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

Date: 11 March 2024 (Morning)
Time: 10:00 am – 11:30 am

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

DEPARTMENT OF MECHANICAL AND PRODUCTION ENGINEERING

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

Summer Semester, A. Y. 2022-2023
Time: 1 Hours 30 Min(s)
Full Marks: 75

There are 3 (Three) 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) A load cell is calibrated in an environment at a temperature of 20°C and has the following deflection/load characteristic: **(13) (CO1) (PO2)**

Load (kg)	0	50	100	150	200	250
Deflection (mm)	0.0	0.9	1.9	3.2	4.2	4.9

When used in an environment at 35°C, its characteristic changes to the following:

Load (kg)	0	50	100	150	200	250
Deflection (mm)	0.3	1.3	2.4	3.7	4.8	5.7

i) Determine the zero drift and sensitivity drift coefficients in units of μm/°C and μm/kg.°C, respectively.
ii) Calculate the total zero drift and sensitivity drift at 30°C in units of μm and μm/kg, respectively.

b) A Bourdon tube pressure gauge has the following errors in its measurement. **(12) (CO1) (PO2)**

No.	Applied load (bar)	Gauge load (bar)	Error
1	0	0	0
2	5	4.1	0.9
3	10	8.3	1.7
4	15	12.2	2.8
5	20	15.8	4.2
6	25	20.5	4.5
7	30	25	5
8	35	29.6	5.5
9	40	34.9	5.1

If the tolerance is 10% of the applied load, does the pressure gauge need to be calibrated? If so, explain the steps involved in the calibration process.

2. a) In the context of a load cell, where the primary sensing component is a strain gauge, could you elucidate the processes occurring within each element of this measurement system to derive the measured weight from the actual weight applied onto the load cell? **(13) (CO2) (PO2) (P1, P3)**

b) In the context of temperature measurement utilizing a thermocouple, where voltage is generated based on the Seebeck effect, the conventional practice entails situating the reference junction in an ice bath to ascertain room temperature accurately. However, consistently managing the reference junction in an ice bath poses logistical difficulties. Could you propose and briefly describe an alternative solution to address this challenge effectively? **(12) (CO2) (PO2) (P1, P3)**

3. a) Please provide a brief explanation of the operational principles underlying the bimetallic strip thermometer, accompanied by a schematic representation, and enumerate the distinctive characteristics inherent to this type of thermometer. **(13) (CO2) (PO2) (P1, P3)**

b) A tachometer serves to measure the rotational speed of engines or rotating machinery, usually quantified in revolutions per minute (RPM). Suppose there is a need to construct a tachometer within a laboratory setting for a particular application, utilizing a capacitive sensor. Elucidate the procedural steps, present a schematic diagram of the measurement setup, and provide a concise overview of the operational mechanism? **(12) (CO2) (PO2) (P1, P3)**