COMMUNICATION SYSTEM

PHYSICS

1. The velocity factor of a transmission line 'x' If dielectric constant of the medium is 2.6, the value of 'x' is

   1) 0.26 2) 0.62 3) 2.6 4) 6.2

2. A step index fiber has a relative refractive index of 0.88%. What is the critical angle at the core-cladding interface ?

   1) 60^0 2) 75^0 3) 45^0 4) None of these

3. A laser beam of pulse power 10^{12} watt is focused on an object are $10^{-4}\ cm^2$. The energy flux in watt/ cm^2 at the point of focus is

   1) 10^{20} 2) 10^{16} 3) 10^{8} 4) 10^{4}

4. The carrier frequency generated by a tank circuit containing 1nf capacitor and $10\mu H$ inductor is

   1) $1592 Hz$ 2) $1592 MHz$ 3) $1592 KHz$ 4) $159.2 Hz$

5. An oscillator is producing FM waves of frequency $2\,KHz$ with a variation of $10\,KHz$. What is the modulating index?

   1) 0.20 2) 5.0 3) 0.67 4) 1.5

6. The maximum peak to peak voltage of an AM wire is 24mV and the minimum peak to peak voltage is 8mV. The modulation factor is

   1) 10% 2) 20% 3) 25% 4) 50%

7. The audio signal used to modulate $60\ \sin\left(2\pi\times10^6 t\right)$ is $150\sin 300\pi t$. The depth of modulation is

   1) 50% 2) 40% 3) 25% 4) 15%

8. An optical fiber communication system works on a wavelength of 1.3 μm. The number of subscribers it can feed if a channel required 20 kHz are

   1) 2.3×10^{10} 2) 1.15×10^{10} 3) 1×10^{5} 4) None of these

9. The electron density of E, F_1, F_2 layers of ionosphere is $2\times10^{11}, 5\times10^{11}$ *and* $8\times10^{11} m^{-3}$ respectively. What is the ratio of critical frequency for reflection of radiowavs

   1) 2:4:3 2) 4:3:2 3) 2:3:4 4) 3:2:4

10. A antenna current of an AM broadcast transmitter modulated by 50% is 11A. The carrier current is

    1) 10.35A 2) 9.25A 3) 10A 4) 5.5A

11. A transmitter transmits a power of 10kW when modulation is 50% power of carrier wave is

    1) 5 kW 2) 8.89 kW 3) 14 kW 4) 5.7 kW

12. A telephone link operating at a central frequency of 10 GHz is established .If 1% this is available then how many telephone channel can be simultaneously given when each telephone covering a bandwidth of 5 kHz

    1) 2×10^4 2) 2×10^6 3) 5×10^4 4) 5×10^6

13. In AM, the cent percent modulation is achieved when

1) Carrier amplitude $=$ signal amplitude 2) Carrier amplitude $\neq$ signal amplitude
3) Carrier frequency $=$ signal frequency 4) Carrier frequency $\neq$ signal frequency

14. The frequency deviation in a FM transmission is 18.75 KHz. If it broadcasts in 88-108 MHz. band, then the percentage modulation is

1) 10% 2) 25% 3) 50% 4) 75%

15. An AM-signal is given as $x_{AM}(t) = 100[p(t) + 0.5g(t)]\cos\omega_c t$ in interval $0 \le t \le 1$. One set of possible values of the modulating signal and modulation index would be

1) t,0.5 2) t,1.0 3)t,1.5 4) $t^2, 2.0$

16. For good demodulation of AM signal of carrier frequency f, the value of RC should be

1) $RC = \frac{1}{f}$ 2) $RC < \frac{1}{f}$ 3) $RC \ge \frac{1}{f}$ 4) $RC >> \frac{1}{f}$

17. An audio signal represented as 25 sin $2\pi(2000t)$ amplitude modulated by a carrier wave :60 sin $2\pi(100{,}000)t$. The modulation index of the modulated signal is

1) 25% 2) 41.6% 3) 50% 4) 75%

18. A radio transmits at 830kHz. At a certain distance from the transmitter magnetic field has amplitude $4.82 \times 10^{-11} T$. The electric field and the wavelength are respectively

