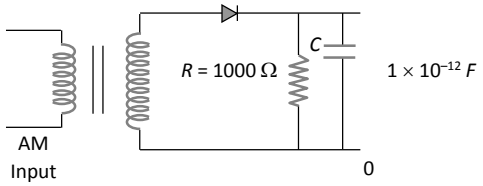
COMMUNICATION SYSTEMS

Single Correct Answer Type

1. Ozone layer above earth's atmosphere will not
   a) Prevent infrared radiations from sun reaching on earth
   b) Prevent infrared radiations originated from earth from escaping earth's atmosphere
   c) Prevent ultra violet rays from sun
   d) Reflect back radio waves
2. Which of the following four alternatives is not correct?
   We need modulation
   a) To increase the selectivity
   b) To reduce the time lag between transmission and reception of the information signal
   c) To reduce the size of antenna
   d) To reduce the fractional band width, that is the ratio of the signal band width to the centre frequency
3. A laser is a coherent source it contains
   a) Many wavelength
   b) Uncoordinated waves of particular wavelength
   c) Coordinated waves of many wavelength
   d) Coordinated waves of particular wavelength
4. In a communication system, noise is most likely to affect the signal
   a) At the transmitter
   b) In the channel or in the transmission line
   c) In the information source
   d) At the receiver
5. The frequency band used in the downlink of satellite communication is
   a) 9.5 to 2.5 GHz b) 896 to 901 MHz c) 3.7 to 4.2 GHz d) 840 to 935 MHz
6. A carrier wave is modulated by a number of sine waves with modulation indices $m_1, m_2, m_3, \ldots$, The total modulation index (m) of the wave is
   a) $m_1 + m_2 + m_3 + \ldots$ b) $m_1 - m_2 + m_3 + \ldots$ c) $\sqrt{m_1^2 + m_2^2 + m_3^2 + \ldots}$ d) $\sqrt{\frac{m_1^2 + m_2^2 + m_3^2 + \ldots}{n}}$
7. The principle used in the transmission of signal through an optical fibre is
   a) Total internal reflection
   b) Reflection
   c) Refraction
   d) Dispersion
8. For a body moving with relativistic speed, if the velocity is doubled, then
   a) Its linear momentum is doubled
   b) Its linear momentum will be less than double
   c) Its linear momentum will be more than double
   d) Its linear momentum remains unchanged
9. In which of the following remote sensing technique is not used
   a) Forest density b) Pollution c) Wetland mapping d) Medical treatment
10. A receiver reconstructs the original message after propagation through the channel.
    a) May be true b) May be false c) May be true or false d) Is certainly true
11. 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

12. Broadcasting antennas are generally
    a) Omnidirectional type b) Vertical type c) Horizontal type d) None of these
13. The carrier frequency generated by a circuit containing 1 nF capacitor and 10 μH inductor is
    a) 1592 Hz b) 1592 kHz c) 159.2 Hz d) 15.92 kHz
14. The difference in the refractive index of the fiber core and fiber cladding in step-index fibers is typically
    a) 0.01% b) 1% c) 10% d) 25%
15. Large band width for higher data rate is achieved by using
    a) High frequency carrier wave b) Low frequency carrier wave
    c) High frequency audio wave d) Low frequency audio wave
16. The main objective of an optical source is
    a) To demodulate the electrical signal
    b) To detect the signal
    c) The convert an electrical energy into an optical energy
    d) All of the above
17. A double star system consists of two stars A and B which have time period T_A and T_B. Radius R_A and R_B and mass M_A and M_B. Choose the correct option.
    a) If $T_A > T_B$ then $R_A > R_B$ b) If $T_A > T_B$ then $M_A > M_B$
    c) $\left(\frac{T_A}{T_B}\right)^2 = \left(\frac{R_A}{R_B}\right)^3$ d) $T_A = T_B$
18. Flash spectrum confirms a/an
    a) Magnetic stom b) Earthquake c) Lunar eclipse d) Total solar eclipse
19. When the modulation percentage is 75, an AM transmitter produces 10 kW. How much of this is carrier power?
    a) 10 kW b) 13.33 kW c) 7.5 kW d) 7.81 kW
20. The SKIP ZONE in Radio Wave Transmission is that range where
    a) There is no reception of either ground wave or sky wave
    b) The reception of ground wave is maximum but that of sky wave is minimum
    c) The reception of ground wave is minimum, but that of sky wave is maximum
    d) The reception of both ground and sky wave is maximum
21. The ratio waves of frequency 30 MHz to 300 MHz belong to
    a) High frequency band b) Very high frequency band
    c) Ultra high frequency band d) Super high frequency band
22. In space communication, the information can be passed from one place to another at a distance of 100 km in
    a) 1 s b) 0.5 s c) 0.003 s d) None of these
23. In earth's atmosphere, for F_1-layer; the virtual height and critical frequency are
    a) 150 km and 3 MHz b) 160 km and 3.5 MHz
    c) 170 km and 4.5 MHz d) 180 km and 5 MHz
24. The audio signal used to modulate $60 \sin(2\pi \times 10^6\, t)$ is $15 \sin 300\pi t$. The depth of modulation is
    a) 50% b) 40% c) 25% d) 15%
25. Frequency range for microwaves is
    a) 3×10^4 to 3×10^9 Hz b) 3×10^9 to 3×10^{13} Hz
    c) 3×10^9 to 3×10^{14} Hz d) 1×10^9 to 3×10^{11} Hz
26. In the given detector circuit, the suitable value of carrier frequency is



a) $<< 10^9\ Hz$ b) $<< 10^5\ Hz$ c) $>> 10^9\ Hz$ d) None of these

27. The range of characteristics impedance for co-axial wire lines is
a) 40 Ω to 150 Ω b) 400 Ω to 1500 Ω c) 4 Ω to 15 Ω d) 40 kΩ to 150 kΩ
28. Which is more advantageous?
a) Analog data communication b) Digital data communication
c) Both are equally good d) Depends on the situation
29. A transmitter transmits the message in original
a) True b) False
c) Something true and sometimes false d) Never true
30. A broken ligament is being 'welded' back in place using 20 ms pulses from a 0.5 W laser operating at a wavelength of 632 nm. The number of photons in 5 pulses of laser are
a) 1.59×10^{-18} b) 3.18×10^{-17} c) 1.59×10^{23} d) 3.18×10^{-16}
31. Faintest stars are called
a) Dwarfs b) Sixth magnitude stars
c) Second magnitude d) Zero magnitude stars
32. Venus looks brighter than other stars, due to
a) Atomic fusion takes place on its surface b) It is closer to the earth than other stars
c) It has higher density than other stars d) It is heavier than other stars
33. What should be the maximum acceptance angle at the aircore interface of an optical fibre if n_1 and n_2 are the refractive indices of the core and the cladding, respectively
a) $\sin^{-1}(n_2/n_1)$ b) $\sin^{-1}\sqrt{n_1^2 - n_2^2}$ c) $\left[\tan^{-1}\frac{n_2}{n_1}\right]$ d) $\left[\tan^{-1}\frac{n_1}{n_2}\right]$
34. Consider telecommunication through optical fibres. Which of the following statements is no true?
a) Optical fibres can be of graded refractive index
b) Optical fibres are subjected to electro-magnetic interference from outside
c) Optical fibres have extremely low transmission loss
d) Optical fibres may have homogeneous core with a suitable cladding
35. When electromagnetic waves enter the ionised layer of ionosphere, then the relative permittivity *ie*,dielectric constant dielectric constant of the ionised layer
a) Does not change
b) Appears to increase
c) Appears to decrease
d) Sometimes appears to increase and sometimes to decrease
36. The antenna current of an AM transmitter is 8 A when only carrier is sent but increases to 8.96 A when the carrier is sinusoidally modulated. The percentage modulation is
a) 50% b) 60% c) 65% d) 71%
37. Which fibers are less expensive and simple to construct?
a) Single-mode step index fiber b) Multi-mode step index fiber
c) Multi graded index fiber d) All are equally expensive
38. The k line of singly ionized calcium has a wavelength of 393.3 nm as measured on earth. In the spectrum of one of the observed galaxies, this spectral line is located at 401.8 nm. The speed with which the galaxy is moving away from us, will be

