Helix TWT Problems

① Solution: Given

Beam Current = 25mA (I_0)

Beam Voltage = 2.5KV (V_0)

$Z_0 = 10\ \Omega$

$N = 40$

$F = 9.5\ GHz$.

$\beta = 2.01 \times 10^3$ rad/m

(i) $v_p = \frac{\omega}{\beta} = \frac{2\pi f}{\beta} = \frac{2 \times \pi \times 9.5 \times 10^9}{2.01 \times 10^3} =$ _____ m/s

(iii) $A_p = [-9.54 + 47.3\,NC]$ dB

$= \left[-9.54 + \left[(47.3)(40)\,\underline{C}\right]^*\right]$ dB = _____

(ii) $C = \left(\frac{I_0 Z_0}{4 V_0}\right)^{1/3} = \left[\frac{(25 \times 10^{-3})(10)}{4(2.5 \times 10^3)}\right]^{1/3}$

$=$ _____

* Substitute this 'C' value in A_p to get final answer of 'A_p'.

(2) Solution: Given:

$V_0 = 4kV$, $E_1 = 4 V/m$

$v_p = 1.1 v_0$

$f = 2 GHz$.

$v_e = ?$

$\rightarrow v_e = \frac{e E_1}{m \omega_e}$

where,

$\omega_e = \beta (v_p - v_0)$

&

$\beta = \frac{\omega}{v_p}$; $v_0 = \sqrt{\frac{2eV_0}{m}}$; $\omega = 2\pi f$

First find,

$$v_0 = \sqrt{\frac{2 \times 1.6 \times 10^{-19} \times 4 \times 10^3}{9.1 \times 10^{-31}}} = \_\_\_\_ \text{ m/s}$$

Next get, $v_p = 1.1 v_0 =$ _____ m/s

Next,

$$\beta = \frac{2\pi f}{v_p} = \frac{2 \times \pi \times 2 \times 10^9}{v_p} = \_\_\_\_$$

Next,

$\omega_e = \beta (v_p - v_0) =$ _____

Finally,

$$v_e = \frac{(1.6 \times 10^{-19})(4)}{(9.1 \times 10^{-31})(\omega_e)} = \_\_\_\_ \text{ m/s}$$