

GANPAT UNIVERSITY
B. TECH SEM- VI (MC) CBCS REGULAR EXAMINATION- APRIL-JUNE 2017
2MC603: Sensor Systems

TIME: 3 HRS

TOTAL MARKS: 60

Instructions: (1) This Question paper has two sections. Attempt each section in separate answer book.
 (2) Figures on right indicate marks.
 (3) Be precise and to the point in answering the descriptive questions.

SECTION: I

Q.1

- A. Explain Hall effect, piezo-resistive effect, magnetostrictive effect and thermo resistive effect. (04)
- B. Explain the parameters for the selection of position sensor. (04)
- C. A platinum resistance temperature detector has a resistance of 100Ω at 0°C , 143.5Ω at 100°C and 187Ω at 220°C . What will be the non-linearity error in $^\circ\text{C}$ at 100°C if the detector is assumed to have a linear relationship between 0 and 220°C ? (02)

OR

Q.1

- A. A thermistor has a resistance of 1016Ω at temperature 298 K and 475Ω at temperature 320 K. Find the temperature sensitivity in K^{-1} [i.e. $(1/R)(dR/dT)$, where R is the resistance at the temperature T(in K)], of this thermistor at 320 K? (03)
- B. Explain glucose sensor and depict any technique to measure it? (03)
- C. Explain various parameters for the selection of force sensor. (04)

Q.2

- A. Explain working principle of inductive proximity sensor with diagram. (04)
- B. An accelerometer has a seismic mass of 0.05 kg and spring constant of 3000 N/m. If maximum displacement of mass is $\pm 1\text{ mm}$, Find out the maximum acceleration which can be measured? (03)
- C. Define Chemical sensors and classify them according to their operating principle. (03)

OR

Q.2

- A. A wire strain gauge has a gauge factor of 2, resistance of 125Ω and length 1 m. If length of wire changes by .005 m, find out the change in resistance? Assume necessary data. (02)
- B. Explain how accelerometer works with diagram and explain (04)
 - a) Capacitive accelerometers
 - b) Thermal accelerometers
- C. Explain how an optical sensor works? And explain photoelectric sensors and their different types with figure? (04)

Q.3

- A. Explain the working of incremental and absolute encoders with neat sketch? (04)
- B. Explain with diagram the construction and working of velocity sensor? (03)
- C. An LVDT is used to measure displacement. The LVDT feeds a Voltmeter of 0-5 V range through a 250 gain amplifier. For a displacement 0.5 mm the output of LVDT is 2 mV. Find out the sensitivity of instrument? (03)

SECTION: II

Q.4

- A. Compare instrument configuration versus signal source type. (04)
- B. Explain 5 bit R-2R ladder DAC. (04)
- C. Consider a measuring system consisting of a sensor, amplifier and recorder having a sensitivity of $0.2 \text{ mv/}^\circ\text{C}$, 2 v/mv and 5 mv/v . What is the sensitivity of total systems? (02)

OR

Q.4

- A. Explain floating and grounded signal source. (04)
- B. Explain 5 bit Binary weighted ladder DAC. (04)
- C. A displacement sensor with range 0 – 10 cm is found to have an error of $\pm 0.15\text{cm}$ when Calibrated by the manufacturer. Calculate:- (02)
 - 1. The % error of sensor
 - 2. The % error when the reading obtained is 2.0 cm.

Q.5

- A. Justify that a seismic sensor is a 2nd order sensor device. (04)
- B. Briefly explain the electronics noise, shot noise, g-r noise and pink noise. (04)
- C. What is the difference between passive and active filter? (02)

OR

Q.5

- A. A 1st order temperature sensor is used to measure the temperature of the oil bath. If the temperature goes above 100°C, heat supplied to the oil bath should be stopped within 5 sec after reading 100°C. Determine the maximum allowable time constant of the sensor if the measurement error of 5% is allowed. (04)
- B. In a photo diode the bias current passing through the diode is 0.1 mA. (04)
1. If the rise time of the photo diode is 0.2 ms and the relation between the rise time and bandwidth is $\tau_{rise} = 1/4\Delta f$, calculate the shot noise current fluctuation.
 2. Calculate the magnitude of the shot noise voltage in dB, when the junction resistance is 250Ω.
- C. How linearity and sensitivity are related? (02)

Q.6

(10)

- A. Design a 2nd order passive RC Low pass filter with a cut-off frequency of 1 kHz.
- B. Explain the 10 bit successive approximation ADC. Also explain how 0.6v analog voltage converts in 10 bit binary sequence using 10 bit successive approximation ADC with $V_{ref} = 1$ volts.

-----END OF PAPER-----