

II B.Tech I Semester Regular Examinations, November 2005
TRANSDUCERS AND INSTRUMENTATION COMPONENTS
(Instrumentation & Control Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
 All Questions carry equal marks

1. (a) Classify various transducers and give an example of each and mention their applications. [8M]
- (b) What is the true value of voltage across the $500\text{ K}\Omega$ resistor connected between terminals A and B as shown in (figure1) below ? What would a voltmeter with a sensitivity of $20\text{ K}\Omega/\text{v}$ read on the following ranges: 50, 15,5 volts when connected across terminals C and D. [8M]

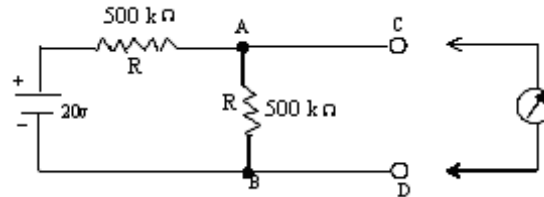


Figure 1:

2. (a) State and explain the laws of thermo couples. [8M]
- (b) List the different types of thermo couples and explain in detail the working of any one of them. [4M]
- (c) A thermocouple having a sensitivity of $40\text{ }\mu\text{V}/^\circ\text{C}$ is calibrated at a reference temp of 0°C . However, if it is actually used with a reference temperature of 40°C . What would be the output voltage of 100°C ? [4M]
3. (a) Explain how by using a differential arrangement a capacitive transducer which works on the principle of variation of capacitance with displacement between two plates, the response can be made linear. [8M]
- (b) Describe the frequency response of capacitive transducers. [8M]
4. (a) What are the importances of cold junction compensation in thermocouple? [8M]
- (b) How is the temperature scale standardized? What are fixed points and how are they used it temperature standards. [8M]
5. (a) Explain the Basic principle of Mechanical Linkages. [8M]
- (b) Illustrate a mechanical system using linkages. [8M]
6. (a) How is ON-OFF application of pneumatic amplifier. [8M]

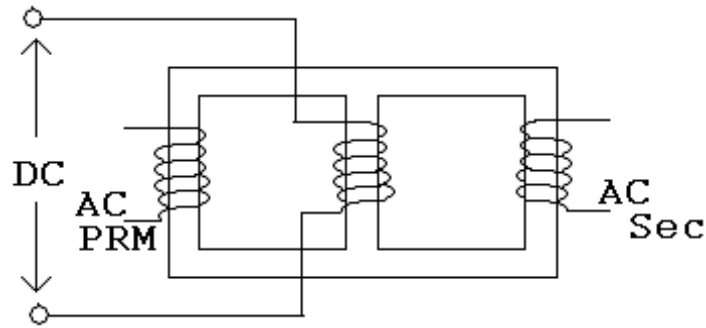


Figure 2:

- (b) Show how ON-OFF control is implemented in pneumatic control scheme. [8M]
7. Which component does the above circuit represent? (figure2) [4M]
- (a) Draw the characteristics of the output for a fixed ac input as dc is changed in the above circuit. [8M]
- (b) Explain how the above component can be used in control system. [4M]
8. (a) Discriminate between ordinary electric motors and Servo motors. [4M]
- (b) Briefly explain the working of D.C and A.C servomotors with neat sketches. [12M]

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1. (a) Define the terms [12M]
 - i. linearity
 - ii. Hysteresis
 - iii. threshold
 - iv. Resolution.
- (b) A $10\text{ K } \Omega$ variable resistance has a linearity of 0.1% and the movement of contact arm is 320°
 - i. Determine the maximum position deviation in degrees and the resistance deviation in ohm. If the instrument is to be used as a potentiometer with a linear scale of 0 to 1.6 volt, determine the maximum voltage error. [4M]
2. (a) Explain how vacuum and pressure of gauges can be measured by using a hot wire resistor. Discuss the nature of the problems faced in measurement. [8M]
- (b) Distinguish between the operational features of the constant temperature and constant current type anemometers. [8M]
3. (a) How the capacitive transducer is useful for the measurement of level of a non-conducting liquid. [8M]
- (b) Explain the principle of capacitive transducer which uses the principle of change in dielectric constant for measurement of displacement. [8M]
4. (a) What are different kinds of photosensitive devices? [6M]
- (b) Explain with diagram the working of one of them in detail. [10M]
5. (a) Distinguish between pivots & bearings. Write down the Advantages and Disadvantages of Pivots and Bearings. [8M]
- (b) Describe the different Basic Counting of Ratchets. Give its uses. [8M]
6. (a) What is the importance of safety precautions in control system. [4M]
- (b) List some methods of implementing safety measures in control system. [6M]
- (c) Describe how valves can be used to avoid failures in control system. [6M]
7. (a) What does a magnetic amplifier amplify? [2M]
- (b) Is magnetic amplifier an energy converter if so how? [4M]
- (c) Draw the circuit diagram of a magnetic amplifier and explain how it exerts controls in a control system. [10M]