a) 6480 kms^{-1} b) 3240 kms^{-1} c) 4240 kms^{-1} d) None of the above

39. In hydrogen spectrum, the wavelength of H_α line is 656 nm, whereas in the spectrum of a distant galaxy, H_α wavelength is 706 nm. Estimated speed of the galaxy with respect to earth is
a) 2×10^8 ms^{-1} b) 2×10^7 ms^{-1} c) 2×10^6 ms^{-1} d) 2×10^5 ms^{-1}
40. The impedance of coaxial cable, when its inductance is 0.40 μH and capacitance is $1 \times 10^{-11} F$, can be
a) $2 \times 10^2\ \Omega$ b) $100\ \Omega$ c) $3 \times 10^3\ \Omega$ d) $3 \times 10^{-2}\ \Omega$
41. The frequency of a FM transmitter without signal input is called
a) Lower side band frequency b) Upper side band frequency
c) Resting frequency d) None of these
42. In an FM system a 7 kHz signal modulate 108 MHz carrier so that frequency deviation is 50 kHz. The carrier swing is
a) 7.143 b) 8 c) 0.71 d) 350
43. A photodetector is made from a semiconductor with $E_g = 0.73\ eV$. What is the maximum wavelength, which it can detect
a) 1000 nm b) 1703 nm c) 500 nm d) 173 nm
44. 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)
45. An oscillator is producing FM waves of frequency 2 kHz with a variation of 10 kHz. What is the modulating index?
a) 0.20 b) 5.0 c) 0.67 d) 1.5
46. The transmission media can be
a) Guided only b) Unguided only c) Both (a) and (b) d) None of these
47. In a radio receiver, the short wave and medium wave stations are tuned by using the same capacitor but coils of different inductance L_s and L_m respectively then
a) $L_s > L_m$ b) $L_s < L_m$ c) $L_s = L_m$ d) None of these
48. If the area to be covered for TV telecast is doubled, then height of transmitting antenna (TV tower) will have to be
a) Doubled b) Halved c) Quadrupled d) Kept unchanged
49. Present day communication systems are
a) Electrical b) Electronic c) Optical d) All of these
50. In amplitude modulation, the bandwidth is
a) Twice the audio signal frequency
b) Thrice the audio signal frequency
c) Thrice the carrier wave frequency
d) Sum of audio signal frequency and carrier wave frequency
51. The highest frequency of radiowaves which when sent at some angle towards the ionosphere, gets reflected from that and returns to the earth is called
a) Critical frequency b) Maximum unusable frequency
c) Polarisation of waves d) None of the above
52. Which one of the following statements is wrong?
a) Radio waves in the frequency range 30 MHz to 60 MHz are called sky waves
b) Radio horizon of the transmitting antenna for space wave is $d_T = \sqrt{(2Rh_T)}$ (R = radius of earth, h_T = height of transmitting antenna)
c) Within the skip distance neither the ground waves nor the sky waves are received
d) The principle of fibre optical communication is total internal reflection
53. 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

54. The diameter of an optical fiber is
a) 10^{-5}m b) 10^{-4}m c) 10^{-3}cm d) 10^{-2}cm

55. In ruby laser, the stimulated emission is due to transition from
a) Metastable state to any lower state
b) Any higher state to lower state
c) Metastable state to ground state
d) Any higher state to ground state

56. The characteristic impedance of a co-axial cable is160 Ω. If its inductance is 0.4 mH, its capacitance would be
a) 15.6 μF b) 1.6 F c) 15.6 nF d) 15.6 pF

57. 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

58. Which frequency range is used for optical communication?
a) 100000 to 400000 GHz
b) 200 kHz to 3 MHz
c) 30000 GHz o 6000 GHz
d) None of the above

59. The velocity of all radio waves in free space is $3 \times 10^8\ m/s$. The frequency of a radio waves of wavelength 150 m is
a) 20 kHz b) 2 kHz c) 2 MHz d) 1 MHz

60. The distance of coverage of a transmitting antenna is 12.8 km. Then, the height of the antenna is (Given that radius of earth = 6400 km)
a) 6.4 m b) 12.8 m c) 3.2 m d) 16 m

61. The maximum electron density in the ionosphere in the morning is 10^{10} m^{-3}. At noon time, it increases to 2×10^{10} m^{-3}. Find the ratio of critical frequency at noon and the critical frequency in the morning.
a) 2.00 b) 2.82 c) 4.00 d) 1.414

62. Through which mode of propagation, the radio waves can be sent from one place to another
a) Ground wave propagation
b) Sky wave propagation
c) Space wave propagation
d) All of the above

63. Intelsat satellite is used for
a) Radio communication
b) Radar communication
c) Intercontinental communication
d) None of the above

64. Modulation is the process of superposing
a) Low frequency audio signal on high frequency waves
b) Low frequency radio signal on low frequency audio waves
c) High frequency audio signal on low frequency radio waves
d) Low frequency audio signal on low frequency radio waves

65. Point to point communication requires the use of
a) A guided medium only
b) Unguided medium only
c) Any medium
d) None of these

66. The attenuation in optical fibre is mainly due to
a) Absorption
b) Scattering
c) Neither absorption nor scattering
d) Both (a) and (b)

67. What is the modulation index of an over modulated wave

a) 1 b) Zero c) < 1 d) > 1

68. The velocity of electromagnetic wave in good conductor is
a) 3×10^8 ms^{-1} b) More than 3×10^8ms^{-1}
c) Very low d) High

69. A radar has a power of 1 kW and is operating at a frequency of 10 GHz. 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
a) 80 km b) 16 km c) 40 km d) 64 km

70. For sky wave propagation of 10 MHz signal, what should be the minimum electron density in ionosphere?
a) $\sim 1.2 \times 10^{12}$ m^{-3} b) $\sim 10^6$ m^{-3} c) $\sim 10^{14}$ m^{-3} d) $\sim 10^{22}$ m^{-3}

71. The bit rate for a signal, which has a sampling rate of 8 kHz and where 16 quantisation levels have been used is
a) 32000 $bits/s$ b) 16000 $bits/s$ c) 64000 $bits/s$ d) 72000 $bits/s$

72. Special theory of relativity states that
a) Mass remains unaffected in any inertial frame
b) Velocity of light remains unaffected in any inertial frame
c) Time remains same in all inertial frames
d) None of the above

73. Long distance short-wave radio broadcasting uses
a) Ground wave b) Ionospheric wave c) Direct wave d) Sky wave

74. The mobile telephones operate typically in the range of
a) $1 - 100$ MHz b) $100 - 200$ MHz c) $1000 - 2000MHz$ d) $800 - 950MHz$

75. If μ_1 and μ_2 are the refractive indices of the materials of core and cladding of an optical fibre, then the loss of light due to its leakage can be minimized by having
a) $\mu_1 > \mu_2$ b) $\mu_1 < \mu_2$ c) $\mu_1 = \mu_2$ d) None of these

76. Which of the following frequencies will be suitable for beyond the horizon communication
a) 10 kHz b) 10 MHz c) 1 GHz d) 1000 GHz

77. Small vales of numerical aperture (NA) decrease the pulse dispersion but increase losses due to
a) Scattering b) Absorption c) Bending d) Microbending

78. The principle of laser action involves
a) Amplification of particular frequency emitted by the system
b) Population inversion
c) Stimulated emission
d) All of the above

