TOPIC : PRINCIPLES OF COMMUNICATION
EXERCISE # 1

5. $h = \lambda = \frac{c}{\nu} = 3\times10^8/10^6 = 300$ m

$\ell_{min} \simeq \frac{\pi}{4} = \frac{300}{4} = 75\text{m}$

6. Three types of modulation are amplitude, frequency and phase modulation.

9. To avoid corruption of transmitted signal modulation is kept < 100%.

11. $C_m(t) = (A_c + A_m \sin \omega_m t) \sin \omega_c t$

$= A_c \sin \omega_c t + \frac{\mu A_c}{2} \cos (\omega_c - \omega_m)t$

$- \frac{\mu A_c}{2} \cos (\omega_c + \omega_m)t$

12. $P_c = \frac{E^2_{rms}}{R} = \frac{E_c^2}{2R}$

15. Nose is generally audio (20 to 20 kHz)

17. $\Delta\omega = 2\omega_m = 2 \times 5 = 10$ kHz.

19. Repeaters add on energy to received signals and retransmit them.

32. Due to H_i-F_i communication system distortion is minimized.

37. Side band frequencies are $\omega_c \pm \Delta\omega = (1000 \pm 0.8)$ kHz i.e. 1000.8 kHz, 999.2 kHz

38. $f_c = 100 f_m = 100 \times 500 = 50000$ cps.

40. Polarization is defined only for transverse waves.

41. $v = \frac{c}{\epsilon_r} = \frac{3\times10^8}{4} = 7.5 \times 10^7$ m/s

56. $d = \sqrt{2Rh} = \sqrt{2\times6.4\times10^6\times240} = 55$ km

62. Amplifier is not energy transformer it just increases the energy level signal .

69. $m = \frac{\Delta f}{f_c} = \frac{10}{2} = 5$

75. Energy flux at point of focus $= \frac{10^{12}}{10^{-4}} = 10^{16}$

76. $\omega = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{10^{-9}\times10\times10^{-6}}}$

$\Rightarrow \quad \nu = 10^7 \times 0.1592 = 1592$ kHz.

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

EXERCISE # 2
PART - I

1. $N = \sigma\pi d^2$

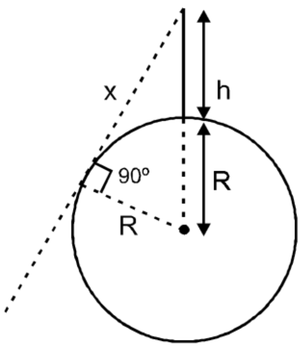
$50 \times 10^5 = \sigma \times \frac{22}{7} \times 2 \times 6.4 \times 10^6 \times 150$

$\sigma = 828.6 \text{ km}^{-2}$

EXERCISE # 3
PART - III

2. Carrier has high frequency which reduces desired anlena aize

3.



$r = R + h \cong R$

$x = \sqrt{(R+h)^2 - R^2}$

$= \sqrt{h^2 + 2hR}$

$x^2 = 25000 + 2.\ 500\ 6.4\ 100000$

$= 25000 + (64 \times 100000000)$

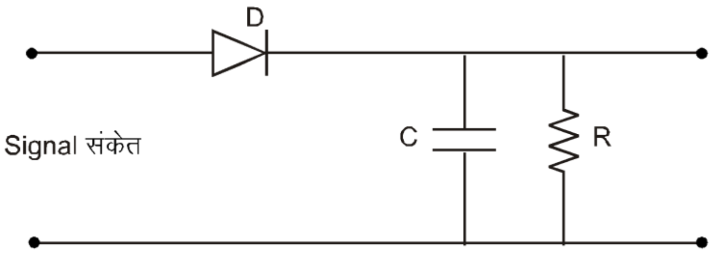
$= 10^4\ (640025)$

$x^2 \cong 10^4.640000$

$x = 8 \times 10^4$ m

$= 80$ km.

4.



