FNU FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

School of Electrical and Electronics Engineering

Bachelor of Engineering (BENG)- Year 4

Electrical and Electronics Engineering

EEB723- Industrial Instrumentation

Semester 2, 2018

(Total Marks: 100 Duration: 3 Hours)

November 2018

Date: As per time table Time: As per time table

Venue: As per exam. Schedule

Instructions to Candidates

1. You will be allowed 10 minutes reading time and **3 hours** to complete this paper.
2. Begin each answer on a fresh page and use both sides of the sheet.
3. Please ensure that **your ID number** is written at the top of each sheet of paper used.
4. Insert all written pages, graph paper, drawing paper etc. in their correct sequences and secure with string.
5. For all sheets of paper on which rough/ draft work has been done, cross it through and you must attach all of them to your answer scripts.
6. Write clearly the numbers of the questions attempted on the top of each sheets.
7. Answer all questions.
8. Use of mobile phones, smart watches or any other electronics devices with electronics storage of data/communication is not allowed during the examination.
9. Use of only non-programmable scientific calculator is allowed.

Total number of pages: 3(three) including this cover page.

(All Questions are compulsory)

Q1. (a) A sensors shows maximum non-linearity is 0.5 units, where the input units are expressed in bars from 1 to 9 bars and the output units are expressed in volts from 1 to 13 V.
(i) Express maximum nonlinearity as a percentage of the full scale deflection.
(ii) To determine the resolution of the sensor use the instrument characteristic as given. [10]

(b) A sensor has a transfer function of 5 mV / ^{0}C and an accuracy of ± 1%. If the temperature is known to be 60 ^{0}C, what can be said about the output voltage. [10]

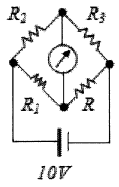
Q2. (a) If the emf output measured from a chromel-constantan thermocouple is 10.72 mV with the reference junction at 0^0C. Explain the technique and determine the temperature corresponding to the emf value of 10.72 mV with the following temperature-emf table of chromel-constantan thermocouple. [10]

Tem(0_C)	120	130	140	150	160	170	180	190	200
Emf(mv)	7.683	8.377	9.078	9.787	10.501	11.222	11.949	12.681	13.419

(b) An iron-constantan thermocouple measuring the temperature of a fluid is connected by mistake with copper-constantan extension leads (such that the two constantan wires are connected together and the copper extension wire is connected to the iron thermocouple wire). If the fluid temperature was actually 200^0C, and the junction between the thermocouple and extension wires was at 50^0C, what emf would be measured at the open ends of the extension wires if the reference junction is maintained at 0^0C? What fluid temperature would be deduced from this (assuming that the connection mistake was not known about)? [10]

$emf_{(\text{iron-constantan})_{50}} = 2.585mv$, $emf_{(\text{copper-constantan})_{50}} = 2.035mv$
$emf_{(\text{iron-constantan})_{190}} = 10.222mv$, $emf_{(\text{iron-constantan})_{200}} = 10.77mv$

Q3. (a) A null-type Wheatstone bridge is used to accurately measure the resistance of a platinum resistance thermometer during a calibration procedure. The circuit shown in Figure is used, in which the known fixed resistance values are given $R_1 = 37.36\ \Omega$, $R_2 = R_3 = 25\ \Omega$ and $R = 25\ \Omega$ at 0°C. Find the temperature of the *RTD*. Knowing that the thermal coefficient $\alpha = 0.00392$ / °C. [10]



(b) A obstruction type flowmeter of the volumetric flow the channel pressure, velocity, cross sectional area and height above the datum is p_1, v_1, A_1 and z_1 for section 1 and the corresponding values for section 2 be p_2, v_2, A_2 and z_2 respectively. A liquid of specific weight γ is flowing then calculate volumetric flow rate Q of liquid in terms of cross sectional area, height and pressure difference. [10]

Q4. (a) Water flows in a 150 mm diameter pipeline in the form of Venturi tube. The mean velocity at the entrance is 4.5 m/sec. The U tube shows a head drop of 5 cm. Calculate the diameter of the throat. [10]

(b) Water flow is controlled from 20 to 50 gal./min. The flow is measured using Venturi tube of 10 cm inlet diameter, and 5 cm throat diameter. Bellows connected to LVDT are used to measure flow such that its output is 1.8 volt / psi. Find the range of voltages that result from the flow rate. [10]

Q5. (a) In an outer type ultrasonic level gauge, the transmitter and receiver sensors are established over a liquid tank such that their height from the bottom of the tank is 2 meters. If the time taken by the signal from the transmitting instant to the receiving instant is 2×10^{-3} sec. Determine the liquid level height in the tank, taking into consideration that the speed of signal is 350 m / sec. [10]

(b) In the design of a capacitance level gauge the separation distance between the two plates is $d$cm and the dimensions of the plates are w meters width and h meters height. The capacitance when the tank is empty is C pF. When certain amount of insulating powder was poured in the tank the capacitance is changed to be 2C pF. If the dielectric constant of the powder is 3 times that of the air. Compute the ratio of the height of the powder to the total height of the tank h. [10]

The End.