**MCQs on BCS**

1. Founded the wave theory of light

1. Francesco Grimaldi
2. Edward Appleton
3. James Clerk Maxwell
4. Christian Huygens

View Answer:

Answer: **Option D**

Solution:

2. Proposed the use of clad glass fiber as a dielectric waveguide

1. Karpon and Keck
2. Karpon and Bockham
3. Bockham and Kao
4. Kao and Keck

View Answer:

Answer: **Option C**

Solution:

3. Developed the first laser

1. Charles Townes
2. Theodore Maiman
3. Gordon McKenzie
4. Albert Einstein

View Answer: Answer: **Option B**

Solution:

4. The band of light wavelengths that are too long to be seen by the human eye

# a. Amber

# b. Visible

# c. Infrared

# d. Ultraviolet

View Answer: Answer: **Option C**

Solution:

5. The band of light wavelengths that are too short to be seen by the human eye a. Amber

1. Visible
2. Infrared
3. Ultraviolet

View Answer: Answer: **Option C** Solution:

6. Which color has the shortest wavelength of light?

1. Red
2. Yellow
3. Blue
4. Green

View Answer: Answer: **Option C** Solution:

7. What generates a light beam of a specific visible frequency?

1. Laser
2. Maser
3. Infrared
4. Flashlight

View Answer: Answer: **Option A** Solution:

8. Which of the following materials is sensitive to light?

1. Photoresist
2. Photosensitive
3. Light Sensitive
4. Maser

View Answer: Answer: **Option A** Solution:

9. The core of an optical fiber has a

1. Lower refracted index than air
2. Lower refractive index than the cladding
3. Higher refractive index than the cladding
4. Similar refractive index with the cladding

View Answer: Answer: **Option C** Solution:

10. Is the different angle of entry of light into an optical fiber when the diameter of the core is many times the wavelength of the light transmitted.

1. Acceptance angle
2. Modes
3. Sensors
4. Aperture

View Answer: Answer: **Option B** Solution:

11. The loss in signal power as light travels down a fiber is called

1. Dispersion
2. Scattering
3. Absorption
4. Attenuation

View Answer: Answer: **Option D** Solution:

12. The bandwidth of optical fiber

1. 900M Hz
2. 900 PHz
3. 900 THz
4. 900 EHz

View Answer: Answer: **Option C** Solution:

13. If a mirror is used to reflect light, the reflected light angle is \_\_\_\_ as the incident angle

1. Smaller
2. Larger
3. The same
4. Independent

View Answer: Answer: **Option C** Solution:

14. What is a specific path the light takes in an optical fiber corresponding to a certain angle and number of reflection

1. Mode
2. Grade
3. Numerical Aperture
4. Dispersion

View Answer: Answer: **Option A** Solution:

15. Is the width of the range of wavelengths emitted by the light source

1. Bandwidth
2. Chromatic Dispersion
3. Spectral width
4. Beamwidth

View Answer: Answer: **Option C** Solution:

16. Which theory states that the light wave behaves as if it consists of many tiny particles?

1. Huygen’s theory
2. Wave theory of light
3. Nyquist theory
4. Quantum theory

View Answer: Answer: **Option D** Solution:

17. Fiber optic cables operate at frequencies near

1. 20 MHz
2. 200 MHz
3. 2G Hz
4. 800 THz

View Answer: Answer: **Option D** Solution:

18. When a beam of light enters one medium from another, which quantity will not change?

1. Direction
2. Speed
3. Frequency
4. Wavelength

View Answer: Answer: **Option C** Solution:

19. Dispersion is used to describe the

1. Splitting of white light into its component colors
2. Propagation of light in straight lines
3. Bending of a beam of light when it goes from one medium to another
4. Bending of a beam light when it strikes a mirror

View Answer: Answer: **Option A** Solution:

20. Luminance efficiency is minimum for a

1. Fluorescent tube
2. High wattage light bulb
3. Mercury vapor lamp
4. Low wattage light bulb

View Answer: Answer: **Option D** Solution:

21. An object farther from a converging lens than its focal point always has a/an \_\_\_\_\_ image.

1. Inverted
2. The same in size
3. Virtual
4. Smaller size

View Answer: Answer: **Option A** Solution:

22. An object nearer to a converging lens than its focal point always has a/an \_\_\_\_\_\_ image.

1. Inverted
2. The same in size
3. Virtual
4. Smaller size

View Answer: Answer: **Option C** Solution:

23. The real image formed by a spherical mirror is \_\_\_\_ relative to its object a. Erect

1. Inverted
2. Smaller
3. Larger

View Answer: Answer: **Option D** Solution:

24. The wavelength of light has no role in

1. Diffraction
2. Interference
3. Polarization
4. Reflection

View Answer: Answer: **Option C** Solution:

25. Longitudinal waves do not exhibit

1. Polarization
2. Refraction
3. Reflection
4. Diffraction

View Answer: Answer: **Option A** Solution:

26. \_\_\_\_\_\_\_\_ dispersion is caused by the difference in the propagation times of light rays that take different paths down a fiber.

1. Material dispersion
2. Wavelength dispersion
3. Modal dispersion
4. Delay dispersion

View Answer: Answer: **Option C** Solution:

27. What is the average insertion loss of fusion splice in fiber optics? a. 0.09 dB

1. 0.9 dB
2. 0.19 dB
3. 0.009 dB

View Answer: Answer: **Option A** Solution:

28. What is the insertion loss of connector-type splices for a single mode fiber optics?

1. 0.51 dB
2. 0.31 dB
3. 0.49 dB
4. 0.38 dB

View Answer: Answer: **Option D** Solution:

29. What is the lifetime of LEDs?

1. 200,000 minutes
2. 200,000 hours
3. 150,000 minutes
4. 150,000 hours

View Answer: Answer: **Option B** Solution:

30. What is the lifetime of ILDs?

1. 50,000 hours
2. 75,000 hours
3. 100,000 hours
4. 125,000 hours

View Answer: Answer: **Option A** Solution:

31. Photodiodes used as fiber optic directors are

1. Unbiased to generate a voltage same as a solar cell
2. Forward bias
3. Reversed bias
4. Thermoelectrically cooled

View Answer: Answer: **Option C** Solution:

32. What type of fiber has the highest modal dispersion?

1. Step-index multimode
2. Graded index multimode
3. Step-index single mode
4. Graded index mode

View Answer: Answer: **Option A** Solution:

33. Laser light is \_\_\_\_\_\_ emission.

1. Coherent
2. Stimulated
3. Spontaneous
4. Coherent and stimulated

View Answer: Answer: **Option D** Solution:

34. A dielectric waveguide for the propagation of electromagnetic energy at light frequencies

1. Stripline
2. Microstrip
3. Laser beam
4. Fiber optics

View Answer: Answer: **Option D** Solution:

35. Is a non-coherent light source foe optical communications system. a. ILD

1. LED
2. APD
3. PIN Diode

View Answer: Answer: **Option B** Solution:

36. Which type of laser is the simplest to modulate directly by changing its excitation?

1. Semiconductor
2. Ruby
3. Helium-neon
4. Neodymium-YAG

View Answer: Answer: **Option A** Solution:

37. Which laser emits light in the visible range 400 to 700 nm?

1. Argon-ion
2. Nitrogen
3. Carbon-dioxide
4. Neodymium-YAG

View Answer: Answer: **Option A** Solution:

38. Which is the proper measurement of average power emitted by a pulsed laser? a. Energy x time

1. Pulse energy x repetition rate
2. Pulse energy / repetition rate
3. Peak power x pulse length

View Answer: Answer: **Option B** Solution:

39. What is the photon energy for an infrared wave with frequency of 10^12 Hz? a. 10.6 x 10^34 joules

1. 6.63 x 10^-34 joules
2. 6.63 x 10^-22 joules
3. 10.6 x 10^22 joules

View Answer: Answer: **Option C** Solution:

40. A positive lens with a focal length of 10 cm forms a real image of an object 20 cm away from the lens. How far is the real image from the lens?

1. 5 cm
2. 10 cm
3. 15 cm
4. 20 cm

View Answer: Answer: **Option D** Solution:

41. Which of the following factor does not harm laser efficiency?

1. Atmospheric absorption
2. Excitation energy not absorbed
3. Problems in depopulating the lower laser level
4. Inefficiency in populating the upper laser level

View Answer: Answer: **Option A** Solution:

42. Which of the following contributes to the broadening of laser emission bandwidth?

1. Doppler shift of moving atoms and molecules
2. Amplification within the laser medium
3. Coherence of the laser light
4. Optical pumping of the laser transition

View Answer: Answer: **Option A** Solution:

43. The first laser emitted

1. Pulses of 694 nm red light
2. A continuous red beam
3. Pulses of white light from a helical flash lamp
4. Spontaneous emission

View Answer: Answer: **Option A** Solution:

44. What is the stage of the sand becoming a silicon?

1. Liquid
2. Gas
3. Molten
4. Hot

View Answer: Answer: **Option C** Solution:

45. Which of the following is used as an optical transmitter on the Fiber Optical Communications?

1. APD
2. LSA diode
3. PIN diode
4. LED

View Answer: Answer: **Option D** Solution:

46. Which of the following is used as an optical receiver in fiber optics communications

1. APD
2. Tunnel diode
3. Laser diode
4. LED

View Answer: Answer: **Option A** Solution:

47. The numerical aperture of a fiber if the angle of acceptance is 15 degrees, is a. 017

1. 0.26
2. 0.50
3. 0.75

View Answer: Answer: **Option B** Solution:

48. The inner portion of the fiber cable is called

1. Cladding
2. Coating
3. Inner conductor
4. Core

View Answer: Answer: **Option D** Solution:

49. Which type of laser is the simplest to modulate directly by changing its excitation?

1. Semiconductor
2. Ruby
3. Helium-neon
4. Neodymium-YAG

View Answer: Answer: **Option A** Solution:

50. The laser frequency when the light has the wavelength 800 nm is

1. 375 x 10^12 Hz
2. 475 x 10^15 Hz
3. 375 x 10^9 Hz
4. 375 x 10^18 Hz

View Answer:

Answer: **Option A**

51. Which of the following is not a common application of fiber-optic cable?

1. Computer networks
2. Long-distance telephone systems
3. Closed circuit TV
4. Consumer TV

View Answer: Answer: **Option D** Solution:

52. Total internal reflection takes place if the light ray strikes the interface at an angle with what relationship to the critical angle?

1. Less than
2. Greater than
3. Equal to
4. Zero

View Answer: Answer: **Option B** Solution:

53. The operation of the fiber-optic cable is based on the principle of

1. Refraction
2. Reflection
3. Dispersion
4. Absorption

View Answer: Answer: **Option B** Solution:

54. Which of the following is not a common type of fiber-optic cable?

1. Single-mode step-index
2. Multimode graded-index
3. Single-mode graded-index
4. Multimode step-index

View Answer: Answer: **Option C** Solution:

55. Cable attenuation is usually expressed in terms of

1. Loss per foot
2. dB/km
3. intensity per mile
4. voltage drop per inch

View Answer: Answer: **Option B** Solution:

56. Which of the cable length has the highest attenuation?

1. 1 km
2. 2 km
3. 95 ft
4. 5500 ft

View Answer: Answer: **Option B** Solution:

57. The upper pulse rate and information carrying capacity of a cable is limited by a. Pulse shortening

1. Attenuation
2. Light leakage
3. Modal dispersion

View Answer: Answer: **Option D** Solution:

58. The core of a fiber optic cable is made of

1. Air
2. Glass
3. Diamond
4. Quartz

View Answer: Answer: **Option B** Solution:

59. The core of a fiber optic is surrounded by

1. Wire braid shield
2. Kevlar
3. Cladding
4. Plastic insulation

View Answer: Answer: **Option C** Solution:

60. The speed of light in plastic compared to the speed of light in air is

1. Slower
2. Faster
3. The same
4. Either lower or faster

View Answer: Answer: **Option A** Solution:

61. Which of the following is not a major benefit of fiber-optic cable?

1. Immunity from interference
2. No electrical safety problems
3. Excellent data security
4. Lower cost

**Option B**

62. The main benefit of light-wave communications over microwaves or any other communications media is

1. Lower cost
2. Better security
3. Wider bandwidth
4. Freedom from interference

View Answer: Answer: **Option C** Solution:

63. Which of the following is not part of the optical spectrum? a. Infrared

1. Ultraviolet
2. Visible color
3. X-rays

View Answer: Answer: **Option D**

Solution:

64. The wavelength of visible light extends from

1. 0.8 to 1.0 nm
2. 400 to 750 nm
3. 200 to 660 nm
4. 700 to 1200 nm

**Option B**

65. The speed of light is

1. 186,000 mi/h
2. 300 mi/h
3. 300,000 m/s
4. 300,000,000 m/s

View Answer: Answer: **Option D**

Solution:

66. Refraction is the

1. Bending of light waves
2. Reflection of light waves
3. Distortion of light waves
4. Diffusion of light waves

View Answer: Answer: **Option A** Solution:

67. The ratio of speed of light in air to the speed of light in another substance is called the

1. Speed factor
2. Index of reflection
3. Index of refraction
4. Dielectric constant

**Option C**

68. A popular light wavelength in fiber-optic cable is

1. 0.7 µm
2. 1.3 µm
3. 1.5 µm
4. 1.8 µm

View Answer: Answer: **Option B** Solution:

69. Which type of fiber optic cable is most widely used?

1. Single-mode step-index
2. Multimode step-index
3. Single-mode graded-index
4. Multimode graded-index

View Answer: Answer: **Option A** Solution:

70. Which type of fiber-optic cable is the best for very high speed data?

1. Single-mode step-index
2. Multimode step-index
3. Single-mode graded-index
4. Multimode graded-index

View Answer:

Answer: **Option A**

Solution:

71. Which type of fiber-optic cable has the least modal dispersion?

1. Single mode step-index
2. Multimode step-index
3. Single-mode graded-index
4. Multimode graded-index

View Answer: Answer: **Option A** Solution:

72. Which of the following is not a factor in cable light loss?

1. Reflection
2. Absorption
3. Scattering
4. Dispersion

View Answer: Answer: **Option A** Solution:

73. A distance of 8 km is the same as

1. 2.5 mi
2. 5 mi
3. 8 mi
4. 12.9 mi

View Answer: Answer: **Option B**

Solution:

74. A fiber-optic cable has a loss of 15 dB/km. The attenuation in a cable, 100 ft long

is

1. 4.57 dB
2. 9.3 dB
3. 24 dB
4. 49.2 dB

View Answer: Answer: **Option A** Solution:

75. Fiber-optic cables with attenuations of 1.8, 3.4, 5.9, and 18 dB are linked together. The total loss is

1. 7.5 dB
2. 19.8 dB
3. 29.1 dB
4. 650 dB

View Answer: Answer: **Option C** Solution:

76. Which light emitter is preferred for high speed data in a fiber-optic system a. Incandescent

1. LED
2. Neon
3. Laser

View Answer: Answer: **Option D**

Solution:

77. Most fiber-optic light sources emit light in which spectrum?

1. Visible
2. Infrared
3. Ultraviolet
4. X-ray

View Answer: Answer: **Option B** Solution:

78. Both LEDs and ILDs operate correctly with

1. Forward bias
2. Reverse bias
3. Neither A or B
4. Either A or B

View Answer: Answer: **Option A** Solution:

79. Single-frequency light is called

1. Pure
2. Intense
3. Coherent
4. Monochromatic

View Answer: Answer: **Option D** Solution:

80. Laser light is very bright because it is

1. Pure
2. White
3. Coherent
4. Monochromatic

View Answer: Answer: **Option C** Solution:

81. Which of the following is NOT a common light detector

1. PIN photodiode
2. Photovoltaic diode
3. Photodiode
4. Avalanche photodiode

View Answer: Answer: **Option B** Solution:

82. Which of the following is the fastest light sensor

1. PIN photodiode
2. Photovoltaic diode
3. Phototransistor
4. Avalanche photodiode

View Answer: Answer: **Option D** Solution:

83. Photodiodes operate property with

1. Forward bias
2. Reverse bias
3. Neither A or B
4. Either A or B

View Answer: Answer: **Option B** Solution:

84. The product of the bit rate and distance of a fiber-optic system is 2 Gbits km/s. What is the maximum rate at 5 km?

1. 100 Mbits/s
2. 200 Mbits/s
3. 400 Mbits/s
4. 1000 Gbits/s

View Answer: Answer: **Option C** Solution:

85. Which fiber-optic system is better?

1. 3 repeaters
2. 8 repeaters
3. 11 repeaters
4. 20 repeaters

View Answer: Answer: **Option A** Solution:

86. An important requirement for successful transmission system using light

1. Powerful, reliable light source
2. Strong glass
3. Reliable, high cost transmission medium
4. Powerful regenerators

View Answer: Answer: **Option A** Solution:

87. What is used to block light from a laser and let other light through

1. Neutral density
2. Color
3. Interference
4. Spatial

View Answer: Answer: **Option C** Solution:

88. \_\_\_\_\_\_\_\_ is a light that can be coherent

1. Spontaneous emission
2. Monochromatic and in-phase
3. Narrow beam divergence
4. Monochromatic

View Answer: Answer: **Option B** Solution:

89. Coherence of laser light is important for \_\_\_\_\_\_\_\_\_

1. Light propagation
2. Getting laser light to pass through air
3. Drilling holes
4. Holography

View Answer: Answer: **Option D** Solution:

90. The ultrapure glass used to manufacture optical fibers is approximately \_\_\_\_ pure a. 99.9 %

1. 99.99 %
2. 99.999 %
3. 99.9999 %

View Answer: Answer: **Option D** Solution:

91. In fiber optics, PCS stands for

1. Plastic-clad-silica
2. Polyethylene-clad-silica
3. Personal carrier system
4. Personal communication

View Answer: Answer: **Option A** Solution:

92. How many longitudinal modes can fall within a laser’s gain bandwidth? a. 2

1. 5
2. 9
3. No fixed limit, dependent on bandwidth and mode spacing

View Answer: Answer: **Option D** Solution:

93. \_\_\_\_\_\_\_\_\_ is the result of photons of light that are absorbed by the atoms of the glass core molecules

1. Ion resonance absorption
2. Ultraviolet absorption
3. Infrared absorption
4. Absorption loss

View Answer: Answer: **Option C** Solution:

94. In fiber optics, SCS stands for

1. Suppressed-clad-silicon
2. Silicon base-class-silica
3. Silica-clad-silica
4. Serial-clad-silicon

View Answer: Answer: **Option C** Solution:

95. Human laser was developed by A. Javen at Bell laboratory in a. 1960

1. 1962
2. 1963
3. 1964

View Answer: Answer: **Option A** Solution:

96. What parameter of light detector determines the range or system length that can be achieved for a given wavelength?

1. Transit time
2. Spectral response
3. Dark current
4. Responsitivity

View Answer: Answer: **Option B** Solution:

97. Dark current in light detectors is caused by

1. Thermally generated carriers in the diode
2. The absence of light input
3. Small leakage current
4. Its imperfection

View Answer: Answer: **Option A** Solution:

98. What is the unit of responsitivity?

1. Ampere/volt
2. Ampere/watt
3. Watt/ampere
4. Volts/ampere

View Answer: Answer: **Option B** Solution:

99. One of the following is not a characteristic of light detectors.

1. Responsitivity
2. Spectral response
3. Transmit time
4. Dispersion

View Answer: Answer: **Option D** Solution:

100. What is the typical wavelength of light emitted from epitaxially grown LEDs? a. 840 nm

1. 490 nm
2. 480 nm
3. 940 nm

View Answer:

Answer: **Option D** 101. SONET stands for

1. System Optical Network
2. Synchronous Optical Network
3. Silica Optic Network
4. System Optical Fiber Net

View Answer:

Answer: **Option B** Solution: 102. Band loss is

1. A reduction in transmitter power caused by earth’s surface curvature
2. A reduction in strength of the signal caused by folded dipole bends
3. An attenuation increase caused by bends radiating from the side of the fiber d. All of these

View Answer: Answer: **Option C** Solution:

103. Infrared range for fiber optics

1. 400 – 700 nm
2. 700 – 1200 nm
3. 300 – 2000 nm
4. 400 – 7000 nm

View Answer:

Answer: **Option B**

**1) In an optical fiber communication system, which among the following is not a typical transmitter function?** **a.** Coding for error protection

1. Decoding of input data
2. Electrical to optical conversion
3. Recoding to match output standard

**ANSWER: (d) Recoding to match output standard**

**2) Which among the following is provided by an optical receiver for the regeneration of data signal with minimum error?** **a.** Photo-diode

1. Signal Processing Circuits
2. Linear Circuitry
3. None of the above

**ANSWER: (c) Linear Circuitry**

**3) For a sine wave, the frequency is represented by the cycles per**

**\_\_\_\_\_\_**

1. Second
2. Minute
3. Hour
4. None of the above

**ANSWER: (a) Second**

**4) Which property/ies of PCM stream determine/s the fidelity to original analog signal?** **a.** Sampling rate

1. Bit depth
2. Both a and b
3. None of the above

**ANSWER: (c) Both a and b**

**5) In single-mode fibers, how does the fraction of energy traveling through bound mode appear in the cladding?** **a.** As a crescent wave

1. As a gibbous wave
2. As an evanescent wave
3. All of the above

**ANSWER: (c) As an evanescent wave**

**6) What is the typical value of refractive index for an ethyl alcohol?** **a.** 1

1. 1.36
2. 2.6
3. 3.4

**ANSWER:(b) 1.36**

**7) If a light travels in a certain medium and it gets reflected off an optically denser medium with high refractive index, then it is regarded as \_\_\_\_\_\_\_**

1. External Reflection
2. Internal Reflection
3. Both a and b
4. None of the above

**ANSWER: (a) External Reflection**

**8) In an optical fiber, the concept of Numerical aperture is applicable in describing the ability of \_\_\_\_\_\_\_\_\_\_**

1. Light Collection
2. Light Scattering
3. Light Dispersion
4. Light Polarization

**ANSWER:(a) Light Collection**

**9) Which among the following do/does not support/s the soot formation process?**

1. OVPO
2. MCVD
3. PCVD
4. All of the above

**ANSWER: (c) PCVD**

**10) Which type of photonic crystal fiber exhibit/s its/their similarity to the periodic crystalline lattice in a semiconductor?** **a.** Index guiding fiber

1. Photonic bandgap fiber
2. Both a and b
3. None of the above

**ANSWER: (b) Photonic bandgap fiber**

**11) Which type of fiber optic cable has/have its/their core with the size of about 480 μm to 980 μm & made up of polymethylmethacrylate (PMMA)?**

1. Glass fiber optic cable
2. Plastic fiber optic cable
3. Plastic clad silica fiber optic cable
4. All of the above

**ANSWER: (b) Plastic fiber optic cable**

**12) In multifiber cable system, which form of outer jacket/s consist/s of polyolefin compounds and are regarded as halogen free?** **a.** OFNR

1. OFNP
2. LSZH
3. All of the above

**ANSWER: (c) LSZH**

**13) During the design of FOC system, which among the following reasons is/are responsible for an extrinsic absorption?** **a.** Atomic defects in the composition of glass

1. Impurity atoms in glass material
2. Basic constituent atoms of fiber material
3. All of the above

**ANSWER: (b) Impurity atoms in glass material**

**14) Which among the following represent/s the measure/s to minimize the inhomogenities for Mie scattering reduction?** **a.** Extrusion Control

1. Increase in relative R.I. difference
2. Removal of imperfections due to glass manufacturing process
3. All of the above

**ANSWER: (d) All of the above**

**15) In Kerr effect, induced index change has its proportionality with respect to \_\_\_\_\_\_\_\_\_**

1. square of electric field
2. cube of electric field
3. cube root of electric field
4. one-fourth power of electric field

**ANSWER: (a) square of electric field**

**16) Which among the following is regarded as an inelastic scattering of a photon?**

1. Kerr Effect
2. Raman Effect
3. Hall Effect
4. Miller Effect

**ANSWER: (b) Raman Effect**

**17) Which kind/s of misalignment assist/s in the reduction of overlap region in fiber?** **a.** Angular

1. Longitudinal
2. Lateral
3. All of the above

**ANSWER: (c) Lateral**

**18) Which is the correct order of sequential steps for an electric arc fusion technique?**

1. Pressing of fiber ends for fusion
2. Application of heat for smoothening of end-surfaces C. Alignment of broken fiber edges
3. A, B, C
4. B, A, C
5. C, B, A
6. C, A, B

**ANSWER: (c) C, B, A**

**19) Which splicing technique involves the alignment and locking of broken fiber edges by means of positioning devices & optical cement?**

1. Fusion
2. Mechanical
3. Both a and b
4. None of the above

**ANSWER:(b) Mechanical**

**20) By using Springroove splicing technique, what is the value of mean insertion loss for multi mode graded index fiber?** **a.** 0.01

1. 0.03
2. 0.05
3. 0.09

**ANSWER: (c) 0.05**

**21) In the fiber optic link, power transfer from one fiber to another and from fiber to detector must take place with \_\_\_\_\_\_\_\_\_coupling efficiency.**

1. maximum
2. stable
3. minimum
4. unpredictable

**ANSWER: (a) maximum**

**22) In spontaneous emission, the light source in an excited state undergoes the transition to a state with \_\_\_\_\_\_\_** **a.** Higher energy

1. Moderate energy
2. Lower energy
3. All of the above

**ANSWER: (c) Lower energy**

**23) Which among the following is a key process adopted for the laser beam formation as it undergoes the light amplification?** **a.** Spontaneous Emission

1. Stimulated Emission
2. Both a and b
3. None of the above

**ANSWER: (b) Stimulated Emission**

**24) While coupling of LEDs with fiber, on which factor/s does the size of source and lighting angle generated within the semiconductor depend/s?**

1. Geometry of die
2. Refractive index of semiconductor
3. Encapsulation Medium
4. All of the above

**ANSWER: (d) All of the above**

**25) Which among the following results in the removal of LED lens interface for achieving high coupling efficiency?** **a.** Spherical lens

1. Cylindrical lens
2. Integral lens LED
3. All of the above

**ANSWER: (c) Integral lens LED**

**26) For a photo-diode with responsivity of 0.50 A/W & optical power of about 12μW, what would be the value of generated photocurrent?** **a.** 3 μA

1. 6 μA
2. 9 μA
3. 12 μA

**ANSWER: (b) 6 μA**

**27) Which component of an optical receiver is a linear frequency shaping filter used for the compensation of signal distortion and Inter Symbol Interference (ISI)?** **a.** Photodetector

1. Amplifier
2. Equalizer
3. None of the above

**ANSWER: (c) Equalizer**

**28) In digital receivers, which codes are used to designate the sampled analog signals after their quantization into discrete levels?** **a.** Binary

1. Decimal
2. ASCII
3. Excess-3

**ANSWER: (a) Binary**

**29) Which feature of an eye-diagram assists in the measurement of additive noise in the signal?**

1. Eye opening (height, peak to peak)
2. Eye overshoot/ undershoot
3. Eye width
4. None of the above

**ANSWER: (a) Eye opening (height, peak to peak)**

**30) Which method determines the dispersion limitation of an optical link?**

1. Link power budget
2. Rise time budget
3. Both a and b
4. None of the above

**ANSWER: (b) Rise time budget**

**31) Which phenomenon causes the dynamic line width broadening under the direct modulation of injection current?** **a.** Modal Noise

1. Mode-partition Noise
2. Frequency Chirping
3. Reflection Noise

**ANSWER: (c) Frequency Chirping**

**32) Speckle pattern is generated due to interference of nodes from a coherent source especially when the coherence time of source is \_\_\_\_\_\_\_\_\_ the intermodal dispersion time in the fiber.** **a.** Less than

1. Greater than
2. Equal to
3. None of the above

**ANSWER: (b) Greater than**

**33) Which among the following is/are determined by the fiber characterization?**

1. Fiber integrity & performance for desired transmission rate
2. Installation practices
3. Service Implementation
4. All of the above

**ANSWER: (d) All of the above**

**34) From the tests carried out in fiber characterization, which among the following measures the total light reflected back to the transmitter caused by the fiber as well as the components like connector pairs and mechanical splices?** **a.** ORL

1. OTDR
2. LTS
3. PMD

**ANSWER: (a) ORL**

[35) In fiber fault location, the equation of length (l) for time difference (t) is expressed as L = ct / 2n1 . Which factor in this equation implies that the light travels a length from source to break point and then through another length on the return trip? a L](#_Toc43225)

[b c](#_Toc43226)

[c t](#_Toc43227)

[d 2](#_Toc43228)

[ANSWER: (d)36) Which line code in PCM indicates the return of signal to zero between each pulse & takes place even due to occurrence of consecutive 0’s & 1’s in the signal? a. Return-to-zero (RZ) 2](#_Toc43229)

1. Non-Return to zero space
2. Return to zero inverted
3. Non-return to zero inverted

**ANSWER: (a) Return-to-zero (RZ)**

**37) In the structure of fiber, the light is guided through the core due to total internal \_\_\_\_\_\_** **a.** reflection

1. refraction
2. diffraction
3. dispersion

**ANSWER: (a) reflection**

**38) In the structure of a fiber, which component provides additional strength and prevents the fiber from any damage?** **a.** Core

1. Cladding
2. Buffer Coating
3. None of the above

**ANSWER: (c) Buffer Coating**

**39) Which is the transmission medium for VLF electromagnetic waves especially applicable for aeronautical and submarine cables?** **a.** Paired wires

1. Coaxial cable
2. Waveguide
3. Wireless

**ANSWER: (a) Paired wires**

**40) Which rays exhibit the variation in the light acceptability ability of the fiber?**

1. Meridional
2. Skew
3. Leaky
4. All of the above

**ANSWER: (b) Skew**

**41) If a fiber operates at 1400nm with the diameter of about 10 μm, n1 = 1.30, Δ = 0.80% , V = 3.5, then how many modes will it have?**

1. 6.125
2. 9.655
3. 12.95
4. 16.55

**ANSWER: (a) 6.125**

**42) Which kind of dispersion phenomenon gives rise to pulse spreading in single mode fibers?** **a.** Intramodal

1. Intermodal
2. Material
3. Group Velocity

**ANSWER: (a) Intramodal**

**43) With respect to single mode and graded index fibers, which parameter specifies the propagation of polarization modes with different phase velocities & the difference between their effective refractive indices?**

1. Mode field diameter
2. Birefringence
3. Fiber beat length
4. Spot Size

**ANSWER: (b) Birefringence**

**44) On which of the following factor/s do/does the ‘Hydrogen Effect’ depend/s?**

1. Type of fiber & Cable Design
2. Operating Wavelength
3. Installation Method
4. All of the above

**ANSWER: (d) All of the above**

**45) Consider the statements given below. Which among them is not a drawback of double crucible method?** **a.** Utility in mass production of fibers

1. High attenuation
2. High OH content in drawn fiber
3. Addition of impurity while the fiber is drawn

**ANSWER: (a) Utility in mass production of fibers**

**46) Consider the assertions given below. Which is the correct sequential order of process adopted in glass fiber preparation?**

1. Drawing of fiber
2. Production of pure glass
3. Pulling of fiber
4. Conversion of pure glass into preform
5. B, D, A, C
6. A, B, C, D
7. C, A, D, B
8. D, B, A, C

**ANSWER: (a) B, D, A, C**

**47) At which level of temperature does the oxidation process occur in**

**MCVD?**

1. Low
2. Moderate
3. High
4. Unpredictable

**ANSWER: (c) High**

**48) Assuming no ISI, the maximum possible bandwidth of a multimode graded index fiber with 5 MHz, shows the total pulse broadening of 0.1s for the distance of about 12km. What would be the value of bandwidth length product?** **a.** 40 MHz

1. 60 MHz
2. 90 MHz
3. 120 MHz

**ANSWER: (b) 60 MHz**

**49) In Rayleigh scattering of light in glass, at which type of temperature does the glass attain the state of thermal equilibrium and exhibits its relativity to annealing temperature?** **a.** Junction

1. Fictive
2. Breakdown
3. Decomposition

**ANSWER: (b) Fictive**

**50) Which type of scattering occurs due to interaction of light in a medium with time dependent optical density variations thereby resulting into the change of energy (frequency) & path?** **a.** Stimulated Brilliouin Scattering (SBS)

1. Stimulated Raman Scattering (SRS)
2. Mie Scattering
3. Rayleigh Scattering

**ANSWER: (a) Stimulated Brilliouin Scattering (SBS)**

**1. Questions & Answers on Optical Fiber Waveguides**

This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Ray Theory Transmission”.

1. Who proposed the idea of transmission of light via dielectric waveguide structure? a) Christian Huygens

1. Karpon and Bockham
2. Hondros and debye
3. Albert Einstein

View Answer

Answer: c

Explanation: It was in the beginning of 20th century where Hondros and debye theoretical and experimental study demonstrated that information can be transferred as a form of light through a dielectric waveguide.

2. Who proposed the use of clad waveguide structure?

1. Edward Appleton
2. Schriever
3. Kao and Hockham
4. James Maxwell View Answer

Answer: c

Explanation: The invention of clad waveguide structure raised the eyebrows of the scientists. The proposals by Kao and Hockham proved beneficial leading in utilization of optical fibre as a communication medium.

3. Which law gives the relationship between refractive index of the dielectric? a) Law of reflection

1. Law of refraction (Snell’s Law)
2. Millman’s Law
3. Huygen’s Law View Answer

Answer: b

Explanation: Snell’s Law of refraction states that the angle of incidence Ø1 and refraction Ø2 are related to each other and to refractive index of the dielectrics. It is given by n1sinØ1 = n2sinØ2 where n1 and n2 are the refractive indices of two mediums. Ø1 and Ø2 are angles of incidence and refraction.

4. The light sources used in fibre optics communication are \_\_\_\_\_\_\_\_\_\_\_\_

1. LED’s and Lasers
2. Phototransistors
3. Xenon lights
4. Incandescent View Answer

5. The \_\_\_\_\_\_\_\_ ray passes through the axis of the fiber core.

1. Reflected
2. Refracted
3. Meridional
4. Shew

View Answer

Answer: c

Explanation: When a light ray is passed through a perfect optical fiber, any discontinuities at the core cladding interface would result in refraction rather than total internal reflection. Such light ray passes through the axis of fiber core and is called as meridional ray. This principle is used while stating the fundamental transmission properties of optical fiber.

6. Light incident on fibers of angles\_\_\_\_\_\_\_\_the acceptance angle do not propagate into the fiber.

1. Less than
2. Greater than
3. Equal to
4. Less than and equal to View Answer

Answer: b

Explanation: Acceptance angle is the maximum angle at which light may enter into the fiber in order to be propagated. Hence the light incident on the fiber is less than the acceptance angle, the light will propagate in the fiber and will be lost by radiation.

7. What is the numerical aperture of the fiber if the angle of acceptance is 16 degree? a) 0.50

1. 0.36
2. 0.20
3. 0.27

View Answer

Answer: d

Explanation: The numerical aperture of a fiber is related to the angle of acceptance as follows:

NA = sin Ѳa

Where NA = numerical aperture Ѳ = acceptance angle.

8. The ratio of speed of light in air to the speed of light in another medium is called as

\_\_\_\_\_\_\_\_\_

1. Speed factor
2. Dielectric constant
3. Reflection index
4. Refraction index View Answer

Answer: d

Explanation: When a ray travels from one medium to another, the ray incident from a light source is called as incident ray. In passing through, the speed varies. The ratio of the speed of incident and the refracted ray in different medium is called refractive index.

9. When a ray of light enters one medium from another medium, which quality will not change? a) Direction

1. Frequency
2. Speed
3. Wavelength View Answer

Answer: b

Explanation: The electric and the magnetic field have to remain continuous at the refractive index boundary. If the frequency is changed, the light at the boundary would change its phase and the fields won’t match. In order to match the field, frequency won’t change



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Single-Mode Fibers”.

1. An optical fiber has core-index of 1.480 and a cladding index of 1.478. What should be the core size for single mode operation at 1310nm? a) 7.31μm

1. 8.71μm
2. 5.26μm
3. 6.50μm View Answer

Answer: d

Explanation: Normalized frequency V<=2.405 is the value at which the lowest order Bessel

function J=0. Core size(radius) .

2. An optical fiber has a core radius 2μm and a numerical aperture of 0.1. Will this fiber operate at single mode at 600 nm? a) Yes

b) No

View Answer

Answer: a

Explanation: V= 2πa.NA/λ. Calculating this equation, we get the value of V. V is the normalised frequency and should be below 2.405 in order to operate the fiber at single mode. Here, V=2.094, is less than 2.405. Thus, this optical fiber exhibit single mode operation.

3. What is needed to predict the performance characteristics of single mode fibers?

1. The intermodal delay effect
2. Geometric distribution of light in a propagating mode
3. Fractional power flow in the cladding of fiber
4. Normalized frequency View Answer

Answer: b

Explanation: A mode field diameter (MFD) is a fundamental parameter of single mode fibers. It tells us about the geometric distribution of light. MFD is analogous to core diameter in multimode fibers, except in single mode fibers not all the light that propagates is carried in the core.

4. Which equation is used to calculate MFD?

1. Maxwell’s equations
2. Peterman equations
3. Allen Cahn equations
4. Boltzmann’s equations View Answer

Answer: b

Explanation: Mode field diameter is an important parameter for single mode fibers because it is used to predict fiber properties such as splice loss, bending loss. The standard technique is to first measure the far-field intensity distribution and then calculating mode field diameter using Peterman equations.

5. A single mode fiber has mode field diameter 10.2μm and V=2.20. What is the core diameter of this fiber? a) 11.1μm

1. 13.2μm
2. 7.6μm
3. 10.1μm View Answer

Answer: d

Explanation: For a single mode fiber, MFD=2w0. Here, core radius

Solving this equation, we get a=5.05μm. Core-

diameter=2a=10.1μm.

6. The difference between the modes’ refractive indices is called as \_\_\_\_\_\_\_\_\_\_\_ a) Polarization

1. Cutoff
2. Fiber birefringence
3. Fiber splicing View Answer

Answer: c

Explanation: There are two propagation modes in single mode fibers. These two modes are similar but their polarization planes are orthogonal. In actual fibers, there are imperfections such as variations in refractive index profiles. These modes propagate with different phase velocities and their difference is given by Bf =ny – nx. Here, ny and nx are refractive indices of two modes.

7. A single mode fiber has a beat length of 4cm at 1200nm. What is birefringence? a) 2\*10-5

1. 1.2\*10-5
2. 3\*10-5
3. 2

View Answer

Answer: c

Explanation: Bf=ny– nx = λ/Lp. Here, λ=wavelength and Lp = beat length. Solving this equation, we will get the answer.

8. How many propagation modes are present in single mode fibers? a) One

1. Two
2. Three
3. Five View Answer

Answer: b

Explanation: For a given optical fiber, the number of modes depends on the dimensions of the cable and the variations of the indices of refraction of both core and cladding across the cross section. Thus, for a single mode fiber, there are two independent, degenerate propagation modes with their polarization planes orthogonal.

9. Numerical aperture is constant in case of step index fiber.

1. True
2. False View Answer

Answer: a

Explanation: Numerical aperture is a measure of acceptance angle of a fiber. It also gives the light gathering capacity of the fiber. For a single mode fiber, core is of constant refractive index. There is no variation with respect to core. Thus, Numerical aperture is constant for single mode fibers.

10. Plastic fibers are less widely used than glass fibers.

1. True
2. False View Answer

Answer: a

Explanation: The majority of the fibers are made up of glass consisting of silica. Plastic fibers are used for short distance transmissions unlike glass fibers which can also be used for long haul applications. Also, plastic fibers have higher attenuation than glass fibers.



This set of Optical Communications Interview Questions and Answers focuses on “Electromagnetic Mode Theory for Optical Propagation”.

1. Which equations are best suited for the study of electromagnetic wave propagation? a) Maxwell’s equations

1. Allen-Cahn equations
2. Avrami equations
3. Boltzmann’s equations View Answer

Answer: a

Explanation: Electromagnetic mode theory finds its basis in electromagnetic waves. Electromagnetic waves are always represented in terms of electric field E, magnetic field H, electric flux density D and magnetic flux density B. These set of equations are provided by Maxwell’s equations.

2. When λ is the optical wavelength in vacuum, k is given by k=2Π/λ. What does k stand for in the above equation?

1. Phase propagation constant
2. Dielectric constant
3. Boltzmann’s constant
4. Free-space constant View Answer

Answer: a

Explanation: In the above equation, k = 2Π/λ, also termed as wave equation, k gives us the direction of propagation and also the rate of change of phase with distance. Hence it is termed as phase propagation constant.

3. Constructive interference occur when total phase change after two successive reflections at upper and lower interfaces is equal to? (Where m is integer) a) 2Πm

1. Πm
2. Πm/4
3. Πm/6 View Answer Answer: a

Explanation: The component of phase waves which is in x direction is reflected at the interference between the higher and lower refractive index media. It is assumed that such an interference forms a lowest order standing wave, where electric field is maximum at the center of the guide, decaying towards zero.

4. When light is described as an electromagnetic wave, it consists of a periodically varying electric E and magnetic field H which are oriented at an angle? a) 90 degree to each other

1. Less than 90 degree
2. Greater than 90 degree
3. 180 degree apart View Answer

Answer: a

Explanation: In case of electromagnetic wave which occur only in presence of both electric and magnetic field, a particular change in magnetic field will result in a proportional change in electric field and vice versa. These changes result in formation of electromagnetic waves and for electromagnetic waves to occur both fields should be perpendicular to each other in direction of wave travelling.

5. A monochromatic wave propagates along a waveguide in z direction. These points of constant phase travel in constant phase travel at a phase velocity Vp is given by? a) Vp=ω/β

1. Vp=ω/c
2. Vp=C/N
3. Vp=mass/acceleration View Answer

Answer: a

Explanation: Velocity is a function of displacement. Phase velocity Vp is a measure of angular velocity.

6. Which is the most important velocity in the study of transmission characteristics of optical fiber?

1. Phase velocity
2. Group velocity
3. Normalized velocity
4. Average velocity View Answer

Answer: b

Explanation: Group velocity is much important in relation to transmission characteristics of optical fiber. This is because the optical wave propagates in groups or form of packets of light.

7. What is refraction?

1. Bending of light waves
2. Reflection of light waves
3. Diffusion of light waves
4. Refraction of light waves View Answer

Answer: a

Explanation: Unlike reflection, refraction involves penetration of a light wave from one medium to another. While penetrating, as it passes through another medium it gets deviated at some angle.

8. The phenomenon which occurs when an incident wave strikes an interface at an angle greater than the critical angle with respect to the normal to the surface is called as \_\_\_\_\_\_\_\_\_\_\_\_ a) Refraction

1. Partial internal reflection
2. Total internal reflection
3. Limiting case of refraction View Answer

Answer: c

Explanation: Total internal reflection takes place when the light wave is in the more dense medium and approaching towards the less dense medium. Also, the angle of incidence is greater than the critical angle. Critical angle is an angle beyond which no propagation takes place in an optical fiber.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Cylindrical Fiber”.

1. A multimode step index fiber has a normalized frequency of 72. Estimate the number of guided modes. a) 2846

1. 2592
2. 2432
3. 2136 View Answer

Answer: b

Explanation: A step-index fiber has a constant refractive index core. The number of guided modes in a step-index fiber are given by M = (V\*V)/2. Here M denotes the number of modes and V denotes normalized frequency.

2. A graded-index fiber has a core with parabolic refractive index profile of diameter of 30μm, NA=0.2, λ=1μm. Estimate the normalised frequency. a) 19.32

1. 18.84
2. 16.28
3. 17.12 View Answer

Answer: b

Explanation: Normalized frequency for a graded index fiber is given by V = 2Πa(NA)/λ. Substituting and calculating the values, we get option 18.84. Here, V denotes normalized frequency and NA = numerical aperture.

3. A step-index fiber has core refractive index 1.46 and radius 4.5μm. Find the cutoff wavelength to exhibit single mode operation. Use relative index difference as 0.25%. a) 1.326μm

1. 0.124μm
2. 1.214μm
3. 0.123μm View Answer

Answer: c

Explanation: The cutoff wavelength is the wavelength beyond which no single mode operation takes place. On solving λc = 2Πan1 2Δ−−−√/V, we get option c. Here, V=2.405, n1 = refractive index of core, a=radius of core.

4. A single-mode step-index fiber or multimode step-index fiber allows propagation of only one transverse electromagnetic wave. a) True

b) False View Answer

Answer: a

Explanation: Single mode step index fiber is also called as mono-mode step index fiber. As the name suggests, only one mode is transmitted and hence it has the distinct advantage of low intermodal dispersion.

5. One of the given statements is true for intermodal dispersion. Choose the right one.

1. Low in single mode and considerable in multimode fiber
2. Low in both single mode and multimode fiber
3. High in both single mode and multimode fiber
4. High in single mode and low in multimode fiber View Answer

Answer: a

Explanation: Single mode propagates only one wave or only one mode is transmitted. Therefore, intermodal dispersion is low in single mode. In multimode fibers, higher dispersion may occur due to varying group velocities of propagating modes.

6. For lower bandwidth applications \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Single mode fiber is advantageous
2. Photonic crystal fibers are advantageous
3. Coaxial cables are advantageous
4. Multimode fiber is advantageous View Answer

Answer: d

Explanation: In multimode fibers, intermodal dispersion occurs. The group velocities often differ which gradually restricts maximum bandwidth attainability in multimode fibers.

7. Most of the optical power is carried out in core region than in cladding. a) True

b) False View Answer

Answer: a

Explanation: In an ideal multimode fiber, there is no mode coupling. The optical power launched into a particular mode remains in that mode itself. The majority of these modes are mostly confined to fiber core only.

8. Meridional rays in graded index fibers follow \_\_\_\_\_\_\_\_\_\_\_\_

1. Straight path along the axis
2. Curved path along the axis
3. Path where rays changes angles at core-cladding interface
4. Helical path View Answer

Answer: b

Explanation: Meridional rays pass through axis of the core. Due to the varying refractive index at the core, the path of rays is in curved form.

9. What is the unit of normalized frequency?

1. Hertz
2. Meter/sec
3. Coulombs
4. It is a dimensionless quantity View Answer

Answer: d

Explanation: Normalized frequency of optical fiber is the frequency which exists at cut-off condition. There is no propagation and attenuation above cut-off. It is directly proportional to numerical aperture which is a dimensionless quantity; hence itself is a dimensionless quantity.

10. Skew rays follow a \_\_\_\_\_\_\_\_\_\_\_

1. Hyperbolic path along the axis
2. Parabolic path along the axis
3. Helical path
4. Path where rays changes angles at core-cladding interface View Answer

Answer: c

Explanation: The ray which does not pass through the fiber axis is termed as skew ray. Unlike Meridional rays, skew rays are more in number which makes them follow a round path called as helical path.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Photonic Crystal Fibers & Attenuation”.

