



Name :

Roll No. :

Invigilator's Signature :

**CS/M.Tech(MT)/SEM-2/MTI-203/2012
2012**

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 five of the following. $5 \times 14 = 70$

1. a) Distinguish between Abrasive Jet Machining and Abrasive Water Jet Machining Process. 4
- b) Derive an equation suggested by Shaw to obtain volumetric material rate in ultrasonic machining process (consider throwing mechanism). 5
- c) Determine the percentage change in the machining time for an ultrasonic machining operation cutting tungsten plates when the tool material is changed from copper to stainless steel. 5
2. a) How does a workpiece can be finished internally by Abrasive Flow Finishing (AFF) process ? Discuss with neat sketch. 4
- b) Discuss the working principle of Magnetic Abrasive Finishing with the help of a neat sketch. Clearly show lines of magnetic force, magnetic equipotential lines, direction of pressure acting on the workpiece direction of rotary motion. 3



- c) The composition of a monel alloy workpiece undergoing Electrochemical Machining (EMC) is given by :

Ni	Cu	Fe	Mn	Si	C
63%	31.7%	2.5%	2%	0.5%	0.3%

If the machining current 1000 amp, estimate volume removal rate. 7

Given :

Metal	Gram atomic weight	Valency of Dissolution	Density (g/cm³)
Ni	58.71	2	8.9
Cu	63.57	1	8.96
Fe	55.85	2	7.86
Mn	54.94	2	7.43
Si	28.09	4	2.33
C	12.01	4	2.1

3. a) Discuss total potential profile when voltage is applied across the electrodes in Electrochemical Machining (ECM). 4
- b) Establish the basic equation for dynamics of ECM process with special reference to (i) zero feed and (ii) constant feed. 6
- c) A laser beam with a power intensity of $2 \times 10^5 \text{ W/mm}^2$ is used to drill a 0.2 mm diameter through hole in a tungsten sheet of 0.4 mm thickness. If the efficiency of the operation is only 10%, estimate the time required. 4
4. a) Distinguish between Electrochemical Machining (ECM) and Electro Discharge Machining (EDM). 4
- b) Why there is no need to have 'short circuit' protection device in Electrochemical Grinding (ECG) ? Discuss with suitable diagram. 3



- c) Explain the working principle of electrostream drilling ?
In what respect it is different from conventional ECM ? 4
- d) A 200 μm wide slot is to be cut in a 2.5 mm thick tungsten sheet using an electron beam with a power 8 kW. Find the speed of cutting. Take melting temperature of tungsten = 3400°C, Thermal conductivity of tungsten = 2.15 W/cm°C, volume specific heat = 2.71 J/cm³-°C. 3
5. a) Distinguish between electrohydraulic forming and electromagnetic forming processes. 4
- b) Discuss plasma arc cutting system. 3
- c) The equilibrium gap when machining (electrochemically) iron, using NaCl solution in water as electrolyte is found to be 0.2 mm with an operating voltage of 12 V. Iron dissolves at a valency 2, the density of iron is 7.8 g/cm³ and the specific resistance of electrolyte is 2.8 ohm-cm. Calculate the metal removal rate/unit work surface area. The overvoltage may be taken as 1.5 V. 7
6. a) Distinguish between micromachining and microfabrication. 2
- b) Explain LIGA process. 3
- c) Write short notes on :
i) Carbon Nanotube
ii) MEMS. 3 + 3
- d) 'Nanofabrication can be performed by Dip Pen Nanolithography' — Discuss with suitable diagram. 3



7. a) Distinguish between 'Ultra Fast Laser Micromachining' and 'Long Pulse Laser Micromachining'. 4
- b) State basic features of micro EDM process. 3
- c) A square through hole of 6 mm × 6 mm is to be drilled in 6 mm thick tungsten carbide sheet. The slurry is made of 1 part of 20 μm radius boron carbide grain mixed with 1 part of water. The feed force is 5 N. The tool oscillates with an amplitude 0.02 mm at 20 kHz. Assuming only 30% of the pulses are effective, calculate the time required to complete the job. Take fracture hardness of tungsten as 6900 N/mm². 7
8. a) What is Electro Discharge Machining process ? What are the advantages of this process over other non-conventional machining processes ? 4
- b) During an electric discharge drilling of a 10 mm square hole in a low carbon steel plate of 5 mm thickness, brass tool and kerosene are used. The resistance and capacitance in the relaxation circuit are 50 Ω and 10 μF respectively. The supply voltage is 200 volts and the gap is maintained at such a value that the discharge (sparking) takes place at 150 volts. Derive the expression and estimate the time required to complete the drilling operation. 10