The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: DMX7304 Factory Automation**
Academic Year	: 2021/22
Date	: 02nd March 2023
Time	: 1330 -1630 hrs.
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Seven (7)** questions in **Three (3)** pages.
3. Answer any **Five (5)** questions only. All questions carry equal marks.
4. Answer for each question should commence from a new page.
5. This is a Closed Book Test (CBT).
6. Answers should be in clear handwriting.
7. Do not use Red colour pens.

Question 01

(a) Distinguish between a production system and a manufacturing system, taking suitable examples to elaborate on your answer. (*04 Marks*)

(b) A fully automated machine in an automated manufacturing system may have the capacity to operate for an extended period of time with no human intervention. However, in reality this may not be the case.

Elaborate on the statement taking a suitable example. (*06 Marks*)

(c) Briefly discuss five reasons for using automation and computer integrated manufacturing in an organization producing products. (*10 marks*)

Question 02

A medium scale mixed fruit Beverage Company has sought your assistance in automating its bottle filling operation. At present, the operation is done manually and consists of the following operations.

- The final beverage is fed into a container, which needs to maintain the level of the liquid at a pre-determined level.
- A bottle is placed at the bottom of the container which contains a valve to release the beverage into the bottle under gravity.
- Once the bottle is filled the operator closes the valve at the bottom of the container and places the bottle away. At the same time, the inlet valve to the vessel is controlled manually to maintain the beverage level at the predetermined level.

(a) Propose a suitable method to automate this process. You may use a neatly drawn sketch to explain. (*04 marks*)

(b) Select appropriate sensors and actuators to accomplish the automation process. You are required to justify your selection. (*06 marks*)

(c) How would you propose to control the system? Briefly explain the types of controllers, control schemes etc. that you would use. (*06 marks*)

(d) Draw a process flow diagram of your system. (*04 marks*)

Question 03

(a) Automation of material handling plays a crucial role in factory automation. Briefly discuss the five categories in which material handling equipment are classified. (*10 marks*)

(b) Implementing an automatic storage and retrieval system (AS/RS) incurs a significant investment for a manufacturing organization. State five reasons for which a manufacturing organization would invest on a AS/RS system. (*05 marks*)

(c) Compare and contrast between bar codes and RFID identification methods in terms of technology, read-write capability, cost per label, reusability, and durability. (*05 marks*)

Question 04

(a) Group Technology (GT) is a manufacturing philosophy, when correctly applied can facilitate computer integration and automation of the manufacturing system. Briefly discuss two conditions that need to be satisfied in order to apply GT. (*04 marks*)

(b) What are the two main obstacles that a company may face when trying to implement GT? Briefly explain. *(04 marks)*

(c) Distinguish between Group Technology and Cellular Manufacturing. *(06 marks)*

(d) Two of the objectives in applying cellular manufacturing are the improvement of product quality and simplification of production scheduling. How are these objectives achieved when applying cellular manufacturing? *(06 marks)*

Question 05

(a) Controlling the manufacturing process is considered as a vital step in automation. Briefly discuss the ways in which various controller modes [Proportional (P), Integral (I), P-I, Proportional plus derivative (P-D) and P-I-D], are selected based on the applicability of the process being controlled. *(10 marks)*

(b) Discuss the pros and cons of applying cascade control schemes in factory automation. *(06 marks)*

(c) What is the advantage of using a feedforward control loop in conjunction with a feedback control loop in controlling processes? *(04 marks)*

Question 06

(a) Distinguish between Profibus-DP and Profibus-PA in the context of industrial communication networks. *(08 marks)*

(b) What is the main disadvantage of using Profibus-DP? Briefly explain the methods in which this disadvantage can be mitigated. *(06 marks)*

(c) Explain the reasons for RS-232 being rapidly replaced by RS-485 in the context of transmission of data in modern automated factory environment. *(06 marks)*

Question 07

Write short notes on any four of the following topics.

(a) Wireless network vs Industrial wireless network.

(b) Smart sensors in the context of factory automation.

(c) Evolution of automation.

(d) Distributed Control Systems (DCS) in the context of factory automation.

(e) IIoT and its technologies. *(4 x 05 marks each = 20 marks)*

End