1. Photonic crystal fibers also called as \_\_\_\_\_\_\_\_\_\_\_

1. Conventional fibers
2. Dotted fibers
3. Stripped fibers
4. Holey fibers View Answer

Answer: d

Explanation: Photonic crystal fibers contain a fine array of air holes running longitudinally down the fiber cladding. The microstructure within the fiber is highly periodic.

2. Conventional optical fibers has more transmission losses than photonic crystal fibers. a) True

b) False View Answer

Answer: a

Explanation: Conventional optical fibers have several hundreds of losses in transmission. Photonic crystal fibers have resulted in reduction in overall transmission losses.

3. Losses in photonic crystal fibers are reduced to a level of \_\_\_\_\_\_\_\_\_\_\_ a) 0.1dB/km

1. 0.2dB/km
2. 0.3dB/km
3. 0.4dB/km View Answer

Answer: c

Explanation: Conventional fibers have losses of several hundred decibels per km. The invention of photonic crystal tubes has reduced the losses by hundreds of decibels.

4. The high index contrast enables the PCF core to be reduced from around 8 μmin conventional fiber to \_\_\_\_\_\_\_\_\_\_\_

1. Less than 1μm
2. More than 5μm
3. More than 3μm
4. More than 2μm View Answer

Answer: a

Explanation: PCF’s have a wider range of optical properties in comparison with standard fibers.

The lesser the core, more is the intensity of light in the core and enhances the non-linear effects.

5. The periodic arrangement of cladding air holes in photonic band gap fibers provides for the formation of a photonic band gap in the \_\_\_\_\_\_\_\_\_\_\_ a) H-plane of fiber

1. E-plane of fiber
2. E-H-plane of fiber
3. Transverse plane of fiber View Answer

Answer: d

Explanation: Photonic band gap fibers are a class of micro structured fiber in which periodic arrangement of air holes is required. As a PBG fiber exhibits a 2-dimensional band gap, than the wavelengths within this band gap cannot propagate perpendicular to the fiber axis.

6. In index-guided photonic crystal fiber structure, the dark areas are air holes. What does white areas suggests? a) Air

1. Silica
2. Water
3. Plasma View Answer

Answer: d

Explanation: Index-guided photonic crystal fibers have greater index contrast because the cladding contains air-holes having refractive index 1. Both index guided and conventional fibers arises from the manner in which guided mode interacts with the cladding region.

7. Which is the unit of measurement of attenuation in optical fibers? a) km

1. dB
2. dB/km
3. Coulomb’s View Answer

Answer: c

Explanation: Attenuation is also referred to as transmission loss. Channel attenuation helped to determine the maximum transmission distance prior to signal restoration. Attenuation is usually expressed in logarithmic unit of decibel. It is given by αdBL = 10 log10Pi / Po

Where αdB = signal attenuation per unit length Pi & Po = Input and output power.

8. The optical fiber incurs a loss in signal power as light travels down the fiber which is called as \_\_\_\_\_\_\_\_\_\_\_

1. Scattering
2. Attenuation
3. Absorption
4. Refraction View Answer

Answer: b

Explanation: When the light is passed through the fiber, it travels a large amount of distance before it starts fading. It needs restoration in the path. This loss or fading is called as Attenuation.

9. If the input power 100μW is launched into 6 km of fiber, the mean optical power at the fiber output is 2μW. What is the overall signal attenuation through the fiber assuming there are no connectors or splices? a) 15.23dB

1. 16.98dB
2. 17.12dB
3. 16.62dB View Answer

Answer: b

Explanation: Signal attenuation is usually expressed in decibels. It is given by

Signal attenuation=10 log10Pi / Po

Where, Pi & Po = Input and output power.

10. A device that reduces the intensity of light in optical fiber communications is \_\_\_\_\_\_\_\_\_\_\_ a) compressor

1. Optical attenuator
2. Barometer
3. Reducer View Answer

Answer: b

Explanation: A compressor compresses the signal before transmission. It does not affect the intensity of light. Optical attenuator is a device that affects the intensity of light and incurs a loss in transmission.

11. A decibel may be defined as the ratio of input and output optical power for a particular optical wavelength. a) True

b) False View Answer

Answer: a

Explanation: Signal attenuation refers to the loss in transmission and it needs a logarithmic unit to express. Decibel is mainly used for comparing two power levels. It has the advantage that the operations of multiplication and division reduce to addition and subtraction.

12. When the input and output power in an optical fiber is 120μW & 3μW respectively and the length of the fiber is 8 km. What is the signal attenuation per km for the fiber? a) 3dB/km

1. 2dB/km
2. 1dB/km
3. 4dB/km View Answer

Answer: b

Explanation: Signal attenuation per unit length is given by αdBL = 10 log10Pi / Po αdBL = 16 dB αdB = 16 dB/L = 2dB/km.



**2. Questions on Transmission Characteristics Of Optical Fibers**

**The section contains questions on material absorption and fiber bend loss, linear and nonlinear scattering losses, chromatic and intermodal dispersion, fiber dispersion, polarization and nonlinear effects.**

This set of Optical Communications Questions and Answers for Freshers focuses on “Material Absorption & Fiber Bend Losses In Silicon Glass Fibers”.

1. Which of the following statements best explain the concept of material absorption?

1. A loss mechanism related to the material composition and fabrication of fiber
2. A transmission loss for optical fibers
3. Results in attenuation of transmitted light
4. Causes of transfer of optical power View Answer

Answer: a

Explanation: Material absorption is a loss mechanism that results in dissipation of transmitted optical power as heat in a waveguide. It can be caused by impurities or interaction with other components of the core.

2. How many mechanisms are there which causes absorption?

1. One
2. Three
3. Two
4. Four View Answer

Answer: b

Explanation: Absorption is a loss mechanism. It may be intrinsic, extrinsic and also caused by atomic defects.

3. Absorption losses due to atomic defects mainly include \_\_\_\_\_\_\_\_\_\_\_ a) Radiation

1. Missing molecules, oxygen defects in glass
2. Impurities in fiber material
3. Interaction with other components of core View Answer

Answer: b

Explanation: Atomic defects are imperfections in the atomic structure of fiber material. Atomic structure includes nucleus, molecules, protons etc. Atomic defects thus contribute towards loss of molecules, oxygen, etc.

4. The effects of intrinsic absorption can be minimized by \_\_\_\_\_\_\_\_\_\_\_ a) Ionization

1. Radiation
2. Suitable choice of core and cladding components
3. Melting View Answer

Answer: c

Explanation: Intrinsic absorption is caused by interaction of light with one or more components of the glass i.e. core. Thus, if the compositions of core and cladding are chosen suitably, this effect can be minimized.

5. Which of the following is not a metallic impurity found in glass in extrinsic absorption? a) Fe2+

1. Fe3+
2. Cu
3. Si

View Answer

Answer: d

Explanation: In the optical fibers, prepared by melting techniques, extrinsic absorption can be observed. It is caused from transition metal element impurities. In all these options, Si is a constituent of glass and it cannot be considered as an impurity to glass itself.

6. Optical fibers suffer radiation losses at bends or curves on their paths. a) True

b) False View Answer

Answer: a

Explanation: Optical fibers suffer radiation losses due to the energy in the bend or curves exceeding the velocity of light in the cladding. Hence, guiding mechanism is inhibited, which in turn causes light energy to be radiated from the fiber.

7. In the given equation, state what αr suggests?

1. Radius of curvature
2. Refractive index difference
3. Radiation attenuation coefficients
4. Constant of proportionality View Answer

Answer: c

Explanation: Above equation represents the fiber loss. This loss is seen at bends and curves as the fibers suffer radiation losses at curves. These radiation losses are represented by a radiation attenuation coefficient (αr).

8. A multimode fiber has refractive indices n1 = 1.15, n2 = 1.11 and an operating wavelength of 0.7μm. Find the radius of curvature?

1. 8.60μm
2. 9.30μm
3. 9.1μm
4. 10.2μm View Answer

Answer: b

Explanation: The radius of curvature of the fiber bend of a multimode fiber is given by



Where, Rc = radius of curvature n1, n2 = refractive indices λ = wavelength.

9. A single mode fiber has refractive indices n1=1.50, n2 = 2.23, core diameter of 8μm, wavelength = 1.5μm cutoff wavelength = 1.214μm. Find the radius of curvature? a) 12 mm

1. 20 mm
2. 34 mm
3. 36 mm View Answer

Answer: c

Explanation: The radius of curvature of the fiber bend of a single mode fiber is given by-



Where R = radius of curvature, n1, n2 = refractive indices, λc = cutoff wavelength, λ = operating wavelength.

10. How the potential macro bending losses can be reduced in case of multimode fiber?

1. By designing fibers with large relative refractive index differences
2. By maintaining direction of propagation
3. By reducing the bend
4. By operating at larger wavelengths View Answer

Answer: a

Explanation: In the case of multimode fibers, radius of curvature is directly proportional to core refractive index and operating wavelength. In order to reduce the macro bending losses, the operative wavelength must be small and fibers must have large relative refractive index difference. Losses are inversely proportional to refractive index differences.

11. Sharp bends or micro bends causes significant losses in fiber. a) True

b) False View Answer

Answer: a

Explanation: Sharp bends usually have a radius of curvature almost near to the critical radius. The fibers with the radius near to the critical radius cause significant losses and hence they are avoided.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Linear & Non-Linear Scattering Losses”.

1. Rayleigh scattering and Mie scattering are the types of \_\_\_\_\_\_\_\_\_\_\_\_\_

1. Linear scattering losses
2. Non-linear scattering losses
3. Fiber bends losses
4. Splicing losses View Answer

Answer: a

Explanation: Rayleigh scattering and Mie scattering both result from non-ideal physical properties of the fiber. These losses may be impossible to eradicate. Linear scattering mechanisms cause the transfer of optical power contained within one propagating mode to be transferred linearly into a different mode.

2. Dominant intrinsic loss mechanism in low absorption window between ultraviolet and infrared absorption tails is \_\_\_\_\_\_\_\_\_\_\_

1. Mie scattering
2. Rayleigh scattering
3. Stimulated Raman scattering
4. Stimulated Brillouin scattering View Answer

3. Rayleigh scattering can be reduced by operating at smallest possible wavelengths. a) True

b) False View Answer

Answer: b

Explanation: Rayleigh scattering results from inhomogeneity of a random nature occurring on a small level compared with the wavelength of light. The Rayleigh scattering is inversely proportional to the wavelength. Thus, as wavelength scattering reduces.

4. The scattering resulting from fiber imperfections like core-cladding RI differences, diameter fluctuations, strains, and bubbles is? a) Rayleigh scattering

1. Mie scattering
2. Stimulated Brillouin scattering
3. Stimulated Raman scattering View Answer

Answer: b

Explanation: Linear scattering also occurs at inhomogeneity which are comparable in size with the guided wavelength. These results from non-perfect cylindrical structures of the waveguide and hence caused by fiber imperfections.

5. Mie scattering has in-homogeneities mainly in \_\_\_\_\_\_\_\_\_\_\_

1. Forward direction
2. Backward direction
3. All direction
4. Core-cladding interface View Answer

Answer: a

Explanation: In Mie scattering, the scattering in-homogeneities size is greater thanλ/10. Also, the scattered intensity has an angular dependence which is very large. The in-homogeneities are mainly in the direction of guided wavelength i.e. in forward direction.

6. The in-homogeneities in Mie scattering can be reduced by coating of a fiber. a) True

b) False

View Answer

Answer: a

Explanation: Mie scattering is a type of linear scattering loss. It results from fluctuations in diameter, differences in core-cladding refractive index, and differences along the fiber length. Therefore, such in-homogeneities can be reduced by controlled extrusion and coating of the fiber.

7. Raman and Brillouin scattering are usually observed at \_\_\_\_\_\_\_\_\_\_\_

1. Low optical power densities
2. Medium optical power densities
3. High optical power densities
4. Threshold power densities View Answer

Answer: c

Explanation: Raman and Brillouin scattering mechanism are non-linear. They provide optical gain but with a shift in frequency, thus contributing to attenuation for light transmission at a particular wavelength. They can be seen at high optical power densities.

8. The phonon is a quantum of an elastic wave in a crystal lattice. a) True

b) False View Answer

Answer: a

Explanation: A phonon is an elastic arrangement of atoms or molecules in condensed matter. This matter maybe solids or liquids. A phonon is a discrete unit of vibrational mechanical energy given by hf joules;

Where h = Planck’s constant f = frequency.

9. A single-mode optical fiber has an attenuation of 0.3dB/km when operating at wavelength of 1.1μm. The fiber core diameter is 4μm and bandwidth is 500 MHz. Find threshold optical power for stimulated Brillouin scattering. a) 11.20 mw

1. 12.77 mw
2. 13.08 mw
3. 12.12 mw View Answer

Answer: b

Explanation: The threshold optical power stimulated Brillouin scattering is given by-

PB = 4.4\*10-3d2λ2αdBv

Where, PB = threshold optical power d = diameter of core λ = wavelength αdB = attenuation.

10. 0.4 dB/km, 1.4μm, 6μm, 550MHz. Find threshold optical power for stimulated Raman scattering. a) 1.98 W

1. 1.20 W
2. 1.18 W
3. 0.96 W

View Answer

Answer: c

Explanation: The threshold optical power stimulated Raman scattering is given by-

PR = 5.9\*10-2d2λαdB

Where, PR = optical power for Raman scattering d = diameter of core λ = wavelength αdB = attenuation.

11. Stimulated Brillouin scattering is mainly a \_\_\_\_\_\_\_\_\_\_\_

1. Forward process
2. Backward process
3. Upward process
4. Downward process View Answer

Answer: b

Explanation: The incident photon in Stimulated Brillouin scattering reduces a phonon of acoustic frequency as well as scattered photon. This produces an optical frequency shift which varies with the scattering angle. This frequency shift is max. in backward direction reducing to zero in forward direction making Stimulated Brillouin scattering a backward process.

12. High frequency optical phonon is generated in stimulated Raman scattering. a) False

b) True View Answer

Answer: b

Explanation: An acoustic proton is generated in Stimulated Brillouin scattering. Raman scattering may have an optical power threshold higher than Stimulated Brillouin scattering.

13. Stimulated Raman scattering occur in \_\_\_\_\_\_\_\_\_\_\_

1. Forward direction
2. Backward direction
3. Upward direction
4. Forward and backward direction

View Answer

Answer: d

Explanation: Stimulated Raman scattering is similar to Stimulated Brillouin scattering except that a high frequency phonon is generated in Stimulated Raman scattering. Stimulated Raman scattering can occur in forward and backward direction as it has optical power threshold higher than Stimulated Brillouin scattering.

14. Stimulated Raman scattering may have an optical power threshold of may be three orders of magnitude \_\_\_\_\_\_\_\_\_\_\_

1. Lower than Brillouin threshold
2. Higher than Brillouin threshold
3. Same as Brillouin threshold
4. Higher than Rayleigh threshold View Answer

Answer: b

Explanation: Stimulated Raman scattering involves generation of high- frequency phonon. Stimulated Brillouin scattering on the other hand, involves the generation of an acoustic phonon in a scattering process.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Dispersion – Chromatic Dispersion “.

1. What is dispersion in optical fiber communication?

1. Compression of light pulses
2. Broadening of transmitted light pulses along the channel
3. Overlapping of light pulses on compression
4. Absorption of light pulses View Answer

Answer: b

Explanation: Dispersion of transmitted optical signal causes distortion of analog as well as digital transmission. When the optical signal travels along the channel, the dispersion mechanism causes broadening of light pulses and thus in turn overlaps with their neighboring pulses.

2. What does ISI stand for in optical fiber communication?

1. Invisible size interference
2. Infrared size interference
3. Inter-symbol interference
4. Inter-shape interference View Answer

Answer: c

Explanation: Dispersion causes the light pulses to broaden and overlap with other light pulses. This overlapping creates an interference which is termed as inter-symbol interference.

3. For no overlapping of light pulses down on an optical fiber link, the digital bit rate BT must be

\_\_\_\_\_\_\_\_\_\_\_

1. Less than the reciprocal of broadened pulse duration
2. More than the reciprocal of broadened pulse duration
3. Same as that of than the reciprocal of broadened pulse duration
4. Negligible View Answer

Answer: a

Explanation: The digital bit rate and pulse duration are always inversely proportional to each other.

BT < = 12 Γ

Where BT = bit rate

2Γ = duration of pulse.

4. The maximum bit rate that may be obtained on an optical fiber link is 1/3Γ. a) True

b) False View Answer

Answer: b

Explanation: The digital bit rate is function of signal attenuation on a link and signal to noise ratio. For the restriction of interference, the bit rate should be always equal to or less than 1/2Γ.

5. 3dB optical bandwidth is always \_\_\_\_\_\_\_\_\_\_\_ the 3dB electrical bandwidth. a) Smaller than

1. Larger than
2. Negligible than
3. Equal to View Answer

Answer: b

Explanation: Optical bandwidth is half of the maximum data rate. For non-return:0 (NRZ), bandwidth is same as bit rate. The bandwidth B for metallic conductors is defined by electrical 3dB points. Optical communication uses electrical circuitry where signal power has dropped to half its value due to modulated portion of modulated signal.

6. A multimode graded index fiber exhibits a total pulse broadening of 0.15μsover a distance of 16 km. Estimate the maximum possible bandwidth, assuming no intersymbol interference. a) 4.6 MHz

1. 3.9 MHz
2. 3.3 MHz
3. 4.2 MHz View Answer Answer: c

Explanation: The maximum possible bandwidth is equivalent to the maximum possible bitrate.

The maximum bit rate assuming no inter-symbol interference is given by

BT = 12 Γ

Where BT = bandwidth.

7. What is pulse dispersion per unit length if for a graded index fiber, 0.1μs pulse broadening is seen over a distance of 13 km? a) 6.12ns/km

1. 7.69ns/km
2. 10.29ns/km
3. 8.23ns/km View Answer

Answer: b

Explanation: The dispersion mechanism causes broadening of light pulses. The pulse dispersion per unit length is obtained by dividing total dispersion of total length of fiber. Dispersion = 0.1\*10-6/13 = 7.69 ns/km.

8. Chromatic dispersion is also called as intermodal dispersion. a) True

b) False View Answer

Answer: b

Explanation: Intermodal delay is a result of each mode having a different group velocity at a single frequency. The intermodal delay helps us to know about the information carrying capacity of the fiber.

9. Chromatic dispersion is also called as intermodal dispersion. a) True

b) False View Answer

Answer: b

Explanation: Intermodal delay, the name only suggests, includes many modes. On the other hand chromatic dispersion is pulse spreading that takes place within a single mode. Chromatic dispersion is also called as intermodal dispersion.

10. The optical source used in a fiber is an injection laser with a relative spectral width σλ/λ of 0.0011 at a wavelength of 0.70μm. Estimate the RMS spectral width. a) 1.2 nm

1. 1.3 nm
2. 0.77 nm
3. 0.98 nm View Answer Answer: c

Explanation: The relative spectral width σλ/λ= 0.01 is given. The rms spectral width can be calculated as follows:

σλ/λ = 0.0011 σλ = 0.0011λ = 0.0011\*0.70\*10-6 = 0.77 nm.

11. In waveguide dispersion, refractive index is independent of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) Bit rate

1. Index difference
2. Velocity of medium
3. Wavelength View Answer

Answer: d

Explanation: In material dispersion, refractive index is a function of optical wavelength. It varies as a function of wavelength. In wavelength dispersion, group delay is expressed in terms of normalized propagation constant instead of wavelength.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Intermodal Dispersion”.

1. Intermodal dispersion occurring in a large amount in multimode step index fiber results in

\_\_\_\_\_\_\_\_\_\_\_\_

1. Propagation of the fiber
2. Propagating through the fiber
3. Pulse broadening at output
4. Attenuation of waves View Answer

Answer: c

Explanation: Pulse broadening due to intermodal dispersion is caused due to difference in propagation delay between different modes in the multimode fiber. As different modes travel with different group velocities, the pulse width at output depends on transmission time of all modes. This creates difference in overall dispersion which results in pulse broadening.

2. After Total Internal Reflection the Meridional ray \_\_\_\_\_\_\_\_\_\_

1. Makes an angle equal to acceptance angle with the axial ray
2. Makes an angle equal to critical angle with the axial ray
3. Travels parallel equal to critical angle with the axial ray
4. Makes an angle equal to critical angle with the axial ray View Answer

Answer: d

Explanation: The Meridional ray travels along the axis of the fiber. When the ray is incident, makes an angle equal to acceptance angle and thus it propagates through the fiber. As the propagating ray gets refracted from the boundary, it makes an angle (i.e. critical angle) with the normal.

3. Consider a single mode fiber having core refractive index n1= 1.5. The fiber length is 12m. Find the time taken by the axial ray to travel along the fiber. a) 1.00μsec

1. 0.06μsec
2. 0.90μsec
3. 0.30μsec View Answer

Answer: b

Explanation: The time taken by the axial ray to travel along the fiber gives the minimum delay time

Tmin = Ln1/c

Where L = length of the fiber n1 = Refractive index of core c = velocity of light in vacuum.

4. A 4 km optical link consists of multimode step index fiber with core refractive index of 1.3 and a relative refractive index difference of 1%. Find the delay difference between the slowest and fastest modes at the fiber output. a) 0.173 μsec

1. 0.152 μsec
2. 0.96 μsec
3. 0.121 μsec View Answer

Answer: a

Explanation: The delay difference is given by δTs = Ln1/c

Where δTs = delay difference n1 = core refractive index

Δ = Relative refractive index difference c = velocity of light in vacuum.

5. A multimode step-index fiber has a core refractive index of 1.5 and relative refractive index difference of 1%. The length of the optical link is 6 km. Estimate the RMS pulse broadening due to intermodal dispersion on the link. a) 92.6 ns

1. 86.7 ns
2. 69.3 ns
3. 68.32 ns View Answer Answer: b

Explanation: The RMS pulse broadening due to intermodal dispersion is obtained by the equation is given below:

σs = Ln1Δ/2√3c

Where σs = RMS pulse broadening L = length of optical link C = velocity of light in vacuum n1 = core refractive index.

6. The differential attenuation of modes reduces intermodal pulse broadening on a multimode optical link. a) True

b) False View Answer

Answer: a

Explanation: Intermodal dispersion may be reduced by propagation mechanisms. The differential attenuation of various modes is due to the greater field penetration of the higher order modes into the cladding of waveguide. These slower modes exhibit larger losses at any core-cladding irregularities.

7. The index profile of a core of multimode graded index fiber is given by?

1. N (r) = n1 [1 – 2Δ(r2/a)2]1/2; r<a
2. N (r) = n1 [3 – 2Δ(r2/a)2]1/2; r<a
3. N (r) = n1 [5 – 2Δ(r2/a)2]1/2; r>a
4. N (r) = n1 [1 – 2Δ(r2/a)2]1/2; r<a View Answer

Answer: d

Explanation: In multimode graded index fibers, many rays can propagate simultaneously. The Meridional rays follow sinusoidal trajectories of different path length which results from index grading.

8. Intermodal dispersion in multimode fibers is minimized with the use of step-index fibers. a) True

b) False View Answer

Answer: b

Explanation: As multimode graded index fibers show substantial bandwidth improvement over multimode step index fibers. So, inter-modal dispersion in multimode fiber is minimized with the use of multimode graded index fibers.

9. Estimate RMS pulse broadening per km due to intermodal dispersion for multimode step index fiber where length of fiber is 4 km and pulse broadening per km is 80.6 ns. a) 18.23ns/km

1. 20.15ns/km
2. 26.93ns/km
3. 10.23ns/km View Answer

Answer: b Explanation:

The RMS pulse broadening per km due to intermodal dispersion for multimode step index fiber is given by

(σs(1 km)/L = 80.6/4 = 20.15 Where L = length of fiber σs = pulse broadening.

10. Practical pulse broadening value for graded index fiber lies in the range of \_\_\_\_\_\_\_\_\_\_ a) 0.9 to 1.2 ns/km

1. 0.2 to 1 ns/km
2. 0.23 to 5 ns/km
3. 0.45 to 8 ns/km View Answer

Answer: b

Explanation: As all optical fiber sources have a finite spectral width, the profile shape must be altered to compensate for this dispersion mechanism. The minimum overall dispersion for graded index fiber is also limited by other intermodal dispersion mechanism. Thus pulse broadening values lie within range of 0.2 to 1 ns/km.

11. The modal noise occurs when uncorrected source frequency is?

1. δf>>1/δT
2. δf=1/δT
3. δf<<1/δT
4. Negligible View Answer

Answer: a

Explanation: Modal noise is dependent on change in frequency. Frequency is inversely proportional to time. The patterns are formed by interference of modes from a coherent source when coherence time of source is greater than intermodal dispersion time δT within fiber.

12. Disturbance along the fiber such as vibrations, discontinuities, connectors, splices, source/detectors coupling result in \_\_\_\_\_\_\_\_\_\_ a) Modal noise

1. Inter-symbol interference
2. Infrared interference
3. Pulse broadening

View Answer

Answer: a

Explanation: Disturbance along the fiber cause fluctuations in specific pattern. These speckle patterns have characteristics time longer than resolution time of detector and is known as modal noise.

13. The modal noise can be reduced by \_\_\_\_\_\_\_\_\_\_

1. Decreasing width of signal longitudinal mode
2. Increasing coherence time
3. Decreasing number of longitudinal modes
4. Using fiber with large numerical aperture View Answer

Answer: d

Explanation: Disturbances along fiber cause fluctuations in speckle patterns. Fibers with large numerical apertures support the transmission of large number of modes giving greater number of speckle, thereby reducing modal noise.

14. Digital transmission is more likely to be affected by modal noise. a) True

b) False View Answer

Answer: b

Explanation: Analog transmission is more affected by modal noise due to higher optical power levels which is required at receiver when quantum noise effects are considered. So it is important to look into design considerations.



This set of Optical Communications Interview Questions and Answers for freshers focuses on “Overall Fiber Dispersion & Modified Single Mode Fibers”.

1. A multimode step index fiber has source of RMS spectral width of 60nm and dispersion parameter for fiber is 150psnm-1km-1. Estimate rms pulse broadening due to material dispersion. a) 12.5ns km-1

1. 9.6ns km-1
2. 9.0ns km-1
3. 10.2ns km-1 View Answer

Answer: c

Explanation: The RMS pulse broadening per km due to material dispersion is given by σm(1 km) = σλLM = 60\*1\* 150pskm-1

= 9.0nskm-1

Where σλ = rms spectral width

1. = length of fiber
2. = dispersion parameter.

2. A multimode fiber has RMS pulse broadening per km of 12ns/km and 28ns/km due to material dispersion and intermodal dispersion resp. Find the total RMS pulse broadening. a) 30.46ns/km

1. 31.23ns/km
2. 28.12ns/km
3. 26.10ns/km View Answer

Answer: a

Explanation: The overall dispersion in multimode fibers comprises both chromatic and intermodal terms. The total RMS pulse broadening σT is given by



Where σm = RMS pulse broadening due to material dispersion σi = RMS pulse broadening due to intermodal dispersion.

3. Γg = dβ / C\*dk. What is β in the given equation?

1. Attenuation constant
2. Propagation constant
3. Boltzmann’s constant
4. Free-space View Answer

Answer: b

Explanation: Above given equation is an equation of transit time or a group delay(Γg) for a light pulse. This light pulse is propagating along a unit length of a single mode fiber.

4. Most of the power in an optical fiber is transmitted in fiber cladding. a) True

b) False View Answer

Answer: b

Explanation: Most of the power in optical fiber is transmitted in fiber core. This is because in multimode fibers, majority of modes propagating in the core area are far from cutoff. Hence more power is transmitted.

5. A single mode fiber has a zero dispersion wavelength of 1.21μm and a dispersion slope of 0.08 psnm-2km-1. What is the total first order dispersion at wavelength 1.26μm. a) -2.8psnm-1 km-1

1. -3.76psnm-1 km-1
2. -1.2psnm-1 km-1
3. 2.4psnm-1 km-1 View Answer

Answer: b

Explanation: The total first order dispersion for fiber at two wavelength is obtained by

DT(1260 nm) = λS0/4 [1-(λ0/λ)4]

= (1260\*0.08\*10-12)/4 \* (1-[1550/1260]4)

= -3.76psnm-1km-1 Where

λ0 = zero dispersion wavelength

λ = wavelength

S0 = dispersion slope

DT = total first order dispersion.

6. The dispersion due to material, waveguide and profile are -2.8nm-1km-1, 20.1nm-1km-1 and 23.2nm-1km-1respectively. Find the total first order dispersion?

1. 36.2psnm-1 km-1
2. 38.12psnm-1 km-1
3. 40.5psnm-1 km-1
4. 20.9psnm-1 km-1 View Answer

Answer: c

Explanation: The total dispersion is given by

DT = DM + DW + DP(psnm-1km-1)

Where

DW = waveguide dispersion DM = Material dispersion DP = profile dispersion.

7. Dispersion-shifted single mode fibers are created by \_\_\_\_\_\_\_\_\_\_

1. Increasing fiber core diameter and decreasing fractional index difference
2. Decreasing fiber core diameter and decreasing fractional index difference
3. Decreasing fiber core diameter and increasing fractional index difference
4. Increasing fiber core diameter and increasing fractional index difference View Answer

Answer: c

Explanation: It is possible to modify the dispersion characteristics of single mode fibers by tailoring of some fiber parameters. These fiber parameters include core diameter and relative index difference.

8. An alternative modification of the dispersion characteristics of single mode fibers involves achievement of low dispersion gap over the low-loss wavelength region between \_\_\_\_\_\_\_\_\_\_ a) 0.2 and 0.9μm

1. 0.1 and 0.2μm
2. 1.3 and 1.6μm
3. 2 and 3μm View Answer Answer: c

Explanation: Dispersion characteristics can be altered by changing fiber parameters and wavelength. The achievement of low dispersion gap over the region 1.3 and 1.6μm modifies the dispersion characteristics of single mode fibers.

9. The fibers which relax the spectral requirements for optical sources and allow flexible wavelength division multiplying are known as \_\_\_\_\_\_\_\_\_\_ a) Dispersion-flattened single mode fiber

1. Dispersion-enhanced single mode fiber
2. Dispersion-compressed single mode fiber
3. Dispersion-standardized single mode fiber View Answer

Answer: a

Explanation: The dispersion-flattened single mode fibers (DFFS) are obtained by fabricating multilayer index profiles with increased waveguide dispersion. This is tailored to provide overall dispersion say 2psnm-1km-1 over the wavelength range 1.3 to 1.6μm.

10. For suitable power confinement of fundamental mode, the normalized frequency v should be maintained in the range 1.5 to 2.4μm and the fractional index difference must be linearly increased as a square function while the core diameter is linearly reduced to keep v constant.

This confinement is achieved by?

1. Increasing level of silica doping in fiber core
2. Increasing level of germanium doping in fiber core
3. Decreasing level of silica germanium in fiber core
4. Decreasing level of silica doping in fiber core View Answer

Answer: b

Explanation: The tailoring of fiber parameters provides suitable power confinement. These parameters may be diameter, index-difference, frequency etc. The doping level of germanium contributes to the tailoring of fiber parameters; which in turn provides suitable power confinement.

11. Any amount of stress occurring at the core-cladding interface would be reduced by grading the material composition. a) True

b) False View Answer

Answer: a

Explanation: A problem arises with that of simple step index approach to dispersion shifting is high. The fibers produced exhibit high dopant-dependent losses at operating wavelengths. These losses are caused by induced-stress in the region of core-cladding interface. This can be reduced by grading the material composition of the fiber.

12. The variant of non-zero-dispersion-shifted fiber is called as \_\_\_\_\_\_\_\_\_\_

1. Dispersion flattened fiber
2. Zero-dispersion fiber
3. Positive-dispersion fiber
4. Negative-dispersion fiber View Answer

Answer: d

Explanation: The dispersion profile for non-zero dispersion shifted fiber is referred to as bandwidth non-zero-dispersion-shifted fiber. It was introduced to provide wavelength division multiplexed applications to be extended into the s-band. The variant of non-zero-dispersionshifted fiber can also be referred to as dispersion compensating fiber.

13. Non-zero-dispersion-shifted fiber was introduced in the year 2000. a) True

b) False View Answer

Answer: b

Explanation: Non-zero-dispersion-shifted fiber was introduced in mid-1990s to provide wavelength division multiplexing applications. In the year 2000, the dispersion profile for nonzero-dispersion-shifted fiber was introduced.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Polarization”.

1. For many applications that involve optical fiber transmission, an intensity modulation optical source is not required. a) True

b) False View Answer

Answer: b

Explanation: In many optical fibers transmission, the cylindrical fibers used generally do not maintain polarization state of light input source not more than a few meters. So for this reason, optical sources intensity modulation is required.

2. The optical source used for detection of optical signal is \_\_\_\_\_\_\_\_\_\_\_\_ a) IR sensors

1. Photodiodes
2. Zener diodes
3. Transistors View Answer Answer: b

Explanation: Optical signal is generally detected by photodiodes because photodiode is generally insensitive to optical polarization or phase of light with the fiber.

3. An optical fiber behaves as a birefringence medium due to differences in \_\_\_\_\_\_\_\_\_\_\_

1. Effective R-I and core geometry
2. Core-cladding symmetry
3. Transmission/propagation time of waves
4. Refractive indices of glass and silica View Answer

Answer: a

Explanation: In an optical fiber with ideal optically circulatory symmetric core, both polarization modes propagate with same velocities. These fibers have variations in internal and external stress; fiber bending and so exhibit some birefringence.

4. The beat length in a single mode optical fiber is 8 cm when light from a laser with a peak wavelength 0.6μm is launched into it. Estimate the modal birefringence. a) 1×10-5

1. 3.5×10-5
2. 2×10-5
3. 4×10-5 View Answer

Answer: a

Explanation: Modal birefringence can be obtained by-

BF = λ/LB = 0.8×10-6/0.08

= 1×10-5 Where λ = peak wavelength LB = beat length.

5. Beat length of a single mode optical fiber is 0.6cm. Calculate the difference between propagation constants for the orthogonal modes. a) 69.8

1. 99.86
2. 73.2
3. 104.66 View Answer

Answer: d

Explanation: The difference between the propagation constant for two orthogonal modes can be obtained by: βx – βy = 2Π/LB = 2×3.14/0.06

= 104.66

Where

βx & βy are propagation constants for slow & fast modes resp. LB = beat length.

6. A polarization maintaining fiber operates at a wavelength 1.2μm and have a modal birefringence of 1.8\*10-3. Calculate the period of perturbation. a) 0.7 seconds

1. 0.6 seconds
2. 0.23 seconds
3. 0.5 seconds View Answer

Answer: b

Explanation: The period of perturbation is given by-

T = λ/BF Where λ is operating wavelength, BF = Birefringence, T = period of perturbation.

7. When two components are equally excited at the fiber input, then for polarization maintaining fibers δΓg should be around \_\_\_\_\_\_\_\_\_\_\_ a) 1.5ns/km

1. 1 ns/km
2. 1.2ns/km
3. 2ns/km View Answer

Answer: b

Explanation: The differential group delay δΓg is related to polarization mode dispersion (PMD) of fiber. This linear relationship to fiber length however applies only to short fiber-lengths in which birefringence are uniform.

8. Polarization modal noise can \_\_\_\_\_\_\_\_\_ the performance of communication system. a) Degrade

1. Improve
2. Reduce
3. Attenuate View Answer

Answer: a

Explanation: Polarization modal noise is generally of larger amplitude than modal noise. It is obtained within multimode fibers and so it degrades the performance of the communication system and prevents transmission of analog signals.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Non-Linear Effects”.

1. The nonlinear effects in optical fibers are large.

1. True
2. False View Answer

Answer: b

Explanation: The nonlinear effect arises from the interactions between light waves and the material transmitting them and thus affects the optical signals. The nonlinear effects are usually small in optical fibers. They have power levels of up to few milliWatts.

2. How many categories of nonlinear effects are seen in optical fibers? a) One

1. Two
2. Three
3. Four View Answer

Answer: b

Explanation: The nonlinear effects are separated on the basis of their characteristics. There are two such categories; one is scattering effect and the other is Kerr effect.

3. Which of the following is not related to Kerr effects?

1. Self-phase modulation
2. Cross-phase modulation
3. Four-wave mixing
4. Stimulated Raman Scattering View Answer

Answer: d

Explanation: Stimulated Raman Scattering is related to scattering. The other effects include modulation and mixing which are parts of Kerr effect.

4. Linear scattering effects are \_\_\_\_\_\_\_ in nature.

1. Elastic
2. Non-Elastic
3. Mechanical
4. Electrical View Answer

Answer: a

Explanation: Linear scattering effects are elastic because the scattered wave frequency is equal to incident wave frequency. Nonlinear scattering effects are purely inelastic.

5. Which thing is more dominant in making a fiber function as a bidirectional optical amplifier? a) Core material

1. Pump source
2. Cladding material
3. Diameter of fiber View Answer

Answer: b

Explanation: Brillouin gain is always greater than Raman gain. It exists for light propagation in opposite direction to the pump source. Also Brillouin frequency shifts and gain bandwidth are much smaller than Raman. Raman amplification occurs for light propagating in either direction. Thus, pump source is more important in making a fiber function as bidirectional optical amplifier.

6. \_\_\_\_\_\_\_\_\_ semiconductor laser sources generally have broader bandwidths. a) Injection

1. Pulsed
2. Solid-state
3. Silicon hybrid View Answer

Answer: b

Explanation: Pulsed semiconductor lasers have broader bandwidths. Therefore, these sources prove to be inefficient pump sources. They prove inefficient especially for narrow gain spectrum.

7. Nonlinear effects which are defined by the intensity – dependent refractive index of the fiber are called as \_\_\_\_\_\_\_\_ a) Scattering effects

1. Kerr effects
2. Raman effects
3. Tomlinson effects View Answer

Answer: b

Explanation: Kerr effects are nonlinear effects. Nonlinear effects are divided into scattering and Kerr effects. Scattering effects include scattering of phonon whereas Kerr effects include intensity refractive index parameters.

8. Self-phase modulation causes modifications to the pulse spectrum. a) True

b) False View Answer

Answer: a

Explanation: Kerr effect results in different transmission phase for the peak of the pulse compared with leading and trailing edges. Self-phase modulation can broaden the frequency spectrum of the pulse as the time varying phase creates a time varying frequency.

9. Self-phase modulation can be used for \_\_\_\_\_\_\_\_\_\_\_\_\_

1. Enhancing the core diameter
2. Wavelength shifting
3. Decreasing the attenuation
4. Reducing the losses in the fiber View Answer

Answer: b

Explanation: Self phase modulation is related to phase change. It imposes a positive frequency sweep on the pulse which in turn enables wavelength or frequency shifting.

10. The beating between light at different frequencies or wavelengths in multichannel fiber transmission causes \_\_\_\_\_\_\_\_ a) Attenuation

1. Amplitude modulation of channels
2. Phase modulation of channels
3. Loss in transmission View Answer

Answer: c

Explanation: Phase modulation is related to frequency and wavelength shifting. In multichannel fiber transmission, phase modulation causes generation of modulation sidebands at new frequencies. This phenomenon is called as four-wave mixing.

11. What is different in case of cross-phase modulation from self-phase modulation?

1. Overlapping but same pulses
2. Overlapping but distinguishable pulses
3. Non-overlapping and same pulses
4. Non-overlapping but distinguishable pulses View Answer

Answer: b

Explanation: In cross phase modulation, variation in intensity of one pulse width modulates the refractive index of the fiber which causes phase modulation of the overlapping phases. In selfphase modulation, this phase modulation broadens the pulse spectrum.

12. When three wave components co-propagate at angular frequency w1, w2, w3, then a new wave is generated at frequency w4, which is given by? a) w4 = w1 – w2 – w3

1. w4 = w1 + w2 + w3
2. w4 = w1 + w2 – w3
3. w4 = w1 – w2 + w3 View Answer

Answer: c

Explanation: This type of frequency mixing is called as four-wave mixing. This frequency combination is problematic for multichannel optical communication as they become phase matched if the channel wavelengths are near to zero dispersion wavelengths.

13. \_\_\_\_\_\_\_\_\_\_\_\_\_ results from a case of nonlinear dispersion compensation in which the nonlinear dispersion compensation in which the nonlinear chirp caused by self-phase modulation balances, postpones, the temporal broadening induced by group velocity delay. a) Four wave mixing

1. Phase modulation
2. Soliton propagation
3. Raman scattering View Answer

Answer: c

Explanation: Soliton propagation is a nonlinear dispersion phenomenon. It limits the propagation distance that can be achieved when acting independently. It balances broadening of light pulse.



**3. Questions & Answers on Optical Fibers And Cables**

The section contains questions and answers on vapour and liquid phase techniques, optical fibers and its cables, fiber transmission characteristics and cable design.

This set of Optical Communications Questions and Answers for Experienced people focuses on “Preparation of Optical Fibers – Liquid Phase Techniques”.

1. What is a fundamental necessity in the fabrication of fibers for light transmission?

1. Same refractive index for both core and cladding
2. Pump source
3. Material composition of fiber
4. Variation of refractive index inside the optical fiber View Answer

Answer: d

Explanation: For fabrication of fibers, two different transparent materials to light over a wavelength range of 0.8 to 1.7μm are required. Fiber should exhibit low attenuation, absorption and scattering losses. The variation of refractive indices in a fiber is a necessity for fiber fabrication.

2. Which materials are unsuitable for the fabrication of graded index fiber?

1. Glass-like-materials
2. Mono-crystalline structures
3. Amorphous material
4. Silica based material

View Answer

Answer: b

Explanation: In case of graded index fiber, it is essential that the refractive index of the material is varied by suitable doping with another compatible material. These two materials should have mutual solubility over a wide range of concentration. This is achieved only in glass-likematerials.

3. How many different categories are available for the methods of preparing optical glasses? a) 1

1. 2
2. 3
3. 4

View Answer

Answer: b

Explanation: The methods of preparing optical glasses are divided into two categories. One is the conventional glass refining technique and other is vapor-phase-deposition method.

4. What is the first stage in liquid-phase-technique?

1. Preparation of ultra-pure material powders
2. Melting of materials
3. Decomposition
4. Crystallization View Answer

Answer: a

Explanation: In liquid-phase-technique melting, the first stage includes the preparation of ultrapure material powders. These are usually oxides or carbonates which decomposes during glass melting.

5. Which processes are involved in the purification stage in liquid-phase-technique?

1. Filtration, Co-precipitation, Re-crystallization
2. Decomposition, Filtration, Drying
3. Doping, Drying, Decomposition
4. Filtration, Drying, Doping View Answer

Answer: a

Explanation: The compounds such as oxides and carbonates are formed during the glass melting. The purification accounts for a large proportion of material cost. These compounds are commercially available. The purification involves filtration, co-precipitation, re-crystallization and drying.

6. At what temperature range, does the melting of multi components glass systems takes place? a) 100-300 degree Celsius

1. 600-800 degree Celsius
2. 900-1300 degree Celsius
3. 1500-1800 degree Celsius View Answer

Answer: c

Explanation: The glass materials in the powdered form and have relatively low melting point. Thus, the glass materials are melted at relatively low temperatures in the range of 900-1300 degrees Celsius.

7. Fiber drawing using preform was useful for the production of graded index fibers. a) True

b) False View Answer

Answer: b

Explanation: A technique for producing fine optical fiber waveguides is to make a preform using the rod in the tube process. This technique was useful for the production of step-index fibers with large core diameters. In this technique, achievement of low attenuation is not critical as there is a danger of including bubbles at the core-cladding interface.

8. The minute perturbations and impurities in the fiber drawing process using preform technique can result in very high losses of \_\_\_\_\_\_\_\_\_\_\_\_\_ a) Between 500 and 1000 dB/km

1. Between 100 and 300 dB/km
2. Between 1200 and 1600 dB/km
3. More than 2000 dB/km View Answer

Answer: a

Explanation: The minute perturbations and impurities in the fiber include formations of bubbles and involvement of particulate matter. The losses due to such impurities can be between 500 and 1000 dB/km.

9. The liquid-phase melting technique is used for the production of fibers \_\_\_\_\_\_\_\_\_\_\_

1. With a core diameter of 50μm
2. With a core diameter less than 100μm
3. With a core diameter more than 200μm
4. With a core diameter of 100μm View Answer

Answer: c

Explanation: The multicomponent glass fibers prepared continuously by liquid-phase melting technique have losses in the range of 5 and 20 dB/km at a wavelength of 0.85μm. This method is thus used for preparation of fibers with a large core diameter. Also this technique is used for the continuous production of fibers.

10. Graded index fibers produced by liquid-phase melting techniques are less dispersive than step-index fibers. a) True

b) False View Answer

Answer: a

Explanation: Liquid-phase melting technique does not offer optimum parabolic profile fibers. This parabolic profile yields minimum pulse dispersion. Graded index fibers prepared using liquid-phase melting techniques are less dispersive but do not have the bandwidth-length products of optimum profile fibers.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Vapor – Phase Deposition Techniques”.

1. Which of the following is not a technique for fabrication of glass fibers?

1. Vapor phase oxidation method
2. Direct melt method
3. Lave ring method
4. Chemical vapor deposition technique View Answer

Answer: c

Explanation: Lave ring method refers to the deposition of a crystalline layer on a substrate. All the other methods, except lave ring method, refer to optical fiber fabrication.

2. \_\_\_\_\_\_\_\_\_\_\_\_\_ technique is method of preparing extremely pure optical glasses. a) Liquid phase (melting)

1. Radio frequency induction
2. Optical attenuation
3. Vapor Phase Deposition (VPD) View Answer

Answer: d

Explanation: Vapor Phase Deposition techniques are used to prepare silica-rich glasses. These glasses exhibit highest transparency and optimal optical properties.

3. Which of the following materials is not used as a starting material in vapor-phase deposition technique? a) SiCl4

1. GeCl4
2. O2
3. B2O3

View Answer

Answer: d

Explanation: In vapor-phase deposition technique, starting materials are volatile organic compounds. These materials are distilled to reduce the concentration of transition metal impurities. B2O3 is used as a dopant.

4. P2O5 is used as a \_\_\_\_\_\_\_\_\_\_\_\_\_

1. Dopant
2. Starting material
3. Cladding glass
4. Core glass View Answer

Answer: a

Explanation: P2O5 is a non silica material. Dopants are formed from non silica materials so that refractive index modification is achieved. Other dopants include Ti O2, Ge O2, etc.

5. How many types of vapor-phase deposition techniques are present? a) One

1. Two
2. Three
3. Four View Answer

Answer: b

Explanation: Vapor-phase deposition techniques are divided into two types. The two types are flame hydrolysis and chemical vapor deposition (CVD). Further, these two types are subdivided into two more sections.

6. \_\_\_\_\_\_\_\_\_\_\_ uses flame hydrolysis stems from work on soot processes which were used to prepare the fiber with losses below 20 dB/km. a) Outside vapor phase oxidation

1. Chemical vapor deposition
2. Liquid phase melting
3. Crystallization View Answer

Answer: a

Explanation: Outside vapor phase oxidation is a type of vapor flame hydrolysis. It was originally developed by Hyde. In this process, the glass composition is deposited from a ‘soot’ generated by hydrolyzing the halide vapors in an oxygen-hydrogen flame.

