POC

1. In a communication system operating at wavelength 800 nm, only one percent of source frequency is available as signal bandwidth. The number of channels accomodated for transmitting TV signals of band width 6 MHz are (Take velocity of light c = 3×10^8m/s, h = 6.6×10^{-34} J-s)

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

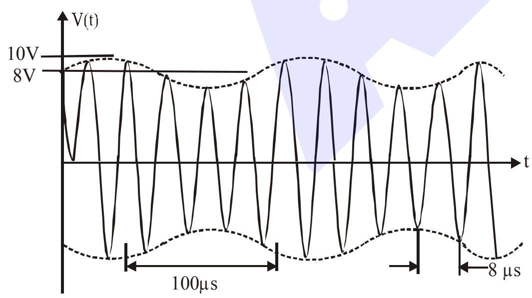
2. The modulation frequency of an AM radio station is 250 kHz, which is 10% of the carrier wave. If another AM station approaches you for license what broadcast frequency will you allot ?

(1) 2750 kHz (2) 2000 kHz
(3) 2250 kHz (4) 2900 kHz

3. A TV transmission tower has a height of 140 m and the height of the receiving antenna is 40 m. What is the maximum distance upto which signals can be broadcasted from this tower in LOS(Line of Sight) mode ?
(Given : radius of earth = 6.4×10^6m).

(1) 80 km (2) 48 km (3) 40 km (4) 65 km

4. An amplitude modulated signal is plotted below :-



Which one of the following best describes the above signal ?

(1) $(9 + \sin(2.5\pi \times 10^5 t)) \sin(2\pi \times 10^4 t)$V
(2) $(9 + \sin(4\pi \times 10^4 t)) \sin(5\pi \times 10^5 t)$V
(3) $(1 + 9\sin(2\pi \times 10^4 t)) \sin(2.5\pi \times 10^5 t)$V
(4) $(9 + \sin(2\pi \times 10^4 t)) \sin(2.5\pi \times 10^5 t)$V

5. An amplitude modulated signal is given by $V(t) = 10[1 + 0.3\cos(2.2 \times 10^4 t)]\sin(5.5 \times 10^5 t)$. Here t is in seconds. The sideband frequencies (in kHz) are, [Given π = 22/7]

(1) 1785 and 1715 (2) 892.5 and 857.5
(3) 89.25 and 85.75 (4) 178.5 and 171.5

6. To double the coverging range of a TV transmittion tower, its height should be multiplied by :-

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

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

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

8. In a line of sight radio communication, a distance of about 50 km is kept between the transmitting and receiving antennas. If the height of the receiving antenna is 70m, then the minimum height of the transmitting antenna should be : (Radius of the Earth = 6.4×10^6 m).

(1) 40 m (2) 51 m (3) 32 m (4) 20 m

9. The physical sizes of the transmitter and receiver antenna in a communication system are :-

(1) proportional to carrier frequency
(2) inversely proportional to modulation frequency
(3) inversely proportional to carrier frequency
(4) independent of both carrier and modulation frequency

10. A signal $A\cos\omega t$ is transmitted using $\nu_0 \sin \omega_0 t$ as carrier wave. The correct amplitude modulated (AM) signal is :

(1) $\nu_0 \sin\omega_0 t + A\cos\omega t$

(2) $\nu_0 \sin\omega_0 t + \frac{A}{2}\sin(\omega_0 - \omega)t + \frac{A}{2}\sin(\omega_0 + \omega)t$

(3) $(\nu_0 + A)\cos\omega t \sin\omega_0 t$

(4) $\nu_0 \sin[\omega_0(1 + 0.01A\sin\omega t)t]$

11. A message signal of frequency 100 MHz and peak voltage 100 V is used to execute amplitude modulation on a carrier wave of frequency 300 GHz and peak voltage 400 V. The modulation index and difference between the two side band frequencies are :

(1) 4; 1×10^8 Hz (2) 0.25; 1×10^8 Hz

(3) 4; 2×10^8 Hz (4) 0.25; 2×10^8 Hz

12. Given below in the the left column are different modes of communication using the kinds of waves given the right column.

A.	Optical Fibre communication	P.	Ultrasound
B.	Radar	Q.	Infrared Light
C.	Sonar	R.	Microwaves
D.	Mobile Phones	S.	Radio Waves

(1) A-S, B-Q, C-R, D-P

(2) A-R, B-P, C-S, D-Q

(3) A-Q, B-S, C-R, D-P

(4) A-Q, B-S, C-P, D-R

13. In an amplitude modulator circuit, the carrier wave is given by,

$C(t) = 4\sin(20000\,\pi t)$ while modulating signal is given by, $m(t) = 2\sin(2000\,\pi t)$. The values of modulation index and lower side band frequency are :

(1) 0.5 and 9 kHz (2) 0.5 and 10 kHz

(3) 0.3 and 9 kHz (4) 0.4 and 10 kHz

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

(1) 600 nm (2) 900 nm

(3) 2400 nm (4) 1500 nm

SOLUTION

1. Ans. (4)

$$f = \frac{3\times10^{8}}{8\times10^{-7}} = \frac{30}{8}\times10^{14}\,\text{Hz}$$

