(6)

Program: B.Sc. Engg. (ME / IPE)
Semester: 4th Sem.

Date: 09 May 2023 (Group A)
Time: 10:00 am – 01:00 pm

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

Semester Final Examination
Course No.: ME 4407
Course Title: Measurement, Instrumentation and Control

Summer Semester, A. Y. 2021-2022
Time: 3 Hours 00 Min(s)
Full Marks: 150

There are 6 (Six) questions. Answer all the questions.
Marks of each question and corresponding CO and PO are written in the brackets.
Do not write on this question paper.

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1. a) What is the main difference between a sensor and transducer? Briefly explain a typical temperature and weight measurement system. **(13)** (CO1) (PO1)

   b) Define sensitivity drift and zero drift. What factors can cause sensitivity drift and zero drift in an instrument and how these can be reduced? **(12)** (CO1) (PO1)

2. a) In what situations would an infrared thermometer be the preferred choice over other temperature measurement devices? How does an infrared thermometer work, and what are the key components of the device? **(13)** (CO2) (PO1)

   b) What are the main components of a LiDAR system, and how do they work together to produce a 3D point cloud? **(12)** (CO2) (PO1)

3. a) Select an appropriate non-invasive and self-cleaning level measuring sensor to measure the level of asphalt inside a hot asphalt tank in a shingle manufacturing plant. Justify your selection and explain its working principle. **(13)** (CO2) (PO2)

   b) In order to measure vacuum pressure (10^{-2} to $1\ mbar$), which pressure measurement device will be more suitable and why? Explain its working principle with schematic diagram. **(12)** (CO2) (PO2)

4. a) Calculate the digital output of 6.5V using the Successive-Approximation ADC method (12-bit A/D with range 1–10V). Also, calculate the error (if any). In order to reduce the error, what are the possible ways that can be implemented on the above method. **(15)** (CO1) (PO2)

   b) Why 'Multiplexer' and 'Sample and Hold' are necessary in a Data Acquisition system? Briefly explain the working steps of a sample and hold circuit. **(10)** (CO1) (PO2)

5. a) Classify and explain the types of actuators according to the motion delivered by it. **(5)** (CO3) (PO1)

b) Three pneumatic cylinders (A, B, and C) are shown in Figure 1 with their limit switches a0, a1, b0, b1, c0, and c1, to detect when the cylinders are fully retracted and fully extended. Design and explain the pneumatic circuit diagram to generate the repeat pattern sequence: $A+B+C+A-B-C-$ by applying the rule "The signal given by the completion of each movement will initiate the next movement". **(20)** (CO3) (PO2)

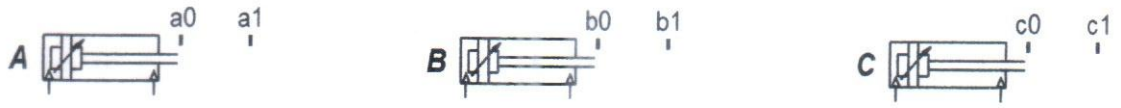

Figure 1 (Question 5 a)

6. In an ammonia plant, nitrogen and hydrogen are mixed in a 1:3 molar ratio. **(25)**

i) To maintain the correct ratio during the production process, what type of control loop can be used? Explain with necessary diagram. (CO4) (PO1) (PO2)

ii) In the above control loop, what type of control algorithm is most suitable and why?

iii) Do you think that Time Proportional Control is needed for the above case? Justify your comment with a suitable diagram.