MASTER OF ENGINEERING IN MECHANICAL ENGINEERING EXAMINATION, 2017

(1st year 2nd semester)

ADVANCED METHODS OF MACHINING

Time: Three hours | Full Marks: 100

GROUP A

Answer ***Question No. 4*** and ***two*** **more** from this group.

Assume suitable data, if needed.

1. a) In a labeled schematic diagram show the set up of abrasive jet machining and explain how the process is carried out. **(7)**

b) State about advantages and applications of the AJM process. **(7)**

c) Discuss about: the influence of jet velocity, grain size and stand-off distance on the performance of the AJM process. **(6)**

2. a) Give the basic idea of USM and explain the mechanics of the process. **(6)**

b) In USM deduce the relationship:

$$Q \quad \alpha \quad \frac{A^{3/4} d^{1/4} F^{3/4} C^{1/4} \nu}{H_w^{3/4}}$$

Where Q is the material removal rate through direct hammering action of the grains due to the vibrating tool, d is the diameter of the spherical abrasive grains, A is the amplitude of oscillation of the tool, C is the concentration of the abrasive grains in the slurry, H_w is Brinell hardness (flow stress) of the work material, ν is the frequency of vibration and F is mean static feed force. *Mention the assumptions made in deriving the relationship.* **(14)**

3. a) Describe with suitable sketches water jet machining and abrasive water jet machining **(10)**

b) i) Assuming no losses, determine water jet velocity, when the water pressure is 4000 bar, being issued from an orifice of diameter 0.3 mm. ii) Determine the mass flow of water for the above case assuming all related coefficients to be 1. iii) If the mass flow rate of abrasive is 1kg/min, determine the abrasive water jet velocity assuming no loss during mixing process using the above data. iv) Determine depth of penetration, if steel plate is AWJ machined at a traverse speed of 300 mm/min with an insert diameter of 1mm. Assume specific energy of steel = 13.6 J/mm^3. **(10)**

[Turn over

4. a) If the diameter of the focused laser beam incident on a tungsten work is 200 μm and 10% of the beam energy is absorbed, find out the minimum value of beam power intensity to achieve the melting. The given thermal properties of tungsten are: melting temperature = 3400° C, thermal conductivity = 2.15 W/cm-°C, volume specific heat = 2.71 J/cm^3-°C. **(4)**

b) Discuss about abrasive slurry used in USM. **(4)**

c) With graphical presentations state about influence of any two important process parameters on material removal rate in USM. **(2)**

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GROUP B

Answer question no. 5 and any two from the rest in this group.

5. With necessary diagrams explain the following (any one)
   i) The mechanism of material removal in ElectricalDischarge Machining process including flushing.
   ii) The effects of impinging electron beam on material surface and formation of penetration zone in Electron Beam Machining process.

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6. Write short notes (any two)
   a) Photochemical Machining process using both positive and negative photo tools.
   b) Electrochemical Grinding process.
   c) Plasma torches in Plasma Arc Machining Process or Electron Beam Machining set-up.

10 + 10

7. In EDM with RC generators derive
   i) the energy delivered per spark and the conditions of maximum power delivery
   ii) thematerial removal rate andthe value of critical resistance.
   Thus justify the adoptation of static pulse generator over RC generator for maximum productivity. Also compare static pulse generator with hybrid generator.

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8. During an ECM operation on an iron workpiece with a square flat face tool,a feed rate of 1 mm/min is used. Calculate the equilibrium gap. If the initial gap is 0.08 cm, determine the time required to arrive at the gap 0.06 cm. At that instant, what will be the material removal rate/unit work surface area?Deduce the formulas used for the purpose.
   The process data are

   applied potential = 10 V
   overvoltage = 1.5 V
   work material = Fe (A = 55.85 g, z = 2, ρ = 7.86 g/cm^3)
   electrolyte conductivity = 0.2 Ω^{-1} cm^{-1}

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