$= 3.75 \times 10^{14}$ Hz

1% of f = 0.0375×10^{14} Hz

= 3.75×10^{12} Hz = 3.75×10^{6} MHz

$$\text{number of channels} = \frac{3.75\times10^{6}}{6} = 6.25\times10^{5}$$

∴ correct answer is (4)

2. Ans. (2)

$$f_{carrier} = \frac{250}{0.1} = 2500\,\text{KHZ}$$

∴ Range of signal = 2250 Hz to 2750 Hz

Now check all options : for 2000 KHZ

f_{mod} = 200 Hz

∴ Range = 1800 KHZ to 2200 KHZ

3. Ans. (4)

Maximum distance upto which signal can be broadcasted is

$$d_{max} = \sqrt{2Rh_T} + \sqrt{2Rh_R}$$

where h_T and h_R are heights of transmiter tower and height of receiver respectively.

Putting all values -

$$d_{max} = \sqrt{2\times6.4\times106}\left[\sqrt{104}+\sqrt{40}\right]$$

on solving, d_{max} = 65 km

4. Ans. (4)

Analysis of graph says

(1) Amplitude varies as 8 – 10 V or 9 ± 1

(2) Two time period as

100 μs (signal wave) & 8 μs (carrier wave)

$$\text{Hence signal is } \left[9\pm1\sin\left(\frac{2\pi t}{T_1}\right)\right]\sin\left(\frac{2\pi t}{T_2}\right)$$

$= 9 \pm 1\sin(2\pi \times 10^{4}t)\sin 2.5\pi \times 10^{5}\, t$

5. Ans. (3)

$$V(t) = 10 + \frac{3}{2}\left[2\cos A\sin B\right]$$

$$= 10 + \frac{3}{2}\left[\sin(A+B) - \sin(A-B)\right]$$

$$= 10 + \frac{3}{2}\left[\sin(57.2\times10^{4}t) - \sin(52.8\times10^{4}t)\right]$$

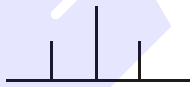
$\omega_1 = 57.2 \times 10^{4} = 2\pi f_1$

$$f_1 = \frac{57.2\times10^{4}}{2\times\left(\frac{22}{7}\right)} = 9.1\times10^{4}$$

$\simeq 91$ KHz

$$f_2 = \frac{52.8\times10^{4}}{2\times\left(\frac{22}{7}\right)}$$

$\simeq 84$ KHz



Side band frequency are

$$f_1 = f_c - f_w = \frac{52.8\times10^{4}}{2\pi} \approx 85.00\text{ kHz}$$

$$f_2 = f_c + f_w = \frac{57.2\times10^{4}}{2\pi} \approx 90.00\text{ kHz}$$

No answer matching but closest answer is option (3).

6. Ans. (2)

7. Ans. (1)

$E_m + E_c = 160$

$E_m + 100 = 160$

$E_m = 60$

$$\mu = \frac{E_m}{E_C} = \frac{60}{100}$$

$\mu = 0.6$

8. Ans. (3)

Sol. Range = $\sqrt{2Rh_T} + \sqrt{2Rh_R}$

$$50\times10^{3} = \sqrt{2\times6400\times10^{3}\times h_T} + \sqrt{2\times6400\times10^{3}\times70}$$

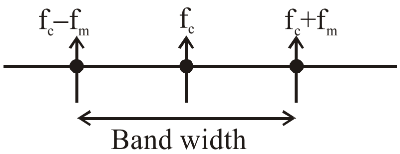
by solving h_T = 32 m

9. Ans. (3)

Sol. The physical size of antenna of reciver and transmitter both inversely proportional to carrier frequency.

10. Ans. (2)

Sol.



Option (2)

11. Ans. (4)

Sol. $f_m = 100\ \text{MHz} = 10^8\ \text{Hz}$, $(V_m)_0 = 100\text{V}$

$f_c = 300\ \text{GHz}$, $(V_c)_0 = 400\text{V}$

$$\text{Modulaton Index} = \frac{(V_m)_0}{(V_c)_0} = \frac{100}{400} = \frac{1}{4} = 0.25$$

Upper band frequency (UBF) = $f_c + f_m$

Lower band frequency (LBF) = $f_c - f_m$

$\therefore$ UBF – LBF = $2f_m = 2 \times 10^8$ Hz

12. Ans. (4)

Sol. Conceptual

13. Ans. (1)

Sol. Modulation index is given by

$$m = \frac{A_m}{A_c} = \frac{2}{4} = 0.5$$

& (a) carrier wave frequency is given by

$= 2\pi f_c = 2 \times 10^4\ \pi$

$f_c = 10$ kHz

(b) modulating wave frequency (f_m)

$2\pi f_m = 2000\ \pi$

$\Rightarrow f_m = 1$ kHz

lower side band frequency $\Rightarrow f_c - f_m$

$\Rightarrow$ 10 kHz – 1 kHz = 9 kHz

14. Ans. (4)

Sol. To minimise attenuation, wavelength of carrier waves is close to 1500 nm