

Department of Mechanical Engineering
Birla Institute of Technology and Science Pilani, Pilani Campus

Comprehensive Examination
(First Semester 2023- 2024)

Part A (Close Book)

Course: Advanced Manufacturing Processes (ME F315)

Total Marks: 25

Time: 60 minutes

Note: Attempt all the questions.

1. Explain complete manufacturing freedom using the 3-axis model of manufacturing products. (2.5)
2. Discuss the open loop and close loop control systems. (2.5)
3. Discuss the principle of rotary abrasive flow finishing. (2.5)
4. Explain the principle of atomic layer deposition. (2.5)
5. Discuss the effect of rotational speed and axial pressure on shape of friction welded parts. (2.5)
6. Explain the attributes of additive manufacturing process? (2.5)
7. Briefly explain different layers present on a metal substrate using a schematic diagram. (2.5)
8. Differentiate between adhesion and ploughing. (2.5)
9. In a selective laser melting process, the scanning speed was kept equal to 500 mm/s, laser power was 100 W, hatch spacing was 0.2 mm and layer thickness was 0.08 mm. During the building of the part, it was observed that the energy density was not sufficient for sintering of the metal particles. Therefore, the energy density was doubled to affect the scan speed, keeping other parameters constant. If the material requires, 20 J/mm³. Calculate – (2.5)
 - a) The energy density after increment.
 - b) New scanning velocity
 - c) Excess/deficient energy
10. While electrochemical machining of tungsten, a MRR of 0.98 cc/min has been observed at 1000 amp. Evaluate the valency at which the metal has been dissolved. (2.5)

*** All the best***

Part B (Open Book)

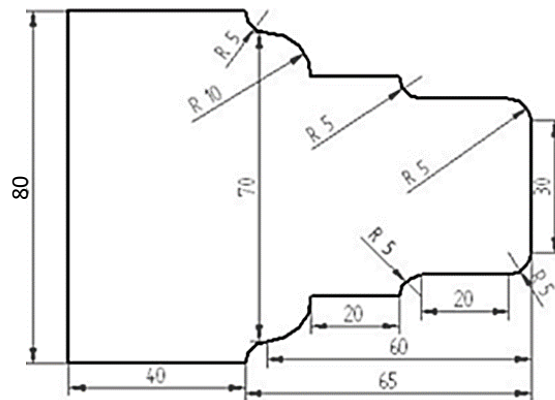
Course: Advanced Manufacturing Processes (ME F315)

Total Marks: 45

Time: 120 minutes

Note: Attempt all the questions.

11. What is LIGA process? Why is this process more useful in industrial applications? Explain different steps involved in LIGA fabrication using appropriate schematic diagrams. (1+1+3)
12. What is severe plastic deformation? How is it used for fabrication of components? Discuss equal channel angular extrusion process using suitable schematic diagram. (1+1+3)
13. What is the principle of chemical vapor deposition (CVD) process? Describe Plasma-enhanced CVD process with schematic diagram. (2+3)
14. What is abrasive wear? Discuss the two body and three body abrasive wear taking real-life examples. (2+3)
15. Write CNC part program for the tool path for the part shown in figure below – (5)



16. A ceramic material is machined by USM at a MRR of $10 \text{ mm}^3/\text{min}$ by Al_2O_3 abrasive grits having a grit diameter of $50 \mu\text{m}$. Keeping other factors unchanged, estimate - (5)
 - a) If $100 \mu\text{m}$ grits were used, what would be the MRR?
 - b) If the operating frequency is increased from initial setting of 20 kHz to 25 kHz , what would be the new MRR
 - c) If the feed force is increased by 50% along with a reduction in concentration of abrasive in slurry by 40% . What would be the effect on MRR?
17. A prototype of a tube with a square cross-section is to be fabricated using stereolithography. The outside dimension of the square = 150 mm and the inside dimension = 100 mm . The height of the tube (z direction) = 90 mm . Layer thickness = 0.15 mm . The diameter of the laser beam (“spot size”) = 0.15 mm , and the beam is moved across the surface of the photopolymer at a velocity of 400 mm/s . Compute an estimate for the time required to build the part, if 15 s are lost each layer to lower the height of the platform that holds the part. Neglect the time for post-curing. (5)
18. What is the Binder Jetting (BJ) Process? Discuss the principle involved in fabrication of a component using BJ process using schematic diagram. Explain the process chain of BP process for fabrication of a metallic component. (2+3+5)

**** All the best****