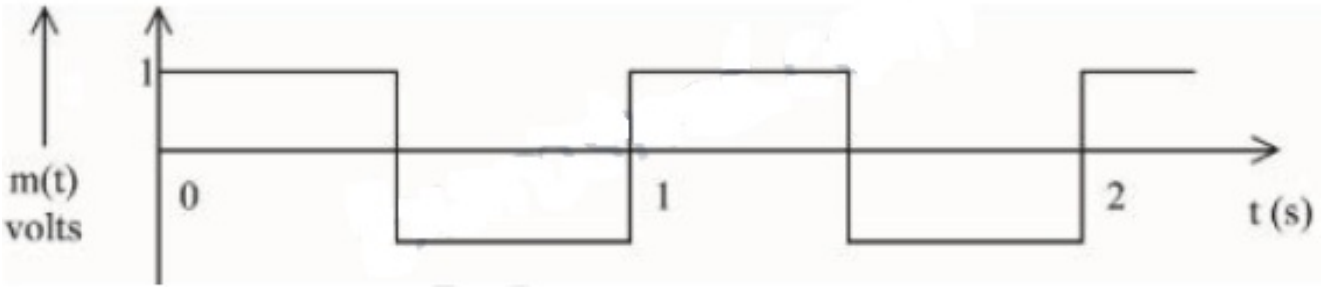
Communication Systems

Question1

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



If the carrier wave is given as c(t) = 2sin (8πt) volts, the modulation index is :
[24-Jan-2023 Shift 1]

Options:

A. 1 / 4

B. 1

C. 1 / 3

D. 1 / 2

Answer: D

Solution:

Modulation index

$$= \frac{\text{Amplitude of mod ulating signal}}{\text{Amplitude of carrier wave}}$$

$$\mu = \frac{1}{2}$$

Question2

Match List I with List II

	LIST I		LIST II
A.	AM Broadcast	I.	88 – 108 MHz
B.	FM Broadcast	II.	540 – 1600 kHz
C.	Television	III.	3.7 – 4.2 GHz
D.	Satellite Communication	IV.	54MH$_z$ – 590 MHz

Choose the correct answer from the options given below: [24-Jan-2023 Shift 2]

Options:

A. A-II, B-I, C-IV, D-III

B. A-IV, B-III, C-I, D-II

C. A-II, B-III, C-I, D-IV

D. A-I, B-III, C-II, D-IV

Answer: A

Solution:

AM Broadast →540 − 1600 KHz
FM Broadcast →88 − 108 MHz
Television →54 − 890 MHz
Salellite communication →3.7 − 4.2 GHz
∴ A-II, B-I, C-IV, D-III

Question3

A message signal of frequency 5 kHz is used to modulate a carrier signal of frequency 2 MHz. The bandwidth for amplitude modulation is: [25-Jan-2023 Shift 1]

Options:

A. 5 kHz

B. 20 kHz

C. 10 kHz

D. 2.5 kHz

Answer: C

Solution:

Solution:
Given
Signal frequency $f_m = 5\,kHz$

Carrier wave frequency $f_c = 2\,MHz$
$f_c = 2000\,KHz$
The resultant signal will have band width of frequency given by
$[(f_c + f_m) - (f_c - f_m)]$
$\Rightarrow [(2000 + 5) - (2000 - 5)]\,kHz$
$\Rightarrow 10\,kHz$

Question4

If the height of transmitting and receiving antennas are 80m each, the maximum line of sight distance will be :
Given : Earth's radius $= 6.4 \times 10^6$m.
[29-Jan-2023 Shift 1]

Options:

A. $32\,km$

B. $28\,km$

C. $36\,km$

D. $64\,km$

Answer: D

Solution:

Solution:
Maximum line of sight distance between two antennas, $d_M = \sqrt{2Rh_T} + \sqrt{2R \cdot h_R}$
$d_M = 2 \times \sqrt{2 \times 6.4 \times 10^6 \times 80} = 64\,km$

Question5

The modulation index for an A.M. wave having maximum and minimum peak to peak voltages of 14 mV and 6 mV respectively is:
[29-Jan-2023 Shift 2]

Options:

A. 1.4

B. 0.4

C. 0.2

D. 0.6

Answer: B

Solution:

$$\mu = \text{ modulation index } = \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$$

$$= \frac{14 - 6}{14 + 6} = 0.4$$

Question6

Match List I with List II :

List I	List II
A. Attenuation	I. Combination of a receiver and transmitter.
B. Transducer	II. Process of retrieval of information from the carrier wave at received
C. Demodulation	III. Converts one form of energy into another
D. Repeater	IV. Loss of strength of a signal while propagating through a medium

Choose the correct answer from the options given below : [30-Jan-2023 Shift 2]

Options:

A. A-I, B-II, C-III, D-IV

B. A-II, B-III, C-IV, D-I

C. A-IV, B-III, C-I, D-II

D. A-IV, B-III, C-II, D-I

Answer: D

Solution:

Question7

The amplitude of 15sin (1000πt) is modulated by 10sin (4πt) signal. The amplitude modulated signal contains frequency(ies) of
(A) 500 Hz
(B) 2 Hz
(C) 250 Hz
(D) 498 Hz
(E) 502 Hz
Choose the correct answer from the options given below: [31-Jan-2023 Shift 1]

Options:

A. A only

B. A, D and E only

C. B only

D. A and B only

Answer: B

Solution:

Carrier wave frequency

$V_C = \frac{100\pi}{2\pi} = 500\,Hz$

Modulating wave frequency

$V_m = \frac{4\pi}{2\pi} = 2\,Hz$

$\therefore \quad V_C - V_m, V_C, V_C + V_m$

$= 498\,Hz .500\,Hz, 502\,Hz$

Question8

Given below are two statements :
Statement I: For transmitting a signal, size of antenna (l) should be comparable to wavelength of signal (at least l = $\frac{\lambda}{4}$ in dimension)
Statement II: In amplitude modulation, amplitude of carrier wave remains constant (unchanged).
In the light of the above statements, choose the most appropriate answer from the options given below
[1-Feb-2023 Shift 1]

Options:

A. Both Statement I and Statement II are correct

B. Both Statement I and Statement II are incorrect

C. Statement I is incorrect but Statement II is correct

D. Statement I is correct but Statement II is incorrect

Answer: D

Solution:

Solution:
In amplitude modulation frequency of carrier wave remains unchanged.
Minimum size of antenna should be $\frac{1}{4}$ th of wavelength.

Question9

Which of the following frequencies does not belong to FM broadcast.
[1-Feb-2023 Shift 1]

Options:

A. 106 MHz

B. 64 MHz

C. 99 MHz

D. 89 MHz

Answer: B

Solution:

Solution:
FM broadcast range is 88 MHz to 108 MHz

Question10

In an amplitude modulation, a modulating signal having amplitude of XV is superimposed with a carrier signal of amplitude YV in first case. Then, in second case, the same modulating signal is superimposed with different carrier signal of amplitude 2YV. The ratio of modulation index in the two case respectively will be:
[1-Feb-2023 Shift 2]

Options:

A. 1 : 2

B. 1 : 1

C. 2 : 1

D. 4 : 1

Answer: C

Solution:

Modulating Index

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

$$\mu_1 = \frac{X}{Y}$$

$$\mu_2 = \frac{X}{2Y}$$

$$\frac{\mu_1}{\mu_2} = \frac{2}{1}$$

Question11

By what percentage will the transmission range of a TV tower be affected when the height of the tower is increased by 21% ? [6-Apr-2023 shift 1]

Options:

A. 12%

B. 15%

C. 14%

D. 10%

Answer: D

Solution:

Solution:
New range is given by $\sqrt{2R(h + 0.21h)}$
$= \sqrt{2Rh \times 1.21}$
$= 1.1\sqrt{2Rh}$
It means new range increases by 10%.

Question12

For an amplitude modulated wave the minimum amplitude is 3V, while the modulation index is 60%. The maximum amplitude of the modulated wave is : [6-Apr-2023 shift 2]

Options:

A. 10V

B. 12V

C. 15V

D. 5V

Answer: B

Solution:

Given, modulation index = 60% = 0.6

$$\frac{A_m}{A_c} = \frac{0.6}{1}$$

Using componendo - dividendo, we can write

$$\frac{A_m + A_c}{A_m - A_c} = \frac{0.6 + 1}{0.6 - 1} = \frac{1.6}{-0.4}$$

$$A_m + A_c = \frac{1.6}{-0.4} \times (A_m - A_c)$$

$= \frac{1.6}{-0.4} \times (-3) = 12V$

Question13

A TV transmitting antenna is 98m high and the receiving antenna is at the ground level. If the radius of the earth is 6400 km, the surface area covered by the transmitting antenna is approximately:
[8-Apr-2023 shift 1]

Options:

A. $1240km^2$

B. $1549km^2$

C. $4868km^2$

D. $3942km^2$

Answer: D

Solution:

Max. distance covered $d = \sqrt{2Rh_T}$
(R = radius of earth, h_T = height of antenna)
Area $A = \pi d^2$
$A = \pi(2Rh_T)$
$A = 2 \times 3.14 \times 6400 \times 98 \times 10^{-3}$
$A \approx 3942km^2$

Question14

The power radiated from a linear antenna of length l is proportional to (Given, λ = Wavelength of wave):
[8-Apr-2023 shift 2]

Options:

A. $\frac{l}{\lambda}$

B. $\frac{l^2}{\lambda}$

C. $\frac{l}{\lambda^2}$

D. $\left(\frac{l}{\lambda}\right)^2$

Answer: D

Question15

A carrier wave of amplitude 15V modulated by a sinusoidal base band signal of amplitude 3V. The ratio of maximum amplitude to minimum amplitude in an amplitude modulated wave is
[10-Apr-2023 shift 1]

Options:

A. 2

B. 1

C. 5

D. $\frac{3}{2}$

Answer: D

Solution:

$V_C = 15$
$V_m = 3$
$V_{max} = 15 + 3 = 18$
$V_{min} = 15 - 3 = 12$
$V_{max} = \frac{18}{12} = \frac{3}{2} = 3 : 2$

Question16

A message signal of frequency 3 kHz is used to modulate a carrier signal of frequency 1.5 MHz. The bandwidth of the amplitude modulated wave is
[10-Apr-2023 shift 2]

Options:

A. 6 kHz

B. 3 kHz

C. 6 MHz

D. 3 MHz

Answer: A

Solution:

Bond width of Amplitude modulated signal (AM) $= 2 \times f_{\text{(message signal)}}$
$= 2 \times 3\,\text{KHz}$
$= 6\,\text{KHz}$

Question17

A transmitting antenna is kept on the surface of the earth. The minimum height of receiving antenna required to receive the signal in line of sight at 4 km distance from it is $x \times 10^{-2}$m. The value of x is (Let, radius of earth R = 6400 km) [11-Apr-2023 shift 1]

Options:

A. 125

B. 12.5

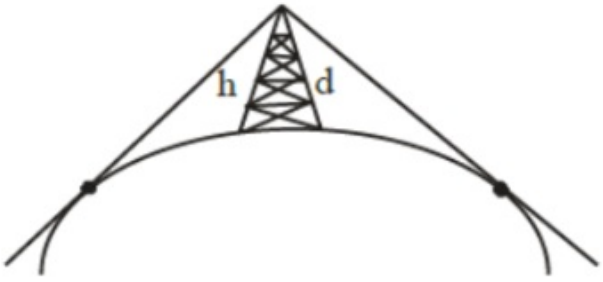
C. 1250

D. 1.25

Answer: A

Solution:

$d = \sqrt{2R \cdot h}$
$d^2 = 2\,Rh$
$(4)^2 = 2 \times 6400 \times h$
$\frac{16}{2 \times 6400} = h = \frac{1}{800}\,\text{km}$
$h = \frac{1000}{800} = \frac{5}{4}\text{m}$
$x \times 10^{-2} = \frac{5}{4}$
$x = \frac{500}{4} = 125$ Ans. Option → (1)



Question18

In satellite communication, the uplink frequency band used is: [11-Apr-2023 shift 2]

Options:

A. $76 - 88\,\text{MHz}$

B. $420 - 890\,\text{MHz}$

C. $3.7 - 4.2\,\text{GHz}$

D. $5.925 - 6.425\,\text{GHz}$

Answer: D

Solution:

Solution:

uplink	Downlink
5.8-6.2 Ghz	4-4.2 Ghz
I. standard	

Question19

The amplitude of 15sin (100πt) is modulated by 10sin (4πt) signal. The amplitude modulated signal contains frequencies of
A. 500 Hz
B. 2 Hz
C. 250 Hz
D. 498 Hz
E. 502 Hz
Choose the correct answer from the options given below :
[12-Apr-2023 shift 1]

Options:

A. A and B only

B. A and D only

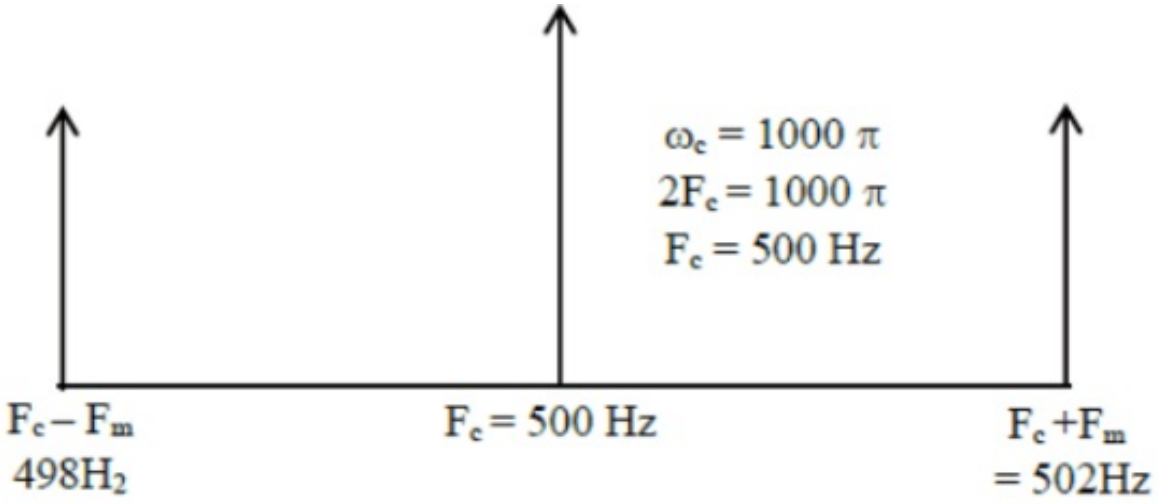
C. A and C only

D. A, D and E only

Answer: D

Solution:

Signal = 15sin (1000πt) is modulated by 10sin (4πt)
$\omega_m = 4\pi$
$2\pi f_m = 4\pi$
$f_m = 2H$



Question20

Match List - I with List - II

List - I (Layer of atmosphere)	List -II (Approximate height over earth's surface)
(A) F1 - Layer	(I) 10 km
(B) D - Layer	(II) 170 – 190 km
(C) Troposphere	(III) 100 km
(D) E-layer	(IV) 65 – 75 km

Choose the correct answer from the options given below: [13-Apr-2023 shift 1]

Options:

A. A - II, B - I, C - IV, D - III

B. A - II, B - IV, C - III, D - I

C. A - II, B - IV, C - I, D - III

D. A - III, B - IV, C - I, D - II

Answer: C

Solution:

F_1 → Lower part of F layer of ionosphere (170 − 190 Km)
D → Lowest layer of ionosphere (65 − 75 Km)
Troposphere → Lowest layer of atmosphere (10 Km)
E → Middle part of ionosphere (100 Km)

Question21

To radiate EM signal of wavelength λ with high efficiency, the antennas should have a minimum size equal to:
[13-Apr-2023 shift 2]

Options:

A. λ

B. $\frac{\lambda}{2}$

C. 2λ

D. $\frac{\lambda}{4}$

Answer: D

Solution:

Minimum length of antenna
Should be $\frac{\lambda}{4}$

Question22

The height of transmitting antenna is 180m and the height of the receiving antenna is 245m. The maximum distance between them for satisfactory communication in line of sight will be: (given R = 6400 km)
[15-Apr-2023 shift 1]

Options:

A. 48 km

B. 104 km

C. 96 km

D. 56 km

Answer: B

Solution:

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

$d = \sqrt{2R}(\sqrt{180} + \sqrt{245})$

$d = \sqrt{2 \times 64 \times 10^5}(\sqrt{180} + \sqrt{245})$

$d = 3577.7(13.416 + 15.652)\text{m}$

$d = 104\,\text{km}$

Question23

A baseband signal of 3.5 MHz frequency is modulated with a carrier signal of 3.5 GHz frequency using amplitude modulation method. What should be the minimum size of antenna required to transmit the modulated signal?
[24-Jun-2022-Shift-1]

Options:

A. 42.8m

B. 42.8 mm

C. 21.4 mm

D. 21.4m

Answer: C

Solution:

$v_c = 3.5 \times 10^9\,\text{Hz}$

$\therefore \lambda = \dfrac{c}{v_c} = \dfrac{3 \times 10^8}{3.5 \times 10^9}$

$\therefore$ Size of antenna $= \dfrac{\lambda}{4}$

$= \dfrac{8.57 \times 10^{-2}}{4}$

$= 21.4\,\text{mm}$

Question24

An antenna is placed in a dielectric medium of dielectric constant 6.25. If the maximum size of that antenna is 5.0 mm, it can radiate a signal of minimum frequency of ____GHz
(Given $\mu_r = 1$ for dielectric medium)
[24-Jun-2022-Shift-2]

Answer: 6

Solution:

We know that $v = f\lambda$
Putting the values,
$\frac{3 \times 10^8}{\sqrt{6.25}} = f \times 20 \times 10^{-3}$
$\Rightarrow f = 6 \times 10^9\,\text{Hz}$

Question25

A signal of 100 THz frequency can be transmitted with maximum efficiency by : [25-Jun-2022-Shift-1]

Options:

A. Coaxial cable

B. Optical fibre

C. Twisted pair of copper wires

D. Water

Answer: B

Solution:

Solution:
Optical fibres supports frequency of electromagnetic waves in the range $10^{14}\,\text{Hz}$ to $10^{15}\,\text{Hz}$.

Question26

	List - I		List -II
A.	Facsimile	I.	Static Document Image
B.	Guided media Channel	II.	Local Broadcast Radio
C.	Frequency Modulation	III.	Rectangular wave
D.	Digital Signal	IV.	Optical Fiber

Choose the correct answer from the following options: [25-Jun-2022-Shift-2]

Options:

A. A-IV, B-III, C-II, D-I

B. A-I, B-IV, C-II, D-III

C. A-IV, B-II, C-III, D-I

D. A-I, B-II, C-III, D-IV

Answer: B

Solution:

Facsimile	-	Static Document Image
Guided Media Channel	-	Optical Fiber
Frequency Modulation	-	Local Broadcast Radio
Digital single	-	Rectangular Wave

Question27

Choose the correct statement for amplitude modulation : [26-Jun-2022-Shift-1]

Options:

A. Amplitude of modulating signal is varied in accordance with the information signal.

B. Amplitude of modulated signal is varied in accordance with the information signal.

C. Amplitude of carrier signal is varied in accordance with the information signal.

D. Amplitude of modulated signal is varied in accordance with the modulating signal.

Answer: C

Solution:

Solution:
In amplitude modulation, amplitude of carrier signal is varied according to the message signal.