1) 0.014 N/C, 36m 2) 0.14 N/C, 36m
3) 0.14 N/C, 360m 4) 0.014 N/C, 360m

19. Which of the following statement is NOT correct?

1) Ground wave signals are more stable than the sky wave signals.
2) The critical frequency of an ionospheric layer is the highest frequency that will be reflected back by the layer when it is vertically incident
3) Electromagnetic waves of frequencies higher than about 30 MHz cannot penetrate the ionosphere
4) Sky wave signals in the broadcast frequency range are stronger at night than in the day time

20. If a carrier wave $c(t) = A\sin\omega_c t$ is amplitude modulated by a modulator signal $m(t) = A\sin\omega_m t$ then equation of modulated signal $[C_m(t)]$ and its modulation index are respectively

1) $C_m(t) = A(1+\sin\omega_m t)\sin\omega_c \text{ t } and\ 2$ 2) $C_m(t) = A(1+\sin\omega_m t)\sin\omega_m \text{ t } and\ 1$
3) $C_m(t) = A(1+\sin\omega_m t)\sin\omega_c \text{ t } and\ 1$ 4) $C_m(t) = A(1+\sin\omega_c t)\sin\omega_m \text{ t } and\ 2$

21. Calculate the power developed by an amplitude wave in a load resistance of $100\,\Omega$, if the peak voltage of carrier wave is 100V and modulation index is 0.4

1) 50watt 2) 54 watt 3) 104 watt 4) 4 watt

22. Consider the following amplitude modulated (AM) signal, where $f_m < B$

$x_{AM}(t) = 10(1 + 0.5\sin 2\pi f_m t)\cos 2\pi f_c t$ The average side-band power for the AM signal given above is

1) 25 2) 12.5 3) 6.25 4) 3.125

23. An antenna has a radiation resistance of $68\,\Omega$, a load resistance of $10\,\Omega$, and power gain of 16. The directive gain of the antenna is

1) 15 2) 16.02 3) 17.08 4) 18.35

24. A 1000kHz carrier wave is modulated by an audio signal of frequency range 100-5000Hz. Then the width of the channel in kHz is

1) 10 2) 20 3) 30 4) 40

25. An amplitude modulated voltage is expressed as $e = 10(1+0.8\cos 2000\pi t)\cos 3\times10^6\pi t$ volt. The peak voltage (in Volts) of carrier wave is

1) 20 2) 10 3) 30 4) 50

26. A broadcast radio transmitter radiates 12 kW when percentage of modulation is 50% then the un modulated carrier power $(in\,kW)$

1) 10.6 2) 12.6 3) 9.6 4) 11.6

27. Audio sine waves of 3 kHz frequency are used to amplitude modulate a carrier signal of 1.5 MHz. Which of the following statements are true?

a) The side band frequency are 1506 kHz and 1494 kHz

b) The bandwidth required for amplitude modulation is 6 kHz

c) The bandwidth required for amplitude is 3 MHz

d) The side band frequency are 1503 kHz and 1497kHz

1) a and b 2) b and d 3) a, b and d 4) all of the above

28. The height of a TV antenna is 200m. The population density is 4000 km^{-2} .Find the population benefitted

1) 3.2×10^8 2) 3.2×10^7 3) 3.2×10^6 4) 3.2×10^5

29. A ground receiver station is receiving a signal at 5 MHz and transmitted from a ground transmitter at a height of 300 m, located at a distance of 100 km from the receiver station. The signal is coming via $\left(Radius\ of\ earth = 6.4\times10^6 m\right)$. $N_{\max}$ $is\,ionosphere = 10^{12} m^3$

1) Space wave propagation 2) Ground wave propagation

3) Sky wave propagation 4) None of the above

30. In amplitude modulation, the modulation index m, is kept less than or equal to 1 because

a) $m>1$, will result in interference between carrier frequency and message frequency, resulting into distortion

b) $m>1$ will result in overlapping of both side bands resulting into loss of information

c) $m>1$ will result in change in phase between carrier signal and message signal

d) $m>1$ indicates amplitude of massage signal greater than amplitude of carrier signal resulting into distortion

1) a and d 2) c and d

3) b and c 4) b and d

PHYSICS

1-10	**2**	**4**	**2**	**3**	**2**	**4**	**3**	**2**	**3**	**1**
11-20	**2**	**1**	**1**	**2**	**1**	**4**	**2**	4	3	3
21-30	2	3	4	1	2	3	2	2	3	4