79. In co-axial cables, the repeater spacing is of the order of
a) 20 km b) 2 km c) 200 km d) 2000 km

80. A signal emitted by an antenna from a certain point can be received at another point of the surface in the form of
a) Sky wave b) Ground wave c) Sea wave d) Both (a) and (b)

81. If a number of sine waves with modulation indices n_1, n_2, n_3..... modulate is carrier wave, then total modulation index (n) of the wave is
a) $n_1 + n_2 \ldots + 2(n_1 + n_2 \ldots)$ b) $\sqrt{n_1 - n_2 + n_3 \ldots \ldots}$
c) $\sqrt{n_1^2 + n_2^2 + n_3^2 \ldots \ldots}$ d) None of these

82. When a low flying aircraft passes over head, we sometimes notice a slight shaking of the picture on our TV screen. This is due to

a) Different of the signal received from the antenna
b) Interference of the direct signal received by the antenna with the weak signal reflected by the passing aircraft
c) Change of magnetic flux occurring due to the passage of aircraft
d) Vibrations created by the passage of aircraft

83. The normalised fiber frequency is expressed by (a=fiber core radius, λ_0=free space wavelength, μ_1, μ_2= refractive index of core and cladding)
a) $\frac{2\pi a}{\lambda_0}(\mu_1^2 - \mu_2^2)^2$ b) $\frac{2\pi a}{\lambda_0}(\mu_1^2 - \mu_2^2)^{1/2}$ c) $\frac{2\pi a}{\lambda_0}(\mu_1^2 - \mu_2^2)^{-1/2}$ d) $\frac{2\pi a}{\lambda_0}(\mu_1^2 - \mu_2^2)$

84. The modulation in which pulse duration varies in accordance with the modulating signal is called
a) PAM b) PPM c) PWM d) PCM

85. 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

86. The characteristic impedance (Z_0) parallel line wire is
a) $Z_0 = \frac{276}{\sqrt{k}}\log\frac{2s}{d}$ b) $Z_0 = \frac{376}{\sqrt{k}}\log\frac{2s}{d}$ c) $Z_0 = \frac{276}{k}\log\frac{2s}{d}$ d) $Z_0 = \frac{276}{\sqrt{k}}\log\frac{d}{2s}$

87. The characteristic impedance of a coaxial cable is of the order of
a) 50 W b) 200 W c) 270 W d) None of these

88. The closed structure of co-axial cable prevents inner copper wire or core or from radiating signal power. The statement is
a) True b) False
c) Neither true nor false d) Partly true and partly false

89. What is the value of frequency at which electromagnetic wave must be propagated for the D-region of atmosphere to have a refractive index of 0.5. Electron density for D-region is 400 electrons/cc
a) 200 kHz b) 104.2 kHz c) 208.4 kHz d) 312.6 kHz

90. Optical fibre works on the principle of
a) Interference of light b) Total internal reflection of light
c) Reflection of light d) Diffraction of light

91. The range of frequencies allotted for FM radio is
a) 88 to 108 kHz b) 88 to 108 MHz c) 47 to 230 kHz d) 47 to 230 MHz

92. Primary constant of a transmission line are
a) Resistance and inductance b) Capacitance and conductance
c) Both (a) and (b) d) None of the above

93. The antenna current of an AM broadcast transmitter modulated by 50% is 11. Find the carrier current
a) 9.25 A b) 10 A c) 10.35 A d) 5.5 A

94. A given fiber has core refractive index of 1.5 and a core cladding index difference factor (Δ) of 0.01125. The numerical aperture is
a) 0.252 b) 0.225 c) 0.5 d) 2.25

95. In amplitude modulation, carrier wave frequencies are
a) Lower compared to those in frequency modulation
b) Higher compared to those in frequency modulation
c) Same as in frequency modulation
d) Lower sometimes and higher sometimes to those in frequency modulation

96. The phenomenon by which light travels in an optical fibres is

a) Reflection b) Refraction
c) Total internal reflection d) Transmission

97. The relation between the maximum electron density N_{max} and the critical frequency f_c for the ionosphere can be given as
a) $f_c = \sqrt{9\ N_{max}}$ b) $f_c = \sqrt{9}\ N_{max}$ c) $f_c = 9\sqrt{N_{max}}$ d) None of these

98. A telephone link operating at a central frequency of 10 GHz is established. If 1% of this available then how many telephone channels can be simultaneously given when each telephone covering a band width of 5 kHz
a) 2×10^4 b) 2×10^6 c) 5×10^4 d) 5×10^6

99. Optical fiber communication is generally preferred over general communication system because
a) It is more efficient b) It has signal security
c) It can be jammed as easily as radiowaves d) All of the above

100. The height of a TV antenna is 200 m. The population density is4000 km^{-2}. Find the population benefited
a) 3.2×10^8 b) 3.2×10^7 c) 3.2×10^6 d) 3.2×10^5

101. A carrier is simultaneously modulated by two sine waves having modulation indices of 0.3 and 0.4. The total modulation index will be
a) 0.1 b) 0.5 c) 0.7 d) 0.35

102. The sky wave propagation is suitable for radio-waves of frequency
a) Upto 2 MHz b) From 2 MHz to 20 MHz
c) From 2 MHz to 30 MHz d) From 2 MHz to 50 MHz

103. Antenna is
a) Inductive b) Capacitive
c) Resistive above its resonant frequency d) Resistive at resonant frequency

104. The electron density of E, F_1, F_2 layers of ionosphere is $2 \times 10^{11}, 5 \times 10^{11}$ and $8 \times 10^{11} m^{-3}$ respectively. What is the ratio of critical frequency for reflection of radiowaves
a) 2 : 4 : 3 b) 4 : 3 : 2 c) 2 : 3 : 4 d) 3 : 2 : 4

105. The velocity of electromagnetic waves in a medium is$2 \times 10^8 ms^{-1}$. The dielectric constant of the medium is
a) 4 b) 2.25 c) 3/2 d) 2/3

106. Because of tilting which waves finally disappear
a) Microwaves b) Surface waves c) Sky waves d) Space waves

107. An optical fibre communication system works on a wavelength of 1.3 μm. The number of subscribers it can feed if a channel requires 20 kHz are
a) 2.3×10^{10} b) 1.15×10^{10} c) 1×10^5 d) None of these

108. An optical fiber made of glass with a core of refractive index of 1.55 and include with another glass with a refractive index of 1.51. Launching takes place from air. What is the value of critical angle for core-clad boundary?
a) 65° b) 72° c) 77° d) 82°

109. If sky wave with frequency of 50 MHz is incident on D region at an angle of 30°, then angle of refraction is
a) 15° b) 30° c) 60° d) 45°

110. If both the length of an antenna and the wavelength of the signal to be transmitted are doubled, the power radiated by the antenna
a) Is doubled b) Is halved c) Remains constant d) Is quadrupled

111. If μ_1 and μ_2 are the refractive indices of the material of core and cladding of an optical fiber, then the loss of light due to its leakage can be minimised by having
a) $\mu_1 > \mu_2$ b) $\mu_1 < \mu_2$ c) $\mu_1 = \mu_2$ d) None of these

112. With reference to ionospheric propogation, an electromagnetic wave with a critical frequency of 15 MHz and incident at an angle of 45° will have MUF of
a) 15 MHz b) $15/\sqrt{2}$ MHz c) $15\sqrt{2}$ MHz d) None of these

113. A $1000kHz$ carrier wave is modulated by audio signal of frequency range 100-$5000Hz$. Then the width of the channel in kHz is
a) 10 b) 20 c) 30 d) 40

114. The glass of optical fiber has refractive index 1.55 and is clad with another glass of refractive index 1.51. When the surrounding is air, the numerical aperture will be
a) 0.625 b) 0.350 c) 0.528 d) 0.704

115. When the modulating frequency is doubled, the modulation index is halved and the modulating voltage remains constant, the modulation system is
a) Amplitude modulation b) Phase modulation
c) Frequency modulation d) All of the above

