Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

PCEI 4302

Fifth Semester Regular Examination – 2014

INSTRUMENTATION DEVICES AND SYSTEMS - I

BRANCH(S) : AEIE, IEE

QUESTION CODE : H 164

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) What is meant by Systematic Characteristics of an instrument ?

(b) Distinguish between Modifying Input and Interfering Input of an instrument.

(c) What should be the responses of a second order instrument operating under critically damped and under damped conditions ? Write in few sentences.

(d) Define "Dynamic Error" of a measurement system.

(e) Write the materials used for constructions of Positive Temperature Coefficient Thermistor and Negative Temperature Coefficient Thermistor.

(f) State Seeback effect and Peltier effect of a thermocouple.

(g) Draw circuit diagram for measurement of temperature using LM335 precision temperature sensor.

(h) Why signal conditioning circuits are used in instrumentation ?

(i) Write few advantages of using instrumentation amplifier.

(j) Write examples of Fixed Head Variable Area type and Variable Head Fixed Area type flow meters.

P.T.O.

2. (a) Comment on Accuracy and Precision of the four instruments (M1, M2, M3 and M4) mentioned below showing five consecutive readings while measuring a parameter whose True Value is 10.0 unit. 5

M1	:	8,	9,	10,	11,	12
M2	:	9.8,	9.9,	10.0,	10.1,	10.2
M3	:	5,	6,	7,	8,	9
M4	:	8.8,	8.9,	9.0,	9.1,	9.2

(b) "Tolerance is the statistical variations amongst a batch of similar elements". Justify with suitable examples. 5

3. (a) Calculate percentage change of the response of a first order instrument after a time interval equal to one Time Constant when excited by a Step input. 5

(b) Derive the response of a second order system operating under critically damped and under damped conditions when excited by a step input. 5

4. (a) With suitable diagram explain Law of Intermediate Temperatures and Law of Intermediate Metals of Thermocouple. Also describe the method of Automatic Cold Junction Compensation of Thermocouple. 5

(b) With suitable diagram describe various types of Capacitive Sensing elements. Comment on Sensitivity and Linearity of the sensors. 5

5. (a) Describe construction of a LVDT and explain principle of displacement measurement. Explain whether the output of LVDT is the Amplitude Modulated signal of the Core Displacement. 5

(b) Describe construction and principle of Pressure measurement using Bourdon Tube, Bellows and Diaphragms. Comment on Linearity of Pressure measurement. Is there any requirement of a Secondary Sensor in order to measure Pressure using above mentioned sensors ? 5

6. (a) Derive an expression of the output unbalanced voltage of Wheatstone Bridge employing one Active Strain Gauge measuring Strain. 5

(b) Write the Ideal and Typical Operational Amplifier Characteristics. Draw circuit diagrams of Inverting Amplifier, Voltage Follower, Differential Amplifier and Voltage Summer. Write the expressions of the output voltages of these circuit configurations. 5

7. (a) Explain the requirements of AC carrier system in instrumentation. Describe the techniques of Amplitude Modulation and Phase Sensitive Demodulation in instrumentation system. 5

(b) Write construction and principle of operation of (i) Rotameter, (ii) Electro-magnetic Flow meter. 5

8. Answer any **two** of the following : 5×2

(a) Derive expressions of Undamped Natural Frequency and Damping Ratio of a Mass-Spring-Damper model of elastic force sensor.

(b) The Resistance-Temperature characteristic of a Thermistor is non-linear. Suggest a method of linearization of Thermistor.

(c) Describe construction and principle of operation of Doppler Shift flow meter.