

value of modulus of elasticity as 250GN/m^2 .

4. a) Illustrate the working of Hall Effects transducer with its necessary.
b) What is telemetry and explain the types with block diagram.
5. a) Why signal conversion is required? Differentiate between binary weighted type and R-2R ladder type D/A converter.
b) Sketch the circuit of Summing amplifier using Op-amp to get
$$V_{out} = 2V_1 - 3V_2 - 5V_3$$
6. a) Clarify the principle of operation of X-Y recorder with its area of application.
b) What do you mean by Data Acquisition System? Explain in brief about modern trends used in Data Acquisition System.
7. Write short notes on: (Any two)
 - a) IEEE Standard.
 - b) Errors in transducer.
 - c) Filtering and Wave Shaping.

POKHARA UNIVERSITY

el: Bachelor
gramme: BE
use: Instrumentation

Semester: Spring

Year : 2014
Full Marks: 100
Pass Marks: 45
Time : 3 hrs.

Candidates are required to give their answers in their own words as far practicable.
figures in the margin indicate full marks.
mpt all the questions.

efine instrumentation system and explain the components of modern instrumentation system with block diagram. 7

en measurements of resistance of resistors are 50Ω , 50.1Ω , 50.0Ω , 50.3Ω , 50.1Ω , 50.2Ω , 50.0Ω , 50Ω , 50.3Ω , 50.2Ω . Assume only random errors are present. Calculate:- 8

- Arithmetic mean
- Standard deviation
- Probable error.

xplain Kelvin's bridge with its necessary diagram. 7

he four arms of an ac bridge at balance are : arm ab – an unknown inductance L_1 having an inherent resistance R_1 ; arm bc – a non-inductive resistance of 1000Ω ; arm cd – a capacitor of $0.5 \mu F$ in parallel with a resistance of 1500Ω ; arm da – a resistance of 200Ω . Ind the value of unknowns. 8

he output of an LVDT is connected to a 5 V voltmeter through an amplifier whose amplification factor is 150. An output of 1 mV appears across the terminals of LVDT, when the core moves through a distance of 0.6 mm. Calculate the sensitivity of LVDT and that of the scale set up. The milli-voltmeter scale has 100 divisions. The scale can be read to $1/3$ of a division. Calculate the resolution of the instrument in mm. 7

A strain gauze having the resistance of 400Ω and gauze factor of 1.5 is connected in series with a ballast resistance of 500Ω . Determine the charge in output when a stress of $200MN/m^2$ is applied and take the

5. a) Elucidate the working principle of instrumentation amplifier with necessary sketch.
b) Find the digital output of 8.217 volt input from a 4 bit successive approximation ADC with reference voltage of 10 volt.
6. a) What is data transmission? Briefly explain the various schemes of data transmission.
b) What is data acquisition system? Explain with sketch, the generic digital data acquisition system.
7. Write short notes on: (Any two)
 - a) Sensor and its type
 - b) Input Characteristics of transducer
 - c) Isolation Amplifier

POKHARA UNIVERSITY

Bachelor
Programme: BE
Subject: Instrumentation

Semester: Fall

Year : 2015
Full Marks: 100
Pass Marks: 45
Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

Figures in the margin indicate full marks.
Attempt all the questions.

Explain the generalized block diagram of an instrumentation system with their function and example. 7

Explain the following terms with reference to measuring instrument: 8

- Accuracy and precision
- Sensitivity and resolution
- Linearity and hysteresis

Explain the conditions for dc bridge balance with its necessary diagram. 7

A 1000 Hz bridge has the following constants arm 8

B, R = 1000 Ω in parallel with C = 0.5 μF ;

C, R = 1000 Ω in series with C = 0.5 μF ;

D, L = 30 mH in series with R = 200 Ω

Find the constants of arm DA to balance the bridge.

Define Strain gauge. Derive the expression between gauge factor & Poisson's ratio. 8

The output of an LVDT is connected to a 5V voltmeter through an amplifier whose amplification factor is 250, an output of 2mV appears across the terminals of LVDT when the core moves through a distance of 0.5mm. Calculate 7

i. The sensitivity of LVDT and the whole setup

ii. If a scale can read up to 1/5 of a division, calculate the resolution of the instrument in mm.

What are physical variables? Explain primary and secondary transducers in brief. 7

Explain the principle of operating of magnetic tape recorder. List out its area of application. 8

- Approximation ADC with the reference voltage of 10 volts.
- b) What are the various types of datatransmission? Explain Synchronous & Asynchronous Data transmission in brief.
6. a) Explain the principle of operation of strip chart recorder.
- Or
- Explain the operation of X-Y recorder with its application.
- b) What are the uses of data acquisition system?
7. Write short notes on: (Any two)
- a) Errors in instrumentation
 - b) Type of transducers
 - c) Filtering

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Instrumentation

Semester: Spring

Year : 2015
Full Marks: 100
Pass Marks: 45
Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

Explain the various components of a generalized Instrumentation System with the help of a block diagram. 7

What are the performance parameters of an instrument? Explain the static characteristics in brief? 8

The Schering Bridge has the following constants, $R_1=1.5K\Omega$, $C_1=0.4\mu F$, $R_2=3K\Omega$ and $C_3=0.4\mu F$ at frequency 1kHz. Determine the unknown resistance and capacitance of the bridge and dissipation factor. 7

What is the use of Wien Bridge? Derive the expression for unknown components in Wien Bridge. What are applications and limitations of Wien Bridge? 8