Question28

A sinusoidal wave $y(t) = 40\sin(10 \times 10^6 \pi t)$ is amplitude modulated by another sinusoidal wave $x(t) = 20\sin(1000\pi t)$. The amplitude of minimum frequency component of modulated signal is : [26-Jun-2022-Shift-2]

Options:

A. 0.5

B. 0.25

C. 20

D. 10

Answer: D

Solution:

Solution:
Modulate signal $s(t) \equiv [1 + 20\sin(1000\pi t)]\sin(10^7\pi t) \equiv \sin(10^7\pi t) + 10\cos(10^7\pi t - 10^3\pi t) + 10\cos(10^7\pi t + 10^3\pi t) \Rightarrow$
Required amplitude $= 10$

Question29

The height of a transmitting antenna at the top of a tower is 25m and that of receiving antenna is, 49m. The maximum distance between them, for satisfactory communication in LOS (Line-Of-Sight) is $K\sqrt{5} \times 10^2$m. The value of K is____
(Assume radius of Earth is $64 \times 10^{+5}$m) [Calculate upto nearest integer value]
[27-Jun-2022-Shift-1]

Answer: 192

Solution:

$$d = \sqrt{2h_tR_e} + \sqrt{2 \times h_RR_e}$$
$$= \sqrt{2 \times 25 \times 64 \times 10^5} + \sqrt{2 \times 49 \times 64 \times 10^5}$$
$$= 8000\sqrt{5} + 11200\sqrt{5}\text{m}$$
$$= 19200\sqrt{5}\text{m}$$
$$= 192\sqrt{5} + 10^2\text{m}$$

Question30

We do not transmit low frequency signal to long distances because-
(a) The size of the antenna should be comparable to signal wavelength which is unreal solution for a signal of longer wavelength.
(b) Effective power radiated by a long wavelength baseband signal would be high.
(c) We want to avoid mixing up signals transmitted by different transmitter simultaneously.
(d) Low frequency signal can be sent to long distances by superimposing with a high frequency wave as well.
Therefore, the most suitable option will be :
[27-Jun-2022-Shift-2]

Options:

A. All statements are true

B. (a), (b) and (c) are true only

C. (a), (c) and (d) are true only

D. (b), (c) and (d) are true only

Answer: C

Solution:

For longer wavelength, size of antenna would increase. Also, mixing of signals needs to be avoided.
Also, we can use modulation to send low frequency signal by superimposing them with high frequency signals

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Question31

Match List-I with List-II

List-I		List-II	
(A)	Television signal	(I)	03 KHz
(B)	Radio signal	(II)	20 KHz
(C)	High Quality Music	(III)	02 MHz
(D)	Human speech	(IV)	06 MHz

[28-Jun-2022-Shift-1]

Options:

A. A-I, B-II, C-III, D-IV

B. A-IV, B-III, C-I, D-II

C. A-IV, B-III, C-II, D-I

D. A-I, B-II, C-IV, D-III

Answer: C

Solution:

Television signal $\Rightarrow 6\,\text{MHz}$
Radio signal $\Rightarrow 2\,\text{MHz}$
High Quality music $\Rightarrow 20\,\text{kHz}$
Human speech $\Rightarrow 3\,\text{kHz}$

Question32

Amplitude modulated wave is represented by $V_{AM} = 10[1 + 0.4\cos(2\pi \times 10^4 t)\cos(2\pi \times 10^7 t)$.. The total bandwidth of the amplitude modulated wave is :

[28-Jun-2022-Shift-2]

Options:

A. $10\,\text{kHz}$

B. $20\,\text{MHz}$

C. $20\,\text{kHz}$

D. $10\,\text{MHz}$

Answer: C

Solution:

$$\text{Bandwidth } = 2 \times f_m$$
$$= 2 \times 10^4\,\text{Hz} = 20\,\text{kHz}$$

Question33

Only 2% of the optical source frequency is the available channel bandwidth for an optical communicating system operating at 1000 nm. If an audio signal requires a bandwidth of 8 kHz, how many channels can be accommodated for transmission :
[29-Jun-2022-Shift-1]

Options:

A. 375×10^7

B. 75×10^7

C. 375×10^8

D. 75×10^9

Answer: B

Solution:

Solution:

$v = f\lambda$

$$\Rightarrow f = \frac{v}{\lambda} = \frac{3 \times 10^8}{1000 \times 10^{-9}}\,\text{Hz} = 3 \times 10^{14}\,\text{Hz}$$

$$\Rightarrow \text{Channels} = \frac{\frac{2}{100} \times 3 \times 10^{14}}{8 \times 10^3} = 75 \times 10^7$$

Question34

The TV transmission tower at a particular station has a height of 125m.

For doubling the coverage of its range, the height of the tower should be increased by
[29-Jun-2022-Shift-2]

Options:

A. 125m

B. 250m

C. 375m

D. 500m

Answer: C

Solution:

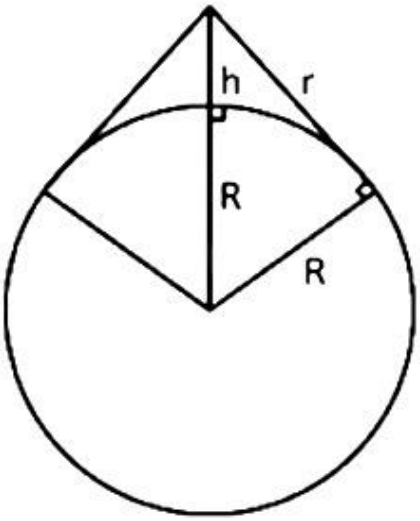
Solution:
Range $R = \sqrt{2hRe}$
Let the height be h' to double the range so
$2R = \sqrt{2h'Re}$
On solving $h' = 4h$
$h' = 500m$
So $\Delta h = 375m$

Question35

The required height of a TV tower which can cover the population of 6.03 lakh is h. If the average population density is 100 per square km and the radius of earth is 6400km, then the value of h will be
[25-Jul-2022-Shift-1]

Answer: 150

Solution:



$r = \sqrt{(h+R)^2 - R^2} \cong \sqrt{2hR}$

$A = \frac{6.03 \times 10^5}{100}$
$\pi r^2 = 6.03 \times 10^3$
$\pi 2Rh = 6.03 \times 10^3$
$h = \frac{6.03 \times 10^3}{2 \times \pi \times R} = 0.015 \times 10 \times 10^3 m$
$= 150m$

Question36

A radio can tune to any station in 6 MHz to 10 MHz band. The value of corresponding wavelength bandwidth will be: [26-Jul-2022-Shift-1]

Options:

A. 4m

B. 20m

C. 30m

D. 50m

Answer: B

Solution:

$v_1 = 6 \times 10^6 Hz$
$\Rightarrow \lambda_1 = \frac{3 \times 10^8}{6 \times 10^6} = 50m$
$v_2 = 10 \times 10^6 Hz$
$\Rightarrow \lambda_2 = \frac{3 \times 10^8}{10 \times 10^6} = 30m$
$\Rightarrow$ Wavelength band with
$= | \lambda_1 - \lambda_2 | = 20m$

Question37

The maximum and minimum voltage of an amplitude modulated signal are 60V and 20V respectively. The percentage modulation index will be : [26-Jul-2022-Shift-2]

Options:

A. 0.5%

B. 50%

C. 2%

D. 30%

Answer: B

Solution:

$V_{max} = 60$
$V_{min} = 20$
% modulation =
$\left(\frac{V_{max} - V_{min}}{V_{max} + V_{min}} \right) 100 \Rightarrow \left(\frac{60 - 20}{60 + 20} \right) 100 \Rightarrow \left(\frac{40}{80} \right) 100$
$\Rightarrow 50\%$

Question38

At a particular station, the TV transmission tower has a height of 100m. To triple its coverage range, height of the tower should be increased to [27-Jul-2022-Shift-1]

Options:

A. 200m

B. 300m

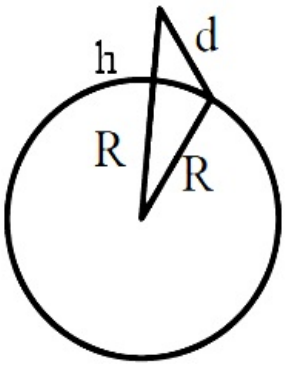
C. 600m

D. 900m

Answer: D

Solution:

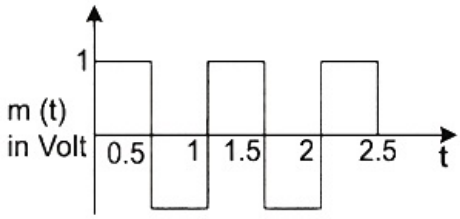
Solution:



Let d be range
$d^2 = (h + R)^2 - R^2$
$= h^2 + R^2 + 2RH - R^2$
$d^2 = h^2 + 2Rh$
as $R > \gg > > h$ then
$d \approx \sqrt{2\,Rh}$... ... (1)
Now, if coverage is to be increased 3 times $3d = \sqrt{2Rh'}$... (2)
Divide 2 and 1 $\frac{3d}{d} = \sqrt{\frac{2Rh'}{2Rh}}$
$9 = \frac{h'}{h}$
$9h = h'$
If h = 100m then tower of height 900m is required

Question39

A square wave of the modulating signal is shown in the figure. The carrier wave is given by C(t) = 5 sin(8πt) Volt. The modulation index is :



[27-Jul-2022-Shift-2]

Options:

A. 0.2

B. 0.1

C. 0.3

D. 0.4

Answer: A

Solution:

Solution:

Modulation Index $\mu = \frac{A_m}{A_C} = \frac{1}{5} = 0.2$

A_m = amp. of modulating signal

A_C = amp. of carrier wave

Question40

In the case of amplitude modulation to avoid distortion the modulation index (μ) should be:
[28-Jul-2022-Shift-1]

Options:

A. $\mu \leq 1$

B. $\mu \geq 1$

C. $\mu = 2$

D. $\mu = 0$

Answer: A

Solution:

$\mu = \frac{A_m}{A_c}$
$\mu \leq 1$ to avoid distortion
because $\mu > 1$ will result in interference between career frequency \& message frequency.

