COMMUNICATION SYSTEMS

FACT/DEFINITION TYPE QUESTIONS

1. Communication is the process of
   (a) keeping in touch
   (b) exchange information
   (c) broad casting
   (d) entertainment by electronics
2. Which of the following is the element of a communication system?
   (a) Transmitter (b) channel
   (c) Receiver (d) All of the above
3. Telephony is an example of _____ mode of communication
   (a) point-to-point (b) broadcast
   (c) both (a) and (b) (d) None of these
4. A transducer used at the transmitting end, serves the purpose of converting
   (a) electrical signal to sound form
   (b) sound signal to electrical form
   (c) electrical signal to magnetic form
   (d) sound signal to magnetic form
5. During the process of transmission and reception the signal gets deteriorated due to
   (a) noise introduced in the system
   (b) distortion in the system
   (c) both (a) and (b)
   (d) neigher (a) nor (b)
6. Reception of information involves
   (a) decoding of signal (b) storage of signal
   (c) interpretation of signal (d) All of the above
7. The term channel is used to indicate
   (a) the amplitude range allocated to a given source
   (b) the frequency range allocated to a given source
   (c) the voltage-range allocated to a given source
   (d) All of the above
8. Buffer amplifier is used at the transmitting end to
   (a) feed carrier frequency to master oscillator
   (b) amplify carrier frequency
   (c) mix modulating signal with carrier frequency
   (d) isolate master oscillator from other stages of transmitter.
9. The purpose of a detector at the receiving end is
   (a) to amplify signal
   (b) to reduce its frequency level
   (c) to modulate signal
   (d) to demodulate signal
10. The phenomenon by which light travels in an optical fibres is
    (a) reflection (b) refraction
    (c) rotal internal reflection (d) transmission
11. The purpose of ...*A*... is to convert the message signal produced by the source of information into a form suitable for transmission through the ...*B*... Here, *A* and *B* refer to
    (a) channel, transmitter (b) transmitter, channel
    (c) receiver, transmitter (d) receiver, channel
12. Range of communication is extended by using
    (a) transmitter (b) transducer
    (c) processor (d) repeater
13. Modem is a short form of
    (a) modulator-demodulator
    (b) multiplexer-demultiplexer
    (c) multivibrator-degenerator
    (d) None of these
14. Optical fibre are used for long distance communication because
    (a) it amplifies signals to be transmitted
    (b) it transfer signals faster than electrical cables
    (c) it pre-emphasise weak signals
    (d) it provide little attenuation as compared to electrical cable for light propagation
15. If the output of the information source is a non-electrical signal like a voice signal, a ...*A*... converts it to ...*B*.. form before giving it as an input to the ...*C*... . Here, *A*, *B* and *C* refer to
    (a) receiver, electrical, channel
    (b) channel, magnetic, transducer
    (c) transducer, electrical, channel
    (d) transducer, electrical, transmitter
16. For transmission of speeches, talks, music, dramas etc------ -- is used
    (a) radio broadcast transmitter
    (b) radio telegraph transmitter
    (c) navigation transmitter
    (d) None of these

17. Electromagnetic waves of audible frequency ranges from
(a) 10 Hz to 10,000 Hz (b) 20 Hz to 20,000 Hz
(c) 30 Hz to 30,000 Hz (d) None of these.

18. E.m.wave of audible frequency cannot be directly propagated over a long distance because
(a) they have vary small energy content
(b) the length of antenna required for transmission of these wave is too large
(c) both (a) and (b)
(d) neither (a) nor (b)

19. There is a need of translating the information contained in our original low frequency baseband signal into ...*X*... or ...*X*... frequencies before transmission . Here, *X* and *Y* refere to
(a) low, radio (b) high, radio
(c) low, audio (d) high, video

20. Bandwidth of optical fibre communication is
(a) 10^6 to 10^9 Hz (b) 10^{13} to 10^{15} Hz
(c) 10^9 to 10^{11} Hz (d) none of these

21. Ground wave propagation is possible for
(a) low radio frequency over a short range
(b) high radio frequency over a short range
(c) high radio frequency over a long range
(d) low radio frequency over a short range.

22. Long range transmission of TV-signal is done by
(a) space-wave (b) sky waves
(c) ground wave (d) artificial satellite.

23. Which mode of communication is most suitable for carrier wave of frequencies around 100 MHz?
(a) Satellite (b) Ground wave
(c) Line of sight (d) Ionospheric

24. Communication on ground is through electromagnetic waves of wavelength
(a) larger than 600 m
(b) between 200 and 600 m
(c) between 1 and 5 m
(d) between 10^{-3} and 0.1

25. Ground waves are polarised
(a) parallel to the earth's surface
(b) normal to the earth's surface
(c) at an angle 45° from earth's surface
(d) in any direction.

26. Field strength of tropospheric TV signal is proportional to
(a) $\frac{1}{\lambda}$ (b) λ (c) $\frac{1}{\lambda^2}$ (d) λ^2

27. Long distance short-wave radio broadcasting uses
(a) ground wave (b) ionospheric wave
(c) direct wave (d) sky wave

28. Space wave communication is limited
(a) to the line of sight distance
(b) by earth's curvature
(c) either (a) or (b)
(d) both (a) and (b)

29. Sky wave propagation is not possible for frequencies
(a) equal to 30 MHz (b) less than 30 MHz
(c) greater than 30 MHz (d) None of these

30. In sky-wave propagation, skip-distance depends on
(a) frequency of e.m. waves transmitted
(b) critical frequency of the layer
(c) height of layer above earth's surface
(d) all of the above

31. Ionosphere as a whole is
(a) +vely charges (b) –vely charges
(c) electrically neutral (d) can't say

32. During ground wave propagation the transmitted waves gets attenuated because
(a) earth surface absorbs the waves
(b) frequency of the waves are too low
(c) energy content of these waves are high
(d) earth surface offers resistance.

33. Long range propagation is not possible by space wave propagation because
(a) height of troposhere is quite small
(b) height of troposhere is large
(c) troposphere absorbs transmitted wave
(d) None of these.

