POC

1. An audio signal $\nu_m = 20 \sin 2\pi (1500\ t)$ amplitude modulates a carrier
$\nu_C = 80 \sin 2\pi (100{,}000\ t)$.
The value of percent modulation is _____.

2. A signal of 0.1 kW is transmitted in a cable. The attenuation of cable is –5 dB per km and cable length is 20 km. The power received at receiver is 10^{-x} W. The value of x is _____.
[Gain in dB = $10 \log_{10}\left(\frac{P_0}{P_i}\right)$]

3. Given below are two statement :
Statement-I: A speech signal of 2 kHz is used to modulate a carrier signal of 1 MHz. The band width requirement for the signal is 4 kHz.
Statement-II : The side band frequencies are 1002 kHz. and 998 kHz.
In the light of the above statements, choose the correct answer from the options given below:
(1) Statement I is true but Statement II is false
(2) Statement I is false but Statement II is true
(3) Both Statement I and Statement II are true
(4) Both Statement I and Statement II are false

4. A transmitting station releases waves of wavelength 960 m. A capacitor of 2.56 μF is used in the resonant circuit. The self inductance of coil necessary for resonance is ____ $\times 10^{-8}$ H.

5. If a message signal of frequency 'f_m' is amplitude modulated with a carrier signal of frequency 'f_c' and radiated through an antenna, the wavelength of the corresponding signal in air is :

(1) $\frac{c}{f_c - f_m}$ (2) $\frac{c}{f_m}$

(3) $\frac{c}{f_c + f_m}$ (4) $\frac{c}{f_c}$

6. The maximum and minimum amplitude of an amplitude modulated wave is 16V and 8V respectively. The modulation index for this amplitude modulated wave is x × 10^{-2}. The value of x is_____.

7. If the highest frequency modulating a carrier is 5 kHz, then the number of AM broadcast stations accommodated in a 90 kHz bandwidth are .....

8. A 25 m long antenna is mounted on an antenna tower. The height of the antenna tower is 75 m. The wavelength (in meter) of the signal transmitted by this antenna would be :
(1) 300 (2) 400 (3) 200 (4) 100

9. Two identical antennas mounted on identical towers are separated from each other by a distance of 45 km. What should nearly be the minimum height of receiving antenna to receive the signals in line of sight ? (Assume radius of earth is 6400 km)
(1) 19.77 m (2) 39.55 m
(3) 79.1 m (4) 158.2 m

10. For VHF signal broadcasting, ____ km^2 of maximum service area will be covered by an antenna tower of height 30m, if the receiving antenna is placed at ground. Let radius of the earth be 6400 km. (Round off to the Nearest Integer) (Take π as 3.14)

11. A carrier signal C(t) = 25 sin (2.512×10^{10} t) is amplitude modulated by a message signal m(t) = 5 sin (1.57×10^8 t) and transmitted through an antenna.What will be the bandwidth of the modulated signal ?
(1) 8 GHz (2) 2.01 GHz
(3) 1987.5 MHz (4) 50 MHz

12. Match List–I with List–II.

List–I
(a) 10 km height over earth's surface
(b) 70 km height over earth's surface
(c) 180 km height over earth's surface
(d) 270 km height over earth's surface

List–II
(i) Thermosphere
(ii) Mesosphere
(iii) Stratosphere
(iv) Troposphere

(1) (a)–(iv), (b)–(iii), (c)–(ii), (d)–(i)
(2) (a)–(i), (b)–(iv), (c)–(iii), (d)–(ii)
(3) (a)–(iii), (b)–(ii), (c)–(i), (d)–(iv)
(4) (a)–(ii), (b)–(i), (c)–(iv), (d)–(iii)

13. A TV transmission tower antenna is at a height of 20 m. Suppose that the receiving antenna is at.
(i) ground level
(ii) a height of 5 m.
The increase in antenna range in case (ii) relative to case (i) is n%.
The value of n, to the nearest integer, is .

14. A carrier wave $V_C(t) = 160 \sin (2\pi \times 10^6 t)$ volts is made to vary between V_{max} = 200 V and V_{min} = 120 V by a message signal $V_m(t) = A_m \sin(2\pi \times 10^3 t)$ volts. The peak voltage A_m of the modulating signal is _____.

