

Lumbini Engineering College

Bhalwari, Rupandehi

Internal Examination-2080

B.E. Computer, 2nd Semester

Full Marks: 100

Course: Instrumentation

Pass Marks: 45

Time: 3 hrs.

Attempt all questions.

- 1a. Define instrumentation system. Draw and explain their functions with example. [8]
- 1b. For Quality factor $Q > 10$, which bridge circuit; you would use "Maxwell" or "Hay"? Justify your answer for the chosen one with valid reasons. [8]
- 2a. Design an Ayrton shunt to provide an ammeter with current ranges of 1A, 5A and 10A. The movement with internal resistance of 50Ω and full scale deflection current of 1mA is used in the configuration. [8]
- 2b. In a balanced network, AB is a resistance of 100Ω in series with an inductor of 0.16H, BC and DA are non-inductive resistance of 500Ω each and CD consists of a resistance R in series with a capacity C. A potential difference of 3V at a frequency $5000/2\pi$ is applied between points A and C. Determine the values of R and C. [8]
- 3a. The output of an LVDT is connected to a 5V voltmeter through an amplifier whose amplification factor is 150. An output of 1mV appears across the terminals of LVDT, when the core moves through a distance of 0.6mm. Calculate the sensitivity of LVDT and that of whose 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. [8]
- 3b. Define strain gauge? Prove that $G = 1 + 2\mu$ for strain gauge where constants has their usual meaning. [8]
- 4a. What is instrumentation amplifier? Derive the relation for the gain of Instrumentation amplifier. [8]
- 4b. Find the digital output of 8.217 volts input from a 4-bits Successive Approximation ADC with the reference voltage of 10V. [8]
- 5a. Write in brief about signal channel data acquisition system and multi-channel data acquisition system with suitable block diagram for each. [8]
- 5b. Explain in brief about working of cathode ray oscilloscope with suitable block diagram. [8]
- 6a. Draw suitable schematic diagram for 4*4 dot matrix display. Also explain the operation of strip chart recorder with suitable diagram. [8]
- 6b. Write short notes on (any three): [12]
- a. R-2R ladder network DAC
 - b. Two wattmeter method
 - c. recent trend for DAS d. LCD

07/15

Subject: - Instrumentation

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All question.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. a) Define Strain Gauge. Prove that $G=1+2\mu$ for strain gauge where constants [8]
has their usual meaning.
- b) The output of an LVDT is connected to a 5V voltmeter through an amplifier whose amplification factor is 100. An output of 1 mV appears [7]
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 mill-voltmeter scale has 100 divisions. The scale can be read to 1/5 of a division. Calculate the resolution of the instrument in mm.

OR

A piezo-electric crystal has the dimension of 4mmx4mmx2mm. The force acting on the crystal is 15 N. The charge sensitivity of the crystal is 150pC/N. Calculate the values of charge and capacitance.

2. a) Find the successive approximation [SAR] ADC output for a 4-bit [7]
converter to a 3.217 V Input, if the reference voltage is 5V.
- b) Describe about the construction and the working principle of an oscilloscope. [8]
3. a) Explain the working principle of Fundamental Suppression Type Harmonic Distortion Analyser. [7]
- b) Define Data Acquisition System. What are the different types of data acquisition system used in Instrumentation? [8]
4. Write short notes on (any one): [5]
 - a. Instrument Transformer
 - b. Flash Type ADC
 - c. Strip chart recorders
 - d. RS 232 Cable



Nepal College of Information Technology

(Affiliated to Pokhara University)

Balkumari, Latitpur, Nepal

Instrumentation

Full Marks : 100

Pass Marks : 45

Time: 3 hours

All question carry equal marks.