Define Strain gauge. Prove that $G = 1+2\mu$ for strain gauge where constants has their as usual meaning. 8

The output of an LVDT is connected to a 5 V voltmeter through an amplifier whose amplification factor is 150. An output of 5 mV appears across the terminals of LVDT, when the core moves through a distance of 0.5 mm. Calculate the sensitivity of LVDT and that of the whole set up. The milli-voltmeter scale has 100 divisions. The scale can be read to 1/5 of a division. Calculate the resolution of the instrument in mm. 7

The resistance of thermistor at $27^\circ C$ is 1050Ω with constant $\beta=3140$. Calculate the value of temperature when the thermistor resistance becomes 2330Ω in $^\circ C$ and Kelvin scale. 7

Explain the working principle of instrumentation amplifier. 8

Find the digital output of 8.217 volts input from a 4-bits Successive 7

wiper as

$$V_{out} = V_{in} \times \frac{\alpha K}{K(1-K)+\alpha} \quad (\text{Where, } \alpha = \frac{R_L}{R_p}).$$

Also, show that maximum relative error occurs at $K = 0.5$.

- b) A quartz piezoelectric pickup has dimension of 5mm*5mm*1.5mm and a voltage sensitivity of 0.012Vm/N. The relative permittivity of the quartz is 1600 and modulus of elasticity of the quartz is 12MN/m². The force applied to the pick-up is 10N. Determine,
- The output Voltage
 - Charge sensitivity
 - Strain
 - Charge generated and the Capacitance of the pick-up
4. a) The resistance of thermistor at 27°C is 1050Ω with constant $\beta=3140$. Calculate the value of temperature when the thermistor resistance becomes 2330Ω in Kelvin scale and find the sensitivity of the transducer at the given operating point.
- b) Explain the working principle of instrumentation amplifier.
5. a) Find the digital output of 8.217 volts input from a 4-bits Successive Approximation ADC with the reference voltage of 10 volts.
- b) What is telemetry? Explain its various types and application of telemetry system.
6. a) With the help of necessary diagram, explain the working principle of magnetic tape recorder, hence verify that it act as a differentiator.
- b) Briefly explain about the digital data acquisition system.
7. Write short notes on: (Any two)
- Isolation amplifier
 - Errors in Transducers
 - Data transmission modes
 - Probability of errors

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Instrumentation

Semester: Fall

Year : 2016
Full Marks: 100
Pass Marks: 45
Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

*The figures in the margin indicate full marks.
Attempt all the questions.*

Design the basic block diagram of an Instrumentation System that measures a change in stress and explain in brief. 7

The resistance of an unknown resistor is determined by the Wheatstone bridge method. The solution for the unknown resistance is stated as $R_x = (R_1 R_2) / R_3$, where; 8

$$R_1 = 500 \Omega \pm 1\%$$

$$R_2 = 615 \Omega \pm 1\%$$

$$R_3 = 100 \Omega \pm 0.5\%$$

Calculate:

- i. the nominal value of the unknown resistor
 - ii. the limiting error in ohms of the unknown resistor
 - iii. the limiting error in ohms of the unknown resistor
- Name the commonly used detectors for ac bridges. Derive the expression for unknown components in Schering Bridge. 8

An ac bridge with terminals ABCD has in arm AB, a pure resistance; arm BC a resistance of 800 Ohm in parallel with a capacitor of 0.5 micro farad; arm CD, a resistance of 400 Ohm in series with a capacitor of 1.0 micro farad; and arm DA, a resistance of 1,000 Ohm. 7

- i) Obtain the value of frequency for which the bridge can be balanced
- ii) Calculate the value of resistance in arm AB to produce balance.

A potentiometer displacement transducer having total resistance $R_p \Omega$ and a dc excitation voltage V_{in} , is to be used with a measurement system having an input resistance $R_L \Omega$. Show that the measured output voltage V_{out} is related to the fractional displacement of the

7

acting on the crystal is 15N. The change sensitivity of the crystal is 150PC/N and its permittivity is 12×10^{-9} F/m. If the modulus of elasticity is 10×10^6 N/m². Calculate the values of charge and capacitance.

4. a) What do you mean by signal conditioning? Explain how the OPAMP can be used as an integrator and differentiator with necessary diagrams and equations.
b) Explain the principle operation of LVDT. List out its area of applications.
5. a) Find the successive approximation (SAR) ADC output for a 4-bit converter to a 3.217V input, if the reference voltage is 5V.
b) Explain the different wired data transmission medium.
6. a) Explain the principle of operation of X-Y recorder with its application.
b) Explain briefly about the modern trends in data acquisition system.
7. Write short notes on: (Any two)
 - a) Basic requirement of Transducer
 - b) Probable error
 - c) Interference signals

POKHARA UNIVERSITY

Semester: Spring

Year : 2016

Full Marks: 100

Pass Marks: 45

Time : 3hrs.

Bachelor
Programme: BE
use: Instrumentation

Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.
Attempt all the questions.