Question41

A FM Broadcast transmitter, using modulating signal of frequency 20 kHz has a deviation ratio of 10 . The Bandwidth required for transmission is :
[28-Jul-2022-Shift-2]

Options:

A. 220 kHz

B. 180 kHz

C. 360 kHz

D. 440 khz

Answer: D

Solution:

Solution:
Given
FM broadcast
Modulating frequency $= 20\,\text{kHz} = f$
Deviation ratio $= \frac{\text{frequency deviation}}{\text{modulating frequency}} = \frac{\Delta f}{f}$
$\Rightarrow$ frequency deviation $- \Delta f = f \times 10$
$= 20\,\text{kHz} \times 10 = 200\,\text{kHz}$
$\Rightarrow$ Bandwidth $= 2(f + \Delta f)$
$= 2(20 + 200)\,\text{kHz}$
$= 440\,\text{kHz}$

Question42

Find the modulation index of an AM wave having 8V variation where maximum amplitude of the AM wave is 9V.
[29-Jul-2022-Shift-1]

Options:

A. 0.8

B. 0.5

C. 0.2

D. 0.1

Answer: A

Solution:

Modulation index: $m = \frac{A_m}{A_c}$

Given $2A_m = 8$

$A_m + A_c = 9 \Rightarrow A_c = 5$

$\therefore m = \frac{4}{5} = 0.8$

Question43

A modulating signal $2\sin(6.28 \times 10^6)t$ is added to the carrier signal $4\sin(12.56 \times 10^9)t$ for amplitude modulation. The combined signal is passed through a non-linear square law device. The output is then passed through a band pass filter. The bandwidth of the output signal of band pass filter will be _____ MHz.
[29-Jul-2022-Shift-2]

Answer: 2

Solution:

$W_C = 12.56 \times 10^9$

$W_m = 6.25 \times 10^6$

After amplitude modulation

Bandwidth frequency

$= \frac{2W_m}{2\pi} = \frac{2 \times 6.28}{2\pi} \times 10^6 = 2\,\text{MHz}$

Question44

If the highest frequency modulating a carrier is 5kHz, then the number of AM broadcast stations accommodated in a 90kHz bandwidth are ..... .
[26 Feb 2021 Shift 2]

Answer: 9

Solution:

Given, highest modulating frequency, $f = 5kHz$
Bandwidth $= 90kHz$

Since, number of station $= \frac{\text{bandwidth}}{\text{band width station (2f)}}$

$= \frac{\text{Bandwidth}}{2f} = \frac{90}{2 \times 5} = 9$

Question45

The maximum and minimum amplitude of an amplitude modulated wave is $16V$ and $8V$, respectively. The modulation index for this amplitude modulated wave is $\times 10^{-2}$. The value of x is ..... .
[26 Feb 2021 Shift 1]

Answer: 33.33

Solution:

Given, maximum amplitude $A_{max} = 16$
Minimum amplitude, $A_{min} = 8$

Since, modulation index $= \frac{A_{max} - A_{min}}{A_{max} + A_{min}}$

$= \frac{16 - 8}{16 + 8} = \frac{8}{24} = \frac{1}{3} = 03333$

$= 33.33 \times 10^{-2} = x \times 10^{-2}$

Hence, $x = 33.33$

Question46

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
[25 Feb 2021 Shift 2]

Options:

A. $\frac{c}{f_c - f_m}$

B. $\frac{c}{f_c + f_m}$

C. $\frac{c}{f_c}$

D. $\frac{c}{f_m}$

Answer: C

Solution:

Solution:
Let λ be the wavelength of carrier signal.
Since, frequency (f_c) = $\frac{\text{speed (c)}}{\text{wavelength } (\lambda)}$

$\therefore \lambda = \frac{c}{f_c}$

Question47

Given, below are two statements
Statement I A speech signal of 2kH z is used to modulate a carrier signal of 1M H z. The bandwidth requirement for the signal is 4kH z.
Statement II The side band frequencies are 1002kH z and 998kH z. In the light of the above statements, choose the correct answer from the options given below
[25 Feb 2021 Shift 1]

Options:

A. Statement I is true but Statement II is fals

B. Statement I is false but Statement II is true.

C. Both Statement I and Statement II are true.

D. Both Statement I and Statement II are false.

Answer: C

Solution:

Solution:
Given, frequency of modulated signal,
$f_m = 2\text{kH z} = 2 \times 10^3\text{H z}$
Frequency of carrier signal, $f_c = 1\text{M H z}$
$= 1 \times 10^6\text{H z}$
$= 1000\text{kH z}$
Then, bandwidth $= 2f_m = 4\text{kH z}$ and side band frequency $= f_c \pm f_m$
$= (1000 \pm 2)\text{kH z}$
$= 1002\text{kH z}$ and 998kH z
Hence, option (c) is the correct.

Question48

An audio signal $v_m = 20 \sin 2\pi(1500\ t\ t)$. amplitude modulates a carrier $v_c = 80 \sin 2\pi\ (100{,}000\ t)$.
The value of percent modulation is
[24feb2021shift1]

Answer: 25

Solution:

Solution:

% modulation $= \frac{A_m}{A_c} \times 100$

$= \frac{20}{80} \times 100 = 25\%$

Question49

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
[25 Feb 2021 Shift 2]

Options:

A. $\frac{c}{f_c - f_m}$

B. $\frac{c}{f_c + f_m}$

C. $\frac{c}{f_c}$

D. $\frac{c}{f_m}$

Answer: C

Solution:

Solution:

Let λ be the wavelength of carrier signal.

Since, frequency $(f_c) = \frac{\text{speed (c)}}{\text{wavelength } (\lambda)}$

$\therefore \lambda = \frac{c}{f_c}$

Question50

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

[18 Mar 2021 Shift 2]

Answer: 50

Solution:

Given, height of the TV transmission antenna, $H = 20m$
Initial range of the antenna at the ground level,
$R = \sqrt{2RH}$
Final range of the antenna at the height of $5m$,
$R' = \sqrt{2RH} + \sqrt{2RH'}$
Percentage increase in the antenna range,

$$\% \text{ range } = \frac{R' - R}{R} \times 100$$

$$= \frac{\sqrt{2RH'}}{\sqrt{2RH}} \times 100 = \frac{\sqrt{H'}}{\sqrt{H}} \times 100$$

$$= \frac{\sqrt{5}}{\sqrt{20}} \times 100 = 50\%$$

Hence, the value of n to the nearest integer is 50 .

Question51

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 6400km. (Round off to the nearest integer).
(Take π as 3.14)
[17 Mar 2021 Shift 1]

Answer: 1206

Solution:

Given, height of antenna tower, $h = 30m$
$= 30 \times 10^{-3}km$
Radius of earth, $R = 6400km$
We know that, $d = \sqrt{2Rh}$ ....(i)
where, d = distance up to which signals can be transmitted
Area, $A = \pi d^2$...(ii)
From Eqs. (i) and (ii), we get
$A = \pi(\sqrt{2Rh})^2 = 2\pi Rh$
$= 2 \times 3.14 \times 6400 \times 30 \times 10^{-3} = 1205.76km^2$
$= 1206km^2$

Question52

Two identical antennas mounted on identical towers are separated from each other by a distance of 45km. What should nearly be the minimum height of receiving antenna to receive the signals in line of sight? (Assume, radius of earth is 6400km.)
[16 Mar 2021 Shift 2]

Options:

A. 19.77m

B. 39.55m

C. 79.1m

D. 158.2m

Answer: B

Solution:

Solution:
Given, distance between two antennas, D = 45km
Radius of Earth, R = 6400km
Height of the receiving antenna, h = ?
We know that,
$D = 2\sqrt{2Rh}$
$\Rightarrow h = \frac{D^2}{8R}$.....(i)
Substituting the given values in Eq. (i), we get
$h = \frac{(45)^2}{8 \times 6400} = \frac{(45)^2}{8 \times 6400}$
$= 39.55m$

Question53

A 25m long antenna is mounted on an antenna tower. The height of the antenna tower is 75m. The wavelength (in m) of the signal transmitted by this antenna would be
[16 Mar 2021 Shift 1]

Options:

A. 300

B. 400

C. 200

D. 100

Answer: D

Solution:

Since, height of antenna = Wavelength of the signal transmitted by antenna (λ) / 4

$\Rightarrow 25 = \frac{\lambda}{4}$

$\Rightarrow \lambda = 25 \times 4$

$\Rightarrow \lambda = 100\text{m}$

Question54

What should be the height of transmitting antenna and the population covered if the television telecast is to cover a radius of 150km ? The average population density around the tower is 2000 / km^2 and the value of $R_e = 6.5 \times 10^6$m.
[22 Jul 2021 Shift 2]

Options:

A. Height = 1731m
Population Covered = 1413×10^5

B. Height = 1241m
Population Covered = 7×10^5

C. Height = 1600m
Population Covered = 2×10^5

D. Height = 1800m
Population Covered = 1413×10^8

Answer: A

Solution:

Solution:
Radius covered $r = \sqrt{2RH_T}$

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

$(150\text{km} \times 10^3)^2 = 26.5 \times 10^6 H_T$

$H_T = 1731\text{m}$

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

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

Question55

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 :
[25 Jul 2021 Shift 2]

Answer: 1

Solution:

Modulation index

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

Question56

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 _____.
[27 Jul 2021 Shift 2]

Answer: 1

Solution:

