Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	INSTRUMENTATION AND MEASUREMENT IN OIL AND GAS
COURSE CODE	:	BEJ 44903
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTIONS
		2.THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**
		3.STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 (a) Explain the function of the measurement system and the basic requirements for measurement.

(4 marks)

(b) Weather research has been carried out to measure the fluctuation of temperature of the industrial area near the neighborhood. The readings are recorded for half of the month every day continuously at 7:00 AM. at the same location by the researcher. **Table Q1(b)** shows the recorded data. Find the mean and the standard deviation of the data.

(6 marks)

(c) A voltmeter having a sensitivity of 1 kΩ/V is connected across an unknown resistance in series with a milliammeter reading of 30 V on a 150 V scale. When the milliammeter reads 600 mA, calculate:

(i) Apparent resistance of the unknown resistance

(2 marks)

(ii) Actual resistance of the unknown resistance

(2 marks)

(iii) Error due to the loading effect of the voltmeter

(2 marks)

(d) An 820 Ω resistance with an accuracy of ±10% carries a current of 10mA. The current was measured by an analog ammeter on a 25 mA range with an accuracy of ±2% of full scale.

(i) Calculate the power dissipated in the resistor.

(2 marks)

(ii) Calculate the accuracy of the result.

(2 marks)

Q2 (a) Water is pumped through a 1.5 inch diameter pipe with a flow velocity of 2.5 ft/s.

(i) Calculate the volume flow rate (ft^3/min)

(5 marks)

(ii) Solve the weight flow rate (lb /min) if the weight is 62.4 lb/ft^3.

(4 marks)

(b) Flow is to be controlled from 20 to 150 gal/min. The flow is measured using an orifice plate system such as that shown in **Figure Q2(b)**. The orifice plate with K=119.5(gal/min)/$psi^{1/2}$. The below measures the pressure with an LVDT so that the output is 1.8V/psi. Calculate the range of voltages that result from the given flow range.

(6 marks)

(c) A coal conveyor system moves at 100 ft/min as shown in **Figure Q2 (c)**. A weighing platform is 5.0 ft in length, and a particular weighing shows that 75 lb of coal is on the platform. Find the coal delivery in lb/h.

(5 marks)

Q3 (a) Referring to the circuit shown in **Figure Q3(a)**, the connecting wires are made of Nickel.

(i) Estimate the resistance in each of the nickel wires, R wire if the temperature of the circuit rises from 20°C to 40°C. Given the temperature coefficient of nickel, Note: αnikel-20 is 0.005866/°C.

(2 marks)

(ii) Predict the temperature when the total resistance of the nickel wires has the value of 25 Ω.

(2 marks)

(b) Based on **Figure Q3(b)** if the RTD sensor measurement is 57°C answer the following.

(i) Calculate the output current from the RTD sensor if the output range is 4 – 20mA.

(4 marks)

(ii) Evaluate the output voltage from the temperature controller if the output range is 0 – 10 VDC.

(4 marks)

(iii) Propose a type of sensor if the process temperature is increased to 1000 °C.

(2 marks)

(c) Estimate an Aluminium rod of 10m in length at 20 °C expand when the temperature is changed from 0 to 100 °C?
Note: The Thermal Expansion Coefficient is **25 x10^{-6} /°C**

(6 marks)

Q4 (a) A pressure difference of 1.1 psi occurs across a constriction in a 5 cm diameter pipe. The constriction constant is 0.009m^3/s per kPa.

(i) Calculate the flow rate in m^3/s.

(4 marks)

(ii) Calculate the flow velocity in m/s.

(3 marks)

(b) A tank holds water with a depth of 7.0 ft. Find the pressure at the tank bottom in psi and Pa (density $=10^3$ Kg/m^3).

(6 marks)

(c) A SS pressure sensor that outputs 25 mV/kPa for a pressure variation of 0.0 to 25 kPa will be used to measure the level of a liquid with a density of.

(i) Find the voltage output that will be expected for level variations from 0.0 to 2.0 m?

