

5th Semester Regular Examination 2017-18
Sensor & Transducers
BRANCH: ECE, ETC
Time: 3 Hours
Max Marks: 100
Q.CODE: B461

Answer Question No.1 and 2 which are compulsory and any four from the rest.
The figures in the right hand margin indicate marks.

- Q1 Answer the following questions: *multiple type or dash fill up type* (2 x 10)**
- The cross-sectional area of Bourdon tube is
a) circular b) elliptical c) rectangular d) none of these
 - Examples of IC temperature sensors are -----, -----.
 - In an instrument the smallest measurable input is known as-----.
 - The errors committed by a person in the measurement are
a) gross error b) random error c) instrumental error d) environmental error
 - For a first order instrument, a 5% settling time is equal to ----- times the time constant.
 - Principle of operation of thermocouple based on ----- principle.
 - The output voltage for single element strain gauge bridge is -----
 - Which of the following should be incorporated in RTD to make a temperature sensing bridge most sensitive to temperature?
a) Pt b) Ni c) Thermister d) Cu
 - Examples of secondary transducer are -----.
 - Full form of PSD is -----.
- Q2 Answer the following questions: *Short answer type* (2 x 10)**
- What are the ideal characteristics of ideal op-amp?
 - What are the salient features of Thermistors?
 - Write two advantages of RTD.
 - Give a general structure of measurement system.
 - Define random error.
 - A resistance potentiometer has a total resistance of 10 K Ω and rated 4W. If the range of potentiometer is 0 to 100 mm, then its sensitivity in V/mm is how much?
 - What is the advantage of IC temperature sensor?
 - What is dynamic error in measurement systems?
 - What is the difference between span and range?
 - What is the significance of slew rate?
- Q3 a) The following results were obtained when a pressure transducer was tested in a laboratory under the following conditions: (10)**

- Ambient temperature 20 °C, supply voltage 10 V (standard)
- Ambient temperature 20 °C, supply voltage 12 V
- Ambient temperature 25 °C, supply voltage 10 V

Input(barg)	0	2	4	6	8	10
	-----Output (mA)----->					
I	4	7.2	10.4	13.6	16.8	20
II	4	8.4	12.8	17.2	21.6	28
III	6	9.2	12.4	15.6	18.8	22

- Predict an output value when the input is 5 barg, $V_S = 12$ V and ambient temperature is 25 °C.
- b)** Derive and draw the response of a second order element to a unit step input. (5)
- Q4** **a)** Derive an expression for the Gauge factor of strain gauge. (10)
b) Explain how displacement is being sensed by LVDT by suitable characteristic curve. (5)
- Q5** **a)** Explain the installation problems of thermocouple and cold junction compensation briefly. (10)
b) Derive an expression for variable dielectric displacement sensor. (5)
- Q6** **a)** Explain the principle of operation of different pressure sensing elements with neat diagram? (10)
b) Explain the torque measurement briefly. (5)
- Q7** **a)** Derive an expression of variable reluctance displacement sensor. (10)
b) Suggest a method to overcome the non-linearity of que.7 (a) output expression. (5)
- Q8** **a)** Explain a complete a.c. carrier system with the schematic block diagram with highlighting PSD. (10)
b) Explain briefly how the push-pull configuration (capacitive type) is being used for improvement of linearity and sensitivity of a level sensor? (5)
- Q9** **a)** A thermocouple has an e.m.f. of 4.1 mV at 100 °C and 16.4 mV at 400 °C relative to a cold junction of 0 °C. A deflection bridge incorporating a nickel metal resistance sensor is to be used as the voltage source $ET_{2,0}$ necessary for automatic reference compensation of the thermocouple e.m.f. The nickel sensor has a resistance of 10 Ω at 0 °C and a temperature coefficient of resistance of $6.8 \times 10^{-3} \text{ }^\circ\text{C}^{-1}$. Design the deflection bridge assuming a 1 V supply is available. (10)
b) Discuss with neat sketch instrumentation amplifier briefly. (5)