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	: 2020/21
Date	: 27th January 2022
Time	: 1400 -1700 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 **Four (4)** 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 factory and an industry, taking suitable examples to elaborate on your answer. (*04 Marks*)

(b) Discuss the stages in which automation evolved to its present day stage with respect to production of goods. Also elaborate on the future trends of automation technologies within the factory environment. (*08 Marks*)

(c) Automation had been employed for decades in process plants, well before the introduction of automation into discrete part manufacturing industries (factories). Discuss the reasons as to why it was not possible to automate factories as in the case of automating process plants at a very early stage in the evolution of automation. (*08 marks*)

Question 02

(a) Sensors play a vital role in the field of factory automation. Discuss with an aid of a block diagram, the contribution offered by sensors in the field of factory automation. (*04 marks*)

(b) Name and briefly discuss the types of sensors used in industry based on the characteristics of the input signal measured/detected. Give at-least two examples each for the above mentioned types of sensors. (*04 marks*)

(c) A highly corrosive concentrated acid is being filed to a storage tank which is cylindrical in shape. The diameter of the tank is 1m and its empty weight is 103 kg. The tank is supported on four legs. The acid in the tank should be maintained at a level of 2m and should be able to measure a minimum acid level variation of 10 cm. (Assume density of acid to be 1100 kg/m^3)

(i) What type of sensor is most appropriate for the above task? Justify your selection.

(ii) Estimate the range and resolution of the selected sensor/s.

(iii) State any assumptions you made in answering (i) and (ii) above. (*12 marks*)

Question 03

(a) Explain the control system hierarchy of a large scale automated industrial plant. Comment on how the complexity and reaction speed vary within the respective levels. (*06 marks*)

(b) Taking suitable examples, distinguish between discrete and continuous plants. Discuss the role played by the control systems for each type of plant discussed above. (*07 marks*)

(c) Select open-loop and closed-loop control systems out of the following systems separately.
Fully automatic washing machine, Inverter type air conditioner, Automatic electric iron, Tine based bread toaster, Stepper motor, Servo-motor and a stepper-motor with a linear encoder. (*07 marks*)

Question 04

(a) Material handling systems are an important aspect in automation as applied to a larger production environment. Briefly explain the design considerations to be taken into account when designing such a system for automation. (*08 marks*)

(b) Explain the importance of the use of Automated Guided Vehicles (AGV)'s in the context of factory automation. (*06 marks*)

(c) What are the categories of AGV's commonly used in industry? Briefly explain each of these categories. (*06 marks*)

Question 05

(a) In modern automated manufacturing systems, a computer system is required to control the automated and semi-automated equipment and to participate in the overall coordination and management of the system. Briefly explain the typical functions of such a computer system in the context of a modern automated manufacturing system. (*08 marks*)

(b) What is meant by system flexibility of a manufacturing system? Explain the functions that need to be performed in each work cycle, if the system is to be flexible. (*08 marks*)

(c) Distinguish between Group Technology and Cellular Manufacturing. (*04 marks*)

Question 06

(a) Explain the importance of Programmable Logic Controllers (PLCs) in factory automation. You may discuss with an appropriate example. (*04 marks*)

(b) Name any 05 components of a PLC system and explain its functions. (*10 marks*)

(c) Briefly explain how PLCs could be used for any three of the following automation tasks.

(i) Plant startup and shutdown.

(ii) Logic and sequence control.

(iii) Coordination and communication.

(iv) Operator control and monitoring.

(v) PID control and computing. (*06 marks*)

Question 07

(a) Industrial automated networks are an indispensable aspect of factory automation. Discuss briefly the requirements that an industrial automation network should possess. (*07 marks*)

(b) Briefly discuss the wired industrial communication system with different communication protocols. (*07 marks*)

(c) What is a virtual field device? Discuss the advantages of implementing such device in relation to industrial communication systems. (*06 marks*)

End