King Abdulaziz University
College of Engineering
Mechanical Engineering Department .

MEP 365
Thermal Measurements
Fall 2022, HW. # 12
Ch. 11 Strain measurements

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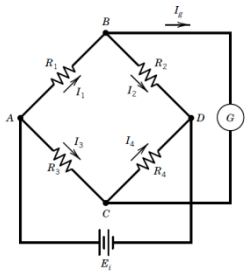
1) Show that for a balanced Wheatstone bridge the relation between the four arm resistances is given by

$$\frac{R_1}{R_2} = \frac{R_3}{R_4}$$

[Note: See Ch. 6 in you textbook]



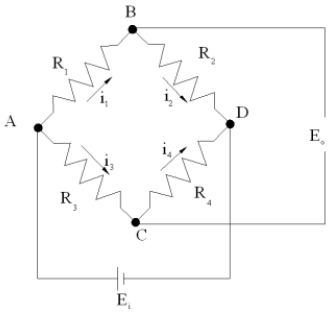
2) Show that that the voltage sensitive Wheatstone bridge, the change of the output voltage for a single active arm can be written

$$\frac{\delta E_o}{E_i} = \frac{\delta R / R}{4 + \delta R / R}$$

Where δR is the change in the resistance of one arm of the Wheatstone bridge assuming $R_1=R_2=R_3=R_4=R$
Reduce the above equation to

$$\frac{\delta E_o}{E_i} = GF\,\frac{\varepsilon}{4}$$

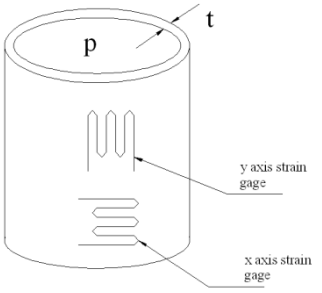
Where GF is the gage factor which is the same for all resistances



3) Consider a Wheatstone bridge circuit having all resistance equal to 100 Ω. The resistance R_1 is a strain gage that can not sustain a power dissipation of more than **0.4 W**. What is the maximum applied voltage Ei that can be used for this bridge circuit? At this level of bridge excitation, what is the bridge sensitivity (i.e. $\delta E_o / \delta R$)

4) A strain gage having a nominal resistance of 350 Ω and a gage factor (GF) of 2 is mounted in an equal-arm bridge, which is balanced at zero applied strain condition. The gage is mounted on 2 cm diameter Aluminum rod, having E_m=**75** GPa. The gage senses axial strain. The bridge output is **4 mV** for a bridge input of 5 V. What is the applied load (F?), assuming the rod is in uniaxial tension

5)A round rod having a cross sectional area of 3 cm^2 experience an axial load of **19 kN**. Two strain gages are mounted on the member, one measuring an axial strain of 600 με (μ in./in.) and the other measuring a lateral strain of **-190 με**. Determine the modulus of elasticity and Poisson's ratio for this material.



6) The pressure inside an Aluminum Soda can is to be measured using a single strain gage. The can diameter is **7** cm, and the wall thickness is **0.25** mm. The strain gage was installed in the x direction when the can was close. It was noticed that the strain gage indicate **-350 miro-strain** when the can was opened. Calculate the initial pressure inside the can.
[Assume $\sigma_x=2\sigma_y$]. Take $E_m=6.9*10^{10}$ Pa, ν_p=0.3

7) Consider a 0, 45, 90° rectangular rosette bonded into Aluminum bar (E_m=70 GPa, ν_p=**0.33**). The measured strains by the strain gauges are:
ε_1=**500** με, ε_2=**200** με, ε_3=**350** με.
Calculate
a) The maximum and minimum stresses and the shear stress
b) The stress principal axis direction i.e. the angle φ