SUB: PHYSICS **COMMUNICATION SYSTEMS**

1. A 100v carrier wave is made to vary between 160v and 40v by a modulating signal. What is the modulation index

   1) 0.4 2) 0.5 3) 0.6 4) 0.3

Ans: 3

Sol: Modulation Index $\mu = \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$

$= \frac{160 - 40}{160 + 40} = \frac{120}{200} = 0.6$

2. To double the covering range of a TV transmission tower, its height should be multiplied by

   1) $\frac{1}{\sqrt{2}}$ 2) 2 3) 4 4) $\sqrt{2}$

Ans: 3

Ans: The distance to horizon of the transmitting tower $d = \sqrt{2gh}$

$\frac{d_2}{d_1} = \sqrt{\frac{h_2}{h_1}} \Rightarrow \frac{2d_1}{d_1} = \sqrt{\frac{h_2}{h_1}} \Rightarrow h_2 = 4h_1$

3. 4000Hz carrier wave is amplitude modulated by the singnal frequency 200-400Hz. The channel width of this case is

   1) 8KHz 2) 4KHz 3) 7.6KHz 4) 3.8KHz

Ans: 1

Ans: $\therefore$ bandwidth $= 2\nu_m$

$= 2 \times 400Hz$

$= 8000Hz$

$= 8KHz$

Sol: Bandwith is equal to twice the frequency of modulating singals

4. A transmitting antenna at the top of a tower has a height 16m and the height of the receiving antenna is 25m. What is the maximum distance b/w them for satisfactory communication in LOS mode?Give radius of earth $6.4\times10^{6}\,m$

1) 250.3m 2) 253.3m 3) 259 m 4) 240.3m

Ans: 2

Sol: $d_m=\sqrt{2RhT}+\sqrt{2RhR}$

$=\sqrt{2\times64\times10^{5}\times16}+\sqrt{2\times64\times10^{5}\times25}$

$=\sqrt{2048\times10^{5}}+\sqrt{3200\times10^{5}}$

$=\sqrt{14310}+\sqrt{17888}$

$=119.6+133.7$

$=253.3m$

5. A message signal of frequency 100MHz and peak voltage 100V is used to modulate a carrier wave of frequency 300GHz and peak voltage 400V. a) The modulation index b) Difference b/w the two side band frequencies are

1) $0.25;1\times10^{8}\,Hz$ 2) $4;2\times10^{8}\,Hz$

3) $4;1\times10^{8}\,Hz$ 4) $0.25;2\times10^{8}\,Hz$

Ans: 4

Sol: $f_m=100MHz$

$f_c=300GHz$

$A_m=100V$

$A_c=400V$

Modulation index $\mu=\frac{A_m}{A_c}=\frac{100}{400}=0.25$

(UBF) upper side band frequency = f_c+f_m

(LBF) lower side band frequency f_c-f_m

Difference $=UBF-LBF$

$=(f_c+f_m)-(f_c-f_m)$

$=2f_m$

$=2\times100\times10^6\,Hz$

$=2\times10^8\,Hz$

6. A signal A coswt is transmitted using $V_0\sin\omega_0 t$ as carrier wave. The correct amplitude modulated (Am) signal is

1) $V_0\sin w_0t+\frac{A}{2}\sin(w_0-w)t+\frac{A}{2}\sin(w_0+w)t$

2) $V_0\sin\left[w_0(1+0.01A\sin wt)t\right]$

3) $(V_0+A)\cos wt\sin w_0t$

4) $V_0\sin w_0t+A\cos wt$

Ans: 1

Sol: $c(t)=v_0\sin w_0t$

$m(t)=A\cos wt$

$cm(t)=v_0\sin w_0t+\frac{A}{2}\sin(w_0-w)t$

$+\frac{A}{2}\sin(w_0+w)t$

7. The wavelength of the carrier waves in a modern optical fiber communication network is close to

1) 600nm 2) 2400nm 3) 1500nm 4) 900nm

Ans: 3

Sol: Fiber optics communication is mainly conducted in wavelength range from 1260nm to 1625nm

8. A TV transmitting antenna is 81m tall. How much service area it can cover if the receiving antenna is at the ground level? $\left(R=6.4\times10^6\,m\right)$

