

# Communication Systems

## Question1

The heights of transmitting and receiving antennas are respectively  $\frac{1}{20000}$  and  $\frac{1}{80000}$  times the radius of the

Earth. The maximum distance between these two antennas for satisfactory communication in line of sight mode is

(Radius of the Earth =  $6.4 \times 10^6$  m )

AP EAPCET 2025 - 26th May Morning Shift

Options:

A.

48 km

B.

96 km

C.

320 km

D.

192 km

**Answer: B**

**Solution:**



$$H_t = \frac{1}{20000} R = \frac{R}{20000}$$

$$H_r = \frac{R}{80000}$$

Maximum distance

$$\begin{aligned} d &= \sqrt{2RH_t} + \sqrt{2RH_r} \\ &= \sqrt{2R \times \frac{R}{20000}} + \sqrt{2R \times \frac{R}{80000}} \\ &= \frac{R}{100} + \frac{R}{200} = \frac{6.4 \times 10^6}{100} + \frac{6.4 \times 10^6}{200} \\ &= 6.4 \times 10^4 + 3.2 \times 10^4 \\ &= 9.6 \times 10^4 \text{ m} = 96 \times 10^3 \text{ m} = 96 \text{ km} \end{aligned}$$

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## Question2

If the ratio of the maximum and minimum amplitudes of an amplitude modulated wave is 7 : 3, then the modulation index is

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**Options:**

A.

0.6

B.

0.7

C.

0.4

D.

0.3

**Answer: C**

**Solution:**



Modulation index is given by

$$\begin{aligned}\mu &= \frac{A_{\max} - A_{\min}}{A_{\max} + A_{\min}} \\ &= \frac{\frac{A_{\max}}{A_{\min}} - 1}{\frac{A_{\max}}{A_{\min}} + 1} \\ &= \frac{\frac{7}{3} - 1}{\frac{7}{3} + 1} = \frac{\frac{4}{3}}{\frac{10}{3}} = 0.4\end{aligned}$$

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## Question3

**Ionosphere acts as a reflector for the frequency range of**

**AP EAPCET 2025 - 23rd May Evening Shift**

**Options:**

A.

3 – 30kHz

B.

3 – 30MHz

C.

3 – 30 Hz

D.

3 – 30GHz

**Answer: B**

**Solution:**

The ionosphere reflects **high frequency (HF)** radio waves, which correspond to the range:

3 MHz to 30 MHz

This property allows long-distance radio communication (sky wave propagation).

**Correct answer:**

**Option B: 3 – 30 MHz**



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## Question4

If the maximum and minimum amplitudes of a modulated wave are 25 V and 5 V respectively, then the modulation index is

AP EAPCET 2025 - 23rd May Morning Shift

Options:

A.

$$\frac{1}{5}$$

B.

$$\frac{1}{3}$$

C.

$$\frac{3}{2}$$

D.

$$\frac{2}{3}$$

**Answer: D**

**Solution:**

$$A_{\max} = 25 \text{ V}$$

$$A_{\min} = 5 \text{ V}$$

∴ Modulation index

$$\begin{aligned} \mu &= \frac{A_{\max} - A_{\min}}{A_{\max} + A_{\min}} \\ &= \frac{25 - 5}{25 + 5} = \frac{20}{30} = \frac{2}{3} \end{aligned}$$

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## Question5

For transmitting a signal of frequency 1000 kHz, the minimum length of the antenna is



## AP EAPCET 2025 - 22nd May Evening Shift

Options:

A.

30 m

B.

50 m

C.

75 m

D.

1500 m

**Answer: C**

**Solution:**

**Step 1: Write down the given data**

$$f = 1000 \text{ kHz} = 1 \times 10^6 \text{ Hz}$$

Speed of electromagnetic wave in free space,

$$c = 3 \times 10^8 \text{ m/s}$$

**Step 2: Find the wavelength**

$$\lambda = \frac{c}{f} = \frac{3 \times 10^8}{1 \times 10^6} = 300 \text{ m}$$

**Step 3: Relation between antenna length and wavelength**

For efficient radiation, the **minimum antenna length** (usually a quarter-wave antenna) is:

$$L = \frac{\lambda}{4}$$

**Step 4: Calculate  $L$**

$$L = \frac{300}{4} = 75 \text{ m}$$

**Answer: Option C — 75 m**

## Question6

If in an amplitude modulated wave, the maximum amplitude is 14 V and the modulation index is 0.4 , then the amplitude of the carrier wave is

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Options:

A.

4 V

B.

8 V

C.

12 V

D.