$\tau = RC = 100 \times 10^3 \times 250 \times 10^{-12}$ sec

$= 2.5 \times 10^7 \times 10^{-12}$ sec

$= 2.5 \times 10^{-5}$ sec

The higher frequency which can be detected with tolerable distortion is

$f = \frac{1}{2\pi m_a RC} = \frac{1}{2\pi \times 0.6 \times 2.5 \times 10^{-5}} \text{Hz}$

$= \frac{100 \times 10^4}{25 \times 1.2\pi} \text{Hz}$

$= \frac{4}{1.2\pi} \times 10^{-4}$ Hz

= 10.61 KHz
This condition is obtained by applying the condition that rate of decay of capacitor voltage must be equal or less then the rate of decay modulated singnal voltage for proper detection of mdoulated signal.

5. f_c = 2MHz = 2000 KHz
f_m = 5KHz
Resultant frequencies are
≡ $f_C + f_m, f_c, f_c - f_m$ = 2005 KHz, 2000, 1995 KHz

6. In amplitude modulation amplitude of carrier wave (high frequency) is varied in proportion to the amplitude of signal.
In frequency modulation frequency of carrier wave (high frequency) is varied in proportion to amplitude of signal.

7. Let c(t) = $A_C \sin \omega_c t$ represent carrier wave and m(t) = $A_m \sin \omega_m t$ represent the message or the modulating signal where $\omega_m = 2\pi f_m$ is the angular frequency of the message signal. The modulated signal c_m (t) can be written as

$$c_m(t) = (A_C + A_m \sin \omega_m t) \sin \omega_c t$$

$$= A_C \left(1 + \frac{A_m}{A_c} \sin \omega_m t\right) \sin \omega_c t \quad \text{..........(i)}$$

Note that the modulated signal now contains the message signal. From Eq. (i), we can write,

$$c_m(t) = A_c \sin \omega_c t + \mu A_c \sin \omega_m t \sin \omega_c t \quad \text{..........(ii)}$$

Here $\mu = A_m/A_c$ is the modulation index; in practice, μ is kept ≤ 1 to avoid distortion.
Using the trignomatric relation sin A sin B = 1/2 (cos (A – B) – cos (A + B),
we can write c_m (t) of Eq. (ii) as

$$c_m(t) = A_c \sin \omega_c t + \frac{\mu A_c}{2} \cos(\omega_C - \omega_m)t - \frac{\mu A_c}{2} \cos(\omega_C + \omega_m)t \quad \text{..........(iii)}$$

In amplitude modulated wave, the frequencies contained are $\omega_c - \omega_m$, ω_c, $\omega_c + \omega_m$.
The frequency of ω_m is not contained in A.M. wave

8. $N = \frac{1}{10}\frac{(10kHz)}{(5kHz)} = \frac{10^9}{5 \times 10^3} = \frac{10^6}{5} = 2 \times 10^5$

9. $D = \sqrt{2h_T R} + \sqrt{2h_R R}$

$D = \sqrt{2 \times 140 \times 64 \times 10^5} + \sqrt{2 \times 40 \times 64 \times 10^5}$

$D = 8 \times 10^3 \left[\sqrt{28} + \sqrt{8}\right]$

$D = 8 \times 10^3 \left[2\sqrt{7} + 2\sqrt{2}\right]$

$D = 16 \times 10^3 [2.6 + 1.4]$ = 64000 m = 64 km ~ 65 km

10. $\omega_s = \frac{2\pi}{100 \times 10^{-6}} = 2\pi \times 10^4 s^{-1}$

$\omega_c = \frac{2\pi}{8 \times 10^{-6}} = 2.5\pi \times 10^5 s^{-1}$

$V_{max} = V_c + V_s = 10$
$V_{min} = V_c - V_s = 8$
∴ V_c = 9mV
V_s = 1mV
Equation of AM wave
$V_{AM} = (V_c + V_s \sin \omega_s t) \sin \omega_c t = \{9 + \sin(2\pi \times 10^4)t\} \times \sin(2.5\pi \times 10^5 t)$ (In mV)

11. Range = $\sqrt{2hR}$
To double the range h have to be made 4 times.

12. $A_C = 100$
$A_C + A_m = 160$

$A_C - A_m = 40$

$A_C = 100$, $A_m = 60$

$\mu = \frac{A_m}{A_c} = 0.6$