7. Complete the given reaction.

SiCl4 + 2H2O → SiO2 + \_\_\_\_\_\_

1. 2HCl
2. 4HCl
3. 2Cl2
4. 4Cl2 View Answer

Answer: b

Explanation: SiCl4 is a starting material used in vapour-phase deposition technique. Dopants are added to the starting material in presence of heat to give glass compound. In the above reaction SiO2 (solid compound) along with 4HCl(gas) is obtained.

8. In modified chemical vapor deposition, vapor phase reactant such as \_\_\_\_\_\_\_\_\_ pass through a hot zone.

1. Halide and oxygen
2. Halide and hydrogen
3. Halide and silica
4. Hydroxides and oxygen View Answer

Answer: a

Explanation: Halide and oxygen are passed through the hot zone during chemical vapor deposition. Glass particles formed during this travel are deposited on the walls of silica tube which are moved back and forth allowing the particles to deposit layer by layer.

9. \_\_\_\_\_\_\_\_\_ is the stimulation of oxide formation by means of non-isothermal plasma maintained at low pressure in a microwave cavity surrounding the tube. a) Outside Vapor Phase Oxidation (OVPO)

1. Vapor Axial Deposition (VAD)
2. Modified Chemical Vapor Deposition (MCVD)
3. Plasma-activated Chemical Vapor Deposition (PCVD) View Answer

Answer: d

Explanation: PCVD method was first developed by Cuppers and Koenig’s. It involves a plasmainduced chemical vapor deposition inside a silica tube. It is different from MCVD process as it involves stimulation of oxide formation by means of non-isothermal plasma.

10. Only graded index fibers are made with the help of vapor-phase deposition techniques. a) True

b) False View Answer

Answer: b

Explanation: Vapor phase deposition techniques are used for preparation of both step-index and graded index fibers. These techniques provide fibers with low attenuation losses. Also, it gives similar performance for the fabrication of both single mode and multimode fibers.

11. Modified Chemical Vapor Deposition (MCVD) process is also called as an inside vapor phase oxidation (IVPD) technique. a) True

b) False View Answer

Answer: a

Explanation: MCVD process was developed by Bell Telephone Laboratories and Southampton University, UK. It is called as inside vapor phase oxidation (IVPO) as it takes place inside the silica tube at the temperatures between 1400 and 1600 degrees Celsius.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Optical Fibers”.

1. Multimode step index fiber has \_\_\_\_\_\_\_\_\_\_\_

1. Large core diameter & large numerical aperture
2. Large core diameter and small numerical aperture
3. Small core diameter and large numerical aperture
4. Small core diameter & small numerical aperture View Answer

Answer: a

Explanation: Multimode step-index fiber has large core diameter and large numerical aperture. These parameters provides efficient coupling to inherent light sources such as LED’s.

2. A typically structured glass multimode step index fiber shows as variation of attenuation in range of \_\_\_\_\_\_\_\_\_\_\_

1. 1.2 to 90 dB km-1 at wavelength 0.69μm
2. 3.2 to 30 dB km-1 at wavelength 0.59μm
3. 2.6 to 50 dB km-1 at wavelength 0.85μm
4. 1.6 to 60 dB km-1 at wavelength 0.90μm View Answer

Answer: c

Explanation: A multimode step index fibers show an attenuation variation in range of 2.6 to 50dBkm-1. The wide variation in attenuation is due to the large differences both within and between the two overall preparation methods i.e. melting and deposition.

3. Multimode step index fiber has a large core diameter of range is \_\_\_\_\_\_\_\_\_\_\_ a) 100 to 300 μm

1. 100 to 300 nm
2. 200 to 500 μm
3. 200 to 500 nm View Answer Answer: a

Explanation: A multimode step index fiber has a core diameter range of 100 to 300μm. This is to facilitate efficient coupling to inherent light sources.

4. Multimode step index fibers have a bandwidth of \_\_\_\_\_\_\_\_\_\_\_

1. 2 to 30 MHz km
2. 6 to 50 MHz km
3. 10 to 40 MHz km
4. 8 to 40 MHz km View Answer

5. Multimode graded index fibers are manufactured from materials with \_\_\_\_\_\_\_\_\_\_\_ a) Lower purity

1. Higher purity than multimode step index fibers.
2. No impurity
3. Impurity as same as multimode step index fibers. View Answer

Answer: b

Explanation: Multimode graded index fibers have higher purity than multimode step index fiber. To reduce fiber losses, these fibers have more impurity.

6. The performance characteristics of multimode graded index fibers are \_\_\_\_\_\_\_\_\_\_\_

1. Better than multimode step index fibers
2. Same as multimode step index fibers
3. Lesser than multimode step index fibers
4. Negligible View Answer

Answer: a

Explanation: Multimode graded index fibers use a constant grading factor. Performance characteristics of multimode graded index fibers are better than those of multimode step index fibers due to index graded and lower attenuation.

7. Multimode graded index fibers have overall buffer jackets same as multimode step index fibers but have core diameters \_\_\_\_\_\_\_\_\_\_\_ a) Larger than multimode step index fibers

1. Smaller than multimode step index fibers
2. Same as that of multimode step index fibers
3. Smaller than single mode step index fibers View Answer

8. Multimode graded index fibers with wavelength of 0.85μm have numerical aperture of 0.29 have core/cladding diameter of \_\_\_\_\_\_\_\_\_\_\_ a) 62.5 μm/125 μm

1. 100 μm/140 μm
2. 85 μm/125 μm
3. 50 μm/125μm View Answer

Answer: b

Explanation: Multimode graded index fibers with numerical aperture 0.29 having a core/cladding diameter of 100μm/140μm. They provide high coupling frequency LED’s at a wavelength of 0.85 μm and have low cost. They are also used for short distance application.

9. Multimode graded index fibers use incoherent source only. a) True

b) False View Answer

Answer: b

Explanation: Multimode graded index fibers are used for short haul and medium to high bandwidth applications. Small haul applications require LEDs and low accuracy lasers. Thus either incoherent or incoherent sources like LED’s or injection laser diode are used.

10. In single mode fibers, which is the most beneficial index profile? a) Step index

1. Graded index
2. Step and graded index
3. Coaxial cable View Answer

Answer: b

Explanation: In single mode fibers, graded index profile is more beneficial as compared to step index. This is because graded index profile provides dispersion-modified-single mode fibers.

11. The fibers mostly not used nowadays for optical fiber communication system are

\_\_\_\_\_\_\_\_\_\_\_

1. Single mode fibers
2. Multimode step fibers
3. Coaxial cables
4. Multimode graded index fibers View Answer

Answer: a

Explanation: Single mode fibers are used to produce polarization maintaining fibers which make them expensive. Also the alternative to them are multimode fibers which are complex but accurate. So, single-mode fibers are not generally utilized in optical fiber communication.

12. Single mode fibers allow single mode propagation; the cladding diameter must be at least

\_\_\_\_\_\_\_\_\_\_\_

1. Twice the core diameter
2. Thrice the core diameter
3. Five times the core diameter
4. Ten times the core diameter View Answer

Answer: d

Explanation: The cladding diameter in single mode fiber must be ten times the core diameter. Larger ratios contribute to accurate propagation of light. These dimension ratios must be there so as to avoid losses from the vanishing fields.

13. A fiber which is referred as non-dispersive shifted fiber is?

1. Coaxial cables
2. Standard single mode fibers
3. Standard multimode fibers
4. Non zero dispersion shifted fibers View Answer

Answer: b

Explanation: A standard single mode fiber having step index profile is known as non-dispersion shifted fiber. As these fibers have a zero dispersion wavelength of 1.31μm and so are preferred for single-wavelength transmission in O-band.

14. Standard single mode fibers (SSMF) are utilized mainly for operation in \_\_\_\_\_\_\_\_\_\_\_ a) C-band

1. L-band
2. O-band
3. C-band and L-band View Answer

Answer: c

Explanation: SSMFs are utilized for operation in O-band only. It shows high dispersion in the range of 16 to 20ps/nm/km in C-band and L-band. So SSMFs are used in O-band.

15. Fiber mostly suited in single-wavelength transmission in O-band is?

1. Low-water-peak non dispersion-shifted fibers
2. Standard single mode fibers
3. Low minimized fibers
4. Non-zero-dispersion-shifted fibers View Answer

Answer: b

Explanation: Standard single mode fibers with a step index profile are called non dispersion shifted fiber and it is particularly used for single wavelength transmission in O-band and as if has a zero-dispersion wavelength at 1.31μm.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on ” Optical Fiber Cables”.

1. When optical fibers are to be installed in a working environment, the most important parameter to be considered is?

1. Transmission property of the fiber
2. Mechanical property of the fiber
3. Core cladding ratio of the fiber
4. Numerical aperture of the fiber View Answer

Answer: b

Explanation: Nowadays, optical fibers are used alternatively to electric transmission lines. They are installed safely and maintained in all environments including underground areas. This requires mechanical strengthening of fibers in order to ensure proper transmission.

2. It is not important to cover these optical fibers required for transmission. a) True

b) False View Answer

Answer: b

Explanation: Unprotected optical fibers have number of losses regarding its strength and durability. Bare glass fibers are brittle and have small cross-section area that makes them highly susceptible to damages while handling and maintenance. Thus, to improve tensile strength, optical fibers should be covered by surrounding them with number of protective layers.

3. Optical fibers for communication use are mostly fabricated from \_\_\_\_\_\_\_\_\_\_\_ a) Plastic

1. Silica or multicomponent glass
2. Ceramics
3. Copper View Answer

Answer: b

Explanation: Silica or a compound of glass are brittle and have almost perfect elasticity until reaching their breaking point. Strength of these materials is high. Thus, optical fibers are fabricated from these materials.

4. An Si-O bond with a Young’s modulus of 9\*1010Nm-1 have an elliptical crack of depth 7nm. The surface energy is 2.29 J. Estimate fracture stress for silica fiber. a) 4.32\*109Nm-1

1. 6.32\*109Nm-1
2. 5.2\*109Nm-1
3. 3\*109Nm-1 View Answer Answer: a

Explanation: For an elliptical crack, the fracture stress is given by-

Sf = (2Eγp/πC)1/2 Where Sf = fracture stress γp = surface energy C = depth of crack.

5. Calculate percentage strain at break for a Si-O bond with a fracture strength of 3.52\*1010Nm-1 and Young’s modulus of 9 \*109Nm-1. a) 3.1 %

1. 2.8 %
2. 4.5 %
3. 3.9 % View Answer

Answer: d

Explanation: Young’s modulus is given by-

E = Stress/Strain

To calculate strain from the above formula, we have to divide stress by Young’s modulus. Therefore, Strain = Stress/E.

6. Stress corrosion must be considered while designing and testing optical fiber cables. a) True

b) False View Answer

Answer: a

Explanation: Stress corrosion means growth of flaws due to stress and water. This occurs as a result of molecular bonds at the tip of crack being attacked by water. Hence, it is important to have a protection against water to avoid stress corrosion.

7. Which statistics are used for calculations of strengths of optical fibers? a) Edwin statistics

1. Newton statistics
2. Wei-bull statistics
3. Gamma statistics View Answer

Answer: c

Explanation: Calculations of strengths are conducted using Wei-bull statistics in case of optical fibers. It describes the strength behavior of a system that is dependent on the weakest link of the system. The Wei-bull statistics gives the probability of failure of the optical fiber at a given strength.

8. What does n denotes in the equation given below, if vc is the crack velocity; A is the constant for the fiber material and KI is the strength intensity factor?

vc = AKIn

1. Refractive index
2. Stress corrosion susceptibility
3. Strain
4. Young’s modulus View Answer

Answer: b

Explanation: The above equation allows estimation of the time to failure of a fiber under stress corrosion conditions. The constant n is called as stress corrosion susceptibility. It is typically in the range of 15 to 50 for a glass.



This set of Optical Communications Interview Questions and Answers for Experienced people focuses on “Stability of the Fiber Transmission Characteristics”.

1. \_\_\_\_\_\_\_\_\_\_\_\_ results from small lateral forces exerted on the fiber during the cabling process. a) Attenuation

1. Micro-bending
2. Dispersion
3. Stimulated Emission View Answer

Answer: b

Explanation: Optical fibers must be designed so that the transmission characteristics of the fiber are maintained after the cabling process. The main problem which occurs in the cabling process is the meandering of the axis of the fiber core on a microscopic scale within the cable form. This phenomenon is called as micro-bending.

2. Microscopic meandering of the fiber core axis that is micro-bending is caused due to

\_\_\_\_\_\_\_\_\_\_\_

1. Environmental effects
2. Rough edges of the fiber
3. Large diameter of core
4. Polarization View Answer

Answer: a

Explanation: Micro-bending can be generated at any stage during manufacturing process, cable installation process or during service. This is mainly due to environmental effects, mainly varying temperatures causing differential expansion or contraction.

3. How many forms of modal power distribution are considered? a) One

1. Two
2. Three
3. Four View Answer

Answer: b

Explanation: Two forms of modal power distribution are considered. The first form is seen when a fiber is excited by a diffuse Lambertian source, and is called as fully filled mode distribution. The second form occurs when, due to mode coupling and attenuation, the distribution of optical power becomes invariant with the distance of propagation along the fiber, and is called as steadystate mode distribution.

4. What does micro-bending losses depend on \_\_\_\_\_\_\_\_\_\_\_\_\_

1. Core material
2. Refractive index
3. Diameter
4. Mode and wavelength View Answer

Answer: d

Explanation: Micro-bending losses cause differential expansion or contraction. These losses are mode dependent. The number of modes is a function inverse to the wavelength of the transmitted light and thus micro-bending losses are wavelength dependent.

5. The fiber should be\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to avoid deterioration of the optical transmission characteristics resulting from mode-coupling-induced micro-bending. a) Free from irregular external pressure

1. Coupled with plastic
2. Large in diameter
3. Smooth and in a steady state View Answer

Answer: a

Explanation: Micro-bending losses results from environmental effects such as temperature variation. The irregular external pressure deteriorates the quality of transmission through the fiber. Thus, controlled coating and cabling of the fiber is essential in order to reduce the cabled fiber attenuation.

6. The diffusion of hydrogen into optical fiber affects the \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Transmission of optical light in the fiber
2. Spectral attenuation characteristics of the fiber
3. Core of the fiber
4. Cladding of the fiber View Answer

Answer: b

Explanation: The hydrogen absorption by an optical fiber increases optical fiber losses. It forms absorption peaks where the hydrogen diffuses into interstitial spaces in the glass. At high temperatures, these losses can increase and reduced if the hydrogen source is removed.

7. \_\_\_\_\_\_\_\_\_\_ can induce a considerable amount of attenuation in optical fibers. a) Micro-bending

1. Dispersion
2. Diffusion of hydrogen
3. Radiation Exposure View Answer

Answer: d

Explanation: The optical transmission characteristics of the fiber cables can be degraded by exposure to nuclear radiation. The nature of this attenuation depends upon fiber structures, optical intensity, wavelength, etc. The radiation-induced attenuation comprises both permanent and temporary components which makes the exposure irreversible and reversible respectively.

8. The radiation-induced attenuation can be reduced through photo-bleaching. a) True

b) False View Answer

Answer: a

Explanation: Photo-bleaching can be exploited to study the diffusion of molecules. It is used to remove the radiation exposure by quenching auto-fluorescence. It helps to increase signal-tonoise ratio of the fiber and thus reduces attenuation.

9. The losses due to hydrogen absorption and reaction with fiber deposits can be temporary. a) True

b) False View Answer

Answer: b

Explanation: Hydrogen absorption occurs in two mechanisms. First phenomenon affects silicabased glass fibers whereas the second one occurs when hydrogen reacts with the fiber deposits to give P-OH, Ge-OH absorption. These losses are permanent.

10. The losses caused due to hydrogen absorption mechanisms are in the range of \_\_\_\_\_\_\_\_\_\_\_ a) 20 dB/km to 25 dB/km

1. 10 dB/km to 15 dB/km
2. 25 dB/km to 50 dB/km
3. 0 dB/km to 5 dB/km View Answer

Answer: c

Explanation: The diffusion of hydrogen into optical fiber leads to an increase in optical fiber losses, causing damage to spectral loss characteristics. This phenomenon gets vibrant at higher temperatures. The losses caused due to such absorption are greater than 25 dB/km.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Cable Design”.

1. The cable must be designed such that the strain on the fiber in the cable does not exceed \_\_\_\_\_\_\_\_\_\_ a) 0.002%

1. 0.01%
2. 0.2%
3. 0.160% View Answer

Answer: c

Explanation: The constraints included in cable design are stability, protection, strength and jointing of the fibers. The fiber cable does not get affected if the strain exerted on it is below 0.2%. Although, it is suggested that the permanent strain on the fiber should be less than 0.1%.

2. How many categories exists in case of cable design?

1. Two
2. Three
3. One
4. Four View Answer

Answer: b

Explanation: Cable design is separated into three categories. They are fiber buffering, cable structural and strength and cable sheath and water barrier. After successfully going through these tests, an optical cable is designed.

3. How many types of buffer jackets are used in fiber buffering? a) Three

1. One
2. Two
3. Four View Answer

Answer: a

Explanation: The buffer jacket is designed to protect the fiber from micro-bending losses. There are three types of buffer jackets used in fiber buffering. They are tight buffer jackets, loose tube buffer jackets and filled loose tube buffer jacket.

4. Loose tube buffer jackets exhibits a low resistance to movement of the fiber. a) True

b) False View Answer

Answer: a

Explanation: Loose tube buffering is achieved by using a hard, smooth, flexible material in the form of extruded tube. The buffer tube is smooth from inside. Thus, it exhibits a low resistance to movement of the fiber. Also, it can be easily stripped for jointing or fiber termination.

5. An inclusion of one or more structural members in an optical fiber so as to serve as a cable core foundation around which the buffer fibers may be wrapped is called \_\_\_\_\_\_\_\_\_\_\_\_\_ a) Attenuation

1. Splicing
2. Buffering
3. Stranding View Answer

Answer: d

Explanation: Optical fiber is made structurally stronger by adding one or more strength members. The core fiber is trapped with buffered fibers or they are slotted in the core foundation. This approach is called as stranding.

6. Which of the following is not a strength member used in optical cable? a) Steel wire

1. Germanium
2. Aramid yarns
3. Glass elements View Answer

Answer: b

Explanation: Strength members or tensile members are added to the fiber to make it stronger and durable. These members include solid steel wire, dielectric aramid yarns (Kevlar), glass elements etc. Germanium is not a structural or strength member.

7. When the stranding approach consists of individual elements (e.g. single-fiber or multi fiber loose tube buffer) than the cable is termed as \_\_\_\_\_\_\_\_\_\_\_\_\_ a) Optical unit cable

1. Coaxial cable
2. Layer cable
3. Bare glass cable View Answer

Answer: c

Explanation: The stranding approach consists of a fiber core foundation around which the buffered fibers are wrapped. The cable elements are stranded in one, two or several layers around the central structural member. When the stranding is composed of individual elements, then the cable is termed as layer cable. If the cable core consists of stranding elements each of which comprises a unit of stranding elements, then it is termed as optical unit cable.

8. The primary function of the structural member is load bearing. a) True

b) False View Answer

Answer: b

Explanation: The primary function of the structural member is not load bearing. It’s function is to provide suitable accommodation for the fiber ribbons within the cables. These fiber ribbons lie in the helical grooves or slots formed in the surface of the structural members.

9. What is the Young’s modulus of Kevlar, an aromatic polyester?

1. 9 ×1010Nm-2
2. 10 ×1010Nm-2
3. 12 ×1010Nm-2
4. 13 ×1010Nm-2 View Answer

Answer: d

Explanation: Kevlar is used as a strength member in an optical fiber. The Young’s modulus of Kevlar is very high which gives it strength to weight ratio advantage four times that of steel. Kevlar is coated with extruded plastic to provide a smooth surface which in turn prevents microbending losses.

10. The cable is normally covered with an outer plastic sheath to reduce \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) Abrasion

1. Armor
2. Friction
3. Dispersion View Answer

Answer: a

Explanation: Abrasion is the process of scraping or wearing something away. If the cable is not coated with plastic sheath, it gives rise to effects such as abrasion and crushing. The most common plastic sheath material used in covering a cable is polyethylene (PE).



**4. Questions on Optical Fiber Connections : Joints, Couplers and Isolators**

The section contains questions on fiber alignment and splices, fiber and beam connectors, fiber couplers, optical isolators and circulators.

This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Fiber Alignment and Joint Loss”.

1. A measure of amount of optical fiber emitted from source that can be coupled into a fiber is termed as \_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) Radiance

1. Angular power distribution
2. Coupling efficiency
3. Power-launching View Answer

Answer: c

Explanation: Coupling efficiency depends upon the type of fiber attached to the source which should consider the parameters such as numerical aperture, core size, R.I. profile, radiance, corecladding index difference. All these parameters relate to the performance of the fibers determined by power coupled into the fiber to power emitted by the source. This is called coupling efficiency ηwhich is given by η = PF/Ps

Where PF = power coupled into the fiber Ps = power emitted by the source.

2. The ratio r = (n1 – n)/(n1 – n) indicates \_\_\_\_\_\_\_\_\_\_\_\_

1. Fresnel reflection
2. Reflection coefficient
3. Refraction coefficient
4. Angular power distribution coefficient View Answer

Answer: b

Explanation: The ratio, r = (n1-n)/(n1-n) is known as Reflection coefficient. It relates the amplitude of the reflected ray to the amplitude of the incident wave.

3. A GaAs optical source having a refractive index of 3.2 is coupled to a silica fiber having a refractive index of 1.42. Determine Fresnel reflection at interface in terms of percentage. a) 13.4%

1. 17.4%
2. 17.6%
3. 14.8% View Answer

Answer: d

Explanation: If the fiber end and the source are in close physical contact, the reflection is given by r = ((n1-n)/(n1-n))2

Multiplying r by 100, we get the value of r in terms of percentage.

4. A particular GaAs fiber has a Fresnel reflection magnitude of 17.6% i.e. 0.176. Find the power loss between the source and the fiber? a) 0.86 dB

1. 0.78 dB
2. 0.84 dB
3. 0.83 dB View Answer

Answer: c

Explanation: The optical losses in decibels at the joint is given by

Loss = -10log10(1-r)

Where L = loss due to Fresnel reflection R = magnitude of Fresnel reflection.

5. Two joined step index fibers are perfectly aligned. What is the coupling loss of numerical aperture are NAR= 0.26 for emitting fiber? a) -0.828 dB

1. -0.010 dB
2. -0.32 dB
3. 0.32 dB View Answer

Answer: b

Explanation: Coupling loss for two joined step index fibers is given by

LF(NA) = -10 log (NAR/NAE)2

Where LF = coupling loss

NAR = Numerical aperture of receiving fiber NAE = Numerical aperture of emitting fiber.

6. Two joined graded index fibers that are perfectly aligned have refractive indices αR = 1.93 for receiving fiber αE = 2.15 for emitting fiber. Calculate the coupling loss. a) 0.23 dB

1. 0.16 dB
2. 0.82 dB
3. 0.76 dB View Answer

Answer: a

Explanation: Coupling loss for two joined and perfectly aligned graded index fiber is given by

LF(α) = -10log10αR(αE+2)/αE(αR+2) Where LF(α) = Coupling loss αR = refractive index of receiving fiber αE = refractive index of emitting fiber.

7. How many types of misalignments occur when joining compatible fiber? a) One

1. Two
2. Five
3. Three View Answer

Answer: d

Explanation: There are three layers of fiber misalignments and they are: Longitudinal, lateral and angular misalignments.

8. Losses caused by factors such as core-cladding diameter, numerical aperture, relative refractive index differences, different refractive index profiles, fiber faults are known as

\_\_\_\_\_\_\_\_\_\_\_\_

1. Intrinsic joint losses
2. Extrinsic losses
3. Insertion losses
4. Coupling losses View Answer

Answer: a

Explanation: There are inherent connection problems while joining fibers. These connection problem cause different losses in the fibers and are called as Intrinsic joint losses.

9. A step index fiber has a coupling efficiency of 0.906 with uniform illumination of all propagation modes. Find the insertion loss due to lateral misalignment? a) 0.95 dB

1. 0.40 dB
2. 0.42 dB
3. 0.62 dB View Answer

Answer: c

Explanation: The insertion loss due to lateral misalignment is given by

Loss10t = -10log10t η10t

Where, Loss10t = insertion loss due to lateral misalignment η10t = Coupling efficiency.

10. A graded index fiber has a parabolic refractive index profile (α=2) and core diameter of 42μm. Estimate an insertion loss due to a 2 μm lateral misalignment when there is index matching and assuming there is uniform illumination of all guided modes only. a) 0.180

1. 0.106
2. 0.280
3. 0.080 View Answer

Answer: d

Explanation: The misalignment loss (assuming there is uniform illumination of all guided modes) is given by

Lt = 0.85(y/a)

Where y = lateral misalignment a = core radius.

11. Determine coupling efficiency if the misalignment loss in a graded index fiber is 0.102. a) 0.136

1. 0.898
2. 0.982
3. 0.684 View Answer

Answer: b

Explanation: If the misalignment loss is known, the coupling efficiency is defined by η = 1-Lt

Where η = coupling efficiency Lt = misalignment loss.

12. In a single mode fiber, the losses due to lateral offset and angular misalignment are given by 0.20 dB and 0.46 dB respectively. Find the total insertion loss.

1. 0.66 dB
2. 0.26 dB
3. 0.38 dB
4. 0.40 dB View Answer

Answer: a

Explanation: The total insertion loss in a single mode fiber is given by

TT = TL + Ta

Where, TT = total insertion loss

TL = lateral offset loss

Ta = Angular misalignment loss.

13. The intrinsic loss through a multimode fiber joint is independent of direction of propagation. a) True

b) False View Answer

Answer: b

Explanation: Intrinsic loss is defined as the summation of lateral offset loss and angular misalignment loss. In case of multimode fibers, the intrinsic loss is dependent on the refractive index gradient. The intrinsic loss through a single mode fiber joint is independent of direction of propagation.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Fiber Splices”.

1. A permanent joint formed between two different optical fibers in the field is known as a \_\_\_\_\_\_\_\_\_\_\_\_

1. Fiber splice
2. Fiber connector
3. Fiber attenuator
4. Fiber dispersion View Answer

Answer: a

Explanation: The jointing of two individual fibers is called as fiber splicing. It is used to establish long-haul optical fiber links by joining two small length fibers.

2. How many types of fiber splices are available?

1. One
2. Two
3. Three
4. Four View Answer

Answer: b

Explanation: Splices are divided into two types depending upon the splicing technique used. These are fusion splicing (welding) and mechanical splicing.

3. The insertion losses of the fiber splices are much less than the Fresnel reflection loss at a butted fiber joint. a) True

b) False View Answer

Answer: a

Explanation: The Fresnel reflection loss is usually more because there is no large step change in refractive index with the fusion splice as it forms a continuous fiber connection. Also, some method of index matching tends to be utilized with mechanical splices.

4. What is the main requirement with the fibers that are intended for splicing?

1. Smooth and oval end faces
2. Smooth and square end faces
3. Rough edge faces
4. Large core diameter View Answer

Answer: b

Explanation: A curved mandrel is used which cleaves the fiber to achieve end preparation. The edges must be smooth and have square face at the end for splicing purpose.

5. In score and break process, which of the following is not used as a cutting tool? a) Diamond

1. Sapphire
2. Tungsten carbide
3. Copper View Answer

Answer: d

Explanation: The score and break process is also called as scribe and break. It involves the scribing of the fiber surface under tension with a cutting tool. Copper is not used as a cutting tool.

6. The heating of the two prepared fiber ends to their fusing point with the application of required axial pressure between the two optical fibers is called as \_\_\_\_\_\_\_\_\_\_\_\_ a) Mechanical splicing

1. Fusion splicing
2. Melting
3. Diffusion

View Answer

7. Which of the following is not used as a flame heating source in fusion splicing? a) Microprocessor torches

1. Ox hydric burners
2. Electric arc
3. Gas burner View Answer

Answer: d

Explanation: Micro-plasma torches uses argon and hydrogen and alcohol vapor. The most widely used heating source is an electric arc. Thus, gas burner is not used in fusion splicing.

8. The rounding of the fiber ends with a low energy discharge before pressing the fibers together and fusing with a stronger arc is called as \_\_\_\_\_\_\_\_\_\_\_\_ a) Pre-fusion

1. Diffusion
2. Crystallization
3. Alignment View Answer

Answer: a

Explanation: Pre-fusion involves rounding of fiber ends. It removes the requirement for fiber end preparation which has a distinct advantage in the field environment. It is utilized with multimode fibers giving average splice losses of 0.09dB.

9. \_\_\_\_\_\_\_\_\_\_\_\_\_ is caused by surface tension effects between the two fiber ends during fusing. a) Pre-fusion

1. Diffusion
2. Self-alignment
3. Splicing View Answer

Answer: c

Explanation: The two fiber ends are close but not aligned before fusion. During fusion, the surface tension affects the fiber ends to get aligned. After fusion, they are aligned in such a way that a transmission medium can get a good continuity.

10. Average insertion losses as low as \_\_\_\_\_\_\_\_\_ have been obtained with multimode graded index and single-mode fibers using ceramic capillaries. a) 0.1 dB

1. 0.5 dB
2. 0.02 dB
3. 0.3 dB View Answer

Answer: a

Explanation: Mechanical techniques for splicing involve the use of an accurately produced rigid tube in which fiber ends are permanently bonded. It utilizes a ceramic capillary in which an epoxy resin is injected through a transverse bore to provide mechanical sealing and index matching. This technique which uses ceramic capillaries provides insertion losses as low as 0.1dB.

11. \_\_\_\_\_\_\_\_\_\_\_\_\_ are formed by sandwiching the butted fiber ends between a V-groove glass substrate and a flat glass retainer plate. a) Springroove splices

1. V-groove splices
2. Elastic splices
3. Fusion splices View Answer

Answer: b

Explanation: In V-groove splices, a V-groove glass substrate is used with a flat glass plate. The name V-groove suggests that the fiber ends are spliced in a V-shape. These splices provide losses as low as 0.01dB.

12. Mean splice insertion losses of 0.05 dB are obtained using multimode graded index fibers with the Springroove splice. a) True

b) False View Answer

Answer: a

Explanation: Springroove utilizes a bracket containing two cylindrical pins which act as alignment guide for two fiber ends. An elastic element is used to press the fibers into a groove. The assembly is secured with a drop of epoxy resin. It provides a loss of 0.05 dB and has found a practical use in Italy.

13. Alignment accuracy of the order \_\_\_\_\_\_\_\_\_\_\_ is obtained using the three glass rod alignment sleeve. a) 0.23 μm

1. 0.15 μm
2. 0.05 μm
3. 0.01 μm View Answer

Answer: c

Explanation: Alignment accuracies as high as 0.05 μmare necessary to obtain low losses. The mode-field diameter for single-mode fiber is in the range 8 to 10μm. The three glass rod alignment provides higher accuracies than rotary splice sleeve.

14. In case of multiple fusion, splice losses using an electric arc fusion device with multimode graded index fiber range from \_\_\_\_\_\_\_\_\_\_\_\_ a) 0.01 to 0.04 dB

1. 0.19 to 0.25 dB
2. 0.12 to 0.15 dB
3. 0.04 to 0.12 dB View Answer

Answer: d

Explanation: In multiple fusions, an electric arc fusing device allows splicing of 12 fibers simultaneously. It takes a tool time of 6 minutes, which requires only 30 seconds per splice. The splice losses for single mode fiber are of 0.04 dB as maximum whereas for graded index fibers, losses are up to 0.12dB.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Fiber Connectors”.

1. Demountable fiber connectors are more difficult to achieve than optical fiber splices. a) True

b) False View Answer

Answer: a

Explanation: Fiber connectors must maintain tolerance requirements similar to splices in order to couple light efficiently between the fibers. Also, fiber connectors must accomplish this in a removable fashion. The connector design must allow repeated connection and disconnection without any problems of fiber alignment.

2. What is the use of an index-matching material in the connector between the two jointed fibers?

1. To decrease the light transmission through the connection
2. To increase the light transmission through the connection
3. To induce losses in the fiber
4. To make a fiber dispersive View Answer

Answer: b

Explanation: The index-matching material used might be epoxy resin. It increases the light transmission through the connection while keeping dust and dirt from between the fibers. It also provides optimum optical coupling.

3. How many categories of fiber connectors exist?

1. One
2. Three
3. Two
4. Four View Answer

Answer: c

Explanation: Fiber connectors are separated into two broad categories. They are butt-jointed connectors and expanded beam connectors. Butt-jointed connectors rely upon alignment of the two fiber ends butted to each other whereas expanded beam connectors uses interposed optics at the joint.

4. The basic ferrule connector is also called as \_\_\_\_\_\_\_\_\_\_\_\_\_

1. Groove connector
2. Beam connector
3. Multimode connector
4. Concentric sleeve connector View Answer

Answer: d

Explanation: The basic ferrule connector is the simplest connector. The ferrules are placed in an alignment sleeve within the connector. The alignment sleeve is concentric which allows the fiber ends to be butt-jointed.

5. What is the use of watch jewel in cylindrical ferrule connector?

1. To obtain the diameter and tolerance requirements of the ferrule
2. For polishing purposes
3. Cleaving the fiber
4. To disperse a fiber View Answer

Answer: a

Explanation: Ferrule connectors have a watch jewel in the ferrule end face. It is used instead of drilling of the metallic ferrule end face which takes time. It is used to obtain close diameter and tolerance requirements of the ferrule end face whole easily.

6. The concentricity errors between the fiber core and the outside diameter of the jeweled ferrule are in the range of \_\_\_\_\_\_\_\_\_\_\_ with multimode step-index fibers. a) 1 to 3μm

1. 2 to 6μm
2. 7 to 10μm
3. 12 to 20μm View Answer

Answer: b

Explanation: The fiber alignment accuracy of the basic ferrule connector is dependent on the ferrule hole into which the fiber is inserted. The concentricity errors in the range of 2 to 6μm gives insertion losses in the range 1 to 2dB with multimode step index fibers.

7. The typical average losses for multimode graded index fiber and single mode fiber with the precision ceramic ferrule connector are \_\_\_\_\_\_\_\_\_\_\_\_\_ respectively. a) 0.3 and 0.5 dB

1. 0.2 and 0.3 dB
2. 0.1 and 0.2 dB
3. 0.4 and 0.7 dB View Answer

Answer: b

Explanation: Unlike metal and plastic components, the ceramic ferrule material is harder than the optical fiber. Thus, it is unaffected by grinding and polishing process. This factor enables to provide the low-loss connectors which have low losses as low as 0.2 and 0.3 dB in case of optical fibers.

8. Bi-conical ferrule connectors are less advantageous than cylindrical ferrule connectors. a) FalseStat

b) True View Answer

Answer: a

Explanation: Cylindrical and bi-conical ferrule connectors are assembled in housings to form a multi-fiber configuration. The force needed to insert multiple cylindrical ferrules can be large when multiple ferrules are involved. The multiple bi-conical ferrule connectors are more advantageous as they require less insertion force.

9. In connectors, the fiber ends are separated by some gap. This gap ranges from \_\_\_\_\_\_\_\_\_\_\_\_ a) 0.040 to 0.045 mm

1. 0.025 to 0.10 mm
2. 0.12 to 0.16 mm
3. 0.030 to 0.2mm View Answer

Answer: b

Explanation: In connectors, gaps are introduced to prevent them from rubbing against each other and becoming damaged during connector fixing/engagement. The gap ranges from 0.025 to 0.10 mm so as to reduce the losses below 8dB for a particular diameter fiber say 50μm



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Expanded Beam Connectors”.

1. What is the use of interposed optics in expanded beam connectors?

1. To achieve lateral alignment less critical than a butt-joined fiber connector
2. To make a fiber loss free
3. To make a fiber dispersive
4. For index-matching View Answer

Answer: a

Explanation: Expanded beam connector utilize interposed optics at the joint in order to expand the beam from transmitting fiber end before reducing it to a size compatible with the receiving fiber end. It helps to achieve lateral alignment less critical than a butt-jointed connector. Also, the longitudinal separation is critical in expanded beam connectors.

2. The expanded beam connectors use \_\_\_\_\_\_\_\_\_\_\_\_ for beam expansion and reduction. a) Square micro-lens

1. Oval micro-lens
2. Spherical micro-lens
3. Rectangular micro-lens View Answer

Answer: c

Explanation: Expanded beam connectors use the principle of transmission of digital data to the receiver. It uses spherical micro-lens to first expand the beam from the transmitting end and reduces the beam at the receiving end.

3. Lens-coupled expanded beam connectors exhibit average losses of \_\_\_\_\_\_\_\_\_ in case of single mode and graded index fibers. a) 0.3 dB

1. 0.7 dB
2. 0.2 dB
3. 1.5 dB

View Answer

Answer: b

Explanation: Lens-coupled expanded beam connectors use spherical micro-lenses. The average losses are in the range of 1dB. With the antireflection coating on the lenses, the losses are reduced to 0.7 dB in case of single mode fibers.

4. Sapphire ball lens expanded beam design is successful than spherical lens coupled design. a) True

b) False View Answer

Answer: a

Explanation: Spherical lens coupled design exhibits losses in the range 0.7 dB to 1dB. Sapphire ball lens expanded beam design achieved successful single mode fiber connection with losses as low as 0.4dB.

5. The fiber is positioned at the \_\_\_\_\_\_\_\_ of the lens in order to obtain a collimated beam and to minimize lens-to-lens longitudinal misalignment effects. a) Aperture

1. Focal length
2. Curve
3. Exterior circumference View Answer

Answer: b

Explanation: The expanded beam connector also uses a molded spherical lens. A lens alignment sleeve is used to minimize the effects of angular misalignment. The fiber is positioned at the focal length of the lens to achieve losses as low as 0.7dB.

6. \_\_\_\_\_\_\_\_\_\_\_ exhibits a parabolic refractive index profile with a maximum at the axis similar to graded index fiber.

1. Lens coupled design
2. Sapphire ball lens
3. Spherical micro-lens
4. GRIN-rod lens View Answer

Answer: d

Explanation: GRIN-rod lens geometry has a parabolic refractive index profile. It facilitates efficient beam expansion and collimation within expanded beam connectors. It finds its applications in fiber couplers and source-to-fiber coupling.

7. The GRIN-rod lens can produce a collimated output beam with a divergent angle αof between \_\_\_\_\_\_\_\_\_\_\_\_\_ from a light source situated on, or near to, the opposite lens face. a) 1 to 5 degrees

1. 9 to 16 degrees
2. 4 to 8 degrees
3. 25 to 50 degrees View Answer

Answer: a

Explanation: GRIN-rod lens comprises of a cylindrical glass rod typically 0.2 to 2 mm in diameter. It exhibits a parabolic refractive index profile. It facilitates efficient beam expansion and collimation with an angle in the range 1 to 5 degrees.

8. In the given equation, if r is the radial distance, n is the refractive index; what does z stands for?

dr2/dz2 = (1/n) (d n/dr)

1. Focal length
2. Distance along the optical axis
3. Axial angle
4. Diameter View Answer

Answer: b

Explanation: The above equation is known as paraxial ray equation which governs the ray propagation through the GRIN-rod lens. GRIN-rod lens geometry is parabolic in nature. Thus z is the distance along the optical axis of a parabolic profile.

9. The majority of the GRIN-rod lenses have diameters in the range of \_\_\_\_\_\_\_\_\_\_\_\_ a) 2 to 2.5 mm

1. 3 to 4 mm
2. 0.1 to 0.4 mm
3. 0.5 to 2 mm

View Answer

Answer: d

Explanation: The GRIN-rod lenses performance directly depends on the radial distance. The diameters in the range of 0.5 to 2 mm may be employed with either single mode or multimode fibers. They are available with numerical apertures of 0.37, 0.46 and 0.6.

10. Which of the following factors does not cause divergence of the collimated beam from a GRIN-rod lens?

1. Lens cut length
2. Size of fiber core
3. Refractive index profile
4. Chromatic aberration

View Answer

Answer: c

Explanation: Various factors contribute to the divergence of the collimated beam from a GRIN-rod lens. Error in lens cut length, finite size of the fiber core and chromatic aberration are the factors that cause divergence.

11. GRIN-rod lens connectors have loss characteristics that are independent of the modal power distribution in the fiber. a) True

b) False

View Answer

Answer: a

Explanation: GRIN-rod lens geometry is analogous to butt-jointed multimode fiber

connectors. The loss characteristics of butt-jointed connectors are dependent on modal power distribution in the fiber



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Fiber Couplers”.

1. When considering source-to-fiber coupling efficiencies, the \_\_\_\_\_\_\_\_ is an important parameter than total output power. a) Numerical aperture

1. Radiance of an optical source
2. Coupling efficiency
3. Angular power distribution View Answer

Answer: b

Explanation: Radiance is the optical power radiated into a unit solid angle per unit emitting surface area. Since this optical power is dependent on radiance, radiance is much important factor than optical power.

2. It is a device that distributes light from a main fiber into one or more branch fibers. a) Optical fiber coupler

1. Optical fiber splice
2. Optical fiber connector
3. Optical isolator View Answer

Answer: a

Explanation: Nowadays, requirements to divide combined optical signals for applications are increasing. Optical fiber coupler is one such device that is used for dividing and combining optical signals. It is generally used in LANs, computer networks etc.

3. Optical fiber couplers are also called as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) Isolators

1. Circulators
2. Directional couplers
3. Attenuators View Answer

Answer: c

Explanation: Optical fiber couplers are passive devices. The power transfer in couplers takes place either through the fiber core cross-section by butt jointing the fibers or by using some form of imaging optics between the fibers. It distributes light from one fiber to many fibers and hence it is also called as a directional coupler.

4. How many types of multiport optical fiber couplers are available at present? a) Two

1. One
2. Four
3. Three View Answer

Answer: d

Explanation: Multiport optical fiber couplers are subdivided into three types. These are three and four port couplers, star couplers and wavelength division multiplexing (WDM) couplers. These couplers distribute light among the branch fibers with no scattering loss.

5. The optical power coupled from one fiber to another is limited by \_\_\_\_\_\_\_\_\_\_\_\_

1. Numerical apertures of fibers
2. Varying refractive index of fibers
3. Angular power distribution at source
4. Number of modes propagating in each fiber View Answer

Answer: d

Explanation: When two fibers are coupled to each other, the optical power is limited by number of modes propagating in each fiber. For example, when a fiber propagating with 500 modes is connected to a fiber that propagates only 400 modes, then at maximum, only 80% of power is coupled into the other fiber.

6. \_\_\_\_\_\_\_\_ couplers combine the different wavelength optical signal onto the fiber or separate the different wavelength optical signal output from the fiber. a) 3-port

1. 2\*2-star
2. WDM
3. Directional

View Answer

Answer: c

Explanation: WDM coupler is abbreviated as wavelength division multiplexing coupler. It is a category of multiport optical fiber couplers. It is designed to permit a number of different peak wavelength optical signals to be transmitted in parallel on a single fiber.

7. How many fabrication techniques are used for 3 port fiber couplers? a) One

1. Two
2. Three
3. Four View Answer

Answer: b

Explanation: There are two fabrication techniques available for three port couplers. First is a lateral offset method which relies on the overlapping of the fiber end faces and the other is the semi-transparent mirror method. Using these techniques, three port couplers with both multimode and single-mode fibers can be fabricated.

8. Which is the most common method for manufacturing couplers?

1. Wavelength division multiplexing
2. Lateral offset method
3. Semitransparent mirror method
4. Fused bi-conical taper (FBT) technique View Answer

Answer: d

Explanation: The FBT technique is basic and simple. In this technique, the fibers are generally twisted together and then spot fused under tension such that the fused section is elongated to form a bi-conical taper structure. A three port coupler can be obtained by removing one of the input fibers.

9. Couplers insertion loss is same as that of excess loss.

1. True
2. False View Answer

Answer: b

Explanation: Excess loss is defined as the ratio of input power to output power. The insertion loss is defined as the loss obtained for a particular port-to-port optical path. Thus, the insertion loss and excess loss are different in nature.

10. A four-port multimode fiber FBT coupler has 50 μW optical power launched into port 1. The measured output power at ports 2,3 and 4 are 0.003, 23.0 and 24.5 μW respectively. Determine the excess loss. a) 0.22 dB

1. 0.33 dB
2. 0.45 dB
3. 0.12 dB View Answer

Answer: a

Explanation: Excess loss is a ratio of power input to power output of the fiber and it is given by

Excess loss = 10log10 P1/(P3+P4)

WhereP1, P3, P4 = output power at ports 1,3 and 4 resp.

11. A four-port FBT coupler has 60μW optical power launched into port one. The output powers at ports 2, 3, 4 are 0.0025, 18, and 22 μW respectively. Find the split ratio? a) 42%

1. 46%
2. 52%
3. 45% View Answer

Answer: d

Explanation: Split ratio indicates the percentage division of optical power between the outputs ports. It is given by

Split ratio = [P3/(P3+P4)]\*100%

Where P3 and P4 are output powers at ports 3 and 4 respectively.

12. How many manufacturing methods are used for producing multimode fiber star couplers? a) Two

1. One
2. Three
3. Five View Answer

Answer: a

Explanation: The manufacturing methods of star couplers are mixer-rod technique and FBT technique. In the mixer-rod method, a thin platelet of glass is employed, which mixes light from one fiber, dividing it among the outgoing fibers. FBT method involves twisting, heating and pulling of fiber.

13. Calculate the splitting loss if a 30×30 port multimode fiber star coupler has 1 mW of optical power launched into an input port. a) 13 dB

1. 15 dB
2. 14.77 dB
3. 16.02 dB View Answer

Answer: c

Explanation: The splitting loss is related to the number of output ports N of a coupler. It is given by-

Splitting loss (Star coupler) = 10log10N (dB).

14. A \_\_\_\_\_\_\_\_\_\_\_\_\_ coupler comprises a number of cascaded stages, each incorporating three or four-port FBT couplers to obtain a multiport output. a) Star

1. Ladder
2. WDM
3. Three-port View Answer

Answer: a

Explanation: A star coupler can be realized by constructing a ladder coupler. It consists of many cascaded stages. If a three-port coupler is used, then a ladder coupler does not form symmetrical star coupler. It is a useful device to achieve a multiport output with low insertion loss.

15. A number of three-port single-mode fiber couplers are used in the fabrication of a ladder coupler with 16 output ports. The three-port couplers each have an excess loss of 0.2 dB along with a splice loss of 0.1 dB at the interconnection of each stage. Determine the excess loss. a) 1.9 dB

1. 1.4 dB
2. 0.9 dB
3. 1.1 dB View Answer

Answer: d

Explanation: The number of stages M within the ladder design is given by 2M=16. Hence M=4.

Thus, excess loss is given by-

Excess loss = (M×loss in each 3-port coupler) + (Number of splices×Loss in each stage) Where number of splices = 3 (as the value of M is equal to 4)



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Optical Isolators and Circulators”.