1. Explain the generalized block diagram of an instrumentation system with their function and example.
2. 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 .
3. 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, $L_4 = 30 mH$ in series with $R_4 = 200 \Omega$. The oscillator frequency is 1000Hz. Find the constants of arm DA to balance the bridge.
4. Error of a potentiometric device is always negative except at two extreme points. Justify.
5. A barium titanate piezoelectric pick up has dimensions of $12mm \times 12mm \times 3mm$ and a voltage sensitivity of $0.015 Vm/N$. $\epsilon_r = 1400$ for $BaTiO_4$ and modulus of elasticity for barium titanate is $10 \times 10^{10} N$. If the force applied is 20 N, determine:
 - i. Output voltage
 - iii. Charge sensitivity
 - v. Strain
 - ii. Charge generated
 - iv. Capacitance of pick up
6. A basic d'Arsonval movement with internal resistance, $R_m = 100 \Omega$, and full-scale current, $I_{fsd} = 1 mA$, is to be converted into a multi range dc voltmeter with voltage ranges of 1-10 V, 0-50 V, 0-250 V, and 0-500 V.
7. Define instrumentation transformer. Explain how current transformer is used to measure high currents with necessary circuit diagram and mathematical expression. Also explain, what happen if the secondary of CT is open when there is high current flowing in primary side.
8. What is signal conditioning? How OP-Amp can be used in various signal processing operations? Explain with examples.
9. What is an instrumentation amplifier? How does it differ from a single Op-Amp differential amplifier? What are the ideal characteristics of Op-Amp.
10. Define data acquisition system. Explain briefly about the modern trends in data acquisition system.
DDAS
11. What is telemetry? Explain its various type and application of telemetry system.
12. Find the digital output of 8.217 volts input from 4-bits Successive Approximation ADC with the reference voltage of 10 volts.
13. What is wave analyzer? What are its types? Explain any one of them with block diagram.
14. Define magnetic tape recorder. Also explain about X-Y recorder and Strip chart recorder.

diameter of the outer electrode is 3.1 mm. Calculate the dielectric stress when a voltage of 100 V is applied across the electrodes. Is it within safe limits? The length of electrodes is 20mm. calculate the change in capacitance if the inner electrode is moved through a distance of 2mm. The breakdown strength of air is 3kV/mm.

- 3 a) Explain any inductive sensor principle used for measurement of displacement? Also, write down its advantages and disadvantages. 7
- b) How the resistance of ammeter and voltmeter is determined? Also shows how the range of ammeter and voltmeter can be extended? 8
- 4 a) Explain the working and construction of energy meter. Also explain creeping error and ways to minimize it. 8
- b) Write difference between OP-Amp and instrumentation amplifier. Show that the gain of the instrumentation amplifier is $\frac{R_3}{R_2} \left\{ \frac{2R_1 + R_{gain}}{R_{gain}} \right\}$. 7
- 5 a) Write the importance of Analog to Digital converter in the field of engineering and how it works. Explain the principle any one Analog to Digital converter. 2+ 6
- Or,
Explain how Digital to Analog converter works with its derivation?
- b) An 8-bits DAC has reference voltage of 12V. Find the minimum value of resistance R such that o/p current doesn't exceeds 10mA if it is use. 7
 - i) WRN DAC
 - ii) R:2R ladder network DAC
- Also, find the smallest value of quantized current in both cases.
- 6 a) Explain the principle of operation of Strip chart Recorder. List out its areas of applications. 8
- b) Explain the working of Digital Voltmeter and list out its types. 7
- 7 Write short notes on: (Any one) 5
 - a) Digital Data Acquisition system
 - b) Seven Segment Display
 - c) RS232
 - d) Importance of filter and wave shaping

UNITED TECHNICAL COLLEGE

QT Exam

Level: Bachelor

Semester: Spring

Year : 2023

Programme: B. E

Full Marks: 50

Course: Instrumentation (New Course)

Pass Marks: 23

Time : 1.5hrs.

Attempt any three questions from 1 to 6(Q.N. 7 is compulsory)

- 1 a) List out the static performance characteristics of the measuring instrument. Explain four of them. A voltmeter has 100 scale divisions and can measure up to 100 V, Each division can be read to $\frac{1}{4}$ division. Determine the Resolution of the Voltmeter in volts. 6+2
- b) In a test, temperature is measured 100 times with variation in apparatus and procedure. After applying the correction, the result is 7

Temp	39 7	39 8	39 9	40 0	40 1	40 2	40 3	40 4	40 5
Freq of Occurrence	1	3	12	23	37	16	4	2	2

Calculate

- Arithmetic mean
- Deviation from mean
- Average deviation
- Standard deviation and Variance
- Probable error

- 2 a) State Wheatstone principle for circuit to be balance. The Schering Bridge has the following constraints, $R_1 = 1.5k\Omega$, $C_1 = 0.4\mu F$, $R_2 = 3k\Omega$ and $C_3 = 0.4\mu F$ at frequency 1kHz. Determine the unknown resistance and capacitance of the bridge and dissipation factor. 8
- b) A capacitive transducer is made up of two concentric cylindrical electrodes. The outer diameter of the inner diameter is 3mm and the dielectric medium is air. The inner 7

National Academy of Science and Technology

(Affiliated To Pokhara University)

Dhangadhi Kailali

Pre-University Examination

Level: Bachelor

Program: B.E. Computer

Course: Instrumentation

Semester : II_Spring

Year: 2023

F.M.: 100

P.M. : 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.

