Module - 2

(1)

Solution of assignment - 3

(1) See hand written notes

(2) "

(3) (a) "

(b) Given data

Voltage sensitivity, $g = 0.05\ Vm/N$
crystal thickness, $t = 2.5mm = 2.5\times10^{-3}m$
pressure applied $p = 1.6\times10^{6}\ N/m^2$

we know that from the formula of the crystal voltage sensitivity is given by

$$g = \frac{V_{out}/t}{p}$$

$$\therefore V_{out} = gtp$$

$$= 0.05\times2.5\times10^{-3}\times1.6\times10^{6}$$

$$= 200V$$

(4) (a) See hand written note.

(b)

Given data

Seperation between plates, $d = 0.05mm$
capacitance of parallel plate capacitor,

$$C = 5\times10^{-12}F$$

We know that

$$\varepsilon A = Cd = 5\times10^{-12}\times0.05\times10^{-3} \quad \left[\because C = \frac{\varepsilon A}{d}\right]$$

$$= 0.25\times10^{-15}F$$

change in capacitance, $\Delta C = 0.75\times10^{-12}F$

Scanned with CamScanner

∴ New capacitance

$$C' = C + \Delta C$$
$$= (5\times10^{-12} + 0.75\times10^{-12})\,F$$
$$= 5.75\times10^{-12}\,F$$

We know that,
New separation between plates

$$d' = \frac{\varepsilon A}{C} = \frac{0.25\times10^{-15}}{5.75\times10^{-12}}$$

$$= 0.04348\ mm.$$

So displacement,

$$x = d - d'$$
$$= 0.05 - 0.04348$$
$$= 0.00652\ mm.$$

(5) See hand written notes.

(6) (a) "

(b) Given

At temperature of 0°C
Absolute temperature, $T_0 = 273K$
Resistance, $R_0 = 4k\Omega = 4000\,\Omega$
At temperature of 40°c
Absolute temp., $T_1 = 273+40 = 313K$
Resistance, $R_1 = 800\,\Omega$
For temperature T_1 and T_0

$$R_1 = R_0 \cdot e^{\beta\left(\frac{1}{T_1} - \frac{1}{T_0}\right)}$$

$$\therefore \beta = \frac{\log_e (R_1/R_0)}{\frac{1}{T_1} - \frac{1}{T_0}}$$

$$= \frac{\log_e\left(\frac{800}{4000}\right)}{\frac{1}{313} - \frac{1}{273}}$$

$$= 3438 \text{ per K.}$$

At temperature of 50°C

Absolute temperature, $T_{50} = 273 + 50 = 323K$

Resistance, $R_{50} = R_0 e^{\beta\left(\frac{1}{T_{50}} - \frac{1}{T_0}\right)}$

$$= 4000\, e^{3438\left(\frac{1}{323} - \frac{1}{273}\right)}$$

$$= 569.4\Omega$$

At temperature of 100°C

Absolute temperature, $T_{100} = 273 + 100 = 373K$

Resistance $R_{100} = R_0 . e^{\beta\left(\frac{1}{T_{100}} - \frac{1}{T_0}\right)}$

$$= 4000 . ^{3438\left(\frac{1}{373} - \frac{1}{273}\right)}$$

$$= 136.7\Omega.$$

$\therefore$ Resistance range is ~~from~~ from 136.7Ω to 569.4Ω

7 (a) see notes.

(b) Given data.

Length of conductor, $l = 24\,mm$

Diameter of conductor, $D = 1.5\,mm$.

Change in diameter, $\Delta D = 0.02\,mm$.

We know that

$$\text{poisson's ratio}, \mu = \frac{\text{Lateral strain}}{\text{Longitudinal strain}}$$

$$= \frac{\Delta D/D}{\Delta l/l}$$

$$= \frac{0.02/1.5}{1/24} = 0.32$$

Again we know that,

$$\text{Gauge factor}, G = 1+2\mu$$

$$= 1+2\times0.32$$

$$= 1.64$$

Any problem clear the next class.