1. An FBG is developed within a fiber core having a refractive index of 1.30. Find the grating period for it to reflect an optical signal with a wavelength of 1.33μm. a) 0.51 μm

1. 0.58 μm
2. 0.61 μm
3. 0.49 μm View Answer

Answer: a

Explanation: The grating period is denoted by Λ. It is given by- Λ = λB/ 2n

Where λB = wavelength n = refractive index.

2. It is a passive device which allows the flow of optical signal power in only one direction and preventing reflections in the backward direction. a) Fiber slice

1. Optical fiber connector
2. Optical isolator
3. Optical coupler View Answer

Answer: c

Explanation: Ideally, an optical isolator transmits the signal power in the desired forward direction. Material imperfections in the isolator medium generate backward reflections. Optical isolators can be implemented by using FBG.

3. Which feature of an optical isolator makes it attractive to use with optical amplifier? a) Low loss

1. Wavelength blocking
2. Low refractive index
3. Attenuation View Answer

Answer: b

Explanation: Optical isolators are made using FBGs. Since FBGs are wavelength dependent, the optical isolators can be designed to allow or block the optical signal at particular wavelength. The wavelength blocking feature makes the optical isolator a very attractive device for use with optical amplifier in order to protect them from backward reflections.

4. Magneto-optic devices can be used to function as isolators. a) True

b) False View Answer

Answer: a

Explanation: Magneto-optic devices use the principle of Faraday rotation. It relates the TM mode characteristics and polarization state of an optical signal with its direction of propagation. The rotation of polarization plane is proportional to the intensity of component of magnetic field in the direction of optical signal. Therefore, it is possible to block and divert an optical signal using magnetic properties which is a function of an isolator.

5. How many implementation methods are available for optical isolators? a) One

1. Four
2. Two
3. Three View Answer

Answer: d

Explanation: Optical isolators can be implemented using three techniques. These are as follows:

-By using FBGs

-By using magnetic oxide materials

-By using semiconductor optical amplifiers (SOAs).

6. A device which is made of isolators and follows a closed loop path is called as a \_\_\_\_\_\_\_\_\_\_\_\_

1. Circulator
2. Gyrator
3. Attenuator
4. Connector View Answer

Answer: a

Explanation: Isolator can be connected together to form multiport devices. A circulator is formed from isolators connected together to form a closed circular path. In circulator, the signal continues to travel in closed loop and does not get discarded unlike isolator.

7. The commercially available circulators exhibit insertion losses around \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) 2 dB

1. 0.7 dB
2. 0.2 dB
3. 1 dB View Answer

Answer: d

Explanation: A number of isolators can be used to implement a circulator. However, as the number of ports increases, the device complexity increases. Hence, three-or four-port circulators are used for optical interconnection with insertion losses around 1 dB and high isolation in the range of 40-50dB.

8. A combination of a FBG and optical isolators can be used to produce non-blocking optical wavelength division add/draw multiplexers. a) True

b) False View Answer

Answer: b

Explanation: Optical wavelength divisions add/draw multiplexers can be produced by a combination of a FBG and a circulator. Non-blocking NXM optical wavelengths divisions add/draw multiplexer is produced where N and M denotes the number of wavelength channels and add/drop channels.



**Multiple Choice Questions**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**BE (2015)Pattern**

**404190 Broadband Communication Systems )**

**Topic : Fibre Optic Communication**

**UNIT II Light wave Systems**

**5. Questions & Answers on Optical Sources : The Laser and Light – Emitting Diode**

The section contains questions on optical sources basics, semiconductor injection laser, injection laser structures and characteristics, non semiconductor lasers, tunable and infrared lasers, led power, led structures and characteristics.

This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Optical Sources : Laser Basics”.

1. A device which converts electrical energy in the form of a current into optical energy is called as \_\_\_\_\_\_\_\_\_\_\_

1. Optical source
2. Optical coupler
3. Optical isolator
4. Circulator

View Answer

Answer: a

Explanation: An Optical source is an active component in an optical fiber communication system. It converts electrical energy into optical energy and allows the light output to be efficiently coupled into the Optical fiber.

2. How many types of sources of optical light are available?

a) One

# b) Two

# Three

d) Four

# View Answer

Answer: c

Explanation: Three main types of optical light sources are available. These are wideband sources, monochromatic incoherent sources. Ideally the optical source should be linear.

3. The frequency of the absorbed or emitted radiation is related to difference in energy E between the higher energy state E2 and the lower energy state E1. State what h stands for in the given equation?

E = E2 - E1 = hf

1. Gravitation constant
2. Planck’s constant
3. Permittivity
4. Attenuation constant View Answer

Answer: b

Explanation: In the given equation, difference in the energy E is directly proportional to the absorbed frequency (f) where h is used as a constant and is called as Planck’s constant. The value of h is measured in Joules/sec & is given by- h = 6.626×10-34Js.

4. The radiation emission process (emission of a proton at frequency) can occur in \_\_\_\_\_\_\_\_\_\_ ways.

1. Two
2. Three
3. Four
4. One View Answer

Answer: a

Explanation: The emission process can occur in two ways. First is by spontaneous emission in which the atom returns to the lower energy state in a random manner. Second is by stimulated emission where the energy of a photon is equal to the energy difference and it interacts with the atom in the upper state causing it to return to the lower state along with the creation of a new photon.

5. Which process gives the laser its special properties as an optical source? a) Dispersion

1. Stimulated absorption
2. Spontaneous emission
3. Stimulated emission View Answer

Answer: d

Explanation: In Stimulated emission, the photon produced is of the same energy to the one which cause it. Hence, the light associated with stimulated photon is in phase and has same polarization. Therefore, in contrast to spontaneous emission, coherent radiation is obtained. The coherent radiation phenomenon in laser provides amplification thereby making laser a better optical source than LED.

6. An incandescent lamp is operating at a temperature of 1000K at an operating frequency of 5.2×1014 Hz. Calculate the ratio of stimulated emission rate to spontaneous emission rate. a) 3×10-13

1. 1.47×10-11
2. 2×10-12
3. 1.5×10-13 View Answer

Answer: b

Explanation: The ratio of the stimulated emission rate to the spontaneous emission rate is given by-

Stimulated emission rate/ Spontaneous emission rate = 1/exp (hf/KT)-1.

7. The lower energy level contains more atoms than upper level under the conditions of

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Isothermal packaging
2. Population inversion
3. Thermal equilibrium
4. Pumping View Answer Answer: c

Explanation: Under the conditions of thermal equilibrium, the lower energy level contains more atoms than the upper level. To achieve optical amplification, it is required to create a nonequilibrium distribution such that the population of upper energy level is more than the lower energy level. This process of excitation of atoms into the upper level is achieved by using an external energy source and is called as pumping.

8. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the laser occurs when photon colliding with an excited atom causes the stimulated emission of a second photon. a) Light amplification

1. Attenuation
2. Dispersion
3. Population inversion View Answer

Answer: a

Explanation: Laser emits coherent radiation of one or more discrete wavelength. Lasers produce coherent light through a process called stimulated emission. Light amplification is obtained through stimulated emission. Continuation of this process creates avalanche multiplication.

9. A ruby laser has a crystal of length 3 cm with a refractive index of 1.60, wavelength 0.43 μm. Determine the number of longitudinal modes. a) 1×102

1. 3×106
2. 2.9×105
3. 2.2×105 View Answer

Answer: d

Explanation: The number of longitudinal modes is given by- q = 2nL/λ Where

q = Number of longitudinal modes

n = Refractive index L = Length of the crystal λ = Peak emission wavelength.

10. A semiconductor laser crystal of length 5 cm, refractive index 1.8 is used as an optical source. Determine the frequency separation of the modes. a) 2.8 GHz

1. 1.2 GHz
2. 1.6 GHz
3. 2 GHz View Answer Answer: c

Explanation: The modes of laser are separated by a frequency internal δf and this separation is given by- δf = c/2nL Where

c = velocity of light n = Refractive index

L = Length of the crystal.

11. Doppler broadening is a homogeneous broadening mechanism. a) True

b) False View Answer

Answer: b

Explanation: Doppler broadening is a inhomogeneous broadening mechanism. In this broadening, the individual groups of atoms have different apparent resonance frequencies. Atomic collisions usually provide homogeneous broadening as each atom in collection has same resonant frequency and spectral spread.

12. An injection laser has active cavity losses of 25 cm-1 and the reflectivity of each laser facet is 30%. Determine the laser gain coefficient for the cavity it has a length of 500μm. a) 46 cm-1

1. 51 cm-1
2. 50 cm-1
3. 49.07 cm-1 View Answer

Answer: d

Explanation: The laser gain coefficient is equivalent to the threshold gain per unit length and is given by –

gth = α + 1/L ln (1/r)

Where

α = active cavity loss L = Length of the cavity r = reflectivity.

13. Longitudinal modes contribute only a single spot of light to the laser output. a) True

b) False View Answer

Answer: a

Explanation: Laser emission includes the longitudinal modes and transverse modes. Transverse modes give rise to a pattern of spots at the output. Longitudinal modes give only a spot of light to the output.

14. Considering the values given below, calculate the mode separation in terms of free space wavelength for a laser. (Frequency separation = 2GHz, Wavelength = 0.5 μm) a) 1.4×10-11

1. 1.6×10-12
2. 1×10-12
3. 6×10-11 View Answer

Answer: b

Explanation: The mode separation in terms of free space wavelength is given by- δλ = λ2/c δf

Where δf = frequency separation λ = wavelength c = velocity of light



This set of Optical Communications test focuses on “Optical Emission From Semiconductors”.

1. A perfect semiconductor crystal containing no impurities or lattice defects is called as

\_\_\_\_\_\_\_\_\_\_

1. Intrinsic semiconductor
2. Extrinsic semiconductor
3. Excitation
4. Valence electron View Answer

Answer: a

Explanation: An intrinsic semiconductor is usually un-doped. It is a pure semiconductor. The number of charge carriers is determined by the semiconductor material properties and not by the impurities.

2. The energy-level occupation for a semiconductor in thermal equilibrium is described by the

\_\_\_\_\_\_\_\_\_\_

1. Boltzmann distribution function
2. Probability distribution function
3. Fermi-Dirac distribution function
4. Cumulative distribution function View Answer

Answer: c

Explanation: For a semiconductor in thermal equilibrium, the probability P(E) that an electron gains sufficient thermal energy at an absolute temperature so as to occupy a particular energy level E, is given by the Fermi-Dirac distribution. It is given by-

P(E) = 1/(1+exp(E-EF/KT))

Where K = Boltzmann constant, T = absolute temperature, EF = Fermi energy level.

3. What is done to create an extrinsic semiconductor?

1. Refractive index is decreased
2. Doping the material with impurities
3. Increase the band-gap of the material
4. Stimulated emission View Answer

Answer: b

Explanation: An intrinsic semiconductor is a pure semiconductor. An extrinsic semiconductor is obtained by doping the material with impurity atoms. These impurity atoms create either free electrons or holes. Thus, extrinsic semiconductor is a doped semiconductor.

4. The majority of the carriers in a p-type semiconductor are \_\_\_\_\_\_\_\_\_\_ a) Holes

1. Electrons
2. Photons
3. Neutrons View Answer

Answer: a

Explanation: The impurities can be either donor impurities or acceptor impurities. When acceptor impurities are added, the excited electrons are raised from the valence band to the acceptor impurity levels leaving positive charge carriers in the valence band. Thus, p-type semiconductor is formed in which majority of the carriers are positive i.e. holes.

5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is used when the optical emission results from the application of electric field.

1. Radiation
2. Efficiency
3. Electro-luminescence
4. Magnetron oscillator View Answer

Answer: c

Explanation: Electro-luminescence is encouraged by selecting an appropriate semiconductor material. Direct band-gap semiconductors are used for this purpose. In band-to-band recombination, the energy is released with the creation of photon. This emission of light is known as electroluminescence.

6. In the given equation, what does p stands for?

p = 2πhk

1. Permittivity
2. Probability
3. Holes
4. Crystal momentum View Answer

Answer: d

Explanation: The given equation is a relation of crystal momentum and wave vector. In the given equation, h is the Planck’s constant, k is the wave vector and p is the crystal momentum.

7. The recombination in indirect band-gap semiconductors is slow. a) True

b) False View Answer

Answer: a

Explanation: In an indirect band-gap semiconductor, the maximum and minimum energies occur at different values of crystal momentum. However, three-particle recombination process is far less probable than the two-particle process exhibited by direct band-gap semiconductors. Hence, the recombination in an indirect band-gap semiconductor is relatively slow.

8. Calculate the radioactive minority carrier lifetime in gallium arsenide when the minority carriers are electrons injected into a p-type semiconductor region which has a hole concentration of 1018cm-3. The recombination coefficient for gallium arsenide is 7.21\*10-10cm3s-1. a) 2ns

1. 1.39ns
2. 1.56ns
3. 2.12ms View Answer

Answer: b

Explanation: The radioactive minority carrier lifetime ςrconsidering the p-type region is given by-

ςr = [BrN]-1 where Br = Recombination coefficient in cm3s-1 and N = carrier concentration in nregion.

9. Which impurity is added to gallium phosphide to make it an efficient light emitter? a) Silicon

1. Hydrogen
2. Nitrogen
3. Phosphorus View Answer

Answer: c

Explanation: An indirect band-gap semiconductor may be made into an electro-luminescent material by the addition of impurity centers which will convert it into a direct band-gap material. The introduction of nitrogen as an impurity into gallium phosphide makes it an effective emitter of light. Such conversion is only achieved in materials where the direct and indirect band-gaps have a small energy difference.

10. Population inversion is obtained at a p-n junction by \_\_\_\_\_\_\_\_\_\_

1. Heavy doping of p-type material
2. Heavy doping of n-type material
3. Light doping of p-type material
4. Heavy doping of both p-type and n-type material View Answer

Answer: d

Explanation: Population inversion at p-n junction is obtained by heavy doping of both p-type and n-type material. Heavy p-type doping with acceptor impurities causes a lowering of the Fermilevel between the filled and empty states into the valence band. Similarly n-type doping causes Fermi-level to enter the conduction band of the material.

11. A GaAs injection laser has a threshold current density of 2.5\*103Acm-2 and length and width of the cavity is 240μm and 110μm respectively. Find the threshold current for the device. a) 663 mA

1. 660 mA
2. 664 mA
3. 712 mA View Answer

Answer: b

Explanation: The threshold current is denoted by Ith. It is given by-

Ith = Jth \* area of the optical cavity Where Jth = threshold current density Area of the cavity = length and width.

1. A GaAs injection laser with an optical cavity has refractive index of 3.6. Calculate the reflectivity for normal incidence of the plane wave on the GaAs-air interface. a) 0.61

[b) 0 12](#_Toc129078)

[c) 0 32](#_Toc129079)

[d) 0View Answer 48](#_Toc129080)

Answer: c

Explanation: The reflectivity for normal incidence of the plane wave on the GaAs-air interface is given by- r = ((n-1)/(n+1))2 where r=reflectivity and n=refractive index.

1. A homo-junction is an interface between two adjoining single-crystal semiconductors with different band-gap energies.
2. True
3. False

View Answer

Answer: b

Explanation: The photo-emissive properties of a single p-n junction fabricated from a singlecrystal semiconductor material are called as homo-junction. A hetero-junction is an interface between two single-crystal semiconductors with different band-gap energies. The devices which are fabricated with hetero-junctions are said to have hetero-structure.

14. How many types of hetero-junctions are available?

1. Two
2. One
3. Three
4. Four View Answer

Answer: a

Explanation: Hetero-junctions are classified into an isotype and an-isotype. The isotype heterojunctions are also called as n-n or p-p junction. The an-isotype hetero-junctions are called as p-n junction with large band-gap energies.

15. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_ system is best developed and is used for fabricating both lasers and LEDs for the shorter wavelength region. a) InP

1. GaSb
2. GaAs/GaSb
3. GaAs/Alga AS DH View Answer

Answer: d

Explanation: For DH device fabrication, materials such as GaAs, Alga AS are used. The bandgap in this material may be tailored to span the entire wavelength band by changing the AlGa composition. Thus, GaAs/ Alga As DH system is used for fabrication of lasers and LEDs for shorter wavelength region (0.8μm-0.9μm).



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “The Semiconductor Injection Laser”.

1. Stimulated emission by recombination of injected carriers is encouraged in \_\_\_\_\_\_\_\_\_\_ a) Semiconductor injection laser

1. Gas laser
2. Chemist laser
3. Dye laser View Answer

Answer: a

Explanation: Stimulated emission by use of optical cavity in crystal structure is used in semiconductor injection diodes. This provides the feedback of protons which gives injection laser many important advantages over other sources like LED’s.

2. In semiconductor injection laser, narrow line bandwidth is of the order? a) 1 nm or less

1. 4 nm
2. 5 nm
3. 3 nm View Answer

Answer: a

Explanation: A narrow line bandwidth of order 1 nm or less is used. This narrow bandwidth is useful in minimizing the effects of material dispersion.

3. Injection laser have a high threshold current density of \_\_\_\_\_\_\_\_\_\_

1. 104Acm-2 and more
2. 102Acm-2
3. 10-2Acm-2
4. 10-3Acm-2 View Answer

Answer: a

Explanation: Injection laser have a high threshold current density of 104Acm-2due to lack of matter and in-efficient light sources. These high current densities are largely utilized in pulse mode in order to minimize junction and thus avert damage.

4. ηT is known as slope quantum efficiency.

1. True
2. False View Answer

Answer: b

Explanation: ηD is known as slope quantum efficiency. It gives a measure rate of optical output power change with current and thus it determines slope of output characteristics in the region. So, ηT is referred to as slope quantum efficiency.

5. The total efficiency of an injection laser with GaAs active region is 12%. The applied voltage is 3.6 V and band gap energy for GaAs is 2.34 eV. Determine external power efficiency. a) 7.8 %

1. 10 %
2. 12 %
3. 6 % View Answer

Answer: a

Explanation: The total external power efficiency is defined as η = ηT(Eq/V)\*100 = 0.12 (2.34/3.6) \*100 = 7.8 %.

6. In a DH laser, the sides of cavity are formed by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Cutting the edges of device
2. Roughening the edges of device
3. Softening the edges of device
4. Covering the sides with ceramics View Answer

Answer: b

Explanation: In a DH laser, the sides of cavity are formed by the roughening edges of the device. This is done so as to reduce the unwanted emission in these directions and limit the number of horizontal transversal modes.

7. A particular laser structure is designed so that the active region extends the edges of devices. a) True

b) False View Answer

Answer: a

Explanation: Laser structures are particularly designed so that the active region does not extend beyond the edges. This is done to reduce problems like difficult heat sinking, lasing from multiple filament in wide active areas, unsuitable light output geometry for efficient coupling and also to reduce required threshold current.

8. Gain guided laser structure are \_\_\_\_\_\_\_\_\_\_

1. Chemical laser
2. Gas laser
3. DH injection laser
4. Quantum well laser View Answer

Answer: c

Explanation: DH injection lasers are known as gain guided laser structure. This is because the optical mode distribution along the junction plane is decided by optical gain.

9. Laser modes are generally separated by few \_\_\_\_\_\_\_\_\_\_

1. Tenths of micrometer
2. Tenths of nanometer
3. Tenths of Pico-meter
4. Tenths of millimeter View Answer

Answer: b

Explanation: The spacing in between modes is about a few tenths of nanometer. The spacing of the modes depends on optical cavity length where each one corresponds to an integral number of lengths.

10. The spectral width of emission from the single mode device is \_\_\_\_\_\_\_\_\_\_

1. Smaller than broadened transition line-width
2. Larger than broadened transition line-width
3. Equal the broadened transition line-width
4. Cannot be determined View Answer

Answer: a

Explanation: Single mode device has a smaller spectral width as compared to that of broadening transition line-width. This is because for a single-mode operation, the laser optical output must have only a single longitudinal and single transverse mode.

11. Single longitudinal mode operation is obtained by \_\_\_\_\_\_\_\_\_\_

1. Eliminating all transverse mode
2. Eliminating all longitudinal modes
3. Increasing the length of cavity
4. Reducing the length of cavity View Answer

Answer: d

Explanation: Single longitudinal mode operation is obtained by reducing the length L of cavity. Length must be reduced until the frequency separation of adjacent modes is given in the equation δf = c/2nL is larger than gain curve. Then only single mode falling in transition line width will oscillate in laser cavity.

12. A correct DH structure will restrict the vertical width of waveguide region is? a) 0.5μm.

1. 0.69 μm
2. 0.65 μm
3. Less than 0.4 μm View Answer

Answer: d

Explanation: The vertical width DH structure should be less than 0.4μm. This allows only fundamental transverse mode and removes any interference of higher order transverse modes on emitted longitudinal waves.

13. The external power efficiency of an injection laser with a GaAs is 13% having band gap energy of 1.64 eV. Determine external power efficiency. a) 0.198

1. 0.283
2. 0.366
3. 0.467

View Answer

Answer: a

Explanation: The external power efficiency of an injection laser is given by ηep = ηT (Eq/V)\*100 ηT = ηep/100 (v/Eg) = 13/100 (2.5/1.64)

= 0.198



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Some Injection Laser Structures”.

1. In multimode injection lasers, the construction of current flow to the strip is obtained in structure by \_\_\_\_\_\_\_\_\_\_

1. Covering the strip with ceramic
2. Intrinsic doping
3. Implantation outside strip region with protons

d)Implantation outside strip region with electrons View Answer

Answer: c

Explanation: The current flow is realized by implanting the region outside strip with protons. This implantation makes the laser highly resistive and gives superior thermal properties due to absence of silicon dioxide layer.

2. What is the strip width of injection laser?

1. 12 μm
2. 11.5 μm
3. Less than 10 μm
4. 15 μm View Answer

Answer: c

Explanation: A strip width less than or equal to 10 μm is usually preferred in injection lasers. This width range provides the lasers highly efficient coupling into multimode fibers as comapred to single mode fibers.

3. Some refractive index variation is introduced into lateral structure of laser. a) True

b) False View Answer

Answer: a

Explanation: Gain guided lasers possess several undesirable characteristics, nonlinearities in light output versus current characteristics, high threshold current, low differential quantum efficiency, movement of optical a;ong junction plane. This problems can be reduced by introducing refractive index variations into lateral structure of lasers so that optical mode is determined along the junction plane.

4. Buried hetero-junction (BH) device is a type of \_\_\_\_\_\_\_\_\_\_\_\_\_ laser where the active volume is buried in a material of wider band-gap and lower refractive index. a) Gas lasers.

1. Gain guided lasers.
2. Weak index guiding lasers.
3. Strong index guiding lasers. View Answer

Answer: d

Explanation: In strong index guiding lasers, a uniformly thick, planar active waveguide is achieved by lateral variations in confinement layer thickness or refractive index. In Buried hetero-junction (BH) devices, strong index guiding along junction plane introduces transverse mode control in injection lasers.

5. In Buried hetero-junction (BH) lasers, the optical field is confined within \_\_\_\_\_\_\_\_\_\_ a) Transverse direction

1. Lateral direction
2. Outside the strip
3. Both transverse and lateral direction View Answer

Answer: d

Explanation: Optical field is strongly confined in both transverse and lateral direction. This provides strong index guiding of optical mode along with good carrier confinement.

6. A double-channel planar buried hetero-structure (DCP BH) has a planar active region, the confinement material is? a) Alga AS

1. InGaAsP
2. GaAs
3. SiO2 View Answer

Answer: b

Explanation: The planar active region made up of InGaAsP can be seen in double-channel planar buried hetero-structure (DCP BH). This material confinement provides a very high power operation with CW output power up to 40 mW in longer wavelength region.

7. Problems resulting from parasitic capacitances can be overcome \_\_\_\_\_\_\_\_\_\_

1. Through regrowth of semi-insulating material
2. By using oxide material
3. By using a planar InGaAsP active region
4. By using a AlGaAs active region

View Answer

Answer: a

Explanation: The use of reverse-biased current confinement layers introduces parasitic capacitances which reduces high speed modulation of BH lasers. This problem can be reduced by regrowth of semi-insulating material or deposition of dielectric material. This causes increase in modulation speeds of 20 GHz.

8. Quantum well lasers are also known as \_\_\_\_\_\_\_\_\_\_

1. BH lasers
2. DH lasers
3. Chemical lasers
4. Gain-guided lasers View Answer

Answer: b

Explanation: DH lasers are known as Quantum well lasers. The carrier motion normal to active layer is restricted in these devices. This results in quantization of kinetic energy into discrete energy levels for carriers moving in that direction. This phenomenon is similar to quantum mechanical problem of one dimensional potential well which is seen in DH lasers.

9. Quantum well lasers are providing high inherent advantage over \_\_\_\_\_\_\_\_\_\_ a) Chemical lasers

1. Gas lasers
2. Conventional DH devices
3. BH device View Answer

Answer: c

Explanation: Quantum well lasers exhibit high incoherent advantage over conventional DH lasers. In Quantum well laser structures, the thin active layer results in drastic changes in electronic and optical properties over conventional DH laser structures. This changes are due to quantized nature of discrete energy levels with step-like density and also allow high gain and low carrier density.

10. Strip geometry of a device or laser is important.

1. True
2. False View Answer

Answer: a

Explanation: Near fluid intensity distribution corresponding to single optical output power level in plane of junction can be seen in GaAs or AlGaAs lasers. This distribution is in lateral direction and is determined by the nature of lateral waveguide. The single intensity maximum shows the fundamental lateral mode is dominant.

11. Better confinement of optical mode is obtained in \_\_\_\_\_\_\_\_\_\_

1. Multi Quantum well lasers
2. Single Quantum well lasers
3. Gain guided lasers
4. BH lasers View Answer

Answer: a

Explanation: As compared to all lasers including single quantum well lasers, multi-Quantum well lasers are having better confinement of optical mode. This results in a lower threshold current density for these devices.

12. Multi-quantum devices have superior characteristics over \_\_\_\_\_\_\_\_\_\_ a) BH lasers

1. DH lasers
2. Gain guided lasers
3. Single-quantum-well devices View Answer

Answer: b

Explanation: Lower threshold currents, narrower bandwidths, high modulation speeds, lower frequency chirps and less temperature dependence are parameters determining characteristics of a particular laser. All the above parameters make multi-quantum devices superior over DH lasers.

13. Dot-in-well device is also known as \_\_\_\_\_\_\_\_\_\_

1. DH lasers
2. BH lasers
3. QD lasers
4. Gain guided lasers View Answer

Answer: c

Explanation: Quantum well lasers are devices in which device contains a single discrete atomic structure or Quantum-dot. These are elements that contain electron tiny droplets which forms a quantum well structure.

14. A BH can have anything from a single electron to several electrons. a) True

b) False View Answer

Answer: b

Explanation: Quantum-dot lasers are fabricated using semiconductor crystalline materials. They have a particular dimension ranging from nm to few microns. The size, shape of these structures and number of electrons they contain are precisely controlled.

15. QD lasers have a very low threshold current densities of range \_\_\_\_\_\_\_\_\_\_ a) 0.5 to 5 A cm-2

1. 2 to 10 A cm-2
2. 10 to 30 A cm-2
3. 6 to 20 A cm-2

View Answer

Answer: d

Explanation: Low-threshold current density between 6 to 20 A cm-2 is obtained with InAs/InGaAs QD lasers which emit at a wavelength of 1.3 μm and 1.5 μm Such low values of threshold current densities make these lasers possible to create stacked or cascaded QD structures. These structures provide high optical gain for short-cavity transmitters and vertical cavity surface-emitting lasers.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on ” Single Frequency Injection Lasers”.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ may be improved through the use of frequency-selective feedback so that the cavity loss is different for various longitudinal modes. a) Frequency selectivity

1. Longitudinal mode selectivity
2. Electrical feedback
3. Dissipated power View Answer

Answer: b

Explanation: Improved longitudinal mode selectivity can be achieved using structures which gives loss discrimination between the desired and all the unwanted modes. Thus, mode discrimination can be seen. To allow for stable mode operation, the use of frequency-selective feedback approach is undertaken.

2. Device which apply the frequency-selective feedback technique to provide single longitudinal operation are referred to as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) DSM lasers

1. Nd: YAG lasers
2. Glass fiber lasers
3. QD lasers View Answer

Answer: a

Explanation: DSM lasers are also known as single frequency lasers. Such devices provide single longitudinal mode operation hence called as dynamic single mode lasers. These lasers reduce fiber intra-modal dispersion within high speed systems.

3. Which of the following does not provide single frequency operation?

1. Short cavity resonator
2. DSM lasers
3. Coupled cavity resonator
4. Fabry-Perot resonator View Answer

Answer: d

Explanation: DSM lasers, short cavity resonators, coupled cavity resonators employ frequency selective feedback approach and provide single mode operation. However, the Fabry-Perot resonator allows several longitudinal modes to exist within the gain spectrum of the device.

4. A method for increasing the longitudinal mode discrimination of an injection laser which is commonly used?

1. Decreasing refractive index
2. Increasing the refractive index
3. Increasing cavity length
4. Shortening of cavity length View Answer

Answer: d

Explanation: The longitudinal mode discrimination of an injection laser is indirectly proportional to the cavity length. Thus, as the cavity length is shortened, the mode discrimination will get increase. If the cavity length is reduced from 250 to 25 units, the mode spacing is increased from 1 to 10 nm.

5. Conventional cleaved mirror structures are difficult to fabricate with the cavity lengths below

\_\_\_\_\_\_\_\_\_\_

1. 200 μm and greater than 150 μm
2. 100 μm and greater than 50 μm
3. 50 μm
4. 150 μm View Answer

Answer: c

Explanation: cleaved laser mirrors are used in Fabry-Perot resonator which does not give result for shorter cavity lengths. These lengths may vary from 20 μm to 50μm. Hence micro-cleaved or etched resonator is used for shorter cavity lens.

6. In the given equation, corrugation period is given by lλb/2Ne. If λb is the Bragg wavelength, then what does ‘l’ stand for? a) Length of cavity

1. Limitation index
2. Integer order of grating
3. Refractive index

View Answer

7. The first order grating (l=1) provide the strongest coupling within the device. a) True

b) False View Answer

Answer: a

Explanation: The period of corrugation is given by lλb/2Ne includes order of grating. The second grating provide larger spatial period and thus helps in fabrication. If the order of grating is 1, then the device is coupled at high level.

8. The semiconductor lasers employing the distributed feedback mechanism are classified in \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ categories. a) One

1. Two
2. Three
3. Four View Answer

Answer: b

Explanation: Considering the device operation, semiconductor lasers are classified into two broad categories referred to as distributed feedback laser and distributed Bragg reflector laser. In the DFB laser, optical grating is applied over the entire active region, whereas in DBR lasers, the grating is etched only near the cavity ends.

9. DBF-BH lasers exhibit low threshold currents in the range of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) 40 to 50 mA

1. 21 to 30 mA
2. 2 to 5 mA
3. 10 to 20 mA View Answer

Answer: d

Explanation: DFB lasers are used to provide single frequency semiconductor optical sources. DFB-BH lasers, developed in laboratories exhibit high modulation speeds, output power but low threshold currents in the range of 10 to 20 mA.

10. Fabry-Perot devices with BH geometries high modulation speeds than DFB-BH lasers. a) True

b) False View Answer

Answer: b

Explanation: DFB-BH lasers exhibit low threshold currents but high output power and modulation speeds. DFB-BH laser is fabricated by etching or grating. Fabry-perot devices provide modulation speeds of M-bits per seconds whereas, DFB-BH lasers provides modulation speeds of G-bits/sec.

11. The InGaAsP/InP double channel planar DFB-BH laser with a quarter wavelength shifted first order grating provides a single frequency operation and incorporates a phase shift of \_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) π/2 Radians

1. 2π Radians
2. π Radians
3. 3π/2 radians View Answer

Answer: a

Explanation: The performance of DFB laser is improved by modifying a grating, which in turn introduces an optical phase shift. The phase shift depends on the wavelength used. A quarter wavelength shifted first order grating incorporates the phase shift of π/2 in the corrugation at the center of laser cavity.

12. The narrow line-width obtained under the CW operation for quarter wavelength shifted DFB laser is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) 2 MHz

1. 10 MHz
2. 3 MHz
3. 1 MHz View Answer

Answer: c

Explanation: A quarter wavelength shifted DFB laser provides a large gain difference between the central mode and side modes. It provides improved dynamic single mode stability. Narrow line-width of around 3 MHz can be obtained under CW operation.

13. Line-width narrowing is achieved in DFB lasers by a strategy referred as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) Noise partition

1. Grating
2. Tuning
3. Bragg wavelength detuning View Answer

Answer: d

Explanation: Line-width narrowing is achieved in DFB lasers by detuning the lasing wavelength towards the shorter wavelength side of gain peak. It increases the differential gain between the central mode and nearest side mode. This strategy is called as Bragg wavelength detuning.

14. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a technique used to render the non-conducting material around the active cavity by producing permanent defects in the implanted area. a) Dispersion

1. Ion de-plantation
2. Ion implantation
3. Attenuation View Answer

Answer: c

Explanation: Ion implantation approach concentrates the injection current in active region. Current confinement is realized by ion implantation. Ions are implanted into a selective area of a semiconducting material to make it non-conducting.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Injection Laser Characteristics”.

1. The threshold temperature coefficient for InGaAsP devices is in the range of \_\_\_\_\_\_\_\_\_\_ a) 10-40 K

1. 40-75 K
2. 120-190 K
3. 150-190 K View Answer

Answer: b

Explanation: The threshold temperature coefficient for InGaAsP devices is in between 40 and 75

K. This range shows higher temperature sensitivity due to intrinsic physical properties of InGaAsP material system, Auger recombination, inter-valence band absorption, carrier leakage effects over hetero-junctions.

2. The process where the energy released during the recombination of an electron-hole event getting transferred to another carrier is known as \_\_\_\_\_\_\_\_\_\_ a) Inter-valence bond absorption

1. Auger recombination
2. Carrier leakage effects
3. Exothermic actions View Answer

Answer: b

Explanation: Auger recombination is a process where energy is released. This energy is released during the recombination of electron-hole and this released energy is transferred to another electron-hole event. During this process, when a carrier is excited to a higher energy level, it loses its excessive amount of energy by emitting a phonon in order to maintain thermal equilibrium. It consists of number of different processes each process involving three particles (2 electrons and 1 or 2 holes and 1 electron).

3. Auger recombination can be reduced by using \_\_\_\_\_\_\_\_\_\_

1. Strained MQW structure
2. Strained SQW structure
3. Gain-guided strained structure
4. Strained Quantum dots lasers

View Answer

Answer: a

Explanation: Auger recombination is a process where energy is released during recombination of electron-hole event is transferred to another event. This loss mechanism can be reduced by using strained by using MCQ laser structure. Strain can be either compressive or tensile, modifying the valence band energy levels of material and therefore can be used to increase energy.

4. High strain in strained MCQ structure should be incorporated. a) True

b) False View Answer

Answer: b

Explanation: Strain is introduced in thin layers of quantum wells by making small differences in lattice constants. High strain should be avoided because it causes damage in these thin-quantum layers. Also carrier leakage adds at high temperatures since it represents processes that prevent carrier from recombination thus reducing device efficiency.

5. The parameter that prevents carrier from recombination is \_\_\_\_\_\_\_\_\_\_

1. Auger recombination
2. Inter-valence band absorption
3. Carrier leakage
4. Low temperature sensitivity View Answer

Answer: c

Explanation: Carrier leakage is the parameter that prevents carriers (electrons, holes) from recombination. At high temperatures, carrier leakage represents all those processes preventing carriers from recombination. It therefore increases the lasing threshold and thus reduces device efficiency.

6. Determine the threshold current density for an AlGaAs injection laser with T0=180k at 30°C. a) 6.24

1. 9.06
2. 3.08
3. 5.09 View Answer

Answer: d

Explanation: The threshold current density for a laser is given by-

Ith = exp(T/T0)

For AlGaAs device,

Ith(30)=exp(T/T0) = exp(293/180) = 5.09.

7. The phenomenon occurring when the electron and photon population within the structure comes into equilibrium is known as \_\_\_\_\_\_\_\_\_\_ a) Auger recombination

1. Inter-valence band absorption
2. Carrier leakage
3. Relaxation oscillations View Answer

Answer: d

Explanation: Phenomenon occurring when the electron and photon population within the structure comes into equilibrium is known as Relaxation oscillations. The application of a current state to device resulting in a switch delay which is followed by high frequency damped oscillations.

8. When a current pulse reaches a laser having parasitic capacitance after the initial delay time, that pulse will \_\_\_\_\_\_\_\_\_\_ a) Have no effect

1. Will get vanished
2. Becomes narrower
3. Gets broader View Answer

Answer: d

Explanation: The pulse will be broadened when it will reach a laser with parasitic capacitance after initial time delay. This is because when a current pulse reaches the laser, the parasitic capacitance of laser provides a source of current over the period when there is high photon density. As electron density is repetitively built up and reduced quickly, there will be several pulses at laser output as photon density will be high resulting in relaxation oscillations.

9. Reducing delay time and \_\_\_\_\_\_\_\_\_\_\_\_ are of high importance for lasers.

1. Auger recombination
2. Inter-valence band absorption
3. Carrier leakage effects
4. Relaxation oscillations View Answer

Answer: d

Explanation: For lasers generally a switch-on delay time may last for 0.5ns and relaxation oscillations behind twice that period. This behavior can produce serious deterioration in shape of laser pulse at a data rate of 100Mbits. So time delay and Relaxation oscillations are highly desirable for lasers.

10. Dynamic line-width broadening under the direct modulation of injection current is known as

\_\_\_\_\_\_\_\_\_\_

1. Auger recombination
2. Inter-valence band absorption
3. Carrier leakage effects
4. Frequency Chirping

View Answer

Answer: d

Explanation: Frequency Chirping is a phenomenon which is due to Dynamic line-width broadening under direct modulation of a single longitudinal mode. Semiconductor laser cause a dynamic shifting of peak wavelength emitted from device. Strong coupling between the free carrier density and refractive index of device present in semiconductor structure results in gaininduced variations which also causes Frequency Chirping.

11. A particular characteristic or parameter that occurs during analog transmission of injection lasers is? a) Noise

1. Mode hopping
2. Carrier leakage effects
3. Frequency Chirping View Answer

Answer: a

Explanation: During analog transmission, noise behavior of device is main thing that affects the operation of injection laser. This noise may be due to instabilities in kinks in light output versus current characteristics, reflection of light back to device and mode partition noise.

12. Intensity of output from semiconductor injection lasers leading to optical intensity noise is due to \_\_\_\_\_\_\_\_\_\_

1. Fluctuations in amplitude
2. Mode hopping
3. Carrier leakage effects
4. Frequency Chirping View Answer

Answer: a

Explanation: Fluctuations in the laser output or intensity of laser output leads to optical intensity noise. These fluctuations are generally caused by temperature variations and spontaneous emission in the laser output. This randomness in fluctuations creates a noise source known as relative intensity noise (RIN).

13. In multimode lasers the optical feedback from unnecessary external reflections affecting stability of frequency and intensity is? a) Remains unaffected

1. Increased gradually
2. Reduced
3. Gets totally vanished View Answer

Answer: c

Explanation: The effect due to unwanted external reflections in multimode laser is reduced. This is because the reflections are spread along any fiber modes so they are weakly coupled back into laser mode.

14. Reduction in the number of modes in multimode fiber increases the mode partition noise. a) False

b) True View Answer

Answer: a

Explanation: Mode partition noise is a result of laser spectral fluctuations and so a reduce in number of modes results in low pulse-width spreading thus providing low values of intermodal dispersion in the fiber. And so, the mode partition noise is decreased in multimode fiber due to reducing the number of modes.

15. The behavior of laser occurring when current is increased above threshold particularly is? a) Mode hopping

1. Auger recombination
2. Frequency chirping
3. Noise View Answer

Answer: a

Explanation: Mode hopping results in the hopping of modes to a higher wavelength. This mode hopping occurs in all injection lasers and is due to increase in temperature. Mode hopping is not a continuous function of drive current but occurs above 1 to 2 mA. Mode hopping alters characteristics of laser and results in kinks in characteristics of single mode device



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Non – Semiconductor Lasers”.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ lasers are presently the major laser source for optical fiber communications.

1. Semiconductor
2. Non-Semiconductor
3. Injection
4. Solid-state View Answer

Answer: c

Explanation: Injection laser coupling using discrete lasers have proved to fruitful. Such lenses provide for relaxation for an alignment tolerances normally required for fiber coupling. Certain non-semiconductor sources are making its lace in the optical fiber communication. At slowly present, injection lasers are mostly used as laser sources.

2. In Nd: YAG lasers, the maximum doping levels of neodymium is \_\_\_\_\_\_\_\_\_\_\_\_ a) 0.5 %

1. 1.5 %
2. 1.8 %
3. 2 % View Answer

Answer: b

Explanation: The Nd: YAG laser structure is formed by doping of yttrium- aluminum -garnet (YAG) with neodymium. The energy levels for lasing transition and pumping are provided by neodymium ions. The maximum doping level of neodymium in YAG is around 1.5 %.

3. Which of the following is not a property of Nd: YAG laser that enables its use as an optical fiber communication source? a) Single mode operation

1. Narrow line-width
2. Long lifetime
3. Semiconductors and integrated circuits View Answer

Answer: d

Explanation: Nd: YAG laser is a non-semiconductor laser. It does not include the use of semiconductors and thus cannot take advantage of well-developed technology associated with integrated circuits. Single mode operation, narrow line-width, lifetime are the properties that are useful for optical communication.

4. The Nd: YAG laser has a narrow line-width which is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) < 0.01 nm

1. > 0.01 nm
2. > 1 mm
3. > 1.6 mm

View Answer

Answer: a

Explanation: The Nd: YAG laser has several properties which make it an active optical source. One of such properties is its narrow line-width. It is less than 0.01 nm which is useful for reducing dispersion of optical links.

5. The strongest pumping bands is a four level system of Nd: YAG laser at wavelength of range\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) 0.25 and 0.56 nm

1. 0.75 and 0.81 nm
2. 0.12 and 0.23 nm
3. 1 and 2 nm View Answer

Answer: b

Explanation: The Nd: YAG laser is a four level system. It consists of number of pumping bands and fluorescent transitions. The strongest pumping bands are the wavelengths of 0.75μm and

0.81μm. and gives lasing transition at 1.064μm and 1.32μm. Single mode emission is usually obtained at these wavelengths.

6. The Nd: YAG laser is costlier than earth-doped glass fiber laser. a) True

b) False View Answer

Answer: a

Explanation: The most important requirement of the Nd: YAG laser is pumping and modulation. These two requirements tend to give a cost disadvantage in comparison with earth-doped glass fiber laser. Also it is easier and less expensive to fabricate glass fiber in earth-doped laser.

7. It is a resonant cavity formed by two parallel reflecting mirrors separated by a mirror separated by a medium such as air or gas is? a) Optical cavity

1. Wheatstone’s bridge
2. Oscillator
3. Fabry-perot resonator View Answer

Answer: d

Explanation: Resonant cavity is formed between two mirrors where fiber core doped with earth ions is placed. This cavity is 250-500 μm long and 5 to 15 μm wide. A Fabry-perot resonator oscillates at resonant frequency for which there is high gain.

8. In a three level system, the threshold power decreases inversely with the length of the fiber gain medium. a) True

b) False View Answer

Answer: b

Explanation: If the imperfection losses are low then in a four level system the threshold power decreases inversely with the length of the fiber gain medium. A three level consists of an optimum length. This optimum length gives the minimum threshold power which is independent of the value of imperfection losses.

9. Which of the following co-dopant is not employed by neodymium and erbium doped silica fiber lasers?

1. Phosphorus pent oxide
2. Germania
3. Nitrogen
4. Alumina View Answer Answer: c

Explanation: Silica based glass fibers are proved to be the best host material till date. These silica fibers are doped with neodymium and erbium. These dopants include co-dopants such as phosphorus pent-oxide, germanium and alumina.

10. Dopants levels in glass fiber lasers are generally \_\_\_\_\_\_\_\_\_\_\_

1. Low
2. High
3. Same as that of GRIN rod lens laser
4. Same as that of semiconductor laser View Answer

Answer: a

Explanation: Dopant levels are low in glass fibers (nearly 400 parts per million). This is because of increasing in concentration quenching which increases with the doping level. It may cause the reduction in the population of the upper lasing level as well as crystallization within the glass matrix.

11. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fibers include addition of lead fluoride to the core glass in order to raise the relative refractive index. a) Solid-state

1. GaAs
2. Semiconductor
3. ZBLANP View Answer

Answer: d

Explanation: Up-conversion pumping of laser material is used to convert an infrared laser output to a visible laser output. ZBLANP is host material on which laser action at all wavelengths can be obtained by pumping. The relative refractive index is increased by addition of lead fluoride which makes it a very interesting host material.

12. The lasing output of the basic Fabry-perot cavity fiber is restricted to between \_\_\_\_\_\_\_\_\_\_\_\_ a) 1 and 2 nm

1. 5 and 10 nm
2. 3 and 6 nm
3. 15 and 30 nm View Answer

Answer: b

Explanation: the gain spectrum of rare earth ions may be seen over a wavelength range of 50 nm. The lasing output will thus be narrow unless the dielectric on the mirror is arranged. Such a narrow line-width is not used for a broadband optical source.

13. In Fabry-perot laser, the lower threshold is obtained by \_\_\_\_\_\_\_\_\_\_\_

1. Increasing the refractive index
2. Decreasing the refractive index
3. Reducing the slope efficiency
4. Increasing the slope efficiency View Answer

Answer: c

Explanation: The finesse of Fabry-perot cavity provides a measure of its filtering properties. When the finesse is high the splitting ratio is low thus lowering the laser threshold in an optical cavity without mirror. In Fabry-perot laser, mirrors are present and thus lower threshold is obtained by reducing the slope efficiency.

14. When did the non-semiconductor laser developed?

1. 1892
2. 1946
3. 1985
4. 1993 View Answer

Answer: c

Explanation: Non-semiconductor sources are crystalline and glass wave-guiding structures. They are doped with rare earth ions and are good optical sources. The development of these sources started in the year 1985. Example: Nd: YAG laser.

15. Y3Al5 O12 is a molecular formula for \_\_\_\_\_\_\_\_\_\_\_\_\_

1. Ytterbium aluminate
2. Yttrium oxide
3. Ytterbium oxy-aluminate
4. Yttrium-aluminum garnet View Answer

Answer: d

Explanation: The atomic number of Yttrium is 39. It is the base element of Yttrium-aluminum garnet. Y3Al5 O12, doped with rare earth ion neodymium to form Nd: YAG laser structure



This set of Optical Communications Quiz focuses on “Narrow – Linewidth and Wavelength – Tunable Lasers”.

1. Which of these factors are critical in affecting the system performance in the case of coherent optical fiber transmission?