10 V

**Answer: D**

**Solution:**

$$\begin{aligned} A_{\max} &= A_m + A_c \\ &= \mu A_c + A_c = (\mu + 1)A_c \\ \Rightarrow A_c &= \frac{A_{\max}}{\mu + 1} = \frac{14}{0.4 + 1} = \frac{14}{1.4} = 10 \text{ V} \end{aligned}$$

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## Question7

In amplitude modulation of waves, the maximum amplitude is 30 mV and minimum amplitude is 5 mV , then the modulation index is



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Options:

A.

$$\frac{4}{7}$$

B.

$$\frac{3}{7}$$

C.

$$\frac{5}{7}$$

D.

$$\frac{2}{7}$$

**Answer: C**

**Solution:**

**Given:**

- Maximum amplitude  $A_{\max} = 30 \text{ mV}$
- Minimum amplitude  $A_{\min} = 5 \text{ mV}$

**Formula for modulation index  $m$ :**

$$m = \frac{A_{\max} - A_{\min}}{A_{\max} + A_{\min}}$$

**Substitute the values:**

$$m = \frac{30-5}{30+5} = \frac{25}{35} = \frac{5}{7}$$

**Answer: Option C —  $\frac{5}{7}$**

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## Question8

**If the sum of heights of transmitting and receiving antennas in line of sight of communication is '  $h$  ' then the height of receiving**



antenna, to have the range maximum is

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Options:

A.

$$\frac{h}{2}$$

B.

$$\frac{h}{4}$$

C.

2 h

D.

$$\frac{2h}{3}$$

**Answer: A**

### Solution:

The range of line of sight communication between two antennas is given by

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

Here,  $h_T + h_R = h$

Let  $h_T = H$ , then

$$h_R = h - H$$

$$\therefore x = \sqrt{2R}[\sqrt{H} + \sqrt{h - H}]$$

$$\frac{dx}{dH} = \sqrt{2R} \left[ \frac{1}{2\sqrt{H}} + \frac{1}{2\sqrt{h - H}}(-1) \right] = 0$$

$$\Rightarrow \frac{1}{2\sqrt{H}} = \frac{1}{2\sqrt{h - H}}$$

$$H = h - H$$

$$\Rightarrow H = \frac{h}{2}$$



## Question9

Which one of the following is not classified as pulse modulation?

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Options:

- A. Pulse duration modulation
- B. Pulse amplitude modulation
- C. Pulse band modulation
- D. Pulse position modulation

**Answer: C**

**Solution:**

The correct answer is Option C: Pulse band modulation.

Here's a brief explanation of why:

Pulse duration modulation (often called Pulse Width Modulation, PWM) varies the width or duration of the pulse.

Pulse amplitude modulation (PAM) varies the amplitude of the pulse.

Pulse position modulation (PPM) varies the position of the pulse within a time frame.

Pulse band modulation is not a standard or recognized method in the classification of pulse modulation techniques.

Therefore, Option C is the one that does not belong.

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## Question10

**The maximum distance between the transmitting and receiving antennas for satisfactory communication in line of sight mode is 57.6 km . If the height of the receiving antenna is 80 m , the height of the transmitting antenna is (radius of earth =  $6.4 \times 10^6$  m )**

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Options:



A. 28.8 m

B. 51.2 m

C. 25.6 m

D. 14.4 m

**Answer: B**

### **Solution:**

Height of receiving antenna=80m=  $h_t$

Maximum distance between

transmitting and receiving antenna in

line of sight mode =  $d_m = 57.6 \text{ km} = 57600 \text{ m}$

Radius of earth =  $6.4 \times 10^6 \text{ m}$

Let height of transmitting antenna  $a = h_t$

We know that, maximum line of sight distance between two antennas

$$\begin{aligned}d_m &= \sqrt{2Rh_T} + \sqrt{2Rh_t} \\ \Rightarrow 57600 &= \sqrt{2 \times 6.4 \times 10^6 \times h_T} + \sqrt{2 \times 6.4 \times 10^6 \times 80} \\ &= \sqrt{12.8 \times 10^6 \times h_T} + \sqrt{1024 \times 10^6} \\ &= \sqrt{12.8 \times 10^6 \times h_T} + 32000 \\ \Rightarrow \sqrt{12.8 \times 10^6 \times h_T} &= 25600 = 256 \times 10^2 \\ \Rightarrow 128 \times 10^6 \times h_T &= 65536 \times 10^4 \\ \Rightarrow h_T &= \frac{65536 \times 10^4}{12.8 \times 10^6} \\ &= \frac{5120}{10^2} = 51.20 \\ h_T &= 51.20 \text{ m}\end{aligned}$$