Explain different types of signals used in an instrumentation system? 7
Ten measurements of resistance of resistor are 200, 200.1, 200.0, 200.2, 200.1, 200.3, 200.0, 2004., 200.1, 200.2, Assume only random errors present. Calculate:

- arithmetic mean
- standard deviation
- Probable error

OR

A Voltmeter having a sensitivity of $2000\Omega/V$ reads 300V on its 500 V scale when connected across an unknown resistor in serial with milliammeter. When milliammeter reads 10 mA. Compute:

- The apparent resistance of unknown resistor
- The actual resistance of unknown resistor
- The error due to loading effect of the voltmeter

Discuss the static and dynamic performance parameters in a measurement system. 8

An AC bridge has the following components: arm AB, $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$; BC, $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$; CD, $L = 30 \text{ mH}$ in series with $R = 200\Omega$. Name the unknown components and its value of arm DA to balance the bridge. Assume frequency $f = 1000 \text{ Hz}$. 7

Define Piezoresistive effect. Prove that $G = 1+2\mu$ for strain gauge where constants has their usual meaning. 8

A piezoelectric crystal has the dimension of $4\text{m} \times 4\text{m} \times 2\text{mm}$. The force

OR

Sketch the circuit of Summing amplifier using Op-Amp to get

$$V_{\text{out}} = V_1 - 2V_2 - V_3$$

5. a) A compressive force is applied to a structural member. The strain is 5 micro-strain. Two separate strain gauges are attached to the structural member, one is a nickel wire strain gauge having a gauge factor of 12 and the other is nichrome wire strain gauge having a gauge factor of 2. Calculate the value of resistance of the gauges after they are strained. The resistance of strain gauges before being strained is 120Ω .

OR

The output of an LVDT is connected to a 5 V voltmeter through an amplifier whose amplification factor is 100. An output of 1 mV appears across the terminals of LVDT, when the core moves through a distance of 0.4 mm. Calculate the sensitivity of LVDT and that of the whole set up. The milli-voltmeter scale has 100 divisions. The scale can be read to $1/5$ of a division. Calculate the resolution of the instrument in mm.

- b) Optical Fibre is the best-wired transmission medium. Support this statement with relevant data.

OR

Describe the different data transmission methods. Explain the block diagram of general telemetry system.

6. a) Why is the data acquisition system needed? Enumerate main elements of a digital data acquisition system.
b) Clarify the principle of operation of Strip Chart recorder with its area of application.
7. Write short notes on: (Any two)
a) Errors in transducer
b) Common Mode Rejection Ratio and its Significance in Instrumentation
c) Wheatstone bridge

POKHARA UNIVERSITY

Semester: Fall

Year : 2017

Full Marks: 100

Pass Marks: 45

Time : 3hrs.

ref: Bachelor
Programme: BE
Course: Instrumentation

Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.
Attempt all the questions.

What is an instrumentation system? Draw and explain their function with example. 2+6

Describe the different criteria for selection of transducers for a particular application. Describe the method for measurement of temperature with use of RTDs. 7

Describe the working of Hay's Bridge for measurement of inductance. Derive the equations for balance. Why is this bridge suited for measurement of inductance of high Q coils? 8

The ac bridge is in balance with the following constants: arm AB, $R_1=1000 \Omega$ in parallel with $C_1=0.5 \mu F$; arm BC, $R_3=1000 \Omega$ in series with $C_3=0.5 \mu F$; arm CD, $L_4=30 \text{ mH}$ in series with $R_4=200 \Omega$. The oscillator frequency is 1000 Hz. Find the constants of arm DA to balance the bridge. 7

Describe about various performance parameters of instrumentation system. 8

Ten measurements of resistance of resistors are 15.2Ω , 15.1Ω , 15Ω , 15.3Ω , 15.1Ω , 15.2Ω , 15Ω , 15Ω , 15.3Ω , and 15.2Ω . Assume only random errors are present. Calculate:- 7

- Arithmetic mean
 - Standard deviation and
 - Probable error
- Explain the different principles of working of capacitive transducers. 8
- Describe in details the successive approximation method of analog to digital conversion. 7

Analytically compute:

- i. The frequency at which bridge becomes at balance.
 - ii. The value of resistance in arm DA to yield this balance.
3. a) A potentiometer displacement transducer having total resistance $R_p \Omega$ and a dc excitation voltage V_{in} , is to be used with a measurement system having an input resistance $R_L \Omega$. Show that the maximum % error is approximately $14.81 \frac{R_p}{R_L}$.
- b) A strain gauze is bonded to a beam of 0.1m long and has a cross-sectional area of 4cm^2 . Young's modulus for steel is 207GN/m^2 . The strain gauze has an unstrained resistance of 240Ω and a gauze factor of 2.2. When a load is applied, the resistance of gauze changes by 0.013Ω . Calculate the change in length of steel beam and the amount of force applied to the beam.
4. a) Discuss Seebeck effect for temperature measurement. Mention the laws governing in it. List out the sources of error occurred in it during temperature measurement.
- b) With necessary circuit diagram describe operation amplifier as an inverter and summer.
5. a) Draw the block diagram of successive approximation Method. Discuss the different steps involved in successive approximation method to convert Analog voltage 13.3V into its equivalent Digital voltage.
- b) What is telemetry? Explain its various types and application of telemetry system.
6. a) Give the functional details of a type of recorder which can be employed for plotting the current versus voltage curve of any transistors and diodes.
- b) Define data acquisition system. Differentiate between analog DAS and digital DAS.
7. Write short notes on: (Any two)
- a) Types of Instruments
 - b) Hall effect transducer
 - c) Isolation amplifier

POKHARA UNIVERSITY

Semester: Spring

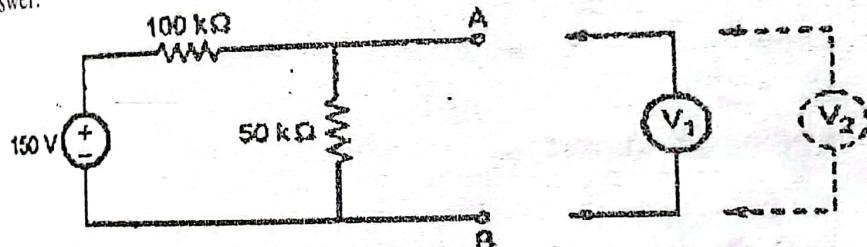
Level: Bachelor
Programme: BE
Subject: Instrumentation

Year : 2017
Full Marks: 100
Pass Marks: 45
Time : 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.
Attempt all the questions.

