

ELE4202: INSTRUMENTATION AND MEASUREMENT TECHNIQUES.

M.Sc-I ,sem-II

Q1. Attempt all questions.

2M

1. Define sensor. Give the classification of sensors.
2. Define the below static characteristics a) Accuracy, b) Precision.
3. What is transducer? Give its classification.
4. What is Error? List types of errors.
5. Distinguish between Active and Passive transducers.
6. A resistance wire strain gauge with gauge factor of 2 is bonded to a steel structural member subjected to a stress of 100MN/m^2 . The modulus of elasticity of steel is 200GN/m . Calculate the percentage change in the value of the gauge resistance due to the applied stress. Comment upon the results.
7. A platinum thermometer has a resistance of $100\ \Omega$ at 25°C . a) Find its resistance at 65°C if the platinum has a resistance temperature co-efficient of $0.00392/^\circ\text{C}$. b) If the thermometer has a resistance of $150\ \Omega$, calculate the temperature.
8. The output voltage of a LVDT is 1.5V at minimum displacement. At a load of $0.5\text{M}\Omega$, the deviation from linearity is maximum and it is $\pm 0.003\ \text{V}$ from a straight line through origin. Find the linearity at the given load.
9. 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 the sensitivity of the LVDT and that of the whole set up. The millivolt meter scale has 100 divisions. The scale can be read to $1/5$ of a division. Calculate the resolution of the instrument in mm.
10. What is piezo-electric effect? List the element which show piezo-electric property.
11. Explain the advantages and limitations of potentiometer transducer used for displacement measurement.
12. A C-type bourdon tube made of Monel metal has dimensions of the tube are: $r=36.5$, $x=16\text{mm}$, $y=3\text{mm}$, $t=0.35\text{mm}$.
Calculate the displacement of the free end if a pressure of 1500kPa is applied. The modulus of elasticity for Monel metal is 180GN/m^2 .
13. What is role of Instrumentation in Biomedical field?

14. List the types of Biomedical Instrumentation system.

15. What is pulse echo system?

16. What is MRI Scanning?

Q2. Attempt the following.

4M

1. Define below dynamic characteristics

a) Speed of response, b) measuring lag, c) fidelity, d) dynamic error.

2. What is error? Explain gross error, systematic error/ observational error/environmental error/ random error.

3. Describe the working and construction of resistance thermometers. Describe the materials used for RTDs along their properties.

4. Differentiate the below a) transducer and inverse transducer

b) Analog and digital transducer

c) Primary and secondary transducer

d) Active and passive transducer

5. What is transducer? Give the classification of transducer.

6. Describe the different criteria for selection of transducers for a particular application.

7. Explain the construction and working principle of capacitive transducers.

8. Define a digital transducer and explain its application for measurement of linear and angular displacement.

9. Explain the construction and principle of working of a linear voltage differential transformer (LVDT).

10. Describe ultrasonic transducer used for displacement measurement.

11. Explain the working principle of Ionization Gauge.

12. List the transducer used for pressure measurement. With neat diagram explain the working principle of thermal conductivity gauge used for very low pressure measurement.

13. List the primary sensing elements of force measurement. Explain different methods of force measurement.

14. A flat circular diaphragm of mild steel has a diameter of 15mm for mild steel, young's modulus is 200GN/m^2 and Poisson's ratio is 0.28. Find the thickness of the Diaphragm, if the

maximum stress is not exceed 300GN/m^2 . When the applied pressure is 300GN/m^2 . Find the deflection at the Centre for the pressure.

15. Explain variable inductance transducer with-

- a) Change of self-inductance.
- b) change of mutual inductance
- c) Production of eddy current.

16. List the type of transducer used for-

- a) Displacement measurement
- b) Force measurement
- c) Pressure measurement
- d) Acceleration measurement.

17. Give the working principle of hot wire anemometer.

18. Explain the working of C-type Bourdon tube and Bellows.

19. What is Synchros? Explain with neat diagram control type Synchros.

20. What is MRI? Explain how it works.

21. Explain different ultrasound imaging modes.

Q3. Attempt the following.

6M

1. Give the overview of the inductive transducers explaining their principle of operations like variations of number of turns, geometric configuration and permeability.

2. Define the below terms

A) accuracy B) Precision c) sensitivity D) reproducibility E) drift F) threshold G) linearity H) Hysteresis .

3. Explain the working of strain gauge and derive the expression for the gauge factor.

4. Describe the properties of materials used for piezo-electric transducers. Derive expressions for voltage sensitivity and charge sensitivity.

5. Classify transducer according to –a) Transduction Principle b) Primary and secondary c) Active and passive transducer.

6. Give working principle of McLeod Gage has volume V of 150cm^3 and capillary diameter of 1.5mm . Calculate the gauge reading for pressure of $40\mu\text{m}$ of mercury.
7. Describe the working principle of: a) McLeod gauge b) Electromagnetic flow meter.
8. State the application of Pitot static tube. A Pitot tube is used to measure the velocity of air stream at 20°C and 0.1MPa . If the velocity is 10m/s . What is the dynamic pressure in newton per square meter? What is the uncertainty? If the dynamic pressure is measured with manometer having an uncertainty of 1Pa ?
9. List the temperature transducers. Explain with circuit diagram of three wire and four wire methods of temperature measurement using RTD. Give salient features of RTD.
10. List the flow rate sensing elements. Explain with neat diagram Orifice plate and venturi tube.
11. A venturi tube of throat diameter 60mm is placed in a water pipe of diameter 100mm to measure the volumetric flow. The volumetric flow rate through the tube is $0.08\text{m}^3/\text{s}$ and the water has a density of 10^3kg/m^3 and viscosity of 10^{-3}Ns/m .
 - a) Determine the Reynold's number for these conditions.
 - b) The co-efficient of discharge is 0.99 ; determine the upstream to throat differential pressure.
 - c) The differential pressure calculated in (b) is applied across an unstressed flat diaphragm. The diaphragm is made of mild steel for which Young's modulus is 206GN/m and Poisson's ratio $=0.28$, and has a diameter of 10mm and a thickness of 0.2mm . Determine the Deflection of the Diaphragm.
12. Describe the following methods used for measurement of low pressure using:
 - a) Thermocouple vacuum gauge , b) Pirani gauge, c) Ionization type vacuum gauge.
13. Describe the construction and working of Radiation Pyrometers, optical Pyrometers.
14. Write a note on ECG AND EEG? What is cardiac analysis?
15. Explain electrical and mechanical activity of Heart.
16. What is EMG signals? How to generate EMG signal.
17. Write a note on CT-scanning system. List the applications.
18. Explain Imaging techniques. with neat diagram explain the working X-ray tube.
19. Explain MRI technology with neat diagram. What is magnetism and Resonance?

Q4. Attempt the following.

12M

1. A set of independent ten measurements were made to determine the weight of a load shot. The weights in gramme are 1.570,1.597,1.562,1.577,1.580,1.564,1.586,1.550,1.575,1.591.

Determine the a) arithmetic mean, b) average deviation, c) standard deviation, d) variance.

2. Explain with neat diagram Ultrasonic imaging system.

3. Define static and dynamic characteristics of transducers-

a) Hysteresis,

b) Linearity

c) Speed of response

d) Dead zone

e) Loading Effect

f) Sensitivity.

4. Explain Doppler ultrasound imaging system. Discuss continuous wave and pulse Doppler measurement system.