34. Sky wave propagation is not possible for waves of frequency > 30 MHz because
(a) these waves do not have much energy to reach ionosphere
(b) they are not reflected by ionosphere
(c) they get absorbed by troposphere
(d) they get reflected by stratosphere

35. Intensity of electric field obtained at receiver antenna for a space wave propagation is
(a) directly proportional to the perpendicular-distance from transmitter to antenna
(b) inversely proportional to the perpendicular-distance from transmitter to antenna
(c) directly proportional to the square perpendicular-distance from transmitter to antenna
(d) inversely proportional to the square perpendicular-distance from transmitter to antenna

36. Critical frequency that gets reflected back from ionosphere is
(a) same for all layers of the ionosphere
(b) different for different layers of the ionosphere
(c) not dependent on layers of the ionosphere
(d) None of these

37. The electron density in all the layers of ionosphere
(a) is the same
(b) decreases with altitude
(c) increases with altitude
(d) sometimes decreases sometimes increases

38. Encoding of signal is required for
(a) modulation at transmitting end
(b) modulation at receiving end
(c) demodulation at receiving end
(d) demodulation at transmitting end

39. For transmission of e.m.wave of audible frequency, these waves are superimposed with waves of
(a) frequency less than 20 Hz
(b) frequency less than 10 KHz.
(c) frequency in the audible range.
(d) radio-frequency.

40. Broadcasting antennas are generally
(a) omnidirectional type (b) vertical type
(c) horizontal type (d) None of these

41. In which of the following remote sensing technique is not used?
(a) Forest density (b) Pollution
(c) Wetland mapping (d) Medical treatment

42. For transmission of TV- signal, sound-part is
(a) amplitude modulated (b) frequency modulated
(c) phase modulated (d) pulse modulated

43. Picture signal of TV-signal is
(a) amplitude modulated
(b) frequency modulated
(c) phase modulated
(d) pulse modulated

44. Wave obtained on superimposition of audible frequency e.m. wave is known as
(a) carrier wave (b) high frequency wave
(c) modulating wave (d) modulated wave

45. An antenna behaves as resonant circuit only when its length is
(a) $\frac{\lambda}{2}$ (b) $\frac{\lambda}{4}$
(c) λ
(d) $\frac{\lambda}{2}$ or integral multiple of $\frac{\lambda}{2}$

46. A geosynchronous satellite is
(a) located at a height of 34860 km to ensure global coverage
(b) appears stationary over a place on earth's magnetic pole
(c) not really stationary at all, but orbits the earth within 24 hours.
(d) always at fixed location in space and simply spins about its own axis

47. Global communication is achieved by using
(a) single geostationary satellite
(b) minimum two geostationary satellite 180° apart
(c) minimum three geostationary satellite 120° apart
(d) minimum four geostationary satellite 90° apart

48. The layer of atmosphere which contains water vapour is
(a) stratosphere (b) mesospshere
(c) troposphere (d) ionosphere

49. The waves used in telecommunication are
(a) IR (b) UV
(c) Microwave (d) Cosmic rays

50. The losses in transmission lines are
(a) radiation losses only
(b) conductor heating only
(c) dielectric heating only
(d) all of these

51. In space communication, the sound waves can be sent from one place to another
(a) through space
(b) through wires
(c) by superimposing it on undamped electromagnetic waves
(d) by superimposing it on damped electromagnetic waves

52. As the height of satellite orbit gets lower, the speed of the satellite
(a) increases (b) decreases
(c) remain same (d) both (a) and (b)

53. Which of the following is drawback of amplitude modulation?
(a) low efficiency (b) noise reception
(c) operating range is small (d) all of these

54. Basic components of transmitter are
(a) message signal generator and antenna
(b) modulator and antenna
(c) signal generator and modulator and antenna
(d) message signal generator, modulator and antenna

55. Which of the following device is fully duplex?
(a) Mobile phone (b) Walky-talky
(c) Loud speaker (d) Radio

56. A radio station has two channels. One is AM at 1020 kHz and the other FM at 89.5 MHz. For good results you will use
(a) longer antenna for the AM channel and shorter for the FM
(b) shorter antenna for the AM channel and longer for the FM
(c) same length antenna will work for both
(d) information given is not enough to say which one to use for which

57. In Laser communication there is
(a) low loss of signal (b) loss of signal
(c) no signal security (d) low band width

58. In optical fibre refractive index of core is
(a) less than R.I of cladding
(b) more than R.I of cladding
(c) equal to R.I of cladding
(d) halfed to R.I of cladding

59. The cellular mobile radio frequency band is
(a) 88 – 108 MHz (b) 54 – 72 MHz
(c) 540 – 1600 KHz (d) 840 – 935 MHz

60. The AM wave is equivalent to the summation of
(a) two sinusoidal waves
(b) three sinusoidal waves
(c) four sinusoidal waves
(d) None of these

61. Citizen's band ratio is the application of
(a) amplitude modulation (b) frequency modulation
(c) phase modulation (d) None of these

62. Frequency of carrier signal is
(a) 5×10^6 Hz (b) 1000 Hz
(c) 2.50×10^3 Hz (d) 2.5×10^6 Hz

63. Frequencies of sideband is
(a) 2.50005×10^6 Hz, 2.49995×10^6 Hz
(b) 2.505×10^6 Hz, 2.495×10^6 Hz
(c) 2.505×10^6 kHz, 2.495×10^6 kHz
(d) 2.505 MHz, 2.495 kHz

64. The picture signal in TV-broadcast is modulated in
(a) SSB (b) VSB (c) FM (d) DSB

65. The process of superimposing signal frequency (i.e., audio wave) on the carrier wave is known as
(a) Transmission (b) Reception
(c) Modulation (d) Detection

66. In frequency modulation
(a) the amplitude of modulated wave varies as frequency of carrier wave
(b) the frequency of modulated wave varies as amplitude of modulating wave
(c) the frequency of modulated wave varies as frequency of modulating wave
(d) the frequency of modulated wave varies as frequency of carrier wave

67. Of the following which is preferred modulation scheme for digital communication?
(a) Pulse Code Modulation (PCM)
(b) Pulse Amplitude Modulation (PAM)
(c) Pulse Position Modulation (PPM)
(d) Pulse Width Modulation (PWM)

68. What is the modulation index of an over modulated wave
(a) 1 (b) Zero
(c) <1 (d) >1

69. The maximum line-of-sight distance d_M between two antennas having heights h_T and h_R above the earth is
(a) $\sqrt{R(h_T + h_R)}$ (b) $\sqrt{2R/(h_T + h_R)}$
(c) $\sqrt{Rh_T} + \sqrt{2Rh_R}$ (d) $\sqrt{2Rh_T} + \sqrt{2Rh_R}$

