Registration no: | | | | | | | | | | |

Total Number of Pages: 02 **B.Tech**

PEEL5301

5th Semester Back Examination 2017-18

Sensors and Transducers

BRANCH: AERO, AUTO, EEE, ELECTRICAL

Time: 3 Hours

Max Marks: 70

Q.CODE: B381

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

The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2 x 10)**

a) Write the Gauge Factor equation for a semiconductor strain gauge.

b) Give the working principle of Tachometer.

c) Give one example each of zero order system and first order system.

d) Write the characteristics equation of thermistor.

e) What are the objectives of using signal conditioning circuits?

f) Write the advantages of using differential push pull capacitance arrangement in a capacitive sensor.

g) Mention the materials used for making RTD.

h) A first order system when subjected to a step input has a temperature rise of 25 degree Celsius after 1 hour and 37.5 degree Celsius after 2 hours starting from cold conditions. Calculate its final temperature rise?

i) Why cold junction compensation of thermocouple is required?

j) Give the output voltage of a Resistive Bridge when the bridge is completely in balance condition.

Q2 **a)** Derive the response of a first order element to a unit step input. Calculate the magnitude of the response at time equal to twice the time constant. **(5)**

b) Give the law of intermediate metals in case of a thermocouple giving suitable mathematical equation. **(5)**

Q3 **a)** Derive the expression of Gauge Factor of strain gauge. **(5)**

b) Explain the working and construction of linear voltage differential transformer. Explain how the magnitude and direction of the displacement of a core of an LVDT is detected? **(5)**

Q4 **a)** Explain the different types of potentiometers in terms of their resolution and sensitivity. **(6)**

b) Derive the unbalanced voltage of a Wheatstone bridge. **(4)**

Q5 **a)** Describe various elastic sensing elements for pressure sensing, force and torque measurement. **(5)**

b) A variable reluctance sensor, consist of a core, variable air gap and an armature. The core is a steel rod of diameter 4cm, a coil of 500 turns is wound onto the core. The armature is a steel plate of thickness 0.5cm. Calculate the inductance of sensor for air gap of 1mm. Given the relative permeability of air=1.0 and the permeability of free space=$4X10^{-7}$. **(5)**

Q6 **a)** Draw the equivalent circuit of ideal op-amp. Lists the characteristics of an ideal op-amp. **(5)**

b) Give the advantages of differential push pull capacitive and inductive arrangement. **(5)**

Q7 A variable dielectric capacitance displacement sensor constant of two square metal plates, 4cm separated by a gap of 1mm thick and same area as the plates can slide between them. Given permittivity of air is 1 and that of the dielectric material is 2. Calculate the capacitance of the sensor when input displacement is X=2.5 cm and X=5cm. **(10)**

Q8 **Write short answer on any TWO:** **(5 x 2)**

a) Force and Torque Measurement
b) Instrumentation Amplifier
c) IC Temperature Sensor
d) Inductive Sensing Element