Draw the generalized block diagram of instrumentation system.
Discuss the various components of instrumentation system with necessary explanations.

For the network shown below ($R_1 = 100\text{ k}\Omega$ and $R_2 = 50\text{ k}\Omega$) find the voltage reading on voltmeter (V_1), if voltmeter sensitivity is $1\text{ k}\Omega/\text{Volt}$. If the voltmeter is replaced by another voltmeter (V_2) having sensitivity $25\text{ k}\Omega/\text{Volt}$, Find the new reading. Comment on answer.



The Table given below lists a sample of experimental data:

Value	3	4	5	6	7	8	9	10	11
Frequency of Occurrence	1	2	3	6	7	6	4	2	1

Calculate:

- Mean
- Standard Deviation
- Probable error of one reading
- Probable error of Mean

Explain the conditions for dc bridge balance with necessary diagram.

An A.C. bridge has the following constants: Arm AB, $R = 1000\Omega$ in parallel with $C = 0.159\mu\text{F}$. Arm BC, $R = 1000\Omega$; Arm CD, $R = 500\Omega$; Arm DA, $C = 0.636\mu\text{F}$ in series with unknown resistance.

7

8

7

8

- b) Differentiate RTD and thermistor for the measurement of temperature. Show the necessary equations for each.
5. a) A compressive force is applied to a structural member. The strain is 5 micro strain. Two separate strain gauges are attached to the structural member, one is nickel wire strain gauge having a gauge factor of -12.1 and the other is nichrome wire strain gauge having gauge factor of 2. Calculate the value of resistance of the gauges after they are strained. The resistance of strain gauges before being strained is 120Ω .
- b) Distinguish between the following terms as used in communication between measurement devices:
- (i) Half duplex and full duplex communication
 - (ii) Asynchronous and Synchronous transmission
 - (iii) Parallel and Serial communication
6. a) Explain how digital and modern digital data acquisitions are different with their block diagrams.
- b) List the advantages of magnetic tape recorder. Explain the operation of strip chart recorder with suitable diagram.
7. Write short notes on: (Any two)
- a) R-2R ladder network DAC
 - b) Classification of transducers
 - c) Hall effect transducer

POKHARA UNIVERSITY

Semester: Fall

Year : 2018

Full Marks: 100

Pass Marks: 45

Time : 3hrs.

D: Bachelor
Programme: BE
SE: Instrumentation

Candidates are required to give their answers in their own words as far as practicable.
figures in the margin indicate full marks.
Attempt all the questions.

What are the basic blocks of a generalized instrumentation system? 8
Draw the various blocks and explain their functions.

A 0-10 A ammeter has a guaranteed accuracy of 1.5 % full scale 7
reading. The current measured by this instrument is 2.5 A. Calculate
the limiting values of current and percentage limiting error.

Describe the working of Hay's bridge for measurement of inductance. 8
Why is this bridge suited for measurement of inductance of high Q
coils?

) An ac bridge has the following constants arm AB, $R=1000 \Omega$ in parallel with $C=0.159\mu F$; BC, $R=1000 \Omega$; CD, $R=500 \Omega$; DA, $C=0.636\mu F$ in series with an unknown resistance. Find the frequency for which this bridge is in balance and determine the value of the resistance in arm DA to produce this balance.

) A capacitance transducer uses two quartz diaphragms of area 750mm^2 separated by a distance of 3.5mm. A pressure of 900kN/m^2 when applied to the top diaphragm produces a deflection of 0.6mm. The capacitor has capacitance 370pF when no pressure is applied to the diaphragms. Find the value of capacitance after the application of pressure of 900kN/m^2 .

) What is signal conditioning? How OPAMP can be used in various signal processing operations? Explain with examples. 8

) Describe the working principle of Stair case Ramp Type ADC. List its drawbacks. 7

5. a) Define data transmission. What are its modes? Compare the wire channels used in data transmission.
b) Explain the principle of operation of X-Y recorder. List out its area of applications.
6. a) What is data acquisition? Explain the functionalities of the components used in analog data acquisition system along with its block diagram.
b) If $R_x = R_1 R_2/R_3$ where $R_1 = 100 \pm 1\%$, $R_2 = 200 \pm 2.5\%$, $R_3 = 100 \pm 2\%$
Find i) The nominal value ii) The limiting error iii) The percentage limiting error of R_x .
7. Write short notes on (Any Two):
 - a) Filter and its types
 - b) Signal conditioning
 - c) IEEE standard.

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Instrumentation

Semester: Spring

Year : 2018

Full Marks: 100

Pass Marks: 45

Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

Define measurement system. What are the fundamental types of signals used in instrumentation system? Briefly explain them. 7

A resistor is measured by the voltmeter-ammeter method. The voltmeter reading is 123.4V on the 250V scale and ammeter reading is 283.5mA on the 500mA scale. Both the meters are guaranteed to be accurate within $\pm 1\%$ of the full scale. Calculate:

- i) the measured value of the resistance.
- ii) the limits within which you can guarantee the results.