70. In AM waves, the amplitude of each side band frequency is
(a) E_c (b) mE_c
(c) $\frac{mE_c}{2}$ (d) 2mE

71. For good demodulation of AM signal of carrier frequency *f*, the value of RC should be
(a) $RC = \frac{1}{f}$ (b) $RC < \frac{1}{f}$
(c) $RC \geq \frac{1}{f}$ (d) $RC >> \frac{1}{f}$

72. If a number of sine waves with modulation indices n_1, n_2, n_3..... modulate a carrier wave, then the total modulation index (n) of the wave is
(a) $n_1 + n_2 ... + 2(n_1 + n_2 ....)$ (b) $\sqrt{n_1 - n_2 + n_3 .....}$
(c) $\sqrt{n_1^2 + n_2^2 + n_3^2 .....}$ (d) $\sqrt{n_1 + n_2 + ...}$

73. Television signals are
(a) frequency modulated
(b) amplitude modulated
(c) both frequency and amplitude modulated
(d) phase modulated

74. For a single side band transmission a balanced modulator is used to
(a) increase power of carrier wave
(b) increase amplitude of carrier wave
(c) suppress audio signal
(d) suppress carrier component

75. Which of the following AM-scheme requires the minimum transmitted power & minimum channel bandwidth?
(a) VSB (b) DSB-SC (c) AM (d) SSB

76. In FM, when frequency deviation is doubled, then
(a) modulation is halved
(b) carrier swing is halved
(c) modulation is doubled
(d) modulation index is decreased

77. In PCM if the transmission path is very long
(a) pulse spacing is reduced
(b) pulse amplitude is increased
(c) pulse width is increased
(d) repeater stations are used.

78. The function of an amplitude limitter in an FM-receiver is
(a) to reduce the amplitude of the signal to suit IF amplifier
(b) to amplify low frequency signal
(c) to eliminate any change in amplitude of receiver FM signal
(d) None of these

79. Which of the following pair is correctly matched
(a) Radio telegraph-VSB (b) Television-SSB
(c) Radio broadcast-AM (d) Radar-AM

80. Depth of modulation in terms of E_{max} and E_{min} is
(a) $m_a = E_{max} + E_{min}/E_{min}$
(b) $ma = E_{max} - E_{min}/E_{max}$
(c) $m_a = E_{max} - E_{min}/E_{max} + E_{min}$
(d) $ma = E_{max} + E_{min}/E_{max} - E_{min}$

81. In an ionized medium, the phase velocity v_p, group velocity v_g and the speed of light are related as
(a) $v_p > v_g > c$ (b) $v_p = v_g = c$
(c) $v_p < v_g < c$ (d) $v_p > c$, $v_g < c$.

82. For a radio wave reaching the ionised medium
(a) will bend away from normal
(b) will bend towards normal
(c) will bend follow a straight-path
(d) None of these.

83. The tank circuit used in a radio transmitter should have
(a) high effective Q
(b) low effective Q
(c) loosely coupled load
(d) Both (a) and (c)

84. Audio signal cannot be transmitted because
(a) the signal has more noise
(b) the signal cannot be amplified for distance communication
(c) the transmitting antenna length is very small to design
(d) the transmitting antenna length is very large and impracticable

85. The fundamental radio antenna is a metal rod which has a length equal to
(a) λ in free space at the frequency of operation
(b) $\lambda/2$ in free space at the frequency of operation
(c) $\lambda/4$ in free space at the frequency of operation
(d) $3\lambda/4$ in free space at the frequency of operation

86. The service area of space wave communication increases by
(a) increasing the height of transmitting antenna
(b) decreasing the height of receiving antenna
(c) increasing the height of both transmitting and receiving antenna
(d) decreasing the distance between transmitting and receiving antenna

87. 100% modulation in FM means
(a) actual frequency deviation > maximum allowed frequency deviation
(b) actual frequency deviation = maximum allowed frequency deviation
(c) actual frequency deviation ≥ maximum allowed frequency deviation
(d) actual frequency deviation < maximum allowed frequency deviation

88. Pre-emphasis in FM system is done to
(a) compress modulating signal
(b) expand modulating signal
(c) amplify lower frequency component of the modulating signal
(d) amplify higher frequency component of the modulating signal

89. The ratio of $E_{max} - E_{min}$ to $E_{max} + E_{min}$ is known as
(a) range of modulating signal
(b) amplitude variation of modulating signal
(c) depth of modulation
(d) None of these.

90. In an AM wave, the information is contained within
(a) r.f. carrier wave
(b) only lower and upper side frequencies
(c) both r.f. carrier and side frequencies
(d) None of these

STATEMENT TYPE QUESTIONS

91. Consider telcommunication through optical fibres. Which of the following statements is/are correct?
I. Optical fibres may have homogeneous core with a suitable cladding
II. Optical fibres can be of graded refractive index
III. Optical fibres are subject to electromagnetic interference from outside
IV. Optical fibres have extremely low transmission loss
(a) I and II (b) I and III
(c) I, II and IV (d) I, II, III and IV

92. Digital signals
I. represent values as discrete values.
II. can utilise binary system
III. can utilise decimal as well as binary systems.
Which of the above statements are correct ?
(a) I and II (b) II and III
(c) I, II and III (d) I and III

93. In statellite communication
I. the frequency used lies between 5 MHz and 1 MHz.
II. the uplink and downlink frequencies are different.
III. the orbit of geostationary satellite lies in the equatorial plane at inclination of 0.
Which of the above statement(s) is/are correct?
(a) II and III (b) I and II
(c) Only I (d) I, II, III and IV

94. Which of the following statements are correct ?
I. At longer wavelength (i.e., at lower frequencies) the antennas have large physical size.
II. They are located on or very near to the ground.
III. In standard AM broadcast, ground based vertical towers are generally used as transmitting antennas.
(a) I and II (b) I, II, and III
(c) II and III (d) I and III

95. Amplitude modulated waves
I. contain frequencies $(w_c - w_m)$, w_c and $(w_c + w_m)$
II. can be produced by application of the message signal and the carrier wave to a non-linear device followed by a band pass filter.
Which of the above statements is/are correct?
(a) I only (b) II only
(c) I and II (d) None of these

MATCHING TYPE QUESTIONS

96. Match the Columns I and II.

Column I	Column II
(A) Attenuation	(1) The process of increasing the amplitude
(B) Amplification	(2) The loss of strength of a signal
(C) Bandwidth	(3) The process of retrieval of information from the carrier wave
(D) Demodulation	(4) The frequency range over which an equipment operates

(a) (A) → (2); (B) → (1); (C) → (4); (D) → (3)
(b) (A) → (4); (B) → (2); (C) → (1); (D) → (3)
(c) (A) → (3); (B) → (1); (C) → (4); (D) → (2)
(d) (A) → (1); (B) → (3); (C) → (4); (D) → (2)

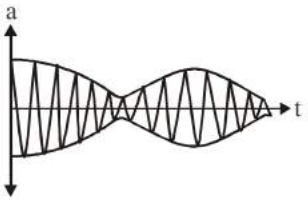
97.