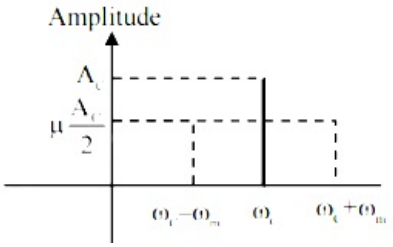
$A_{max} = A_c + A_m = 12$
$A_{min} = A_c - A_m = 3$
$\Rightarrow A_c = \frac{15}{2}$ & $A_m = \frac{9}{2}$
modulation index $= \frac{A_m}{A_c} = \frac{9/2}{15/2} = 0.6$
$\Rightarrow x = 1$

Question57

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 _____
[27 Jul 2021 Shift 1]

Answer: 1

Solution:



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

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

Question58

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 kH z. The value of α is :
[25 Jul 2021 Shift 1]

Options:

A. 200 kHz

B. 50 kHz

C. 100 kHz

D. 0

Answer: A

Solution:

Solution:
Bandwidth $= 2 \times f_m$
$= 2 \times 10^5 \text{H Z} = 200\text{K H Z}$

Question59

A carrier wave $V_C(t) = 160\sin(2\pi \times 10^6 t)$ volts is made to vary between $V_{max} = 200V$ and $V_{min} = 120V$ 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 _____.
[20 Jul 2021 Shift 1]

Answer: 40

Solution:

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 $A_m = 40$

Question60

A carrier signal C(t) = 25 sin left(2.512 times 10^{10} t right) is amplitude modulated by a message signal m(t) = 5 sin left(1.57 times 10^{8} t right) and transmitted through an antenna. What will be the bandwidth of the modulated signal?
[17 Mar 2021 Shift 2]

Options:

A. 8 GHz

B. 2.01 GHz

C. 1987.5 MHz

D. 50 MHz

Answer: D

Solution:

Solution:
Given, carrier signal,
$C(t) = 25\sin(2.512 \times 10^{10}t)$
Message signal,
$m(t) = 5\sin(1.57 \times 10^{8}t)$
Angular frequency of the message signal,
$\omega_m = 1.57 \times 10^{8} \text{rad s}^{-1}$
Frequency of the message signal,
of the message $f_m = \frac{\omega_m}{2\pi}$
Substituting the values in the above equation, we get $f_m = \frac{1.57 \times 10^{8}}{2\pi} \text{Hz}$
Bandwidth of the modulated signal is
$\beta = 2f_m$
Substituting the values in the above equation, we get
$\beta = 2\left(\frac{1.57 \times 10^{B}}{2\pi}\right)$
$\beta = 50\text{MHz}$
Hence, the bandwidth of the modulated signal is 50MHz.

Question61

An amplitude modulated wave is represented by $C_m(t) = 10(1 + 0.2\cos 12560\,t)\sin(111 \times 10^4 t)$ V. The modulating frequency in kHz will be ..... .
[26 Aug 2021 Shift 1]

Answer: 2

Solution:

Solution:
The amplitude modulated wave is represented by
$C_m(t) = 10(1 + 0.2\cos 12560\,t)\sin(111 \times 10^4 t)\,V$
Comparing with standard equation,
$C_m(t) = (A_C + A_m \sin \omega_m t)\sin \omega_C t$
$\omega_m = 12560\,\text{rad / s}$
$\Rightarrow 2\pi f_m = 12560$
$f_m = \frac{12560}{2\pi} = \frac{12560 \times 7}{2 \times 22} \simeq 2000\,\text{Hz}$
$\simeq$ 2 kHz

Question62

A transmitting antenna at top of a tower has a height of 50m and the height of receiving antenna is 80m. What is range of communication for line of sight (LOS) mode?
[Use radius of Earth = 6400 km]
[26 Aug 2021 Shift 2]

Options:

A. 45.5 km

B. 80.2 km

C. 144.1 km

D. 57.28 km

Answer: D

Solution:

Solution:
Given, height of transmitting antenna, $H_T = 50\text{m}$
Height of receiving antenna, $H_R = 80\text{m}$
Radius of earth, $R = 6400\,\text{km} = 6.4 \times 10^6\text{m}$
For maximum range of communication for LOS,
$d_{max} = \sqrt{2H_TR} + \sqrt{2H_RR}$

$\Rightarrow d_{max} = \sqrt{2 \times 50 \times 6.4 \times 10^6} + \sqrt{2 \times 80 \times 6.4 \times 10^6}$
$\Rightarrow d_{max} = 10^3[\sqrt{640} + \sqrt{1024}]$
$= 57.29 \times 10^3 m$
$d_{max} = 57.28\,km$
Hence, maximum range of communication for LOS is 57.28 km.

Question63

An antenna is mounted on a 400m tall building. What will be the wavelength of signal that can be radiated effectively by the transmission tower upto a range of 44 km?
[27 Aug 2021 Shift 2]

Options:

A. 37.8 m

B. 605 m

C. 75.6 m

D. 302 m

Answer: B

Solution:

Solution:
Given, height of tower, $H = 400m$
Range of tower,
$d = 44km = 44 \times 10^3 m$
Since, $d = \sqrt{2hR_e}$
where, R_e is radius of earth $= 6400km = 6400 \times 10^3 m$
$\Rightarrow h = \frac{d^2}{2R_e} = \frac{44 \times 10^3 \times 44 \times 10^3}{2 \times 6400 \times 10^3}$
$h = 151.25m$
and wavelength $(\lambda) = 4h = 151.25 \times 4$
$= 605m$

Question64

If the sum of the heights of transmitting and receiving antennas in the line of sight of communication is fixed at 160m, then the maximum range of LOS communication is .....km.
(Take, radius of Earth = 6400 km)
[31 Aug 2021 Shift 1]

Answer: 64

Solution:

Given,
Height of transmitting anteena (H_T)+ height of receiving anteena (H_R) = 160m
Radius of earth, $R_e = 6400\,km$
Let, range = d
If height of transmitting antenna be x
then, height of receiving anteena = 160 - x
We know that, $d = \sqrt{2Rh_T} + \sqrt{2Rh_R} = \sqrt{2R}[\sqrt{h_T} + \sqrt{h_R}]$
$= \sqrt{2 \times R}[\sqrt{x} + \sqrt{160 - x}]$
$= \sqrt{2R}[\sqrt{x} + \sqrt{160 - x}]$
For maximum range
$\frac{d}{dx}(d) = \frac{d}{dx}\sqrt{2R}[\sqrt{x} + \sqrt{160 - x}] = 0$
$\Rightarrow \frac{d}{dx}[\sqrt{x} + \sqrt{160 - x}] = 0$
$\Rightarrow \frac{1}{2}x^{-\frac{1}{2}} - \frac{1}{2}(160 - x)^{-\frac{1}{2}} = 0$
$\Rightarrow \frac{1}{2}\frac{1}{\sqrt{x}} = \frac{1}{2}\frac{1}{\sqrt{160 - x}}$
$\Rightarrow x = 160 - x$
$\Rightarrow 2x = 160$
$\Rightarrow x = 80$
$\therefore$ Maximum range
$(d_{max}) = \sqrt{2}R[\sqrt{x} + \sqrt{160 - x}]$
$= \sqrt{2 \times 6400}[\sqrt{80} + \sqrt{160 - 80}]$
$= 80\sqrt{2}\left[\sqrt{\frac{80}{1000}} + \sqrt{\frac{80}{1000}}\right]$
$= 80\sqrt{2} \times 2\sqrt{\frac{80}{1000}}$
$= 80\sqrt{2} \times \frac{2\sqrt{80}}{10\sqrt{10}} = 16\sqrt{\frac{2 \times 80}{10}}$
$= 16 \times 4 = 64\,km$

Question65

An amplitude modulated wave is represented by the expression $v_m = 5(1 + 0.6\cos 6280\,t)\sin(211 \times 10^4 t)$ volts The minimum and maximum amplitudes of the amplitude modulated wave are, respectively:
[Sep. 02, 2020 (I)]

Options:

A. 3 . 2V , 5V

B. $\frac{5}{2}$V , 8V

C. 5V , 8V

D. 3V , 5V

Answer: B

Solution:

From the given expression,
$V_m = 5(1 + 0.6\cos 6280\,t)\sin(211 \times 10^4 t)$

Modulation index, $\mu = 0.6$
$\because A_m = \mu A_c$
$\frac{A_{max} + A_{min}}{2} = A_c = 5$ ...(i)
$\frac{A_{max} - A_{min}}{2} = A_m = 3$ ...(ii)
From equation (i) + (ii),
Maximum amplitude, $A_{max} = 8$.
From equation (i) −(ii)
Minimum amplitude $A_{min} = 2$.

Question66

A 100V carrier wave is made to vary between 160V and 40V by a modulating signal. What is the modulation index? [12 Jan. 2019 I]

Options:

A. 0.3

B. 0.5

C. 0.6

D. 0.4

Answer: C

Solution:

Maximum amplitude $= E_m + E_c = 160$
$E_m + 100 = 160$
$E_m = 160 - 100 = 60$
Modulation index,
$\mu = \frac{E_m}{E_c} = \frac{60}{100}$
$\mu = 0.6$

Question67

To double the covering range of a TV transition tower, its height should be multiplied by: [12 Jan 2019 II]

Options:

A. $\frac{1}{\sqrt{2}}$

B. 2

C. 4

D. $\sqrt{2}$

Answer: C

Solution:

As we know, Range $= \sqrt{2hR}$
therefore to double the range height 'h' should be 4 times.

