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V Semester Diploma Examination, June/July-2023

ADVANCED MANUFACTURING TECHNOLOGIES

Time : 3 Hours] **[Max. Marks : 100**

Instruction : Answer **one** full question from each section.

SECTION – I

1. (a) The materials used in the manufacturing of aircraft have changed significantly from the construction of the first aircraft. With its objective of flying using air support while, resisting gravitational force, the materials used for the construction of aircraft must have some specific characteristics. Which are the advanced materials used in aircraft and what specific characteristics are present in these materials ? **10**

   (b) How will you decide to recommend specific advanced machining process (es) for **10**

   (i) Cutting a glass plate in two parts

   (ii) Making a hole in Mild Steel (MS) work-piece ?

2. (a) An iron work-piece is subjected to electro-chemical machining using copper as electrode and sodium chloride solution (specific resistant = 5.0 ohm-cm) as electrolyte. The supply voltage is 16 V DC and current is 6000 A. If a gap between the tool and work-piece is 0.05 cm, calculate the MMR and Electrode feed rate. **10**

   (for Iron Atomic weight = 56, Valency = 2 and Density = 7.87 g/cm^3)

   (b) Laser Beam Machining (LBM) is a well established machining option for manufacturing geometrically complex or hard material parts that are extremely difficult to machine by conventional machining processes. Discuss the process parameters required in LBM process. **10**

   Suggest a suitable process parameter that need to be considered for this case and justify.

SECTION – II

3. (a) Ultrasonic machining offers a solution to the expanding need for machining brittle materials such as single crystals, glasses and polycrystalline ceramics, and for increasing complex operations to provide intricate shapes and work-piece profiles. Illustrate the working of USM. What factors influence the metal removal rate in ultrasonic machining ? 10

(b) It is necessary to provide a L shape through hole in a steel work-piece of 12 mm thickness. The dimension of "L" is 25 mm × 15 mm. The steel is good conductor of electricity. Keeping this in mind, suggest a suitable non-traditional machining process for the above application. Explain the principle and working of this non-traditional machining process with the help of a sketch. 10

4. (a) Suggest a suitable non-conventional machining process for manufacturing complex and precise components in the vacuum environment. Illustrate with neat sketch about the suitable machine. 10

(b) An electric discharge machining operation is being performed on tungsten.

(i) Determine the amount of metal removed in the operation after one hour at a discharge amperage = 20 amps.

(ii) If the work material were tin, determine the amount of material removed in the same time.

Use metric units and express the answer in mm^3. 10

The melting temperature 3410 °C for tungsten and 232 °C for tin.
(Take K = 664)

SECTION – III

5. (a) Illustrate how Additive Manufacturing can overcome the limitations of traditional manufacturing methods with needs and benefits of AM. 10

(b) In Additive Manufacturing, the material properties are being established alongside the geometry of the part. There are different classes of a materials used in additive manufacturing. Discuss these (any three) different materials with respect to their properties and applications. 10

6. (a) Additive Manufacturing Techniques are classified based on the state of raw materials as solid based, liquid based and powder based. Mention which category the Fused Deposition Modeling (FDM) comes under. Illustrate the process with a neat sketch. 10

(b) The binding technique determines the process speed and part properties in Additive Manufacturing Process. Discuss the various binding technique used in Additive Manufacturing Process. 10

SECTION – IV

7. (a) Two vernier caliper are used to measure a 10.000 mm gage block. Five measurements are taken with each caliper. For caliper A, the five measurements were 10.01 mm, 10.00 mm, 10.02 mm, 10.02 mm and 10.01 mm. **10**

For caliper B, the five measurements were 10.01 mm, 9.98 mm, 9.98 mm, 10.01 mm and 9.99 mm.

Determine :

(i) The mean and standard deviation of the error for each of the calipers.

(ii) Which caliper has the better accuracy ?

(iii) Which caliper has the better precision

(b) Safety and reliability are prime importance for AM produced parts, which are used in aviation and power industries. The parts are tested using non-destructive testing methods. Discuss the different NDT methods and suggest the best non-destructive testing and support you selection. **10**

8. (a) A sine bar is used to determine the angle of a part feature. The length of the sine bar is 6.000 in. The rolls have a diameter of 1.000 in. **10**

All inspection is performed on a surface plate. In order for the sine bar to match the angle of the part, the following gage blocks must be stacked :

2.0000, 0.5000, 0.3550.

Determine the angle of the part feature and why sine bar is not suitable for measuring angle above 45 degree.

(b) 3D printing is finally crossing the threshold from prototype to production. However, there are still a few challenges that hold AM back such as quality measures and quality control. These are essential for repeatability, consistency, scalability and overall confidence in the process. **10**

Discuss the machine which measures the physical geometrical characteristics of an object in three dimensions (or directions).

SECTION – V

9. (a) Industry 4.0 paradigm shift, made possible by technological advances. Explore conservative benefits exists in industry 4.0 and what are the risks of an industry 4.0 solution. **10**

(b) Automation in manufacturing is the process of using production management software or robotic tools to operate a factory when making a physical product. Discuss the various levels of automation in Advanced Manufacturing. **10**

10. (a) Why should you be concerned about the work envelope shape when installing a robot for a particular application in advanced manufacturing industry ? **10**

Discuss the working of most popular pick and place SCARA robot configuration with neat sketch.

(b) Driverless vehicles and navigation systems are improving day after day and are contributing to boost the AGV (Automated Guided Vehicle) market worldwide. Illustrate the working principle of AGV. **10**
