Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	DIGITAL MANUFACTURING
COURSE CODE	:	BDX 31503
PROGRAMME	:	BDX
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ANY **FIVE (5)** FROM SIX (6) QUESTIONS PROVIDED 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 PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) As a aircraft manufacturing engineer, you are assigned to setup a new manufacturing process plan for machining metal-based components by implementing digital manufacturing concept. The concept must be the latest technology in industrial manufacturing. Suggest a systematic approach for your digital manufacturing concept. Support your answer with a simple example.

(8 marks)

(b) Control Centred is an important concept in digital manufacturing. Describe the technologies involved under this concept and its advance.

(4 marks)

(c) Digital Threat and Digital Twin is applied in an aircraft manufacturing. Describe this technology based on an appropriate example and sketch.

(4 marks)

(d) State **FOUR (4)** advantages when applying Digital Manufacturing technology in manufacturing.

(4 marks)

Q2 (a) Data mining in digital manufacturing seeks to mine the hidden and useful information and knowledge from the huge volumes of data, and be able to provide powerful decision supports for online monitoring and projection in manufacturing processing. As an aircraft manufacturing manager, you are assigned to setup a new manufacturing process plan for machining composite-based components using CNC Milling.

(i) Explain the definition of Data mining in Digital Aircraft Manufacturing.
(ii) Suggest a systematic approach for conducting data mining analysis.
(iii) Support your answer with a simple data analysis example.

(12 marks)

(b) Architecture Model for Industry 4.0, provide a solution-neutral reference for applications that make use of Internet of Things (IoT), big data analytics, and other technologies advancements in digital manufacturing process. There are beneficial to promote common understanding and system interoperability. Choose **TWO (2)** type of Architecture model in Digital Manufacturing system as an example and support your answer with model structure sketching.

(8 marks)

Q3 (a) Aircraft company manufactures fastener for aircraft purpose like rivet, screw and others in mass production. A new engineer attempts to explore intelligent knowledge-based manufacturing system. Analyze the available information to develop the system.

(8 marks)

(b) **Figure Q3(b)** shows a schematic diagram for an automated feeding and cutting mechanism. Assume that the cutter is moving downward for cutting materials. The materials is moving forward (horizontally) based on intermittent feeder. The cutting process starts when a sensor detect the incoming pre-cut materials and running automatically until N number of **cut**. Propose a control system using Electro Pneumatic technology. Support your answer with the step-displacement, pneumatic circuit and electrical circuit diagrams.

(12 marks)

Q4 In Virtual Manufacturing Aircraft production line, a photo electric sensor is used to ensure the turbine blade parts has uniform size in an automatic quality inspection process as shown in **Figure Q4**. If the sensor detects the part, that's mean the part has unacceptable height and must be rejected. Once the rejected part is being detected, a double acting pneumatic cylinder which is attached near the sensor push the rejected part off the conveyor into rejected box. Otherwise the turbine blade parts continue moving on the conveyor and the cylinder remain inactive. If the cylinder rejects more than 10 parts, an emergency indicator emits red light to show that the rejected parts has reached the limit so the system could stop the entire system for 5 minutes and before continuing. Select the Programmable Logic Controller (PLC) system including pneumatic diagram, motion diagram, electrical diagram and ladder diagram for this automation system according to ISO 1219 standard respectively. All components require 12VDC supply voltage.

(20 marks)

Q5 (a) In Digital Manufacturing, there are two type of Radio Frequency Identification (RFID) which are active and passive system. Differentiate the technological principle between both RFID systems.

(8 marks)

(b) The output voltage of a particular thermocouple sensor is registered to be 45.5 mV at temperature 120°C. It had previously been set to emit a zero voltage at 0°C. Since an output/input relationship exists between the two temperatures, by using the given formula:

$$S = C + ms$$

where C = output value at a stimulus value of zero

m = constant of proportionality (sensitivity)

s = *stimulus*

(i) Determine the transfer function of the thermocouple.

(6 marks)

(ii) Find the temperature corresponding to a voltage output of 18.5 mV

(6 marks)

Q6 (a) Industrial revolution 4.0 (IR 4.0) also sometimes referred to as internet of thing (IOT) or smart manufacturing system to create a more holistic and better connected ecosystem for companies that focus on aircraft manufacturing and technologies. Analyze **THREE (3)** core technologies that play important roles in IoT that can benefit the aircraft manufacturing industry to understand the value of IR4.0 in manufacturing cases with example of application.

(10 marks)

(b) The internet of things (IoT) operates around a vast network. Various components are involved which work together to form a cohesive system. The IoT is seen as the key ingredient for the development of smart environments. The situation presents a challenge to identify the most suitable IoT communication solutions for a particular smart environment. Propose **FOUR (4)** major of smart environment in IoT and sketch the example of application to represent the IR 4.0 concept.

(10 marks)

- END OF QUESTION -

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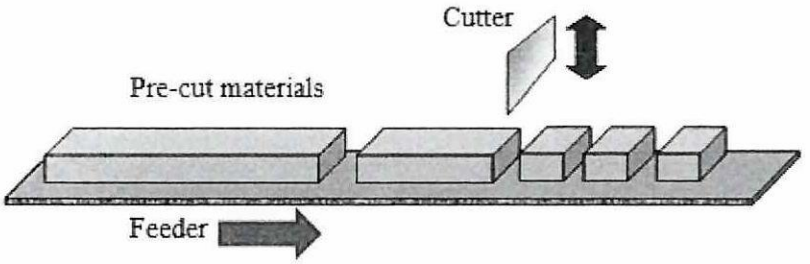

FIGURE Q3(b) Automated feeding and cutting mechanism

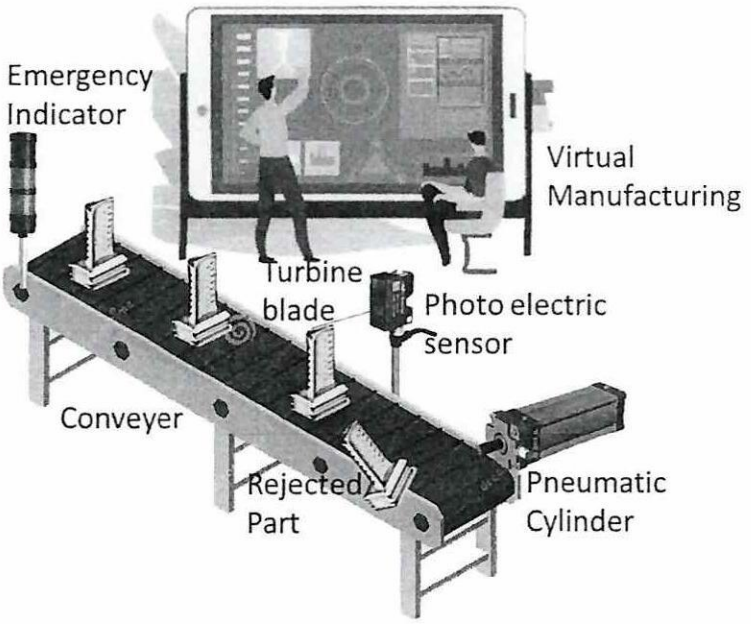

FIGURE Q4 Virtual manufacturing