

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	: DMX6570 Factory Automation
Academic Year	: 2020/21
Date	: 27 th 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 **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 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) What are industrial networks and give reasons for them to be more prevalent in modern industrial environment? (06 marks)
- (b) Distinguish between device busses and process busses, and discuss the applicability of such busses in the context of industrial networks. (08 marks)
- (c) Discuss the operation and advantages offered by ASI bus employed at device level within an industrial communication system. (06 marks)

Question 05

- (a) What makes an industrial robot differ from other automated machines/tools employed within a factory environment? Explain. *(06 marks)*
- (b) Industrial robots are an indispensable tool in the area of factory automation. Discuss the reasons taking suitable examples. *(06 marks)*
- (c) Select an appropriate operation/task where an industrial robot could be employed in a factory environment and state the type of robot that you would select in order to perform the selected operation/task. Justify your selection. *(08 marks)*

Question 06

- (a) What is Numerical Control? Distinguish Numerical Control (NC) machines from Computer Numerical Control (CNC) machines. *(06 marks)*
- (b) Discuss the applicability of CNC technology in relation to factory automation. *(07 marks)*
- (c) Explain how adaptive control can be utilized in CNC machine tools for an effective material removal process *(07 marks)*

Question 07

- (a) It will not be possible to achieve automation in a factory environment without an actuation system. Explain the main purpose of an actuation system with respect to factory automation. Discuss the pros and cons of different actuation systems employed in factory automation. *(08 marks)*
- (b) Discuss the operational principle of a stepper motor. What are the types of stepper motors available as actuation systems? Briefly explain. *(08 marks)*
- (c) Pneumatic and hydraulic actuation systems use directional control valves to direct the flow of fluid through the system. Briefly discuss the types of directional control valves used in such systems. *(04 marks)*

End

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