Assertion and Reason

1	b	2	d	3	a	4	a	5	e
6	c	7	a	8	c	9	a	10	a
11	e	12	b						

AS Answers and Solutions

Communication

1. (a) By using $f_c \approx 9(N_{max})^{1/2} \Rightarrow f_c \approx 2\ MHz$

2. (d) Carrier frequency > audio frequency

3. (c)

4. (a) A maximum frequency deviation of 75 *kHz* is permitted for commercial FM broadcast stations in the 88 to 108 *MHz VHF* band.

5. (b) $v.f. = \frac{1}{\sqrt{k}} = \frac{1}{\sqrt{2.6}} = 0.62$

6. (c) Carrier + signal $\rightarrow$ modulation.

7. (c)

8. (d) Here $\frac{n_1 - n_2}{n_1} = \frac{0.88}{100} \Rightarrow \frac{n_2}{n_1} = 0.9912$

$\therefore$ Critical angle $\theta_c = \sin^{-1}\left(\frac{n_2}{n_1}\right) = \sin^{-1}(0.9912) = 84°24'$

9. (c)

10. (c)

11. (a)

12. (d) Radio waves can be transmitted from one place to another as grand wave or sky wave or space wave propagation.

13. (b) The energy flux

$$\phi = \frac{\text{Pulsepower}}{\text{Area}} = \frac{10^{12}}{10^{-4}} = 10^{16}\ \frac{W}{cm^2}$$

14. (c) $\nu = \frac{1}{2\pi\sqrt{LC}} = \frac{1}{2\times 3.14\sqrt{10\times 10^{-6}\times 1\times 10^{-9}}} =$ 1592 *kHz*

15. (b)

16. (a) VHF (Very High Frequency) band having frequency range 30 *MHz* to 300 *MHz* is typically used for TV and radar transmission.

17. (c)

18. (d)

19. (c) $MUF = \frac{f_c}{\cos\theta} = \frac{60}{\cos 70°} = 175\ MHz$

20. (b)

21. (d)

22. (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.

23. (a) $d = \sqrt{2hR} \Rightarrow d \propto h^{1/2}$

24. (d) Surgery needs sharply focused beam of light and laser can be sharply focused.

25. (d) Laser beams are perfectly parallel. So that they are very narrow and can travel a long distance without spreading. This is the feature of laser while they are monochromatic and coherent these are characteristics only.

26. (b) The formula for modulating index is given by

$$m_f = \frac{\delta}{\nu_m} = \frac{\text{Frequency variation}}{\text{Modulating frequency}} = \frac{10\times 10^3}{2\times 10^3} = 5$$

27. (d) Here, $V_{max} = \frac{24}{2} = 12\ mV$ and $V_{min} = \frac{8}{2} = 2\ mV$

Now,

$$m = \frac{V_{max} - V_{min}}{V_{max} + V_{min}} = \frac{12-4}{12+4} = \frac{8}{16} = \frac{1}{2} = 0.5 = 50\%$$

28. (a) Here, $f_c = 1.5\ MHz = 1500\ kHz,\ f_m == 10\ kHz$

$\therefore$ Low side band frequency

$= f_c - f_m = 1500\ kHz - 10\ kHz = 1490\ kHz$

Upper side band frequency

$= f_c + f_m = 1500\ kHz + 10\ kHz = 1510\ kHz$

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

30. (b) It mix weak signals with carrier signals.

31. (b)

32. (a) Frequency modulation requires much wider channel (7 to 15 times) as compared to AM.

33. (c)

34. (b) $P_t = P_c\left(1+\frac{m_a^2}{2}\right)$; Here $m_a = 1$

$\Rightarrow 1800 = P_c\left(1+\frac{(1)^2}{2}\right) \Rightarrow P_c = 1200W$

35. (c)

36. (a)

37. (c)

38. (c) An antenna is a metallic structure used to radiate or receive EM waves.

39. (a)

40. (b) Pulse code modulation is a digital system.

41. (b)

42. (c) In telecommunication, microwaves are used.

43. (a) Carrier swing $= \frac{\text{Frequency deviation}}{\text{Modulating frequency}} = \frac{50}{7} = 7.143$

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

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

46. (d)

47. (d) Few advantages of optical fibres are that the number of signals carried by optical fibres is much more than that carried by the *Cu* wire or radio waves. Optical fibres are practically free from electromagnetic interference and problem of cross talks whereas ordinary cables and microwave links suffer a lot from it.

48. (b) The process of changing the frequency of a carrier wave (modulated wave) in accordance with the audio frequency signal (modulating wave) is known as frequency modulation (FM).

49. (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*.

50. (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 location 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.

