Transducer and Measurement

Assignment-2

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Ex 4.3 Capacitance of crystal : 10^{-9} F

Capacitance of cable $= 3 \times 10^{-10}$ F

capacitance constant of crystal $= 4 \times 10^{-6}$ c/m

$R = 10^6 \Omega$

$C = 10^{-9} + 3 \times 10^{-10} + 10^{-10} = 1.4 \times 10^{-9}$

$\tau = RC = 1.4 \times 10^{-3}$.

$K_i = 4 \times 10^{-6}$ c/cm

$K = K_i / e = 2857$ V/cm

K is the voltage sensitivity constant

$$\left| \frac{e_o}{x_i} \right| = \frac{K \tau \omega}{\sqrt{1 + (\tau\omega)^2}}$$

Substituting the values of K, T and ω for $x_i = 10^{-4}$ cm

$e_o = 0.248$ V

Q 8.6) $N(\theta) = 4.0 + 1.5 \cos 200(2\pi\theta)$ milliwebers

$E = b_m \omega_r \sin(m\omega_r t)$ $\omega_r = 100$

comparing the given eqn

$N(\theta) = a + b\cos(m\theta)$

$|\vec{E}| = b_m \omega_r = 1.5 \times 22 \times 1000$

$= 33,0000$ milliwebers

$= 33$ webbers

$1000 \text{ rpm} = \frac{2\pi}{60} \times 1000 = \frac{2000\pi}{6}$

Amplitude $= 1.5 \times 22 \times \frac{2000}{6} \pi \times 10^{-3}$

$= 3.45$V

Frequency $= 366.66$ Hz

For 10000 rpm

Amp = 3454

Frequency $= 3666.66$ Hz

Date.....

Q13.11)

$d = 150mm$

$E_0 = 60mV$

$B = 500\ V\text{-}s/m^2$

As we know $E_0 = \frac{4B}{\pi d} Q \times 10^{-8}$ Vol

$$Q = \frac{E_0 \times \pi \times d \times 10^8}{4B}$$

$$Q = (60 \times \pi \times 150 \times 10^{-2} \times 10^{+8}) / 500$$

$$Q = 5.6454 \times 10^6\ cm^3\ s^{-1}$$

Nakra

Q49)

Cap. of ustal $= 5 \times 10^{-9} F$

Cap. of cable $= 5 \times 10^{-10} F$

• charge $= 4 \times 10^{-10}$ colon produced due to a force of 10 N. for 20N it is 8×10^{-10} colon.

$R = 1M\Omega$.

Capacitance $= 5 \times 10^{-10} F$

$\omega = 200 \times 2\pi = 1256.6$

$A = 20N$

Total Capacitance $= 5 \times 10^{-9} + 5 \times 10^{-10} + 5 \times 10^{-10}$

$= 6 \times 10^{-9} F$

$\tau = RC = 6 \times 10^{-3} s$ $\omega = 200 \times 2\pi = 1256.6\ rad\ s^{-1}$

as we know $q = VC$, $V = q/C$

$$V = \frac{8 \times 10^{-10}}{6 \times 10^{-9}} = 0.133V = 133.33mV$$

$$\frac{V_i'}{V_0} = \frac{T\omega}{\sqrt{1 + T^2\omega^2}} \times \frac{1}{\sqrt{\left(1 - \frac{\omega^2}{\omega_n^2}\right)^2 + 4\xi^2 \frac{\omega^2}{\omega_n^2}}}$$

$$\frac{V_i'}{V_0} = 1.0087 \times 1$$

$$\therefore \frac{133.3}{V_0} = 1.0087$$

$$V_0 = 132.150\ mV$$

Spiral

o/p = $V_0 \times 0.2$ = 26.438 cm

Nakra.

Q4.10

$$C = \frac{\varepsilon_0 \varepsilon A}{3.6\pi t} = \frac{8.85 \times 10^{-12} \times 5 \times \pi \times 10^{-2}}{3.6 \times \pi \times 10^{-3}}$$

$$= 1.229 \times 10^{-10} F$$

total capacitance = $1.229 \times 10^{-10} F + 2 \times 10^{-11} F + 5 \times 10^{-11} F$

$$19.29 \times 10^{-11} F$$

$$K = \frac{K_i}{C} = \frac{10^{-5}}{1.929 \times 10^{-10}} = 51840.33 \text{ V/cm}$$

$\left|\frac{e_0}{x_i}\right| = \frac{K\tau\omega}{\sqrt{1+(\omega\tau)^2}}$ (gain formula) $\tau = RC$ time constant

As gain is 50 ε_0 eff $= \frac{0.5}{50} = 0.01$.

$\tau = RC = 20 \times 10^6 \times 83.907 \times 10^{-12} = 1.678 \times 10^{-3}$ sec

$$x_i = 0.01 \left(\sqrt{\frac{1+(\tau\omega)^2}{(\tau\omega)K^2}} \right)$$

$\omega = 200\pi = 628.318$; $\tau\omega = 1.054$.

$$\boxed{x_i = 2.569 \times 10^{-7}}$$

$$\boxed{P = 350.6 N}$$

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