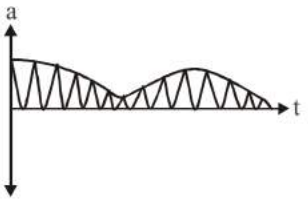
Column I (Name of the stratum)	Column II (Frequencies most affected)
(A) Troposphere	(1) Efficiently reflects HF waves
(B) Stratosphere	(2) Partially absorbs HF waves
(C) Mesosphere	(3) V H F upto several GHZ
(D) Thermosphere	(4) Reflects LF absorbs MF and HF to some degree

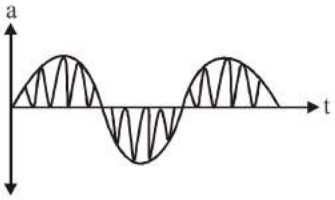
(a) (A) → (2); (B) → (1); (C) → (4); (D) → (3)
(b) (A) → (4); (B) → (2); (C) → (1); (D) → (3)
(c) (A) → (3); (B) → (4); (C) → (2); (D) → (1)
(d) (A) → (1); (B) → (3); (C) → (4); (D) → (2)

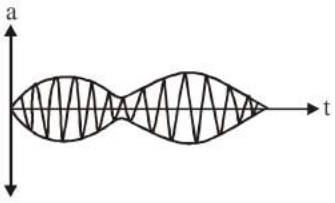
DIAGRAM TYPE QUESTIONS

98. Which one of the following represents rectified wave?

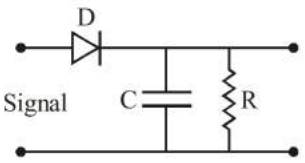
(a)


(b)


(c)


(d)


99. 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.



(a) 10.62 MHz (b) 10.62 kHz
(c) 5.31 MHz (d) 5.31 kHz

ASSERTION- REASON TYPE QUESTIONS

Directions : Each of these questions contain two statements, Assertion and Reason. Each of these questions also has four alternative choices, only one of which is the correct answer. You have to select one of the codes (a), (b), (c) and (d) given below.

(a) Assertion is correct, reason is correct; reason is a correct explanation for assertion.
(b) Assertion is correct, reason is correct; reason is not a correct explanation for assertion
(c) Assertion is correct, reason is incorrect
(d) Assertion is incorrect, reason is correct.

100. **Assertion :** Amplification is necessary to compensate for the attenuation of the signal in communication system.
Reason : Amplification is the process of increasing the amplitude and consequntly the strength of signal using an electronic circuit.

101. **Assertion :** The loss of strength of a signal while propagating through a medium is known as attenuation.
Reason : Transmitter helps to avoid attenuation.

102. **Assertion :** Telephony is an example of point-to-point communication mode.
Reason : In point-to-point communication modes, communication takes places over a link between a single transmitter and a receiver.

103. **Assertion :** The information contained in our original low frequency baseband signal is to be translated into high or radio frequencies before transmission.
Reason : For transmitting a signal, the antenna should have a size comparable to the wavelength of the signal.

104. **Assertion :** When the height of a TV transmission tower is increased by three times, the range covered is doubled.
Reason : The range covered is proportional to the height of the TV transmission tower.

105. **Assertion :** Microwave communication is preferred over optical communication.
Reason : Information carrying capacity is directly proportional to bandwidth.

106. **Assertion :** Long distance communication between two points on the earth is achieved by using sky waves.
Reason : Sky wave propagation takes place above the frequency of 30 MHz.

107. **Assertion :** The television signals are propagated through sky waves.
Reason : Television signals have frequency in the range of 1000 MHz to 2000 MHz range.

108. **Assertion :** Space waves are used for line-of-sight communication.
Reason : Space wave travels in a straight line from transmitting anttena to receiving antenna.

109. **Assertion :** The ionosphere layer acts as a reflector for all range of frequencies.
Reason : Ionosphere does not allow electromagnetic wave to penetrate and escape.

110. **Assertion :** The process of retrival of information from the carrier wave at the receiver is termed as modulation.
Reason : Repeater helps to modulate the signals.

111. **Assertion :** AM detection is the process of recovering the modulating signal from amplitude modulated waveform, which is carried out using a rectifier and an envelope detector.
Reason : Amplitude modulated waves can be produced by application of the message signal and the carrier wave to a non-linear device followed by band pass filter.

CRITICAL THINKING TYPE QUESTIONS

112. A broadcast radio transmitter radiates 12 kW when percentage of modulation is 50%, then the unmodulated carrier power is
(a) 5.67 kW (b) 7.15 kW
(c) 9.6 kW (d) 12 kW

113. A transmitter radiates 10 kW of power with the carrier unmodulated and 11.8 kW with the carrier sinusoidally modulated. The modulation factor is
(a) 56% (b) 60% (c) 72% (d) 84%

114. What will be the image frequency of an FM radio receiver that is tuned to 98.6 MHz broadcast station?
(a) 111.8 MHz (b) 108 MHz
(c) 121.6 MHz (d) 132 MHz

115. A 1 kW carrier is modulated to a depth of 80%. The total power in the modulated wave is
(a) 1.32 (b) 1.56 (c) 1.84 (d) 1.96

116. The frequency deviation in a FM transmission is 18.75 KHz. If it broadcasts in 88-108 MHz band, then the percent modulation is
(a) 10% (b) 25% (c) 50% (d) 75%