SOLUTIONS

1. $Velocity\ \ factor = \frac{1}{\sqrt{k}} = \frac{1}{\sqrt{2.6}} = 0.26$

2. $Here\ \frac{n_1 - n_2}{n_1} = \frac{0.88}{100} \Rightarrow \frac{n_2}{n_1} = 0.9912$

$\therefore Critical\ \ angle.$

$$\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right) = \sin^{-1}\left(0.9912\right) = 84^0 24^0$$

3. The energy flux, $\phi = \frac{Pulse\ \ power}{Area} = \frac{10^{12}}{10^{-4}} = 10^{16}\ \frac{W}{cm^2}$

4. $v = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\times 3.14\sqrt{10\times 10^{-6}\times 1\times 10^{-9}}} = 1592kHz$

5. The formula for modulating index is given by

$$m_f = \frac{\delta}{v_m} = \frac{Frequency\ \mathrm{var}\,iation}{Modulating\ \ freequency} = \frac{10\times 10^3}{2\times 10^3} = 5$$

6. $Here\ V_{\max} = \frac{24}{2} = 12mV\ \ and\ V_{\min} = \frac{8}{2} = 2mV$

$$Now\ m = \frac{V_{\max} - V_{\min}}{V_{\max} + V_{\min}} = \frac{12-4}{12+4} = \frac{8}{16} = \frac{1}{2} = 0.5 = 50\%$$

7. $m_a = \frac{E_m}{E_c} = \frac{15}{60}\times 100 = 25\%$

8. Optical source frequency $f = \frac{c}{\lambda} = \frac{3\times 10^8}{1.3\times 10^{-6}} = 2.3\times 10^{14}\,Hz$

Numbers of channels are subscribers $= \frac{2.3\times 10^{14}}{20\times 10^3}$

$= 1.15\times 10^{10}$

9. $f_c \propto \left(N\right)^{1/2}$

$\Rightarrow \left(f_c\right)_E : \left(f_c\right)_{F_1} : \left(f_c\right)_{F_2}$

$= \left(2\times 10^{11}\right)^{1/2} : \left(5\times 10^{11}\right)^{1/2} : \left(8\times 10^{11}\right)^{1/2}$

$= 2:3:4$

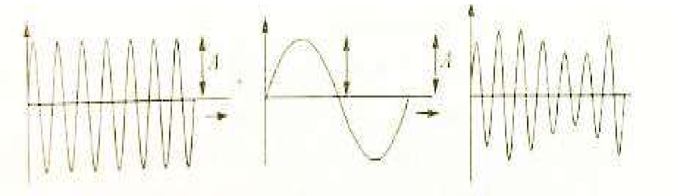
10. $l_{carrier} = \frac{I_{rms}}{\sqrt{1+\frac{m_a^2}{2}}} = \frac{11}{\sqrt{1+\frac{\left(0.5\right)^2}{2}}} = 10.35A$

11. $P_c = \frac{P}{\left(1+\frac{m_a^2}{2}\right)} = \frac{10000}{\left(1+\frac{\left(0.5\right)^2}{2}\right)} = \frac{10000}{1.125} = 8.89kW$

12. $1\%\,of\ 10GHz = 10\times 10^9 \times \frac{1}{100} = 10^8\,Hz$

$$Number\ \ of\ \ channels = \frac{10^8}{5\times 10^3} = 2\times 10^4$$

13. When signal amplitude is equal to the carrier amplitude, the amplitude of carrier wave varies between 2A and zero



$$m_c = \frac{\text{amplitude } charge\ of\ carrier}{\text{amplitude } of\ normal\ carrier} = \frac{2A - A}{A} \times 100 = 100\%$$

14. For given transmission band 88-108 $MHz(\Delta f)_{\max}$

$= 75$ kHz

$given\ (\Delta f)_{actual} = 18.75kHz$

$$\therefore \%\text{mod}\,ulation\ m = \frac{(\Delta f)_{actual}}{(\Delta f)_{\max}} \times 100 = \frac{18.75}{75} = 25\%$$