15. What should be the height of transmitting antenna and the population covered if the television telecast is to cover a radius of 150 km ? The average population density around the tower is 2000/km^2 and the value of $R_e = 6.5 \times 10^6$ m.
(1) Height = 1731 m
Population Covered = 1413×10^5
(2) Height = 1241 m
Population Covered = 7×10^5
(3) Height = 1600 m
Population Covered = 2×10^5
(4) Height = 1800 m
Population Covered = 1413×10^8

16. In amplitude modulation, the message signal $V_m(t) = 10 \sin (2\pi \times 10^5 t)$ volts and
Carrier signal
$V_C(t) = 20 \sin (2\pi \times 10^7 t)$ volts
The modulated signal now contains the message signal with lower side band and upper side band frequency, therefore the bandwidth of modulated signal is α kHz. The value of α is :
(1) 200 kHz (2) 50 kHz
(3) 100 kHz (4) 0

17. A message signal of frequency 20 kHz and peak voltage of 20 volt is used to modulate a carrier wave of frequency 1 MHz and peak voltage of 20 volt. The modulation index will be :

18. The amplitude of upper and lower side bands of A.M. wave where a carrier signal with frequency 11.21 MHz, peak voltage 15 V is amplitude modulated by a 7.7 kHz sine wave of 5V amplitude are $\frac{a}{10}$V and $\frac{b}{10}$V respectively. Then the value of $\frac{a}{b}$ is _____.

19. The maximum amplitude for an amplitude modulated wave is found to be 12V while the minimum amplitude is found to be 3V. The modulation index is 0.6x where x is _____.

20. An amplitude modulated wave is represented by $C_m(t) = 10(1 + 0.2 \cos 12560t) \sin(111 \times 10^4 t)$ volts.
The modulating frequency in kHz will be ..... .

21. A transmitting antenna at top of a tower has a height of 50 m and the height of receiving antenna is 80 m. What is range of communication for Line of Sight (LoS) mode ? [use radius of earth = 6400 km]
(1) 45.5 km (2) 80.2 km
(3) 144.1 km (4) 57.28 km

22. A transmitting antenna has a height of 320 m and that of receiving antenna is 2000 m. The maximum distance between them for satisfactory communication in line of sight mode is 'd'. The value of 'd' is ..... km.

23. An antenna is mounted on a 400 m tall building. What will be the wavelength of signal of signal that can be radiated effectively by the transmission tower upto a range of 44 km?
(1) 37.8 m (2) 605 m
(3) 75.6 m (4) 302 m

24. If the sum of the heights of transmitting and receiving antennas in the line of sight of communication is fixed at 160 m, then the maximum range of LOS communication is _____km. (Take radius of Earth = 6400 km)

25. A bandwidth of 6 MHz is available for A.M. transmission. If the maximum audio signal frequency used for modulating the carrier wave is not to exceed 6 kHz. The number of stations that can be broadcasted within this band simultaneously without interfering with each other will be_____.

26. A carrier wave with amplitude of 250 V is amplitude modulated by a sinusoidal base band signal of amplitude 150 V. The ratio of minimum amplitude to maximum amplitude for the amplitude modulated wave is 50 : x, then value of x is .....

SOLUTION

1. Official Ans. by NTA (25)

Sol. % modulation = $\frac{Am}{Ac} \times 100$

% modulation = $\frac{20}{80} \times 100$

% modulation = 25%

Ans 25

2. Official Ans. by NTA (8)

Sol. Sound level decreases by 5dB every km so sound level decreased in 20 km = 100 dB

$\beta_2 - \beta_1 = 10\log_{10}\frac{I_2}{I_1}$

$-100 = 10\log_{10}\frac{I_2}{I_1} \Rightarrow \frac{I_1}{I_2} = 10^{10}$

$I_2 = 10^{-10} I_1 \Rightarrow P_2 = 10^{-10} P_1 = 10^{-8}$ W

x = 8 $\boxed{\text{Ans. 8}}$

3. Official Ans. by NTA (3)

Sol. f_m = 2kHz

f_c = 1MHz = 1000 kHz

Band width = $2f_m$ = 4kHz

∴ Side frequencies will be

= $f_c \pm f_m$

= (1000 ± 2) kHz

= 998 kHz & 1002 kHz

So statement-I & statement-II both are correct.

