Antenna Theory and Design

Homework 17 :-

33) Calculate gain of a slot antenna of dimensions 29cm × 2.0cm for use at frequency 500MHz center-feed-point impedance for this antenna

Sol

given → frequency $f = 500MHz$

$$\lambda = \frac{c}{f}$$

$$= \frac{3\times10^8}{500\times10^6}$$

$$= 0.6m$$

→ given $L = 0.29m$

It can be expressed in terms of λ as

$$L = 0.4833\lambda$$

→ given $w = 0.02m$

→ we know that $a = 0.25w$

$$a = 5\times10^{-4}m$$

$$\Rightarrow d = 2a$$

$$= 2(5\times10^{-4}m)$$

$$= 1\times10^{-3}m$$

$$R_a = 69.98\Omega$$

$$Z_{dd} = -j\frac{120}{\sqrt{\varepsilon_r}}\left[\ln\left(\frac{2L}{d}\right) - 1\right]\cot\left(\frac{\beta L}{2}\right)$$

→ Substituting all the values we get

$$Z_{dd} = j33.7849$$

⇒ For dipole impedance is given by

$$Z_{in}|_{dipole} = R_a + jX_a$$

$$= 69.98 + j33.7849\,\Omega$$

⇒ For slot, impedance is given by

$$Z_{in}|_{slot} = \frac{\eta^2}{4Z_{in}|_{dipole}}$$

$$= \frac{377^2}{4(69.98 + j33.7849)}$$

$$= 428.25 - j225.8\,\Omega$$

→ $$G_r = \frac{120}{R_a}\frac{F^2(\theta)_{max}}{\sin^2\left(\frac{\beta L}{2}\right)}$$

So we get $G_r = 1.623$

$= 2.184\,dB$

3)

$$\lambda = \frac{c}{f}$$

$$= \frac{3 \times 10^8}{1000 \times 10^6} \quad (\text{given frequency} = 1000\,\text{MHz})$$

$$= 0.31\,\text{m}$$

$$Z_0 = \frac{\Omega^2}{4} \frac{\cos^2(\beta z_f)}{R_{sm}} = 50$$

R_{sm} at ω $\quad Z_0 = 50\Omega$ (given)

Distance $z_f = 6\,\text{cm}$