1. Laser line-width and stability
2. Refractive index and index difference
3. Core cladding diameter
4. Frequency View Answer Answer: a

Explanation: The system employing intensity modulation does not consider line-width and stability as the factors of utmost importance. In coherent optical source transmission, laser linewidth and stability are critical factors. These factors affect the system performance and are in the range of 0.5-1 Megahertz.

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ occurs as a result of the change in lasing frequency with gain. a) Frequency multiplication

1. Dispersion
2. Attenuation
3. Line-width broadening View Answer

Answer: d

Explanation: Line-width broadening is a fundamental consequence of spontaneous emission process. It is related to the fluctuations in the phase of the optical fields. These phase fluctuations are due to the phase noises associated with the spontaneous emission process.

3. Laser cavity length can be extended by \_\_\_\_\_\_\_\_\_\_\_

1. Increasing the refractive index
2. Reducing frequency
3. Introduction of external feedback
4. Using GRIN-rod lenses View Answer

Answer: c

Explanation: the lasers having long external cavity are referred to as LEC lasers. The extension of the laser cavity length by introduction of external feedback can be achieved by using an external cavity with a wavelength dispersive element.

4. What is the purpose of wavelength dispersive element is LEC lasers?

1. Wavelength selectivity
2. Reduction of line-width
3. Frequency multiplication
4. Avalanche multiplication View Answer

Answer: a

Explanation: A wavelength dispersive element is a part of the laser cavity. It is required because the long resonator structure has very closely spaced longitudinal modes which necessitates additional wavelength selectivity.

5. An effective method to reduce the line-width is to make the cavity longer. a) True

b) False

View Answer

Answer: a

Explanation: As the laser power increases, the device line-width decreases. The output power f laser cannot be mode arbitrarily large. Thus, the line-width is reduced by making the cavity longer. Longer cavity also enables increased wavelength selectivity.

6. Which devices are used to modulate the external cavity in order to achieve the higher switching speeds?

1. Electromagnetic
2. Acousto-optic
3. Dispersive
4. Lead View Answer

Answer: b

Explanation: The devices are tuned mechanically to extend the cavity of laser. The disadvantage of using mechanically tuned devices is low. Thus, electro-optic devices are used to modulate the external cavity in order to achieve higher switching speeds.

7. How many techniques are used to tune monolithic integrated devices (lasers)? a) Five

1. One
2. Two
3. Three View Answer

Answer: c

Explanation: There are two techniques which can be employed to tune monolithic integrated devices. In the first method, the mode selectivity of a coupled cavity structure is used. Other method is used to a refractive index change in the device cavity provided by application of an electric field.

8. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ laser can be produced when a coupler section is introduced between the amplifier and phase sections of a structure. a) SG-DBR

1. GCSR
2. Y 4-shifted
3. DSM View Answer

Answer: b

Explanation: DBR lasers are capable of wavelength tuning. Grating assisted co-directional coupler with sampled reflector (GCSR). Laser is capable of a tuning range greater than 40 nm. It consists of a co-directional coupler between the amplifier and the phase section.

9. The rare-earth-doped fiber lasers have spectral line-width in the range of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) 0.1 to 1 nm

1. 1.2 to 1.5 nm
2. 6 to 10 nm
3. 2 to 2.3 nm View Answer

Answer: a

Explanation: The rare-earth-doped fiber lasers have spectral line-width in the range of 0.1 to 1 nm. These line-widths are too long for high speed transmission is possible in this range.

10. The lasing line-width of Fox-smith resonator is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Less than 1 MHz
2. 1 MHz
3. 2 MHz
4. Greater than 3 MHz View Answer

Answer: a

Explanation: Fox-smith resonator employs a fused coupled fabricated from erbium-doped fiber. Narrower spectral line-width can be obtained using a resonator. It provides favorable line-widths than semiconductor laser.

11. What is the widest tuning range obtained in optical fiber laser structure? a) 60 nm

1. 80 nm
2. More than 100 nm
3. 100 nm View Answer

Answer: c

Explanation: A tuning range greater than 100 nm by using an erbium-doped photonic crystal fiber. A wider tuning range greater than 100 nm is obtained at wavelength 1.55 nm.

12. How many techniques can be used to increase the injection cavity length? a) One

1. Two
2. Three
3. Four View Answer

Answer: b

Explanation: Two techniques can be used to increase the injection laser cavity length. These are using laser chips and by extending a cavity with a passive medium such as air, glass etc.

13. The mechanism which results from a refractive index change in the passive waveguide layer is called as \_\_\_\_\_\_\_\_\_\_\_ a) Absorption

1. Spontaneous emission
2. Monolithic inversion
3. Bragg wavelength control View Answer

Answer: d

Explanation: A wider wavelength tuning length is obtained by separating the Bragg region in the passive waveguide and by introducing a phase region within a waveguide control mechanism provides phase control. It takes place by some changes in a passive waveguide layer.

14. How many sections are included in a sampling grating distributed Bragg-reflector laser (SGDBR)?

1. Four
2. Five
3. Three
4. Two View Answer

Answer: b

Explanation: In SG-DBR laser, five sections are longitudinally integrated together on a semiconductor substrate. These five sections include two diffraction Bragg grating sections, a gain, a phase and an amplifier section.

15. Fiber based lasers provide diffraction-limited power at higher levels than solid-state laser. a) True

b) False View Answer

Answer: a

Explanation: In fiber lasers, the active gain medium is doped with rare earth elements. These lasers have active regions several kilometers long and thus provide high optical gain. Solid-state lasers, on the other hand, provide diffraction limited power at lower levels



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Mid Infrared and Far Infrared Lasers”.

1. The parameters having a major role in determining threshold current of efficiency of injection laser are \_\_\_\_\_\_\_\_\_\_\_

1. Angle recombination and optical losses
2. Frequency chirping
3. Relaxation oscillation
4. Mode hopping View Answer

Answer: a

Explanation: Optical losses due to free carrier absorption are more because of their dependence on square of the wavelength. Also irradiative recombination through Auger recombination contributes to it. Both these effects cause more problems in md-infrared wavelengths and so are of much importance art high temperature due to high concentration of free carriers. They also limit maximum operating temperatures.

2. Auger current is mostly \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for material with band gap providing longer wavelength emission. a) Unaffected

1. Lesser
2. Larger
3. Vanishes View Answer

Answer: c

Explanation: The total current required for injection laser threshold is more than that provided to radioactive recombination as Auger current is added. This current depends on electronic band structure of material and often consists of different Auger transitions. So it is larger for materials with band gaps providing longer wavelength emission.

3. Injection lasers operating in smaller wavelengths are subjected to increased carrier losses. a) True

b) False View Answer

Answer: b

Explanation: Injection lasers operating in longer wavelengths (mid and far infrared) are subjected to increased carrier losses as compared to devices operating up to 1.6μm. This is from nonradiative recombination through Auger interaction. This recombination energy is dissipated as thermal energy to other free carriers. If band gap of semiconductor is increased, occurrence of these events gets increased.

4. Devices based on quaternary PbSnSeTe and their ternary compounds, emit at wavelength? a) Between 3-4 μm

1. Longer than 4 μm
2. Between 3.5 to 4.2 μm
3. Between 2 to 3 μm View Answer

Answer: b

Explanation: Quaternary devices emit at wavelength longer than 4μm. Auger effects are less in these alloys which provide lower current thresholds and higher maximum operating temperature.

5. Replacing Sn with Eu, Cd or Ge in some \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ the band gap.

1. Remove the band gap
2. Does not affect
3. Decreases
4. Increases View Answer

Answer: d

Explanation: When in a particular alloy laser for example PbSnSeTe, if Sn is replaced with Eu, Cd or Ge, there is an increase in band gap. This increase in band gap provides the laser to operate in shorter wavelength.

.

6. Lasing obtained in \_\_\_\_\_\_\_\_\_\_ when 191 mW of pump light at a wavelength of 0.477 μm is launched into laser.

1. Ternary PbSnSeTe alloy laser
2. Quaternary PbSnSeTe alloy laser
3. Doped Fluoro-zirconate fiber
4. Ternary PbEuTe alloy laser View Answer

Answer: c

Explanation: When Fluoro-zirconate fiber lasers are doped with Erbium helium or thulium, there are emission at 2-3 μm wavelength range. But lasing was obtained in this doped Fluorozirconate fiber at a wavelength of 0.477μm.

7. The thulium doped fiber laser when pumped with alexandrite laser output at 0.786 μm, the laser emits at \_\_\_\_\_\_\_\_\_\_\_ a) 0.6 μm

1. 0.8 μm
2. 2.3 μm
3. 1.2μm View Answer

Answer: c

Explanation: The thulium system emits at 2.3 μmwhen subjected to alexandrite laser at 0.786 μm. this system is four levels in which the pump band is upper lasing level at 2.3μm.

8. The diode-cladding-pumped Erbium praseodymium-doped fluoride device operates at wavelength.

1. Around 3 μm
2. 4 μm
3. 2.6 μm
4. 1.04 μm View Answer

Answer: a

Explanation: The diode-cladding-pumped Erbium praseodymium-doped fluoride device operates at a wavelength of 3 μm. This laser is capable of producing a very high output power of about 1W or more. It consists of double clad fluoride fiber.

9. A technique based on inter-sub band transition is known as \_\_\_\_\_\_\_\_\_\_\_

1. Auger recombination
2. Frequency chirping
3. Inter-valence band absorption
4. Quantum cascading View Answer

Answer: d

Explanation: The quantum cascaded laser is a layered semiconductor device having a series of coupled quantum wells grown on GaAs or Imp substrate. This principle of QC lasers provides emission of an optical signal around full wavelength range. Quantum mechanical band structure determines the emitted wavelength.

10. In a QC laser, a same electron can emit number of photons. a) True

b) False View Answer

Answer: a

Explanation: The QC laser operates by pumping a energy level and then using the energy in a controlled manner. This gives some energy each time over several steps. And since a QC laser structure includes a series of energy levels the same electron emits a number of photons while cascading down through each energy level.

11. The phenomenon resulting in the electrons to jump from one state to another each time emitting of photon is known as \_\_\_\_\_\_\_\_\_\_\_ a) Inter-valence band absorption

1. Mode hopping
2. Quantum cascading
3. Quantum confinement View Answer

Answer: d

Explanation: In Quantum confinement, charge carriers are trapped in a small area and this occurs in quantum wells at nanometer scale. When the quantum layer size raises to a size comparable to emission wavelength, the electron motion becomes perpendicular to plane of layer. Due to this, the electrons jump from one state to another each time from one state to another.

12. A QC laser is sometimes referred as \_\_\_\_\_\_\_\_\_\_\_

1. Unipolar laser
2. Bipolar laser
3. Gain guided laser
4. Non semiconductor laser

View Answer

Answer: a

Explanation: A QC laser utilizes only n-type of charge carriers. Their operation is entirely based on electrons and holes play no part in this, so they are known as unipolar lasers.

13. In QC lasers, it is possible to obtain different output signal wavelengths. This can be achieved by \_\_\_\_\_\_\_\_\_\_\_

1. Inter-valence band absorption
2. Mode hopping
3. Quantum cascading
4. Selecting layers of different thickness View Answer

Answer: d

Explanation: In QC laser, electrons emit energy. This energy emitted at this stage determines wavelength of radiation and it depends only on thickness of the layer. Thus output signal wavelength is dependent on thickness of lasers.

14. QC lasers \_\_\_\_\_\_\_\_\_\_\_\_\_\_ the performance characteristics.

1. Have negligible effects
2. Does not affects
3. Improves
4. Degrades View Answer

Answer: c

Explanation: QC lasers are based on inter sub band transition techniques. They have ability of carrying large amount of currents. A single electron is enough to generate number of photons. Thus, provides an increase in output signal power which is greater than thousands at same wavelength due to large number of cascaded stages.

15. An MQW cascaded laser is more advantageous because of \_\_\_\_\_\_\_\_\_\_\_

1. Mode hopping
2. Auger recombination
3. Control over layers of material
4. Properties of material View Answer

Answer: c

Explanation: In MQW cascaded layers, cascading creates number of injector/collector and active region in single stage. Each region contains a single quantum wells. Such structures permit maximum injection/collection of current and thereby produce a large number of photons. This formation of any injector/collector and active regions is achieved through precise control of several hundreds of layers of the material, where each layer should only be few nanometers thick



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “LED Power and Efficiency”.

1. The absence of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in LEDs limits the internal quantum efficiency. a) Proper semiconductor

1. Adequate power supply
2. Optical amplification through stimulated emission
3. Optical amplification through spontaneous emission View Answer

Answer: c

Explanation: The ratio of generated electrons to the electrons injected is quantum efficiency. It is greatly affected if there is no optical amplification through stimulated emission. Spontaneous emission allows ron-radiative recombination in the structure due to crystalline imperfections and impurities.

2. The excess density of electrons Δnand holes Δpin an LED is \_\_\_\_\_\_\_\_\_\_\_\_ a) Equal

1. Δpmore than Δn
2. Δn more than Δp
3. Does not affects the LED View Answer

Answer: a

Explanation: The excess density of electrons ΔnandΔp (holes) is equal. The charge neutrality is maintained within the structure due to injected carriers that are created and recombined in pairs. The power generated internally by an LED is determined by taking into considering the excess electrons and holes in p- and n-type material respectively.

3. The hole concentration in extrinsic materials is \_\_\_\_\_\_\_\_\_ electron concentration. a) much greater than

1. lesser than
2. equal to
3. negligible difference with View Answer

Answer: a

Explanation: In extrinsic materials, one carrier type will be highly concentrated than the other type. Hence in p-type region, hole concentration is greater than electron concentration in context of extrinsic material. This excess minority carrier density decays with time.

4. The carrier recombination lifetime becomes majority or injected carrier lifetime. a) True

b) False View Answer

Answer: b

Explanation: The initial injected excess electron density and τrepresents the total carrier recombination time. In most cases, Δnis a small fraction of majority carriers and contains all minority carriers. So in these cases, carrier recombination lifetime becomes minority injected carrier lifetime τi.

5. In a junction diode, an equilibrium condition occurs when \_\_\_\_\_\_\_\_\_\_\_\_ a) Δngreater than Δp

1. Δnsmaller than Δp
2. Constant current flow
3. Optical amplification through stimulated emission View Answer

Answer: c

Explanation: The total rate at which carriers are generated in sum of externally supplied and thermal generation rates. When there is a constant current flow in this case, an equilibrium occurs in junction diode.

6. Determine the total carrier recombination lifetime of a double heterojunction LED where the radioactive and nonradioactive recombination lifetime of minority carriers in active region are 70 ns and 100 ns respectively. a) 41.17 ns

1. 35 ns
2. 40 ns
3. 37.5 ns View Answer

Answer: a

Explanation: The total carrier recombination lifetime is given by

τ = τrτnr/τr+τnr = 70× 100/70 + 100 ns = 41.17 ns Where

τr = radiative recombination lifetime of minority carriers τnr = nonradioactive recombination lifetime of minority carriers.

7. Determine the internal quantum efficiency generated within a device when it has a radiative recombination lifetime of 80 ns and total carrier recombination lifetime of 40 ns. a) 20 %

1. 80 %
2. 30 %
3. 40 % View Answer

Answer: b

Explanation: The internal quantum efficiency of device is given by ηint = τ/τr = 40/80 ×100 = 80% Where

τ = total carrier recombination lifetime τr = radiative recombination lifetime.

8. Compute power internally generated within a double-heterojunction LED if it has internal quantum efficiency of 64.5 % and drive current of 40 mA with a peak emission wavelength of 0.82 μm.

1. 0.09
2. 0.039
3. 0.04
4. 0.06 View Answer

Answer: b

Explanation: The power internally generated within device i.e. double-heterojunction LED can be computed by

Pint = ηint hci/eλ = 0.645×6.626×10-34×3×108×40×10-3/ 1.602×10-19 × 0.82 × 10-6

= 0.039 W Where

ηint = internal quantum efficiency h = Planck’s constant c = velocity of light i = drive current e = electron charge λ = wavelength.

9. The Lambertian intensity distribution \_\_\_\_\_\_\_\_\_\_ the external power efficiency by some percent.

1. Reduces
2. Does not affects
3. Increases
4. Have a negligible effect View Answer

Answer: a

Explanation: In Lambertian intensity distribution, the maximum intensity I0is perpendicular to the planar surface but is reduced on the sides in proportion to the cosine of θ i.e. viewing angle as apparent area varies with this angle. This reduces the external power efficiency. This is because most of the light is tapped by total internal refraction when radiated at greater than the critical angle for crystal air interface.

10. A planar LED fabricated from GaAs has a refractive index of 2.5. Compute the optical power emitted when transmission factor is 0.68. a) 3.4 %

1. 1.23 %
2. 2.72 %
3. 3.62 %

View Answer

Answer: c

Explanation: The optical power emitted is given by Pe = PintFn2/4nx2 = Pint (0.680×1/4×(2.5)2) = 0.0272 Pint.

Hence power emitted is only 2.72 % of optional power emitted internally.

Where,

Fn2 = transmission factor nx = refractive index.

11. A planar LED is fabricated from GaAs is having a optical power emitted is 0.018% of optical power generated internally which is 0.018% of optical power generated internally which is 0.6 P. Determine external power efficiency. a) 0.18%

1. 0.32%
2. 0.65%
3. 0.9% View Answer

Answer: d

Explanation: Optical power generated externally is given by ηcp = (0.018Pint/2Pint)\*100

Where,

Pint = power emitted ηcp = external power efficiency.

12. For a GaAs LED, the coupling efficiency is 0.05. Compute the optical loss in decibels. a) 12.3 dB

1. 14 dB
2. 13.01 dB
3. 14.6 dB View Answer

Answer: c

Explanation: The optical loss in decibels is given by-

Loss = -10log10 ηc Where, ηc = coupling efficiency.

13. In a GaAs LED, compute the loss relative to internally generated optical power in the fiber when there is small air gap between LED and fiber core. (Fiber coupled = 5.5 \* 10-4Pint) a) 34 dB

1. 32.59 dB
2. 42 dB
3. 33.1 dB View Answer Answer: b

Explanation: The loss in decibels relative to Pint is given by-

Loss = -10log10Pc/Pint

Where,

Pc = 5.5 \* 10-4Pint.

14. Determine coupling efficiency into the fiber when GaAs LED is in close proximity to fiber core having numerical aperture of 0.3. a) 0.9

1. 0.3
2. 0.6
3. 0.12

View Answer

Answer: a

Explanation: The coupling efficiency is given by ηc = (NA)2 = (0.3)2 = 0.9.

15. If a particular optical power is coupled from an incoherent LED into a low-NA fiber, the device must exhibit very high radiance. a) True

b) False View Answer

Answer: a

Explanation: Device must have very high radiance specially in graded index fiber where Lambertian coupling efficiency with same NA is about half that of step-index fibers. This high radiance is obtained when direct bandgap semiconductors are fabricated with DH structure driven at high current densities.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “LED Structures”.

1. The amount of radiance in planer type of LED structures is \_\_\_\_\_\_\_\_\_\_\_\_ a) Low

1. High
2. Zero
3. Negligible View Answer

Answer: a

Explanation: Planer LEDs are fabricated using liquid or vapor phase epitaxial processes. Here ptype is diffused into n-type substrate which creates junction. Forward current flow through junction provides Lambertian spontaneous emission. Thus, device emits light from all surfaces. However a limited amount of light escapes the structure due to total internal reflection thus providing low radiance.

2. In optical fiber communication \_\_\_\_\_\_\_\_\_\_\_\_\_ major types of LED structures are used. a) 2

1. 4
2. 6
3. 3

View Answer

Answer: c

Explanation: Optical fiber communication involves the use of 6 different major LED structure. These are the surface emitter, edge emitter, the super luminescent, the resonant cavity LED, planar LEDs and Dome LEDs.

3. As compared to planar LED structure, Dome LEDs have \_\_\_\_\_\_\_\_\_\_\_\_\_\_ External power efficiency \_\_\_\_\_\_\_\_\_\_\_ effective emission area and \_\_\_\_\_\_\_\_\_\_\_\_\_ radiance. a) Greater, lesser, reduced

1. Higher, greater, reduced
2. Higher, lesser, increased
3. Greater, greater, increased View Answer

Answer: b

Explanation: In Dome LEDs, the diameter of dome is selected so as to maximum the internal emission reaching surface within critical angle of GaAs. Thus, dome LEDs have high external power efficiency. The geometry of Dome LEDs is such that dome is much larger than active recombination area, so it has greater emission era and reduced of radiance.

4. The techniques by Burros and Dawson in reference to homo structure device is to use an etched well in GaAs structure. a) True

b) False View Answer

Answer: a

Explanation: Burros and Dawson provided a technique to restrict emission to small active region within device thus providing high radiance. Etched well in a GaAs substrate is used to prevent heavy absorption of emitted region and physically accommodating the fiber. These structures provide low thermal impedance allowing high current densities of high radiance.

5. In surface emitter LEDs, more advantage can be obtained by using \_\_\_\_\_\_\_\_\_\_\_\_ a) BH structures

1. QC structures
2. DH structures
3. Gain-guided structure

View Answer

Answer: c

Explanation: DH structures provide high efficiency from electrical and optical confinement. Along with efficiency, they provide less absorption of emitted radiation.

6. Internal absorption in DH surface emitter Burros type LEDs is \_\_\_\_\_\_\_\_\_\_\_\_

1. Cannot be determined
2. Negligible
3. High
4. Very low View Answer

Answer: d

Explanation: The larger band gap confining layers and the reflection coefficient at the back crystal space is high in DH surface emitter Burros type LEDs. This provides good forward radiance. Thus these structure LEDs have very less internal absorption.

7. DH surface emitter generally give \_\_\_\_\_\_\_\_\_\_\_\_

1. More coupled optical power
2. Less coupled optical power
3. Low current densities
4. Low radiance emission into-fiber View Answer

Answer: a

Explanation: The optical power coupled into a fiber depends on distance, alignment between emission area and fiber, SLED emission pattern and medium between emitting area and fiber. All these parameters if considered, reduces refractive index mismatch and increases external power efficiency thus providing more coupled optical power.

8. A DH surface emitter LED has an emission area diameter of 60μm. Determine emission area of source.

1. 1.534\*10-6
2. 5.423\*10-3
3. 3.564\*10-2
4. 2.826\*10-9 View Answer

Answer: d

Explanation: The emission area A of source is given by A = π(30\*10-6) 2= 2.826\*10-9cm2.

9. Estimate optical power coupled into fiber of DH SLED having emission area of 1.96\*10-5, radiance of 40 W/rcm2, numerical aperture of 0.2 and Fresnel reflection coefficient of 0.03 at index matched fiber surface. a) 5.459\*10-5

1. 1.784\*10-3
2. 3.478\*102
3. 9.551\*10-5 View Answer

Answer: d

Explanation: The optical power coupler in the step index fiber of SLED is given by

Pc = π(1-r) A RD(NA) 2

= 3.14 (1-0.03)\*1.96\*10-5\*40\*(0.2) 2 = 9.551\*10-5W.

10. In a multimode fiber, much of light coupled in the fiber from an LED is \_\_\_\_\_\_\_\_\_\_\_\_ a) Increased

1. Reduced
2. Lost
3. Unaffected View Answer

Answer: c

Explanation: Optical power from an incoherent source is initially coupled into large angle rays falling within acceptance angle of fiber but have more energy than Meridional rays. Energy from these rays goes into the cladding and thus may be lost.

11. Determine the overall power conversion efficiency of lens coupled SLED having forward current of 20 mA and forward voltage of 2 V with 170 μWof optical power launched into multimode step index fiber. a) 1.256\*10-5

1. 4.417\*102
2. 4.25\*10-3
3. 2.14\*10-3 View Answer

Answer: c

Explanation: The overall power conversion efficiency is determined by η pc = Pc/P = 170\*10-6/20\*10-3\*2 = 4.25\*10-3.

12. The overall power conversion efficiency of electrical lens coupled LED is 0.8% and power applied 0.0375 V. Determine optical power launched into fiber. a) 0.03

1. 0.05
2. 0.3
3. 0.01 View Answer

Answer: a

Explanation: Optical power launched can be computed by

η pc = Pc/P Pc = η pc\* P = 0.8 \* 0.0375 = 0.03.

13. Mesa structured SLEDs are used \_\_\_\_\_\_\_\_\_\_\_\_

1. To reduce radiance
2. To increase radiance
3. To reduce current spreading
4. To increase current spreading View Answer

Answer: c

Explanation: The planar structures of Burros-type LED allow lateral current spreading specially for contact diameters less than 25 μm.This results in reduced current density and effective emission area greater than contact area. This technique to reduce current spreading in very small devices is Mesa structured SLEDs.

14. The InGaAsP is emitting LEDs are realized in terms of restricted are \_\_\_\_\_\_\_\_\_\_\_\_ a) Length strip geometry

1. Radiance
2. Current spreading
3. Coupled optical power View Answer

Answer: a

Explanation: The short striped structure of these LEDs around 100 μmimproves the external efficiency of LEDs by reducing internal absorption of carriers. These are also called truncated strip E-LEDs.

15. The active layer of E-LED is heavily doped with \_\_\_\_\_\_\_\_\_\_\_\_ a) Zn

1. Eu
2. Cu
3. Sn

View Answer

Answer: a

Explanation: Zn doping reduces the minority carrier lifetime. Thus this improves the device modulation bandwidth hence active layer is doped in Zn in E-LEDs.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “LED Characteristics”.

1. Intrinsically \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are a very linear device.

1. Injection lasers
2. DH lasers
3. Gain-guided
4. LEDs View Answer

Answer: d

Explanation: The ideal light output power against current characteristics for an LED linear. This tends to be more suitable for analog transmission where several constraints are put in linearity of optical source.

2. Linearizing circuit techniques are used for LEDs.

1. True
2. False View Answer

Answer: a

Explanation: In practice, LEDs exhibit nonlinearities depending on configuration used. Thus, to allow its used in high quality analog transmission system and to ensure linear performance of device, linearizing circuit techniques is used.

3. The internal quantum efficiency of LEDs decreasing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ with \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ temperature. a) Exponentially, decreasing

1. Exponentially, increasing
2. Linearly, increasing
3. Linearly, decreasing View Answer

Answer: b

Explanation: The light emitted from LEDs decreases. This is due to increase in p-n junction temperature. Thus, this results in exponentially decreasing internal quantum efficiency with temperature increment.

4. To utilize \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of SLDs at elevated temperatures, the use of thermoelectric coolers is important. a) Low-internal efficiency

1. High-internal efficiency
2. High-power potential
3. Low-power potential View Answer

Answer: c

Explanation: The output characteristics of SLDs are typically of nonlinear in nature. This is observed with a knee becoming apparent at an operating temperature around 20 degree c. Thus, to utilize high-power potential of these devices at elevated temperature, thermoelectric coolers are necessarily used.

5. For particular materials with smaller bandgap energies operating in \_\_\_\_\_\_\_\_\_\_\_\_\_ wavelength, the linewidth tends to \_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) 2.1 to 2.75 μm, increase

1. 1.1 to 1.7 μm, increase
2. 2.1 to 3.6 μm, decrease
3. 3.5 to 6 μm, decrease View Answer

Answer: b

Explanation: For materials with smaller bandgap, linewidth increases to 50 to 160 nm. This increases in band gap is due to increased doping levels and formation of bandtail states.

6. The active layer composition must be adjusted if a particular center wavelength is desired. a) True

b) False View Answer

Answer: a

Explanation:There is a difference in output spectra between surface and edge emitting LEDs when devices have generally heavily doped and lightly doped active layers by reduction in doping.

7. In optical fiber communication, the electrical signal dropping to half its constant value due to modulated portion of optical signal corresponds to \_\_\_\_\_\_\_ a) 6 dB

1. 3 dB
2. 4 dB
3. 5 dB View Answer

Answer: b

Explanation: Modulation bandwidth in optical communication is often defined in

electrical/optical terms. So when considering electrical circuitry in optical fiber system, electrical 3 dB point or frequency at which output electrical power is reduced by 3 dB bandwidth with respect to input electrical power.

8. The optical 3 dB point occurs when currents ratio is equal to \_\_\_\_\_\_\_\_\_\_\_\_\_ a) 83

1. 22
2. 12
3. 34

View Answer

Answer: c

Explanation: In optical regime, the bandwidth is defined by frequency at which output current has dropped to ½ output input current system.

9. The optical bandwidth is \_\_\_\_\_\_\_\_\_\_\_\_\_ the electrical bandwidth. a) Smaller

1. Greater
2. Same as
3. Zero with respect to View Answer

Answer: b

Explanation: The difference between optical and electrical bandwidth In terms of frequency depends on the shape of the frequency response of the system. If the system response is assumed to be Gaussian, then optical bandwidth is a factor of √2 greater than electrical bandwidth.

10. When a constant d.c. drive current is applied to device, the optical o/p power is 320 μm. Determine optical o/p power when device is modulated at frequency 30 MHz with minority carrier recombination lifetime of LED i.e. 5ns. a) 4.49\*10-12

1. 6.84\*10-9
2. 1.29\*10-6
3. 2.29\*10-4 View Answer

Answer: d

Explanation: The output o/p at 30 MHz is

Pc(30 MHz) = Pdc/(1+(wΓi)2)1/2 = 320\*10-6/(1+(2π\*30\*10-6\*5\*10-9)2)1/2 = 2.29\*10-4W.

11. The optical power at 20 MHz is 246.2 μW. Determine dc drive current applied to device with carrier recombination lifetime for LED of 6ns.

1. 3.48\*10-4
2. 6.42\*10-9
3. 1.48\*10-3
4. 9.48\*10-12 View Answer

Answer: a

Explanation: The optical output power at 20 MHz is

Pe(20 MHz) = Pdc/(1+(WTi)2)1/2

246.2\*10-6 = Pdc/(1+(2π\*20\*10-6\*5\*10-9)2)1/2 Pdc = 3.48\*10-4.

12. Determine the 3 dB electrical bandwidth at 3 dB optical bandwidth Bopt of 56.2 MHz. a) 50.14

1. 28.1
2. 47.6
3. 61.96 View Answer

Answer: b

Explanation: The 3dB electrical bandwidth is given by

B = Bopt/ √2 = 56.2/2

= 28.1 MHz.

13. The 3 dB electrical bandwidth B is 42 MHz. Determine 3dB optical bandwidth Bopt. a) 45.18

1. 59.39
2. 78.17
3. 94.14 View Answer

Answer: b

Explanation: The 3dB electrical bandwidth is

B = Bopt/√2

Bopt = B\*√2

= 42\*√2

= 59.39 MHz.

14. Determine degradation rate βrif constant junction temperature is 17 degree celsius. a) 7.79\*10-11

1. 7.91\*10-11

1. 6.86\*10-11
2. 5.86\*10-11 View Answer

Answer: a

Explanation: The degradation rate βris determined by βr = β0exp (-Ea/KT)

= 1.89\*107exp (-1\*1.602\*10-19/1.38\*10-23\*290) = 7.79\*10-11 h-1.

15. Determine CW operating lifetime for LED with βrt = -0.58 and degradation rate βr = 7.86\*10-11 h-1.

1. 32.12

1. 42
2. 22.72
3. 23.223 View Answer

Answer: c

Explanation: The CW operating lifetime is given by t = Ln 0.58/7.86\*10-11 = 22.72h-1



**6. Questions on Optical Detectors**

The section contains questions on device types, absorption, optical detection principles, quantum efficiency, semiconductor photodiodes, infrared photodiodes and metal semiconductors

This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Device Types”.

1. \_\_\_\_\_\_\_\_\_\_\_\_ converts the received optical signal into an electrical signal. a) Detector

1. Attenuator
2. Laser
3. LED View Answer

Answer: a

Explanation: A detector is an essential component of an optical fiber communication system. It dictates the overall system performance. Its function is to convert optical signal into an electrical signal. This electrical signal is then amplified before further processing.

2. The first generation systems of optical fiber communication have wavelengths between

\_\_\_\_\_\_\_\_\_\_\_

1. 0.2 and 0.3 μm
2. 0.4 and 0.6 μm
3. 0.8 and 0.9 μm
4. 0.1 and 0.2 μm View Answer

Answer: c

Explanation: The first generation systems operated at a bit-rate of 45 Mbps with repeater spacing of 10 km. It operates at wavelengths between 0.8 and 0.9μm. These wavelengths are compatible with AlGaAs laser and LEDs.

3. The quantum efficiency of an optical detector should be high. a) True

b) False View Answer

Answer: a

Explanation: The detector must satisfy stringent requirements for performance and compatibility. The photo detector thus produces a maximum electrical signal for a given amount of optical power; i.e. the quantum efficiency should be high.

4. Which of the following does not explain the requirements of an optical detector?

1. High quantum efficiency
2. Low bias voltages
3. Small size
4. Low fidelity View Answer

Answer: d

Explanation: The size of the detector must be small for efficient coupling to the fiber. Also, ideally, the detector should not require excessive bias voltages and currents. The fidelity and quantum efficiency should be high.

5. How many device types are available for optical detection and radiation? a) One

1. Two
2. Three
3. Four View Answer

Answer: b

Explanation: Two types of devices are used for optical detection and radiation. These are external photoemission and internal photoemission devices. External photoemission devices are too bulky and require high voltages for operation. Internal devices provide good performance and compatibility.

6. The \_\_\_\_\_\_\_\_\_\_\_ process takes place in both extrinsic and intrinsic semiconductors. a) Avalanche multiplication

1. External photoemission
2. Internal photoemission
3. Dispersion View Answer

Answer: c

Explanation: During intrinsic absorption, the received photons excite electrons from the valence band and towards the conduction band in the semiconductor. Extrinsic absorption involves impurity centers created with the material. Generally, intrinsic absorption is preferred for internal photoemission.

7. \_\_\_\_\_\_\_\_\_\_\_\_ are widely used in first generation systems of optical fiber communication. a) p-n diodes

1. 4-alloys
2. 3-alloys
3. Silicon photodiodes View Answer

Answer: d

Explanation: The first generation systems operates at wavelengths 0.8 and 0.9 μm. Silicon photodiodes have high sensitivity over the 0.8-0.9 μm wavelength band with adequate speed, long term stability. Hence, silicon photodiodes are widely used in first generation systems.

8. Silicon has indirect band gap energy of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. 1.2 eV
2. 2 eV
3. 1.14 eV
4. 1.9 eV View Answer

Answer: c

Explanation: Silicon’s indirect band gap energy of 1.14 eV gives a loss in response above 1.09μm. To avoid this, narrower bandgap materials are used. Hence, silicon’s usefulness is limited to first generation systems and not for second and third generation systems.

9. Which of the following detector is fabricated from semiconductor alloys?

1. Photoconductive detector
2. p-i-n detector
3. Photodiodes
4. Photoemission detectors View Answer

Answer: a

Explanation: The detectors fabricated from semiconductor alloys can be used for longer wavelengths. Photoconductive detector and hetero-junction transistor have found favor as a potential detector over a wavelength range of 1.1 to 1.6μm.

10. Silicon photodiodes provide high shunt conductance.

1. True
2. False View Answer

Answer: b

Explanation: Semiconductor photodiodes provide best solution for detection in optical fiber communications. Silicon photodiodes have high sensitivity, negligible shunt conductance and low dark current



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Optical Detection Principles”.

1. P-n photodiode is forward biased.

1. True
2. False View Answer

Answer: b

Explanation: p-n photodiode includes p and n regions. The electric field developed across the p-n junction sweeps holes and electrons to p and n regions respectively. P-n photodiode is thus reverse biased due to reverse leakage current.

2. The depletion region must be \_\_\_\_\_\_\_\_\_\_\_\_ to allow a large fraction of the incident light to be absorbed in the device(photodiode). a) Thick

1. Thin
2. Long
3. Inactive View Answer

Answer: a

Explanation: In p-n photodiode, intrinsic conditions are created in the depletion region. The depletion region must be thick in order to achieve maximum carrier pair generation. Also, its width must be limited to enhance the speed of operation of the p-n photodiode.

3. The process of excitation of an electron from valence band to conduction band leaves an empty hole in the valence band and is called as \_\_\_\_\_\_\_\_\_\_\_\_ a) Detection

1. Absorption
2. Degeneration of an electron-hole pair
3. Regeneration of an electron-hole pair View Answer

Answer: d

Explanation: A photon is incident in the depletion region of a device has an energy greater than or equal to the band gap energy of the fabricating material. This will cause excitation of an electron from valence to the conduction band. This creates an empty hole in valence band which is referred to as photo-generation of an electron-hole pair.

4. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ always leads to the generation of a hole and an electron. a) Repulsion

1. Dispersion
2. Absorption
3. Attenuation

View Answer

Answer: c

Explanation: Absorption affects the electron and excites it to some other level say conduction band. This is called as photo-generation as absorption always leads to the generation of hole and electron. This does not mean that both contribute to the electronic transport.

5. The electron hole pairs generated in a photodiode are separated by the \_\_\_\_\_\_\_\_\_\_\_\_ a) Magnetic field

1. Electric field
2. Static field
3. Depletion region View Answer

Answer: b

Explanation: Electric field separates the electron-hole pairs in a photodiode. The electric field distribution is determined by an internal and an external field component. A reverse bias voltage is usually applied to the p-n photodiode.

6. Electric field in the depletion region should be high.

1. True
2. False View Answer

Answer: a

Explanation: The electric field in the depletion region is always kept high in order to extract all photogenerated carriers. Only the extracted electron hole pairs contribute to the overall photocurrent.

7. The photocurrent of an optical detector should be \_\_\_\_\_\_\_\_\_\_ a) Less

1. More
2. Linear
3. Non-linear View Answer

Answer: c

Explanation: A linear relationship must exist between the intensity of the incident light and the photocurrent. This makes the photodiode free of noise. It increases system performance.

8. How many types of optical detectors are available?

1. One
2. Four
3. Two
4. Three

View Answer

Answer: d

Explanation: Three types of optical detectors are available. These are diodes, photoconductors and photo-transistors. Diodes include p-n photodiodes, p-i-n diodes, avalanche photodiodes and schottky diodes.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Absorption”.

1. The absorption of photons in a photodiode is dependent on \_\_\_\_\_\_\_\_\_\_

1. Absorption Coefficient α0
2. Properties of material
3. Charge carrier at junction
4. Amount of light View Answer

Answer: a

Explanation: Absorption in a photodiode is for producing carrier pans. Thus, photocurrent is dependent on absorption coefficient α 0of the light in semiconductor used to fabricate device.

2. The photocurrent in a photodiode is directly proportional to absorption coefficient. a) True

b) False View Answer

Answer: a

Explanation: The absorption of photons produces carrier pairs. Thus, photocurrent is dependent on absorption coefficient and is given by

I = Po e(1-h)/hf(1-exp (-α rd)) Where r = Fresnel coefficient D = width of absorption region.

3. The absorption coefficient of semiconductor materials is strongly dependent on \_\_\_\_\_\_\_\_\_\_ a) Properties of material

1. Wavelength
2. Amount of light
3. Amplitude View Answer

Answer: b

Explanation: In some common semiconductors, there is a variation in absorption curves for materials. It is found that they are each suitable for different wavelength and related applications. This is due to difference in band gap energies. Thus absorption coefficient depends on wavelength.

4. Direct absorption requires assistance of photon.

1. True
2. False View Answer

Answer: b

Explanation: Indirect absorption requires photon assistance resulting in conversation of energy and momentum. This makes transition probability less likely for indirect absorption than direct absorption where no photon is included.

5. In optical fiber communication, the only weakly absorbing material over wavelength band required is? a) GaAs

1. Silicon
2. GaSb
3. Germanium View Answer

Answer: c

Explanation: The transition over wavelength band in silicon is due to indirect absorption mechanism. This makes silicon weakly absorbent over particular wavelength band.

6. The threshold for indirect absorption occurs at wavelength \_\_\_\_\_\_\_\_\_\_ a) 3.01 μm

1. 2.09 μm
2. 0.92 μm
3. 1.09 μm View Answer

Answer: d

Explanation: The band gap for silicon is 4.10 eV corresponding to threshold of 0.30 μm in ultraviolet. Thus it’s outside wavelength range is the one which is required.

7. The semiconductor material for which the lowest energy absorption takes place is? a) GaAs

1. Silicon
2. GaSb
3. Germanium View Answer

Answer: d

Explanation: Germanium absorption is by indirect optical transition. The threshold for direct absorption is at 1.53μm. Below this, germanium becomes strongly absorbing to corresponding link.

8. The wavelength range of interest for Germanium is \_\_\_\_\_\_\_\_\_\_

1. 0.8 to 1.6 μm
2. 0.3 to 0.9 μm
3. 0.4 to 0.8 μm
4. 0.9 to 1.8 μm View Answer

Answer: a

Explanation: Germanium is used in fabrication of detectors over the whole wavelength range i.e. first and second generation 0.8 to 1.6 μm while specially taking into consideration that indirect absorption will occur up to a threshold of 1.85 μm.

9. A photodiode should be chosen with a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ less than photon energy. a) Direct absorption

1. Band gap energy
2. Wavelength range
3. Absorption coefficient View Answer

Answer: d

Explanation: A photodiode selection must be made by choosing that diode having band gap energy less than photon energy corresponding to longest operating wavelength. This provides high absorption coefficient which ensures a good response and limits the thermally generated carriers to obtain low dark current with no incident light.

10. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ photodiodes have large dark currents.

1. GaAs
2. Silicon
3. GaSb
4. Germanium View Answer

Answer: c

Explanation: Germanium photodiodes provide narrow band gaps as compared to other semiconductor materials. This is main disadvantage with use of germanium photodiodes at shorter wavelength and thus they have large dark current.

11. For fabrication of semiconductor photodiodes, there is a drawback while considering \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) GaAs

1. Silicon
2. GaSb
3. Germanium View Answer

Answer: d

Explanation: Due to drawback with germanium to be used as fabricating material, there is an increased investigation of direct band gap III and V alloys for longer wavelength region.

12. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ materials are potentially superior to germanium. a) GaAs

1. Silicon
2. GaSb
3. III – V alloys View Answer

Answer: d

Explanation: The band gap energies for III – V alloys materials can be tailored to required wavelength. This can be achieved by changing relative concentration of their constituents which results in low dark currents. Thus, III – V alloys are superior potentially to germanium.

13. \_\_\_\_\_\_\_\_\_\_\_\_ alloys such as InGaAsP and GaAsSb deposited on InP and GaSb substrate. a) Ternary

1. Quaternary
2. Gain-guided
3. III – V alloys View Answer

Answer: a

Explanation: Ternary alloys are used to fabricate photodiodes for longer wavelength band. Thus, these alloys such as InGaAsP and GaAsSb are deposited on InP and GaSb substrates.

14. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ alloys can be fabricated in hetero-junction structures. a) InGaSb

1. III – V alloys
2. InGaAsP
3. GaAsSb View Answer

Answer: b

Explanation: III – V alloys enhances the high speed operations of hetero-junction structures. Thus these structures can be fabricated with III-V alloys.

15. The alloys lattice matched to InP responds to wavelengths up to 1.7μm is? a) InAsSb

1. III – V alloys
2. InGaSb
3. InGaAs View Answer

Answer: d

Explanation: Although there were difficulties in growth of IOnGaAs alloys, the problems are now reduced. These alloys lattice matched to InP responding to wavelength around 1.7 μmare widely utilized for fabrication of photodiodes operating around 1.7μm.



This set of Optical Communications Mcqs focuses on “Quantum Efficiency , Responsivity and Long – Wavelength Cut-Off”.

1. The fraction of incident photons generated by photodiode of electrons generated collected at detector is known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) Quantum efficiency

1. Absorption coefficient
2. Responsivity
3. Anger recombination View Answer

Answer: a

Explanation: Efficiency of a particular device is obtained by ratio of input given to that of output obtained. Thus, similarly, in photodiode, input i.e. incident photon and output generated electrons and their ratio is quantum efficiency.

2. In photo detectors, energy of incident photons must be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ band gap energy. a) Lesser than

1. Greater than
2. Same as
3. Negligible View Answer

Answer: b

Explanation: While considering intrinsic absorption process, the energy of incident photon must be greater than band gap energy of material fabricating photo detector.

3. GaAs has band gap energy of 1.93 eV at 300 K. Determine wavelength above which material will cease to operate. a) 2.431\*10-5

1. 6.424\*10-7
2. 6.023\*103
3. 7.234\*10-7 View Answer

Answer: b

Explanation: The long wavelength cutoff is given by λc = hc/Eg = 6.6268\*10-34\*2.998\*108/1.93\*1.602\*10-19 = 6.424\*10-7μm.

4. The long cutoff wavelength of GaAs is 0.923 μm. Determine bandgap energy. a) 1.478\*10-7

1. 4.265\*10-14
2. 2.784\*10-9
3. 2.152\*10-19

View Answer

Answer: d

Explanation: Long wavelength cutoff of photo detector is given by λc = hc/Eg

Eg = hc/λc = 6.6268\*10-34\*2.998\*108/0.923\*10-6 = 2.152\*10-19eV.

5. Quantum efficiency is a function of photon wavelength.

1. True
2. False View Answer

Answer: a

Explanation: Quantum efficiency is less than unity as all of incident photons are not absorbed to create electrons holes pairs. For example quantum efficiency of 60% is equivalent to 60% of electrons collected per 100 photons. Thus efficiency is a function of photon wavelength and must be determined at a particular wavelength.

6. Determine quantum efficiency if incident photons on photodiodes is 4\*1011 and electrons collected at terminals is 1.5\*1011? a) 50%

1. 37.5%
2. 25%
3. 30% View Answer

Answer: b

Explanation: Quantum efficiency is given by

Quantum Efficiency = No. of electrons collected/No. of incident photons

= 1.5\*1011/4\*1011 = 0.375 \* 100 = 37.5%.

7. A photodiode has quantum efficiency of 45% and incident photons are 3\*1011. Determine electrons collected at terminals of device. a) 2.456\*109

1. 1.35\*1011
2. 5.245\*10-7
3. 4.21\*10-3 View Answer

Answer: b

Explanation: Quantum efficiency is given by

Quantum efficiency = No. of electrons collected/No. of incident photons

Electrons collected = Quantum efficiency \* number of incident photons = 45/100 \* 3\*1011 = 1.35\*1011.

8. The quantum efficiency of photodiode is 40% with wavelength of 0.90\*10-6. Determine the responsivity of photodiodes. a) 0.20

1. 0.52
2. 0.29
3. 0.55

View Answer

Answer: c

Explanation: Responsivity of photodiodes is given by

R = ηe λ/hc

= 0.4\*1.602\*10-19 \* 0.90\*10-6/6.626\*10-34 \* 3\*108 = 0.29 AW-1.

9. The Responsivity of photodiode is 0.294 AW-1at wavelength of 0.90 μm. Determine quantum efficiency. a) 0.405

1. 0.914
2. 0.654
3. 0.249 View Answer

Answer: a

Explanation: Responsivity of photodiode is

R = ηe λ/hc η = RXhc/eλ

= 0.294\*6.626\*10-34\*3\*108/ 1.602\*10-19\*0.90\*108 = 0.405 AW-1.

