that 10% of the beam power is absorbed. Given thermal diffusivity = $0.071 \text{ cm}^2/\text{s}$, thermal conductivity = $0.27 \text{ W/cm}^\circ\text{C}$ and melting temperature = 1450°C . 5
7. a) Discuss various non-materials and their applications. 6
- b) Write short notes on the following : 8
- i) Magnetostrictive effect
 - ii) Pressure intensifier
 - iii) Feed mechanism in USM
 - iv) Electrolytes in ECM.
8. a) Classify Electrodischarge Machining (EDM). 2
- b) Discuss with schematic diagram of EDM process. 5
- c) What are the different circuits available for EDM operation ? Discuss the circuit of resistance-capacitance relaxation circuit with a constant D.C. source. 7
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