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QP-Code : 20ME53I

**Makeup Examination – Sept. 2023
V Semester Diploma Examination**

ADVANCED MANUFACTURING TECHNOLOGIES

Exam Date / Time: 22nd Sep. 2023 / 2.00 PM

Time: 3 Hours

Max.Marks: 100

- Instructions:** (1) Answer one full question from each section.
(2) One full question carries 20 marks.

SECTION – I

- 1 (a)** Back in the days, aircrafts were constructed using wood and fabrics. But the aircrafts that are made of wood and fabrics were subjected to rapid deterioration and high maintenance. Thus, the search for better materials began. Now, aluminium, steel, titanium and composite materials are preferred in the construction of aerospace structures. Why such materials are used in aerospace structures? Where else do you find the applications of these materials? **10 Marks**
- 1(b)** Explain the most widely used non-traditional machining method which performs cutting, welding, drilling, surface texturing, wire stripping in manufacturing and can create fine features that are difficult or impossible to make using traditional machining equipment. **10 Marks**
- 2(a)** Superalloys are the materials best-suited for practical high temperature performance, these are materials that can survive hotter temperatures. Specifically, they are usually used for turbine blades. Why are Superalloys important and also, Special? **10 Marks**
- 2(b)** In an aerospace application manufacturing of critical components of cryogenic engine is uphill task in conventional machining method. However, industries found the way by using Electron Beam Machining process. Illustrate the working of Electron Beam Machining. **10 Marks**

SECTION – II

- 3(a)** Additive manufacturing (AM), also known as rapid prototyping or 3D printing, generally refers to techniques that produce three-dimensional parts by adding material gradually in a layer by layer fashion. In this sense, AM differs fundamentally from forming and subtractive techniques. There are different classes of materials used in additive manufacturing. Differentiate these different materials used in Additive manufacturing with respect to their Properties and Applications? **10 Marks**
- 3(b)** The Fighter jet Aircraft ventilation distributor originally made by using composite of seven separate parts. The objective was to minimize the final delivery time by dramatically reducing manufacturing time through 3D printing, using sintering technology, also ensuring lower manufacturing costs. Illustrate how this Process can be achieved? **10 Marks**
- 4(a)** Selective Laser Sintering (SLS) and 3D Printing (3DP) are two powerful and versatile AM techniques which are applicable to powder-based material systems. Differentiate and suggest the best technique among the two. Present arguments to support your selection. **10 Marks**

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- 4(b) Uniform wares explore the advantages of Additive Manufacturing (AM) technology, pushing the boundaries of design in an industry traditionally centred around heritage. What benefits exist in additive manufacturing? Differentiate the technologies available in additive manufacturing and list their applications. 10 Marks

SECTION – III

- 5(a) Like other conventional manufacturing, Additive Manufacturing (AM) components are also known to have various internal defects, such as balling, porosity, internal cracks and thermal/internal stress, which can significantly affect the quality, mechanical properties and safety of final parts. Therefore, inspection methods are important for reducing manufactured defects and improving the surface quality and mechanical properties of AM components. In this regard, discuss different inspection methods adopted in AM with their merits and demerits? 10 Marks
- 5(b) In most of the conventional methods, the tested materials may not be useful after testing, however, without destruction testing the properties of finished components are more economical. Why is Non-Destructive Testing (NDT) Important? What Tests are Available? What criterions are considered in selection of these NDT methods? 10 Marks
- 6(a) 3D printing is finally crossing that 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. Discuss the different Quality control methods adopted in AM with their merits and demerits? 10 Marks
- 6(b) AM-produced parts are being used by NASA in mission-critical situations and in the aviation and power industries where safety and reliability are of prime importance. These parts are tested using Non-Destructive testing methods. Suggest the best Non-Destructive testing method used in this case. Present arguments to support your selection. 10 Marks

SECTION – IV

- 7(a) 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 Marks
- 7(b) In manufacturing lead time, the highest time-consuming task is material handling. An automatic system may boost up the material movement and can reduce overall cost of the product. Explain the different types of automatic guided vehicles (AGV's) used in an Industry to transfer the material. 10 Marks
- 8(a) Industrial automation is the use of data-driven control systems, such as industrial computers, PLC controllers or robots, which reduces the need for human action by operating industrial processes or machinery. Does the convergence of these, Operation Technology (OT) and Information Technology (IT) is beneficial in advanced manufacturing? Justify your arguments. 10 Marks

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8(b) Robots have existed for a few decades, and have been evolving with the advances in technology from a hardware and software standpoint. The evolution of these has produced robots that are superior to preceding generations due to their traits of improved perception, adaptability, mobility, and systems integration. Explain the functioning of advanced robots in Industry-4.0 Technologies. 10 Marks

SECTION – V

9(a) Electrochemical process is most commonly used method for mass production, and is able to cut extremely hard materials which are difficult to machine using conventional methods. Its use is limited to electrically conductive materials. Explain how this process works. 10 Marks

9(b) Electrical discharge machining (EDM) 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 an EDM process? Suggest, suitable process parameters that need to be considered for this case and justify. 10 Marks

10 (a) In an aerospace application, manufacturing the critical components of cryogenic engine is uphill task in conventional machining method. However, industries found the way by using Electron Beam Machining process. With a neat diagram explain the working of Electron Beam Machining. 10 Marks

10(b) An electric discharge machining operation is being performed on two work materials: tungsten and zinc. Determine the amount of metal removed in the operation after one hour at a discharge amperage = 20 amps for each of these metals. The melting temperature of tungsten and zinc are 6170°F and 420°F, respectively. 10 Marks