



Assume any missing data....Exam is two pages.

Attempt the following questions:

Max. Marks (50)

Question 1:

(12marks)

(1-a) Explain the theory and operation of:

(6marks)

- I. Photo electric sensors.
- II. LVDT displacement sensors.
- III. Toothed rotor variable reluctance tachogenerator.

(1-b) Plot a graph of the following reading for a pressure sensor to determine if there is hysteresis, and if so, what is the maximum hysteresis as a percentage of FSD? (6marks)

True pressure (KPa)	0	20	40	60	80	100	80	60	40	20	0
Gauge pressure (KPa)	0	15	32	49	68	91	84	61	42	24	4

Question 2:

(16marks)

(2-a) Describe the difference between:

(8marks)

- I. Sensitivity and Resolution.
- II. Accuracy and precision.
- III. Incremental and absolute encoder sensors.
- IV. Hall Effect and optical encoder sensors.
- V. Successive approximation A/D and flash converter.

(2-b) A strain gauge is bonded to a beam which is 10 cm long and has a cross sectional area of  $4 \text{ cm}^2$ . Young's modulus for steel is 207 G Pa. the strain gauge has an unstrained resistance of  $220 \Omega$  and a GF of 2.2. When a load is applied, the resistance of gauge changes by  $0.02 \Omega$ . Find the change in length of the steel beam, and the amount of force applied to the beam.

(8marks)

**Question 3:****(14marks)**

(3-a) A steel cantilever is 200 mm long, 30 mm width, and 8mm thickness.

**(9marks)**

- I. Calculate the value of deflection at the free end of cantilever when a force of 30N is applied at this end. The modulus of elasticity for steel is 200GPa.
- II. An LVDT with a sensitivity of 0.5v/mm is used. The voltage is read on a 20v voltmeter having 100 division. Two-tenths of division can be read. Calculate the resolution of the LVDT.
- III. Find the minimum and maximum value of force.

(3-b) A 250  $\Omega$  platinum RTD is being used to measure the temperature of an oven. The present resistance reading is 330  $\Omega$ . What is the oven's temperature? Temperature coefficient for platinum is 0.0039  $\Omega/\Omega/^{\circ}\text{C}$ .

**(5marks)****Question 4:****(8marks)**

(4-a) A chromed-Constant thermocouple has a cold junction at 20  $^{\circ}\text{C}$  as shown in next table, what will be the thermoelectric emf when the hot junction is at 200  $^{\circ}\text{C}$ .

**(4marks)**

T( $^{\circ}\text{C}$ )	0	20	200
Emf(mv)	0	1.192	13.419

(4-b) for R-2R Ladder (DAC) as shown in fig.1

**(4marks)**

Calculate the analog voltage value that outputs when the switch positions is 1010. Where,  $v_s = 10\text{ v}$ .

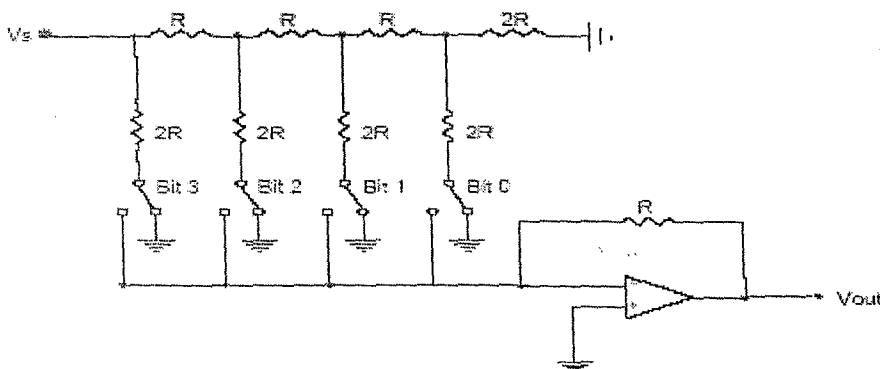


fig.1.

With my best wishes,

Dr. Mahmoud M. Saafan

9:00 AM, Thursday, 17<sup>th</sup> May. 2018.