OR

Mention the important considerations required while fabricating a p-n junction diode to be used as a Light Emitting Diode (LED). What should be the order of band gap of an LED if it is required to emit light in the visible range?

Answer:

Required consideration of p-n junction diode to be used as LED

(1) It should emit maximum light.

(2) It should not be operated a very high reverse voltage

Band gap required in LED to emit light in visible range is 1.8 eV.

Q17. Write three important factors which justify the need of modulating a message signal. Show diagrammatically how an amplitude modulate wave is obtained when a modulating signal is superimposed on a carrier wave.

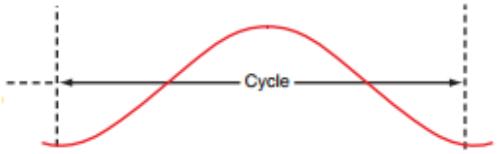
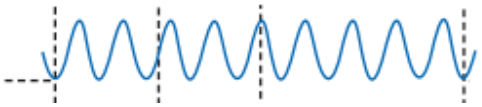
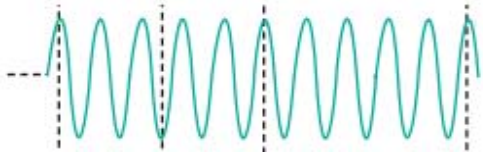
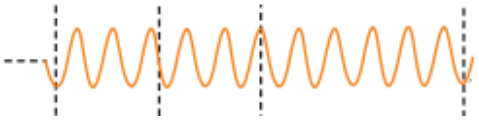
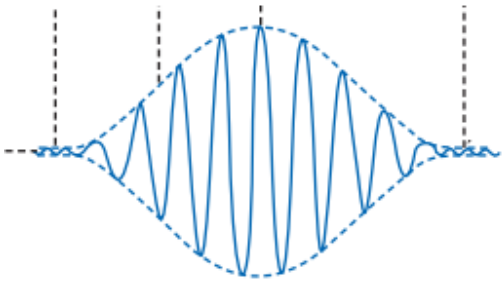
Answer: Three important reasons for modulating a message signal is

i. For sending message signal to long distance without loss - We modulate the carrier signal with your information signal (signal which is to be transmitted) and then use a transmitter to send so that your information can travel to a longer distance. At the receiver side of the communication system the demodulator separates the information signal from the carrier and then your information signal is processed, in absence of modulation message signal will attenuate and cannot be send to long distance.

ii. Antenna Size: In signal transmission antenna size required is one-fourth of wave length $h = \frac{\lambda}{4}$, thus to transmit 60 KHz signal ($\nu = 60 \times 1000\ Hz, \lambda = \frac{3\times10^8}{60\times1000} = 0.5 \times 10000\ m = 5\ KM, h = \frac{5}{4} = 1.25\ KM$), we require 1.25 KM antenna length, which is impractical to design and use. Modulation technique helps to reduce the frequency at the source hence low height antenna is required.

iii. Modulation allows us to send a signal over a bandpass frequency range. If every signal gets its own frequency range, then we can transmit multiple signals *simultaneously* over a single channel, all using different frequency ranges.

Diagrammatic representation of Amplitude Modulation

<table>
<tr><td>Intelligence or Modulating Signal
$m(t) = A_m Sin\omega_m t$
  </td><td>Lower Side Bands
  </td></tr>
<tr><td>Carrier wave $C(t) = A_c Sin\omega_c t$
  </td><td>Upper Side Bands
  </td></tr>
<tr><td colspan="2">Composite AM wave – Amplitude Modulated wave
  </td></tr>
</table>

Q18. A capacitor of unknown capacitance is connected across a battery of V volts. The charge stored in it is 360 μ*C*. When potential across the capacitor is reduced by 120 V, the charge stored in it becomes 120 μ*C* .

Calculate:

(i) The potential V and the unknown capacitance C.

(ii) What will be the charge stored in the capacitor, if the voltage applied had increased by 120V?