4. Official Ans. by NTA (10)

Sol. λ = 960 m

C = 2.56 μF = 2.56×10^{-6} F

c = 3×10^8 m/s

L = ?

Now at resonance, $\omega_0 = \frac{1}{\sqrt{LC}}$

[Resoant frequency]

$2\pi f_0 = \frac{1}{\sqrt{LC}}$

On substituting $f_0 = \frac{c}{\lambda}$, we have $2\pi\frac{c}{\lambda} = \frac{1}{\sqrt{LC}}$

Squaring both sides : $4\pi^2\frac{c^2}{\lambda^2} = \frac{1}{LC}$

$= \frac{4\times10\times(3\times10^8)^2}{(960)^2} = \frac{1}{L\times2.56\times10^{-6}}$

$\Rightarrow \frac{1}{L} = \frac{4\times10\times9\times10^{16}\times2.56\times10^{-6}}{960\times960}$

$\Rightarrow$ L = 10×10^{-8} H

5. Official Ans. by NTA (4)

Sol. (4) $\lambda = \frac{v}{f} = \frac{c}{f_c}$

6. Official Ans. by NTA (33)

Sol. Modulation index = $\frac{A_{max} - A_{min}}{A_{max} + A_{min}}$

$= \frac{16-8}{16+8} = \frac{8}{24} = \frac{1}{3} = 0.33$

$x \times 10^{-2} = 0.33$

x = 33

7. Official Ans. by NTA (9)

Sol. B. W. (Bandwidth) = 2 × maximum frequency at modulating signal

= 2 × 5kHz = 10 kHz

∴ No of stations accommodate

= $\frac{90}{10} = 9$

8. Official Ans. by NTA (4)

Sol. Length of Antena = 25m = $\frac{\lambda}{4}$

$\Rightarrow \boxed{\lambda = 100\,m}$

9. Official Ans. by NTA (2)

Sol. D = $2\sqrt{2Rh}$

h = $\frac{D^2}{8R} = \frac{45^2}{8\times6400}$ km $\cong$ 39.55 m

10. Official Ans. by NTA (1206)

Sol. d = $\sqrt{2Rh}$

A = πd^2

A = $\pi 2Rh$

= $3.14 \times 2 \times 6400 \times \frac{30}{1000}$

A = 1205.76 km²

A ≃ 1206 km²

11. Official Ans. by NTA (4)

Sol. (4) Band width = 2 f_m

$\omega_m = 1.57 \times 10^8 = 2\pi f_m$

BW = $2f_m = \frac{10^8}{2}$ Hz = 50 MHz

12. Official Ans. by NTA (1)

Sol. Order of atmosphere stratification from bottom Troposphere, stratosphere, Mesosphere, Thermosphere

(a) → (iv)

(b) → (iii)

(c) → (ii)

(d) → (i)

13. Official Ans. by NTA (50)

Sol. Range = $\sqrt{2Rh}$

Range (i) = $\sqrt{2Rh}$

Range (ii) = $\sqrt{2Rh} + \sqrt{2Rh'}$

where h = 20 m & h' = 5m

$$\text{Ans} = \frac{\sqrt{2Rh'}}{\sqrt{2Rh}} \times 100\% = \frac{\sqrt{5}}{\sqrt{20}} \times 100\% \quad = 50\%$$

14. Official Ans. by NTA (40)

Sol. Maximum amplitude

$A_{max} = A_m + A_C$

$\Rightarrow V_{max} = V_m + V_C$

$200 = V_m + 160$

$V_m = 40$

$\therefore$ Peak voltage $A_m = 40$

Ans. 40

15. Official Ans. by NTA (1)

Sol. Radius covered r = $\sqrt{2RH_T}$

$$150 \text{ km} = \sqrt{2 \times (6.5 \times 10^6 \text{m}) H_T}$$

$(150 \text{ km} \times 10^3)^2 = 2 \times 6.5 \times 10^6 \, H_T$

$H_T = 1731\text{m}$

Population covered = $(\pi r^2)(2000/\text{km}^2)$

$= 3.14 \times (150)^2 \times 2000 = 1413 \times 10^5$

16. Official Ans. by NTA (1)

Sol. Bandwidth = $2 \times f_m$

$= 2 \times 10^5$ HZ = 200 KHZ

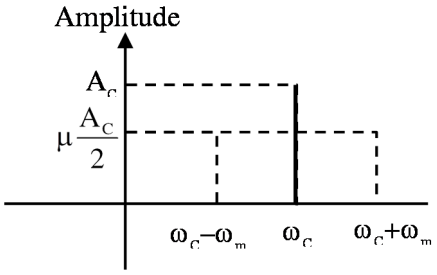
17. Official Ans. by NTA (1)