117. A 10 kW carrier is sinusoidally modulated by two carriers corresponding to a modulation index of 30% and 40% respectively then total power radiated by the modulator is
(a) 10.25 kW (b) 11.25 kW
(c) 12.75 kW (d) 17 kW

118. An FM signal has a resting frequency of 105 MHz and highest frequency of 105.03 MHz when modulated by a signal of frequency 5 kHz. The carrier swing is
(a) 25 kHz (b) 54 kHz (c) 60 kHz (d) 75 kHz

119. 12 signals each band limited to 5 kHz are to be transmitted by frequency-division multiplexer. If AM-SSB modulation guard band of 1 kHz is used then the bandwidth of multiplexed signal is
(a) 101 kHz (b) 99 kHz (c) 84 kHz (d) 71 kHz

120. A device with input x(t) and outputy(t) is characterized by: $y(t) = x^2(t)$. An FM signal with frequency deviation of 90 kHz and modulating signal bandwidth of 5 kHz is applid to this device. The bandwidth of the output signal is
(a) 370 kHz (b) 190 kHz
(c) 380 kHz (d) 95 kHz.

121. An audio frequency of 10 kHz is transmitted by SSB after AM with carrier waves of frequency 1MHz. The frequency of current in output load is
(a) 1010 kHz or 990 kHz (b) 1010 MHz or1010 MHz
(c) 110 kHz or 990 kHz (d) 110 MHz or 990 MHz

122. An AM wave is expressed as $e = 10(1 + 0.6 \cos 2000\pi t) \cos 2 \times 10^8 \pi t$ volts, the minimum and maximum value of modulated carrier wave are respectively.
(a) 10 V and 20 V (b) 4V and 8V
(c) 16 V and 4V (d) 8 V and 20 V

123. An AM wave varies from 10V to 4V. Its percentage modulation is
(a) 36% (b) 42.8% (c) 54% (d) 68%

124. An audio signal represented as $25 \sin 2\pi (2000\, t)$ amplitude modulated by a carrier wave : $60 \sin 2\pi (100, 000)t$. The modulation index of the modulated signal is
(a) 25% (b) 41.6% (c) 50% (d) 75%

125. For an AM wave, the maximum voltage was found to be 10 V and minimum voltage was 4 V. The modulation index of the wave is
(a) 0.33 (b) 0.43 (c) 0.56 (d) 0.64

126. For an AM-system the total power of modulated signal is 600 W and that of carrier is 400 W, the modulation index is
(a) 0.25 (b) 0.36 (c) 0.54 (d) 1

127. The rms value of a carrier voltage is 100 volts. Compute its rms value when it has been amplitude modulated by a sinusoidal audio voltage to a depth of 30%.
(a) 94 V (b) 104.5V (c) 114.4 V (d) 124 V

128. Calculate the power developed by an amplitude modulated wave in a load resistance of 100 Ω, if the peak voltage of carrier wave is 100 V and modulation index is 0.4.
(a) 50 watt (b) 54 watt
(c) 104 watt (d) 4 watt

129. The maximum and minimum amplitude of an AM wave are 90 mV and 30 mV respectively. The depth of modulation is
(a) 0.6 (b) 0.5 (c) 0.4 (d) 0.3

130. For 100% modulation (AM), the useful part of the total power radiated is
(a) $\frac{1}{2}$ of the total power (b) $\frac{1}{3}$ of the total power
(c) $\frac{1}{4}$ of the total power (d) $\frac{2}{3}$ of the total power

131. Consider the following amplitude modulated (AM) signal , where $f_m < B\, x_{AM}(t) = 10(1 + 0.5 \sin 2\pi f_m t) \cos 2\pi f_c t$
The average side-band power for the AM signal given above is
(a) 25 (b) 12.5 (c) 6.25 (d) 3.125

132. An AM- signal is given as
$x_{AM}(t) = 100[p(t) + 0.5g(t)] \cos \omega_c t$
in interval $0 \le t \le 1$. One set of possible values of the modulating signal and modulation index would be
(a) t, 0.5 (b) t, 1.0 (c) t, 1.5 (d) t^2, 2.0

133. A sinusoidal carrier voltage of frequency 10 MHz and amplitude 200 volts is amplitude modulated by a sinusoidal voltage of frequency 10 kHz producing 40% modulation. Calculate the frequency of upper and lower sidebands.
(a) 10010 kHz, 9990 kHz (b) 1010 kHz, 990 kHz
(c) 10100 Hz,9990 Hz (d) 1010 MHz, 990 MHz

HINTS AND SOLUTIONS

FACT/DEFINITION TYPE QUESTIONS

1. (b) **2.** (d) **3.** (a)

4. (b) The message from the information source may not be in electrical form so to convert these information i.e. in form of sound to electrical form a transducer like a microphone is used.

5. (c) Noise the unwanted energy and distortion both occuring at various stage of a system leads to deterioration of signal as signal to noise ratio becomes so poor that signal becomes unintelligble and useless.

6. (d) The received signals is either AM or FM so it needs to be demodulated ie. decoded to get back original signal. It also needs to be stored and interpreted at receiving end.

7. (b) Channel indicate frequency range at which different R.F. signals all transmitted.

8. (d) Buffer amplifier isolate master oscillator from the influence of modulation done at a later stage.

9. (d) The RF-signal coming from the transmitter needs to be demodulated by a detector inorder to remove the carrier frequency and receive back the low-frequency original signal.

10. (c) In optical fibre, light travels inside it, due to total internal reflection.

11. (b) The purpose of transmitter is to convert the message signal produced by source of information into a form suitable for transmission through the channel.

12. (d) **13.** (a) **14.** (d)

15. (d) If the output of information source is non-electrical signal like a voice signal, a transducer converts it to electrical form before giving it as an input to the transmitter.

16. (a) Radio broadcast transmitter are used for above purpose. AM transmitter operating on long wave, medium & short wave are used.

17. (b) Sound waves such as speech or song etc. that a human being can hear ranges from 20 Hz to 20 kHz frequencies above 20 kHz can not be heard by human ear.

18. (c) Electromagnetic wave of audible frequency have vary small energy content $\approx 10^{-12}$ eV and their amplitude is greatly reduced due to dissipations of ennergy in travelling a long distance.

