Total number of printed pages – 6

B. Tech

CPEN 5301

Fifth Semester Examination – 2008

SENSORS AND SIGNALS

Full Marks – 70

Time – 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2 ×10

   (a) Can elastic sensing elements be used as primary sensing elements ? Give your answer in two to three sentences.

   (b) Write the expressions of direct piezo-electric effect and reverse piezoelectric effect, using "d" constant.

P.T.O.

(c) What do you understand by "Ion selective electrodes"?

(d) A deflection bridge produces an output voltage that is measured using a voltmeter. What should be the voltmeter input impedance so as to avoid loading effect ?

(e) Mention the factors that influence the limitations of practical operational amplifiers.

(f) Justify the name "double sideband carrier suppressed amplitude modulation".

(g) What are the advantages and disadvantages of aflash analog-to-digital converter?

(h) An analog-to-digital converter has an input range of 0 to 5 volt and incorporates a 12-bit binary encoder. Calculate the maximum percentage quantization error.

(i) What are "pixels" of a large-scale deflection system ?

(j) Write the applications of pneumatic measurement system. What is it's signal range ?

2. (a) Derive the expression of the sensitivity of a strain gauge element. Mention whether the strain gauge element has high or low values of temperature coefficient of resistance and temperature coefficient of linear expansion. 5

(b) Describe the construction and principle of operation of LVDT. How a d.c. voltage signal can be generated from the output of LVDT in order to represent the core position with respect to null position ? 5

3. (a) What is contact potential ? Write the expression of the e.m.f. of a thermocouple. Explain the law of intermediate metals and law of intermediate temperatures. Is it a reversible process ? 5

(b) Draw a schematic diagram of a pillar load cell using strain gauges. How the strain gauges are mounted ? Explain it's operation. 5

4. (a) Draw the circuit symbol and simplified equivalent circuit for operational amplifier. Write the characteristics of an ideal and typical operational amplifier. 5

(b) A slowly varying voltage signal with positive and negative amplitudes is amplitude modulated by a carrier and then transmitted. Explain how the original signal can be extracted from the transmitted signal at the receiver end. 5

5. (a) What is a current transmitter ? What is live zero ? Compare the operation and performance of open loop and closed loop current transmitters. 5

(b) Draw the circuit diagram of a oscillator using inductive sensor. Write the voltage

differential equation and the transfer function. Write the expressions of the natural frequency, damping ratio and change in natural frequency with respect to change in inductance of the sensor. 5

6. (a) Write two examples where the output signal from primary sensing or signal conditioning element is frequency modulation of the measurand. With suitable diagram explain how the frequency modulated signal can be converted to digital form. 5

(b) Draw the circuit diagram and explain the operation of a successive approximation type ADC. 5

7. (a) With a suitable schematic diagram and block diagram explain the operation of a closed loop recorder using servomotor. Derive the transfer function of the closed loop servo recorder. 7

(b) Compare LEDs and LCDs. 3

8. Write short note on any *two* : 5×2

(a) Spark energy and ignition energy.

(b) Pneumatic transmission and it's step response.

(c) Calculation of maximum stored energy for fault detection.