1) 3258 Km^2 2) 4180 Km^2 3) 2510 Km^2 4) 1525 Km^2

Ans: 1

Sol: Service area it can cover $A = \pi d^2$

$$A = \pi(2hR)$$

$$= \frac{22}{7} \times 2 \times 81 \times 6.4 \times 10^6 m^2$$

$$= 3258 km^2$$

9. What should be the length of the dipole antenna for a carrier wave of frequency $3 \times 10^8 Hz$

1) 1m 2) 0.5m 3) 2m 4) 2.5m\

Ans: 2

Sol: Lenth of dipole antenna

$$= \frac{\lambda}{2} = \frac{c}{2\upsilon} = \frac{3 \times 10^8}{2 \times 3 \times 10^8} = 0.5m$$

10. The LC product of a tuned amplifier circuit require to generate a carrier wave of 1MHz for amplitude modulation is

1) $1.5 \times 10^{-14} s$ 2) $1.2 \times 10^{-12} s$ 3) $3.2 \times 10^{-12} s$ 4) $2.5 \times 10^{-14} s$

Ans: 4

Sol: Frequency of tuned amplifier is $\upsilon = \frac{1}{2\pi\sqrt{LC}}$

As per question $\upsilon = 1MHz = 10^6 Hz$

$$10^6 = \frac{1}{2\pi\sqrt{LC}}$$

$$LC = \frac{1}{4\pi^2 \left(10^6\right)^2} = 2.5 \times 10^{-14} s$$

11. A sinu soidal voltage amplitude modulates another sinu-soidal voltage of amplitude 2kv to result in two side bands, each of amplitude 200v. The modulation index is

Ans: 0.2

Sol: Amphitude of each side band $= \frac{\mu A_C}{2}$

$$200V = \frac{\mu \times 2KV}{2}$$

$$200V = \frac{\mu \times 2000V}{2}$$

$$\mu = \frac{2 \times 200}{2000} = 0.2$$

12. A meassage singal of frequency 100KHz and peak voltage of 100 volts is used to modulate a carrier of frequency 1MHz and peak voltage voltage of 200volts. Detes mine modulation index

Ans: 0.5

Sol: modulation index $= \frac{100}{200} = 0.5$

13. A fax message is to be sent from Delhi to Washington via a geostationasy satellite. The minimum distance between the dispatch and it sgetting received is (Take height of the geostationary catellite=36000Km)

Ans: $72 \times 10^3 Km$

Sol: $s = 2h$

$= 2 \times 36000 Km$

$= 72000 Km$

$= 72 \times 10^3 Km$

14. A diode AM detector with the output circuit consisting of $R = 1k\Omega$ and $C = 1\mu F$ would be more suitable for detecting a carrier signal of

1) 0.1 KHz 2) 0.5 KHz 3) 1 KHz 4) 10 KHz

Ans: 4

Sol: $RC = \left(10^3 \Omega\right)\left(10^{-6} F\right) = 10^{-3} s$

For good detection (demodulation)

$$\frac{1}{\upsilon_C} << RC \text{ or } \upsilon_C >> \frac{1}{RC}$$

$$\upsilon_C >> \frac{1}{10^{-3}s} = 10^3 s^{-1} = 1\,kHz$$

$$i.e., \upsilon_C >> 1\,kHz$$

15. In a communication system operating at wavelength 800 nm, only one percent of source frequency is available as signal bandwidth . The number of channels accommodated for transmitting TV signals of bandwidth 6MHz are (Take velocity of light $c = 3\times10^8\, m/s$, $h = 6.6\times10^{-34}\, J/s$)

1) 3.75×10^6 2) 4.87×10^5 3) 6.25×10^5 4) 3.86×10^6

Ans: 3

Sol: $\lambda = 800nm, c = 3\times10^8\ m/s$

$$\Delta\upsilon = 6\ MHz = 6\times10^6\ Hz$$

Operating frequency,

$$\upsilon = \frac{c}{\lambda} = \frac{3\times10^8}{800\times10^{-9}} = \frac{3}{8}\times10^{15}\ Hz$$

Number of channels accommodated

$$= \frac{1\%\ of\ \upsilon}{\lambda} = \frac{\frac{3}{8}\times\frac{10^{15}}{10^2}}{6\times10^6} = \frac{1}{16}\times10^7 = 6.25\times10^5$$