15. Comparing $(X_{AM})t = 100[1 + 0.5t]\cos\omega_c t\ \ for\ 0 < t < 1$

With standard AM signal $x_{AM} = E_c[1 + m_a \cos\omega_m t]\cos\omega_c t$

We have modulating signal $t\ and\ , m_a = 0.5$

16. For good demodulation

$$\frac{1}{f} << RC\ or\ RC >> \frac{1}{f}$$

17. Modulation index $= \dfrac{B}{A}$

$B = 25, A = 60$

$$\Rightarrow M.I = \frac{25}{60} = 0.416 \Rightarrow m\% = 41.6\%$$

18. Frequency of EM wave $\nu = 830\ kHz$

$= 830 \times 10^3 Hz$

Magnetic field $B = 4.82 \times 10^{-11} T$

As we know, frequency, $\nu = \dfrac{c}{\lambda}$

$$or\ \lambda = \frac{c}{\nu} = \frac{3 \times 10^8}{830 \times 10^3}$$

$\lambda = 360\ m$

$And\ E = BC = 4.82 \times 10^{-11} \times 3 \times 10^8$

$= 0.014\ N/C$

19. Above critical frequency (f_c), an electromagnetic wave penetrates the ionosphere and is not reflected by it.

20. Modulation index

$$m_a = \frac{E_m}{E_c} = \frac{A}{A} = 1$$

Equation of modulated signal $[C_m(t)]$

$= E_{(C)} + m_a E_{(C)} \sin \omega_m t$

$= A\left(1+\sin \omega_m t\right) \sin \omega_C t$

$\left(As\ E_{(C)} = A \sin \omega_C t\right)$

21. $E_c = 100V, m_a = 0.4, R = 100\Omega,$

$$P_c = \frac{E_c^{\ 2}}{2R} = \frac{(100)^2}{2\times 100} = 50\ watt$$

$$P = \left(1+\frac{m_a^{\ 2}}{2}\right)P_c = \left[1+\frac{(0.4)^2}{2}\right]\times 50 = 54\ watt$$

22. Average side-band power $P_{av} = \frac{m_a}{4} P_c^2$

$Here\ m_a = 0.5$

$P_c = 10$

$$\therefore P_{av} = \frac{0.5\times 10\times 10}{4} = 6.25$$

23. $\eta = \frac{R}{R+R_L} = \frac{68}{68+10} 0.872$

$\Rightarrow Power\ gain = \eta G$

$$\Rightarrow directive\ gain\ G = \frac{Power\ gain}{\eta} = \frac{16}{0.872} = 18.35$$

24. Band width

$= 2\times frequency$

$= 2\times 5000$

$= 10kHz$

25. Comparing given expression with

$(e)_{AM} = E_c\left(1+m_a \cos \omega_m t\right)\cos \omega_c t$

Peak value of carrier wave, $E_c = 10V$.

26. $P_c = \frac{P_t}{1+\frac{m_a^2}{2}} = \frac{12}{1+\frac{(0.5)^2}{2}} = \frac{12}{1.25} = 9.6\ kW$

27. $\omega_m = 3\ kHz, \omega_c = 1.5MHz = 1500\ kHz$

$side\ band\ \ frequences = \left(\omega_c - \omega_m\right)\ and\ \left(\omega_c + \omega_m\right)$

$= (1500-3)kHz\ and\ (1500+3)kHz$

$= 1497\ kHz\ and\ 1503\ kHz$

$Bandwidth = 2\omega_m = 2\times 3 = 6\ kHz$

28. $As, d = \sqrt{2Rh}$

$Population \operatorname{cov} ered = \pi d^2 \times population\ density$

$= \pi(2Rh)\times \rho$

$$= \frac{22}{7} \times 2 \times 6400 \times 0.2 \times 400$$

$$= 3.2 \times 140^7$$

29. Maximum distance covered by space wave communication

$\sqrt{2Rh} = 62km$

Critical frequency $\nu_c = 9\left(N_{\max}\right)^{1/2} = 9\,MHz$

$5MHz < \nu_c \Rightarrow sky\ wave\ propagation,\ i.e.,\ ionospheric\ propagation$

30. Modulation index

$$\mu = \frac{A_m}{A_c} = \frac{\Delta V_{(\max)}}{V_{m\ (\max)}} = \frac{frequency\ deviation}{\max.frequency\ of\ \text{mod}ulated\ wave}$$

If $m_f > 1\ then\, \Delta V_{\max} > V_m$. this means there will be overlapping of both side bands of modulated wave resulting into loss of information.