10. Determine wavelength of photodiode having quantum efficiency of 40% and Responsivity of 0.304 AW-1.

1. 0.87 μm
2. 0.91 μm
3. 0.88 μm
4. 0.94 μm View Answer

Answer: d

Explanation: The Responsivity of photodiode is R = ηe λ/hc λ = Rhc/ηe

= 0.304\*6.626\*10-34\*3\*108/0.4\*1.602\*10-19 = 0.94 μm.

11. Determine wavelength at which photodiode is operating if energy of photons is 1.9\*10-19J? a) 2.33

1. 1.48
2. 1.04
3. 3.91

View Answer

Answer: c

Explanation: To determine wavelength, λ = hc/t

= 6.626\*10-34\*3\*108/1.9\*10-19 = 1.04 μm.

12. Determine the energy of photons incident on a photodiode if it operates at a wavelength of 1.36 μm.

1. 1.22\*10-34J
2. 1.46\*10-19J
3. 6.45\*10-34J
4. 3.12\*109J View Answer

Answer: b

Explanation: The wavelength of photodiode is given by λ = hc/t E = hc/λ

= 6.626\*10-34\*3\*108/1.36\*10-6 = 1.46\*10-19J.

13. Determine Responsivity of photodiode having o/p power of 3.55 μm and photo current of 2.9 μm.

1. 0.451
2. 0.367
3. 0.982
4. 0.816 View Answer

Answer: d

Explanation: The Responsivity of photodiode is

R = Ip/Po

= 2.9\*10-6/3.55\*10-6 = 0.816 A/W.

14. Determine incident optical power on a photodiode if it has photocurrent of 2.1 μA and responsivity of 0.55 A/W. a) 4.15

1. 1.75
2. 3.81
3. 8.47 View Answer

Answer: c

Explanation: The Responsivity of photodiode is

R = Ip/Po

Po = Ip/R

= 2.1\*10-6/0.55 = 3.81 μm.

15. If a photodiode requires incident optical power of 0.70 A/W. Determine photocurrent. a) 1.482

1. 2.457
2. 4.124
3. 3.199 View Answer

Answer: b

Explanation: The Responsivity of photodiode is given by

R = Ip/Po

Ip = R\*Po

= 0.70\*3.51\*10-6

= 2.457μm



This set of Optical Communications Multiple Choice Questions & Answers focuses on “Semiconductor Photodiodes Without Internal Gain”.

1. The width of depletion region is dependent on \_\_\_\_\_\_\_\_\_\_\_ of semiconductor.

1. Doping concentrations for applied reverse bias
2. Doping concentrations for applied forward bias
3. Properties of material
4. Amount of current provided View Answer

Answer: a

Explanation: The depletion region is formed by immobile positively and immobile negatively charged donor and acceptor atoms in n- and p-type respectively. When carriers are swept towards majority side under electric field, lower the doping, wider the depletion region.

2. Electron-hole pairs are generated in \_\_\_\_\_\_\_\_\_\_\_

1. Depletion region
2. Diffusion region
3. Depletion region
4. P-type region

View Answer

Answer: c

Explanation: Photons are absorbed in both depletion and diffusion regions. The position and width of absorption region depends on incident photons energy. The absorption region may extend throughout device in weakly absorption of photons. Thus carriers are generated in both regions.

3. The diffusion process is \_\_\_\_\_\_\_\_\_\_\_\_\_ as compared with drift. a) Very fast

1. Very slow
2. Negligible
3. Better View Answer

Answer: b

Explanation: None.

4. Determine drift time for carrier across depletion region for photodiode having intrinsic region width of 30μm and electron drift velocity of 105 ms-1. a) 1×10-10 Seconds

1. 2×10-10 Seconds
2. 3×10-10 Seconds
3. 4×10-10 Seconds View Answer

Answer: c

Explanation: The drift time is given by tdrift = w/vd = 30×10-6/1×10-10 = 3×10-10 seconds.

5. Determine intrinsic region width for a photodiode having drift time of 4×10-10 s and electron velocity of 2×10-10ms-1. a) 3×10-5M

1. 8×10-5M
2. 5×10-5M
3. 7×10-5M View Answer

Answer: b

Explanation: The drift time is given by tdrift = w/vd

4×10-10 = w/2×105 = 4×10-10×2×105 = 8×10-5m.

6. Determine velocity of electron if drift time is 2×10-10s and intrinsic region width of 25×10-

6

μm.

1. 12.5×104
2. 11.5×104
3. 14.5×104
4. 13.5×104 View Answer

Answer: a

Explanation: The drift time is given by tdrift = w/vd vd = 25×10-6/2×10-10 = 12.5×104ms-1.

7. Compute junction capacitance for a p-i-n photodiode if it has area of 0.69×10-6m2, permittivity of 10.5×10-13Fcm-1 and width of 30μm. a) 3.043×10-5

1. 2.415×10-7
2. 4.641×10-4
3. 3.708×10-5 View Answer

Answer: b

Explanation: The junction capacitance is given by, Cj = εsA/w = 10.5×10-13×0.69×10-6/30×10-13 = 2.415×10-7F.

8. Determine the area where permittivity of material is 15.5×10-15Fcm-1 and width of 25×10-6 and junction capacitance is 5pF. a) 8.0645×10-5

1. 5.456×10-6
2. 3.0405×10-2
3. 8.0645×10-3 View Answer

Answer: d

Explanation: The junction capacitance is given by, Cj = εsA/ w = 5×10-12×25×10-6/15.5×10-15 = 8.0645×10-3m2.

9. Compute intrinsic region width of p-i-n photodiode having junction capacitance of 4pF and material permittivity of 16.5×10-13Fcm-1 and area of 0.55×10-6m2. a) 7.45×10-6

1. 2.26×10-7
2. 4.64×10-7
3. 5.65×10-6 View Answer

Answer: b

Explanation: The junction capacitance is given by,

Cj = εsA/ W w = εsA/Cj

= 16.5×10-13 × 0.55×10-6/4×10-12 = 2.26×10-7.

10. Determine permittivity of p-i-n photodiode with junction capacitance of 5pF, area of 0.62×10-6m2 and intrinsic region width of 28 μm.

1. 7.55×10-12
2. 2.25×10-10
3. 5×10-9
4. 8.5×10-12 View Answer

Answer: b

Explanation: The junction capacitance is given by, Cj = εsA/ W εs = Cj w/A = 5×10-12×28×10-6/0.62×10-6 = 2.25×10-10Fcm-1.

11. Determine response time of p-i-n photodiode if it has 3 dB bandwidth of 1.98×108Hz. a) 5.05×10-6sec

1. 5.05×10-7Sec
2. 5.05×10-7sec
3. 5.05×10-8Sec View Answer

Answer: c

Explanation: The maximum response time is

Maximum response time = 1/Bm = 1/1.98×108 = 5.05×10-9sec.

12. Compute maximum 3 dB bandwidth of p-i-n photodiode if it has a max response time of 5.8 ns.

1. 0.12 GHz
2. 0.14 GHz
3. 0.17 GHz
4. 0.13 GHz View Answer

Answer: c

Explanation: The maximum response time is Maximum response time = 1/Bm = 1/5.8×10-9 = 0.17 GHz.

13. Determine maximum response time for a p-i-n photodiode having width of 28×10-6m and carrier velocity of 4×104ms-1. a) 105.67 MHz

1. 180.43 MHz
2. 227.47 MHz
3. 250.65 MHz View Answer

Answer: c

Explanation: Maximum 3 dB bandwidth of photodiode is given by Bm = Vd/2ΠW = 4×10-4/2×3.14×28×10-6 = 227.47 MHz.

14. Determine carrier velocity of a p-i-n photodiode where 3dB bandwidth is1.9×108Hz and depletion region width of 24μm. a) 93.43×10-5

1. 29.55×10-3
2. 41.56×10-3
3. 65.3×10-4 View Answer

Answer: b

Explanation: Maximum 3 dB bandwidth of photodiode is given by

Bm = Vd/2ΠW

Vd = Bm × 2Π × W = 1.98×108×2Π×24×10-6 = 29.55×10-3.

15. Compute depletion region width of a p-i-n photodiode with 3dB bandwidth of 1.91×108and carrier velocity of 2×104ms-s. a) 1.66×10-5

1. 3.2×10-3
2. 2×10-5
3. 2.34×104 View Answer

Answer: a

Explanation: Maximum 3 dB bandwidth of photodiode is given by

Bm = Vd/2ΠW

W = Vd/Bm2Π

= 2×10-5/1.91×108×2Π = 1.66×10-5m



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Semiconductor Photodiodes With Internal Gain”.

1. \_\_\_\_\_\_\_\_\_\_\_ has more sophisticated structure than p-i-n photodiode.

1. Avalanche photodiode
2. p-n junction diode
3. Zener diode
4. Varactor diode View Answer

Answer: a

Explanation: Avalanche photodiode is second major type of detector in optical communications. This diode is more sophisticated so as to create a much higher electric field region.

2. The phenomenon leading to avalanche breakdown in reverse-biased diodes is known as

\_\_\_\_\_\_\_

1. Auger recombination
2. Mode hopping
3. Impact ionization
4. Extract ionization View Answer

Answer: c

Explanation: In depletion region, almost all photons are absorbed and carrier pairs are generated. So there comes a high field region where carriers acquire energy to excite new carrier pairs. This is impact ionization.

3. \_\_\_\_\_\_\_ is fully depleted by employing electric fields.

1. Avalanche photodiode
2. P-I-N diode
3. Varactor diode
4. P-n diode View Answer

Answer: a

Explanation: APD is fully depleted by electric fields more than 104V/m. This causes all the drifting of carriers at saturated limited velocities.

4. At low gain, the transit time and RC effects \_\_\_\_\_\_\_\_

1. Are negligible
2. Are very less
3. Dominate
4. Reduce gradually View Answer

Answer: c

Explanation: Low gain causes the dominance of transit time and RC effects. This gives a definitive response time and thus device obtains constant bandwidth.

5. At high gain, avalanche buildup time \_\_\_\_\_\_\_\_

1. Is negligible
2. Very less
3. Increases gradually
4. Dominates View Answer

Answer: d

Explanation: High gain causes avalanche buildup time to dominate. Thus the bandwidth of device decreases as increase in gain.

6. Often \_\_\_\_\_\_\_\_\_\_ pulse shape is obtained from APD.

1. Negligible
2. Distorted
3. Asymmetric
4. Symmetric View Answer

Answer: c

Explanation: Asymmetric pulse shape is acquired from APD. This is due to relatively fast rise time as electrons are collected and fall time dictated by transit time of holes.

7. Fall times of 1 ns or more are common.

1. False
2. True View Answer

Answer: b

Explanation: The use of suitable materials and structures give rise times between 150 and 200 ps. Thus fall times of 1 ns or more are common which in turn limits the overall response of device.

8. Determine Responsivity of a silicon RAPD with 80% efficiency, 0.7μm wavelength. a) 0.459

1. 0.7
2. 0.312
3. 0.42

View Answer

Answer: a

Explanation: The Responsivity of a RAPD is given by-

R = ηeλ/hc A/w where, η=efficiency, λ = wavelength, h = Planck’s constant.

9. Compute wavelength of RAPD with 70% efficiency and Responsivity of 0.689 A/w. a) 6μm

1. 7.21μm
2. 0.112μm
3. 3μm View Answer Answer: c

Explanation: The wavelength can be found from the Responsivity formula given by- R = ηeλ/hc. The unit of wavelength isμm.

10. Compute photocurrent of RAPD having optical power of 0.7 μw and responsivity of 0.689 A/W.

1. 0.23 μA
2. 0.489 μA
3. 0.123 μA
4. 9 μA View Answer

Answer: b

Explanation: The photocurrent is given byIP=P0R. Here IP = photocurrent, P0=Power, R = responsivity.

11. Determine optical power of RAPD with photocurrent of 0.396 μAand responsivity of 0.49 A/w.

1. 0.91 μW
2. 0.32 μW
3. 0.312 μW
4. 0.80 μW View Answer

Answer: d

Explanation: The photocurrent is given by IP = P0R. Here IP = photocurrent, P0 = Power, R = responsivity.

P0 = IP/R gives the optical power.

12. Determine the Responsivity of optical power of 0.4μW and photocurrent of 0.294 μA. a) 0.735

1. 0.54
2. 0.56
3. 0.21 View Answer

Answer: a

Explanation: The photocurrent is given by IP = P0R. Here IP = photocurrent, P0 = Power, R = responsivity.

R = IP/P0 gives the responsivity.

13. Compute multiplication factor of RAPD with output current of 10 μAand photocurrent of 0.369μA.

1. 25.32
2. 27.100
3. 43
4. 22.2 View Answer

Answer: b

Explanation: The multiplication factor of photodiode is given by- M = I/IP where I = output current, IP = photocurrent.

14. Determine the output current of RAPD having multiplication factor of 39 and photocurrent of 0.469μA.

1. 17.21
2. 10.32
3. 12.21
4. 18.29 View Answer

Answer: d

Explanation: The multiplication factor of photodiode is given by-

M = I/IP where I = output current, IP = photocurrent. I = M\*IP gives the output current inμA.

15. Compute the photocurrent of RAPD having multiplication factor of 36.7 and output current of 7μA.

1. 0.01 μA
2. 0.07 μA
3. 0.54 μA
4. 0.9 μA View Answer

Answer: a

Explanation: The multiplication factor of photodiode is given by-

M = I/IP where I = output current, IP = photocurrent. IP = I/M Gives the output current inμA.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Mid Infrared and Far Infrared Photodiodes”.

1. In the development of photodiodes for mid-infrared and far-infrared transmission systems, lattice matching has been a problem when operating at wavelengths \_\_\_\_\_\_\_\_\_\_\_\_ a) 1 µm

1. Greater than 2 µm
2. 2 µm
3. 0.5 µm View Answer

Answer: b

Explanation: Lattice matching for alloy materials is obtained at wavelengths above 2 µm. For example, a lattice-matched alloy material system (GaSb) was utilized in a p-i-n photodiode for high speed operation at wavelengths up to 2.3 µm.

2. What is generally used to accommodate a lattice mismatch?

1. Alloys
2. Attenuator
3. Graded buffer layer
4. APD array View Answer

Answer: c

Explanation: The use of indium alloy cause inherent problems of dislocation-induced junction leakage and low quantum efficiency. To avoid these problems, a compositionally graded buffer layer is used to accommodate a lattice mismatch.

3. HgCdTe material system is utilized to fabricate long-wavelength photodiodes. a) True

b) False View Answer

Answer: a

Explanation: HgCdTe family alloys allow resonant characteristics via hole ionization. Its band gap energy variation enables optical detection to far-infrared. Thus, this material can be used for fabrication of long-wavelength photodiodes.

4. Avalanche photodiodes based on HgCdTe are used for \_\_\_\_\_\_\_\_\_\_\_\_\_\_ in both the near and far infrared.

1. Dispersion
2. Dislocation
3. Ionization
4. Array applications View Answer

Answer: d

Explanation: Avalanche photodiodes based on HgCdTe are used for array applications. The materials of APDs based on HgCdTe possess uniform avalanche gain across an array. This variation in gain is variation in gain is lower in HgCdTe as compared with silicon.

5. The detection mechanism in \_\_\_\_\_\_\_\_\_\_\_\_ relies on photo excitation of electrons from confined states in conduction band quantum wells. a) p-i-n detector

1. Quantum-dot photo detector
2. p-n photodiode
3. Avalanche photodiodes View Answer

Answer: b

Explanation: Quantum-dot photo detector’s detection mechanism involves photo excitation of electrons. This process of photo excitation in photo detectors is similar to that in the Quantumdot semiconductor optical amplifier. The dots-in-well in Quantum-dot detector is called as DWELL structure.

6. When determining performance of a photo detector \_\_\_\_\_\_\_\_\_\_\_ is often used. a) No. of incident photon

1. No. of electrons collected
2. Responsivity
3. Absorption coefficient View Answer

Answer: c

Explanation: The expression for quantum efficiency does not include photon energy. Thus for characterizing performance of photo detector, Responsivity is used.

7. The important parameter for exciting an electron with energy required from valence band to conduction band is? a) Wavelength

1. Absorption coefficient
2. Responsivity
3. Band gap energy View Answer

Answer: a

Explanation: As wavelength of incident photon becomes longer, the photon energy is less than energy required to excite electron. Mostly parameters of photodiode are dependent on wavelength.

8. \_\_\_\_\_\_\_\_\_\_ is less than or unity for photo detectors.

1. Absorption coefficient
2. Band gap energy
3. Responsivity
4. Quantum efficiency View Answer

Answer: d

Explanation: Quantum efficiency determines the absorption coefficient of semiconductor material of photo detector. It is not all incident photons are absorbed to create electron-hole pairs. Thus quantum efficiency must be less than unity.

9. There must be improvement in \_\_\_\_\_\_\_\_\_\_ of an optical fiber communication system. a) Detector

1. Responsivity
2. Absorption Coefficient
3. Band gap energy View Answer Answer: a

Explanation: If proper and improved and highly efficient detector is utilized, it will then reduce the repeated stations. It will also lower down both capital investment and maintenance cost.



This set of Optical Communications online test focuses on “Phototransistors and Metal – Semiconductor – Metal Photodetectors”.

1. The \_\_\_\_\_\_\_\_\_\_\_\_\_ is photosensitive to act as light gathering element.

1. Base-emitter junction
2. Base-collector junction
3. Collector-emitter junction
4. Base-collector junction and Base-emitter junction View Answer

Answer: a

Explanation: Base-collector junction is photosensitive in n-p-n phototransistor and act as light gathering element. This light absorbed affects the base current and gives multiplication of primary photocurrent in device.

2. A large secondary current \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in n-p-n InGaAs phototransistor is achieved. a) Between base and collector

1. Between emitter and collector
2. Between base and emitter
3. Plasma View Answer

Answer: b

Explanation: The photo-generated holes are swept to the base. This increases the forward bias device. This generates secondary current between emitter and collector.

3. \_\_\_\_\_\_\_ emitter-base and collector-base junction capacitances is achieved by use of heterostructure along with \_\_\_\_\_\_\_\_\_ base resistance. a) Low, high

1. High, low
2. Low, low
3. High, negligible View Answer

Answer: c

Explanation: In hetero-structure, there is low doping level in emitter and collector which is coupled with heavy doping base. This is due low emitter-base and collector-base junction capacitance and low base resistance. This allows large current gain.

4. A \_\_\_\_\_\_\_\_ is created by hetero-junction at collector-base junction. a) Potential barrier

1. Depletion region
2. Parasitic capacitance
3. Inductance View Answer

Answer: a

Explanation: Potential barrier is created at emitter-base junction by hetero-junction. This eliminates hole junction from base. This is achieved when junction is forward-biased and provides good emitter-base efficiency.

5. Phototransistors based on hetero-junction using \_\_\_\_\_\_\_\_\_ material are known as waveguide phototransistors. a) InGaP

1. InGaAs
2. InGaAsP/ InAlAs
3. ErGaAs View Answer

Answer: c

Explanation: Phototransistor using InGaAsP/ InAlAs are known as waveguide phototransistors. They function as waveguide phototransistors. They function as high performance photo-detectors at 1.3 micro-meter wavelength. They utilize a passive waveguide layer under active transistor region.

6. A phototransistor has collector current of 18 mA, incident optical power of 128 μW with a wavelength of 1.24 μm. Determine an optical gain. a) 1.407 \*102

1. 19.407 \*102
2. 2.407 \*102
3. 3.407 \*102 View Answer

Answer: a

Explanation: The optical gain is given by-

G0=hcIc/λeP0, where h=Planck’s constant, Ic=collector current, λ=wavelength, P0=incident optical power.

7. For a phototransistor having gain of 116.5, wavelength of 1.28 μm, optical power 123μW. Determine collector current. a) 0.123 mA

1. 0.0149 mA
2. 1.23 mA
3. 0.54 mA View Answer

Answer: b

Explanation: The collector current is given by-

Ic= G0λeP0/ hc, where h=Planck’s constant, Ic=collector current, λ=wavelength, P0=incident optical power.

8. The detection mechanism in the \_\_\_\_\_\_\_\_\_\_\_\_ photo-detector includes inter sub-band transitions. a) Dwell

1. Set
2. Avalanche
3. Futile View Answer

Answer: a

Explanation: The inter sub-band transitions are also known as type-2 transitions. It comprises of mini-bands within a single energy band, The detection mechanism in DWELL photo-detector includes inter sub-band transitions.

9. Which of the following is the difference between the n-p-n and conventional bipolar transistor?

1. Electric property
2. Magnetic property
3. Unconnected base
4. Emitter base efficiency View Answer

Answer: c

Explanation: The n-p-n bipolar transistor differs in the following ways: base is unconnected, base-collector junction is photosensitive as a light gathering element.

10. The n-p-n hetero-junction phototransistor is grown using \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Liquid-phase tranquilizers
2. Liquid-phase epistaxis
3. Solid substrate
4. Hetero poleax View Answer

Answer: b

Explanation: The technique LPE consists of a thin layer of n-type collector based on a p-type base layer. Liquid phase epistaxis is used in hetero-junction technology.

11. The \_\_\_\_\_\_\_\_\_\_\_\_\_ at emitter-base junction gives good emitter base injection efficiency. a) Homo-junction

1. Depletion layer
2. Holes
3. Hetero-junction

View Answer

Answer: d

Explanation: The hetero-junction at the emitter-base junction effectively eliminates hole injection from the base when the junction is forward biased. This gives good emitter-base injection efficiency.

12. Waveguide phototransistors utilize a \_\_\_\_\_\_\_\_\_\_\_ waveguide layer under the \_\_\_\_\_\_\_\_\_ transistor region.

1. Active, passive
2. Passive, active
3. Homo, hetero
4. Hetero, homo View Answer

Answer: b

Explanation: Waveguide phototransistors are based on hetero-junction structure. They function as high-performance photo-detectors and thus utilize a passive waveguide layer under the active transistor region.

13. What is the main benefit of the waveguide structure over conventional hetero-junction phototransistor?

1. High depletion region
2. Depletion width
3. Increased photocurrent, responsivity
4. Low gain View Answer

Answer: c

Explanation: Waveguide structure offers increased photocurrent. Photocurrent is directly proportional to the responsivity; thus in turn increases responsivity.

14. Waveguide structure provides high quantum efficiency.

1. True
2. False View Answer

Answer: b

Explanation: Responsivity and quantum efficiency follow a different path. They are indirectly proportional to each other. Thus, in waveguide structure, as the responsivity increases, quantum efficiency remains low.

15. Metal-semiconductor-metal (MSM) photo-detectors are photoconductive detectors. a) True

b) False

View Answer

Answer: a

Explanation: MSM photo-detectors are the simplest of photo-detectors. It provides the simplest form of photo-detection within optical fiber communications and are photoconductive.



**7. Questions & Answers on Direct Detection Receiver Performance Considerations**

The section contains questions and answers on noise, receiver noise and structures, fet pre amplifiers and high performance receivers.

This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Noise”.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_ refers to any spurious or undesired disturbances that mask the received signal in a communication system. a) Attenuation

1. Noise
2. Dispersion
3. Bandwidth View Answer

Answer: b

Explanation: Noise is an unwanted and undesirable quantity. It affects the received signal in a communication system. In optical fiber communication systems, noise is due to the spontaneous fluctuations rather than erratic disturbances.

2. How many types of noise are observed because of the spontaneous fluctuations in optical fiber communication systems? a) One

1. Four
2. Two
3. Three View Answer

Answer: d

Explanation: There are three types of noise because of the spontaneous fluctuations in optical fiber communication systems. These are thermal noise, the dark current noise and quantum noise. These noise types are not caused by the electronic interference.

3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is caused due to thermal interaction between the free electrons and the vibrating ions in the conduction medium. a) Thermal noise

1. Dark noise
2. Quantum noise
3. Gaussian noise View Answer Answer: a

Explanation: Thermal noise is basically a spontaneous fluctuation caused due to thermal interaction of electrons and ions. It is especially prevalent in resistors at room temperature. Thermal noise is measured in the form of current and is called as thermal noise current.

4. A small leakage current still flows from the device terminals even if there is no optical power incident on the photo detector. a) True

b) False View Answer

Answer: a

Explanation: A reverse leakage current that flows from the device terminals is called as dark current. This dark current contributes to the total system noise. This gives random fluctuations about the average particle flow of the photocurrent.

5. \_\_\_\_\_\_\_\_\_\_\_ distribution provides the description the random statistics of light emitted in black body radiation. a) Poisson

1. Cumulative
2. Probability
3. Bose-Einstein View Answer

Answer: d

Explanation: Incoherent light is emitted by independent atoms and therefore there is no phase relationship between the emitted photons. The property dictates an exponential intensity distribution which is identical to Bose-Einstein distribution.

6. The probability of zero pairs being generated when a light pulse is present is given by which of the following equation? a) P(0/1) = exp(-Zm)

1. P(x) = exp (Zm)
2. P(y) = x (0) + x(1)
3. P(z) = P(-Zm) View Answer

Answer: a

Explanation: The probability of zero pairs being generated when a light pulse is present is given by equation – P (0/1) = exp(-Zm)

Where, P (0/1) represents the system error probability p(e) and Zm is variance of the probability distribution.

7. The minimum pulse energy needed to maintain a given bit-error-rate (BER) which any practical receiver must satisfy is known as \_\_\_\_\_\_\_\_\_\_\_

1. Minimal energy
2. Quantum limit
3. Point of reversed
4. Binary signaling View Answer

Answer: b

Explanation: A perfect photo detector emits no electron-hole pairs in the absence of illumination. The error probability determines a standardized fundamental limit in digital optical communications. This limit is termed as quantum limit.

8. A digital optical fiber communication system requires a maximum bit-error-rate of 10-9. Find the average number of photons detected in a time period for a given BER. a) 19.7

1. 21.2
2. 20.7
3. 26.2 View Answer

Answer: c

Explanation: The probability of error is given by-

P(e) = exp(-Zm)

Where, Zm = No. of photons

Here P(e) = 10-9, therefore Zm is calculated from above relation.

9. For a given optical fiber communication system, P(e) = 10-9, Zm = 20.7, f = 2.9×1014, η = 1. Find the minimum pulse energy or quantum limit. a) 3.9×10-18

1. 4.2×10-18
2. 6.2×10-14
3. 7.2×10-14 View Answer

Answer: a

Explanation: The minimum pulse energy or quantum limit is given by –

Emin = Zmhf/η

Where, Zm = Number of photons

h = Planck’s constant f = frequency η = Quantum efficiency.

10. An analog optical fiber system operating at wavelength 1μmhas a post-detection bandwidth of 5MHz. Assuming an ideal detector and incident power of 198 nW, calculate the SNR (f = 2.99×1014Hz).

1. 46
2. 40
3. 50
4. 52

View Answer

Answer: c

Explanation: The SNR is given by –

S/N = ηP0/2hfB

Where, η = 1 (for ideal detector) P0 = incident power h = Planck’s constant B = Bandwidth.

11. The incident optical power required to achieve a desirable SNR is 168.2nW. What is the value of incident power in dBm? a) -37.7 dBm

1. -37 dBm
2. – 34 dBm
3. -38.2 dBm View Answer

Answer: a

Explanation: Incident power in denoted by P0. It is given by –

P0 = 10log10(P0(watts))

Where P0(watts) = incident power in Watts/milliWatt.

12. In the equation given below, what does τstands for?

Zm = ηP0τ/hf

1. Velocity
2. Time
3. Reflection
4. Refractive index View Answer

Answer: b

Explanation: In the given equation, Zm is the variance of the probability distribution. The number of electrons generated in time τis equal to the average of the number of photons detected over this time period Zm. Hence, τ is the time and P0 is the incident power, ηis the quantum efficiency and f is the frequency.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Receiver Noise”.

1. Which are the two main sources of noise in photodiodes without internal gain?

1. Gaussian noise and dark current noise
2. Internal noise and external noise
3. Dark current noise & Quantum noise
4. Gaussian noise and Quantum noise View Answer

Answer: c

Explanation: The two main sources of noise in photodiodes without internal gain are dark current noise and quantum noise. They are regarded as shot noise on the photocurrent. These noise are together called as analog quantum noise.

2. The dominating effect of thermal noise over the shot noise in photodiodes without internal gain can be observed in wideband systems operating in the range of \_\_\_\_\_\_\_\_ a) 0.4 to 0.5 μm

1. 0.8 to 0.9 μm
2. 0.3 to 0.4 μm
3. 0.7 to 0.79 μm View Answer

Answer: b

Explanation: When the photodiode is without internal avalanche gain, the detector load resistor and active elements’ thermal noise in the amplifier tends to dominate. It is seen in wideband systems operating in the 0.8 to 0.9 μmwavelength band. This is because the dark currents in the silicon diodes can be made very small.

3. A silicon p-i-n photodiode incorporated in an optical receiver has following parameters:

Quantum efficiency = 70%

Wavelength = 0.8 μm

Dark current = 3nA

Load resistance = 4 kΩ

Incident optical power = 150nW.

Bandwidth = 5 MHz

Compute the photocurrent in the device. a) 67.7nA

1. 81.2nA
2. 68.35nA
3. 46.1nA View Answer

Answer: a

Explanation: The photocurrent is given by

Ip = ηP0eλ/hc

Where η = Quantum efficiency P0 = Incident optical power e = electron charge λ = Wavelength

h = Planck’s constant c = Velocity of light.

4. In a silicon p-i-n photodiode, if load resistance is 4 kΩ, temperature is 293 K, bandwidth is 4MHz, find the thermal noise in the load resistor. a) 1.8 × 10-16A2

1. 1.23 × 10-17A2
2. 1.65 × 10-16A2
3. 1.61 × 10-17A2 View Answer

Answer: d

Explanation: The thermal noise in the load resistor is given by – it2 = 4KTB/RL Where T = Temperature B = Bandwidth

RL = Load resistance.

5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a combination of shunt capacitances and resistances. a) Attenuation

1. Shunt impedance
2. Shunt admittance
3. Thermal capacitance View Answer

Answer: c

Explanation: Admittance is a measure of how easily a circuit will allow a current to flow. It is the inverse of impedance and is measured in Siemens. It is a combination of shunt capacitances and resistances.

6. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is used in the specification of optical detectors.

1. Noise equivalent power
2. Polarization
3. Sensitivity
4. Electron movement View Answer

Answer: a

Explanation: Noise equivalent power is defined as the amount of incident optical power per unit bandwidth required to produce an output power equal to detector output noise power.

Noise equivalent power is the value of incident power which gives an output SNR of unity.

7. A photodiode has a capacitance of 6 pF. Calculate the maximum load resistance which allows an 8MHz post detection bandwidth. a) 3.9 kΩ

1. 3.46 kΩ
2. 3.12 kΩ
3. 3.32 kΩ View Answer

Answer: d

Explanation: The load resistance is given by-

RL = 1/2πCdB

Where

B = Post detection bandwidth Cd = Input capacitance RL = Load resistance.

8. The internal gain mechanism in an APD is directly related to SNR. State whether the given statement is true or false. a) True

b) False View Answer

Answer: a

Explanation: The internal gain mechanism in an APD increases the signal current into the amplifier. This improves the SNR because the load resistance and amplifier noise remains unaffected.

9. \_\_\_\_\_\_\_\_\_\_\_\_ is dependent upon the detector material, the shape of the electric field profile within the device. a) SNR

1. Excess avalanche noise factor
2. Noise gradient
3. Noise power View Answer

Answer: b

Explanation: Excess avalanche noise factor is represented as F (M). Its value depends upon the detector material, shape of electric field profile and holes and electrons inclusion. It is a function of multiplication factor.

10. For silicon APDs, the value of excess noise factor is between \_\_\_\_\_\_\_\_\_ a) 0.001 and 0.002

1. 0.5 and 0.7
2. 0.02 and 0.10
3. 1 and 2 View Answer

Answer: c

Explanation: The excess noise factor (K) is same as that of the multiplication factor. In case of holes, the smaller values of K produce high performance and therefore the performance is achieved when k is small. For silicon APDs, k = 0.02 to 0.10.

11. \_\_\_\_\_\_\_\_\_\_ determines a higher transmission rate related to the gain of the APD device. a) Attenuation

1. Gain-bandwidth product
2. Dispersion mechanism
3. Ionization coefficient View Answer

Answer: b

Explanation: Gain-bandwidth product is defined as Gain multiplied by the bandwidth. Gain is a dimensionless quantity but the gain-bandwidth product is therefore measured in the units of frequency.

12. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ APDs are recognized for their high gain-bandwidth products. a) GaAs

1. Alloy-made
2. Germanium
3. Silicon View Answer

Answer: d

Explanation: Silicon APDs possess a large asymmetry of electron and hole ionization coefficient. Thus, they possess high gain-bandwidth products. These APDs do not operate at high transmission rates.

13. APDs do not operate at signal wavelengths between 1.3 and 1.6μm. a) True

b) False View Answer

Answer: a

Explanation: APDs having high gain-bandwidth products do not operate at signal wavelengths between 1.3 and 1.6 μm.Hence, these APDs are not prefered for use in receivers operating at high transmission rates.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “FET Pre – Amplifiers”.

1. \_\_\_\_\_\_\_\_\_\_\_\_ is the lowest noise amplifier device.

1. Silicon FET
2. Amplifier-A
3. Attenuator
4. Resonator-B View Answer Answer: a

Explanation: FET operates by controlling the current flow with an electric field produced by an applied voltage on the gate of the device. Silicon FET is fabricated for low noise devices. It is the lowest noise amplifier device available.

2. FET device has extremely high input impedance greater than \_\_\_\_\_\_\_\_\_

1. 107 Ohms and less than 108
2. 106 Ohms and less than 107
3. 1014 Ohms
4. 1023 Ohms View Answer

Answer: c

Explanation: FET operation involves the applied voltage on the gate of the device. The gate draws virtually no current, except for leakage, giving the device extremely high input impedance.

3. The properties of a bipolar transistor are superior to the FET. a) True

b) False View Answer

Answer: b

Explanation: bipolar transistor operates by controlling the current flow with an electric field produced with a base current. The properties of a bipolar transistor are limited by its high transconductance than the FET.

4. Bipolar transistor is more useful amplifying device than FET at frequencies \_\_\_\_\_\_\_\_\_\_\_\_\_ a) Above 1000 MHz

1. Equal to 1 MHz
2. Below 25 MHz
3. Above 25 MHz View Answer

Answer: d

Explanation: In FETs, the current gain drops to values near unity at frequencies above 25MHz. The trans-conductance is fixed with decreasing input impedance. Therefore, bipolar transistor is more useful amplifying device at frequencies above 25MHz.

5. High-performance microwave FETs are fabricated from \_\_\_\_\_\_\_\_\_\_\_ a) Silicon

1. Germanium
2. Gallium arsenide
3. Zinc

View Answer

Answer: c

Explanation: Since the mid- 1970s, the development of high-performance microwave FETs found its way. These FETs are fabricated from gallium arsenide and are called as GaAs metal Schottky field effect transistors (MESFETs).

6. Gallium arsenide MESFETs are advantageous than Silicon FETs. a) True

b) False View Answer

Answer: a

Explanation: Gallium arsenide MESFETs are Schottky barrier devices. They operate with both low noise and high gain at microwave frequencies (GHz). Silicon FETs cannot operate with wide bands.

7. The PIN-FET hybrid receivers are a combination of \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Hybrid resistances and capacitances
2. Pin photodiode and low noise amplifier (GaAs MESFETs)
3. P-N photodiode and low noise amplifier (GaAs MESFETs)
4. Attenuator and low noise amplifier (GaAs MESFETs) View Answer

Answer: b

Explanation: The PIN-FET or p-i-n/FET receiver utilizes a p-i-n photodiode along with a low noise preamplifier (GaAs MESFETs). It is fabricated using thick-film integrated circuit technology. This hybrid integration reduces the stray capacitance to negligible levels.

8. PIN-FET hybrid receiver is designed for use at a transmission rate of \_\_\_\_\_\_\_\_\_\_\_\_\_ a) 130 Mbits-1

1. 110 Mbits-1
2. 120 Mbits-1
3. 140 Mbits-1 View Answer

Answer: d

Explanation: At 140 Mbits-1, the performance of PIN-FET hybrid receiver is found to be comparable to germanium and alloy APD receivers. A digital equalizer is necessary as the highimpedance front end effectively integrates the signal at 140 Mbits-1.

9. It is difficult to achieve higher transmission rates using conventional \_\_\_\_\_\_\_\_\_\_ a) Voltage amplifier

1. Waveguide Structures
2. PIN-FET or APD receivers
3. MESFET View Answer Answer: c

Explanation: It is difficult to achieve higher transmission rates due to limitations in their gain bandwidth products. Also, the trade-off between the multiplication factor requirement and the bandwidth limits the performance of conventional receivers.

10. Which receiver can be fabricated using PIN-FET hybrid approach?

1. Trans-impedance front end receiver
2. Gallium arsenide receiver
3. High-impedance front-end
4. Low-impedance front-end View Answer

Answer: a

Explanation: Trans-impedance front-end receivers are fabricated using the PIN-FET hybrid approach. An example of such receivers consists of a GaAs MESFET and two complementary bipolar microwave transistors.

11. A silicon p-i-n photodiode utilized with the amplifier and the receiver is designed to accept data at a rate of \_\_\_\_\_\_\_\_\_\_\_

1. 276Mbits-1
2. 274 Mbits-1
3. 278Mbits-1
4. 302Mbits-1 View Answer

Answer: b

Explanation: A silicon p-i-n photodiode is used with the low-noise preamplifier. This preamplifier is based on a GaAs MESFET. Thus, a receiver using p-i-n photodiode accepts a data rate of 274 Mbits-1 giving a sensitivity around -35dBm.

12. What is usually required by FETs to optimize the figure of merit?

1. Attenuation of barrier
2. Matching with the depletion region
3. Dispersion of the gate region
4. Matching with the detector View Answer

Answer: d

Explanation: Total capacitance is given by Ct = Cd + Ca. The figure of merit is optimized when Cd=Ca. This requires FETs to be matched with the detectors. This requires FETs to be matched with the detectors. This procedure is usually not welcomed by the device and is not permitted in current optical receiver design



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “High Performance Receivers”.

1. How many design considerations are considered while determining the receiver performance? a) Three

1. Two
2. One
3. Four View Answer

Answer: a

Explanation: Three main considerations are utilized for determining the receiver performance. Noise performance is a major design consideration providing a limitation to the sensitivity. Other two considerations are bandwidth and dynamic range.

2. FET preamplifiers provide higher sensitivity than the Si-bipolar device. a) True

b) False View Answer

Answer: a

Explanation: At low speeds, the FET preamplifiers provide higher sensitivity than the Si-bipolar device. It is apparent that below 10Mbits-1the Si MOSFET preamplifier provides a lower noise performance than GaAs MESFET.

3. What is the abbreviation of HBT?

1. Homo-junction unipolar transistor
2. Homo-junction bipolar transistor
3. Hetero-junction bipolar transistor
4. Hetero-Bandwidth transcendence View Answer

Answer: c

Explanation: HBT is abbreviated as Hetero-junction bipolar transistor. It comprises a selectively doped hetero-junction FET. It is a high-speed, low-noise transistor device.

4. What type of receivers are used to provide wideband operation, low-noise operation? a) APD optical receivers

1. Optoelectronic integrated circuits (OEICs)
2. MESFET receivers
3. Trans-impedance front-end receivers View Answer

Answer: b

Explanation: A strategy for the provision of wideband, low-noise receivers involves the use of pi-n photodiode detector along with the monolithic integration of the device with semiconductor alloy FETs. It has an operating wavelength of 1.1 to 1.6 μmranges.

5. \_\_\_\_\_\_\_\_\_\_\_ circuits extends the dynamic range of the receiver.

1. Monolithic
2. Trans-impedance
3. Automatic Error Control (AEC)
4. Automatic Gain Control (AGC) View Answer

Answer: d

Explanation: AGC circuit extends the dynamic range by diverting excess photocurrent away from the input of the receiver. The receiver dynamic range is an important performance parameter as it provides a measure of the difference between the sensitivity and its overload level.

6. The sensitivity of the low-impedance configuration is \_\_\_\_\_\_\_\_\_\_\_\_ a) Good

1. Poor
2. Great
3. Same as that of high-impedance configuration View Answer

Answer: b

Explanation: A receiver saturation level is determined by the value of the photodiode bias resistor. The photodiode bias resistor valve is indirectly proportional to the sensitivity but is directly proportional in low impedance configuration. The low resistor value provides less sensitivity in the low-impedance configuration.

7. What is generally used to determine the receiver performance characteristics? a) Noise

1. Resistor
2. Dynamic range & sensitivity characteristics
3. Impedance View Answer

Answer: c

Explanation: Dynamic range and sensitivity characteristics involve a graph of received power level and the value of feedback resistor. The high value of photodiode bias resistor in the high impedance front end causes high sensitivity and a narrow dynamic range. These factors prove useful for determining the performance characteristics of receiver.

8. The \_\_\_\_\_\_\_\_\_\_ technique eliminates the thermal noise associated with the feedback resistor in the trans-impedance front end design. a) Compensation

1. Resonating impedance
2. Electromagnetic
3. Optical feedback

View Answer

Answer: d

Explanation: The optical feedback strategy proves most useful at low transmission rate. The use of optically coupled feedback has demonstrated dynamic ranges of around 40 dB for p-i-n receivers operating at modest bit rates. It removes thermal noise associated with the feedback resistor.

9. The removal of the feedback resistor in the optical feedback technique allows reciever sensitivity of the order of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) -54 dBm at 2Mbit/sec

1. -12 dBm at 2Mbit/sec
2. -64 dBm at 2Mbit/sec
3. -72 dBm at 2Mbit/sec View Answer

Answer: c

Explanation: The removal of feedback resistor in the optical feedback technique allows low noise performance. Low noise performance, in turn, affects sensitivity. The receiver sensitivity gets high of the order of -64 dBm at 2Mbit/sec transmission rates.

10. The optical feedback technique is useful at low transmission rates. a) True

b) False View Answer

Answer: a

Explanation: The optical feedback technique is useful at low transmission rates because in this case the feedback resistors employed are smaller than the optimum value for low-noise performance. This is done to maintain the resistor at a practical size of 1MΩ. Large values of feedback resistor limits the dynamic range.

11. How many types of optical amplifier technologies are available. a) One

1. Three
2. Four
3. Two View Answer

Answer: d

Explanation: There are two basic optical amplifier technologies available. They are semiconductor optical amplifiers and fiber amplifiers. Both these devices are utilized in the preamplification role.

12. The optimum filter bandwidth is typically in the range \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ a) 0.1 to 0.3 nm

1. 0.5 to 3 nm
2. 0.1 to 0.3 μm
3. 0.5 to 3 μm View Answer

Answer: b

Explanation: The optimum fiber bandwidth is determined by detector noise, transmission rate and the transmitter chirp characteristics. It is typically in the range of 0.5 to 3 nmas it depends upon the filter insertion loss.



**8. Questions on Optical Amplification , Wavelength Conversion and Regeneration**

The section contains questions and answers on semiconductor optical amplifiers, fiber and waveguide amplifiers and conversion.

This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Optical Amplifiers – Semiconductor Optical Amplifiers”.

1. For linear as well as in nonlinear mode \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are most important network elements.

1. Optical amplifier
2. Optical detector
3. A/D converter
4. D/A converters View Answer

Answer: a

Explanation: In single-mode fiber system, signal dispersion is very small, hence there is attenuation. These systems don’t require signal regeneration as optical amplification is sufficient so optical amplifier are most important.

2. The more advantages optical amplifier is \_\_\_\_\_\_\_\_\_\_\_\_

1. Fiber amplifier
2. Semiconductor amplifier
3. Repeaters
4. Mode hooping amplifier View Answer

Answer: b

Explanation: Semiconductor optical amplifiers are having smaller size. They can be integrated to produce subsystems. Thus are more profitable than other optical amplifier.

3. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cannot be used for wideband amplification.

1. Semiconductor optical amplifier
2. Erbium-doped fiber amplifier
3. Raman fiber amplifier
4. Brillouin fiber amplifier

View Answer

Answer: d

Explanation: Brillouin fiber amplifiers provide a very narrow spectral bandwidth. These bandwidth can be around 50 MHz, hence cannot be employed for wideband amplification.

4. \_\_\_\_\_\_\_\_\_\_\_\_ is used preferably for channel selection in a WDM system.

1. Semiconductor optical amplifier
2. Erbium-doped fiber amplifier
3. Raman fiber amplifier
4. Brillouin fiber amplifier View Answer

Answer: d

Explanation: Brillouin fiber provides amplification of a particular channel. This amplification can be done without boosting other channels besides that particular channel.

5. For used in single-mode fiber \_\_\_\_\_\_\_\_\_\_ are used preferably.

1. Semiconductor optical amplifier
2. Erbium-doped fiber amplifier
3. Raman fiber amplifier
4. Brillouin fiber amplifier View Answer

Answer: a

Explanation: Semiconductor optical amplifiers have low power consumption. There single mode structure makes them appropriate and suitable for used in single mode fiber.

6. Mostly \_\_\_\_\_\_\_\_\_\_\_\_ are used in nonlinear applications.

1. Semiconductor optical amplifier
2. Erbium-doped fiber amplifier
3. Raman fiber amplifier
4. FPAs View Answer

Answer: d

Explanation: FPAs have a resonant nature. This can be combined with their high internal fields. They provide pulse shaping and bi-stable elements. Thus, are used widely in nonlinear application.

7. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is superior as compared to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. TWA, FPA
2. FPA, TWA
3. EDFA, FPA
4. FPA, EDFA View Answer Answer: a

Explanation: In TWA operating in single-pass amplification mode, the Fabry-Perot resonance is suppressed by facet reflectivity reduction. This affects in increasing of amplifier spectral bandwidth. This makes them less dependence of transmission characteristics on fluctuations in biased current, input signal polarization. Thus FPA are superior to TWA.

8. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ are operated at current beyond normal lasing threshold current, practically. a) Semiconductor optical amplifier

1. Erbium-doped fiber amplifier
2. Raman fiber amplifier
3. Brillouin fiber amplifier View Answer

Answer: a

Explanation: The anti-reflection facet coatings affects in the form of increasing lasing current threshold. This causes SOAs to be operated at current beyond normal lasing threshold current.

9. An uncoated FPA has peak gain wavelength 1.8μm, mode spacing of 0.8nm, and long active region of 300 v. Determine RI of active medium. a) 4.25×106

1. 3.75×107
2. 3.95×107
3. 4.25×109 View Answer

Answer: b

Explanation: n=λ2/2δλL=1.8×10-6/2×0.8×10-9×300×10-6=3.75×107.

10. Determine the peak gain wavelength of uncoated FPA having mode spacing of 2nm,and 250μmlong active region and R.I of 3.78. a)2.25×10-4

1. 4.53×10-8
2. 1.94×10-6
3. 4.25×109 View Answer

Answer: c

Explanation: The peak gain wavelength is given by λ2=n2δλL=3.78×2×2×10-9×250×10-6=1.94×10-6m.