Sol. Modulation index

$$\mu = \frac{A_m}{A_c} = \frac{20}{20} = 1$$

18. Official Ans. by NTA (1)

Sol.



$$\frac{a}{10} = \frac{b}{10} = \frac{\mu A_C}{2}$$

$$\Rightarrow \frac{a}{b} = 1$$

19. Official Ans. by NTA (1)

Sol. $A_{max} = A_c + A_m = 12$

$A_{min} = A_c - A_m = 3$

$\Rightarrow A_c = \frac{15}{2}$ & $A_m = \frac{9}{2}$

$$\text{modulation index} = \frac{A_m}{A_c} = \frac{9/2}{15/2} = 0.6$$

$\Rightarrow x = 1$

20. Official Ans. by NTA (2)

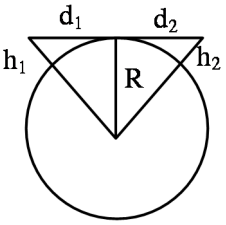
Sol. $W_m = 12560 = 2\pi f_m$

$$f_m = \frac{12560}{2\pi} = 2000 \text{ Hz}$$

Ans. 2.00

21. Official Ans. by NTA (4)

Sol.



$d_t = \sqrt{2Rh_1} + \sqrt{2Rh_2}$

$= \sqrt{2R}\left(\sqrt{h_1} + \sqrt{h_2}\right)$

$= (2 \times 6400 \times 10^3)^{1/2}\left(\sqrt{50} + \sqrt{80}\right)$

= 3578 (7.07 + 8.94) = 57.28 Km

22. Official Ans. by NTA (224)

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

$$d_m = \left(\sqrt{2 \times 6400 \times 10^3 \times 320} + \sqrt{2 \times 6400 \times 10^3 \times 2000}\right)\text{m}$$

$\boxed{d_m = 224\text{km}}$

23. Official Ans. by NTA (2)

Sol. h : height of antenna

λ : wavelength of signal

$h < \lambda$

$\lambda > h$

$\lambda > 400$ m

24. Official Ans. by NTA (64)

Sol. $h_T = h_R = 160$ … (i)

$$d = \sqrt{2Rh_T} + \sqrt{2Rh_R}$$

$$d = \sqrt{2R}\left[\sqrt{h_T} + \sqrt{h_R}\right]$$

$$d = \sqrt{2R}\left[\sqrt{x} + \sqrt{160 - x}\right]$$

$$\frac{d(d)}{dx} = 0$$

$$\frac{1}{2\sqrt{x}} + \frac{1(-1)}{2\sqrt{160-x}} = 0$$

$$\frac{1}{\sqrt{x}} = \frac{1}{\sqrt{160-x}}$$

$x = 80$ m

$$d_{max} = \sqrt{2\times 6400}\left[\sqrt{\frac{80}{1000}} + \sqrt{\frac{20}{1000}}\right]$$

$$= \frac{80\sqrt{2}\times 2\sqrt{80}}{10\sqrt{10}}$$

$$= 8\times 2\times\sqrt{2}\times 2\sqrt{2} = 64 \text{ km}$$

25. Official Ans. by NTA (500)

Sol. Signal bandwidth = 2 fm

= 12 kHz

$$\therefore N = \frac{6MHZ}{12kHZ} = \frac{6\times 10^6}{12\times 10^3} = 500$$

26. Official Ans. by NTA (200)

Sol. $A_{max} = A_C + A_m = 250 + 150 = 400$

$A_{min} = A_C - A_m = 250 - 150 = 100$

$$\frac{A_{min}}{A_{max}} = \frac{100}{400} = \frac{1}{4} = \frac{50}{200}$$

$x = 200$