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

**Mid-Semester Examination**
(First Semester 2023- 2024)

**Course:** Advanced Manufacturing Processes (ME F315)

**Total Marks:** 50                                                      **Time:** 90 minutes
**Note:** Attempt all the questions.

### [Part 1: Short Answer]

1. Discuss the consequences of Abrasive Jet Machining of a mild steel sample. How can it be achieved?                **(3+2)**

2. What is the role of dielectric fluid in spark generation in an EDM Process? What will happen if dielectric fluid gets replaced by an electrolyte?                **(3+2)**

3. Discuss with suitable schematic diagrams the principle involved in the transferred and non-transferred plasma arc machining. Which is suitable for non-conductive materials and why?                **(1.5+1.5+2)**

4. Discuss the consequences of machining a hole in a 5 μm tungsten thin foil using the e-beams accelerated at 100 kV and 50 kV. The density of tungsten is 19300 $kg/m^3$. Justify your answer.                **(3+2)**

### [Part 2: Long Answer]

5. Derive the below equation for volumetric material removal rate in hammering model proposed by M. C. Shaw for material removal in the USM process. K, $K_1$, and $K_2$ are constants, $F_{avg}$ is average force, a is amplitude, d is diameter of abrasive particle, f is frequency, and $H_w$ is hardness of material.                **(5+5)**

$$MRR_V = KK_1K_2\left[\frac{4Favg \times a}{\pi K_2 H_w(\lambda + 1)}\right]^{\frac{3}{4}} d^{\frac{1}{4}}.f$$

6. Discuss with suitable schematic diagrams about the different forces applied by the abrasive particles on the asperities present on a component surface during the following processes –                **(2.5+2.5+2.5+2.5)**
   a) Abrasive flow finishing
   b) Rotary abrasive flow finishing
   c) Magnetorheological finishing processes
   d) Magnetorheological Abrasive Flow Finishing

7. A Nickel super-alloy containing elements: Ni, Cr, Fe, and Ti was used to fabricate a component using the ECM process. Using the data provided in the table below and considering the lowest valency of dissolution for each element, calculate material removed (in $cm^3$) in 10 seconds when a current of 1000 A is being passed through the cell.                **(5+5)**

| Elements | Ni | Cr | Fe | Ti |
|---|---|---|---|---|
| % Weight (x) | 70 | 20 | 5 | Balance |
| Gram Atomic Weight (A) | 58.71 | 51.99 | 55.85 | 47.9 |
| Valency of dissolution (Z) | 2 | 2/3/6 | 2/3 | 3 |
| Density $\rho$ ($g/cm^3$) | 8.9 | 7.19 | 7.86 | 4.51 |

*** All the best ***