11. An SOA has net gain coefficient of 300, at a gain of 30dB. Determine length of SOA. a) 0.32 m

1. 0.023 m
2. 0.245 m
3. 0.563 m View Answer Answer: b

Explanation: The length of SOA is determined by

L = Gs(dB)/10×g×loge = 30/10×300×0.434`= 0.023 m.

12. An SOA has length of 35.43×10-3m, at 30 dB gain. Determine net gain coefficient. a) 5.124×10-3

1. 1.12×10-4
2. 5.125×10-3
3. 2.15×10-5 View Answer

Answer: c

Explanation: The net gain coefficient of SOA is given by g = L×10×loge/Gs(dB) = 35.43×10-3×10×0.434/30 =5.125×10-3.

13. An SOA has mode number of 2.6, spontaneous emission factor of 4, optical bandwidth of 1 THz. Determine noise power spectral density. a) 1.33×10-3

1. 5.13×1012
2. 3.29×10-6
3. 0.33×10-9 View Answer

Answer: a

Explanation: The noise power spectral density Past is

Past = mnsp(Gs-1) hfb

= 2.6×4(1000-1)×6.63×10-34×1.94×1014×1×1012 = 1.33×10-3W.

14. An SOA has noise power spectral density of 1.18mW, spontaneous emission factor of 4, optical bandwidth of 1.5 THz. Determine mode number. a) 1.53 × 1028

1. 6.14 × 1012
2. 1.78 × 1016
3. 4.12 × 10-3 View Answer

Answer: a

Explanation: The mode number is determined by

m = Past/nsp(Gs-1) hfB

= 1.18×10-3/4(1000-1)×6.63×10-34×1.94×1014×1.3×1012 = 1.53 × 10-34.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Fiber and Waveguide Amplifiers”.

1. The spectral dependence on gain is always constant.

1. True
2. False View Answer

Answer: b

Explanation: The spectral dependence on gain is mostly not constant. Thus the spectral bandwidth for erbium-doped silica fibers is restricted to around 300 GHz.

2. ESA \_\_\_\_\_\_\_\_ the pumping efficiency of device.

1. Increases
2. Does not affects
3. Reduces
4. Has negligible effect on View Answer

Answer: c

Explanation: In erbium fiber amplifier photons at pump wavelength promotes the electrons in upper lasing level into a high state of excitation. These electrons decay non-radiate to intermediate levels and then back to upper lasing level thereby reducing pumping efficiency.

3. Signal amplification is obtained in \_\_\_\_\_\_\_\_\_\_\_\_

1. Erbium-doped fluoro-zir-carbonate fiber multimode
2. Rare-earth-doped fiber amplifiers
3. Raman fiber systems
4. Brillouin fiber amplifier View Answer

Answer: a

Explanation: To avoid excited state absorption (ESA). We should use different glass technology in place by using a 488 nmpump wavelength; erbium-doped multimode fluoro zir carbonate fiber provides gain at 1.525 μmwavelengths.

4. It is possible to construct a single rare-earth-doped fiber amplifier which provides amplification for all-bands. a) True

b) False View Answer

Answer: b

Explanation: Each material has different absorption emission properties to absorb energy either in single or multi steps. Also it possesses property to emit light in one or more narrow spectral ranges. Thus we cannot construct a single earth-doped fiber for all bands.

5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is constructed using erbium-doped glass.

1. An erbium-based micro fiber amplifier
2. Rare-earth-doped fiber amplifiers
3. Raman fiber systems
4. Brillouin fiber amplifier View Answer

Answer: a

Explanation: As compared to other glass, erbium-based micro fiber amplifier is more advantageous. This amplifier provides high optical gain over just a few centimeters of fiber over many meters.

6. \_\_\_\_\_\_\_\_\_\_\_\_ uses Er3+-doped erbium glass.

1. An erbium-based micro fiber amplifier
2. Rare-earth-doped fiber amplifiers
3. Raman fiber systems
4. Brillouin fiber amplifier View Answer

Answer: a

Explanation: The erbium-based micro fiber amplifier uses Er3+-doped erbium glass. It supports the doping constructions of erbium ions at high levels as compared to conventional glasses.

7. The most advantageous amplification is \_\_\_\_\_\_\_\_\_\_\_\_

1. An erbium-based micro fiber amplifier
2. Rare-earth-doped fiber amplifiers
3. Raman fiber systems
4. Brillouin fiber amplifier View Answer

Answer: c

Explanation: As compared to all the amplifications, Raman amplification is more advantageous. It has self-phase matching between pump of signal together with broad gain bandwidth as compared to other nonlinear processes.

8. \_\_\_\_\_\_\_\_\_ is also known as lump Raman amplifiers.

1. An erbium-based micro fiber amplifier
2. Rare-earth-doped fiber amplifiers
3. Raman fiber systems
4. Discrete Raman amplifiers View Answer

Answer: d

Explanation: Discrete Raman Amplifiers are lumped elements. This lumped element is to be inserted in transmission line to provide gain.

9. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ extends the pump power into transmission line fiber.

1. An erbium-based micro fiber amplifier
2. Rare-earth-doped fiber amplifiers
3. Raman fiber systems
4. Distributed Raman amplification View Answer

Answer: d

Explanation: In Distributed Raman amplification, all pump power is confined to lumped element. And it is distributed when the amplification takes place among several kilometers.

10. \_\_\_\_\_\_\_\_\_\_\_\_\_ are called hybrid Raman amplifier.

1. Lumped and distributed Raman Amplifiers
2. Rare-earth-doped fiber amplifiers
3. Raman fiber systems
4. Distributed Raman amplification View Answer

Answer: a

Explanation: Lumped and distributed Raman Amplifiers can be combined together to be used in wideband application. This combination increases overall amplified spectral bandwidth.

11. In \_\_\_\_\_\_\_\_\_\_\_ the ASE contributes most of noise.

1. An erbium-based micro fiber amplifier
2. Rare-earth-doped fiber amplifiers
3. Raman fiber systems
4. Distributed Raman amplification View Answer

Answer: d

Explanation: ASE contributes most of noise in Raman Amplification. The common sources of noise include beating of signal with ASE, mixing, self-phase modulation and cross-plane modulation.

12. In \_\_\_\_\_\_\_\_\_\_\_\_\_ Rayleigh scattering can be reduced.

1. An erbium-based micro fiber amplifier
2. Rare-earth-doped fiber amplifiers
3. Raman fiber systems
4. Distributed Raman amplification View Answer

Answer: d

Explanation: Rayleigh scattering adverse effects can be reduced in Raman Amplification. This can be done by employing two or more stages of amplification over single stage amplification over fiber.

13. Compute the fiber nonlinear coefficient of a parametric optical amplifier having parametric peak gain of 63.6 dB, signal power of 1.6W, length 520.

1. 2.78×10-2 W-1km-1
2. 9.61×10-3 W-1km-1
3. 3.25×10-3 W-1km-1
4. 5.61×10-4 W-1km-1

View Answer

Answer: b

Explanation: The fiber nonlinear coefficient can be found by γ = Gp(dB)-log10(0.25)/Ppl×L × 1/10log10(2.718)2 = 63.6+6/1.6×1.6×520×1/8.7 = 9.61×10-3 W-1km-1.

14. Compute signal power for parametric amplifier having length of 500, nonlinear gain coefficient 12.6×10-3 W-1km-1 and parametric peak gain of 63.9 dB. a) 0.245 W

1. 0.012 W
2. 0.19 W
3. 0.342 W View Answer

Answer: b

Explanation: Signal power is given by

Pp=Gp(dB)-log10(0.25)/γL× 1/10log10(2.718)2= 63.9+6/12.6×10-3×1/ 8.7 = 0.012 W.

15. Compute the gain of parametric amplifier having signal power of 1.6W, length of 500, nonlinear coefficient of 10.19 \* 10-3W-1km-1. a) 34.890

1. 19.15
2. 18.22
3. 16.11 View Answer

Answer: c

Explanation: Quadratic gain is given by-

Gp(dB)=10log10(γPplL)2

Where L=length of amplifier Ppl=signal power γ=nonlinear coefficient.



This set of Optical Communications online quiz focuses on “Wavelength Conversion and Optical Regeneration”.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is defined as a process by which the wavelength of the transmitted signal is changed without altering the data carried by the signal. a) Wavelength conversion

1. Attenuation
2. Sigma management
3. Wavelength dispersion View Answer

Answer: a

Explanation: Wavelength conversion observes the changes in the length of the wave. It does not proportionate with the data carried by the signal or wave.

2. The device which is used to perform wavelength conversion is called as \_\_\_\_\_\_\_\_\_\_\_ a) Attenuator

1. Wavelength Gyrator
2. Wavelength Circulator
3. Wavelength translator View Answer

Answer: d

Explanation: Wavelength translator changes the frequency of the wave and hence it is also called as frequency changer. It does not affect the data carried by the wave.

3. A wavelength converter is termed as \_\_\_\_\_\_\_ if the converted wavelength is longer than the original signal wavelength. a) Down converter

1. Up converter
2. Attenuator
3. Shifter View Answer

Answer: b

Explanation: A wavelength converter is capable of receiving an incoming signal at any wavelength at the input port and produces output at the output port. A converter is termed as up converter when the output signal wavelength is longer than the original signal wavelength.

4. The \_\_\_\_\_\_\_\_\_\_\_ converters cannot process different modulation formats. a) Shifting

1. Optoelectronic wavelength
2. Opt-circular
3. Magnetic simulating View Answer

Answer: b

Explanation: In optoelectronic wavelength converters, the information contained in the intensity, frequency, phase of the signal is required to be reprocessed for the purpose of wavelength conversion. It does not process all the modulation formats.

5. The optical medium, in case of optical wavelength conversion is \_\_\_\_\_\_\_\_\_\_\_ a) Depleted

1. Linear
2. Non-linear
3. Dispersive View Answer

Answer: c

Explanation: The implementation of optical wavelength conversion involves non-linearity of the optical medium. It can be either active or passive, each providing different nonlinear effects.

6. The process of imposing the nonlinear response of the medium onto the control signal is known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_ scheme. a) Demodulation

1. Absorption
2. Cross-modulation
3. Repeater mixing View Answer

Answer: c

Explanation: The cross-modulation scheme involves changes produced due to the intensity variation of the intensity-modulated input signal. It takes place in the active cavity.

7. How many approaches are adopted by the cross-modulation scheme? a) Four

1. Three
2. Two
3. Five View Answer

Answer: a

Explanation: Based on the properties of the nonlinear medium, the cross-modulation scheme can be divided into four main approaches. These are cross-gain modulation, cross-phase modulation, cross-absorption modulation, differential polarization modulation.

8. \_\_\_\_\_\_\_\_\_\_ wavelength converters make use of a passive optical medium to exploit nonlinear effects. a) Bipolar

1. Optoelectronic
2. Magnetic
3. Coherent View Answer

Answer: d

Explanation: The nonlinear effects include four-wave mixing and difference frequency generation. Coherent wavelength converters use a passive medium to extend the changes of nonlinear effects.

9. A \_\_\_\_\_\_\_\_\_\_\_\_\_ wavelength converter utilizes the nonlinear properties of a semiconductor optical amplifier to perform the conversion process. a) Cross-gain modulation

1. Cross-phase modulation
2. Cross-absorption modulation
3. Differential polarization modulation View Answer

Answer: a

Explanation: Cross-gain modulation wavelength converter is also called as XGM wavelength converter. It uses semiconductor optical amplifier(SOA) along with its nonlinear properties for the conversion process.

10. The intensity modulated data on one signal wavelength is called as \_\_\_\_\_\_\_ a) Dispersed data

1. Pump signal
2. Probe signal
3. Frequency signal View Answer

Answer: b

Explanation: Pump signal is intensity modulated data. It produces variations in the carrier density within the SOA which provides inverted gain modulation in the SOA medium.

11. The probe signal is inverse to that of the pump signal.

1. True
2. False View Answer

Answer: a

Explanation: The gain modulations of the pump signal are imprinted onto the probe signal. Thus, the probe signal acquires the inverse copy of the pump signal, thereby contributing to the wavelength conversion with the pump signal.

12. In the XGM converter, the transfer function maintains the rectangular shape. a) True

b) False View Answer

Answer: b

Explanation: By default, the ideal transfer function should be rectangular in shape. But it does not apply the same for XGM converter as the amplitude gradually decreases.

13. The speed of operation of XGM wavelength conversion is determined by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of the SOA. a) Depletion level

1. Hole concentration
2. Carrier dynamics
3. Electron concentration View Answer

Answer: c

Explanation: The carrier dynamics deals with the interaction time between the input and the probe signal. On increasing the interaction time, the speed of operation of XGM wavelength conversion is increased.

14. \_\_\_\_\_\_\_\_\_\_\_\_ is defined as the deviation in the emission frequency with respect to time when a laser is driven by a time-varying current source. a) Intensity probe

1. Dispersion
2. Attenuation
3. Frequency chirp View Answer

Answer: d

Explanation: Frequency chirp occurs during the process of XGM and XPM. It is often termed as instantaneous frequency variation.

15. When frequency chirp shifts the optical frequency towards the shorter wavelength, it is known as \_\_\_\_\_\_\_\_ a) Red shift

1. Green shift
2. Yellow shift
3. Blue shift View Answer

Answer: d

Explanation: When frequency chirp shifts the optical frequency towards the shorter wavelength, it is known as blue shift. Similarly, when frequency chirp shifts the optical frequency towards the longer wavelength, it is known as red shift.



# Multiple Choice Questions

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

## BE (2015)Pattern

**404190 Broadband Communication Systems )**

**Topic : Fibre Optic Communication**

# UNIT III: Multichannel Systems

**9. Questions & Answers on Integrated Optics and Photonics**

The section contains questions on photonics technologies, planar waveguides, photonic integrated circuits, optical bistability and digital optics.

This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Integrated Optics and Photonics Technologies”.

1. Integrated technology for optical devices are developed within optical fiber communication. a) True

b) False

View Answer

Answer: a

Explanation: Integration of optical devices enable fabrication of the whole system onto a single chip. Integration of such devices has become a confluence of several optical terms.

2. When both active and passive devices are integrated on a single chip, in multilayered form, then these devices are known as \_\_\_\_\_\_\_\_\_\_\_\_\_ a) IP devices

1. IO devices
2. Wavelength converters
3. Optical parametric amplifiers View Answer

Answer: a

Explanation: IP technology enables fabrication of subsystems and systems. This is all realized on a single substrate. The integration on a single chip is done in IP technology.

3. \_\_\_\_\_\_\_\_\_ is a further enhancement of \_\_\_\_\_\_\_\_ a) IP, IO

1. IO, IP
2. IO, wavelength converters
3. IP, wavelength converters View Answer

Answer: a

Explanation: IP seems to be a miniaturization process and integration of optical systems on a single chip. IO devices are formed when both active and passive elements are interconnected. Thus, IP is a developed version of IO.

4. Thin transparent dielectric layers on planar substrates are used in \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_ devices. a) Wavelength converters and amplification devices

1. IP and IO
2. IP and wavelength converters
3. IO and amplification devices View Answer

Answer: b

Explanation: IP and IO provide an alternative to conversion of optical signal back to electrical signal. Thin transparent dielectric layers act as optical waveguides to produce small-scale and miniature circuits.

5. \_\_\_\_\_\_\_\_\_\_ did not make significant contribution to earlier optical fiber systems. a) IO

1. IP
2. Wavelength amplifiers
3. Couplers View Answer

Answer: a

Explanation: IO is based on single mode optical waveguides. Thus it is incompatible with multimode fiber systems. Thus, IO has less importance than IP.

6. Side or edge-emitting or conducting optical devices cannot be integrated on same substrate. a) True

b) False View Answer

Answer: b

Explanation: In serial integration of device, different elements of optical chip can be interconnected in a consecutive manner. Thus, integration of side or edge emitting optical devices can be done on a single substrate.

7. Hybrid \_\_\_\_\_\_\_\_ integration demands \_\_\_\_\_\_\_\_\_ IP circuits to be produced on a single substrate. a) IP, single-layered

1. IO, multilayered
2. IP, multilayered
3. IO, multilayered View Answer

Answer: c

Explanation: To gain control of optical signals, elements can be directly attached to IP circuit. Both active and passive devices should be on the same substrate. To make devices compatible with 3d structures of other IP/IO devices, hybrid IP integration demands multilayered IP circuits.

8. Using SOI integration technique \_\_\_\_\_\_\_\_\_\_ components can be coupled to IP devices. a) Passive

1. Layered
2. Demounted
3. Active

View Answer

Answer: d

Explanation: SOI is used to produce micro-waveguide bends and couplers thereby maintaining compatibility with silicon fabrication techniques. Thus, active components like optical sources, detectors can be coupled to other IP devices using SOI technique.

9. Who invented the IO technology?

1. Albert Einstein
2. Anderson
3. M.S Clarke
4. Robert View Answer

Answer: b

Explanation: The birth of IO can be traced back to the basic ideas outlined by Anderson in 1966. He suggested the micro-fabrication technology which in turn led to the term integrated optics in 1969.

10. Electronic circuits have a practical limitation on speed of operation at a frequency of around \_\_\_\_\_\_\_\_\_ a) 1010Hz

1. 1012Hz
2. 1014Hz
3. 1011Hz

View Answer

Answer: a

Explanation: The speed of operation of electronic devices or circuits results from their use of metallic conductors to transport electronic charges and build up signals. It has a limitation to speed of operation of frequency around 1010Hz.

11. The use of light as an electromagnetic wave of high frequency provides high speed operation around \_\_\_\_\_\_\_\_\_\_\_\_ times the conceivable employing electronic circuits. a) 108Hz

1. 105Hz
2. 106Hz
3. 104Hz View Answer

Answer: d

Explanation: The use of light with its property as an electromagnetic wave offers the possibility of high speed operation. For this, the frequency should be high as 1014to 1015Hz.

12. How many layers are possessed by waveguide structures of silica-on-silicon(SOS)? a) Two

1. Three
2. Four
3. One

View Answer

Answer: b

Explanation: The SOS is a part of IP technology. The waveguide structures provided by it comprises of three layers. They are buffer, the core and the cladding.

13. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is a versatile solution-based technique for making ceramic and glass materials. a) SOL gel process

1. SSL gel process
2. SDL gel process
3. SAML gel process View Answer

Answer: a

Explanation: The SOL gel process involves the transition of system from a liquid to a gel. The SOL gel process along with SOS technique is used for the fabrication of ceramic fibers, film coatings and waveguide based optical amplifiers.



This set of Basic Optical Communications Questions and Answers focuses on “Planar Waveguides and Integrated Optical Devices”.

1. Optical fibre communications uses \_\_\_\_\_\_\_ dielectric waveguide structures for confining light. a) Rectangular

1. Circular
2. Triangular
3. Planar

View Answer

Answer: b

Explanation: The use of circular dielectric waveguide structures is universally acceptable. This has been a boon for optical fibre communications.

2. \_\_\_\_\_\_\_\_\_\_ waveguide is formed when the film is sandwiched by layers of different refractive index. a) Planar

1. Circular
2. Asymmetric
3. Symmetric View Answer

Answer: c

Explanation: When the film is sandwiched between layers of same refractive index, symmetric waveguide is formed. Owing to the different refractive index, asymmetry is observed and hence asymmetric waveguide is formed.

3. When the dimensions of the guide are reduced, the number of \_\_\_\_\_\_\_\_\_\_\_ also decreases. a) Propagating nodes

1. Electrons
2. Holes
3. Volume of photons View Answer

Answer: a

Explanation: The dimensions of the guide are directly proportional to the number of propagating nodes. As the dimensions are reduced, the number of propagating nodes also decreases.

4. What does hff stands for in the equation hff = h+x+x2?

1. Frequency of layer
2. Diameter of curve
3. Effective guide layer thickness
4. Space propagation View Answer

Answer: c

Explanation: In the above equation, h is the height, x and x2 are the evanescent field penetration depths. hff Denotes the effective guided layer thickness.

5. \_\_\_\_\_\_\_\_\_\_\_ waveguides are plagued by high losses. a) Circular

1. Planar
2. Depleted
3. Metal-clad View Answer

Answer: d

Explanation: All suitable waveguide materials are subject to limitations in the confinement. However, metal-clad waveguides are not so limited. Hence, they are plagued by high losses.

6. The planar waveguides may be fabricated from glasses and other isotropic materials such as \_\_\_\_\_\_\_\_\_\_\_ and

\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Octane and polymers
2. Carbon monoxide and diode
3. Fluorides and carbonates
4. Sulphur dioxide and polymers View Answer

Answer: d

Explanation: These materials are isotropic. However, their properties do not affect the fabrication of planar waveguides. Their properties cannot be controlled by external energy sources.

7. Which of the following devices are less widely used in the field of optical fibre communications? a) Acousto-optic devices

1. Regenerators
2. Reflectors
3. Optical translators View Answer

Answer: a

Explanation: Acousto-optic devices are less widely used, mainly in the area of field deflection. Regenerators, reflectors form a base for the optical fibre communications.

8. Which of the following materials have refractive index near two? a) GA As

1. Zinc
2. InP
3. AlSb View Answer

Answer: b

Explanation: Two basic groups are distinguished on the basis of the respective refractive indices near two and near three. GaAs, InP, AlSb have refractive indices near 3.

9. Passive devices are fabricated by \_\_\_\_\_\_\_\_\_\_ technique. a) Fassbinder

1. High density integration
2. Radio-frequency sputtering
3. Lithium implantation View Answer

Answer: c

Explanation: Passive devices’ fabrication comes mainly from microelectronics industry. Radio frequency sputtering is used to deposit thin films of glass onto glass substrates.

10. Strip pattern in waveguide structures is obtained through \_\_\_\_\_\_\_\_\_\_\_\_ a) Lithography

1. Cryptography
2. Depletion of holes
3. Implantation View Answer

Answer: a

Explanation: Field strength is an important aspect when it comes to strip patterns in waveguide structures. The electron and laser beam lithography is used to obtain stripe pattern in waveguide structures.

11. Propagation losses in slab and strip waveguides are smaller than the single mode fibre losses. a) True

b) False View Answer

Answer: b

Explanation: The losses are in the range of 0.1 to 0.3 dB/cm. In case of slab and stripe waveguides, the losses are much higher whereas in case of single-mode fibres, they are much less.

12. A passive Y-junction beam splitter is fabricated from \_\_\_\_\_\_\_\_\_\_ a) GaAs

1. ZnS
2. AlbS
3. LiNbO3 View Answer

Answer: d

Explanation: A passive Y-junction splitter is used to combine signals from separate sources or to divide a signal into two or more channels. It is fabricated from the waveguide materials such as LiNbO3.

13. A passive Y-junction beam splitter is also used as a switch. a) True

b) False View Answer

Answer: a

Explanation: A passive junction beam splitter finds application where equal power division of the incident beam is required. It can be used as a switch if it is fabricated from an electro-optic material.

14. The linear variation of refractive index with the electric field is known as the \_\_\_\_\_\_\_\_ a) Linear implantation

1. Ionization
2. Koppel effect
3. Pockels effect View Answer

Answer: d

Explanation: The change in refractive index is related by the applied field via the linear and quadratic electrooptic coefficients. The variation of R.I with the electric field is known as Pockels effect.

15. Planar waveguides are used to produce \_\_\_\_\_\_\_ coupler.

1. MMI
2. CMI
3. Frequency
4. Differential View Answer

Answer: a

Explanation: MMI couplers are abbreviated as Multimode interference couplers. These are similar to fused fibre couplers. These are easily produced by using planar waveguides.



This set of Optical Communications Question Bank focuses on “Optoelectronic Integration and Photonic Integrated Circuits”.

1. Monolithic integration for optical sources are confined to the use of \_\_\_\_\_\_\_\_\_\_ semiconductors. a) Ⅲ-Ⅴ

1. Ⅱ-Ⅲ
2. Ⅰ-Ⅱ
3. Ⅶ-Ⅷ View Answer

Answer: a

Explanation: Ⅲ-Ⅴsemiconductor compounds are much useful. They possess both optical and electronic properties. These properties can be exploited to produce high performance devices.

2. Circuits fabricated from GaAs or AlGaAs operate in wavelength region of \_\_\_\_\_\_\_\_\_\_ a) 0.1 and 0.2 μm

1. 0.8 and 0.9 μm
2. 0.4 and 0.6 μm
3. 0.6 and 0.7 μm View Answer

Answer: b

Explanation: Circuits fabricated from GaAs use injection laser which is fabricated on GaAs with a MESFET. This is used to bias and modulate the laser.

3. The OEICs realization \_\_\_\_\_\_\_\_\_\_ as compared to the other developments in IO. a) Scripted

1. Decreased
2. Lagged behind
3. Increased View Answer

Answer: c

Explanation: IO devices use dielectric materials such as lithium niobate. This lagging behind is caused by inherent difficulties in fabrication of OEICs even if Ⅲ-Ⅴ semiconductors are used.

4. Compositional and structural differences between photonic and electronic devices \_\_\_\_\_\_\_\_\_\_ a) Provide high efficiency

1. Provide low efficiency
2. Highly used
3. Create problems View Answer

Answer: d

Explanation: Compositional and structural differences cause epitaxial crystal growth, planarization for lithography, electrical interconnections. They also cause thermal and chemical stability of materials, electric matching and heat dissipation.

5. To avoid large chip \_\_\_\_\_\_\_\_\_\_ devices are used.

1. InGaAsP
2. InGa
3. GaAs
4. InGaAs View Answer

Answer: a

Explanation: To avoid large chip, InGaAsP devices are used with directly modulated semiconductor lasers. This gives good dynamic characteristics at 40 Gbit/s at 1.55 μmwavelength.

6. Devices operating at transmission rates greater than 40 Gb/s are \_\_\_\_\_\_\_\_\_ a) GaAs and InP

1. GaAs
2. InGa
3. InGaAs View Answer

Answer: a

Explanation: Optoelectronic integrated circuits are based on heterojunction bipolar transistor and electron mobility transistor use GaAs and InP. These are capable of operating at transmission rates higher than 40 Gb/s.

7. HEMT based \_\_\_\_\_\_\_\_\_\_ have a spot-size convertor with a photodiode. a) p-n junction diode

1. p-i-n photoreceiver
2. IGBT
3. BJT

View Answer

Answer: b

Explanation: P-I-N photoreceiver comprises of spot-size convertor with a photodiode. Spot-size convertor increases fiber alignment tolerances by one order of magnitude. This enables use of cleaved instead of lensed fiber.

8. P-I-N photoreceiver based on HEMT is integrated with \_\_\_\_\_\_\_\_\_ guiding layers. a) GaAs and InP

1. GaAs
2. InGa
3. InGaAsP View Answer

Answer: d

Explanation: P-I-N photoreceiver is integrated with InGaAsP guiding layers. In this HEMT based technology, InGaAsP provides more confinement.

9. An optical power splitter integrated with optical waveguide amplifier is more useful. a) True

b) False View Answer

Answer: a

Explanation: The aim of optical waveguide amplifier is to reduce the number of amplifiers in system. Alongwith, it also reaches maximum number of nodes.

10. The use of intelligent optical switches is necessary. a) False

b) True View Answer

Answer: b

Explanation: Most applications of OEICs in optical networks require large switching capacity to support a large number of WDM channels. This also provides control of both optical signal wavelength and signal power.

11. The wafer scale replication technology uses \_\_\_\_\_\_\_\_\_\_\_\_ a) SOL gel

1. GaAs
2. InGa
3. InGaAsP View Answer

Answer: a

Explanation: Replication technology employs hot embossing, molding and ultraviolet lithography. Ultraviolet curable SOL gel enables refractive and diffractive micro-optical elements to be replicated directly on glass substrates.

12. \_\_\_\_\_\_\_\_\_\_\_ is useful for production of both planar micro-optical elements and stacked optical microsystems.

1. Wavelength amplifier
2. Wavelength convertor
3. Replication technology
4. Optical switching matrix View Answer

Answer: c

Explanation: SOL gel materials used in replication technology allows combination of replication with lithography. This leaves selected areas material-free for sawing and bunding.

13. Optical interconnection between optoelectronic device is achieved in \_\_\_\_\_\_\_\_\_ a) Wavelength amplifier

1. Wavelength convertor
2. Replication technology
3. Chip-to-chip interconnection View Answer

Answer: d

Explanation: The chip-to-chip interconnection of optical components have a vertical cavity surface-emitting laser. These are assembled in micro-trenches in which embedded electrodes are connected through passive junction of poliver waveguide on alignment pits.

14. Multilevel interconnections are incorporated in \_\_\_\_\_\_\_ a) PIC

1. AWG based coupler
2. Convertors
3. OEIC technologies View Answer

Answer: a

Explanation: PIC reduces the overall size of optical functions. This causes the interconnection of several modules growing on same substrate.

15. When there is M number of WDM channels present at N input ports, then the output port 1 produces a

\_\_\_\_\_\_\_\_\_

1. CW signal
2. WDM signal
3. Amplified signal
4. Distorted signal View Answer

Answer: b

Explanation: The reconstituted spectrum of WDM signal at any output port consists of a different set of wavelength channels with at least one wavelength channel from each input port producing a WDM signal having wavelength signal from each of input ports.



1. \_\_\_\_\_\_\_\_\_\_\_ provides a series of optical processing functions.

1. Wavelength convertors
2. Wavelength amplifiers
3. Detectors
4. Bi-stable optical devices View Answer

2. \_\_\_\_\_\_\_\_\_\_\_ comprise of Fabry-Perot cavity.

1. Wavelength convertors
2. Wavelength amplifiers
3. Bi-stable optical devices
4. Detectors View Answer

Answer: c

Explanation: Fabry-Perot cavity consists of a material in which there are variations in refractive index with optical intensity. These variations are nonlinear giving rise to bistability.

3. The optical path length in nonlinear medium is integer number of \_\_\_\_\_\_ wavelength. a) Half

1. Double
2. Three-fourth
3. Single View Answer

Answer: a

Explanation: Fabry-Perot cavity exhibits a sharp resonance to optical power passing into and through it. This is achieved when optical path length is integer number of half wavelength in nonlinear medium.

4. As compared to laser, the value of \_\_\_\_\_\_\_\_\_ in the cavity controls the optical transmission. a) Amplification

1. Refractive index
2. Rectification
3. Reflection View Answer

Answer: b

Explanation: The refractive index value in the Fabry-Perot cavity controls the optical transmission. This provides high optical output on resonance and low optical output off resonance.

5. \_\_\_\_\_\_\_\_\_\_\_ are able to latch between two distinct optical states.

1. Wavelength converters
2. Wavelength amplifiers
3. Detectors
4. Bistable optical devices View Answer

Answer: d

Explanation: The transfer characteristic for Bistable optical devices exhibit two state hysteresis resulting from turning in and out of resonance. So they can be latched between two states responding to external signal acting as flip-flop.

6. \_\_\_\_\_\_\_\_\_\_ can act as AND, OR, NOT gate.

1. Wavelength converters
2. Wavelength amplifiers
3. Detectors
4. Bistable optical devices View Answer

Answer: d

Explanation: BOD’s exhibit 2-state hysteresis. Thus they are able to latch between two operating states (0 and 1) thereby providing logic functions.

7. \_\_\_\_\_\_\_ proves superior to \_\_\_\_\_\_\_

1. BOD’s, electronic devices
2. Electronic devices, BOD’s
3. BOD’s, convertors
4. Convertors, BOD’s View Answer

Answer: a

Explanation: There is also a thing of picosecond switching using only Pico-joules of energy. A BOD comprises of these switching properties. Thus, it proves superior to electronic devices.

8. \_\_\_\_\_\_\_\_ BOD’s provides optical feedback.

1. Extrinsic
2. Intrinsic
3. Detector
4. Bistable View Answer

Answer: b

Explanation: All optical or intrinsic devices which utilize a nonlinear optical medium between a pair of partially reflecting mirrors forming a nonlinear etalon in which feedback is provided optical.

9. \_\_\_\_\_\_\_\_\_\_\_ devices employ artificial nonlinearity. a) Extrinsic

1. Intrinsic
2. Hybrid
3. Bistable View Answer

Answer: c

Explanation: Hybrid devices have artificial nonlinearity in an electro-optic medium in the cavity. This produces variations in refractive index through electro-optic effect.

10. Hybrid devices have limited \_\_\_\_\_\_\_\_ speed.

1. Switching
2. Planar
3. Curvature
4. Electrical View Answer

Answer: a

Explanation: Hybrid BOD’s provides flexibility. But at the same time their switching speeds are limited by use of electrical feedback. These devices are interconnected to provide a more complex logic circuit.

11. \_\_\_\_\_\_\_ exhibit optical bistability.

1. Extrinsic lasers
2. Intrinsic lasers
3. Detectors
4. Semiconductor lasers View Answer

Answer: d

Explanation: Semiconductor lasers have optical bistability. This is due to nonlinearities in absorption, gain, dispersion, wave guiding and the selection of output polarization.

12. \_\_\_\_\_\_\_\_\_\_\_ is fabricated with tandem electrode.

1. Full convertor
2. Semiconductor
3. Detector diode
4. Bistable laser diode View Answer

Answer: d

Explanation: Bistable laser diode is fabricated with tandem electrode. The tandem electrode provides two gain sections. Also it has a loss region between them.

13. Optical pulsing can be obtained using \_\_\_\_\_\_\_\_\_

1. BODs
2. WDM
3. Detector
4. Semiconductor View Answer

Answer: a

Explanation: BODs with a very narrow bi-stable loop can provide optical pulsing. This type of device can be used to shape, clean up and amplify a noisy input pulse.

14. A weak second beam is introduced in \_\_\_\_\_\_\_\_\_

1. BOD differential amplifier
2. WDM
3. Detector
4. Semiconductor laser View Answer

Answer: a

Explanation: A weak second beam in BOD differential amplifier is introduced into the nonlinear optical cavity.

This is used to control the resonance and transmission of the main beam through effects of its own stored energy.



**10. Questions on Optical Fiber Systems 1 : Intensity Modulation**

The section contains questions and answers on optical transmitter and receiver circuit, system design and planing considerations, analog systems, multiplexing strategies, dispersion management and optical amplifier applications.

This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “The Optical Transmitter Circuit”.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_ must be operated in stimulated emission region. a) Injection laser

1. LED’s
2. Detector
3. Receiver View Answer Answer: a

Explanation: Injection laser is a threshold device. In stimulated emission region, continuous optical output power levels are in the range of 1 to 10mW.

2. Coherent radiation is relatively \_\_\_\_\_\_\_\_\_\_

1. Parabolic
2. Elliptic
3. Directional
4. Rectangular View Answer

Answer: c

Explanation: Most of the light output is coupled into optical fibre. This is because of the isotropic distribution of narrow-line width, coherent radiation is directional.

3. \_\_\_\_\_\_\_\_\_\_\_\_\_ are capable of launching powers between 0.5 and several mW. a) LED’s

1. Injection laser
2. Attenuator
3. Reflector View Answer

Answer: b

Explanation: Coupling efficiency up to 30% may be obtained by placing a fiber close to laser mirror. These can approach 90% with suitable lens and optical coupling arrangements. So they can launch 0.5 to several mW of optical power into fiber.

4. LED’s display good linearity.

1. True
2. False View Answer

Answer: a

Explanation: LED’s appear to be suited to analog transmission. This is because of its output which is directly proportional to the drive current.

5. Which behaviour may prove as a limitation for injection lasers and LED’s? a) Isotropic

1. Radioactive
2. Thermal
3. Photosensitive View Answer

Answer: c

Explanation: The thermal behaviour of the injection lasers and the LED’s limits their operation within the optical transmitter. The main problem is caused by the variation of injection laser threshold current.

6. Optical output power from an LED is directly proportional to the device junction temperature. a) False

b) True View Answer

Answer: b

Explanation: Output power is dependent on the junction temperature in case of LED’s. Most LED’s exhibit a decrease in the optical output power following an increase in junction temperature.

7. \_\_\_\_\_\_\_\_\_\_\_\_\_ from the LED is dependent on the effective minority carrier lifetime in the semiconductor material.

1. Spontaneous emission
2. Stimulated emission
3. Absorption
4. Diffusion View Answer

Answer: a

Explanation: The speed of the response of the LED is dictated by the respective emission mechanism. Spontaneous emission is related to the carrier lifetime and hence dictating the speed of response.

8. The \_\_\_\_\_\_\_\_\_ of the LED is twice that of the effective minority carrier lifetime. a) Dwell time

1. Reflection scatters
2. Sensitivity
3. Rise time View Answer

Answer: d

Explanation: The response of the optical fiber source is specified in terms of the rise time. This rise time is reciprocally related to the device frequency response.

9. The finite spectral width of the optical source causes \_\_\_\_\_\_\_\_\_\_\_ a) Depletion

1. Frequency burst
2. Pulse broadening
3. Efficient reflection View Answer

Answer: c

Explanation: The finite spectral width causes pulse broadening due to material dispersion on an optical fiber communication link. This results in a limitation on the bandwidth-length product.

10. The coherent emission from an injection laser has a line width of \_\_\_\_\_\_\_\_ a) 2 nm

1. 3nm
2. 8 nm
3. 1nm View Answer Answer: d

Explanation: An optical source such as an injection laser is a narrow line width device as compared to the LED. It has a narrow line width of 1 nm or less.

11. Extinction ratio is denoted by symbol \_\_\_\_\_\_\_\_\_\_ a) ε

1. σ
2. β
3. ρ

View Answer

Answer: a

Explanation: Extinction ratio is defined as the ratio of the optical energy emitted in the 0 bit period to that emitted during the 1 bit period. It is denoted by ε.

12. The use of low impedance driving circuit may increase \_\_\_\_\_\_\_\_\_\_\_\_\_ a) Noise

1. Width
2. Intensity
3. Switching speed View Answer

Answer: d

Explanation: Pulse shaping is usually required to increase the switching speed. However, increased switching speed may be obtained from an LED without a speed-up element by use of a low-impedance driving circuit.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “The Optical Receiver Circuit”.

1. \_\_\_\_\_\_\_\_\_\_\_\_ limits receiver sensitivity.

1. Noise
2. Depletion layer
3. Avalanche
4. Current View Answer

Answer: a

Explanation: Receiver noise affects receiver sensitivity. It can dictate the overall system design. The noise can be temperature, environmental factor or due to components.

2. A \_\_\_\_\_\_\_\_\_\_\_\_ performs the linear conversion of the received optical signal into an electric current. a) Receiver

1. Converter
2. Detector
3. Reflector View Answer

Answer: c

Explanation: An optical signal is always fed to a detector. A detector is an optoelectronic converter which linearly converts the received optical signal into an electric current.

3. \_\_\_\_\_\_\_\_\_\_ are provided to reduce distortion and to provide a suitable signal shape for the filter. a) Detector

1. Equalizer
2. Filters
3. Amplifier View Answer

Answer: b

Explanation: Optical detectors are linear devices. They do not introduce distortion themselves but other components may exhibit nonlinear behaviour. To compensate for distortion, an equalizer is provided in the receiver circuit.

4. A \_\_\_\_\_\_\_\_\_ maximizes the received signal-to-noise ratio in the receiver circuitry. a) Filter

1. Equalizer
2. Detector
3. Reflector View Answer

Answer: a

Explanation: A filter reduces the noise bandwidth as well as inbounds noise levels. A filter maximizes the received signal-to-noise ratio while preserving the essential features of the signal. It also reduces ISI.

5. \_\_\_\_\_\_\_\_ can be operated in three connections.

1. Reflectors
2. Diodes
3. LED’s
4. FET’s View Answer

Answer: d

Explanation: FET’s or bipolar transistors are operated in three useful connections. These are the common emitter, the common base or gate, and the emitter or source follower.

6. How many structures of pre-amplifiers exist?

1. Two
2. Three
3. Four
4. One

View Answer

Answer: b

Explanation: The basic structures of pre-amplifiers are observed in three forms. These are low-impedance, highimpedance and trans-impedance front end preamplifier structures.

7. What is the main factor contributing to the choice of the operational amplifier? a) Gain

1. Impedance
2. Conductance
3. Gain-Bandwidth product View Answer

Answer: d

Explanation: A TTL interface stage is always used with the operational amplifier. A device that requires higher accuracy often tends to depend on gain-bandwidth product.

The choice of amplifier for receiver accuracy is dependant on gain-bandwidth product.

8. The multiplication factor for the APD varies with the device temperature. a) True

b) False View Answer

Answer: a

Explanation: Optimum multiplication factor is required for smooth voltage variance. The multiplication factor for APD varies with the device temperature thus making provision of fine control for bias voltage.

9. How many categories of dynamic gain equalizers are available? a) One

1. Two
2. Three
3. Four View Answer

Answer: b

Explanation: Dynamic gain equalizers are categorized into two types. These are single-channel and multichannel equalizers, thus providing operation using single or multiple wavelengths.

10. How many simultaneous channels can be provided in a band DGE(Dynamic gain equalizer)? a) Six

1. Two
2. Eight
3. Ten

View Answer

Answer: c

Explanation: Generally, eight channels are provided simultaneously in a band DGE. These are for the attenuation purpose of channels along with gain equalization.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “System Design Considerations”.

1. \_\_\_\_\_\_\_\_\_\_ is the unique property of the glass fiber.

1. Transmission
2. Opaque property
3. Ductile
4. Malleable View Answer

Answer: a

Explanation: Glass fibres have a unique property as a transmission medium which enables their use in the communication. The major transmission characteristics are dispersion and attenuation.

2. \_\_\_\_\_\_\_\_\_\_ limits the maximum distance between the optical fiber transmitter and receiver. a) Attenuation

1. Transmission
2. Equipment
3. Fiber length View Answer

Answer: a

Explanation: Attenuation along with dispersion and the conductor size are some of the factors that limit the maximum distance between the optical transmitter and the receiver. The associated constraints within the equipment also affect the distance.

3. The \_\_\_\_\_\_\_\_\_\_\_ incorporates a line receiver in order to convert the optical signal into the electrical regime. a) Attenuator

1. Transmitter
2. Repeater
3. Designator

View Answer

Answer: c

Explanation: Repeaters are a mediator between transmitter and receiver. The weak signal is strengthened back by the repeaters on its path to the receiver.

4. A regenerative repeater is called as \_\_\_\_\_\_\_\_\_\_\_\_

1. Repetitive repeater
2. Regenerator
3. Attenuator
4. Gyrator View Answer

Answer: b

Explanation: When digital transmission techniques are used, the repeater also regenerates the original digital signal in the electrical signal before it is retransmitted as an optical signal via a line transmitter.

5. The wavelength range of \_\_\_\_\_\_\_\_\_\_ will be fruitful for the operating wavelength of the system referring to the system performance. a) 0.8 – 0.9 μm

1. 1.1 – 2 μm
2. 5.2 – 5.7 μm
3. 3.1 – 3.2 μm View Answer

Answer: a

Explanation: It is useful if the operating wavelength of the system is established to range of 0.8-0.9 μm. This will be dictated by the overall requirements for the system performance, cost, etc.

6. How many encoding schemes are used in optical fiber communication system design requirements? a) Three

1. One
2. Two
3. Four View Answer

Answer: c

Explanation: Encoding schemes are used for digital transmission of data. These are bi-phase and delay modulation codes. They are also called as Manchester and Miller codes respectively.

7. In \_\_\_\_\_\_\_\_ the optical channel bandwidth is divided into non-overlapping frequency bands. a) Time division multiplexing

1. Frequency division multiplexing
2. Code division multiplexing
3. De-multiplexing View Answer

Answer: b

Explanation: In FDM, the non-overlapping frequency bands are divided to the individual frequencies. These individual signals can be extracted from the combined FDM signal by electrical filtering at the receiver terminal.

8. A multiplexing technique which does not involve the application of several message signals onto a single fiber is called as \_\_\_\_\_\_\_\_\_

1. Time division multiplexing
2. Frequency division multiplexing
3. Code division multiplexing
4. Space division multiplexing View Answer

Answer: d

Explanation: In SDM, each signal channel is carried on a separate fiber within a fiber bundle or multi-fiber cable form. The cross coupling between channels is negligible.

9. Which of the following is not an optical fiber component? a) Fiber

1. Connector
2. Circulator
3. Detector View Answer

Answer: c

Explanation: Circulator is a device used in electromagnetic theory. All others are optical components.

10. \_\_\_\_\_\_\_\_technique involves an increase in the number of components required. a) Time division multiplexing

1. Space division multiplexing
2. Code division multiplexing
3. Frequency division multiplexing

View Answer

Answer: b

Explanation: SDM involves good optical isolation due to the negligible cross coupling between channels. It uses separate fiber and thus requires more number of components.

11. Time division multiplexing is inverse to that of frequency division multiplexing. a) True

b) False View Answer

Answer: a

Explanation: TDM involves distribution of channels in time slots whereas FDM involves bands that are run on different frequencies. Both of these techniques improve accuracy and reduce complexity.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Digital System Planning Considerations”.

1. Sampling rate for each speech channel on 32-channel PCM is 8 KHz each encoded into 8 bits. Determine number of bits in a frame. a) 64

1. 128
2. 32
3. 256

View Answer

Answer: d

Explanation: Number of bits in a frame can be calculated as follows: Bits in a frame = No. of channels \* Sampling rate for each channel.

2. Sampling rate for each speech channel on 32-channel PCM is 8 KHz each encoded into 8 bits. Determine the transmission rate for system with 256 bits in a frame. a) 2.96 Mbits/s

1. 2.048 Mbits/s
2. 3.92 Mbits/s
3. 4 Mbits/s View Answer

Answer: b

Explanation: Transmission rate can be determined by- Transmission rate = Sampling rate \* No. of bits in a frame.

3. Sampling rate for each speech channel on 32-channel PCM is 8 KHz each encoded into 8 bits. Determine the bit duration with transmission rate of 2.048 M bits/s. a) 388 ns

1. 490 ns
2. 488 ns
3. 540 ns

View Answer

Answer: c

Explanation: Bit duration is the reciprocal of the transmission rate. Thus, it is given by- Bit duration = 1/transmission rate.

4. The bit duration is 488 ns. Sampling rate for each channel on 32-channel PCM is 8 KHz encoded into 8 bits. Determine the time slot duration. a) 3.2 μs

1. 3.1 μs
2. 7 μs
3. 3.9 μs View Answer

Answer: d

Explanation: Time slot duration is given by – Time slot duration = Encoded bits \* bit duration.

5. Sampling rate for each speech channel on 32-channel PCM is 8 KHz each encoded into 8 bits. Determine duration of frame with time slot duration of 3.9μs. a) 125 μs

1. 130 μs
2. 132 μs
3. 133 μs View Answer

Answer: a

Explanation: Duration of a frame is determined by – Duration of a frame = 32 \* time slot duration.

6. Sampling rate for each speech channel on 32-channel PCM is 8 KHz each encoded into 8 bits. Determine the duration of multi-frame if duration of a frame is 125μs. a) 2ms

1. 3ms
2. 4ms
3. 10ms View Answer

Answer: a

Explanation: Multi-frame duration can be determined by – Multi-frame duration = 16 \* Duration of a single frame.

