**EI1**

**Hall Ticket Number:**

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| **III/IV B.Tech (Regular) DEGREE EXAMINATION** | | | |
| **January, 2024** | **Common to CE, CS, EC, EE, IT & ME** | | |
| **Seventh Semester** | **Sensors and signal conditioning** | | |
| **Time:** Three Hours | | **Maximum:** 70 Marks | |
| ***Answer question 1 compulsory.*** | | | **(14X1 = 14Marks)** |
| ***Answer one question from each unit.*** | | | **(4X14=56 Marks)** |
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|  |  |  | CO | BL | M |
| 1 | a) | Define transducer | CO1 | L1 | 1M |
|  | b) | List the dynamic characteristics of instruments | CO1 | L1 | 1M |
|  | c) | Define strain | CO1 | L1 | 1M |
|  | d) | What is a primary sensor? | CO1 | L1 | 1M |
|  | e) | What is the working principle of capacitive transducer? | CO2 | L1 | 1M |
|  | f) | What is an eddy current? | CO2 | L1 | 1M |
|  | g) | Which material is normally used to construct the core of LVDT? | CO2 | L1 | 1M |
|  | h) | Draw the schematic of a differential capacitor based on variation of the distance between plates. | CO2 | L2 | 1M |
|  | i) | What is self generating sensor? | CO3 | L1 | 1M |
|  | j) | What are the drawbacks of piezo-electric sensors? | CO3 | L1 | 1M |
|  | k) | What are the sources of noise in electronic circuits? | CO3 | L1 | 1M |
|  | l) | What are the advantages of digital sensors over analog sensors? | CO4 | L1 | 1M |
|  | m) | List different sensors for incremental position encoder. | CO4 | L1 | 1M |
|  | n) | What is the working principle of quartz microbalance? | CO4 | L1 | 1M |
| **Unit-I** | | | | | |
| 2 | a) | Classify transducers and give example of each type. | CO1 | L1 | 7M |
|  | b) | The expected value of voltage to be measured is 175V. However, the measurement gives a value of 173V. Calculate (i) absolute error (ii) percentage error (iii) Relative accuracy (iv) percentage accuracy (v) Error expressed as percentage of full scale reading if scale range is 0-200V. | CO1 | L2 | 7M |
| **(OR)** | | | | | |
| 3 | a) | Derive the expression for gauge factor of a resistive strain gauge. | CO1 | L1 | 7M |
|  | b) | A platinum resistance thermometer is used to measure temperature between 00C and 2000C. Given that the resistance at t0C as Rt = ( 1 + αt + βt2 ) and R0 = 100.0 Ω, R100 = 138.50 Ω and R200 = 175.83 Ω, Calculate the non linearity at 1000C as a percent of full scale deflection. | CO1 | L2 | 7M |
| **Unit-II** | | | | | |
| 4 | a) | Explain the measurement of displacement using LVDT. | CO2 | L1 | 7M |
|  | b) | The output of an LVDT is connected to a 5V voltmeter through an amplifier of amplification factor 250. The voltmeter scale has 100 divisions and the scale can read to 1/5 th of a division. An output of 2 mV appears across the terminals of the LVDT when the core is displaced through a distance of 0.5 mm. Calculate (i) the sensitivity of the LVDT (ii) the resolution of the instrument in mm. | CO2 | L3 | 7M |
| **(OR)** | | | | | |
| 5 | a) | Explain the measurement of displacement using capacitive transducer. | CO2 | L2 | 7M |
|  | b) | Design a signal conditioning circuit using ac bridge for a differential inductive sensor. Derive the relation between change in inductance and change in voltage. | CO2 | L3 | 7M |
| **Unit-III** | | | | | |
| 6 | a) | What is a thermocouple? Write its working principle. List different thermocouples with their operating range. | CO3 | L1 | 7M |
|  | b) | Write in detail about the working principle of photo voltaic sensor. | CO3 | L1 | 7M |
| **(OR)** | | | | | |
| 7 | a) | Draw the circuit diagram of chopper amplifier and explain its operation by considering signals at various stages of the circuit. | CO3 | L2 | 7M |
|  | b) | Write the need of composite amplifier. Draw an example circuit. | CO3 | L2 | 7M |
| **Unit-IV** | | | | | |
| 8 | a) | Draw the block diagram of digital quartz thermometer and explain the function of each block. | CO4 | L1 | 7M |
|  | b) | Draw the basic block diagram of a frequency meter and explain its operation. | CO4 | L1 | 7M |
| **(OR)** | | | | | |
| 9 | a) | A given sensor has an output frequency of 9 kHz to 11 kHz. Determine the measurement time and the number of counts needed to measure the frequency with a 12 bit resolution. | CO4 | L3 | 7M |
|  | b) | Draw the schematic of vibrating wire strain gage and explain its working principle. | CO4 | L1 | 7M |

