1-a Write short notes about:- (18 marks)

Loading error effect.
Functions of measurement systems.
Elements of an instrumentation system.
Sample & Hold circuit.
Basic components of DAS.
Selecting points of transducers.

1-b A strain gauge having a resistance of 120 Ω and gauge factor of 2 is fastened to a steel rod, subjected to a stress of 1000 kg/cm^2. The modulus of elasticity of the steel is $2x10^6$ kg/cm^2, This strain gauge is connected in series with a ballast resistance of 120 Ω across 12V supply .

i- Drive a mathematical expressions for both gauge factor of the strain, and the voltage sensitivity of the circuit.

ii- Calculate the percentage change in resistance of the strain gauge, the voltage sensitivity of the circuit and change in output voltage when the gauge is subjected to a stress.

(12 marks)

2-a Explain the function and theory of operation of the following:- (12 marks)

Capacitive transducers.
Pressure sensing elements.
Mechanical sensing elements.
Hall effect transducer.
Liquid level transducers.
Biomedical transducers.

2-b A capacitance transducer of two parallel plates of dimensions of 20mm x 30mm and separated 2.5 mm apart.

i- Drive a mathematical expression for both sensitivity and change in capacitance due to varying the permittivity of the dielectric material between the plates.

ii- Calculate the change in capacitance when dielectric material moves 5mm. given ε_0 = 8.854 PF/m, and $\varepsilon_r = 81$ (10 marks)

3-a Write the differences between:- (12 marks)

Sensitivity & Accuracy.
Primary & Secondary Transducers.
Eddy current & Toothed Rotor Tachometer.
Precision & Stability.
Active & Passive Transducers.
Inductive & Capacitive Transducers.

3-b A barium titanate Piezo-electric crystal has the dimensions of 6mm x 6mm x 1.5mm. and voltage sensitivity is 0.012 Vm/N , relative permittivity is 1400, the modulus of elasticity is $12x10^{10}$ N/m^2 . The force acting on the crystal is 10 N. (16 marks)

i- Drive a mathematical expression for the output voltage .

ii- Calculate output voltage, charge sensitivity, and charge generated, and strain.

3-c What is Telemetry?. Explain with drawing the basic components of telemetry system, and discuss both the concepts and applications of it. (10 marks)

GOOD LUCK
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