116. You are using light of wavelength 1400 nm in a photodetector. Which of the following semiconductor is to be used having band gap as?
$(h = 6.63 \times 10^{-34}\text{Js}; c = 3 \times 10^{8}\text{ms}^{-1})$
a) 1eV b) 2eV c) 3eV d) 3.5eV

117. If the maximum amplitude of an amplitude modulated wave is 25 V and the minimum amplitude is 5 V, the modulation index is
a) 1/5 b) 1/3 c) 3/2 d) 2/3

118. A transmitter supplies 9 kW to the aerial when unmodulated. The power radiated when modulated to 40% is
a) 5 kW b) 9.72 kW c) 10 kW d) 12 kW

119. The optical fibres have an inner core of refractive index n_1 and a cladding of refractive index n_2 such that
a) $n_1 = n_2$ b) $n_1 \leq n_2$ c) $n_1 < n_2$ d) $n_1 > n_2$

120. In an amplitude modulated wave for audio frequency of 500 $cycle/second$, the appropriate carrier frequency will be
a) 50 $cycles/s$ b) 100 $cycles/s$ c) 500 $cycles/s$ d) 50,000 $cycles/s$

121. Which one of the following is a full duplex transmission system?
a) TV b) Radio
c) Telephone d) Walky-talky (wireless used in the army)

122. An earth satellite emits a radio signal of frequency 10^8 Hz. An observer on the ground detects beats between the received signal and a local signal also of frequency 10^8 Hz. At a particular moment, the beat frequency is 2400 Hz. What is the component of satellite velocity directed towards earth at this moment?
a) 1080 ms^{-1} b) 1800 ms^{-1} c) 3600 ms^{-1} d) 7200 ms^{-1}

123. A step index fibre has a relative refractive index of 0.88%. What is the critical angle at the corecladding interface
a) 60° b) 75° c) 45° d) None of these

124. In earth's atmosphere, for E-layer, the virtual height and critical frequency are
a) 80 km and 3MHz b) 90 km and 3.5 MHz
c) 120 km and 4.5 MHz d) 110 km and 4 MHz

125. What should be minimum length of antenna for efficient transmission of signals of wavelength λ?
a) $\lambda/2$ b) $\lambda/3$ c) $\lambda/4$ d) $\lambda/5$

126. A wave is represented as $e = 10\sin(10^8 t + 6\sin 1250t)$ then the modulating index is
a) 10 b) 1250 c) 10^8 d) 6

: ANSWER KEY :

1)	d	2)	b	3)	d	4)	b	5)	c	6)	c	7)	a	8)	a
9)	d	10)	d	11)	a	12)	b	13)	b	14)	b	15)	a	16)	c
17)	d	18)	d	19)	d	20)	a	21)	b	22)	d	23)	d	24)	c
25)	d	26)	a	27)	a	28)	b	29)	d	30)	c	31)	b	32)	b
33)	b	34)	b	35)	c	36)	d	37)	b	38)	a	39)	b	40)	a
41)	c	42)	a	43)	b	44)	a	45)	b	46)	c	47)	b	48)	a
49)	d	50)	a	51)	b	52)	c	53)	c	54)	b	55)	d	56)	c
57)	d	58)	a	59)	c	60)	b	61)	d	62)	d	63)	c	64)	a
65)	a	66)	d	67)	d	68)	c	69)	a	70)	a	71)	a	72)	b
73)	c	74)	d	75)	a	76)	b	77)	d	78)	d	79)	a	80)	d
81)	c	82)	b	83)	b	84)	c	85)	c	86)	a	87)	c	88)	a
89)	c	90)	b	91)	b	92)	c	93)	c	94)	b	95)	a	96)	c
97)	c	98)	a	99)	d	100)	b	101)	b	102)	c	103)	d	104)	c
105)	b	106)	b	107)	b	108)	c	109)	b	110)	c	111)	a	112)	c
113)	a	114)	b	115)	c	116)	a	117)	d	118)	b	119)	d	120)	d
121)	c	122)	d	123)	d	124)	d	125)	c	126)	d				

: HINTS AND SOLUTIONS :

1 **(d)**

Ozone layer will absorb UV rays; reflects the infrared radiation and does not reflected back radiowaves

2 **(b)**

Modulation does not change time log between transmission and reception.

3 **(d)**

Laser is a coherent source of coordinated waves of particular wavelength

4 **(c)**

Total modulation index of the wave

$m = \sqrt{m_1^2 + m_2^2 + m_3^2 + \ldots}$

7 **(a)**

The optical fibres are used to transmit light signals from one place to another without any practical loss in the intensity of light signal. It works on the principle of total internal reflection.

8 **(a)**

From Einstein's theorem

Relativistic momentum $= \frac{m_0 v}{\sqrt{1-v^2/c^2}}$

Putting $v = 2v$

We get $p = \frac{m_0(2v)}{\sqrt{1-(2v^2)/c^2}} = 2\left(\frac{m_0 v}{\sqrt{1-4v^2/c^2}}\right)$

So, the momentum becomes more than the double.

9 **(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

10 **(d)**

The statement is invariably true

11 **(a)**

For efficient radiation and reception, the height of to be the transmitting and receiving antennas should be comparable to a quarter wavelength of the frequency used.

Therefore FM has shorter antenna and AM has longer antenna.

12 **(b)**

$C = 1\ nF = 10^{-9}F, L = 10\mu H = 10^{-5}H$

$v = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\pi\sqrt{10^{-5} \times 10^{-9}}} = \frac{10^7}{2\pi}$

$= 1.592 \times 10^4\ Hz = 1592\ kHz$

14 **(b)**

The percentage difference in the refractive indices of fibre core and fibre cladding in step index fibre

$= \frac{\mu_1 - \mu_2}{\mu_1} \times 100 \approx 1\%$

15 **(a)**

High frequency carrier wave provides a larger band width.

16 **(c)**

The main objective of optical source is to convert the electrical energy into the optical energy

17 **(d)**

In case of binary star system angular velocity and hence the time period of both the stars are equal.

19 **(d)**

$P_t = P_c(1 + m^2/2)$

$P_c = \dfrac{P_t}{1 + m^2/2}$

$= \dfrac{10}{1 + \frac{1}{2}(3/4)^2} = \dfrac{10 \times 32}{41}$

$P_c = 7.81$ kw

21 **(b)**

Radiowaves of frequency 30 MHz to 300 MHz belong to very high frequency band

22 **(d)**

In space communication, the information can be passed from one place to another with the speed of light($c = 3 \times 10^8\ ms^{-1}$). Hence, time taken for a distance of 100 $km = \frac{100 \times 10^3}{3 \times 10^8} = 3.3 \times 10^{-4} s$

24 **(c)**

$m_a = \dfrac{E_m}{E_c} = \dfrac{15}{60} \times 100 = 25\%$

25 **(d)**

Frequency range for microwaves is 1×10^9 to 3×10^{11} Hz

26 **(a)**

Using $\frac{1}{f_{carrier}} << RC$

We get time constant, $RC = 1000 \times 10^{-12} = 10^{-9} s$

Now $v = \frac{1}{T} = \frac{1}{10^{-9}} = 10^9 Hz$

Thus the value of carrier frequency should be much less than $10^9 Hz$, say 100 kHz

27 **(a)**

Characteristic impedance (Z_0) of a co-axial wire line is lower *ie*, from 40 to 15Ω

28 **(b)**

Digital data communication is more advantageous.

