Homework #7

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Sec. 3 (PIV)

Measurement

and 1000 Ω.

7.7 Determine the system sensitivity for a bridge with a single active gage having $R_g = 350\ \Omega$ and $S_g = 2.05$ if $r = 3$ and if the bridge voltage is 5 V.

วิธีทำ จากสูตร $V_s = (1+r)\sqrt{A P_D R_g}$; $P_g = P_D A$

; $V_s = (1+r)\sqrt{P_g R_g}$ — (1)

จากสูตร $S_s = \frac{r}{1+r} S_g \sqrt{P_g R_g}$

$$\sqrt{P_g R_g} = \frac{S_s (1+r)}{r S_g} \quad \text{— (2)}$$

แทน (2) ใน (1) ;

$$V_s = \frac{(1+r)^2 S_s}{r S_g}$$

$$; \quad S_s = \frac{r V_s S_g}{(1+r)^2} \quad \text{— (3)}$$

แทนค่า $V_s = 5$, $r = 3$, $S_g = 2.05$ ใน (3) ;

$$S_s = \frac{3(5)(2.05)}{(1+3)^2}$$

$$\therefore S_s = 1.921875\ \Omega/V$$

7.9 Determine the voltage output from a Wheatstone bridge if a single active gage is used in an initially balanced bridge to measure a strain of 1200 μm/m. Assume that a digital voltmeter will be used to measure the voltage and that $S_g = 2.06$, $r = 1$, and $v_s = 6$ V.

วิธีทำ จาก $V_s = (1+r)\sqrt{P_g R_g}$ — (1)

, $S_s = \frac{r}{1+r} S_g \sqrt{P_g R_g}$ — (2)

และ $\frac{\Delta V_o}{\varepsilon} = S_s \Rightarrow \Delta V_o = \varepsilon S_s$ — (3)

แทน (3) ใน (2); $\Delta V_o = \frac{\varepsilon r}{1+r} S_g \sqrt{P_g R_g}$ — (4)

$$\sqrt{P_g R_g} = \frac{\Delta V_o (1+r)}{S_g \varepsilon r} \quad \text{— (5)}$$

แทน (5) ใน (1) ;

$$V_s = (1+r)\Delta V_o \frac{(1+r)}{\varepsilon r S_g}$$

$$; \quad \Delta V_o = \frac{\varepsilon V_s r S_g}{(1+r)^2} \quad \text{— (6)}$$

แทนค่า ;

$$\Delta V_o = \frac{1200\mu \times 6 \times 1 \times 2.06}{(1+1)^2}$$

$$= 3.708\ \text{mV}$$

7.11 A 350-Ω strain gage with $S_g = 2.07$ is employed in a single-arm Wheatstone bridge with $r = 1$. If the gage is subjected to a strain of 1600 μin./in., determine the reading on a $4\frac{1}{2}$-digit DVM if

	v_s (V)	Amplifier Gain G
(a)	2	10
(b)	4	10
(c)	6	100
(d)	5	50

$$v_s = (1+r)\sqrt{p_g R_g} \quad -(1) \qquad \Delta v_o = \frac{r}{1+r}\sqrt{p_g R_g} S_g \epsilon \quad -(2)$$

จาก (2); $\sqrt{p_g R_g} = \frac{\Delta V_o (1+r)}{r S_g \varepsilon}$ $-(3)$ แทนใน (1);

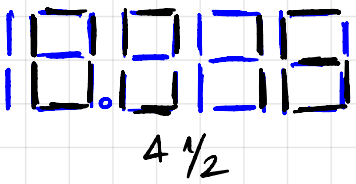
$V_s = \frac{(1+r)^2 \Delta V_o}{r S_g \varepsilon} \Rightarrow \Delta V_o = \frac{r S_g \varepsilon V_s}{(1+r)^2}$ $-(4)$

(a) $V_s = 2$ V, $G = 10$

แทนค่าใน (4); $\Delta V_o = \frac{1 \times 2.07 \times 1600 \times 10^{-6} \times 2}{(1+1)^2}$

