Bengal Engineering and Science University, Shibpur

B.E. (Mechanical) Part – IV 8th Semester examination 2012

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) Suggest a suitable process for manufacturing tiny watch gears of medium batch size. What are the equipments required for the process?

   (b) Draw the flow chart of the above process and describe the steps followed.

   (c) State the merits and demerits of the process.

2. (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.

3. (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 ductile work material in AJM process is given by $MRR_{ductile} = 0.5\frac{MV^2}{H}$. 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 $V = 4.355\sqrt{\frac{H}{\rho}}$.

4. (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.

5. (a) List-out the process parameters which directly affect the machining characteristics in Electron Beam Machining (EBM).

   (b) With the help of a neat labeled sketch describe the constructional features of an electron beam gun.

   (c) Discuss the process capabilities of EBM.

Second Half

6. (a) Discuss the effect of current density, amount of electrolyte and sludge concentration on MRR in ECM process.

   (b) The equilibrium gap when machining (electro-chemically) iron using chloride solution in water as the electrolyte, is found to be 0.25 mm with an operating voltage of 10 volt. Iron dissolves at a valency of 2. The specific resistance of the electrolyte is 2.8 ohm-cm. Calculate the metal removal rate per unit surface area, if the feed is applied at an angle of 12^0 to the normal of the work piece. Take the over voltage as 1.5 V.

7. (a) Write the effect of conductivity of the dielectric fluid on MRR in EDM process. Compare die-sinking EDM with WEDM.

   (b) With schematic diagram discuss the working principle of USM. Derive an expression for MRR in USM process.

8. (a) Why transducer-concentrator assembly is used in USM process? Write few applications of USM in industry.

   (b) A square hole of 5mm×5mm has to be drilled in a 5 mm thick tungsten carbide sheet. The slurry is made of 1 part of 10μ radius B_4C grain mixed with 1.5 parts of water. The feed force is constant and equal to 5 N. The tool oscillates with amplitude of 0.015 mm at 20 kHz. Assume that only 20% of the pulses are effective. Estimate the machining time.

9. (a) How the concept of Nano-technology is developed? Compare among the traditional machining, non-traditional machining, micro-machining and nano-machining. What is Nanometer and Nanoscale? Write the application of Nano technology in manufacturing.

   (b) Derive an expression of MRR for an alloy in ECM process.

10. Write short notes in the followings:

   (a) Equilibrium gap and its role in ECM operation
   (b) Focused ion beam machining
   (c) Electrodes and power supply in EDM operation