

**Non-Traditional Manufacturing and Nanotechnology**  
**(ME – 803)**

Time: 3 hours

Full Marks: 70

*Use separate answer script for each half.*  
*Answer SIX questions, taking THREE from each half.*  
*The questions are of equal value.*

**FIRST HALF**

1. (a) With the help of few case-studies illustrate the need of non-conventional production processes in the present industrial scenario.  
(b) State the differences between traditional and nontraditional machining processes.  
(c) Classify nontraditional production processes according to the type of energy used. Name the processes under each group.
2. (a) Draw a neat sketch of Chemical Machining (CHM) set-up and describe the procedural steps followed.  
(b) Write down the desirable properties of 'maskants' and 'etchants' used in Chemical Machining process.  
(c) State the advantages and disadvantages of Chemical Machining process.
3. (a) Draw the schematic diagram of Abrasive Jet Machining (AJM) set-up and label its various components.  
(b) With the help of necessary figures describe the effect of nozzle tip distance (NTD) on material removal rate and machining accuracy in AJM process.  
(c) State the limitations of AJM process.
4. (a) Write down the assumptions made for modelling the material removal rate in Abrasive Jet Machining (AJM) process.  
(b) Prove that the material removal rate for brittle work material in AJM process is given by  $MRR_{brittle} = 1.04 \frac{MV^{3/2}}{\rho^{1/4} H^{3/4}}$ . The notations carry their usual meanings.  
(c) Show that in AJM process material removal rate for both ductile and brittle material becomes equal when the velocity of abrasive particles is  $V = 4.355 \sqrt{\frac{H}{\rho}}$ .
5. (a) Give examples of a solid state laser and a gas laser. Draw a neat labeled sketch of any one of them.  
(b) State the cut quality characteristics and process characteristics of laser cutting.  
(c) Give a comparative list of the different laser cutting methods. Write the energy balance equation for fusion cutting (melt & blow) method.

Subject: **Non-Traditional Manufacturing and Nano-Technology**

(ME-803)

**Second Half**

1. (a) Why no metal deposition occurs in the electrode in ECM operation? How hydrogen bubbles are formed and how does it effect on MRR?  
(b) The equilibrium gap when machining (electro-chemically) iron using chloride solution in water as the electrolyte, is found to be 0.20 mm with an operating voltage of 10 volt. Iron dissolves at a valency of 2. The specific resistance of the electrolyte is 2.6 ohm-cm. Calculate the metal removal rate per unit surface area, if the feed is applied at an angle of  $15^{\circ}$  to the normal of the work piece. Take the over voltage as 1.5 V.
2. (a) What is the function of the transducer-concentrator assembly in USM process? Write the effect of hardness and amplitude of vibration on metal removal rate.  
(b) A cylindrical impression with a diameter of 10 mm and a depth of 2 mm has to be made on a tungsten carbide surface. The feed force is constant and equal to 4.5 N. The slurry is made of 1 part of  $10\mu$  radius  $B_4C$  grain mixed with 1.5 parts of water. The tool oscillates with amplitude of  $30\mu$  at 25 kHz. The fracture hardness of tungsten carbide work-piece may be taken as  $6900\text{ N/mm}^2$ . Estimate the machining time.
3. (a) With the schematic diagram discuss the working principle of electric discharge machining process.  
(b) For spark machining of a  $5\text{mm}\times 5\text{mm}$  square through hole in a solid low carbon steel plate of 5 mm thickness, a brass tool is used with kerosene as the dielectric. The resistance and the capacitance in the relaxation circuit of the spark generator are 120 ohm and  $20\mu\text{F}$ , respectively. The supply voltage is 220 V and the gap is maintained at such a value that the discharge takes place at 120 V. Estimate the time required to complete the job. Assume data if any.
4. (a) Write the effect of conductivity of the dielectric fluid, the resistance, capacitance and spark-gap on MRR in EDM process.  
(b) How the concept of Nano-technology is developed? What is Nanometer and Nano-scale? Write the application of Nano technology in manufacturing.
5. Write short notes in the followings:
  - (a) Carbon Nano-tube
  - (b) Power supply and electrodes used in EDM operation
  - (c) MRR for an alloy in ECM process