29 **(d)**

No, the message signal has to be transformed to make it suitable for transmission

30 **(c)**

The power of laser is 0.5 W, let n photon/s are incident by laser pulse on the broken ligament, then

$n \times hv = 0.5$ W

$\Rightarrow \dfrac{nhc}{\lambda} = 0.5 \Rightarrow n = \dfrac{0.5 \times \lambda}{hc}$

$= \frac{0.5 \times 632 \times 10^{-9}}{6.626 \times 10^{-34} \times 3 \times 10^8} = 1.59 \times 10^{18}$ photon/s

So, number of photons contained in 5 pulses are,

$n \times 5 \times (20 \times 10^3) = 1.59 \times 10^{23}$

32 **(b)**

Venus looks brighter than other stars because it is closer to earth than other stars.

33 **(b)**

Core of acceptance angle $\theta = \sin^{-1}\sqrt{n_1^2 - n_2^2}$

34 **(b)**

Some of the characteristics of an optical fibre are as follows.

(i) This works on the principle of total internal reflection.
(ii) It consists of core made up of glass/silica/plastic with refractive index n_1, which is surrounded by a glass or plastic cladding with refractive index $n_2 (n_2 > n_1)$. The refractive index of cladding can be either changing abruptly or gradually changing (Graded index fibre).
(iii) There is a very little transmission loss through optical fibres.
(iv) There is no interference from stray electric and magnetic fields to the signals through optical fibres.

35 **(c)**

When electromagnetic waves enter the ionised layer of ionosphere, then the relative permittivity of the ionised layer appears to decrease

36 **(d)**

We know that $\left(\frac{I_t}{I_c}\right)^2 = 1 + \frac{m^2}{2}$

Here, $I_t = 8.96A$ and $I_c = 8A$

$\therefore \left(\frac{8.96}{8}\right)^2 = 1 + \frac{m^2}{2}$ or $1.254 = 1 + \frac{m^2}{2}$

or $\frac{m^2}{2} = 0.254$ or $m^2 = 0.508$

or $m = 0.71 = 71\%$

37 **(b)**

Multi-mode step index fibers are less expensive and easy to construct

38 **(a)**

Here, $\lambda_0 = 393.3$ nm

$\lambda = 401.8$ nm

Red shift, $z = \frac{\lambda - \lambda_0}{\lambda_0} = \frac{401.8 - 393.3}{393.3} = \frac{8.5}{393.3} = 0.0216$

Now $z = \frac{v}{c}$ then

$v = zc = 0.0216 \times 3 \times 10^8 = 6.48 \times 10^6 \text{ ms}^{-1} = 6480 \text{ km s}^{-1}$

39 **(b)**

The wavelength of light emitted by a moving object is shifted. This effecd is called the Doppler's shift given by

$\lambda = \lambda_0 \left(1 + \frac{v}{c}\right)$ ... (i)

Where λ is perceived wavelength, v the velocity and c the speed of light.

From Eq. (i) $v = c\left(\frac{\lambda - \lambda_0}{\lambda_0}\right)$

Given, $\lambda_0 = 656$ nm, $\lambda = 706$ nm,

$c = 3 \times 10^8 \text{ ms}^{-1}$

$v = 3 \times 10^8 \left(\frac{706 - 656}{656}\right)$

$v = 3 \times 10^8 \times \frac{50}{656} \approx 2 \times 10^7 \text{ ms}^{-1}$

40 **(a)**

Using $Z = \sqrt{\frac{L}{C}}$ we get $Z = \sqrt{\frac{0.40 \times 10^{-6}}{10^{-11}}} = 2 \times 10^2 \Omega$

42 **(a)**

Carrier swing $= \frac{\text{Frequency deviation}}{\text{Modulation frequency}} = \frac{50}{7} = 7.143$

43 **(b)**

Limiting value of hv is E_g, such that $hv = \frac{hc}{\lambda} = E_g$

or $\lambda = \frac{hc}{E_g} = \frac{6.63\times10^{-34}J-s\times3\times10^{8}ms^{-1}}{0.73\times1.6\times10^{-19}\,J}$

$= 1703\,nm$

45 **(b)**

The modulation index is given as

$$\beta = \frac{\Delta f}{f_m}$$

Where, Δf is frequency deviation, f_m the highest modulating frequency.

Given, $\Delta f = 10$ kHz $= 10 \times 10^3$ Hz,

$f_m = 2$ kHz $= 2 \times 10^3$ Hz

$$\therefore\ \beta = \frac{10 \times 10^3}{2 \times 10^3} = 5$$

46 **(c)**

The transmission media can be both, guided as well as unguided

47 **(b)**

As $v = \frac{c}{\lambda} \Rightarrow v_m = \frac{c}{\lambda_m}$ and $v_s = \frac{c}{\lambda_s}$

$\because\ \lambda_m > \lambda_s \Rightarrow v_m < v_s$

Also, $v_m = \frac{1}{2\pi\sqrt{L_m C}}$ and $v_s = \frac{1}{2\pi\sqrt{L_s C}}$

$$\Rightarrow \frac{v_m}{v_s} = \sqrt{\frac{L_s}{L_m}} \Rightarrow L_s < L_m$$

48 **(a)**

In optical communication, light is transmitted in form of light pulses along an optical fibre is transmission medium. Since, wavelength of light is very small as compared o the radio waves, it provides a very large band width and can carry a huge amount of information.

In optical fibres there occurs a total internal reflection of light so interference phenomenon must not occur.

49 **(d)**

The modern communication systems are electrical, electronic or optical

50 **(a)**

In amplitude modulation, Bandwidth $v_{USB} - v_{LSB}$

$= (v_c + v_m) - (v_c - v_m) = 2v_m$

∴ Bandwidth = Twice the frequency of modulating signal frequency

51 **(b)**

The highest frequency of radiowaves that can be reflected by the ionosphere is called maximum usable frequency

54 **(b)**

The diameter of optical fiber is 10^{-4} cm

55 **(d)**

For a ruby laser, a crystal of ruby is formed into a cylinder. A fully reflecting mirror is placed on one end and a partially reflecting mirror on the other. A high-intensity lamp is spiraled around the ruby cylinder to provide a flash of white light that triggers the laser action. The green and blue wavelengths in the flash excite electrons in the chromium atoms to a higher energy level. Upon returning to their normal state, the electrons emit their characteristic ruby-red light. The mirrors reflect some of this light back and forth inside the ruby crystal, stimulating other excited chromium

atoms to produce more red light, until the light pulse builds up to high power and drains the energy stored in the crystal. In ruby laser stimulated emission is due to transition from metastable state to ground state.

56 **(c)**

From $Z_0 = \sqrt{\frac{L}{C}}$,

$C = \frac{L}{Z_0^2} = \frac{0.4 \times 10^{-3}}{160 \times 160}$

$= 15.62 \times 10^{-19}\text{F} = 15.62\ \text{nF}$

57 **(d)**

Following are the problems which are faced while transmitting audio signals directly.

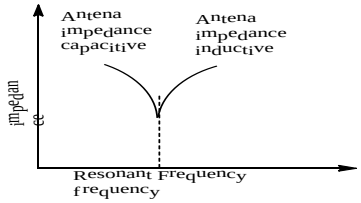
(i) These signals are relatively of short range

(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

58 **(a)**

Optical communication is made of communication by which we can transfer the information from one place to another through optical carrier waves. Light frequencies used in optical communication system lie between 10^{14} Hz to 4×10^{14} Hz (ie, 100,000 to 400,000 GHz.)