Explain Maxwell Bridge. Derive the expression for unknown components in Maxwell Bridge. 8

A variable potential divider has a total resistance of $2 \text{ k}\Omega$ and is fed from 10 V DC supply. The output is connected to load resistance of $5 \text{ k}\Omega$. Determine the loading errors for the wiper positions corresponding to $K = 0, 0.25, 0.5, 0.75$ and 1.0 . Use your result to plot the graph of error versus K . 7

Explain the principle of operation on LVDT. Write its merit and demerits. 8

Define piezoelectric effect. Derive an expression for output voltage when a stress is applied to a piezoelectric transducer. 7

What is an instrumentation amplifier? How does it differ from a single Op-Amp differential amplifier? What are the ideal characteristics of Op-Amp. 8

Design a 4-bit weighted-resistor DAC, whose full scale output voltage is -10V. Logic levels are $1=+5\text{V}$ and $0=0\text{V}$. What is the output voltage when input is 1010? 7

- used in instrumentation system with a numerical example.
5. a) Consider a 6 bit digital to analog converter with a resistance of $320 \text{ k}\Omega$ in the LSB position. The converter is designed with weighted resistor network. The reference voltage is 10 V. The output of the resistive network is connected to an Op-Amp with a feedback resistor of $5 \text{ k}\Omega$. What is the analog output of the binary input of 111010?
- b) Describe the different data transmission methods. Explain the block diagram of general telemetry system.
6. a) Give the functional details of a type of recorder which can be employed for plotting the Stress versus Strain curve for brittle material.
- b) What is data acquisition system? Briefly explain about the digital data acquisition system.
7. Write short notes on: (Any two)
- a) Isolation amplifier
 - b) Classification of transducers
 - c) Static parameters

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Instrumentation

Semester: Fall

Year : 2019
Full Marks: 100
Pass Marks: 45
Time : 3hrs.

*Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.
Attempt all the questions.*

- Explain the various components of a generalized Instrumentation System with the help of a block diagram. 7
- Three resistances have the following ratings: 8
- $$R_1 = 20 \Omega \pm 0.1; R_2 = 20 \Omega \pm 0.1; R_3 = 60 \Omega \pm 0.25$$
- Determine the magnitude and limiting error in ohms, if the resistances are connected in series. Also obtain percentage relative error in the resultant. 8
- i) An ac bridge has the following components: arm AB, $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$; BC, $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$; CD, $L = 30 \text{ mH}$ in series with $R = 200 \Omega$. Find the constants of arm DA to balance the bridge. Express the result as a pure R in series or parallel with a pure C or L Assume frequency $f = 1000 \text{ Hz}$. 7
- ii) What is the use of Wein Bridge? Derive an expression for to calculate unknown electrical parameter frequency in terms of known parameter of Wein Bridge circuit. 8
- a) A capacitive transducer uses two quartz diaphragms of area 750 mm^2 separated by a distance of 3.5 mm . A pressure of 900 kN/m^2 when applied to the top diaphragm produces a deflection of 0.6 mm . The capacitance is 370 pF when no pressure is applied to the diaphragms. Find the value of capacitance after the application of pressure of 900 kN/m^2 . 8
- b) Define gauge factor. Derive an expression for gauge factor of a strain gauge. 8
- a) "Error of a potentiometric device is always negative except at two extreme points." Justify it with necessary derivations. 8
- b) Explain successive approximation type analog to digital converter 8

solve the following problems:

- i) If $R_1 = 1 \Omega$, $R_2 = 2 \Omega$, and $R_x = 3 \Omega$, to what value should R_3 be adjusted so as to achieve a balanced condition?
- ii) If $V_0 = 6 \text{ V}$, $R_a = 0.1 \Omega$, and R_x were then to deviate by a small amount to $R_x = 3.01 \Omega$, what would be the reading on the ammeter?
- b) A POT having total resistance $R_p \Omega$ and a dc excitation voltage V_{in} , is to be used with a measurement system having an input resistance $R_L \Omega$. Show that the measured output voltage V_{out} is related to the fractional displacement of the wiper as,
$$V_{out} = V_{in} \times \frac{\alpha K}{K(1-K)+\alpha}$$

(where, $\alpha = \frac{R_L}{R_p}$). What should be done to make this transducer linear?
4. a) Define thermistor. Explain the laws of thermocouple. How is thermopile formed?
b) An 8-bit DAC has reference voltage of 10V. It uses R-2R ladder network. Find the minimum value of resistance R such that the analog voltage of operational amplifier having feedback resistance $10K\Omega$ does not exceed 9.5V
5. a) Define transmission medium? State its type with example. Also, clarify the modes of data transmission in a system.
b) Describe the components of Strip chart recorder with suitable diagram. What are the applications of strip chart recorder?
6. a) Define data acquisition system. Explain the function of different components of digital data acquisition system.
b) What are the features that makes instrumentation amplifier superior over OPAMP. Draw instrumentation amplifier circuit and derive an expression for voltage gain of an instrumentation amplifier.
7. Write short notes on: (Any two)
 - a) Wien Bridge and its application
 - b) Errors in transducer
 - c) IEEE Standards

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Instrumentation

Semester: Spring

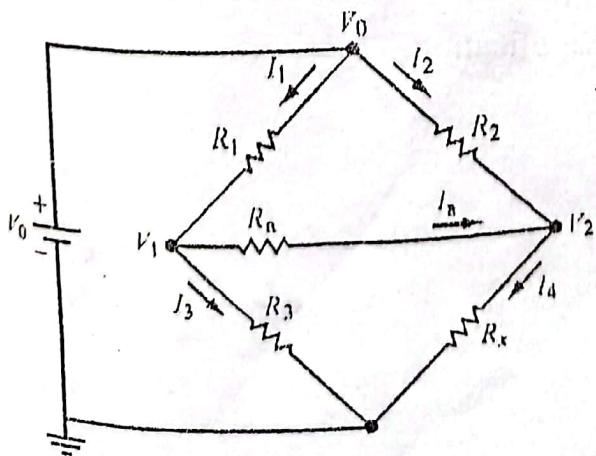
Year : 2019
Full Marks: 100
Pass Marks: 45
Time : 3hrs.

*Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.
Attempt all the questions.*

Draw the generalized elaborated block diagram of instrumentation system. Discuss the various components of instrumentation system with necessary explanations. 7

Two resistors have values $R_1 = 47 \Omega \pm 2\%$ and $R_2 = 82 \Omega \pm 5\%$ Calculate: 8

- The magnitude of error in each resistor
- The limiting error in ohms and in percent when the resistors are connected in series and
- iii. The value of the equivalent resistor and expected error in percent when the resistors are connected in parallel.
- Show that Hay's Bridge can be used to measure the value of unknown inductance of a coil having high quality factor.
- A strain gauge having a resistance of 200Ω and gauge factor 2.5 is connected in series with a blast resistance of 400Ω across 24V. Determine the change in o/p voltage when a stress of 140 MN/m^2 is applied. The modulus of elasticity is 200 GN/m^2 .
- For the Wheatstone Bridge Circuit of figure below,



4. a) Define gauge factor. A strain gauge having resistance of 600 ohm and gauge factor 2.0 is connected in series with a blast resistance of 1000 ohm across 50 volt. Determine the change in output when a stress of 150 MN per square meter is applied. The modulus of elasticity is 250 GN per square meter.
- b) Which is the fastest ADC? Explain successive approximation technique for A/D signal conversion.

OR,

A D/A converter has 6 bits and reference voltage of 10V. Calculate the minimum value of resistance(R) such that the maximum value of output current does not exceed 10mA. Find also the smallest quantized value of output current.

5. a) What is an instrumentation amplifier? How does it differ from a single Op-Amp differential amplifier? Derive an expression for output voltage of a difference amplifier.
- b) Define data acquisition? Explain one of the recent trend used for data acquisition.
6. a) Explain about X-Y recorder and Strip chart recorder.
- b) Define telemetry. What are its types? Compare the wire channels used in telemetry.
7. Write short notes on: (Any two)
- Classification of transducers
 - Filter and its types
 - Measurement standards

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Instrumentation

Semester: Fall

Year : 2020
Full Marks: 100
Pass Marks: 45
Time : 3 hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

What are the basic blocks of generalized instrumentation system? Draw the various blocks and explain their function. 7

Temperature was measured in eight locations in a room, and the values obtained were 28.2, 16.5, 32.1, 29.7, 27.1, 19.0, 22.0 and 10.0 °C. Assuming that the random errors are present. Calculate

- (i) Arithmetic mean
- (ii) Standard Deviation
- (iii) Probable error of readings?

a) What is the use of Maxwell Bridge? Derive the expression for unknown components and what are its limitation. 7

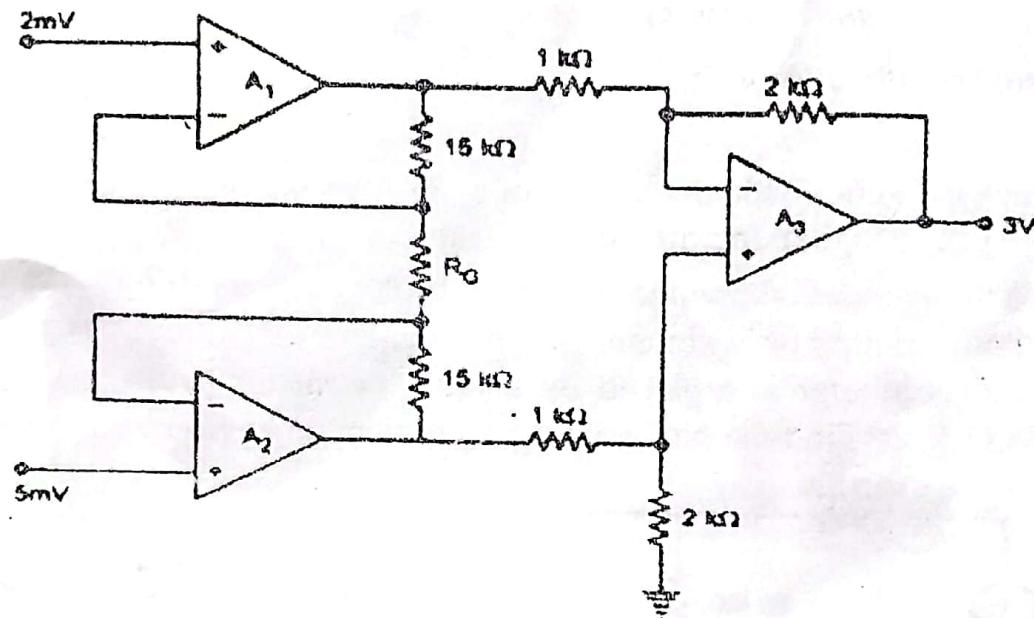
b) A Quartz piezoelectric pickup has dimension of 10mm*10mm*2.5mm and a voltage sensitivity of 0.012Vm/N. The relative permittivity of the quartz is 1600 and modulus of elasticity of the quartz is 12×10^{10} N/m². The force applied to the pickup is 20N. Analytically compute