Question68

An amplitude modulated signal is given by $V(t) = 10[1 + 0.3\cos(2.2 \times 10^4 t)]\sin(5.5 \times 10^5 t)$. Here t is in seconds. The sideband frequencies (in kHz) are, [Given $\pi = \frac{22}{7}$]

[11 Jan 2019 II]

Options:

A. 1785 and 1715

B. 178.5 and 171.5

C. 89.25 and 85.75

D. 892.5 and 857.5

Answer: C

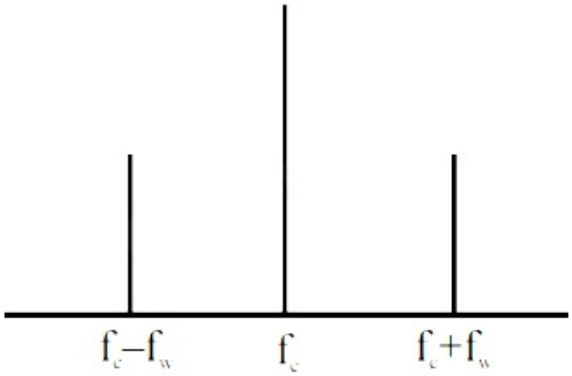
Solution:

Equation given
$V(t) = 10[1 + 0.3\cos(2.2 \times 10^4)]$
$\sin(5.5 \times 10^5 t)$
$= 10 + 1.5[\sin(57.2 \times 10^4 t) + \sin(52.8 \times 10^4 t)]$
$\omega_c + \omega_w = 57.2 \times 10^4 = 2\pi f_1$

$$f_1 = \frac{57.2 \times 10^4}{2 \times \left(\frac{22}{7}\right)} = 9.1 \times 10^4 \simeq 91\text{KHz}$$

$\omega_c - \omega_w = 52.8 \times 10^4$

$$f_2 = \frac{52.8 \times 10^4}{2 \times \left(\frac{22}{7}\right)} \simeq 84\text{KHz}$$



Upper side band frequency (f_1) is

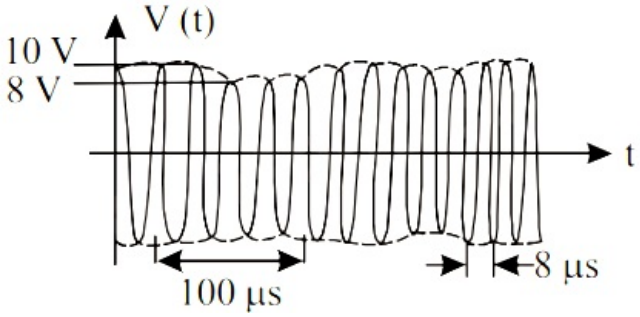
$f_1 = f_c - f_w = \frac{52.8 \times 10^4}{2\pi} \approx 85.00\text{kHz}$

Lower side band frequency (f_2) is

$f_2 = f_c + f_w = \frac{57.2 \times 10^4}{2\pi} \approx 90.00\text{kHz}$

Question69

An amplitude modulated signal is plotted below:



Which one of the following best describes the above signal? [11 Jan. 2019 II]

Options:

A. $(9 + \sin(2.5\pi \times 10^5 t))\ \sin(2\pi \times 10^4 t)\,\text{V}$

B. $(1 + 9\sin(2\pi \times 10^4 t))\ \sin(2.5\pi \times 10^5 t)\,\text{V}$

C. $(9 + \sin(2\pi \times 10^4 t))\ \sin(2.5\pi \times 10^5 t)\,\text{V}$

D. $(9 + \sin(4\pi \times 10^4 t))\ \sin(5\pi \times 10^5 t)\,\text{V}$

Answer: C

Solution:

Solution:

After analysing the graph we may conclude that

(i) Amplitude varies as $8 - 10\text{V}$ or 9 ± 1

(ii) Two time period as

$100\mu s$ (signal wave) & $8\mu s$ (carrier wave)

So, equation of AM signal is

$\left[9 \pm 1 \sin\left(\frac{2\pi t}{T_1}\right) \sin\left(\frac{2\pi t}{T_2}\right)\right]$

$= [9 \pm \sin(2\pi \times 10^4 t)]\ \sin(2.5\pi \times 10^5 t)\,\text{V}\ ]$

Question70

A TV transmission tower has a height of 140m and the height of the receiving antenna is 40m. What is the maximum distance upto which signals can be broadcasted from this tower in LOS (Line of Sight) mode? (Given : radius of earth $= 6.4 \times 10^6\text{m}$). [10 Jan. 2019 I]

Options:

A. 65km

B. 48km

C. 80km

D. 40km

Answer: A

Solution:

Solution:
Maximum distance upto which signal can be broadcasted
$d_{max} = \sqrt{2Rh_T} + \sqrt{2Rh_R}$
where h_T and h_R are heights of transmission tower and receiving antenna respectively.
Putting values R, hT and hR
$d_{max} = \sqrt{2 \times 6.4 \times 106}[\sqrt{140} + \sqrt{40}]$
or, $d_{max} \simeq 65km$

Question71

The modulation frequency of an AM radio station is 250 kH z, which is 10% of the carrier wave. If another AM station approaches you for license what broadcast frequency will you allot? [10 Jan. 2019 I]

Options:

A. 2750kH z

B. 2900kH z

C. 2250kH z

D. 2000kH z

Answer: D

Solution:

Solution:
According to question, modulation frequency, 250 H z is 10% of carrier wave
$f_{carrier} = \frac{250}{0.1} = 2500K\,H\,Z$
∴ Range of signal 2500 ± 250K H z = 2250H z to 2750H z For 2000K H Z
$f_{mod} = 200H\,z$
∴ Range = 1800K H Z to 2200K H Z

Question72

In a communication system operating at wavelength 800 nm, only one percent of source frequency is available as signal bandwidth. The

number of channels accomodated for transmitting TV signals of band width 6M H z are (Take velocity of light $c = 3 \times 10^8 ms$, $h = 6.6 \times 10^{-34} J - s$)
[9 Jan. 2019 II]

Options:

A. 3.75×10^6

B. 3.86×10^6

C. 6.25×10^5

D. 4.87×10^5

Answer: C

Solution:

Solution:

Frequency, $f = \frac{V}{\lambda} = \frac{3 \times 10^8}{8 \times 10^{-7}} = \frac{30}{8} \times 10^{14} H z$

$= 3.75 \times 10^{14} H z$

1% of $f = 0.0375 \times 10^{14} H z$

$= 3.75 \times 10^{12} H z = 3.75 \times 10^6 M H z$

As we know, number of channels accomodated for transmission $= \frac{\text{total bandwidth of Channel}}{\text{bandwidth needed per channel}}$

$= \frac{3.75 \times 10^6}{6} = 6.25 \times 10^5$

Question73

In an amplitude modulator circuit, the carrier wave is given by, $C(t) = 4 \sin(20000\pi t)$ while modulating signal is given by, $m(t) = 2 \sin(2000\pi t)$. The values of modulation index and lower side band frequency are :
[12 April 2019 II]

Options:

A. 0.5 and 10kH z

B. 0.4 and 10kH z

C. 0.3 and 9kH z

D. 0.5 and 9kH z

Answer: D

Solution:

Solution:

Modulation index, $\mu = \frac{A_m}{A_c} = \frac{2}{4} = 0.5$

Given, $f_e = \frac{20000\pi}{2\pi} = 10000 Hz$

and $f_m = \frac{2000\pi}{2\pi} = 1000 Hz$

$\therefore LSB = f_e - f_m = 10000 - 1000 = 9000 Hz$

Question74

A message signal of frequency 100M Hz and peak voltage 100V is used to execute amplitude modulation on a carrier wave of frequency 300GHz and peak voltage 400 V. The modulation index and difference between the two side band frequencies are : [10 April 2019 II]

Options:

A. 4; $1 \times 10^8 Hz$

B. 4; $2 \times 10^8 Hz$

C. 0.25; $2 \times 10^8 Hz$

D. 0.25; $1 \times 10^{-8} T$

Answer: C

Solution:

Solution:

Range of frequency $= (f_c - f_m)$ to $(f_c + f_m)$

$\therefore$ Band width $= 2f_m = 2 \times 100 \times 10^6 Hz$

$= 2 \times 10^8 Hz$

and Modulation index $= \frac{A_m}{A_c} = \frac{100}{400} = 0.25$

Question75

A signal $A \cos \omega t$ is transmitted using $v_0 \sin \omega_0 t$ as carrier wave. The correct amplitude modulated (AM) signal is: [9 April 2019 I]

Options:

A. $v_0 \sin \omega_0 t + \frac{A}{2} \sin(\omega_0 - \omega) t + \frac{A}{2} \sin(\omega_0 + \omega) t$

B. $v_0 \sin[\omega_0(1 + 0.01A \sin \omega t)t]$

C. $v_0 \sin \omega_0 t + A \cos \omega t$

D. $(v_0 + A) \cos \omega t \sin \omega_0 t$

Answer: A

Question76

The physical sizes of the transmitter and receiver antenna in a communication system are:
[9 April 2019 II]

Options:

A. independent of both carrier and modulation frequency

B. inversely proportional to carrier frequency

C. inversely proportional to modulation frequency

D. proportional to carrier frequency

Answer: B

Solution:

Solution:
Size of antenna,
$l = \frac{\lambda}{4}$. As $\lambda = \frac{C}{f} \therefore l \propto \frac{1}{f}$

Question77

The wavelength of the carrier waves in a modern optical fiber communication network is close to :
[8 April 2019 I]

Options:

A. 2400nm

B. 1500nm

C. 600nm

D. 900nm

Answer: B

Solution:

Solution:
Carrier waves of wavelength 1500nm is used in modern optical fiber communication.

Question78

In a line of sight ratio communication, a distance of about 50km is kept between the transmitting and receiving antennas. If the height of the receiving antenna is 70m, then the minimum height of the transmitting antenna(Radius of the Earth $= 6.4 \times 10^6$m).
[8 April 2019 II]

Options:

A. 20m

B. 51m

C. 32m

D. 40m

Answer: C

Solution:

Solution:
(c) LOS = $\sqrt{2h_T R} + \sqrt{2h_R R}$
or $50 \times 103 = \sqrt{2h_T \times 6.4 \times 10^6} + \sqrt{2 \times 70 \times 6.4 \times 40^6}$
On solving, $h_T = 32$m

Question79

A telephonic communication service is working at carrier frequency of 10GH z. Only 10% of it is utilized for transmission. How many telephonic channels can be transmitted simultaneously if each channel requires a bandwidth of 5kH z ?
[2018]

Options:

A. 2×10^3

B. 2×10^4

C. 2×10^5

D. 2×10^6

Answer: C

Solution:

Solution:
given 10% of 10GH z used for tranomission.

