NCERT SOLUTIONS
PHYSICS XII CLASS
CHAPTER - 15
COMMUNICATION SYSTEMS

15.1 Which of the following frequencies will be suitable for beyond-the-horizon communication using sky waves?
(a) 10 kHz (b) 10 MHz (c) 1 GHz (d) 1000 GHz

Sol. **(b).** 10 kHz cannot be radiated due to the problem of size of antenna. 1 GHz and 1000 GHz will penetrate.

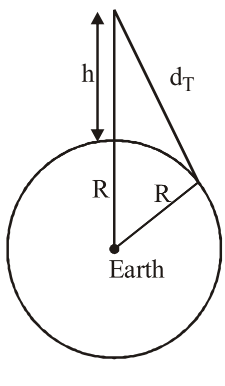
15.2 Frequencies in the UHF range normally propagate by means of:
(a) Ground waves. (b) Sky waves.
(c) Surface waves. (d) Space waves.

Sol. **(d).** Reason : Propagation of waves in ultra light frequency range is possible by space waves.

15.3 Digital signals
(i) do not provide a continuous set of values,
(ii) represent values as discrete steps,
(iii) can utilize binary system, and
(iv) can utilize decimal as well as binary systems.
Which of the above statements are true?
(a) (i) and (ii) only (b) (ii) and (iii) only
(c) (i), (ii) and (iii) but not (iv) (d) All of (i), (ii), (iii) and (iv).

Sol. **(c).** Reason : Decimal system involves continuous set of values.

15.4 Is it necessary for a transmitting antenna to be at the same height as that of the receiving antenna for line-of-sight communication? A TV transmitting antenna is 81m tall. How much service area can it cover if the receiving antenna is at the ground level?



Sol. No.

$$d_T^2 = (R+h)^2 - R^2$$

$$= R^2\left[\left(1+\frac{h}{R}\right)^2 - 1\right] = R^2\left[1+\frac{2h}{R} - 1\right] = R^2\frac{2h}{R} = 2h.R$$

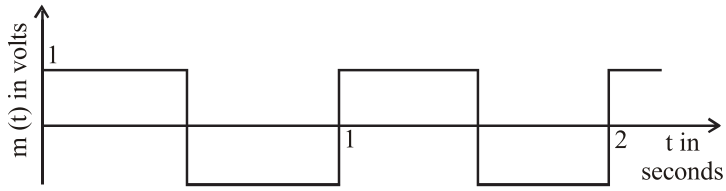
Service area will be $A = \pi\,(d_T)^2 = \frac{22}{7}\times(2hR) = \frac{22}{7}\times 2\times 81\times 6.4\times 10^6 = 3258\ km^2$.

15.5 A carrier wave of peak voltage 12V is used to transmit a message signal. What should be the peak voltage of the modulating signal in order to have a modulation index of 75%?

Sol. $\mu = 0.75 = \frac{A_m}{A_c}$

Hence, $0.75\ A_c \Rightarrow A_m = 0.75 \times 12V = 9V$

15.6 A modulating signal is a square wave, as shown in figure.

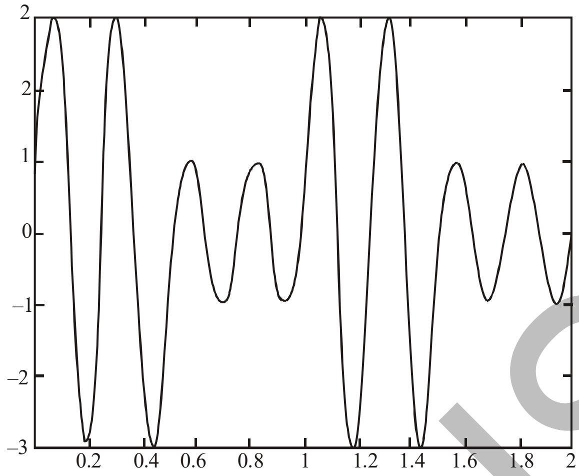


The carrier wave is given by c (t) = 2sin ($8\pi t$) volts.

(i) Sketch the amplitude modulated waveform

(ii) What is the modulation index?

Sol. (i)



(ii) $\mu = 0.5$

15.7 For an amplitude modulated wave, the maximum amplitude is found to be 10V while the minimum amplitude is found to be 2V. Determine the modulation index, μ.
What would be the value of ì if the minimum amplitude is zero volt?

Sol. The AM wave is given by $(A_c + A_m \sin \omega_m t) \cos \omega_c t$.

The maximum amplitude is $M_1 = A_c + A_m$ while the minimum amplitude is $M_2 = A_c - A_m$.

Hence, the modulation index is $\mu = \dfrac{A_m}{A_c} = \dfrac{M_1 - M_2}{M_1 + M_2} = \dfrac{8}{12} = \dfrac{2}{3}$

With $M_2 = 0$, clearly, $\mu = 1$, irrespective of M_1.

15.8 Due to economic reasons, only the upper sideband of an AM wave is transmitted, but at the receiving station, there is a facility for generating the carrier. Show that if a device is available which can multiply two signals, then it is possible to recover the modulating signal at the receiver station.

Sol. The received signal is given by $A_1 \cos (\omega_c + \omega_m) t$

The carrier $A_c \cos \omega_c t$ is available at the receiving station.

By multiplying the two signals, we get

$$A_1 A_c \cos (\omega_c + \omega_a) t \cos \omega_c t = \frac{A_1 A_c}{2} [\cos (2\omega_c + \omega_m) t + \cos \omega_m t]$$

If this signal is passed through a low-pass filter, the modulating signal, which is recorded is given by

$$\frac{A_1 A_c}{2} \cos \omega_m t.$$