FNU FIJI NATIONAL UNIVERSITY

College of Engineering, Science and Technology

School of Electrical & Electronics Engineering

Bachelor of Engineering (BENG)- Year 3

EEB 721- Principles of Measurements and Instrumentation

Semester 1, 2019

(Total Marks: 100 Duration: 3 Hours)

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: 4(four) including this cover page.

(All 10 Questions are compulsory – 10 marks each)

1. What are the main elements in a complex measurement system and what are their functions. Explain with neat sketch diagram.

[10]

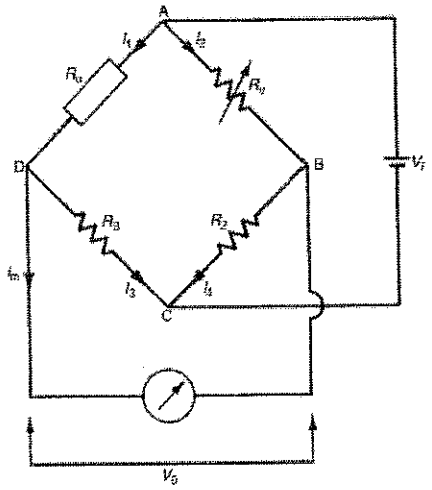
2. In a practical exercise to determine the freezing point of a metal alloy, the following measurements of the freezing point temperature were obtained:
519:5, 521:7, 518:9, 520:3, 521:4, 520:1, 519:8, 520:2, 518:6, 521:5.
The probability of any data point lying outside particular deviation boundaries expressed by the following table.

Deviation Boundaries	% of Data Points within Boundaries	Probability of Any Particular Data Point Being Outside Boundary
$\pm\sigma$	68.0	32.0%
$\pm 2\sigma$	95.4	4.6%

Express the mean value and the error boundaries expressed to
(a) 68% confidence limits (b) 95.4% confidence limits

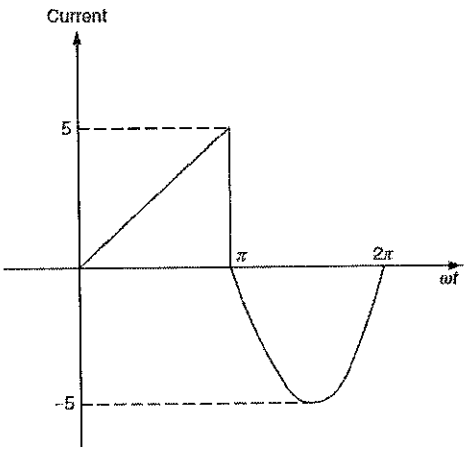
[10]

3. In the Wheatstone bridge circuit of Figure below, R_v is a decade resistance box with a specified inaccuracy of $\pm 0.2\%$ and $R_2 = R_3 = 500\ \Omega\ \pm 0.1\%$. If the value of R_v at the null position is 520.4 Ω, determine the error band for R_u expressed as a percentage of its nominal value.



[10]

4. Calculate the reading that would be observed on a moving iron ammeter when it is measuring the current in the circuit shown in Figure below.



[10]

5. In an experiment to determine the characteristics of a displacement sensor with a voltage output, the following output voltage values were recorded when a set of standard displacements was measured:

Displacement (cm)	1	2	3	4	5	6	7	8	9	10
Voltage (V)	2.1	4.3	6.2	8.5	10.7	12.6	14.5	16.3	18.3	21.2

Fit a straight line to this set of data using least squares regression and estimate the output voltage when a displacement of 4.5 cm is measured.

[10]

6 Design a first order active high pass filter has a pass band gain of two and a cut-off corner frequency of 1kHz. If the input capacitor has a value of 10nF, determining resistor and the gain resistors in the feedback network. Also, plot the expected frequency response of the filter.

[10]

7. Demonstrate 8 bit R-2R resistor-ladder network Digital-to-analogue (D/A) converter with neat diagram. If digital signal with binary value of 11010100 and V_{ref} is 10V is applied to D/A converter then find out equivalent analog output.

[10]

8. (a)Find out the V_{out} if $V_1 = 10V$, $V_2 = 20V$. The value of $R_1 = R_2 = 1k\Omega$ and $R_3 = R_4 = 2k\Omega$ as shown in figure 1.
(b) Find out the V_{out} if $V_1 = 5V$, $V_2 = 10V$, $V_3 = 15V$. The value of $R_1 = 1k\Omega$, $R_2 = 2.5\ k\Omega$ and $R_3 = 5k\Omega$ and $R_f = 10k\Omega$ as shown in figure 2.

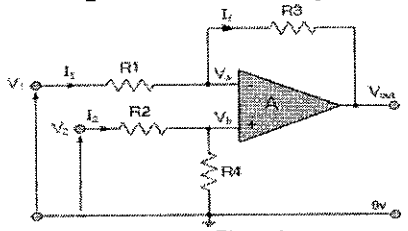


Figure 1.

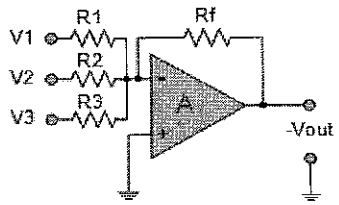


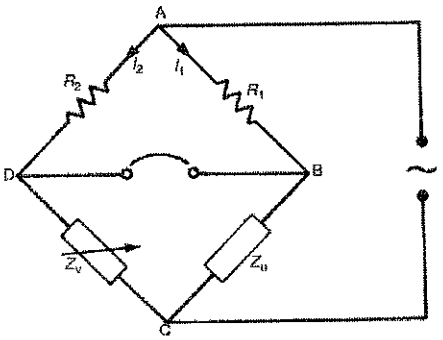
Figure 2.

[10]

9. Derive an expression to measure unknown frequency with the help of Wien's bridge.

[10]

10. A null-type impedance bridge is used to accurately measure the capacitance of a capacitive pressure sensor during a calibration procedure. The circuit shown in Figure below is used, in which the known fixed resistance values are given by R_1 =491.7Ω and R_2 = 483.2 Ω. The pressure sensor is inserted in the circuit as Z_u and an accurate variable capacitor box with capacitance C_v is used for Z_v. The capacitor box is adjusted until the bridge output voltage goes to zero. At this balance point, the value of $C_v$is 103.7 pF. Calculate the capacitance of the pressure sensor.



[10]

THE END