#420623

Topic: Propagation of Electromagnetic Waves

Answer the following questions:

(a) Long distance radio broadcasts use short-wave bands. Why?

(b) It is necessary to use satellites for long distance TV transmission.Why?

(c) Optical and radiotelescopes are built on the ground but X-ray astronomy is possible only from satellites orbiting the earth.Why?

(d) The small ozone layer on top of the stratosphere is crucial for human survival. Why?

(e) If the earth did not have an atmosphere, would its average surface temperature be higher or lower than what it is now?

(f) Some scientists have predicted that a global nuclear war on the earth would be followed by a severe nuclear winter with a devastating effect on life on earth. What might be the basis of this prediction?

Solution

(a)

Long distance radio broadcasts use short-wave bands because they can be reflected by the ionosphere of the earth's atmosphere and thus can be send to longer distances.

(b)

Yes, long distance TV transmission requires UHF and still higher frequencies. Ionosphere does not reflect frequencies more than 30 MHz and hence satellites are used to reflect these waves.

(c)

With reference to X-rays astronomy, X-rays are absorbed by the atmosphere. But visible and radio waves can penetrate it. Thus, optical and radio telescopes are built on th ground, while X-rays astronomy is possible only with help of the satellites orbiting the earth.

(d)

It absorbs ultraviolet radiations from the sun and prevents it from reaching the earth's surface and causing damage to life.

(e)

The temperature of the earth would be lower because of the absence of Greenhouse effect,which retains the heat from sun in the atmosphere.

(f)

The clouds produced by global nuclear war would perhaps cover substantial parts of the sky preventing solar light from reaching many parts of the globe. This would caus a winter.

#421794

Topic: Propagation of Electromagnetic Waves

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 $1000\ GHz$

Solution

For beyond-the-horizon communication, it is necessary for the signal to cover large distance. $10\ KHz$ signals cannot be radiated efficiently because of the antenna size. The high energy signal waves ($1\ GHz - 1000\ GHz$) penetrate the ionosphere and escape. $10\ MHz$ frequencies get reflected easily from the ionosphere. Hence, signal waves of such frequencies are suitable for beyond-the-horizon communication.

#421795

Topic: Propagation of Electromagnetic Waves

Frequencies in the UHF range normally propagate by means of

A Ground waves

B Sky waves

C Surface waves

D Space waves

Solution

Owing to its high frequency, an ultra high frequency (UHF) wave can neither travel along the trajectory of the ground nor can it get reflected by the ionosphere. The signals having UHF are propagated through line-of-sight communication, which is nothing but space wave propagation.

#421796

Topic: Elements of Communication System

Digital signals

(i) do not provide a continuous set of values.

(ii) represent values as discrete steps.

(iii) can utilize binary system.

(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 (i), (ii), (iii) and (iv)

Solution

A digital signal uses the binary (0 and 1) system for transferring message signals. Such a system cannot utilize the decimal signals, represent discontinuous values line-of-sight communication, which is nothing but space system (which corresponds to analogue signals). Digital signals represent discontinuous values.

#421801

Topic: Modulation

A carrier wave of peak voltage $12\ V$ 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%?

Solution

$A_c = 12\ V$

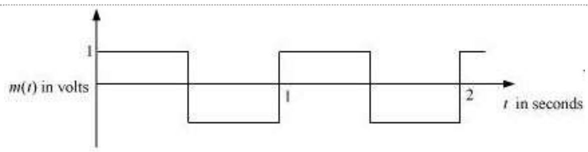
Modulation index, $m = 0.75$

M_m is the amplitude of modulating wave.

$m = A_m/A_c$. So, $A_m = 9\ V$

#476068

Topic: Amplitude Modulation



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

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

(i) Sketch the amplitude modulated waveform.

(ii) What is the modulation index?

Solution

(a)

$y(t) = [A_c + m(t)]c(t)$

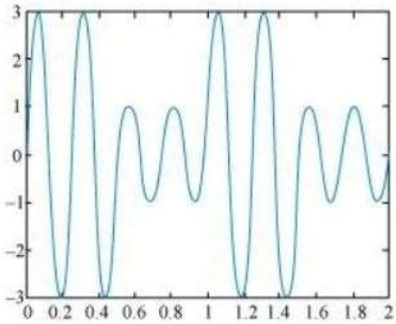
where

A_c is the amplitude of the carrier wave.

The modulated waveform $y(t)$ is shown in the figure.

(b)

Modulation index, $\mu = M/A = 0.5$



#476069

Topic: Amplitude Modulation

For an amplitude modulated wave, the maximum amplitude is found to be $10\ V$ while the minimum amplitude is found to be $2\ V$. Find the modulation index, μ.

What would be the value of μ is the minimum amplitude is zero volt?

Solution

$$\mu = \frac{V_{max} - V_{min}}{V_{max} + V_{min}}$$

Hence, $\mu = \dfrac{10-2}{10+2} = 2/3$

If $V_{min} = 0, \mu = 0$

#476070

Topic: Amplitude Modulation

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

Solution

Upper side band:

$$y_u(t) = \frac{AM}{2} sin((w_c + w_m)t)$$

$$c(t) = Asin(w_c t)$$

$$r(t) = y_t c_t = \frac{A^2M}{2} sin(w_c t) sin((w_c + w_m))$$

$$= \frac{A^2M}{2}[cos(w_m t) - cos[(w_m + 2w_c)t]]$$

By passing $r(t)$ through a low-pass filter, the higher frequency is removed.

$$\implies r'(t) = \frac{A'A^2M}{4} cos(w_m t)$$

Hence, it is possible to recover the modulating signal at the receiver station from the upper side band of transmitted AM wave from the carrier signal.