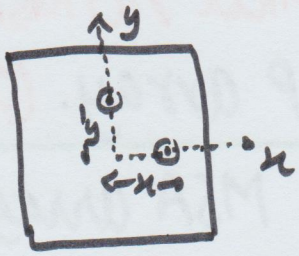
# Assignment-8 Solutions

**1.** (d) Circularly polarized MSA can not be designed by using square MSA with single diagonal feed. (d)

**2.** Common data for Q2&3:




$f = 2.5\,GHz$, $\varepsilon_r = 2.2$, $h = 0.32\,cm$

(b) $$W = \frac{c}{2f\sqrt{\frac{\varepsilon_r+1}{2}}} = 4.74\,cm$$

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

$$\varepsilon_{eff} = 2.06$$

$$L_{eff} = \frac{c}{2f\sqrt{\varepsilon_{eff}}} = 4.18\,cm, \quad \Delta L = \frac{h}{\sqrt{\varepsilon_{eff}}} = \frac{0.32}{\sqrt{2.06}} = 0.22\,cm$$

$$L = L_{eff} - 2\Delta L \Rightarrow L = 3.74\,cm = 37.4\,mm \simeq 37\,mm$$

So the approximate square patch length is 37 mm (b)

**3.** (d) Approximate feed position should be between $\lambda/6$ to $\lambda/4$ or 6.17 to 9.25 mm

Most appropriate option is **8 mm** for feed position among given options. (d)

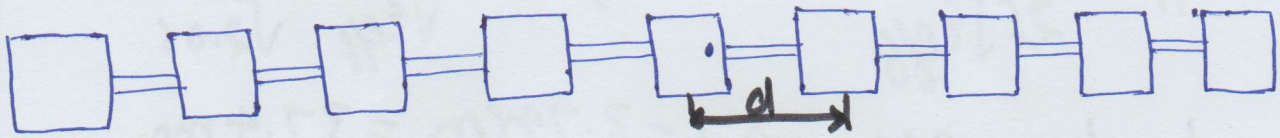
4. (c) A single feed circularly polarized MSA provides less axial ration bandwidth over dual feed circularly polarized MSA. (c)

5. (a) Sequentially rotated CP array provides better axial ratio(AR) bandwidth over conventional CP array. (a).

6. (c) A MSA array using corporate feed configuration has large bandwidth as compared to series feed MSA array. (c)

7. (d) In order to design series feed broadside MSA array, phase contributed by connecting feed line length should be 180° (d)

8. (b)




square MSA length = 5.6, $n = 9$

frequency $f = 1.8$ GHz $\quad \lambda_0 = \frac{c}{f} = \frac{3\times10^{10}}{1.8\times10^{9}} = 16.67$ cm

Inter element spacing $= 0.6\lambda_0$

$d = 10$ cm

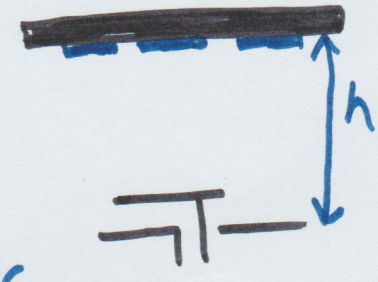
total array length = $(n-1)d$ + square MSA length

$= (9-1)\times10 + 5.6 = 85.6$ cm

total antenna array length will be 85.6 cm (b)

9. $f = 2.45\ GHz$ $\varepsilon_r = 3.38$, $h = 1.6mm$

(d) $\lambda_0 = \frac{c}{f} = \frac{3 \times 10^{11}}{2.45 \times 10^9} = 122.4$




gap b/w fed patch and parasitic patch $h = \frac{\lambda_0}{2} = 61.2mm$

Answer is 61.2mm (d)

10. square MSA gain = 6.5 dBi

(c) In corporate feed, all the elements are fed with equal amplitude in same phase.

No of elements in 2x2 array = n = 4

Gain of 2x2 array = $10 \log n$ + single MSA gain

$= 10 \log 4 + 6.5$

$= 12.5\ dBi$

there will be some feed line losses so approx gain of array will be 12 dBi (c)