

II B.Tech I Semester Regular Examinations, November 2006
SENSORS & SIGNALS CONDITIONING
(Instrumentation & Control Engineering)

Time: 3 hours

Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) Define and derive expression for the following for a second order system. (i) Resonant frequency (ii) Resonant peak (iii) Bandwidth
(b) A second order system has a natural frequency of 10Hz and a damping ratio of 0.3. Calculate the value of resonant frequency and the magnitude ratio at this frequency. Calculate the bandwidth. [8+8]
2. (a) What is difference between metallic & semiconductor strain gauges? Describe the principle of working and constructional details for the bonded type strain gauge.
(b) How is the force on cantilever beam measured by using strain gauge elements? Find the output in volts/micro strain. [8+8]
3. (a) Define electro magnetic interference and explain different types of electro magnetic interferences?
(b) Draw the block diagram of an ac signal conditioning system and the functions of the each block? [8+8]
4. (a) List the few applications of Hall effect transducers and explain any one application in detail.
(b) Explain the pressure measurement using Burdon tube and LVDT as secondary transducer. [8+8]
5. (a) List the applications of resolver to digital and digital to resolver converter.
(b) Explain how LVDT can be used for linear displacement. Also explain what is residual voltage. [8+8]
6. (a) Explain how Electro Chemical Cell can be used for measurement of temperature.
(b) Describe the properties of materials used for piezo-electric transducers. [8+8]
7. Show how a Composite amplifier is constructed using op-amps. List its advantages and disadvantages. [16]
8. (a) Classify encoders? Explain the principle of working of Incremental position encoder.

- (b) A photo transistor of circuit shown in fig. 8 with characteristics shown in fig. has a supply voltage of 20V and a collector load resistance of $2k\Omega$. Determine the output voltage when the illumination level is : (a) Zero (b) 300W/m^2 (c) 100W/m^2 . [8+8]

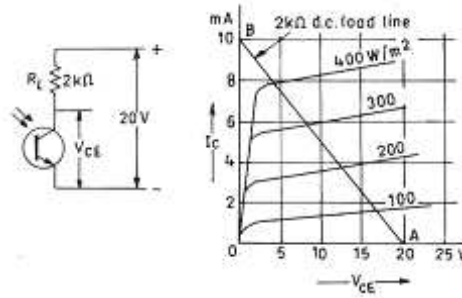


Figure 8

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1. (a) A $10\text{ k}\Omega$ variable resistance has a linearity of 0.1% and the movement of contact arm is 320° **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
(b) Define and discuss the dynamic characteristics of a measurement system. [8+8]
2. (a) What is the gauge sensitivity? Explain with a neat sketch to find the sensitivity of a half bridge.
(b) A steel cantilever is 0.25 m long, 20 mm wide and 4 mm thick. Calculate the value of deflection at free end for the cantilever when a force of 252 N is applied at this end. The modulus of elasticity for steel is 200 GN/m^2 [8+8]
3. (a) Describe the circuit of a three op-amp configuration of an instrumentation amplifier?
(b) How does the basic circuit of Kelvin's bridge differ from that of Wheatstone bridge? [8+8]
4. Explain the principle of operation of capacitive transducers based on variable dielectric and variable area type. How do you measure liquid level using capacitive transducer, explain. [16]
5. Explain the differential pressure measurement using inductive transducer in combination with a bridge. Derive an expression for the output voltage of the bridge. [16]
6. (a) A mercury thermometer has a capillary tube of 0.3 mm diameter. If the bulb is made of zero expansion material what volume must it have if a sensitivity of $3\text{ mm}/^\circ\text{C}$ is desired? Assuming operating temperature to be 20°C and coefficient of volumetric expansion of mercury is 0.181×10^{-3}
(b) Explain the factors affecting the static accuracy of filled in thermometers. [8+8]
7. (a) Explain the operation of Charge amplifier.
(b) What is the effect of noise in Charge amplifier. [8+8]
8. (a) Define an encoder? Explain the principle of working of Absolute position encoder.
(b) Explain the principle of working of SAW-device thermometer? Draw the characteristics. [8+8]

Code No: R050212202

Set No. 2

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Max Marks: 80

Answer any FIVE Questions
All Questions carry equal marks

1. (a) A $10\text{ k}\Omega$ variable resistance has a linearity of 0.1% and the movement of contact arm is 320° **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
(b) Define and discuss the dynamic characteristics of a measurement system. [8+8]
2. (a) Discuss the principle of operation of strain gauge. What is gauge factor? Compare some of the important characteristics of metallic and semiconductor type strain gauges.
(b) Explain the working principle of potentiometer. Derive an expression for its loading error. [8+8]
3. (a) What are the issues to be considered when using a divider for conversion of voltage to resistor variation and derive its expression?
(b) Compare the measuring accuracy of a Wheatstone bridge with the accuracy of an ordinary ohmmeter? [10+6]
4. (a) Explain the working principle and applications of variable reluctance type of transducers.
(b) Explain the design features of capacitive pressure transducers. [8+8]
5. (a) Explain how variable oscillators are classified. Explain working of any one of them.
(b) How resolver to digital converters are constructed. Explain its working. [8+8]
6. (a) Explain how Electro Chemical Cell can be used for measurement of temperature.
(b) Describe the properties of materials used for piezo-electric transducers. [8+8]
7. (a) With a schematic diagram, explain the operation of Instrumentation amplifier.
(b) List the characteristics of Instrumentation amplifier. [10+6]
8. Explain junction semiconductor sensor and give its merits. [16]

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1. (a) Derive the equations for time response of a first order system when subjected to unit ramp input. Draw the response curves and find the steady error
(b) Classify various transducers and give an example of each and mention their applications. [8+8]
2. (a) What are the main factors considered for lead arrangement an RTD? Explain any one briefly
(b) What are RTD's and on what basic principles do they work? Explain their construction. [8+8]
3. (a) Describe the operation of carey-Foster Slide-wire Bridge with neat diagram?
(b) A resistance R is measured using the connections of fig. The current measured is 10 A on range 10 A and the voltage measured is 125 V on 150 V range. The scales of the ammeter and voltmeter are uniform, the total divisions of ammeter are 100 and that of voltmeter are 150. The scales of these measurements are such that 1/10 of a scale division can be distinguished. The constructional error of the ammeter is $\pm 0.3\%$ and that of voltmeter $\pm 0.4\%$. The resistance of the ammeter is 0.25Ω . Calculate the value of R and the limits of possible error in the results. [8+8]
4. Give an overview of the inductive transducer explaining their principle of operation like variation of number of turns, geometric configuration and permeability. [16]
5. (a) How variable oscillators are classified. Explain any one of them.
(b) Explain the working of Hay's Bridge with the help of necessary equations also state any one of its application. [8+8]
6. (a) A pulse is applied to a piezo-electric transducers for a time T. Prove tat in order to keep the under shoot to a value within 5% the value of the constant should be approximately 20T.
(b) What is photo resistor? Explain briefly. [8+8]
7. (a) Define Noise. How an op-amp is affected by noise. How it can be reduced.
(b) Explain the operation of Electrometer amplifier. [8+8]
8. (a) Explain ultrasonic based sensor used for measurement of flow?
(b) Define a encoder? Explain the principle of working of Absolute position encoder. [8+8]

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Set No. 4
