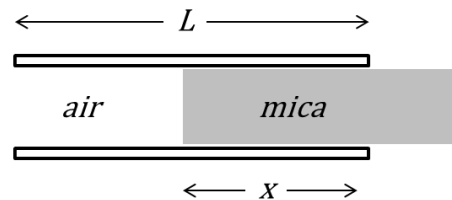Course No.   : ES ZG511 Mechatronics
Course Title   : MECHATRONICS AND AUTOMATION
Nature of Exam   : Closed Book
Weightage   : 30%
Duration   : 2 Hours
Date of Exam   :

No. of Pages   = 1
No. of Questions = 8

Note:
1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

Q.1.   Based on the definition of 'Mechatronics', justify that Automatic Washing Machine is a Mechatronic product.   [2 Marks]

Q.2.   In a process industry, dry reagent powder is stored in a cylindrical tank of diameter 1m and height 2m. Suggest at least 3 sensing methods for detecting the amount of powder stored in the tank; with their main advantage and limitation.   [4.5 Marks]

Q.3.   List at least two advantages of LVDT, Eddy current sensor, and IR sensor over Potentiometer, Capacitive and Ultrasonic sensors, respectively. Exclude terms like, cost, availability, simplicity, maintenance, life etc.   [3 Marks]

Q.4.   Show the output curve of RTD, thermocouple and thermistor in a single graph and mention at least three main differences among them, based on this graph.   [3 Marks]

Q.5.   (a) What is the essential condition for a fluid, so that its flow can be measured by a magnetic flowmeter?
       (b) How the resolution of a magnetic flowmeter can be increased?
       (c) Determine the value of magnetic field for a magnetic flowmeter, if the voltage output is 2.5 mV, for a flow rate of 120 liters per minute. The length of connector s 2cm, and the diameter of the pipe is 10cm.   [4 Marks]

Q.6.   Name the different sensing elements that can be used for a load cell. Sensitivity of a load cell is given as 2.1 mV/V, and output voltage of 7.5mV for an applied load of 7.5N. If the capacity of the load cell is 25N, determine the excitation voltage value.   [3.5 Marks]

Q.7.   A liner potentiometer of total variable length of 10cm, is to be designed for a resolution of 1.0 Ω/m. The maximum permissible non-linearity error value is desired as 2%. Consider the resistance of the voltage measuring device as 10KΩ. Compute the maximum and minimum value of the resistances with its corresponding error and resolution values.   [5 Marks]

Q.8.   A capacitor is constructed as shown in the figure. The gap between the plates are 5mm. In this gap, another plate of mica can move to fill the gap, with a value 'x'. find out the value of sensitivity of the setup with respect to the variable length 'x'. The width of the plate is 50mm and the dielectric constant of mica is 8. The permittivity of air is 8.85×10^{-12} F/m.

[5 Marks]

****