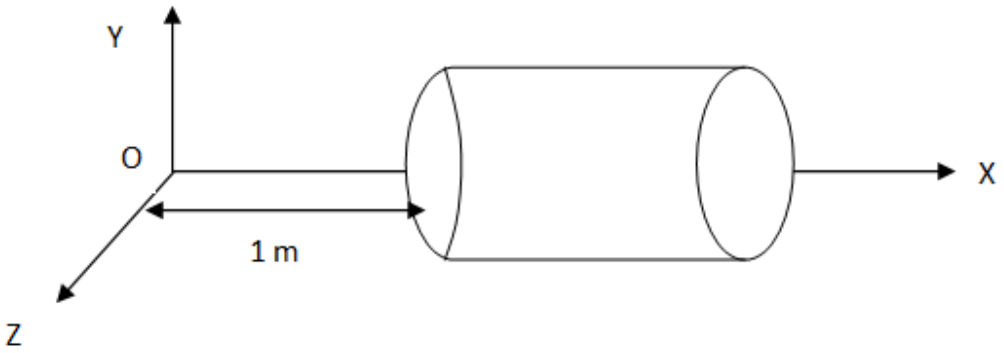
Answer: Case I: Q = 360 μ*C,* Q=CV, 360 = CV →(1)
Case II: Q = 120 μ*C*, Potential = V-120, therefore 120 = C(V-120) →(2)

Or 120 = CV -120 C, putting CV=360 from equation (1) we get 120 = 360-120C or C =240/120 = 2
Also from 1, 360 = 2V or V=180.

(i) Potential V =180 Volt, Capacitance C = 2 μf
(ii) V = 120, C= 2, Q=? We know Q=CV , Q = 2x120 =240 μC

OR

A hollow cylindrical box of length 1m and area of cross-section 25 cm^2 is placed in a three dimensional coordinate system as shown in the figure.

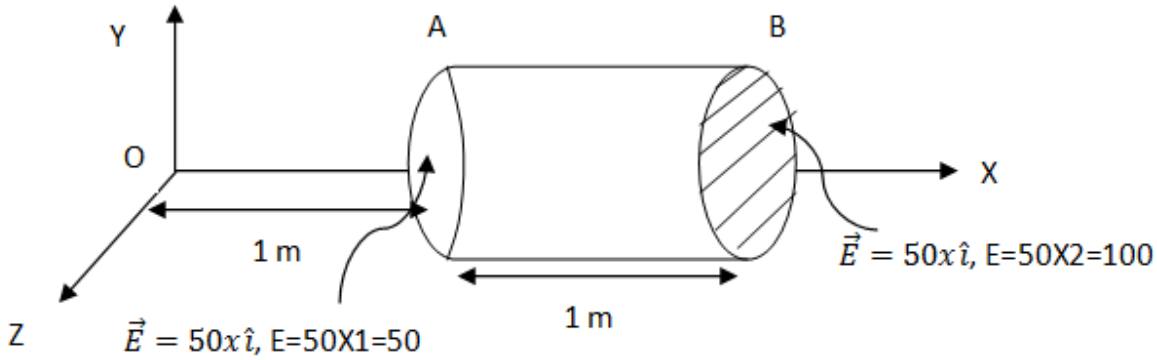


The electric field in the region is given by $\vec{E} = 50x\hat{\imath}$, where E is in NC^{-1} and x is in metres. Find:

(i) Net flux through the cylinder.

(ii) Charge enclosed by the cylinder.

Answer: Cylinder has one curved surface; electric lines are parallel to curved surface so flux is zero and two vertical surface A and B as shown in this figure



We know that flux = $\phi = \vec{E}.\vec{A} = EAcos\theta$

Total Flux = Flux through A + Flux through Curved Surface + Flux through B

= E_AAcos0 + EAcos90 + E_BAcos180

A=25, E_A=50, E_B=100

(i) Total Flux ϕ =50X25 + 0 + 100X25(-1) = 1250 -2500 = -1250

(ii) From Gauss's theorem $\phi = \frac{Q}{\epsilon_0}$ where Q= Enclosed charge

Therefore $Q = \epsilon_0\phi = 8.85 \times 10^{-12} \times 1250 = 11062.5 \times 10^{-12} = 110.625 \times 10^{-10}$