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## **Question11**

**An information signal of frequency 10 kHz is modulated with a carried wave of frequency 3.62MHz The upper side and lower side frequencies are**

**AP EAPCET 2024 - 21th May Morning Shift**

**Options:**

- A. 3650 kHz and 3590 kHz
- B. 3620 kHz and 3600 kHz
- C. 3610 kHz and 3580 kHz
- D. 3600 kHz and 3620 kHz

**Answer: B**

### **Solution:**

Given:

Signal frequency,  $v_s = 10$  kHz

Carrier wave frequency,  $v_c = 3.61$  MHz = 3610 kHz

We can calculate the side band frequencies using these formulas:

#### **Upper Side Band Frequency:**

The formula for the upper side band frequency is:

$$v_u = v_c + v_s$$

Substitute the given values:

$$v_u = 3610 + 10$$

$$v_u = 3620 \text{ kHz}$$

#### **Lower Side Band Frequency:**

The formula for the lower side band frequency is:

$$v_l = v_c - v_s$$

Substitute the given values:

$$v_l = 3610 - 10$$

$$v_l = 3600 \text{ kHz}$$

Therefore, the upper side band frequency is 3620 kHz, and the lower side band frequency is 3600 kHz.

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## **Question12**

**In amplitude modulation, the amplitude of the carrier wave is 10 V and the amplitude of one of the side bands is 2 V . Then, the modulation index is**

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Options:

A. 0.4

B. 0.6

C. 0.7

D. 0.5

**Answer: A**

**Solution:**

To determine the modulation index in amplitude modulation:

Given:

Carrier amplitude,  $A_c = 10 \text{ V}$

Side band amplitude,  $A_s = 2 \text{ V}$

The relationship between  $A_c$  and  $A_s$  is defined by the formula:

$$A_s = \frac{A_c \times m}{2}$$

Here,  $m$  represents the modulation index. Rearranging the formula to solve for  $m$ , we have:

$$m = \frac{2A_s}{A_c}$$

Substituting the given values:

$$m = \frac{2 \times 2}{10} = 0.4$$

Thus, the modulation index is 0.4.

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## Question 13

**A carrier is simultaneously modulated by two sine waves with modulation indices of 0.3 and 0.4 , then the total modulation index is**

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Options:



- A. 1
- B. 0.12
- C. 0.5
- D. 0.7

**Answer: C**

### **Solution:**

The effective modulation index, when a carrier is modulated by two sine waves, can be calculated using the formula:

$$\mu = \sqrt{\mu_1^2 + \mu_2^2}$$

Where:

$$\mu_1 = 0.3$$

$$\mu_2 = 0.4$$

To find the total modulation index:

$$\mu = \sqrt{(0.3)^2 + (0.4)^2}$$

Calculating inside the square root:

$$= \sqrt{0.09 + 0.16}$$

$$= \sqrt{0.25}$$

$$= 0.5$$

Therefore, the total modulation index is 0.5.

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## **Question14**

**If the maximum and minimum voltages of an  $AM$  wave are  $V_{\max}$  and  $V_{\min}$  respectively. Then, the modulation factor  $m$  is**

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**Options:**

A.  $(V_{\max} + V_{\min}) / (V_{\max} \cdot V_{\min})$

B.  $(V_{\max} - V_{\min}) / (V_{\max} + V_{\min})$

C.  $2V_{\max} - V_{\min} / (V_{\max} + V_{\max})$

D.  $(V_{\max} + V_{\min}) / (V_{\max} - V_{\min})$

**Answer: B**

## Solution:

Given:

**Maximum voltage of an AM wave:**  $V_{\max}$

**Minimum voltage of an AM wave:**  $V_{\min}$

**Amplitude of the modulating signal** is calculated as:

$$A_m = \frac{V_{\max} - V_{\min}}{2}$$

**Amplitude of the carrier signal** is calculated as:

$$A_C = \frac{V_{\max} + V_{\min}}{2}$$

The **modulation index** or **modulation factor**  $m$  is defined as the ratio of the amplitude of the modulating signal to the amplitude of the carrier signal:

$$m = \frac{A_m}{A_C}$$

Substituting the expressions for  $A_m$  and  $A_C$ , the modulation index becomes:

$$m = \frac{\frac{V_{\max} - V_{\min}}{2}}{\frac{V_{\max} + V_{\min}}{2}} \Rightarrow m = \frac{V_{\max} - V_{\min}}{V_{\max} + V_{\min}}$$

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