$\Delta V_o = 1.656$ mV

จาก $G = 10$; $\Delta V_o = 16.56$ mV $= 0.01656$ V



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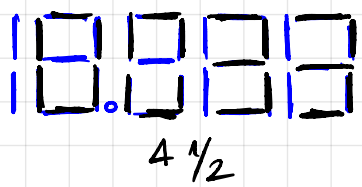
ค่าที่อ่านได้คือ 0.016 V

(b) $V_s = 4$, $G = 10$

แทนค่าใน (4); $\Delta V_o = \frac{1 \times 2.07 \times 1600 \times 10^{-6} \times 4}{(1+1)^2}$

$\Delta V_o = 3.312$ mV

จาก $G = 10$; $\Delta V_o = 33.12$ mV $= 0.03312$ V



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ค่าที่อ่านได้คือ 0.033 V

7.11 A 350-Ω strain gage with $S_g = 2.07$ is employed in a single-arm Wheatstone bridge with $r = 1$. If the gage is subjected to a strain of 1600 μin./in., determine the reading on a $4\frac{1}{2}$-digit DVM if

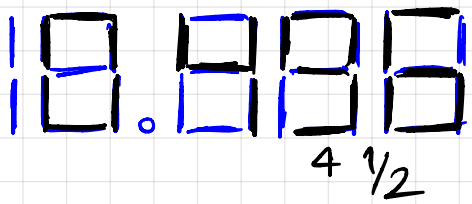
	v_s (V)	Amplifier Gain G
(a)	2	10
(b)	4	10
(c)	6	100
(d)	5	50

(c) $V_S = 6V$ $G = 100$

แทนค่าใน (4); $\Delta V_o = \frac{1 \times 2.07 \times 1600 \times 10^{-6} \times 6}{(1+1)^2}$

$\therefore \Delta V_o = 4.968\ mV$

ที่ $G = 100$; $\Delta V_o = 496.8\ mV = 0.4968\ V$



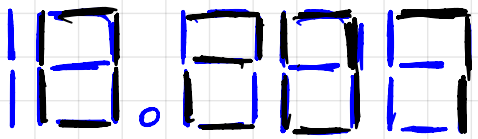
ค่าที่อ่านได้คือ 0.496 V

(d) $V_S = 5V$, $G = 50$

แทนค่าใน (4); $\Delta V_o = \frac{1 \times 2.07 \times 1600 \times 10^{-6} \times 5}{(1+1)^2}$

$\therefore \Delta V_o = 4.14\ mV$

ที่ $G = 50$; $\Delta V_o = 207\ mV = 0.207\ V$



ค่าที่อ่านได้คือ 0.207 V

7.13 Four strain gages ($R_g = 500\ \Omega$, $S_g = 2.06$) are attached to a bar to produce a load cell. The supply voltage $v_s = 4$ V and the amplifier (with a variable gain 10–100) is set at $G = 20$. When a load of 10,000 lb is applied to the bar the $4\frac{1}{2}$-digit DVM provides a count of 6280. What adjustments are required to make the count correspond to the applied load?

วิธีทำ

$$\Delta V_o = \frac{10000\mu - 6280\mu}{20} \quad \left| \quad 0.186m = \frac{1}{4}\frac{\Delta R_g}{500}\right.$$

$$= 0.186\ mV \quad \left| \quad \Delta R_g = 23.25\ M\Omega \right. \#$$

7.14 An oscilloscope with an input impedance of $10^6\ \Omega$ is connected to a Wheatstone bridge with one active gage ($R_g = 350\ \Omega$, $S_g = 3.35$, and $r = 5$). The bridge is powered with a 9-V constant-voltage supply. If the gage responds to a dynamic strain pulse having a magnitude of 900 μm/m, determine the sensitivity setting on the oscilloscope that will give a trace deflection of four divisions.

วิธีทำ

$$S_R d_s = \frac{r}{(1+r)^2} V_s S_g \varepsilon$$

$$S_R(4) = \frac{5}{(1+5)^2} \times 9 \times 3.35 \times 900 \times 10^{-6}$$

$$S_R = 942.1875\ \mu V/DIV \#$$