1. a) What are the basic blocks of a generalized instrumentation system. Explain their function with example. [7]
- b) What is Signal Conditioning? Explain transducer, primary and Secondary transducer with circuit diagram. [8]

OR

Why performance parameters are necessary in measuring instrument?
Explain Static Performance in details.

2. a) How frequency is measured using Wein Bridge? Explain with necessary derivation [7]

- b) A 1000 Hz bridge has the following constants arm

AB, $R = 1000 \Omega$ in parallel with $C = 0.5 \mu F$;

BC, $R = 1000 \Omega$ in series 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. [8]

3. a . Why digital multimeter is more applicable than voltmeter, ammeter and ohmmeter? Explain in brief [8]
- b) Explain the working principle of wattmeter and Energy meter with its block diagram and application. [7]

4. a) What is data acquisition system? Explain with block diagram
Multi-channel Data Acquisition system [7]

b) How an op-amp can be used as adder? Design an operational
amplifier circuit whose output is $V_o = 5V_1 + 8V_2 + V_3 - 10V_4$ [8]

5. a) Why ADC is necessary in signal conditioning.? Explain the basic
working of Dual Slope ADC and Weighted Resistor DAC [7]

b) What is Wave Analyzer? Explain Frequency Selective Wave
Analyzer with its block diagram [8]

6. a) Explain with block diagram and connection of Computer Based
Digital Instruments: IEEE 488 GPIB Instrument

OR

What are output devices? Explain the operation of magnetic
tape recorder with its application. [8]

b) How an Oscilloscope is used for the analysis of different signals.
Explain in brief Cathode Ray Tube , Vertical and Horizontal
Deflection Systems [7]

7. Write short notes on :(Any two) [2x5=10]

- a) Standard Units
- b) Instrumentational amplifier
- c) Sensor and its type
- d) Probes and Connectors

NEPAL ENGINEERING COLLEGE

Level: Bachelor
Programme: BE
Course: Instrumentation

Assessment Spring

Year : 2023

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.

1. a) What is an instrumentation system? Explain the generalized block diagram of an instrumentation system with their function and example. 7
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? 8
2. a) What is D'Arsonval Principle? How can we extend range of ammeter? Calculate the necessary values of resistors to be provided using Ayrton's multiranging method so that a dc milliammeter having a basic movement with $R_m = 40 \Omega$ and full-scale current of 1 mA can be used for measuring currents in the range of 10 mA, 20 mA, 30 mA, 40 mA and 50 mA. 8
b) What is instrument transformer? Elucidate the working principle of Dynamometer Type Wattmeter with necessary sketch. 7
3. a) What is Isolation Amplifier? Explain how the Op-Amp can be used as differential and integrator with necessary diagrams and equations. 8
b) What do you mean by Data Acquisition System? Briefly explain about the digital data acquisition system. 7
4. a) What is an Quantization Error? Describe in details the successive approximation method of analog to digital conversion. 8
b) An 8-bit DAC has a reference voltage of 12V. It uses a R-2R ladder network. Find the minimum value of resistance R such that the output current of the ladder does not exists above 10 mA. Also find the smallest value of quantized current. 7
5. a) Explain working of Basic Spectrum Analyzer using Swept Receiver Design. 7
b) What is Vector Voltmeter? Explain working of Integrating Type Digital Voltmeter with its block diagram. 8

6. a) What is Data Logger? Describe working of Oscilloscopes with its block diagram. 8
- b) An ac bridge with terminals ABCD has in arm AB, a pure resistance; arm BC, a resistance of $800\ \Omega$ in parallel with a capacitor of $0.5\ \mu\text{F}$; arm CD, a resistance of $400\ \Omega$ in series with a capacitor of $1.0\ \mu\text{F}$; and arm DA, a resistance of $1000\ \Omega$. 7
- I. Obtain the value of frequency for which the bridge can be balanced.
- I. Calculate the value of resistance in arm AB to produce balance.
7. Write short notes on: (Any two) 2×5
- a) Probes and Connectors
- b) Frequency Counter
- c) Potentiometer Type Recorder