(5 marks)

(ii) Solve the sensitivity for level measurement expressed in mV/cm?

(2 marks)

Q5 (a) A magnetic amplifier requires a 5 to 10 V input signal from a 4 to 20 mA control signal using a resistor in the current line, 100 Ω as shown in **Figure Q5(a)**. Show a signal-conversion system to provide this relationship.

(10 marks)

(b) An equal percentage valve has a maximum flow of 50 cm^3/s and a minimum of 2 cm^3/s. If the full travel is 3 cm, determine the flow at a 1 cm opening valve.

(5 marks)

(c) Determine the proper valve flow coefficient, (Cv) for a valve that must allow 150 gals of liquid per minute with a specific gravity of a 0.8 maximum pressure of 50 psi.

(5 marks)

-END OF QUESTIONS –

FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2022/2023
COURSE NAME : INSTRUMENTATION AND MEASUREMENT IN OIL AND GAS
PROGRAMME CODE : BEJ
COURSE CODE : BEJ 44903

Table Q1 (b)

Day	Temperature ^{0}C
1	32.1
2	29.8
3	30.2
4	31.1
5	32.0
6	29.7
7	30.1
8	34.3
9	31.2
10	31.7
11	30.2
12	29.9
13	29.5
14	30.1
15	29.8

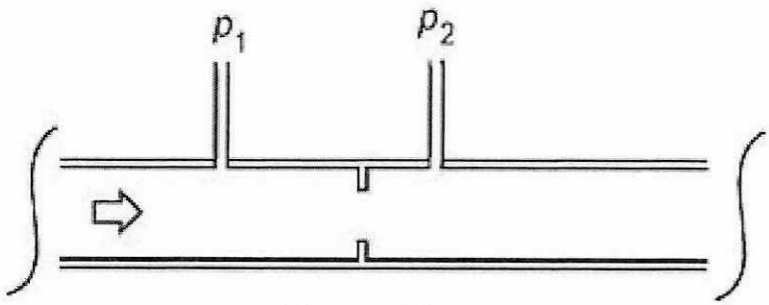

Figure Q2(b)

FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2022/2023
COURSE NAME : INSTRUMENTATION AND MEASUREMENT IN OIL AND GAS

PROGRAMME CODE : BEJ
COURSE CODE : BEJ 44903

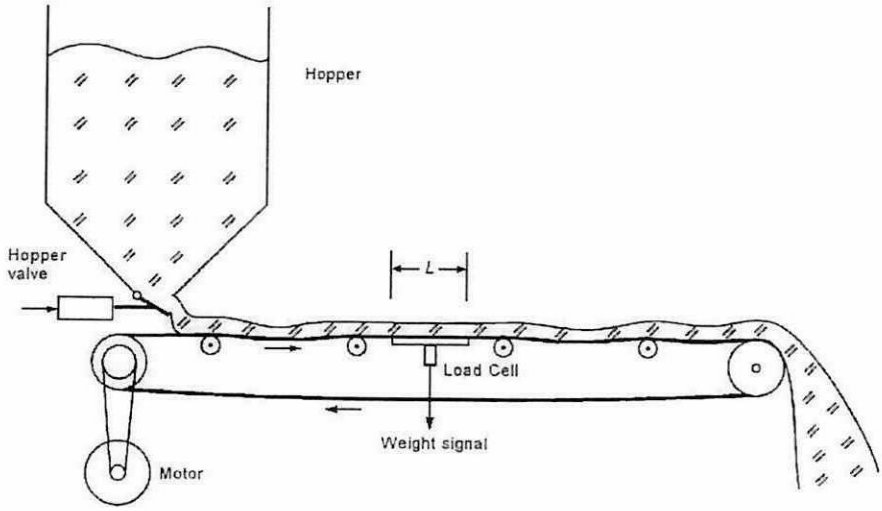

Figure Q2(c)

