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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023**

COURSE NAME : ADDITIVE MANUFACTURING
COURSE CODE : BDX 30603
PROGRAMME CODE : 3 BDX
EXAMINATION DATE : JULY/AUGUST 2023
DURATION : 3 HOURS
INSTRUCTION :

1. ANSWER **FOUR (4)** QUESTIONS FROM **FIVE (5)** QUESTIONS PROVIDED IN THIS SECTION
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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- Q1** (a) The Fourth Industrial Revolution, 4IR, or Industry 4.0, conceptualises rapid change to technology, industries, and societal patterns and processes in the 21st century due to increase interconnectivity and smart automation.
- (i) All revolutions have benefits and drawbacks, challenges and opportunities, uncertainties and certainties. In the case of the Fourth Industrial Revolution, distinguish **THREE (3)** advantages and disadvantages. (6 marks)
- (ii) Creating a digital ecosystem to drive Malaysia towards the future IR4.0 is the union and conception of emerging technologies in industries. Briefly describe all Nine Pillars of Malaysia IR4.0. (9 marks)
- (b) The special need that motivated the development of Additive Manufacturing is that product designers would like to have a physical model of a new part design rather than a computer model or line drawing. Compare and contrast graphically available prototyping technologies;
- Material removal processes (Subtractive Manufacturing) and
 - Material addition processes. (Additive Manufacturing)
- (10 marks)
- Q2** (a) As per ISO/ASTM standards, additive manufacturing technologies are divided into seven types according to the techniques used to create those layers, energy source and fuse material. Compare **TWO (2)** advantages and disadvantages of additive manufacturing technology and list out all the **SEVEN (7)** types. (9 marks)
- (b) Fused Deposition Modelling (FDM) 3D printing, also known as fused filament fabrication (FFF), is an additive manufacturing (AM) process within the realm of material extrusion. Describe in detail the working principle of the Fused Deposition Modeling machine relevant to:- (8 marks)
- Printer Overview
 - Schematic diagram
 - Part preparation step
 - Post-processing
- (c) Resin 3D printers are growing in popularity because of their incredibly accurate prints and the technology's increased affordability. Stereolithography (SLA) and digital light processing (DLP) are two types of 3D printing that build parts by polymerizing a liquid

photopolymer resin. Make a comparison table between SLA and DLP focusing on key characteristics as below.

- i. Resolution
- ii. Layer Thickness
- iii. Print Accuracy and Precision

(8 marks)

- Q3** (a) 3D printers rely on toolpaths to execute their tasks. A slicer automatically generates these paths in all 3D printing software programs. STL file format provides two different ways of storing information about the triangular facets that tile the object surface. Compare the differences between the two ways and elaborate on **FIVE (5)** differences in their characteristic.
- (9 marks)
- (b) Faulty or poorly exported STL files can lead to unexpected results: missing faces, poor resolution or other geometric inaccuracies. Discuss **THREE (3)** common STL errors with proper illustrations.
- (8 marks)
- (c) Many software solutions exist dedicated to the preparation of STL files for 3D printing and they can repair most STL errors. Proposed **FOUR (4)** commonly used software.
- (8 marks)
- Q4** (a) One of the most important decisions when 3D Printing is the parameter setting when printing the model. Considerations must be made to minimize required support material, ensure a reliable print with the best surface quality and maximize strength.
- (i) What is the most dominant surface effect caused by 3D Printing processes? Recommend how can this effect be minimized to avoid the rough appearance.
- (6 marks)
- (ii) Due to the anisotropic nature of FDM printing, understanding the application of a component and how it is built are critical to the success of a design. FDM components are inherently weaker in one direction due to layer orientation. Scrutinize the statement and give comments with the help of sketches.
- (9 marks)
- (b) The printing process in FDM systems offers several parameters, some of which are widely adjustable while some are rigid and these parameters of the printing process can affect things like quality, durability and speed of the printing process. Analyse **FOUR (4)** printing parameters that can be changed in order to get a stronger model or a faster print or actually a usable print.
- (10 marks)

Q5 One 3D FDM printing specifically can be incredibly useful as it allows you to quickly produce parts to test their functionality. It can also be said that this technology can revolutionize the way many companies work.

- (a) Discuss the applications of 3D printing in the food industry. Elaborate **THREE (3)** benefits of 3d-printed food and explain **THREE (3)** ingredients suitable for food 3d printing.

(15 marks)

- (b) Discuss the applications of 3D printing in the electronics industry. Elaborate **FOUR (4)** benefits of 3d-printed electronics.

(10 marks)

-END OF QUESTIONS –

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