59 **(c)**

Here : Velocity of electromagnetic waves in free space and wavelength

$v = 3 \times 10^8 m/s$ and $\lambda = 150m$

The frequency of radio waves is given by

$= \frac{v}{\lambda} = \frac{3 \times 10^8}{150} = 2 \times 10^6\ Hz = 2\ MHz$

60 **(b)**

Given $d = 12.8$ km, $R = 6400$ km

We have $d = \sqrt{2hR}$

$h = \frac{d^2}{2R} = \frac{(12.8)^2}{2 \times 6400} = 12.8$ m

61 **(d)**

Given, the maximum electron density in the morning

$N_{max} = 10^{10}\ \text{m}^{-3}$

$f_c' = 9(N_{max})^{1/2} = 9(10^{10})^{1/2}$

Critical frequency $f_c' = 9 \times 10^5$

The maximum electron density at noon

$N_{max} = 2 \times 10^{10}\ \text{m}^{-3}$

Critical frequency

$f_c'' = 9 \times (N_{max}')^1 = 9 \times (2 \times 10^{10})^1 = 9 \times \sqrt{2} \times 10^5$

The ratio of critical frequency at noon and critical frequency in the morning.

$$\frac{f_c''}{f_c'} = \frac{9 \times \sqrt{2} \times 10^5}{9 \times 10^5}$$

Or $\frac{f_c''}{f_c'} = \sqrt{2} = 1.414$

62 **(d)**

The radio waves can be sent from one place to another through following propagation mode. (i) space wave propagation, sky wave propagation and ground wave propagation

63 **(c)**

Intelsat satellite is used for intercontinental communication

64 **(a)**

Modulation is a process of superposing a low frequency audio signals (called modulating signal) on a high frequency radio wave called carrier wave

66 **(d)**

A very small part of light energy is lost from an optical fibre due to absorption or due to light leaving the fibre as a result of scattering of light sideways by impurities in the glass fibre.

67 **(d)**

When $m_a > 1$ then carrier is said to be over modulated

68 **(c)**

The velocity of electromagnetic waves in a conductor is given by

$$v = \frac{1}{\sqrt{\mu_0 \mu_r \varepsilon_0 \varepsilon_r}} = \frac{c}{\sqrt{\mu_r \varepsilon_r}}$$

Since, the value of μ_r and ε_r are greater than 1, hence $v << c$

69 **(a)**

$d = \sqrt{2hR} = \sqrt{2 \times 500 \times 6.4 \times 10^6}\ m$

$= 80{,}000m = 80\ km$

70 **(a)**

Area (A) covered by TV signal is given by

$A = \pi d^2$

Where d is range given by

$d = \sqrt{2Rh}$

Where R is radius of earth and h the height of antenna.

$\therefore A = \pi(2Rh)$

Given, $A_1 = A, A_2 = 2A$

$\therefore \frac{A_1}{A_2} = \frac{h_1}{h_2} \Rightarrow \frac{h_1}{h_2} = \frac{1}{2}$

$\Rightarrow h_2 = 2h_1$

Hence, height of transmitting antenna will have to be doubled.

71 **(a)**

If n is the number of bits per sample, then number of quantisation levels $= 2^n$

Since the number of quantisation levels is 16

$\Rightarrow 2^n = 16 \Rightarrow n = 4$

$\therefore$ bit rate = sampling rate × no. of bits per sample

$= 8000 \times 4 = 32{,}000\ bits/s$

75 **(a)**

Refractive index of core is always greater than refractive index of cladding, to minimize the loss of light.

77 **(d)**

Pulse dispersion ∝ numerical aperture of fiber. When numerical aperture of an optical fibre is small, then the energy losses will increase due to micro-bending

78 **(d)**

Laser action involves all the given phenomenon

(i) Amplification of particular frequency

(ii) Population inversion

(iii) Stimulated emission

80 **(d)**

A signal emitted by an antenna from a certain point can be received at another point of the surface in the form of sky wave and ground wave depending upon the frequency of signal

83 **(b)**

The normalised fiber frequency, $v = \frac{2\pi a}{\lambda_0}(\mu_1^2 - \mu_2^2)^{1/2}$

$$v = \frac{2\pi a}{\lambda_0} \times 100 = 1\%$$

85 **(c)**

In space communication, the sound waves can be sent from one place to another by superimposing it on undamped electromagnetic waves

86 **(a)**

Choice (a) is correct as $Z_a = \frac{276}{\sqrt{k}} \log \frac{2s}{d}$

87 **(c)**

The characteristic impedance of a coaxial cable is of the order of 270 Ω.

88 **(a)**

The statement is perfectly true

89 **(c)**

Here, $N = 400$ electronic/cc$= 400 \times 10^6$ electrons m^{-3}

$$\mu = 0.5 = \sqrt{1 - \frac{81.56\,N}{v^2}}$$

$$= \sqrt{1 - \frac{81.56 \times 400 \times 10^6}{v^2}}$$

On solving, $v = 208.4$ kHz.

92 **(c)**

A transmission line has four primary constants, resistance, inductance, capacitance and conductance

93 **(c)**

$$I_{\text{carrier}} = \frac{I_{\text{total}}}{(1 + m_a^2/2)^{1/2}}$$

$$= \frac{11}{\sqrt{1 + (0.5)^{2/2}}} = 10.35 \text{ A}$$

94 **(b)**

$NA = \mu_1(2\Delta)^{1/2} = 1.5(2 \times 0.01125)^{1/2} = 0.225$

96 **(c)**

In optical fibre, light travels inside it, due to total internal reflection

97 **(c)**

If maximum electron density of the ionosphere in N_{max} per m^3, then $f_c = 9(N_{max})^{1/2}$. Above f_c, a wave will penetrate the ionosphere and is not reflected by it.

98 **(a)**

1% of $10\ GHz = 10 \times 10^9 \times \frac{1}{100} = 10^8 Hz$

Number of channels $= \frac{10^8}{5\times10^3} = 2 \times 10^4$

99 **(d)**

An optical fibre is move efficient, has signal security and cannnot be grounded as easily as radiowaves

100 **(b)**

$d = \sqrt{2hR}$;

Population converted$= \pi d^2 \times$ population density

$= \pi(2Rh) \times \rho$

$= \frac{22}{7} \times 2 \times 6400 \times 0.2 \times 4000$

$= 3.2 \times 10^7$

101 **(b)**

Here, $m_1 = 0.3$ and $m_2 = 0.4$

$m = \sqrt{m_1^2 + m_2^2} = \sqrt{0.3^2 + 0.4^2}$

$= \sqrt{0.09 + 0.16} = \sqrt{0.25} = 0.5$

102 **(c)**

The sky waves are the radiowaves of frequency between 2 MHz to 30 MHz. These waves can propagate through atmosphere but reflected back by the ionosphere of earth's atmosphere. These waves can propagate from transmitter to receiver through sky, therefore, their propagation is called sky wave propagation.

103 **(d)**

An antenna is a form of tuned circuit consisting of inductance and capacitance, and as a result it has a resonant frequency, at the frequency where the capacitive and inductive reactance's cancel each other out. At this point the antenna appears purely resistive, the reactance being a combination of the loss resistance and radiation resistance.

104 **(c)**

$f_c \propto (N)^{1/2} \Rightarrow (f_c)_E : (f_c)_{F_1} : (f_c)_{F_2}$

$= (2 \times 10^{11})^{1/2} : (5 \times 10^{11})^{1/2} : (8 \times 10^{11})^{1/2} = 2 : 3 : 4$

105 **(b)**

$\sqrt{k} = \frac{v_c}{v} = \frac{3 \times 10^8}{2 \times 10^9} = \frac{3}{2}; k = \frac{9}{4} = 2.25$

107 **(b)**

Optical source frequency

$f = \frac{c}{\lambda} = \frac{3 \times 10^8}{1.3 \times 10^{-6}} = 2.3 \times 10^{14} Hz$

$\therefore$ Number of channels or subscribers $= \frac{2.3\times10^{14}}{20\times10^3}$

$= 1.15 \times 10^{10}$

108 **(c)**

$\theta_c = \sin^{-1}\left(\frac{\mu_2}{\mu_1}\right) = \sin\left(\frac{1.51}{1.55}\right) = 77°$

