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 × 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 $\left(cm^3/s\right)$ 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 $2\ cm^3/min$ 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 = $7{\cdot}8\ gm/cm^3$. 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, $y = 10 + 0 \cdot 20x - 0 \cdot 05x^2$ 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/ cm^3, 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 1×10^5 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 cm^2/s, thermal conductivity = 0·27 W/cm-°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