Name : ....

Roll No. : ....

Invigilator's Signature : ....

CS/M.TECH (MTI)/SEM-2/MTI-203/2011

2011

MODERN MANUFACTURING 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 *seven* questions   7 × 10 = 70

PART - A

1. a) State the role of 'Jet Former' in Abrasive Water Jet Machining system.   2

    b) Discuss various potential designs for abrasive particle water jet mixing in Abrasive water jet machining system.   3

    c) A 100 μm wide slot is to be cut in a thick tungsten sheet using a electron beam with a power of 7 kW. What will be the speed of cutting ?

        Given, specific heat = 2.71 J/cm³-°C, Thermal conductivity of tungsten = 2.15 W/cm-°C. Melting temperature of tungsten = 3400°C.   5

30119 (M.Tech)   [Turn over

2. a) With the help of neat diagram, explain the working principle of MAF (Magnetic Abrasive Finishing) process. Clearly show lines of magnetic equipotential lines, direction of pressure acting on the workpiece, direction of rotary motion and semi-magnetic abrasive particle.   4

   b) What do you understand by 'transducer' and 'magnetostriction' effects ?   2

   c) Derive the basic equation representing dynamics of ECM process.   4

3. a) Derive an equation suggested by Shaw to obtain volumetric material rate in Ultrasonic Machining process (Consider hammering mechanism).   5

   b) A cylindrical impression with diameter of 20 mm and a depth of 2mm has to be made on a tungsten carbide surface. The feed force is constant and equal to 8N. The average diameter of the grains in the abrasive slurry is 0·02 mm. The tool oscillates with an amplitude of 35µ at 25 kHz. The slurry contains 1 part abrasive to about 1 per water. The fracture hardness of tungsten carbide may be taken as 7000 N/mm^2. Estimate the machining time.   5

4. a) Discuss the process of formation of hydroxyl ions in ECM process.   3

   b) Distinguish between chemical machining (ChM) and Electrochemical Machining (ECM) processes.   3

   c) Explain the mechanism of material removal during Electrochemical Grinding (ECG) and how it is different from Electrochemical Machining (ECM).   4
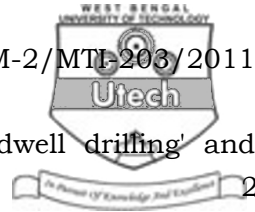
5. a) Write a major difference between 'dwell drilling' and 'Penetration' drilling'. 2

   b) What are meant by 'non-transferred' and 'transferred, modes' of plasma ars ? 3

   c) A laser beam with a power intensity of 2×10^5 W/mm^2 falls on a stainless steel. Find out time required for the stainless steel surface to reach the melting temperature (1455°C) assuming that only 8% of the beam power is absorbed. Take thermal diffusivity of stainless steel = 0·071 cm^2/sec. Thermal conductivity of steel = 0·27W/cm-°C. 5

6. a) Discuss the principle of Working of Electrochemical Debarring (ECDe) process. 3

   b) Differentiate between standoff and contact operations in explosive forming. 3

   c) Write short notes on any one of the following : 4
      i) Electromagnetic Forming
      ii) Electrohydraulic Forming

7. a) Discuss the working principle of abrasive flow finishing process. 3

   b) What is the role of intensifier in water jet maching system ? 2

   c) The composition of a Nimonic Alloy turbine blade is 18% cobalt, 62% Ni and 20% chromium. It is being machined electrochemically with a current of 1500 ampere. Find out the volume removal rate. The dissolution valency of chromium is 6 whereas that for both nickel and cobalt is 2 and the other data are as given below : 5

Metal	Gram Atomic wt.	Valency of Dissolution	Density (g/cm^3)
Chromium	51.99	6	7.19
Cobalt	58.93	2	8.85
Nickel	58.71	2	8.9.
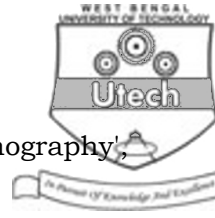
8. a) Discuss the process 'Dip Pen Nanolithography'. 2

   b) State various components of MEMS. 2

   c) 'Carbon Nanotubes can be made by laser evaporation'. Justify the statement with suitable diagram. 3

   d) Write short notes on :

   i) Smart materials   ii) IC fabrication. 3

9. a) State various classifications of Micromachining. 2

   b) Discuss basic features of Micro ECM process. 2

   c) During an ECM operation on an Titanium workpiece (Atomic weight A = 47·9, Z = 3, ρ = 4·71 g/cm^3) with a square face copper tool using brine as the electrolyte both having a flat surface, a feed rate of 3 mm/min is used. The D.C. voltage used is 12V and the total overvoltage is 1·5V. The dimension of tool face is 30 mm × 30 mm. The boiling temperature of electrolyte is 90 °C. Find out total force acting on the tool [Take viscosity of electrolyte = 0·9 × 10^{-3} kg/m-sec Density of electrolyte = 1·08 g/cm^3. Specific heat of electrolyte = 0.98 Conductivity of electrolyte 0·2 Ω^{-1} cm^{-1}. Initial temp. of electrolyte = 30°C. The electrolyte is fed from one side of square shaped tool. 6

10. a) Briefly discuss the mechanics of metal removal in Electro-Discharge Machining (EDM). 4

    b) Derive an expression of charging and discharging circuit for EDM process. 6