Assignment -3 Solutions

1. Directivity of a $\lambda/4$ monopole antenna is twice to that of $\lambda/2$ dipole antenna. (C)

(C).

2. As the ground plane radius of monopole antenna increases, its impedance curve shifts toward inductive region (C)

(C).

3. Monopole antenna diameter $d = 0.4\,cm$

(C)

freq range = 1710 to 1880 MHz

$$f_c = \frac{1880 + 1710}{2} = 1795\ MHz$$

$$\%\ BW = \frac{1880 - 1710}{1795} \times 100 = 5.6\%$$

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

for monopole antenna $l + r = 0.24\lambda$

$$\lambda = \frac{3 \times 10^{10}}{1795 \times 10^{6}} = 16.7\,cm$$

$$r = d/2 = 0.2\,cm$$

$$l = 0.24\lambda - r$$

$$l = 4 - 0.2$$

$$l = 3.8\,cm$$

Monopole antenna wire length should be 3.8 cm (C)

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

$\varepsilon_{eff} = 1.2$ (bcoz only side is printed with metal otherside it is air so effective ε_r will reduce)

length of monopole $l = 12\,cm$

width of monopole $w = 0.5 = 2\pi r$

$$r = \frac{0.5}{2\pi} \simeq 0.1\,cm$$

4. (b) for monopole

$$l + r = 0.24\lambda$$

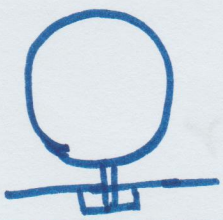
$$\lambda = \frac{l+r}{0.24} = \frac{12+0.1}{0.24} = 50.4\,cm$$

$$f = \frac{c}{\lambda} = \frac{3\times10^{10}}{50.4} = 595\,MHz$$

Approx. resonance frequency of monopole antenna will be 595 MHz (b)

5. (c). Gain of monopole antenna in dBi will be 5 (c)

6. (d) (d)



7. ( ) diameter $d = 0.05\lambda$ $C = \pi d = \frac{c}{f} = \pi \times 0.05 = 0.157$

for loop antenna $R_{in} = 20\pi^2 \left(\frac{C}{\lambda}\right)^4 N^2$ $R_{in} = 50\Omega$

1 turns

$$50 = 20\pi^2 (0.15\lambda)^4 \cdot N^2$$

$$N \simeq 20$$

(c) 20 turns are required to match antenna with 50Ω

8. loop diameter $d = 4cm$ wire diameter $= 1mm$

(d). $\mu_r = 10$ $R_{in} = 50\Omega$ $f = 100MHz$ $\lambda = \frac{c}{f}$

$$\lambda = \frac{3\times10^{10}}{100\times10^6} = 300cm$$

$$C_\lambda = \frac{c}{\lambda} = \frac{\pi d}{\lambda} = \frac{\pi\times4}{300} = 0.042$$

$$R_{in} = 20\pi^2 \mu_r^2 N^2 \left(\frac{c}{\lambda}\right)^4$$

$$50 = 20\pi^2 \times 100 \times N^2 \times (0.042)^4$$

$$N \simeq 28.7$$

$$N = 29$$

29 turns are required to match antenna impedance with 50Ω.

9. slot antenna length $l = 15cm$

(b) slot antenna width $w = 0.5cm = \pi d \Rightarrow d = 0.16cm$

$$l + d = 0.5\lambda \Rightarrow \lambda = \frac{l+d}{0.5} = 29.15\,cm$$

$$f = \frac{c}{\lambda} = \frac{3\times10^{10}}{29.15} = 1GHz.$$

Approx. resonance frequency of slot will be 1 GHz (b)

10. (d)

dipole antenna impedance $Z_c = 68$

for slot $Z_s Z_c = \frac{\eta^2}{4}$ η = free space impedance

$$Z_{sc} = \frac{\eta^2}{4 Z_c}$$

$$Z_{sc} = \frac{377 \times 377}{4 \times 68}$$

$$Z_{sc} \simeq 522\,\Omega$$

Input Impedance of slot antenna will be 522Ω (d)

11. (b)

If a slot antenna is backed by metallic cavity at a distance of $\lambda/4$, radiation pattern will be unidirectional. (b)