8. (a) In what way a stepper motor is different from an ordinary motor. [4M]
(b) Explain the working of a variable reluctance stepper motor with a neat sketch. [8M]
(c) What is step angle and what is its significance? [4M]

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1. (a) Define the following static characteristics with necessary examples and graphs:
 - i. Accuracy
 - ii. sensitivity
 - iii. static error
 - iv. Dead space
 - v. Drift. [10M]
- (b) A voltage has a true value of 1.50 volts. An Analog indicating instrument with a scale range of 0-2.50 volts shows a voltage of 1.46 volts. What are the values of absolute error and correction. Express the error as a traction of the true value and the full-scale deflection. [6M]
2. (a) Derive an expression for gauge factor of a strain gauge. Also find an expression for a four arm active Wheatstone bridge output used to measure strain.
- (b) Explain the classification of strain gauges with their salient features. [16M]
3. Explain the different principles of working of capacitive transducers. [16M]
4. (a) Write short notes on bimetallic thermometer. [6M]
- (b) A bimetal strip 55 mm long is made of strips of nickel-chrome alloy and Invar bonded together at 30°C . Each materials has a thickness of 1.5 mm. Find the radius of curvature of the strip subjected to 110°C , Assume the following data.
 For Invar $\rightarrow \alpha_1 = 1.5 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$ $E_1 = 1.5 \times 10^{11} \text{ N/m}^2$.
 For Nickel-Chrome alloy \rightarrow
 $\alpha_2 = 12.5 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$ $E_2 = 2.3 \times 10^{11} \text{ N/m}^2$. [10M]
5. (a) What is the coupling mechanism with operation of a clutch in an automotive?
- (b) In what way are different from chain and belt drives?
- (c) Enumerate the applications of friction drives. [16M]
6. (a) What are the types characteristics of plugs used in pneumatic control valve. [8M]
- (b) Explain the term valve rangeability. [8M]
7. (a) What is the difference between a switch and a relay. [4M]

- (b) Explain the working of a electromechanical relay with a neat sketch and give the applications. [12M]
8. (a) Discriminate between ordinary electric motors and Servo motors. [4M]
- (b) Briefly explain the working of D.C and A.C servomotors with neat sketches. [12M]

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1. (a) Categorise various errors and explain the causes and suggest remedies. [12M]
(b) The true value of voltage across a resistor is 50V. The measurement find a value of 49V. Calculate
 - i. the absolute error
 - ii. the percent error
 - iii. the percent accuracy. [4M]
2. (a) Discuss with a suitable processing circuit how efficient load cells are constructed using metallic strain gauges. [10M]
(b) A strain gauge of nominal resistance 200Ω is fixed on one flat surface of a short column of $2cm \times 2cm$ cross sectional area. The column is subjected to an axial force of 100 n. The strain gauge forms, one arm of a bridge with other arms all-equal to 200Ω . Find the open circuit output of the bridge excited by 10v. Given, young's modulus of elasticity = $2.1 \times 10N/m^2$. [6M]
3. (a) Prove that the current I flowing in the circuit in which the transducer is connected across a battery of constant d.c.voltage E_b is directly proportional to the angular velocity $d\theta/dt$. Since voltage signals are readily manipulated, how might the current signal be transduced to a proportional voltage? The area of capacitor is $A = k\theta$. [8M]
(b) Derive the formula for sensitivity of the
 - i. Parallel plate capacitor. [4M]
 - ii. Cylindrical capacitor. [4M]
4. (a) Describe a thermocouple with suitable sketches. [8M]
(b) Explain how it can be used to measure high temperature. [8M]
5. Write short notes on: [16M]
 - (a) Flat pivot
 - (b) Flat collar pivot
 - (c) Conical pivot.
6. (a) What is the importance of safely precautions in control system. [4M]
(b) List some methods of implementing safely measures in control system. [6M]
(c) Describe how values can be used to avoid failures in control system. [6M]

7. (a) Express a relationship between various voltages of a synchro transmitter.[8M]
(b) How are synchros useful in error detection and correction in a servo control system. [8M]
8. (a) In what way a stepper motor is different from an ordinary motor. [4M]
(b) Explain the working of a variable reluctance stepper motor with a neat sketch. [8M]
(c) What is step angle and what is its significance? [4M]

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