$f_m = \frac{10}{100} \times 10GHz$

$f_m = 1GHz \rightarrow$ used

$f_c = 10GHz$

$\text{no. of channels} = \frac{\text{max frequency}}{\text{bandwidth required}}$

$= \frac{1 \times 10^9}{5 \times 10^3}$

$= \frac{10 \times 10^8}{5 \times 10^3}$

no chanuels. $= 2 \times 10^5$

Question80

A carrier wave of peak voltage 14V is used for transmitting a message signal. The peak voltage of modulating signal given to achieve a modulation index of 80% will be:
[2018]

Options:

A. 11.2V

B. 7V

C. 22.4V

D. 28V

Answer: A

Solution:

Solution:

Given : modulation index $m = 80\% = 0.8$

$E_c = 14V$, $E_m = ?$

using, $m = \frac{E_m}{E_c} \Rightarrow E_m = m \times E_c = 0.8 \times 14 = 11.2V$

Question81

The number of amplitude modulated broadcast stations that can be accommodated in a 300kHz band width for the highest modulating frequency 15kHz will be:
[Online April 15, 2018]

Options:

A. 20

B. 10

C. 8

D. 15

Answer: B

Solution:

Solution:
Given, modulating frequency $f_m = 15K\,Hz$
$\therefore$ Bandwidth of one channel $= 2f_m = 30kHz$
$\therefore$ No of channels accommodate $= \frac{300kHz}{30kHz} = 10$

Question82

The carrier frequency of a transmitter is provided by a tank circuit of a coil of inductance 49μH and a capacitance of 2.5nF . It is modulated by an audio signal of 12kH z. The frequency range occupied by the side bands is:
[Online April 15, 2018]

Options:

A. $18kHz - 30kHz$

B. $63kHz - 75kHz$

C. $442kHz - 466kHz$

D. $13482kHz - 13494kHz$

Answer: C

Solution:

Solution:
Given : Inductance, $L = 49\mu H = 49 \times 10^{-6}H$
capacitance $C = 2.5nF = 2.5 \times 10^{-9}F$
Using $\omega = \frac{1}{\sqrt{LC}}$

$= \frac{1}{\sqrt{49 \times 10^{-6} \times \frac{2.5}{10} \times 10^{-9}}} = \frac{1}{7 \times 5 \times 10^{-8}} = \frac{10^8}{7 \times 5}$

or, $\frac{10^8}{7 \times 5} = 2\pi \times f = 2 \times \frac{22}{7} \times f$ $(\because \omega = 2\pi f)$

or, $f = \frac{10^7}{22} = \frac{10^4}{22}kHz = 454.54kHz$
Therefore frequency range $454.54 \pm 12kHz$
i.e. $442kHz - 466kHz$

Question83

In amplitude modulation, sinusoidal carrier frequency used is denoted by ω_c and the signal frequency is denoted byω_m. The bandwidth ($\Delta\omega_m$) of the signal is such that $\Delta\omega_m < \omega_c$. Which of the following frequencies

is not contained in the modulated wave?
[2017]

Options:

A. $\omega_m + \omega_c$

B. $\omega_c - \omega_m$

C. ω_m

D. ω_c

Answer: C

Solution:

Solution:
Modulated carrier wave contains frequency ω_c and $\omega_c \pm \omega_m$

Question84

A signal is to be transmitted through a wave of wavelength lambda, using a linear antenna. The length 1 of the antenna and effective power radiated P_{eff} will be given respectively as :
(K is a constant of proportionality)
[Online April 9, 2017]

Options:

A. λ, $P_{eff} = K\left(\frac{1}{\lambda}\right)^2$

B. $\frac{\lambda}{8}$, $P_{eff} = K\left(\frac{1}{\lambda}\right)$

C. $\frac{\lambda}{16}$, $P_{eff} = K\left(\frac{1}{\lambda}\right)^3$

D. $\frac{\lambda}{5}$, $P_{eff} = K\left(\frac{1}{\lambda}\right)^{\frac{1}{2}}$

Answer: A

Solution:

Solution:
Length of antenna = comparable to λ
Power radiated by linear antenna inversely depends on the square of wavelength and directly on the length of the antenna. Hence,
Power $P = \mu\left(\frac{1}{\lambda}\right)^2$
here $\mu = K$

Question85

A signal of frequency 20kH z and peak voltage of 5 Volt is used to modulate a carrier wave of frequency 1.2M H z and peak voltage 25 Volts. Choose the correct statement.
[Online April 8, 2017]

Options:

A. Modulation index = 5, side frequency bands are at 1400kH z and 1000kH z

B. Modulation index = 5, side frequency bands are at 21.2kH z and 18.8kH z

C. Modulation index = 0.8, side frequency bands are at 1180kH z and 1220kH z

D. Modulation index = 0.2, side frequency bands are at 1220kH z and 1180kH z

Answer: D

Solution:

Solution:

Modulation index (m) = $\frac{V_m}{V_0} = \frac{5}{25} = 0.2$

Given, frequency of carrier wave (f_c) = 1.2×10^6H z

= 1200kH z.

Frequency of signal (f_0) = 20kH z.

Side frequency bands = $f_c \pm f_0$

$f_1 = 1200 - 20 = 1180$kH z

$f_2 = 1200 + 20 = 1220$kH z

Question86

Choose the correct statement:
[2016]

Options:

A. In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.

B. In frequency modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the frequency of the audio signal.

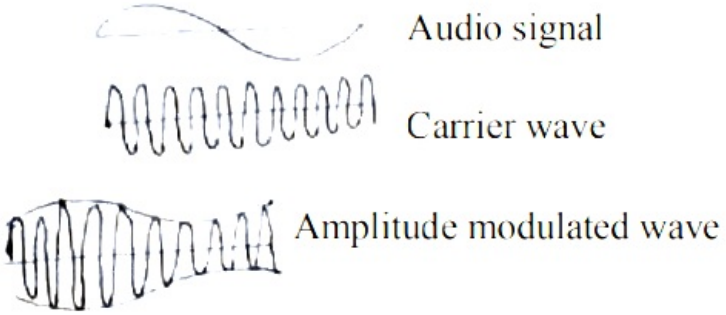
C. In amplitude modulation the amplitude of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.

D. In amplitude modulation the frequency of the high frequency carrier wave is made to vary in proportion to the amplitude of the audio signal.

Answer: C

Solution:

In amplitude modulation, the amplitude of the high frequency carrier wave made to vary in proportional to the amplitude of audio signal.



Question87

A modulated signal $C_m(t)$ has the form $C_m(t) = 30\sin 300\pi t + 10(\cos 200\pi t - \cos 400\pi t)$. The carrier frequency f_c, the modulating frequency (message frequency) f_ω and the modulation indix μ are respectively given by: [Online April 10, 2016]

Options:

A. $f_c = 200Hz;\ f_w = 50Hz;\ \mu = \frac{1}{2}$

B. $f_c = 150Hz;\ f_w = 50Hz;\ \mu = \frac{2}{3}$

C. $f_c = 150Hz;\ f_w = 30Hz;\ \mu = \frac{1}{3}$

D. $f_c = 200Hz;\ f_w = 30Hz;\ \mu = \frac{1}{2}$

Answer: B

Solution:

Solution:

Comparing the given equation with standard modulated signal wave equation, $m = A_c \sin\omega_c t + \frac{\mu A_c}{2}\cos(\omega_c - \omega_s)t - \frac{\mu A_c}{2}\cos(\omega_c + \omega_s)t$

$\mu\frac{A_c}{2} = 10 \Rightarrow \mu = \frac{2}{3}$ (modulation index)

$A_c = 30$

$\omega_c - \omega_s = 200\pi$

$\omega_c + \omega_s = 400\pi$

$\Rightarrow f_c = 150,\ f_s = 50Hz$

Question88

An audio signal consists of two distinct sounds: one a human speech signal in the frequency band of 200Hz to 2700Hz, while the other is a

high frequency music signal in the frequency band of 10200H z to 15200H z. The ratio of the AM signal bandwidth required to send both the signals together to the AM signal bandwidth requried to send just the human speech is :
[Online April 9, 2016]

Options:

A. 2

B. 5

C. 6

D. 3

Answer: C

Solution:

Solution:
Ratio of AM signal Bandwidths $= \frac{15200 - 200}{2700 - 200} = \frac{15000}{2500} = 6$

Question89

A signal of 5kH z frequency is amplitude modulated on a carrier wave of frequency 2M H z. The frequencies of the resultant signal is/are :
[2015]

Options:

A. 2005kH z, 2000kH z and 1995kH z

B. 2000kH z and 1995kH z

C. 2M H z only

D. 2005kH z and 1995kH z

Answer: A

Solution:

Solution:
Amplitude modulated wave consists of three frequencies are $\omega_c + \omega_m$, ω, $\omega_c - \omega_m$
i.e. 2005kH z, 2000kH z, 1995kH z

Question90

Long range radio transmission is possible when the radio waves are reflected from the ionosphere. For this to happen the frequency of the

radio waves must be in the range:
[Online April 19,2014]

Options:

A. $80-150MHz$

B. $8-25MHz$

C. $1-3MHz$

D. $150-1500kHz$

Answer: B

Solution:

Solution:
Frequency of radio waves for sky wave propagation is $2MHZ$ to $30MHZ$.