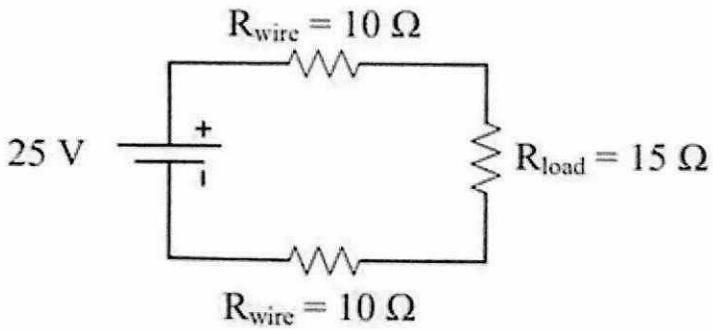

Figure Q3(a)

FINAL EXAMINATION

SEMESTER / SESSION : SEM II 2022/2023
COURSE NAME : INSTRUMENTATION AND MEASUREMENT IN OIL AND GAS

PROGRAMME CODE : BEJ
COURSE CODE : BEJ 44903

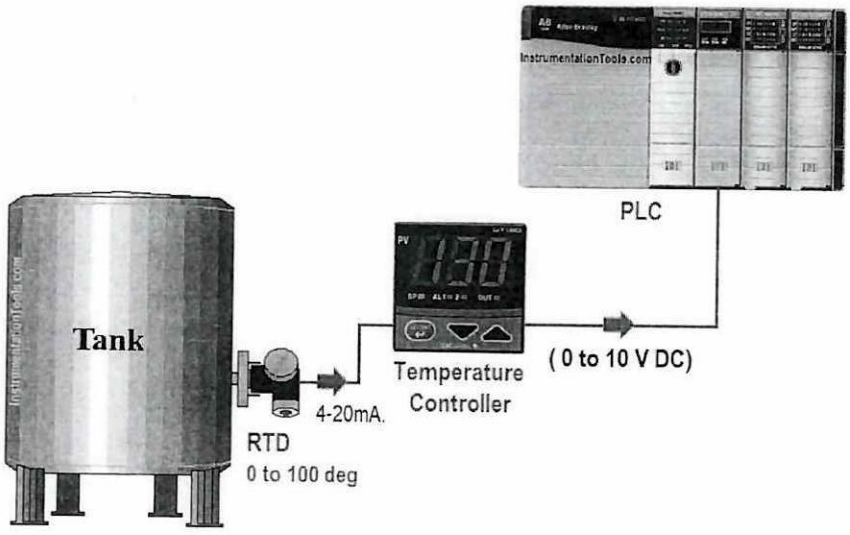

Figure Q3(b)

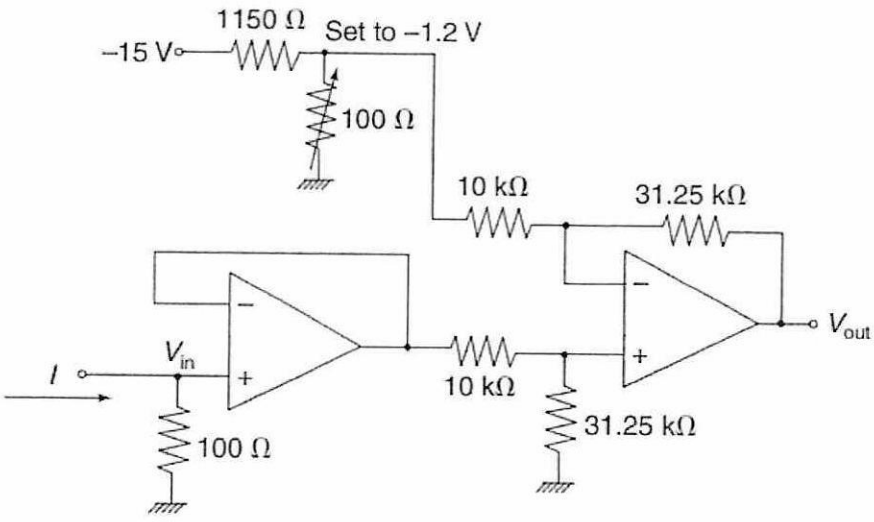

Figure Q5(a)