51. (a) The critical frequency of a sky wave for reflection from a layer of atmosphere is given by $f_c = 9(N_{\max})^{1/2}$

$\Rightarrow 10\times10^6 = 9(N_{\max})^{1/2}$

$\Rightarrow N_{\max} = \left(\frac{10\times10^6}{9}\right)^2 \simeq 1.2\times10^{12}\,m^{-3}$

52. (b) Core of acceptance angle $\theta = \sin^{-1}\sqrt{n_1^2 - n_2^2}$

Critical Thinking Questions

1. (b) $n_{eff} = n_0\sqrt{1-\left(\frac{80.5\,N}{\nu^2}\right)} = 1\sqrt{1-\frac{80.5\times(400\times10^6)}{(55\times10^6)^2}} \approx 1$

Also $n_{eff} = \frac{\sin i}{\sin r} \Rightarrow \sin r = \sin i \Rightarrow r = i = 45°$

2. (b) For demodulation $\frac{1}{f_c} << RC$

$\frac{1}{f_c} = \frac{1}{100 \times 10^3} = 10^{-5}\ s$

$RC = 10^3 \times 10 \times 10^{-12}\ s = 10^{-8}\ s$

We see that $\frac{1}{f_c}$ here is not less than RC as required by the above condition. Hence, this is not good.

3. (a) Optical source frequency $f = \frac{c}{\lambda}$

$= 3 \times 10^8/(800 \times 10^{-9}) = 3.8 \times 10^{14}\ Hz$

Bandwidth of channel (1% of above) = $3.8 \times 10^{12}\ Hz$

Number of channels =(Total bandwidth of channel)/ (Bandwidth needed per channel)

(a) Number of channels for audio signal

$= (3.8 \times 10^{12})/(8 \times 10^3) \sim 4.8 \times 10^8$

4. (b) Limiting value of $h\nu$ is E_g, such that

$h\nu = \frac{hc}{\lambda} = E_g$

or $\lambda = \frac{hc}{E_g} = \frac{6.63 \times 10^{-34}\ J\text{-}s \times 3 \times 10^8\ ms^{-1}}{0.73 \times 1.6 \times 10^{-19}\ J}$

$= 1703\ nm$

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

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

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

6. (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 $m = 0.71 = 71\%$

7. (d) $\frac{P_t}{P_c} = 1 + \frac{m^2}{2}$ or $P_c = P_t\left[\frac{2}{2 + m^2}\right]$

$\therefore\ P_c = 1500\left[\frac{2}{2+1}\right]$ $\because m = 100\% = 1$

$= 1000\ W$

8. (c) $P_c = P_t\left[\frac{2}{2 + m^2}\right] = 900\left[\frac{2}{2+1}\right] = 600W$

Now, $P_{LSB} = \frac{m^2}{4} \times P_c = \frac{1}{4} \times 600 = 150\ W$

9. (b) CS = $2 \times \Delta f$ or $\Delta f = CS/2$

$\therefore\ \Delta f = \frac{200}{2} = 100\ kHz$

Now $m_f = \frac{\Delta f}{f_m} = \frac{100}{10} = 10$

10. (b) $m_f = \frac{\delta}{f_m} = \frac{2250}{500} = 4.5$

$\therefore$ New deviation $= 2(m_f\ f_m) = 2 \times 4.5 \times 6 = 54\ kHz.$

11. (c) $m_a = \frac{E_m}{E_c} = \frac{15}{60} \times 100 = 25\%$

12. (a) If n is the number of bits per sample, then number of quantisation level = 2^n

Since the number of quantisation level is 16

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

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

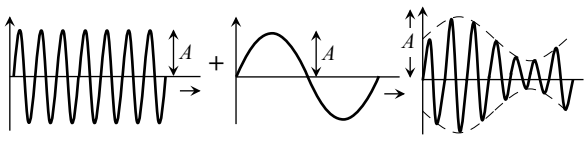
$= 8000 \times 4 = 32{,}000\ bits/sec.$

13. (c) $P_{sb} = P_c\left(\frac{m_a}{2}\right)^2 = P_c\frac{(0.5)^2}{4} = 0.0625\ P_c$

Also $P = P_c\left(1 + \frac{m_a^2}{2}\right) = P_c\left(1 + \frac{(0.5)^2}{2}\right) = 1.125P_c$

$\therefore$ % saving $= \frac{(1.125P_c - 0.0625P_c)}{1.125P_c} \times 100 = 94.4\%.$

14. (a) When signal amplitude is equal to the carrier amplitude, the amplitude of carrier wave varies between $2A$ and zero.



$m_a = \frac{\text{Amplitude chargeof carrier}}{\text{Amplitude of normal carrier}} = \frac{2A - A}{A} \times 100 = 100\%$

Assertion and Reason

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

2. (d) TV signals (frequency greater than 30 *MHz*) cannot be propagated through sky wave propagation.

   Above critical frequency, an electromagnetic wave penetratates the ionosphere and is not reflected by it.

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) Having the range of wavelength from 30 *km* to 30 *cm* are known as short wave. 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.

5. (e) The electrical conductivity of earth's atmosphere increases with height so assertion is false.

   When high energy particles enters in earth's atmosphere. They ionises the gases present in atmosphere. Also as we go up, the air thins out gradually and air pressure decreases.

6. (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.

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

8. (c) As the distance increases, TV signals becomes 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) 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.

10. (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.

11. (e) The electronic reproduction of a document at a distance plane is known as FAX modulation and demodulation is done by modem.

12. (b) A dish antenna is a directional antenna because it can transmit or sec.