109 **(b)**

For D-region, $N = 10^9\ \text{m}^{-3}$

$$\mu = \sqrt{1 - \frac{81.45\,N}{\text{v}^2}} = \sqrt{1 - \frac{81.45 \times 10^9}{(50 \times 10^6)^2}} = 1$$

$$\mu = \frac{\sin i}{\sin r} = 1$$

Or $\sin r = \sin i$ or $r = i = 30°$

110 **(c)**

Power radiated by the antenna is proportional to $\left(\frac{l}{\lambda}\right)^2$. When both the length of the antenna l and wavelength of the signal λ are doubled, the power radiated by the antenna remains constant

11 **(a)**

Working of optical fiber is based on total internal reflection. Hence, $\mu_1 > \mu_2$

112 **(c)**

MUF $= v \sec\theta = 15 \sec 45° = 15\sqrt{2}$ MHz

113 **(a)**

Band width $= 2 \times$ frequency of modulating

$= 2 \times 5000\ Hz = 10\ kH_z$

114 **(b)**

For air, $\mu_0 = 1$. Here, $\mu_1 = 1.55, \mu_2 = 1.51$

$$NA = \frac{\sqrt{\mu_1^2 - \mu_2^2}}{\mu_0}$$

$$= \frac{\sqrt{(1.55)^2 - (1.51)^2}}{1} = 0.350$$

116 **(a)**

$$E_g = \frac{hc}{\lambda} = \frac{(6.63 \times 10^{-34}) \times (3 \times 10^8)}{(1400 \times 10^{-9}) \times (1.6 \times 10^{-19})} = 1\ \text{eV}$$

117 **(d)**

Maximum amplitude, $A_{\max} = A_c + A_m$ ...(i)

Minimum amplitude, $A_{\min} = A_c - A_m$ ...(ii)

Solving (i) and (ii), we get

$$A_c = \frac{A_{\max} + A_{\min}}{2}, A_m = \frac{A_{\max} - A_{\min}}{2}$$

Modulation index, $\mu = \frac{A_m}{A_c} = \frac{A_{\max} - A_{\min}}{A_{\max} + A_{\min}}$

$$= \frac{25\,V - 5\,V}{25\,V + 5\,V} = \frac{20}{30} = \frac{2}{3}$$

118 **(b)**

$$P_t = P_c\left[1 + \frac{m^2}{2}\right] = 9\left[1 + \frac{(0.4)^2}{2}\right]$$

$$= 9\left[1 + \frac{0.16}{2}\right] \quad (\because m = 40\% = 0.4)$$

$$= 9(1.08) = 9.72\ kW$$

119 **(d)**

Optical fibre is made of a thin glass core (diameter 10 to 100μm) surrounded by a glass coating called cladding is protected by a jacket of plastic.

The refractive index of the glass used for making core ($n_1 = 1.7$) is a little more than the refractive index of the glass ($n_2 = 1.5$) used for making the cladding $ie, n_1 > n_2$.

120 **(d)**

Carrier frequency > audio frequency

121 **(c)**

Telephone is a full duplex transmission system.

122 **(d)**

Here, $v - v' = \Delta v = 2400\ Hz$

As $\Delta v = \frac{vv}{c}$

or $v = \frac{c\Delta v}{v} = \frac{3\times10^8\times2400}{10^8} = 7200\ \text{ms}^{-1}$

123 **(d)**

Here $\frac{\mu_1-\mu_2}{\mu_1} = \frac{0.88}{100} \Rightarrow \frac{\mu_2}{\mu_1} = 0.9912$

$\therefore$ Critical angle $\theta_c = \sin^{-1}\left(\frac{\mu_2}{\mu_1}\right) = \sin^{-1}(0.9912) = 82°24'$

124 **(d)**

The virtual height and critical frequency of E-layer is 110 km and 4 MHz

125 **(c)**

For efficient transmission of signals of wavelength's λ, the minimum length of antenna should be $\lambda/4$.

126 **(d)**

Comparing with standard equation

Assertion - Reasoning Type

This section contain(s) 31 questions numbered 1 to 31. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1
b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1
c) Statement 1 is True, Statement 2 is False
d) Statement 1 is False, Statement 2 is True

1 **Statement 1:** FM broadcast is preferred over AM broadcast
Statement 2: Process of combing the message signals with carrier wave is called demodulation

2 **Statement 1:** Optical fiber communication has immunity to cross-talk
Statement 2: Optical interference between fibres is zero

3 **Statement 1:** Microwave communication is preferred over optical communication
Statement 2: Microwaves provide large number of channels and band width compared to potical signals.

4 **Statement 1:** The surface wave propagation is used for medium wave band and for television broadcasting
Statement 2: The surface waves travel directly from transmitting antenna to receiver antenna through atmosphere

5 **Statement 1:** Television signals are received through sky wave propagation.
Statement 2: The ionosphere reflects electromagnetic waves of frequencies greater than a certain critical frequency.

6 **Statement 1:** Only microwaves are used in radar
Statement 2: Because microwaves have very small wavelength.

7 **Statement 1:** The propagation of the radio waves is termed as sky wave propagation
Statement 2: All radio wave are called sky waves

8 **Statement 1:** The television broadcasting becomes weaker with increasing distance
Statement 2: The power transmitted from TV transmitter varies inversely as the distance of the receiver

9 **Statement 1:** In He-Ne laser, population inversion takes place between energy levels of neon atoms
Statement 2: Helium atoms have a meta-stable energy level.

10 **Statement 1:** A portable AM radio set must be kept horizontal to receive the signals property
Statement 2: Radio waves are polarized electromagnetic waves

11 **Statement 1:** Modem is a demodulator.
Statement 2: It works only in both transmitting and receiving mode.

12 **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.

13 **Statement 1:** Microwave propagation is better than the sky wave propagation
Statement 2: Microwaves have frequencies 100 to 300 GHz, which have very good directional properties

14 **Statement 1:** The electrical conductivity of earth's atmosphere decreases with altitude
Statement 2: The high energy particles ($i.e.$, γ-rays and cosmic rays) coming from outer space and entering out earth's atmosphere cause ionisation of the atoms of the gases present there and the pressure of gases decreases with increases in altitude

15 **Statement 1:** Microwave communication is preferred over optical communication.

16 **Statement 1:** Diode lasers are used as optical sources in optical communication

Statement 2: Diode lasers consume less energy

17 **Statement 1:** In space communication the information can be transferred from one place to another at a distance of 100 km in 0.003 s.

Statement 2: $\text{time} = \frac{\text{distance}}{\text{velocity}}$

18 **Statement 1:** Optical fibre communication has immunity to cross talk.

Statement 2: Optical interference between fibre is zero.

19 **Statement 1:** Modem is a modulation as well as demodulator

Statement 2: It works only in a transmitting mode

20 **Statement 1:** The electromagnetic waves of shorter wavelength can travel longer distance on earth's surface than those of longer wavelengths

Statement 2: Shorter the wavelength, the larger is the velocity of wave propagation

21 **Statement 1:** Transmission Electron Microscope (TEM) provides two dimensional images

Statement 2: Scanning Electron Microscope (SEM) provides three dimensional images

22 **Statement 1:** Satellite is an ideal platform for remote sensing

Statement 2: Satellite in polar orbit can provide global coverage or continuous coverage of the fixed area in geostationary configuration

23 **Statement 1:** Higher the modulation index, the reception will be strong and clear

Statement 2: The degree to which the carrier wave is modulated is called modulation index

24 **Statement 1:** Short wave bands are used for transmission of radio waves to a large distance

Statement 2: Short waves are reflected by ionosphere

25 **Statement 1:** Electromagnetic waves with frequencies smaller than the critical frequency of ionosphere cannot be used for communication using sky wave propagation

Statement 2: The refractive index of the ionosphere becomes very high for frequencies higher than the critical frequency

26 **Statement 1:** A dish antenna is highly directional

Statement 2: This is because a dipole antenna is omni directional

27 **Statement 1:** Fax is a modulating and demodulating device

Statement 2: It is necessary for exact reproduction of a document

28 **Statement 1:** Higher the modulation index, the reception will be strong and clear

Statement 2: The degree, to which the carrier wave is modulated is called modulation index

29 **Statement 1:** Electromagnetic waves with frequencies more than the critical frequency of ionosphere cannot be used for communication using sky wave propagation.