- i. The output voltage.
- ii. Charge sensitivity.
- iii. Strain.
- iv. Charge generated.
- v. The capacitance pickup.

a) Discuss "Seebeck effect" for temperature measurement. What are the laws governed by Thermocouple for temperature measurement. List out the error that get occurred in Thermocouple during temperature measurement. 7

b) Design an Instrumentation System to measure Pressure of COCA-COLA following through Factory pipe line to yields the results of pressure as Analog read output. 8

4. a) A compressive force is applied to a structural member. The strain is 5 micro-strains. Two separate strain gauges are attached to the structural member, one is a nickel wire strain gauge having a gauge factor of -10 and other is nichrome wire strain gauge having a gauge factor of 3. Calculate the value of resistance of the gauges after they are strained. The resistance of strain gauges before being strained is 200 ohm.
- b) Find the suitable value of R_G to provide the output of 3V, from the circuit shown in the figure below:



5. a) Define isolation amplifier. State the importance of signal conditioning in instrumentation.
- b) Define telemetry. What are its types? Compare the wire channels used in telemetry.
6. a) Define recorder. Why recording is important? If VI characteristics of a diode is required to be recorded, which recorder would you prefer. Explain its operation with necessary diagram.
- b) Define data acquisition? Explain any one modern trend used for data acquisition.
7. Write short notes on: (Any two)
- a) Maxwell's bridge
- b) Observation of interference in Instrumentation
- c) Signal conditioning

POKHARA UNIVERSITY

Level: Bachelor
Programme: BE
Course: Instrumentation

Semester: Fall

Year : 2021
Full Marks: 100
Pass Marks: 45
Time : 3 hrs.

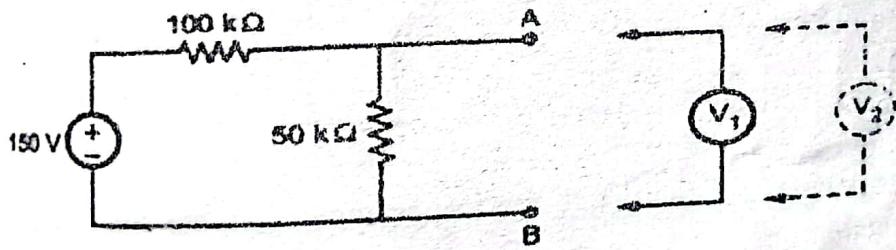
Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

- a) Draw the generic block diagram of an instrumentation system. Explain the type of signal obtained in each stage. 7

- b) For the network shown below ($R_1 = 100\text{ k}\Omega$ and $R_2 = 50\text{ k}\Omega$) find the voltage reading on voltmeter (V), if voltmeter sensitivity is $1\text{ k}\Omega/\text{Volt}$. If the voltmeter is replaced by another voltmeter having sensitivity $25\text{ k}\Omega/\text{Volt}$, Find the new reading. Comment on answer. 8



- i) State the conditions for DC bridge balanced with necessary derivation. 8
Compare the result with AC bridge.

- ii) An ac bridge is in balance with the following constants: arm AB, $R=450\Omega$; arm BC, $R=300\Omega$ in series with $C=0.265\mu\text{F}$; arm CD, unknown; arm DA, $R=200\Omega$ in series with $L=15.9\text{ mH}$. Find the constants of arm CD. Assume oscillator frequency is 1KHz. 7

- iii) Error of a potentiometric device is always negative except at two extreme points. Justify. 7

- iv) The output of an LVDT is connected to a 5 volt voltmeter through an amplifier whose amplification factor is 250. An output of 2mV appears across the terminals of LVDT when the core moves through a distance of 0.5 mm. Calculate the sensitivity of the LVDT and that of the whole set up. The milli voltmeter scale has 100 divisions. The scale can be read to 1/5 of a division. Calculate the resolution of the instrument in mm. 8

- b) Explain the principle of operation of inductive transducer. A variable inductive transducer with inductance of 5 mH and numbers of turn is 50. When the numbers of turn changes to 60, find the value of inductance of coil?
4. a) An excitation of 10 V is given to a strain gauge. It was observed that the full-scale output voltage was 30 mV. What is its sensitivity? Which temperature transducer: Thermocouple or RTD or Thermistor do you prefer for temperature measurement in term of linearity and why?
b) Differentiate between Isolation versus Instrumentation Amplifier. Draw Instrumentation amplifier circuit and derive an expression for voltage gain $A_v = \{R_4/R_3\} [1 + 2(R_2/R_1)]$.
5. a) Design successive approximation method that becomes capable to convert Analog Voltage 11.1V into its equivalent digital voltage. Design part must include circuit Diagram as well as successive tabular steps involved during transformation from ADC to DAC.
b) Differentiate between Serial versus Parallel Transmission. How data are transmitted via optical fiber? List out the advantages of optical fiber and losses that get occurred in optical fiber.
6. a) Explain the principle of operation of Magnetic Tape Recorder. List out its areas of applications.
b) Differentiate between DAS versus FSD. Draw generalized block diagram of digital "Data Acquisition System" and discuss its various components
With necessary explanation:
7. Write short notes on: (Any two)
- Selection of transducer
 - Gaussian Probability curve
 - PMMC

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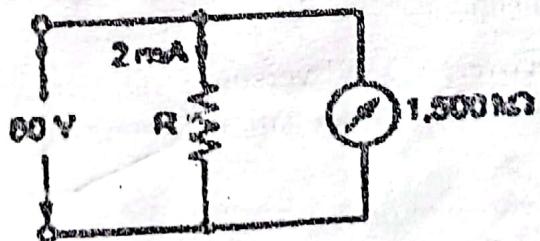
Level: Bachelor
Programme: BE
Course: Instrumentation

Semester: Spring

Year : 2021
Full Marks: 100
Pass Marks: 45
Time : 3 hrs.

*Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.
Attempt all the questions.*

- a) Differentiate between Intelligent versus Dumb Instrumentation. Draw generalized block diagram for Instrumentation system and discuss its various components with necessary explanations 8
- b) A Voltmeter having a sensitivity of $15\text{k}\Omega/\text{V}$ reads 80V on a 100V scale, when connected across an unknown resistor. The current through the resistance is 2mA. Calculate the % error due to loading effect. 7



- a) Differentiate between Maxwell's versus Hays bridge. Derive the components of unknown arm for the Hays bridge circuit. List out the advantages and disadvantages for the Maxwell's bridge circuit. 7
- b) State Wheatstone principle for circuit to be balance. A 1000Hz bridge has following constants arms,
 $AB, R = 1000\Omega$ in parallel with $C = 0.5\mu\text{F}$
 $BC, R = 1000\Omega$ in series with $C = 0.5\mu\text{F}$
 $CD, L = 30\text{ mH}$ in series with $R = 200\Omega$
Find, the constants of arms DA to balance the bridge. 8
- a) How does the capacitance of capacitive transducer vary with the overlapping area of the plates? 7

4. a) A capacitive transducer is made up of two concentric cylindrical electrodes. The length of the electrodes is 25mm, the inner diameter of outer cylinder electrodes is 4.2 mm and the outer diameter of inner cylindrical electrode is 4mm. Determine the sensitivity of transducer. Determine also the dielectric stress when a voltage of 150V is applied across the electrodes. For a displacement of inner electrodes of 2.5 mm, determine the change in capacitance. Assume air as medium. The breakdown strength of air is 3kV/mm.
- b) Define virtual ground and CMRR in OP-AMP. Derive the gain of Non-inverting OP-AMP.
5. a) Find out the output voltage expression for differentiator and integrator circuit. Design an adder circuit using opamp to get output expression given by $V_o = -3V_1 - 15V_2 - 120V_3$.
- b) What are the various type of data transmission medium? Explain Synchronous and Asynchronous data transmission in brief.
6. a) Convert an analog signal having the magnitude 3.625 in a 4-bit digital word successive approximation ADC if the reference voltage is 8v.
- b) Explain widely spread modern trend in data acquisition techniques. Description should reflect Practical trends in measurement types and accessories.
7. Write short notes on: (Any two)
- Magnetic Data Recorder
 - Calibration and error in transducer
 - IEEE standards.

POKHARA UNIVERSITY

Semester: Fall

Level: Bachelor
Programme: BE
Course: Instrumentation

Year : 2022

Full Marks: 100

Pass Marks: 45

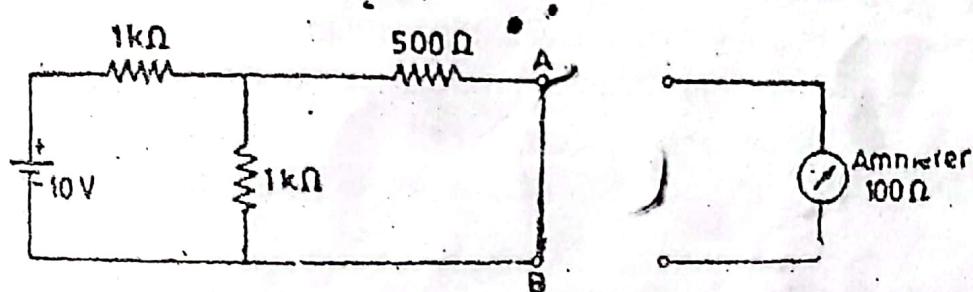
Time : 3hrs.

Candidates are required to give their answers in their own words as far as practicable.

The figures in the margin indicate full marks.

Attempt all the questions.

- a) Explain the generalized block diagram of an instrumentation system with their function and example. 8
- b) It is desired to measure the value of current in the 500 ohms resistor as shown in Fig. by connecting a 100 ohms ammeter. Find: (a) the actual value of current (b) measured value of current c) percentage error in the measurement and accuracy. 7



- a) Define and list out static and dynamic characteristics of instrumentation systems. Explain any four static characteristics in brief. 8
- b) The arms of Maxwell ABCD bridge are as follows: AB is an non inductive resistance of 1000Ω in parallel with a capacitance of $0.5 \mu F$, BC is an non inductive resistance of 600Ω , CD is an inductive impedance of unknown value and DA is non inductive resistance of 400Ω . If the balance is obtained under these condition, Find the value of unknown arm CD. 7
- a) Explain the loading effect in potentiometer and write the methods of reducing loading effect. 8
- b) A strain gauge having resistance of 600Ω and gauge factor 2.0 is connected in series with a blast resistance of 100Ω across 50 volt. Determine the change in output when a stress of 150 MN/m^2 is applied. The modulus of elasticity is 250 MN/m^2 . 7