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B.E/B.Tech. (Full Time) DEGREE END SEMESTER EXAMINATIONS, NOV/DEC 2012
MECHANICAL ENGINEERING BRANCH
FIFTH SEMESTER
ME 9304 – MODERN MACHINING PROCESSES
(REGULATIONS 2008)

11

Time: 3 hr

Max.Mark: 100

Answer ALL Questions
Part – A (10 x 2 = 20 Marks)

1. What are the requirements that demand the use of modern machining processes?
2. List the transfer media for thermal based modern machining processes.
3. Why should the working temperature be less than 323 K if we use sodium bicarbonate as abrasive particle?
4. What do you understand by "grain throwing" and "grain hammering" effects in ultrasonic machining?
5. What is the effect of additives in dielectric during Electric Discharge Machining (EDM)?
6. "Though kerosene is used as dielectric in EDM, it doesn't catch fire during spark discharge". State the reason.
7. What happens when you perform Electro Chemical Machining (ECM) with alternating voltage?
8. What is the effect of hydrogen bubbles in ECM?
9. Why do we prefer argon gas in ion beam machining?
10. Does laser beam machining produce more thermal damage to the workpiece than the EDM? Justify your answer.

Part-B (5 x 16 = 80 Marks)

11.
 - i. Explain the construction details of dual-gas plasma torch and water-injected plasma torch and also bring out their impacts on machining. (6)
 - ii. In an electron beam machining process, voltage of the electric field is 2.2×10^5 V, beam current is 2.5×10^{-5} A, current density is 2×10^{-3} A/cm², vaporisation temperature of the workpiece is 4000 K and mass of one atom of the workpiece is 8.5×10^{-28} gm. Calculate the velocity of the electron impingement, power of the electron beam, electron beam pressure and thermal velocity acquired by an electron of the workpiece. (5)
 - iii. With neat sketch, make a comparison between the experimental set up of solid state laser beam and ion beam machining processes. (5)
 12.
 - a.
 - i. How will you decide to recommend specific modern machining processes for the following applications? (10)
 - a. Cutting a glass plate.
 - b. Etching and for the production of Microsystems.
 - c. High aspect ratio micro holes in electrically non-conductive materials.
 - d. Machining of asbestos.
 - e. Steel Pipe cutting.
 - ii. Why do the different modern machining processes affect the fatigue strength of work materials to different degrees? (6)
- (OR)**
- b.
 - i. Explain the physical parameters, process economy and shape applications of any four modern machining processes. (12)
 - ii. What are the commonly used modern machining processes in industries? Justify your answer. (4)

13. a. i. Discuss the effects of the following parameters on the Material Removal Rate (MRR) and surface finish in Ultrasonic Machining (USM) with necessary graphs having suitable range for process parameters. (8)
- Amplitude.
 - Frequency.
 - Static load.
 - Size of the tool.
- ii. What are the effects of the shape of concentrator and nodal point clamping in USM? (4)
- iii. What is a catcher? Explain the different types of catcher. (4)

(OR)

- b. i. Find out the condition for which abrasive jet machine will produce equal MRR both for ductile and brittle materials. (6)
- ii. Discuss the abrasive feed mechanism in abrasive water jet machining. (4)
- iii. Explain the effect of nozzle exit pressure on the depth of cut during water jet machining. (6)
14. a. i. Explain the three kinds of layers on an electrical discharge machined component. (4)
- ii. In a RC pulse generator for EDM, the open circuit voltage is 110 V, minimum discharge voltage is 15 V, spark gap resistance is 0.5Ω and spark energy is 0.5 J. If the generator is expected for maximum power during charging, find the discharge time. (4)
- iii. Draw and explain the various power generator circuits of EDM and also show their voltage waveforms. (8)

(OR)

- b. i. Derive a mathematical expression for the relaxation circuit of EDM to deliver maximum power to the spark gap. (4)
- ii. Explain the adaptive gap control and wire drive system in wirecut EDM. (6)
- iii. Discuss the capabilities and applications of electrical discharge diamond grinding process. (6)
15. a. i. Describe the dynamics of ECM process for zero and finite feed rate. (12)
- ii. In ECM operation of pure iron, an equilibrium gap of 1.5 mm is to be kept. Find the supply voltage, if the total overvoltage is 2.5 V. The resistivity of the electrolyte is $50 \Omega\text{-mm}$ and the set feed rate is 0.25 mm/min. (4)

(OR)

- b. i. Composition of Nickel superalloy is as follows: (4)
- Ni = 72%, Cr = 20.5%, Fe = 4.5% and rest Titanium.
- Calculate the rate of dissolution if the radius of the cylindrical tool is 20 mm and a current of 500 A is being passed through the cell. Assume dissolution to take place at lowest valency of the elements.

| Element | Atomic Weight | Density (g/cc.) | Valency |
|---------|---------------|-----------------|---------|
| Ni | 58.71 | 8.9 | 2 |
| Cr | 51.99 | 7.19 | 2 |
| Fe | 55.85 | 7.86 | 2 |
| Ti | 47.9 | 4.51 | 3 |

- ii. Write down the steps involved in photo chemical machining. (4)
- iii. Explain the various hybrid ECM processes with neat sketch. (8)