

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 / MEX6270 Factory Automation
Academic Year	: 2019/20
Date	: 08 th October 2020
Time	: 0930 - 1230hrs
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Eight (8)** questions in **Four (4)** pages.
3. Answer **Five (5)** questions.
6. This is a Closed Book Test(CBT).
7. Answers should be in clear hand writing.
8. Do not use Red colour pen.

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1. (a) "Automation is not always the right answer for a given production situation".
Explain giving reasons.
 - (b) In automatic control of systems, feedback control is often required to ensure high-performance control. Explain with special emphasis on:
 - (i) Practical difficulties in implementation
 - (ii) Cost concerns
 - (c) Explain the application of automation in the context of a factory and an industry.

2. (a) Draw a typical instrumentation system employed in controlling a plant or device, and discuss the role of sensors in such a system. Quote an example and explain your answer.
- (b) Define sensitivity in relation to a sensor. In a particular sensor, a movement of **0.001 mm** causes an output voltage change of **0.02 V**. Calculate the sensitivity of the sensor.
- (c) Briefly describe the common sensors used in robotics, by taking a suitable industrial application. Explain how you would select a particular sensor of an industrial robot.
3. (a) What is an actuation system? Briefly explain the types of actuation systems used in factory automation.
- (b) Why are fluid actuation systems widely used in factory automation? Discuss with an appropriate example.
- (c) Draw symbols to represent the following.
- (i) Pressure relief valve.
 - (ii) 2/2 valve which has actuation push button and spring.
 - (iii) Pilot operated 4/2 valve.
 - (iv) Directional control valve.
4. (a) Explain the control hierarchy of a large scale automated industrial plant. Indicate the response time and complexity within its respective levels. You may use a neatly drawn sketch to elaborate.
- (b) Explain the significance of control bandwidth, in the performance of an industrial control system.
- (c) Briefly explain the typical control modes that are commonly employed at the device level in the context of closed loop control mechanisms. (Hint : Control modes -the manner in which the control unit reacts to the error signal and the way in which it rectifies the error.

5. (a) Explain the term of 'primitive communication' in relation to factory automation eith using suitable example.
- (b) Write any two serial communication protocols used in industrial communication systems and briefly explain them.
- (c) Discuss the applicability of Profibus in relation to industrial/factory automation.
- (d) Explain the operation and advantages of following device buses.
- (i) AS-i bus
 - (ii) CAN bus
6. (a) Briefly explain the operational princile of a brushless d.c. permanenet magnet motor that are commonly used in industrial applications.
- (b) Two separate d.c. motors are to be employed in an industrial application that requires:
- (i) a high torque at low speeds for the movement of lage loads.
 - (ii) a torque which is almost constant regardless of speed.
- Suggest the suitable forms of d.c. motors that can be employed to accomplish the above two condiditons. Justify your answer.
- (c) Distinguish between variabelbe reluctance stepper motors and permanent magnet stepper motors.
7. (a) Explain the differences between microprocessors and microcontrollers.
- (b) Write three common programming languages that are used in PLC programming.
- (c) Draw a Ladder Logic diagrams to implement the following gates,
- (i) OR
 - (ii) AND
- (d) Design Ladder Logic for a car that considers the variables below to control the motor M. Also an alarm should goes off if the doors opened/closed and the keys are in ignition.
- doors opened/closed (D)
 - keys in ignition (K)
 - motor running (M)
 - transmission in park (P)
 - ignition start (I)

8. (a) Why is Numerical Control (NC) technology an important aspect in factory automation? Discuss some of the major areas of application of NC technology in factory automation.
- (b) Distinguish absolute programming from incremental programming in relation to CNC programming. Discuss the applicability of each of the two methods in relation to material removal process.
- (c) Discuss the significance of cutter diameter compensation and tool length offset in CNC programming.