Assignment -2 Solutions

1. (c) WHO has classified overhead high voltage transmission lines as class 2B - possible carcinogen to human (C).

2. (a) People living within 50 meter in the main beam of cell tower antenna are considered to be in extremely high radiation zone. (a)

3. (d) Maximum antenna dimension = 80cm = D

$f = 3\,GHz \quad \lambda = \frac{c}{f} = \frac{3\times10^{10}}{3\times10^{9}} = 10\,cm.$

far field distance $d_{min} = \frac{2D^2}{\lambda}$

$d_{min} = \frac{2\times80\times80}{10}$

$d_{min} = 1280\,cm.$

Minimum far field distance is 1280cm (d)

4. (b) length of dipole antenna $l = 25\,mm \quad f = 900\,MHz$

$\lambda = \frac{3\times10^{11}}{900\times10^{6}} = 333.3\,mm$

$\frac{l}{\lambda} = \frac{25}{333.3} \Rightarrow l = \frac{3\lambda}{40}$ — small dipole antenna

small dipole length $\frac{\lambda}{50} < l < \frac{\lambda}{10}$

so the current distribution for this antenna will be triangular. (b)

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5. (b) dipole length $l = 15\text{cm}$ $f = 400\text{MHz}$ $\lambda = \frac{c}{f}$

$$\lambda = \frac{3\times10^{10}}{400\times10^{6}} = 75$$

$$\frac{l}{\lambda} = \frac{15}{75} \Rightarrow l = \frac{\lambda}{5} \text{ - case of small dipole}$$

$$R_{in} = 20\pi^2\left(\frac{l}{\lambda}\right)^2 \Rightarrow R_{in} = 20\pi^2\left(\frac{15}{75}\right)^2$$

$$R_{in} = 7.9\Omega \simeq 8\Omega$$

$l < \frac{\lambda}{2}$ so it will be capacitive – using transmission line concept

Answer is (b) 8Ω, capacitive.

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6. (C) Maximum achievable directivity from a dipole antenna of arbitrary length can be 3.25 (C)

Common data: $\varepsilon_r = 4.4$, $h = 0.16\text{cm}$, $\tan\delta = 0.02$

$f = 2.45\text{GHz}$ $\lambda_0 = \frac{c}{f} = \frac{3\times10^{10}}{2.45\times10^{9}} = 12.24\text{cm}$ $w = 0.5\text{cm}$

Effective dielectric constant $\varepsilon_{eff} = 1.2$ (because one side, metal is printed and other side is air)

7. (b)

$l + d = 0.48\lambda$ $\quad d = w$ $\quad \lambda = \frac{\lambda_0}{\sqrt{\varepsilon_{eff}}}$

$l = 0.48 \times \frac{12.24}{\sqrt{1.2}} - 0.5$

$l = 4.86$ cm

$l = 4.9$ cm

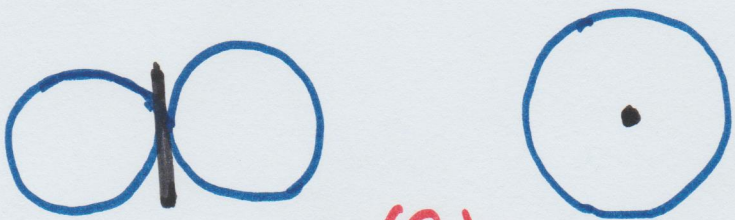
Approx resonant length of printed dipole antenna is 4.9 cm (b)

8. (c)

Approximate gain of the printed dipole antenna will be 2.0 dBi (C)

9. (a)

Radiation pattern of small dipole antenna



E plane (a) H plane

figure of 8 in E plane and omni in H plane.

10. (c)

Input resistance of folded dipole $Z_{in} = N^2 Z_d$

or

$\boxed{R_{in} = N^2 R_d}$

Impedance of resonant dipole antenna $R_{in} = 68\Omega$

$N = 2$ (2fold)

$R_{in} = 4 \times 68$

$R_{in} = 272\Omega$

Input resistance of folded dipole is 272Ω (C)

11. length of dipole $l = 14\,cm$

(b) diameter of dipole $d = 4\,mm = 0.4\,cm$

$$l + d = 0.48\lambda \Rightarrow \lambda = \frac{l+d}{0.48}$$

$$\lambda = \frac{14 + 0.4}{0.48} = 30\,cm$$

$$f = \frac{c}{\lambda} = \frac{3 \times 10^{10}}{30} = 1\,GHz.$$

Its approximate resonance frequency is 1 GHz (b)