# Assignment-7 solutions.

1. For a given frequency, size of MSA can be reduced by
(a). Cutting slots.(a)

2. $\varepsilon_r = 2.55$, $h = 0.32\,cm$, $\tan\delta = 0.0012$ $f = 1800\,MHz$
(d) $\varepsilon_{eff} \leq 2.55$

$\varepsilon_{eff} = 2.45$ (Assume)

$$\lambda_0 = \frac{c}{f} = \frac{3\times10^{10}}{1800\times10^6} = 16.67\,cm$$

$$L_{eff} = \frac{\lambda}{4} = \frac{\lambda_0}{4\times\sqrt{\varepsilon_{eff}}} = 2.66\,cm$$

$$\Delta L = \frac{h}{\sqrt{\varepsilon_{eff}}} = \frac{0.32}{\sqrt{2.45}} = 0.20$$

$$L = L_{eff} - \Delta L = 2.66 - 0.20 = 2.46\,cm \simeq 2.5\,cm$$

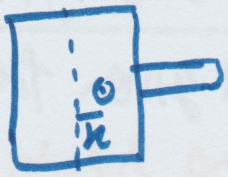
length of patch should be 2.5 cm (d)

3. RMSA with single short at corner will be most
(d). Compact. (d)

4. A shorted 90° sectoral MSA will not provide high
(c). resonance frequency among given options.

5. A single shorted compact RMSA provides less gain
(a) and less BW.

**6.** **(a)** For a single stub loaded RMSA, as the stub length increases from $0.05\lambda$ to $0.2\lambda$, value of $x$ $\boxed{\text{increases}}$ as compare to RMSA without stub.

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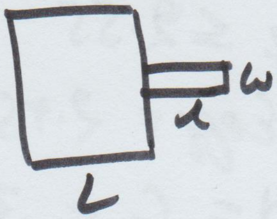
**7.** **(b)** $L = 16\,cm$, $\varepsilon_r = 2.32$, $h = 0.8\,mm$,
$\tan\delta = 0.0012$




$w = 0.5\,cm$ $l = 4\,cm$

$$\Delta l_1 = \frac{w \cdot l}{W} = \frac{0.5 \times 4}{16} = 0.125\,cm$$

$$f = \frac{c}{2(l_e + \Delta l)\sqrt{\varepsilon_e}}$$

$\varepsilon_e \leq \varepsilon_r$
$\varepsilon_e = 2.2$

$$= \frac{3 \times 10^{10}}{2 \times (16.1 + 0.125) \times \sqrt{2.2}}$$

$$l_e = l + \frac{2h}{\sqrt{\varepsilon_{eff}}} = 16.05$$

$= 625\,MHz$

Approximate resonance freq of antenna is 625MHz.

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**8.** **(b)** Tuneable RMSA provides symmetrical radiation pattern for two symmetrical stubs in comparison to single stub RMSA. (b)

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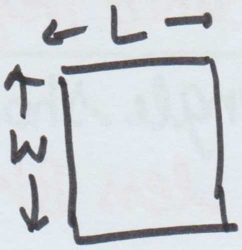
Common data: $\varepsilon_r = 4.4$, $h = 0.16\,cm$
$\tan\delta = 0.02$




$L = 10\,cm$ $W = 15\,cm$

$$\varepsilon_{eff} = \frac{\varepsilon_r + 1}{2} + \frac{\varepsilon_r - 1}{2}\left(1 + \frac{10h}{W}\right)^{-1/2}$$ $\varepsilon_{eff} = 4.3$

9. (b)

$$L_{eff} = L + 2\Delta L$$

$$\Delta L = \frac{h}{\sqrt{\varepsilon_{eff}}} = \frac{0.16}{\sqrt{4.3}}$$

$$L_{eff} = 10.15$$

$$L_{eff} = \frac{c}{2f\sqrt{\varepsilon_{eff}}} \Rightarrow f_L = \frac{c}{2\,L_{eff}\sqrt{\varepsilon_{eff}}}$$

$$f \simeq 710\,MHz$$

Approx. resonance frequency $f = 710\,MHz$.

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10. (a)

$$\Delta W = \Delta L = \frac{0.16}{\sqrt{4.3}}$$

$$W_{eff} = W + \frac{2\times 0.16}{\sqrt{4.3}} = 15.15$$

$$f_W = \frac{c}{2\,W_{eff}\sqrt{\varepsilon_{eff}}} = 475\,MHz$$

Approx resonance frequency $\boxed{f_W = 475\,MHz}$ (a).