Statement 2: The refractive index of the ionosphere becomes very high for frequencies higher than the critical frequency.

30 **Statement 1:** Optical fibres are widely used in communication network.

Statement 2: Optical fibres are small in size, light weight, flexible and there is no scope for interference in them.

31 **Statement 1:** Television signals are received through sky-wave propagation

Statement 2: The ionosphere reflects electromagnetic waves of frequencies greater than a certain critical frequency

: ANSWER KEY :

1)	C	2)	a	3)	a	4)	a	5)	d	6)	a	7)	c
8)	C	9)	a	10)	b	11)	d	12)	b	13)	a	14)	d
15)	A	16)	b	17)	d	18)	a	19)	c	20)	c	21)	b
22)	A	23)	c	24)	a	25)	d	26)	b	27)	d	28)	b
29)	a	30)	b	31)	c								

: HINTS AND SOLUTIONS :

1 **(c)**

In AM modulation, the amplitude of the carrier signal varies in accordance with the information signal. AM signals are noisily because electrical noise signals significantly affect this. In FM modulation, amplitude of carrier wave is fixed while its frequency is changing. FM gives better quality transmission. It is preffered for transmission of music.

Demodulation is the process in which the original modulating voltage is removed from the modulated wave

2 **(a)**

Optical communication is a system by which we transfer the information over any distance from one location to other through optical range of frequency using optical fibre. The optical interference between fibres is zero. Hence, optical fibre communication has immunity to cross-talk

3 **(a)**

Microwave communication is preferred over optical communication because microwaves provide large number of channels and wider band width compared to optical signals as information carrying capacity is directly proportional to band width. So, wider the band width, greater the information carrying capacity

4 **(a)**

Both assertion and reason are true and reason is the correct explanation of assertion. (for more detail, refer theory)

5 **(d)**

In sky wave propagation the radio waves which have frequency between 2 MHz to 30 MHz, are reflected back to the ground by the ionosphere. But radio waves having frequency greater than 30 MHz cannot be reflected by theionosphere because at this frequency they sky wave propagation less reliable for propogation of TV signal having frequency greater than30 MHz

Critical frequency is defined as the highest frequency that is returned tp the earth by thye ionosphere. Thus, above this frequeancy a wave whether it is electromagnetic will penetrate the ionosphere and is not reflected by it,

6 **(a)**

We know that in radar a beam signal is required in certain direction. This can only be possible for wave containing very small wavelength. As the wavelength of microwave is a few millimeter, thus the microwaves are used in a radar system

7 **(c)**

The sky waves are of practical importance for very long distance ratio communication. If one wishes to send signals at far away stations, then either repeater transmitting stations are necessary or height of the antenna is be increased. However, much before the advent of satellite, radio broadcast covered long distances by the reflection of signals from the ionospheric. This mode of transmission is called ionospheric propagation or sky wave of transmission is called ionospheric propagation or sky wave propagation. All radio waves are not sky waves

8 **(c)**

As the distance increases. TV signals become weaker. So assertion is true. The power transmitted from TV transmitter is inversely proportional to the square of the distance of the receiver. That's why reason is false

9 **(a)**

The transition in He-Ne laser in shown below

As electric discharge in the gas pumps the helium atoms to higher energy states (which is metastable state$\approx 10^{-8}$ s). These atoms collide with the ground state neon atoms and excite to higher states (levels) and produce in inverted population inversion causing a unidirectional photon beam (laser light)

10 **(b)**

It is true that the radiowaves are polarised electromagnetic waves. The antenna of portable AM radio is sensitive to only magnetic components of electromagnetic waves. On account of this the set should be put horizontal and in proper situation so that the signals are received properly from radio station

11 **(d)**

Modem is a modulating and demodulating device. It acts as a modulator in transmitting model and as demodulator in receiving mode.

13 **(a)**

Microwaves have got good directional properties. Due to it, the microwaves can be directed as beam signals in a particular direction, much better than radio waves, because microwaves do not bend around the corners of any obstacle coming in their way

14 **(d)**

The electrical conductivity of earth's atmosphere increases with height so assertion is false. When high energy particles enter in earth's atmosphere they ionise the gases present in atmosphere. Also as we go up, the air thins out gradually and air pressure decreases

15 **(a)**

Microwave communication is preferred over optical communication because microwaves provide large number of channels and wider band width compared to optical signals as information carrying capacity is directly proportional to band width. So, wider the band width, greater the information carrying capacity

16 **(b)**

In optical communication, diode laser is used to generate analog signals or digital pulses for transmission through optical fibres. The advantage of diode lasers is their small size and low power input

17 **(d)**

In space communication the information can be transferred from one place to another with the speed of light ($c = 3 \times 10^8\ ms^{-1}$)

So, time taken for a distance of 100 km is given by

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$$t = \frac{100 \times 10^3}{3 \times 10^8} = 3.3 \times 10^{-4}\text{s}$$

18 **(a)**

Optical communication is a system by which we transfer the information over any distance from one location to other through optical range of frequency using optical fiber. The optical interference between fibers is zero. Hence optical fiber communication has immunity to cross talk

19 **(c)**

Modem is a modulating and demodulating device. It acts as modulator in transmitting mode and as demodulator in receiving mode

20 **(c)**

The electromagnetic waves of shorter wavelength do not suffer much diffraction from the obstacles of earth's atmosphere so they can travel long distance.

Also, shorter the wavelength, shorter is the velocity of wave propagation

22 **(a)**

The remote sensing is done through a satellite. A remote sensing satellite files in a polar orbit at an altitude of 918 km, around the earth, in such away that it passes over a given location on the earth at the same local time

23 **(c)**

The modulation index determines the dtrength and quality of the transmitted signal.
If the modulation index is small the amount of variation in the carrier amplitude will be small consequently the audio signal being transmitted will not be strong.
Hence, for high modulation index or greater degree of modulation, the audio signal reception will be clear and strong.

24 **(a)**

Waves having the range of wavelength from 30 km to 30 cm are known as short waves. These waves are used for radio transmission and for general communication purpose to a longer distance from ionosphere. Ionosphere is the outermost region of atmosphere extending from height of 80 km to 400 km approximately, above the surface of earth. Therefore, both the assertion and reason are true and reason is the correct explanation of assertion

25 **(d)**

A is wrong. Frequency more than critical one can't be transmitted

26 **(b)**

A dish antenna is a directional antenna because it can transmit

27 **(d)**

The electronic reproduction of a document at a distance plane is known as FAX. Modulation and demodulation is done by modem

28 **(b)**

The modulation index determines the strength and quality of the transmitted signals.
If the modulation index is small the amount of variation in the carrier amplitude will be small consequently the audio signal being transmitted will not be strong.
Hence, for high modulation index is greater degree of modulation, the audio signal reception will be clear and strong

29 **(a)**

1. If Assertion is True, Reason is True, Reason is correct explanation of 1
2. If Assertion is True, Reason is True, Reason is not correct explanation of 1
3. If Assertion is True, Reason is False
4. If Assertion is False, Reason is True

31 **(c)**

In sky wave propagation the radio waves which have frequency between 2 MHz to 30 MHz, are reflected back to the ground by the ionosphere. But, radio waves having frequency greater than 30 MHz cannot be reflected by the ionosphere because at this frequency they penetrates the ionosphere. It makes that sky wave propagation less reliable for propagation of TV signal having frequency greater than 30 MHz
Critical frequency is defined as the higher frequency that is returned to the earth by the ionosphere. Thus, above this frequency a wave whether it is electromagnetic will penetrate the ionosphere and is not reflected by it. Hence, choice (c) is correct.