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Sensors & Instruments

EET 3120

Homework#3  
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1. A metallic wire embedded in a strain gage is 4.2 cm long with a diameter of 0.07 mm. The gage is mounted on the upper surface of a cantilever beam to sense strain. Before strain is applied, the initial resistance of the wire is 64 Ω. Strain is applied to the beam, stretching the wire 0.1mm, and changing its electrical resistivity by 2 × 10-8 Ωm. If Poisson’s ratio for the wire is 0.342, ﬁnd the change in resistance in the wire due to the strain to the nearest hundredth ohm.

**Relative Change in Resistance formula:**

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ΔL = 0.1mm, L = 42 m

Poisson’s ratio (ν) = 0.342

Changing Resistivity () = 2 × 10-8

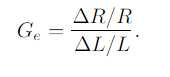
Resistivity () = where A is the area of the wire A = π\*r2. And r = Diameter /2

= = 5.86 \*10-4

= (1+2\*0.342)0.002381+ = **4.04\*10-3** **Ω**

1. A metallic strain gage has a resistance of 350 Ω at zero strain. It is mounted on a 1-m-long column. The column is strained axially by 1 cm. Determine a typical resistance (in Ω) of such a gage under its strained condition.

**Engineering Gage Factor:**



, R = 350 Ω, = 2, L = 1m = 0.01cm, ΔL = 1cm

=

1. A resistive accelerometer is fabricated with an internal mass of 1 gm and 2-mm-long strain gages, each having a spring constant of 300 N/m. When the gages are strained by 2 % in a direction parallel to the strain gages, determine (a) the acceleration (in m/s2) in the direction parallel to the strain gages and (b) the acceleration (in m/s 2) in the direction perpendicular to the strain gages.

**Accelerometer with strain gages:**



(2mm)(0.02) = 0.4\*10-4m

1. A variable-capacitance relative humidity sensor has a capacitance of 10 µ F at 10 % relative humidity and 35 µ F at 50 % relative humidity. Determine (a) its capacitance at 78 % relative humidity, (b) its capacitance at 0 % relative humidity, and (c) its sensitivity.

**Relative Humidity:**

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10µF = A + B \* 10%

35µF = A + B \* 50%

**Solving for B using both equations:**

35-10 = (A+B\*50%) - (A + B \* 10%)

35-10 = A+B\*0.5 – A – B\*0.1

25 = 0.5B – 0.1B

B = = **62.5**

**Solving for A:**

10µF = A + B \* 10%

10 = A + (62.5\*.01)

10 = A + 6.25

A = 10 – 6.25

A = **3.75**

**At 78% Humidity**

C = A + B \*RH; C = 3.75 + 62.5\*0.78

C = **52.5 µF**

**At 0% Humidity**

C = 3.75 + 62.5\*0

C = **3.75**