Secondly for frequency range 20 Hz to 20kHz the length of antenna required is of the order of wavelength of wave to be transmited

i.e. length of antenna $\approx \lambda = c/\nu(m) = 1.5 \times 10^7$m

for ν in the range 20 to 20 kHz

and $c = 3 \times 10^8$ m/s.

An antenna of length 1.5×10^4 m is not practically possible.

19. (b) There is a need of translating the information contained in our original low frequency baseband signal into high or radio frequencies before transmission.

20. (b)

21. (a) Since the attenuation of ground waves increases with increase in frequencies so only low frequency- radio waves uses this mode of propagation for short distances.

22. (d) TV-signal (30 MHz -300 MHz) are not reflected by ionosphere. Therefore, sky-wave propagation is not possible and similarly ground & space wave is also not feasible hence they are transmitted to artificial satellite from where they are transmitted back to the earth.

23. (c) **24.** (d) **25.** (b)

26. (a) **27.** (c)

28. (d) The space wave propagation is limited due to the line of sight distance and by the curvature of the earth.

29. (c) Sky wave propagation is not possible for frequency > 30 MHz because they are not reflected by ionosphere.

30. (d) Skip distance is the minimum distance on earth's surface from the transmitter where e.m. wave of a definite frequency can reach after reflection from the ionosphere

It is given by $D_{skip} = 2h\sqrt{\frac{f^2}{f_c^2} - 1}$

$\Rightarrow$ Dskip is dependent on h, f and fc.

31. (c) Ionsphere contain free electron & + ve ions. In equillibrium, the no. of free electron is equal to the number of positive ions. So as a whole it is elecrically neutral.

32. (d) During ground wave propagation of radio waves, a charge induced on the earth's surface which takes the form of current as the wave propagate. The earth offers resistance in the flow of induced current due to which the waves are attenuated.

33. (a) space wave propagation takes place in such a way that the radio waves transmitted at an angle from earth's surface gets reflected by the troposphere and then reaches the receiving antenna since the height of troposphere is quite small, long-range propagation by this mode is not possible.

34. **(b)** Stratosphere and troposphere allows the radio waves to pass through it but they are not reflected back to earth's surface by ionosphere.
Only frequency 1500 kHz to 30 MHz can be propagated by this mode.

35. **(d)**

36. **(b)** Critical frequency $f_c = 9\sqrt{N_m}$

where N_m represents election density of layers

$\because f_c \propto \sqrt{N_m}$

$\Rightarrow f_c$ is different for different layers.

37. **(c)** Electron density of each layer of ionosphere is different from the other. i.e. they are stratified. As we move upward density increases.

38. **(a)** Encoding modulation of signal i.e. to be transmitted is done with carrier frequency at transmitting end to avoid interference with other signals that are also transmitted.

39. **(d)** Since radio frequency waves can travel long distances because these waves are of wave length of the order of 100 m and their energy content is quite large therefore e.m.wave of audible frequency are superimposed with radio frequency waves.

40. **(b)**

41. **(d)** Remote sensing is the technique to collect information about an object in respect of its size, colour, nature, location, temperature etc. without physically touching it. There are some areas or locations which are inaccessible. So to explore these areas or locations, a technique known as remote sensing is used. Remote sensing is done through a satellite.

42. **(b)** Due to several advantage of FM over AM, to get better quality signal the sound part of TV-signal is frequency modulated.

43. **(a)** Picture signal in amplitude modulated to avoid complication in development of transmitter & receiver structure.

44. **(d)** On superimposition of two waves the audible frequency wave is the modulating wave and radio-wave is the carrier wave, thus the resultant wave obtained is known as modulated wave as it is obtained by the process of modulation.

45. **(d)** **46.** **(c)** **47.** **(c)**

48. **(c)** **49.** **(c)** **50.** **(d)** **51.** **(c)**

52. **(b)** **53.** **(d)** **54.** **(d)**

55. **(a)** Duplex or full duplex refers to the simultaneous transmission of data in two directions. A mobile phone is a full duplex device because both people can talk at once and hear each at the same time. Walky-talky is a half duplex device because only one person can talk at a time.

56. **(b)** The frequency of AM channel is 1020 kHz whereas for the FM it is 89.5 MHz (given). For higher frequencies (MHz), space wave communication is needed. Very tall towers are used as antennas.

57. **(a)** **58.** **(b)** **59.** **(d)** **60.** **(b)** **61.** **(a)**

62. **(d)** $\omega_c = \dfrac{5\times10^6\pi}{2\pi} = 2.5\times10^6\,\text{Hz}$

63. **(a)** $\omega_c + \omega_m$
$= 2.5\times10^6 + 0.0005\times10^6\,\text{Hz}$
$\omega_c - \omega_m$
$= 2.5\times10^6 - 0.0005\times10^6\,\text{Hz}$
$= 2.4995\times10^6\,\text{Hz}$

64. **(b)**

65. **(c)** Carrier + signal $\rightarrow$ modulation.

66. **(b)** In frequecy modulation the frequency of the modulated wave is the linear function of the amplitude of the modulating wave.

67. **(a)**

68. **(d)** When $m_a > 1$ then carrier is said to be over modulated.

69. **(d)** The maximum line-of-sight distance d_M is given by

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

70. **(c)**

71. **(d)** For good demodulation,

$$\frac{1}{f} << RC \text{ or, } RC >> \frac{1}{f}$$

72. **(c)**

73. **(c)** TV signal comprises of video and audio signals.
Video signal is AM and sound signal is FM.

74. **(d)** Since maximum part of the power of modulated wave is contained with the carrier wave which does not transmit any desired information, hence to avoid wastage of power to suppress carrier balanced modulator is used.

75. **(d)** Since in SSB transmision only one side band is transmitted while in other 3-cases more than a side band is transmitted, so minimum power is transmitted for SSB. Similarly SSB bandwidth is minimum BW= ω_m.

76. **(c)** $m = \dfrac{(\Delta f)_{\text{actual}}}{(\Delta f)_{\max}} \times 100 \Rightarrow m \propto (\Delta f)_{\text{actual}}$

i.e. if frequency deviation is doubled then modulation is doubled.

77. **(d)** When transmission path is long more repeater stations are needed at intermediate points as repeater receives signal, remove the noise, amplify it and retransmit it along the channel.