Question91

For sky wave propagation, the radio waves must have a frequency range in between:
[Online April 12,2014]

Options:

A. $1MHz$ to $2MHz$

B. $5MHz$ to $25MHz$

C. $35MHz$ to $40MHz$

D. $45MHz$ to $50MHz$

Answer: B

Solution:

Solution:
Sky wave propagation is suitable for frequency range $5MHz$ to $25MHz$

Question92

A transmitting antenna at the top of a tower has height 32 m and height of the receiving antenna is 50m. What is the maximum distance between them for satisfactory communication in line of sight (LOS) mode?
[Online April 9,2014]

Options:

A. 55.4km

B. 45.5km

C. 54.5km

D. 455km

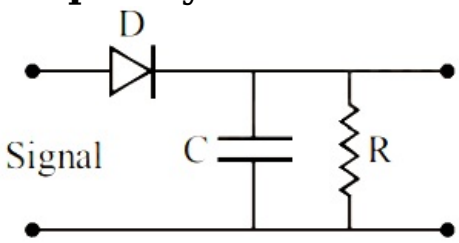
Answer: B

Solution:

Solution:
Given: $h_R = 32m$
$h_T = 50m$
Maximum distance, $d_M = ?$
Applying, $d_M = \sqrt{2Rh_T} + \sqrt{2Rh_R}$
$= \sqrt{2 \times 6.4 \times 10^6 \times 50} + \sqrt{2 \times 6.4 \times 10^6 \times 32} = 45.5km$

Question93

A diode detector is used to detect an amplitude modulated wave of 60% modulation by using a condenser of capacity 250 picofarad in parallel with a load resistance 100 kilo ohm. Find the maximum modulated frequency which could be detected by it.



[2013]

Options:

A. 10.62M H z

B. 10.62kH z

C. 5.31M H z

D. 5.31kH z

Answer: B

Solution:

Given : Resistance R = 100 kilo ohm
$= 100 \times 10^3 \omega$
Capacitance C = 250 picofarad
$= 250 \times 10^{-12} F$
$\tau = RC = 100 \times 10^3 \times 250 \times 10^{-12} sec$
$= 2.5 \times 10^7 \times 10^{-12} sec$
$= 2.5 \times 10^{-5} sec$
The higher frequency whcih can be detected with tolerable distortion is $f = \frac{1}{2\pi m_a RC} = \frac{1}{2\pi \times 0.6 \times 2.5 \times 10^{-5}} H z$

$= \frac{100 \times 10^4}{25 \times 1.2\pi}\text{H z} = \frac{4}{1.2\pi} \times 10^4\text{H z}$
$= 10.61\text{K H z}$
This condition is obtained by applying the condition that rate of decay of capacitor voltage must be equal or less than the rate of decay modulated signal voltage for proper detection of mdoulated signal.

Question94

Which of the following modulated signal has the best noise-tolerance? [Online April 25, 2013]

Options:

A. Long-wave

B. Short-wave

C. Medium-wave

D. Amplitude-modulated

Answer: B

Solution:

Solution:
Short-wave has the best noise tolerance.

Question95

Which of the following statement is NOT correct? [Online April 23, 2013]

Options:

A. Ground wave signals are more stable than the sky wave signals.

B. The critical frequency of an ionospheric layer is the highest frequency that will be reflected back by the layer when it is vertically incident.

C. Electromagnetic waves of frequencies higher than about 30 MHz cannot penetrate the ionosphere.

D. Sky wave signals in the broadcast frequency range are stronger at night than in the day time.

Answer: C

Solution:

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

Question96

This question has Statement- 1 and Statement- 2 . Of the four choices given after the Statements, choose the one that best describes the two Statements.
Statement-1: Short wave transmission is achieved due to the total internal reflection of the e-m wave from an appropriate height in the ionosphere.
Statement-2: Refractive index of a plasma is independent of the frequency of e-m waves.
[Online April 22, 2013]

Options:

A. Statement- 1 is true, Statement- 2 is false.

B. Statement- 1 is false, Statement- 2 is true.

C. Statement-1 is true, Statement-2 is true but Statement -2 is not the correct explanation of statement- 1

D. Statement-1 is true, Statement- 2 is true and Statement -2 is the correct explanation of Statement-1.

Answer: A

Solution:

Solution:

Effective refractive index of the ionosphere $n_{eff} = n_0\left[1 - \frac{80.5N}{f^2}\right]^{\frac{1}{2}}$

where f is the frequency of em waves

Question97

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 the equation of modulated signal $[C_m(t)]$ and its modulation index are respectively.
[Online April 9, 2013]

Options:

A. $C_m(t) = A(1 + \sin\omega_m t)\sin\omega_c t$ and 2

B. $C_m(t) = A(1 + \sin\omega_m t)\sin\omega_m t$ and 1

C. $C_m(t) = A(1 + \sin\omega_m t)\sin\omega_c t$ and 1

D. $C_m(t) = A(1 + \sin\omega_c t)\sin\omega_m t$ and 2

Answer: C

Solution:

Solution:

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

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

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

$= A(1 + \sin w_c t) \sin \omega_m t$

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

Question98

A radar has a power of 1kW and is operating at a frequency of 10GH z. It is located on a mountain top of height 500m. The maximum distance upto which it can detect object located on the surface of the earth (Radius of earth $= 6.4 \times 10^6$m) is : [2012]

Options:

A. 80km

B. 16km

C. 40km

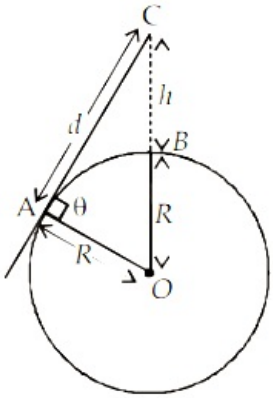
D. 64km

Answer: A

Solution:

Solution:

Let d is the maximum distance, upto which it can detect the objects



From ΔAOC

$OC^2 = AC^2 + AO^2$

$(h + R)^2 = d^2 + R^2$

$\Rightarrow d^2 = (h + R)^2 - R^2$

$d = \sqrt{(h + R)^2 - R^2}$; $d = \sqrt{h^2 + 2hR}$

$d = \sqrt{500^2 + 2 \times 6.4 \times 10^6} = 80\text{km}$

Question99

A radio transmitter transmits at 830kH z. At a certain distance from the transmitter magnetic field has amplitude 4.82×10^{-11}T . The electric field and the wavelength are respectively.
[Online May 26,2012]

Options:

A. 0.014N / C, 36m

B. 0.14N / C, 36m

C. 0.14N / C, 360m

D. 0.014N / C, 360m

Answer: D

Solution:

Solution:
Frequency of EM wave $\nu = 830\text{K H z} = 830 \times 10^3\text{H z}$
Magnetic field, $B = 4.82 \times 10^{-11}\text{T}$
As we know, frequency, $\upsilon = \frac{c}{\lambda}$
or $\lambda = \frac{c}{\upsilon} = \frac{3 \times 10^8}{830 \times 10^3}$
$\lambda \simeq 360\text{m}$
And, $E = BC = 4.82 \times 10^{-11} \times 3 \times 10^8$
$= 0.014\text{N / C}$

Question100

Given the electric field of a complete amplitude modulated wave as

$$\vec{E} = \hat{i}E_c\left(1 + \frac{E_m}{E_c}\cos\omega_m t\right)\cos\omega_c t$$

Where the subscript c stands for the carrier wave and m for the modulating signal. The frequencies present in the modulated wave are
[Online May 19, 2012]

Options:

A. ω_c and $\sqrt{\omega_c^2 + \omega_m^2}$

B. ω_c, $\omega_c + \omega_m$ and $\omega_c - \omega_m$

C. ω_c and ω_m

D. ω_c and $\sqrt{\omega_c\omega_m}$

Answer: B

Solution:

The frequencies present in amplitude modulated wave are Carrier frequency $= \omega_c$
Upper side band frequency $= \omega_c + \omega_m$
Lower side band frequency $= \omega_c - \omega_m$

Question101

A 10kW transmitter emits radio waves of wavelength 500 m. The number of photons emitted per second by the transmitter is of the order of
[Online May 12, 2012]

Options:

A. 10^{37}

B. 10^{31}

C. 10^{25}

D. 10^{43}

Answer: B

Solution:

Solution:
Power $= \frac{nhc}{\lambda}$
(where, n = no. of photons per second)
$\Rightarrow n = \frac{10 \times 10^3 \times 500}{6.6 \times 10^{-34} \times 3 \times 10^8} \simeq 10^{31}$

Question102

This question has Statement -1 and Statement −2. Of the four choices given after the statements, choose the one that best describes the two statements.
Statement -1 : Sky wave signals are used for long distance radio communication. These signals are in general, less stable than ground wave signals.
Statement -2: The state of ionosphere varies from hour to hour, day to day and season to season.
[2011]

Options:

A. Statement-1 is true, Statement-2 is true, Statement-2 is the correct explanation of Statement-1.

B. Statement-1 is true, Statement-2 is true, Statement-2 is not the correct explanation of Statement -1 .

C. Statement -1 is false, Statement -2 is true.

D. Statement -1 is true, Statement -2 is false.

Answer: B

Solution:

Solution:
For long distance communication, sky wave signals are used.
Also, the state of ionosphere varies every time.
So, both statements are correct.

Question103

Which of the following four alternatives is not correct?
We need modulation:
[2011 RS]

Options:

A. to reduce the time lag between transmission and reception of the information signal

B. to reduce the size of antenna

C. to reduce the fractional band width, that is the ratio of the signal band width to the centre frequency

D. to increase the selectivity

Answer: A

Solution:

Low frequencies cannot be transmitted to long distances. Therefore, they are super imposed on a high frequency carrier signal by a process known as modulation. Speed of electro-magnetic waves will not change due to modulation. So there will be time lag between transmission and reception of the information signal.