78. **(c)** The limitter removes from the carrier all amplitude variations which may caused by changes in the transmission path, by man-made static or natural static. This suppression of amplitude variation is necessary because FM-receives, a vary large improvement in S/N results from this.

79. **(c)** Radio telegraph–AM and FM is used
Television–VSB is used
Radar–PM or FM is used
and Radio broadcast–AM and FM is used
So correct pair is (c).

80. **(c)**

81. **(d)** Phase velocity of e.m.wave in free space $c = \frac{1}{\sqrt{\mu_0 \in_0}}$

Phase velocity of e.m.wave in ionised medium

$$v_p = \frac{1}{\sqrt{\mu_0 \varepsilon_0 \left(1 - \frac{Ne^2}{\varepsilon_0 m \omega^2}\right)}}$$

$\therefore \quad v_p > c$ but $v_g < c$ in ionised medium.

82. **(a)** Radio wave enters from an un-ionised medium to an ionised medium, the wave incident on the boundary of the medium deviates from its straight path i.e. will bend away from normal because ionised medium behaves as a rarer medium w.r.t. to unionised medium.

83. **(d)**

84. **(d)** Following are the problems which are faced while transmitting audio signals directly,
(i) These signals are relatively of short range.
(ii) If every body started transmitting these low frequency signals directly, mutual interference will render all of them ineffective.
(iii) Size of antenna required for their efficient radiation would be larger, *i.e.*, about 75 km.

85. **(c)**

86. **(c)** Maximum range of space wave propagation

$$d = \frac{4}{3} \times 1.23 \left[\sqrt{H_t} + \sqrt{H_r}\right]$$

$$\Rightarrow \quad d \propto H_t$$

$$d \propto H_r$$

$\therefore$ d increases if H_t and H_r i.e. height of transmitting and receiving antenna increases.

87. **(b)** $$m = \frac{\text{actual frequency deviation}}{\text{max. allowed frequency deviation}} \times 100\%$$

$$= \frac{(\Delta f)\text{actual}}{(\Delta f)\text{max}} \times 100\%$$

if (Δf) actual $= (\Delta f)$ max
$m = 100\%$

88. **(d)** Pre-emphasis of higher frequency component is required in FM-system because high frequency terms of modulating signal have small amplitude and therefore small power relative to those of low frequency term.
In the reproduced program at the o/p, these high frequency terms have poor S/N ratio and at time noise may completely mask the signal at these high frequencies, so it is necessary to provide pre-emphasis of high frequencies.

89. **(c)** $\frac{E_{max} - E_{min}}{E_{max} + E_{min}} = m_a$ -Depth of modulation.

90. **(b)** The modulated voltage comprises of
(i) Carrier wave of frequency ω_c
(ii) Lower side frequency $(\omega_c - \omega_m)$ wave
(iii) Upper side frequency $(\omega_c + \omega_m)$ wave
Thus in an AM wave information is contained in lower $(\omega_c - \omega_m)$ and upper $(\omega_c + \omega_m)$ side frequencies.

STATEMENT TYPE QUESTIONS

91. **(c)** Optical fibres are not subjected to electromagnetic interference from outside.

92. **(a)** Digital signals are the values in the form of 0 or 1. It represents discrete values in the binary bits which are non-continuous set of values.

93. **(a)** In statellite communication, the frequency used is more than 40 MHz. The uplink and downlink frequencies are different to avoid distortion of signal and the orbit of geostationary satellite lies in the equatorial plane at an inclination of 0°.

94. **(b)** At longer wavelengths (i.e., at lower frequencies), the antennas have large physical size and they are located on or very near to the ground. In standard AM broadcast, ground based vertical towers are generally used as transmitting antennas. For such antennas ground has a strong influence on the propagation of the signal.

95. **(c)**

MATCHING TYPE QUESTIONS

96. **(a)** (A) → (2); (B) → (1); (C) → (4); (D) → (3)
97. **(c)** (A) → (3); (B) → (4); (C) → (2); (D) → (1)

DIAGRAM BASED QUESTIONS

98. **(b)**

99. **(b)** **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

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

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

$= 10.61$ KHz

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

ASSERTION- REASON TYPE QUESTIONS

100. (a) : Amplification is necessary to compensate for the attenuation of the signal in communication systems.

101. (c) : A transmitter processes the incoming message signal, so as make it suitable for transmission through a channel and subseqeuent reception.

102. (a)

103. (a) : For transmitting a signal, we need an antenna or an aerial. This antenna should have a size comparable to the wavelength of the signal so that the antenna properly senses the time variation of the signal. For an electromagnetic wave frequency 20 kHz, the wavelength is 15 km. Obviously such a long antenna is not possible to cosntruct and operate. Hence direct transmission of such baseband signals is not practical. Therefore there is a need of translating the information constained in our original low frequency baseband signal into high or radio frequencies before trasnsmission.

104. (c) : The range covered is not proportional to the height of the TV transmission tower. The range depends directly on square root of the height of the antenna *i.e.*

$S \propto \sqrt{h}$.

Let the height of the TV transmission tower be h and h' which covers the range S and S' respectively.

$\therefore \quad S = \sqrt{2hR}$ and $S' = \sqrt{2h'R}$

For $S' = 2S$ *i.e.* $\sqrt{2h'R} = 2\sqrt{2h'R}$

105. (a) : Microwave communication is preferred over optical communication because microwave provide large number of channels and wide badwidth compared to optical signals as infromation carrying capacity is directly proportional to bandwidth. So wider the bandwidth greater the information carrying capacity.

106. (c) : Long distance communication between two points on the earth is achieved through reflection of electromagnetic waves by ionosphere. Such waves are called sky waves Sky wave propagation takes place up to frequency of about 30 MHz.

107. (d) : As television signals being of frequency 100 MHz to 200 MHz cannot be reflected by ionosphere but they penetrate it, so they are not propagated through sky waves. In fact, television signals are propagated through space wave propagation.

108. (a) : A space wave travels in a straight line from transmitting antenna to the receiving antenna. Space waves are used for line-of-sight communication as well as satellite communication. At frequencies above 40 MHz communication is essentially limited to line of sight paths.

109. (d) : The ionosphere layer acts as a reflector for a certain range of frequencies *i.e.* 3 to 30 MHz.Electromagnetic waves of frequencies higher than 30 MHz penetrate the ionosphere and escape.

110. (d) : The process of retrieval of information from the carrier wave at the receiver is termed as demodulation. Repeater is a combination of a receiver and a transmitter, a repeater picks up the signal from the transmitter, amplifies and retransmist it to the receiver sometimes with a change in carrier frequency.

111. (b)

CRITICAL THINKING TYPE QUESTIONS

112. (c) $P_c = \frac{P_t}{1+\frac{m_a^2}{2}} = \frac{12}{1+\frac{(0.5)^2}{2}} = \frac{12}{1.25} = 9.6$ kW

113. (b) $P_c = P_t\left(1+\frac{m^2}{2}\right)$

$\Rightarrow \quad 11.8 = 10\left(1+\frac{m^2}{2}\right)$

$\Rightarrow \quad m = 0.6 \ \Rightarrow \%$ modulation $= 60\%$.

114. (c) FM(I.F)=11.5MHz

F(image) $= f_s + 2f_{IF} = 98.6 + 2 \times 11.5 = 121.6$ MHz

115. (a) $P = P_c\left[1+\frac{m_a^2}{2}\right] = 1\left[1+\frac{(0.8)^2}{2}\right] = 1.32$kW.

116. (b) For given transmission band 88-108 MHz

$(\Delta f)_{max} = 75$ kHz

given $(\Delta f)_{actual} = 18.75$ kHz

$\therefore$ % modulation $m = \frac{(\Delta f)_{actual}}{(\Delta f)_{max}} \times 100 = \frac{18.75}{75} = 25\%$

117. (b) $P_c = \frac{E_c^2}{2} = 10$ kW

$m_a = \sqrt{m_1^2 + m_2^2} = \sqrt{0.30^2 + 0.40^2} = 0.50$

$\therefore P_t = P_c\left(1 + \frac{m_a^2}{2}\right) = 10\left(1 + \frac{(0.5)^2}{2}\right) = 11.25$ kW

118. (c) Carrier Swing $= 2 \times \Delta f$

$= 2 \times 105.03 - 105 = 2 \times 0.03$ MHz

$= 0.06$ MHz $= 60$ kHz

119. (d) Total signal B.W$= 12 \times 5 = 60$ kHz

11 guard band are required between 12 signal

$\therefore$ guard bandwidth $= 11 \times 1$kHz $= 11$kHz

$\therefore$ total bandwidth $= 60 + 11 = 71$kHz

120. (c) For x(t), BW $= 2(\Delta\omega + \omega)$

$\Delta\omega$ is deviation and ω is the band width of modulating signal.

$\therefore$ BW $= 2(90 + 5) = 190$

For $x^2(t)$, BW $= 2 \times 190 = 380$

121. (a) SSB transmission to signal are possible at load

$\omega_c + \omega_m$ or $\omega_c - \omega_m$

$\Rightarrow (1000 + 10)$ kHz or $(100 - 10)$ kHz.

$\Rightarrow 1010$ kHz or 990 kHz

122. (c) $E_{max} = (1 + m_a)E_c = (1 + 0.6) \times 10 = 16$ V

$E_{min} = (1 - m_a)E_c = (1 - 0.6) \times 10 = 4$V.

123. (b) $m_a = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} = \frac{10 - 4}{10 + 4} = \frac{6}{14} = 0.428 = 42.8\%$

124. (b) Modulation index $= \frac{B}{A}$

$B = 25, A = 60$

$\Rightarrow$ M.I. $= \frac{25}{60} = 0.416 \Rightarrow m\% = 41.6\%$

125. (b) $m_a = \frac{V_{max} - V_{min}}{V_{max} + V_{min}} = \frac{10 - 4}{10 + 4} = \frac{6}{14} = 0.43$

126. (d) $P_T = P_C\left(1 + \frac{m_a^2}{2}\right)$

$\therefore 600 = 400\left(1 + \frac{m_a^2}{2}\right) \Rightarrow \frac{3}{2} = 1 + \frac{m_a^2}{2}$

or $\frac{m_a^2}{2} = \frac{1}{2} \Rightarrow m_a = 1$

127. (b) $P_t = P_c\left[1 + \frac{m_a^2}{2}\right] \Rightarrow \frac{V^2_{rms}}{2} = \frac{V_c^2}{2}\left[1 + \frac{m_a^2}{2}\right]$

$V^2_{rms} = V^2_c\left[1 + \frac{m_a^2}{2}\right]$

$\Rightarrow V_{rms} = V_c\sqrt{1 + \frac{m_a^2}{2}} \Rightarrow V_{rms} = 100\sqrt{1 + \frac{(0.3)^2}{2}}$

$= 104.5$ volts.

128. (b) $E_c = 100$ V, $m_a = 0.4$, $R = 100\,\Omega$,

$P_c = \frac{E_c^2}{2R} = \frac{(100)^2}{2 \times 100} = 50$ watt

$P = \left(1 + \frac{m_a^2}{2}\right)P_c = \left[1 + \frac{(0.4)^2}{2}\right] \times 50 = 54$ watt

129. (b) $m_a = \frac{E_{max} - E_{min}}{E_{max} + E_{min}} = \frac{90 - 30}{90 + 30} = \frac{60}{120} = \frac{6}{12} = 0.5$

130. (b) 100% modulation $\Rightarrow m_a = 1$

$\frac{\text{useful power}}{\text{total power radiated}} = \frac{m_a^2}{2 + m_a^2} = \frac{1}{2 + 1} = \frac{1}{3}$

$\Rightarrow$ Useful power $= \frac{1}{3}$ (total power radiated)

131. (c) Average side-band power $P_{av} = \frac{m_a}{4}P_c^2$

Here $m_a = 0.5$

$P_c = 10$

$\therefore P_{av} = \frac{0.5 \times 10 \times 10}{4} = 6.25$

132. (a) Comparing $(x_{AM})t = 100[1 + 0.5\,t]\cos\omega_c t$ for $0<t<1$ with standard AM signal $x_{AM} = E_c[1 + m_a \cos\omega_m t]\cos\omega_c t$

We have modulating signal t and $m_a = 0.5$.

133. (a) Modulating signal frequency $\rightarrow$ 10kHz

Carrier signal frequency$\rightarrow$ 10 MHz

$\therefore$ Side band frequency are

USB $= 10$ MHz $+ 10$ kHz $= 10010$ kHz

LSB $= 10$MHz $- 10$ kHz $= 9990$ kHz