7. Determine excess avalanche noise factor F(M) if APD has multiplication factor of 100, carrier ionization rate of 0.02. a) 3.99

1. 3.95
2. 4.3
3. 4

View Answer

8. Compute average number of photons incident at receiver in APD if quantum efficiency is 80%, F (M) = 4, SNR = 144.

1. 866
2. 865
3. 864
4. 867

View Answer

Answer: c

Explanation: Average number of photons arezm=[2βςF(M)]\*[S/N\*η] Here, η = quantum efficiency, S/N = signal to noise ratio.

9. Determine incident optical power if zm=864, wavelength = 1μm. a) -85 dBm

1. -80 dBm
2. -69.7 dBm
3. -60.7 dBm View Answer

Answer: d

Explanation: Incident optical power is P0=zmhcBT/2λ. Here zm=average number of photons, hc=Planck’s constant.

10. Determine wavelength of incident optical power if zm=864, incident optical power is -60.7 dB, BT=1 \* 107. a) 1 μs

1. 2 μs
2. 3 μs
3. 4 μs

View Answer

Answer: a

Explanation: Wavelength is determined by λ=zmhcBT/2P0. Here zm=average number of photons, hc=Planck’s constant, P0=incident optical power.

11. Determine total channel loss if connector loss at source and detector is 3.5 and 2.5 dB and attenuation of 5 dB/km.

1. 34 dB
2. 35 dB
3. 36 dB
4. 38 dB View Answer

Answer: a

Explanation: The total channel loss is CL=(αfc+αj)L + αcr. Here αcr=loss at detector and source combined, αfc = attenuation in dB/km.

12. Determine length of the fiber if attenuation is 5dB/km, splice loss is 2 dB/km, connector loss at source and detector is 3.5 and 2.5. a) 5 km

1. 4 km
2. 3 km
3. 8 km

View Answer

Answer: b

Explanation: Length of the fiber is L = CL/(αfc+αj) – αcr. Here αcr = loss at detector and source combined, αfc = attenuation in dB/km.

13. Determine total RMS pulse broadening over 8 km if RMS pulse broadening is 0.6ns/km. a) 3.6 ns

1. 4 ns
2. 4.8 ns
3. 3 ns

View Answer

Answer: c

Explanation: Total RMS pulse broadening is given by – σT = σ\*L Where σ = rms pulse broadening and L = length of the fiber.

14. Determine RMS pulse broadening over 8 km if total RMS pulse broadening is 5.8ns/km. a) 0.2ns/km

1. 0.1ns/km
2. 0.4ns/km
3. 0.72ns/km View Answer

Answer: d

Explanation: RMS pulse broadening is given by – σ = σT/L where σ = rms pulse broadening and L = length of the fiber.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Analog Systems”.

1. Determine dispersion equalization penalty if total RMS pulse broadening is 4.8ns, BT is 25 Mbits/s. a) 0.03 dB

1. 0.08 dB
2. 7 dB
3. 0.01 dB View Answer

Answer: a

Explanation: Dispersion equalization penalty is denoted by DL. It is given by- DL = 2 (2σTBT√2)4. Here σT=RMS pulse broadening.

2. Determine RMS pulse broadening with mode coupling if pulse broadening is 0.6 over 8km. a) 1.6ns

1. 1.7ns
2. 1.5ns
3. 1.4ns View Answer

Answer: b

Explanation: Total RMS pulse broadening with mode coupling is given by- σT = σ√L. Here σT = RMS pulse broadening, L = length of the fiber.

3. Determine dispersion equalization penalty with mode coupling of 1.7ns if BT is 25 Mbits/s. a) 4.8 \* 104dB

1. 4 \* 104dB
2. 4.2 \* 104dB
3. 3.8 \* 104dB View Answer

Answer: c

Explanation: Dispersion equalization penalty is denoted by DL. With mode coupling, it is given by- DL=2 (2σTBT√2)4. Here σT=RMS pulse broadening.

4. Determine dispersion equalization penalty without mode coupling if BT is 150 Mbits/s and total rms pulse broadening is 4.8ns. a) 34 dB

1. 33 dB
2. 76.12 dB
3. 34.38 dB View Answer

Answer: d

Explanation: Dispersion equalization penalty is denoted by DL(WM). It is given by-

DL(WM) = 2 (2σTBT√2)4. Here σT = RMS pulse broadening, (WM) = without mode coupling.

5. Determine ratio of SNR of coaxial system to SNR of fiber system if peak output voltage is 5V, quantum efficiency of 70%, optical power is 1mW, wavelength of 0.85μm. a) 1.04 \* 104

1. 2.04 \* 104
2. 3.04 \* 104
3. 4.04 \* 104 View Answer

Answer: a

Explanation: Ratio of SNR of coaxial system to SNR of fiber system is given by-

Ratio = V2hc/2KTZ0ηPiλ. Here, η=quantum efficiency, Pi = 0ptical power in mW, V=optical output voltage.

6. Determine the peak output voltage if efficiency is 70%, wavelength is 0.85μm and output power is 1mW. a) 7V

1. 8V
2. 5V
3. 6V

View Answer

Answer: b

Explanation: Peak output voltage is given by-

V2 = (2KTZ0ηPiλ \* Ratio)/hc. Here, η = quantum efficiency, Pi=0ptical power in mW, V=optical output voltage.

7. Determine the efficiency of a coaxial cable system at 17 degree Celsius with peak output voltage 5V, 0.85 μm wavelength and SNR ratio of 1.04 \* 104. a) 80%

1. 70%
2. 40%
3. 60% View Answer

Answer: b

Explanation: The efficiency of a coaxial cable system is η=V2hc/2KTZ0ηPiλ \* Ratio. Hereη=quantum efficiency, Pi = 0ptical power in mW, V=optical output voltage.

8. Determine the wavelength of a coaxial cable system operating at temperature 17 degree Celsius at output voltage of 5V, 100Ω impedance, optical power of 1mW, 70% quantum efficiency. a) 0.39μm

1. 0.60μm
2. 0.85μm
3. 0.98μm View Answer

Answer: c

Explanation: The wavelength can be determined by – λ = V2hc/2KTZ0ηPi \* Ratio. Hereη=quantum efficiency, Pi = 0ptical power in mW, V = optical output voltage.

9. Determine the impedance of a coaxial cable system operating at temperature 17 degree Celsius at output voltage of 5V, 0.85μmwavelength, optical power of 1mW, 70% quantum efficiency and SNR ratio of 1.04 \* 104. a) 80Ω

1. 50Ω
2. 90Ω
3. 100Ω View Answer

Answer: d

Explanation: The impedance is given by-Z0=V2hc/2KTPi \* Ratio. Hereη=quantum efficiency, Pi = Optical power in mW, V=optical output voltage.

10. The 10-90% rise times for components used in D-IM analog optical link is given. (LED=10ns, Intermodal=9ns/km, Chromatic=2ns/km, APD = 3ns). Link is of 5km. Determine the total rise time. a) 62ns

1. 53ns
2. 50ns
3. 52ns View Answer

Answer: d

Explanation: Total rise time is given by-

Tsyst=1.1[Ts2+Tn2+Tc2+TD2]1/2. Here Ts = rise time, Tn = intermodal time, Tc = Chromatic time.

11. The 10-90% rise times for components used in D-IM analog optical link is given. (LED=10ns,

Intermodal=9ns/km, Chromatic=2ns/km, APD = 3ns). Link is of 5km. It has an optical bandwidth of 6MHz. Determine maximum permitted system rise time. a) 58.3ns

1. 54ns
2. 75ns
3. 43.54ns View Answer

Answer: a

Explanation: The maximum permitted system rise time is given by- Tsyst(Max) = 0.35/Bopt. Here, Bopt=Optical Bandwidth.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Multiplexing Strategies”.

1. What is the full form of ETDM?

1. Electronic tube di-cyclic mechanism
2. Electrical time division multiplexing
3. Emphasis tier division mechanism
4. Electrical tube dielectric medium View Answer

Answer: b

Explanation: ETDM is the major baseband digital strategy. It allows for greater exploitation of available fiber bandwidth.

2. The practical limitations of the speed of electronic circuits have been pushed towards operational frequencies around \_\_\_\_\_\_\_\_\_\_\_ a) 100 MHz

1. 120 MHz
2. 100GHz
3. 80 Hz View Answer

Answer: c

Explanation: The speed of the circuitry in the fiber optic communication plays an important role in its performance. It is pushed around 100 GHz frequency allowing for 100 Gbit/s feasibility.

3. A strategy used for increasing the bitrate of digital optical fiber systems beyond the bandwidth capabilities of the drive electronics is known as \_\_\_\_\_\_\_\_\_\_\_ a) Optical time division multiplexing

1. Electrical time division multiplexing
2. Frequency division multiplexing
3. Code division multiplexing View Answer

Answer: a

Explanation: OTDM is favourable for long distance transmission of signal. It is designed to push the bitrate of the fiber systems beyond the bandwidth limits to gain performance.

4. \_\_\_\_\_\_\_\_\_\_\_\_ semiconductor laser sources provide low duty cycle pulse streams for subsequent time multiplexing.

1. Diameter preferred
2. Mode locked
3. Divine
4. Depletion View Answer

Answer: b

Explanation: Mode locked semiconductor laser sources were used at the transmitter side. They provide effective distribution of time multiplexing providing low duty cycle pulse streams.

5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ are the devices which are employed to eliminate the laser chirp. a) Optical intensity modulators

1. Demodulators
2. Circulators
3. Optical Isolators View Answer

Answer: a

Explanation: Optical intensity modulators eliminate the laser chirp. This laser chirp may result in dispersion of the transmitted pulses as they propagate within the single mode fiber, thus limiting the achievable transmission distance.

6. \_\_\_\_\_\_\_\_\_\_\_\_\_ provides operation at high transmission rate.

1. Optical intensity modulators
2. Demodulators
3. Circulators
4. Electro-absorption modulators View Answer

Answer: d

Explanation: Electro-absorption modulators are employed at the transmitter and receiver sections. They provide operation at high transmission rate and for field trial.

7. In \_\_\_\_\_\_\_\_\_\_ the microwave frequency are modulated with an optical carrier and transmitted using a single wavelength channel.

1. Subcarrier multiplexing
2. TDM
3. FDM
4. Code division multiplexing View Answer

Answer: a

Explanation: Optical Subcarrier multiplexing (SCM) is transmitted using a single wavelength channel. It enables multiple broadband signals to be transmitted over single-mode fiber.

8. Which of the following techniques is easy to implement?

1. Amplitude shift keying
2. Phase shift keying
3. Frequency shift keying
4. SCM View Answer

Answer: c

Explanation: Frequency shift keying has an advantage of being simple to implement at the modulator as well as demodulator side. It is formed by up converting to a narrowband channel at high frequency employing frequency.

9. Which of the following is the disadvantage of SCM?

1. Source nonlinearity
2. Linearity
3. Distortion
4. Narrow bandwidth View Answer

Answer: a

Explanation: The problem associated with SCM is source nonlinearity. The distortion caused by this becomes noticeable when several subcarriers are transmitted from a single optical source.

10. In CATV, the signal must be received with a carrier to noise ratio of between \_\_\_\_\_\_\_\_\_\_ a) 90 and 100 dB

1. 10 and 30 dB
2. 60 and 70 dB
3. 45 and 55 dB View Answer

Answer: d

Explanation: The CATV multichannel spectrum tends to minimize the required bandwidth. The carrier to noise ratio must be between to avoid degradation of picture quality.

11. The IF signal can be input to a demodulator to recover the baseband signal. a) True

b) False View Answer

Answer: a

Explanation: The IF signal is obtained through SCM at the receive terminals. The baseband video signal in a CATV is obtained through IF signal by using it with a demodulator input.



This set of Optical Communications Multiple Choice Questions & Answers (MCQs) focuses on “Application of Optical Amplifiers “.

1. Which of the following is not a drawback of regenerative repeater? a) Cost

1. Bandwidth
2. Complexity
3. Long haul applications View Answer

Answer: d

Explanation: The regenerative repeaters are useful in long haul applications. However, such devices increase the cost and complexity of the optical communication system. It act as a bottleneck by restricting the system operational bandwidth.

2. The term flexibility, in terms of optical amplifiers means the ability of the transmitted signal to remain in the optical domain in a long haul link. a) True

b) False View Answer

Answer: a

Explanation: Repeaters are usually used to maintain the transmitted signal in the optical domain. But, it has its own drawbacks. Thus, flexible systems which include optical amplifiers are used for such purpose.

3. How many configurations are available for employment of optical amplifiers? a) Three

1. Four
2. Two
3. Five View Answer

Answer: a

Explanation: Optical amplifiers can be employed in three configurations. These are simplex mode, duplex mode, multi-amplifier configuration.

4. Repeaters are bidirectional.

1. True
2. False View Answer

Answer: b

Explanation: Repeaters are unidirectional. Optical amplifiers have the ability to operate simultaneously in both directions at the same carrier wavelength.

5. It is necessary to \_\_\_\_\_\_\_\_\_\_\_\_ the optical carriers at different speeds to avoid signal interference. a) Inculcate

1. Reduce
2. Intensity-modulate
3. Demodulate View Answer

Answer: c

Explanation: Optical amplifiers are bidirectional. They operate in both directions at the same carrier wavelength. In order to avoid interference, the optical carriers should be intensity modulated.

6. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ increases the system reliability in the event of an individual amplifier failure. a) Simplex configuration

1. Duplex configuration
2. Serial configuration
3. Parallel multi-amplifier configuration View Answer

Answer: d

Explanation: The optical amplifiers with spectral bandwidths in the range 50 to 100 nm allow amplifiers to be more reliable than repeaters. The parallel multi-amplifier configuration increases system reliability and relaxes the linearity.

7. Which of the following is not an application of optical amplifier? a) Power amplifier

1. In-line repeater amplifier
2. Demodulator
3. Preamplifier View Answer

Answer: c

Explanation: Optical amplifiers have a wide variety of applications in the transmitter as well as receiver side. It is used as the power amplifier in the transmitter side and as preamplifier at the receiver side.

8. \_\_\_\_\_\_\_\_\_ reconstitutes a transmitted digital optical signal. a) Repeaters

1. Optical amplifiers
2. Modulators
3. Circulators View Answer

Answer: a

Explanation: Optical amplifiers simply act as gain blocks on an optical fiber link. However, in contrast, the regenerative repeaters reconstitute a transmitted digital optical signal.

9. \_\_\_\_\_\_\_\_\_\_\_\_\_ are transparent to any type of signal modulation. a) Repeaters

1. Optical amplifiers
2. Modulators
3. Circulators View Answer

Answer: b

Explanation: The main benefit of acting as a gain block for optical amplifier is that it can be transparent to modulation bandwidth. However, both the noise and signal distortions are continuously amplified.

10. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ imposes serious limitations on the system performance. a) Fiber attenuation

1. Fiber modulation
2. Fiber demodulation
3. Fiber dispersion View Answer

Answer: d

Explanation: The fiber dispersion calculation does not take into account the non-regenerative nature of the amplifier repeaters. In this, the pulse spreading and the noise is accumulated.

11. \_\_\_\_\_\_\_\_\_\_ is the ratio of input signal to noise ratio to the output signal to noise ratio of the device. a) Fiber dispersion

1. Noise figure
2. Transmission rate
3. Population inversion View Answer

Answer: b

Explanation: Noise figure judges the performance factor of the devices. It is the in and out the ratio of signal to noise degradation for any device.

12. How many factors govern the noise figure of the device? a) Four

1. Three
2. Two
3. One

View Answer

Answer: a

Explanation: Noise figure is governed by factors such as the population inversion, the number of transverse modes in the amplifier cavity, the number of incident photons on the amplifier and the optical bandwidth of the amplified spontaneous emissions.

13. What is the typical range of the noise figure?

1. 1 – 2 dB
2. 3 – 5 dB
3. 7 – 11 dB
4. 12 – 14 dB View Answer

Answer: c

Explanation: Typical noise figures range from 7 to 11 dB. The SOAs are generally at the bottom end of the range and the fiber amplifiers towards the top end.



This set of Optical Communications Problems focuses on “Dispersion Management and Soliton Systems”.

1. Calculate second order dispersion coefficient for path length L2 20km and L1 160km. Dispersion coefficient for L2 is 17.

1. -2.125ps/nm km
2. -3.25ps/nm km
3. -3.69ps/nm km
4. -1.28ps/nm km View Answer

Answer: a

Explanation: The second order dispersion coefficient for path length is given by- β21 = -β22L2/L1. Here, β22 = Dispersion coefficient forL2, L2 and L1 are path lengths.

2. Calculate the path length L2 if L1is 160, dispersion coefficient of L2 is 17, dispersion coefficient of L1 is -2.25 ps/nmkm. a) 40 km

1. 20 km
2. 30 km
3. 10 km View Answer

Answer: b

Explanation: The path length L2 is given by-

L2 = β21L1/-β22. Here, β22 = Dispersion coefficient forL2, β21 = Dispersion coefficient for L1, L2 and L1 are path lengths.

3. Calculate path length L1 if L2 is 20, dispersion coefficient of L2 is 17, dispersion coefficient of L1 is -2.25 ps/nmkm.

1. 180 km
2. 30 km
3. 160 km
4. 44 km View Answer

Answer: c

Explanation: The path length L1is given by-

L1 = β21L2/-β22. Here, β22 = Dispersion coefficient forL2, β21 = Dispersion coefficient for L1, L2 and L1 are path lengths.

4. Calculate second order dispersion coefficient for path length L1 20 km and L1 160 km. Dispersion coefficient for L1 is -2.125\*10-12s/nmkm. a) 20

1. 19
2. 18
3. 17

View Answer

Answer: d

Explanation: The second order dispersion coefficient for path length is given by- β22=-β21L2/L1. Here, β21 = Dispersion coefficient forL1, L2 and L1 are path lengths.

5. Calculate dispersion slope for second path fiber if L1 is 150, L2 is 10 and s1 is 0.075. a) 1.125

1. 2.125
2. 3.125
3. 1.9

View Answer

Answer: a

Explanation: Dispersion slope for second path fiber is s2 = -s1(L1/L2). Here s1 and s2 are dispersion slopes for L1, L2. L2 and L1 are path lengths.

6. Calculate dispersion slope for first path fiber if L1 is 160, L2 is 20 and s2 is 0.6ps/nm km. a) 0.1

1. 0.432
2. 0.236
3. 0.075

View Answer

Answer: d

Explanation: Dispersion slope for first path fiber is s1 = -s2(L1/L2). Here s1 and s2 are dispersion slopes for L1, L2. L2 And L1 are path lengths.

7. Calculate L2 if dispersion slope for first path fiber is 0.075 and L1 is 160 km and s2 is -0.6ps/nm km. a) 20 km

1. 30 km
2. 40 km
3. 50 km View Answer

Answer: a

Explanation: L2 is determined by –

L2 = (-s1/s2)\*L1. Here s1 and s2 are dispersion slopes for L1, L2. L2 and L1 are path lengths.

8. Calculate L1 if dispersion slope for first path fiber is 0.075 and L2 is 20 km and s2 is -0.6ps/nm km. a) 170 km

1. 160 km
2. 180 km
3. 175 km View Answer

Answer: b

Explanation: L1 is determined by –

L2 = (-s1/s2)\* L2. Here s1 and s2 are dispersion slopes for L1, L2. L2 and L1 are path lengths.

9. Calculate separation of soliton pulses over a bit period length if R2 pulse width is 6 ps for bit period of 70 ps. a) 5.9

1. 5.7
2. 5.8
3. 5.4

View Answer

Answer: c

Explanation: The separation of soliton pulses over a bit period length is calculated by – q0 = T0/2ς. Here ς = pulse width and T0 = bit period.

10. Calculate RZ pulse width if bit period is 60ps and separation of soliton pulses is 5.4. a) 5.5ps

1. 8.1ps
2. 4.3ps
3. 2.3ps View Answer

Answer: a

Explanation: RZ pulse width can be calculated by – ς = T0/q0. Here ς = pulse width and T0 = bit period.

11. Calculate bit period if RZ pulse width is 50ps and separation of soliton pulses is 5.6. a) 570ps

1. 540ps
2. 430ps
3. 560ps View Answer

Answer: d

Explanation: Bit period can be calculated by – T0 = 2T2q0. Here T2=pulse width and T0=bit period.

12. Calculate value of dimensionless parameter if bit period is 45ps and RZ pulse width is 4 ps. a) 5.625

1. 5.0
2. 4
3. 6.543 View Answer

Answer: a

Explanation: Dimensionless parameter is given by – q0 = T0/2ς. Here ς=pulse width and T0=bit period.



## 11. Questions & Answers on Optical Fiber Systems 2 : Coherent and Phase Modulated

The section contains questions on coherent transmission, modulation formats, demodulation schemes, receiver sensitivities and multi carrier systems.

This set of Optical Communications Questions and Answers for Entrance exams focuses on “Practical Constraints of Coherent Transmission”.

1. Which technology development has helped the field of optical fiber communication? a) Glass technology

1. Component technology
2. Multiplexing
3. Power View Answer

Answer: b

Explanation: Substantial developments in component technology have allowed the initial difficulties in the optical fiber communication to go away. The coherent factor experienced most of the difficulties.

2. \_\_\_\_\_\_\_\_\_\_ dictates the performance characteristics required from components and devices which are to be utilized in coherent optical fiber systems. a) System considerations

1. Bluetooth technology
2. Multiplexing
3. Practical constraints

View Answer

Answer: d

Explanation: Practical constraints inhibit the development of coherent optical fiber communications. These constraints are derived from factors associated with the elements of the coherent optical fiber communication.

3. Coherent optical transmission is degraded by the \_\_\_\_\_\_\_\_ associated with the transmitter and local oscillator lasers.

1. Phase noise
2. White noise
3. Dissipation
4. Power View Answer

Answer: a

Explanation: Phase noise is determined by the laser line width. The phase noise associated with both the transmitter and the mid-tier section severely degrades the coherent optical transmission as well as reception.

4. \_\_\_\_\_\_\_\_\_\_\_ improves the spectral purity of the device output and noise current. a) Power dissipation

1. Laser line width reduction
2. Laser line width injection
3. Phase noise View Answer

Answer: b

Explanation: Laser line width determines the level of phase noise and long term phase stability. The reduced phase noise is obtained using narrow-line width devices. This improves the spectral purity as well as reduces the noise current.

5. \_\_\_\_\_\_\_\_\_\_\_\_ is the principal cause of line width broadening in the coherent devices. a) Electromagnetic field

1. Power dissipation
2. Injection laser phase noise
3. Gaussian noise View Answer

Answer: c

Explanation: Injection laser phase noise affects the system performance. The system performance considerations include receiver noise, power loss and line width broadening.

6. Which technique was started for narrowing of injection laser line widths? a) External resonator cavity

1. Long-hauled oscillator
2. Circulator
3. Gyrator View Answer

Answer: a

Explanation: Many approaches evolved in time for laser line width problem. The one which sustained and showed effects was the use of external resonator cavity in the lasers.

7. The line width tolerance is wider for heterodyne receivers. a) False

b) True View Answer

Answer: b

Explanation: The laser line width requirements depend on the modulation format, coherent detection mechanism which includes the use of heterodyne and homodyne receivers. The line width tolerance is wider for heterodyne receivers when employing FSK modulation.

8. \_\_\_\_\_\_\_\_\_\_\_ is an alternative to reduce phase noise and line width requirements. a) Homodyne detection

1. Heterodyne detection
2. FSK modulation
3. Phase diversity reception View Answer

Answer: d

Explanation: The more sensitive coherent transmission techniques are most affected by phase noise problem. A specially configured reception technique called as phase diversity reception technique is used to overcome phase noise problem.

9. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is the progressive spatial separation between the two polarization modes as they propagate along the fiber.

1. Fiber birefringence
2. Fiber dispersion
3. Fiber separation
4. Fiber coupling View Answer

Answer: a

Explanation: In a perfectly formed fiber, both modes would travel together. But, in practice, the fiber contains random manufacturing irregularities. This result in a progressive spatial separation called as fiber birefringence.

10. How many compensator devices are required to provide full polarization-state control? a) Three

1. One
2. Four
3. Two View Answer

Answer: d

Explanation: At least two compensator devices are required to provide full polarization-state control. They can be placed in either the incoming signal path or the local oscillator output path.

11. Which technique was found to be providing an infinite range of polarization control? a) Homodyne detection

1. Fiber squeezers
2. Heterodyne detection
3. Power dissipation View Answer

Answer: b

Explanation: Four fiber squeezers provide an infinite range of adjustment or endless polarization control. Stress was applied to the fiber in the local oscillator path using the squeezers which are angled at 45 degrees to each other.

12. What is the main drawback of the squeezer?

1. Damages the fiber
2. Attenuation
3. Dispersion
4. Signal degradation View Answer

Answer: a

Explanation: The squeezers are simple to configure. The main drawback of squeezer is that they tend to damage the fiber and could not be engineered into reliable transducers for practical systems.

13. The use of balanced receiver compensates the losses due to coupling optics. a) True

b) False View Answer

Answer: a

Explanation: The losses due to coupling optics and the suppression of the excess noise in the local oscillator signal are eliminated by the use of balanced receiver. It is also called as balanced-mixer receiver.

14. \_\_\_\_\_\_\_\_\_\_\_ is the phenomenon which occurs in the single carrier systems due to small refractive index changes induced by the optical power fluctuations. a) SBS gain

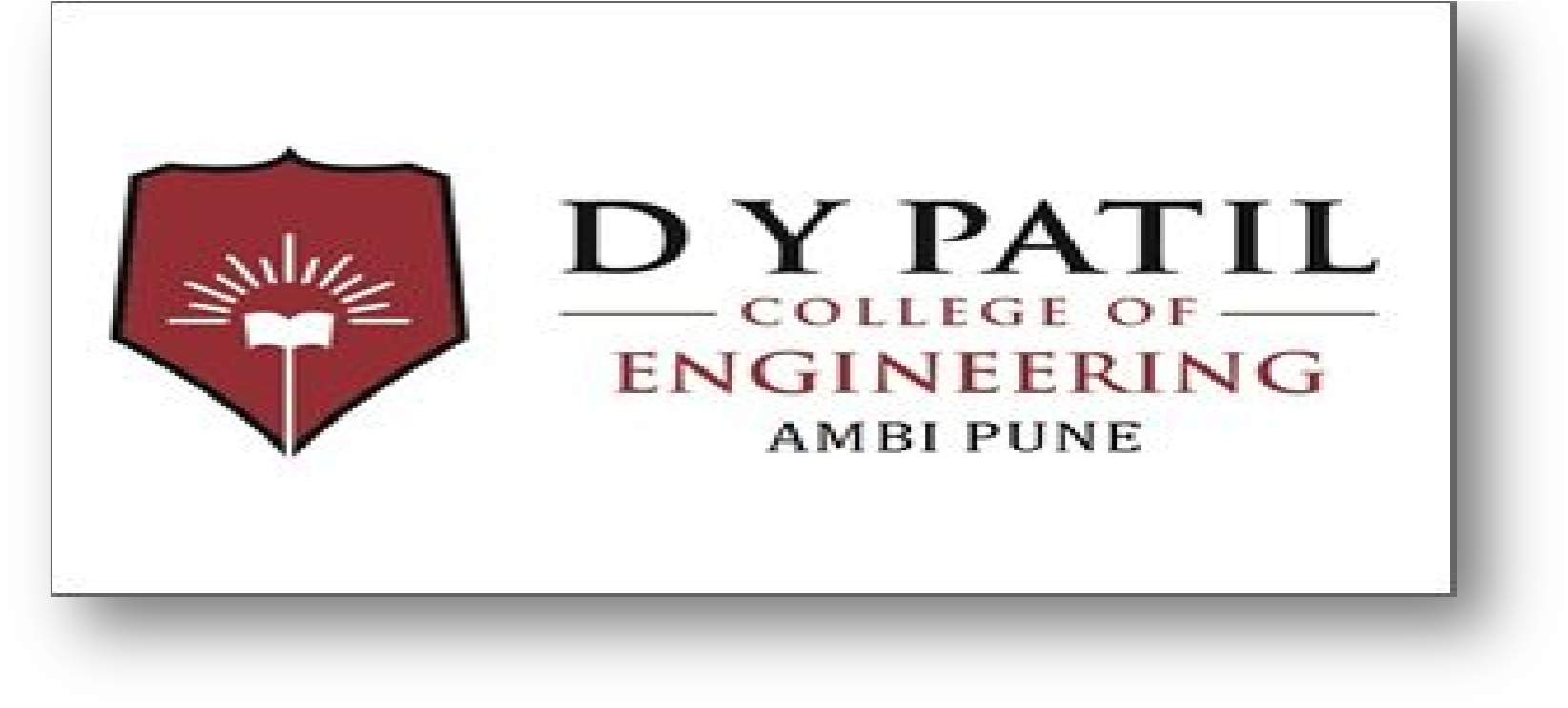
1. Self-phase modulation
2. FSK modulation
3. Birefringence View Answer

Answer: b

Explanation: It occurs only in the single-carrier systems. It affects the phase of the transmitted signal.



`



# Short Answers Questions

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

## BE (2015)Pattern

**404190 Broadband Communication Systems )**

**Topic : Optical Fibre Communication**

INTRODUCTION ................................................................................................................................................................. 7

1. What is a fiber optic? ................................................................................................................................................ 9
2. How many kinds of fibers are there? ............................................................................................................... 9
3. What are fiber optics made off? .......................................................................................................................... 9
4. Are there different qualities of fiber optics? ................................................................................................. 9
5. What is a light guide? .............................................................................................................................................10
6. What are bare fibers? .............................................................................................................................................10
7. What are sheathed fibers? ...................................................................................................................................10
8. Is the sheath color important?...........................................................................................................................10
9. What is a harness? ...................................................................................................................................................10
10. Do fibers have losses? ............................................................................................................................................10
11. Why do some fibers change the color of the light? ..................................................................................10
12. Is low attenuation a sign of good quality fiber? ........................................................................................11
13. What are the advantages of glass fiber optics? .........................................................................................11
14. And the disadvantages? ........................................................................................................................................11
15. What are the advantages of polymer fiber optics? ..................................................................................12
16. And the disadvantages? ........................................................................................................................................12
17. Can I light a house with fiber optics? .............................................................................................................13
18. Are fiber optics efficient as a means to transport light? .......................................................................12
19. What can justify the use of fiber optics? .......................................................................................................13
20. Are fibers safe? ..........................................................................................................................................................13
21. Who makes fiber optics? ......................................................................................................................................13
22. How are fiber optics made? ................................................................................................................................13
23. Are optical fibers fragile? .....................................................................................................................................14
24. Can fibers be bent at right angles? ..................................................................................................................14
25. Can lighting fiber optics be spliced or joined? ...........................................................................................14
26. Will light go any length along a fiber? ...........................................................................................................14
27. How many sizes are there of lighting fiber optics? .................................................................................14 28. Can you put any amount of light into a fiber optic? ................................................................................15
28. Do fiber optics transmit radiation ...................................................................................................................15
29. Glass or polymer? ....................................................................................................................................................15
30. Can fibers be made any size? .............................................................................................................................15 32. How long will fiber optics last? .........................................................................................................................16
31. Can several fibers give the same amount of light? ..................................................................................16
32. What are side-emitting fibers? ..........................................................................................................................16
33. Are there different types of side emitting fibers? ....................................................................................16
34. What are solid core fibers? .................................................................................................................................16
35. What are multistranded optics? .......................................................................................................................17 38. What are coiled or roped optics? .....................................................................................................................17
36. Solid core or multicore? ........................................................................................................................................17
37. Can side emitting optics be as bright or brighter than neon? ............................................................17
38. With all the limitations, what are the uses of side emitting optics? ................................................18
39. What are the design constraints to side emitting optics? ....................................................................18
40. Could the light along a side emitting optic be absolutely homogeneous?.....................................18
41. Will we always see a difference in brightness along an optic? ..........................................................18
42. Can light be made to move or chase along a side emitting optic? ....................................................19
43. Are the side-emitting fibers with reflecting core more luminous? ..................................................19
44. Is there any way to improve side-emitting viewing? .............................................................................19 I L L U M I N A T O R S
45. What is an illuminator? ......................................................................................................................................... 21
46. What makes a good illuminator? ....................................................................................................................... 21
47. Is bigger better? ....................................................................................................................................................... 21
48. How many types of illuminators are there? .................................................................................................. 22
49. Halogen or gas discharge? ................................................................................................................................... 22
50. Must all illuminators have forced ventilation? .............................................................................................. 22
51. How noisy is an illuminator? .............................................................................................................................. 22
52. Are certifications important? ............................................................................................................................... 23
53. Are machines with the CE mark certified? ..................................................................................................... 23
54. How then do I recognize a product's quality? .............................................................................................. 23
55. What about ISO 9000? ........................................................................................................................................... 24
56. How does a color change works?....................................................................................................................... 24
57. What is a dychroic filter? ...................................................................................................................................... 24
58. Are heat fuses necessary? .................................................................................................................................... 24
59. Can multiple illuminators change colors simultaneously? ....................................................................... 25
60. Can illuminators be computer controlled? ..................................................................................................... 25
61. What is DMX? ............................................................................................................................................................ 25

E N D S , F I T T I N G S A N D T E R M I N A L S

1. What are end terminations? ................................................................................................................................. 27
2. What are single ends? ............................................................................................................................................ 27
3. Are there many types of single ends? .............................................................................................................. 27
4. Is the fiber end important? .................................................................................................................................. 27
5. How are glass fibers ended?................................................................................................................................ 28
6. How are polymer fibers terminated? ................................................................................................................ 28
7. How are solid core fibers terminated? ............................................................................................................ 28
8. How are coiled, twisted or roped fibers terminated? ................................................................................ 29
9. What is a common end? ........................................................................................................................................ 29
10. Is the common end important? .......................................................................................................................... 29
11. What makes a good common end? .................................................................................................................... 29
12. How many types of common end are there? ................................................................................................. 29
13. What is a randomized common end? ............................................................................................................... 30
14. What are end fittings? ............................................................................................................................................ 30
15. How many types of end fittings are there? .................................................................................................... 30
16. Fittings or fixtures?................................................................................................................................................. 30
17. Who manufactures end fittings? ......................................................................................................................... 30
18. Are end fittings standard? .................................................................................................................................... 30
19. What is an optical port .......................................................................................................................................... 31
20. Are there different types of optical port? ....................................................................................................... 31
21. Who manufactures optical ports? ....................................................................................................................... 31
22. Are optical ports compatible? .............................................................................................................................. 31

S Y S T E M S

1. What is a fiber optics system? ............................................................................................................................ 31
2. What is a fiber optics systems integrator? .................................................................................................... 33
3. What is the difference between a fiber optics manufacturer and

a fiber optics system manufacturer? ................................................................................................................. 33

1. Who are the best fiber optics manufacturers? ............................................................................................. 33
2. Who are the best systems integrators? ........................................................................................................... 34
3. How many parts does a fiber optics system have? ..................................................................................... 34
4. Are fiber optics systems expensive? ................................................................................................................ 34
5. Will fiber optics systems be cheaper in the future? ................................................................................... 35
6. Are fiber optics systems difficult to install? .................................................................................................. 35
7. What is a starry sky? .............................................................................................................................................. 35
8. What is an effect wheel? ........................................................................................................................................ 35 98 What is an animation harness? ........................................................................................................................... 35
9. What are spatial effects? ........................................................................................................................................ 36
10. How would you describe in one word fiber optics lighting systems? ................................................ 36

### I N T R O D U C T I O N

**Fiber optics lighting is not a revolutionary or new technology, in essence is only about carrying light, from one point to another by means of a lens, more or less flexible and long.**

The problem is the air of mysticism surrounding the industry\*.

The result is a strange industry where it is difficult to know for sure the result of the system being ins- talled and where disappointment, in part due to unfair hopes, is common.

The present work is a collection of the questions most often made by professionals during seminars, consulting, and projects over a quarter of a century. The questions are worded in a short straight- forward manner and answered based on objective scientific criteria, without publicity, trademarks, or personal preferences, in an effort to help the general understanding of these systems.

### F I B E R S

1. . What is a f iber opt ic?

Fiber optics are long lenses. A cylinder or rod of transparent material forming a core surrounded by an external cladding with a slightly different material. Light, when entering the fiber, rebounds on the outer cladding towards the core. This way the light advances through the fiber in bounds or steps, until it exits at the other end.

1. . How many kinds of f ibers are there?

In truth, there is only one fiber optic. The term "fiber optics" applies really to a branch of light physics dealing with the properties of certain materials that display a phenomenon called "total internal reflection", and not to an object. All optical elements such as lenses, prisms and rods use total internal reflection as a mecha- nism for light transportation. In the elements described as fiber optics light travels by virtue of this effect but it does so in a number of ways; monomode, multimode, step index, gradient index and so on.

For lighting purposes or, to be more exact, to handle visible light, the standard type or fibers are the so-called multimode step index fibers. The use of the other types is confined exclusively to data or signal transmission.

1. . What are f iber opt ics made off?

For lighting purposes or visible light spectrum transmission, several kinds of fibers are used. Glass in very fine strands that have to be bunched together in order to make a sizeable light carrier, PMMA, and polycarbonate in sizes from 0,25 to 3mm and solid core fibers made from special polymers in a Teflon sheath from 3mm to over one-inch thick. Other types of fibers such as liquid core, colored fibers, fluorescent, and scintillating are little used and for specialized applications.

1. . Are there di fferent qual i t ies of f iber opt ics?

Definitely yes. The raw materials used in the manufacture of fibers may be similar in some instances but the process to make finished optics can vary greatly from one manufacturer to another.

The greatest differences arise from the level of purity and refinement with which the raw materials are pro- duced, the degree of impurities, contamination and the very technology of the process.

Optical properties such as numerical aperture, attenuation and selective spectral absorption

are widely diffe- rent from one fiber to other. This means that some fibers may be suitable for one task and useless for others.

1. . What is a l ight guide?

When a number of single fibers are grouped together to make a larger diameter light conductor the resulting structure is called a light guide. Sometimes large diameter solid core fibers are also termed light guide.

Light guides can come in many forms and finished, clad with a number of different polymers, articulated ana- conda type flexible metal coverings, rigid tubes, heat shrink tubes, etc.

1. . What are bare f ibers?

The term is used mainly with PMMA fibers and refers to the optics that have no external protection sheath.

1. . What are sheathed f ibers?

The optics that have an external cladding whether opaque or transparent in order to afford a mechanical protection to the optics.

1. . Is the sheath color important?

This is a particularly slippery subject and the cause of heated debate. Some scientists affirm that an opaque white or light colored cladding, especially in single core fibers improve, marginally, the transmission properties of the optics. Others say that this is nonsense. In any case, the difference if it exists, must surely be minimal.

1. . What is a harness?

The term applied in the industry to describe a group of fibers or light guides, individually terminated and with a common end. Generally, each harness must have its own illuminator.

1. . Do f ibers have losses?

All things in the universe are inefficient. This means that when a measured amount of something enters a system, less comes out than originally went in. If you pour a liter of water into one end of a pipe, you will always get less than a liter out of the other end. If you apply a voltage to the extreme of one wire, no matter how you do it, you will get a lesser value at the other end.

Fiber optics are no exception, the light entering one end encounters all kinds of obstacles and flaws, resul- ting in losses; from 2 to 10% for every running meter.

1. . Why do some f ibers change the color of the l ight?

In fact, all fibers change the color of the light in one way or another. Due to the physical characteristics of the conductor some frequencies travel with less impediment than others and it is impossible to produce a fiber that would have the same attenuation on the whole of the visible spectrum. To expect a light conductor to transport millions of different wavelengths along with exactly the same attenuation in every one would be quite unreasonable.

Some fibers absorb a little more blue than red and less green than yellow and others just the opposite. Consequently, the hue and tone of the light varies from meter to meter, in some cases very apparently. This phenomenon is referred to as selective spectral absorption.

1. . Is low attenuat ion a sign of good qual i ty f iber?

Generally yes, but in lighting fiber optics the manufacturer's attenuation figures are frequently meaningless. (In order to be reasonable this is the only figure they can quote) Attenuation is measured using a laser, a light emitting diode or a collimated light source. In all three cases the light used is monochromatic, meaning that only one wavelength or a very narrow set of wave- lengths is used.

The figures issued by manufacturers, per example: 150dB/Km refer to that single wavelength and corres- ponding color which could be yellow or yellow/green. The same fiber may have an attenuation of 750dB/Km on the blue end of the spectrum and 400dB/Km on the red side. To calculate the average attenuation for white light would involve firstly analyzing the light of the lamp in the illuminator to determine its composition that could vary enormously, even for two identical lamps. Then one would have to measure attenuation in all individual wavelengths taking into account the amount of each present on the lamp's emission. Finally, we would have to compute to obtain a result which would only hold true for that lamp/fiber combination.

To be honest a close average can be worked out with a few instruments but lamp deterioration due to aging, dust in the system and coloring of the common end due to solvent migration from the potting compounds, if used, soon make nonsense of averaged figures.

1. . What are the advantages of glass f iber opt ics?

Glass fiber optics are very resilient and ideally suited for working in places where the actual conductor will be subject to extreme temperatures or/and radiation, are little affected by most solvents and oils and the spectral transmission is good.

1. . And the disadvantages?

It must be borne in mind that the actual nature of the conductor, in lighting systems, represents only one of the elements responsible for system performance. Glass light guides are always sheathed in a poly- mer tube and the common end encapsulated with epoxy compounds.

The actual element in contact with the environment is the polymer tube. In fact, the characteristics of this element will, for all purposes, determine the resilience of the system. This little considered point makes nonsense of some critics of polymer fiber who complain of the plastic contents. The fact is that if we take a 2mm-polymer fiber and a glass fiber with the same optical diameter we will find out that the latter contains more plastic than the former. Naturally we are talking about a bare PMMA fiber, this is to say without cladding. PMMA fibers can be used bare, glass fibers cannot; must always be cladded. At the common end, the epoxy compounds make up to 17% of the total optical area to receive the light from the lamp. It is a well known fact that these potting adhesives behave erratically in the presence of high temperatures and steep radiation gra- dients, such as the ones present at the screen or focus of the lamp in the generator, light source or illumina- tor. This epoxy tends to age very quickly, darken, absorb more radiation, heat up and contribute to the pre- mature failure or deterioration of the system. On the other hand, glass fibers are very brittle. Studies show that vibration affects adversely glass fibers up to the point where shatter may occur. If the external sheath or tube becomes also hard and lose flexibility because of environmental factors then the light guide becomes extremely fragile.

1. . What are the advantages of polymer f iber opt ics?

The spectral transmission of PMMA fibers is difficult to improve upon, the quality of the light transmitted over distances longer than four or five meters is considerable better that the standard glass fibers. Cost is another factor; polymer fibers have a lower cost per optical area unit than glass, in part due to the easier manufacturing process. High quality PMMA systems rely on a fusion process to construct the common end, hence dispensing with the use of epoxy potting compounds. In all instances where the use of many fibers or light points is prescribed polymer systems are a much better option. Another point to bear in mind is the weight factor: glass fibers are heavier than polymer, a fact that may be critical in some applications, such as automotive and aircraft uses.

1. . And the disadvantages?

The ends of polymer fibers cannot operate with high temperatures. Light sources or illuminators are needed with a screen temperature lower than 60ºC. Although some polymers can work with 100ºC and over, the fact is that these constant high temperatures cause changes on the polymer chains, especially at the common end. This results on a hardening and blushing or blooming of the material, causing a deterioration of the system. The use of very powerful and hot illuminators with polymer fibers, in most cases is sheer madness. Although there is very little data on polymer aging, some manufacturers offer a 20-year guarantee on their systems, which is more than adequate in most instances.

Radius of curvature is a delicate mater with large diameter solid core fibers and has to be handled with great care in order not to alter the internal architecture of the fibers, which will result in losses. Bare or unsheathed fibers are very delicate and the external cladding becomes rapidly damaged due to abrasions and scratches.

1. . Can I l ight a house wi th f iber opt ics?

A house can be lit with anything, from candles and gas lamps to fiber optics. There is the question, however, of the efficiency of the system. One should never forget that a light source, such as an electric lamp, delivers its maximum output hanging free in mid air, and that any thing added, such as a coffer, a louver or an optical system of lenses or reflectors diminishes the performance.

Truth is that in most cases light issuing from a lamp in a spherical fashion is of little use because we want the light pointing towards a given direction, in order to perform a task. Nevertheless, is also true that anything around or in front of a lamp rests light to the general output of the system.

With fiber optics, this is no exception. The lamp enclosed in the illuminator would give a greater quantity of light if taken out and hung from a ceiling than pushing the light through fibers.

There is a common misconception amongst the public that if we have a 100 Lm lamp in one place and we run ten fibers to different rooms we would have a 100 Lm light in each room. This sounds very much like the parable of the bread and the fishes and clashes with the laws of thermodynamics, as we know them.

If you have a 100 Lm lamp in a box and run ten fibers out, the total combined output of the fibers will always be considerably less than 100 Lm, now and in the future.

1. . Are f iber opt ics eff icient as a means to transport l ight?

The straight answer is no. If we take any other means of light re-direction or distribution we will find out that are far more efficient.

1. . What can just i fy the use of f iber opt ics?

In the great majority of tasks, using traditional means, the amount of light used is far in excess to the quantity really needed. Most light goes to illuminate areas that do not need light at all.

With fiber optics, we can distribute minute quantities of light exactly where needed, an impossible feat with conventional lighting because light sources are too large.

The distinct possibilities to put the lamp within easy reach whilst the light is distributed in zones with difficult access is another advantage of fiber optics. The main reasons for the use of fiber optics in lighting are safety, control, miniaturization, cost and ease of maintenance.

1. . Are f ibers safe?

Fiber optics are passive elements, therefore do not use power to generate light, as is the case with lamps. As light conductors only carry light from one point to another, never electricity.

Fiber optics can be put under, or in direct contact with water, can be cut, handled, broken or hammered and can never be anything but totally safe lighting conductors, with the exception of power conversion.

Because standard lighting fiber optics have a very restricted transmission window most radiation which could be harmful to beings or things is not transmitted. In fact the amount of infrared and ultraviolet issuing from a fiber optic is, in most instances, negligible.

The use of fiber optics in the lighting of museum pieces or radiation sensitive material is one of the main appli- cations of these light conductors.

There is, however, the phenomenon of power to light conversion on the extremes of the fibers: a very high temperature may be present, with the use of high powered illuminators, very close to the tip. If a light guide is cut, abraded or damaged in anyway along its length a very hot spot may ensue which can destroy the fiber and the surrounds. When using systems with high power densities additional precautions should be obser- ved to maintain safety in the system.

1. . Who makes f iber opt ics?

Glass manufacturers mainly make Glass fibers. Chemical companies fabricate PMMA fibers. Compa- nies, both public and private, manufacture other types of fiber optics, especially solid core polymer and gene- rally with their own proprietary process.

1. . How are f iber opt ics made?

The actual process varies considerably from one manufacturer to another. In essence, a large cylinder of core is made off high purity material, an element called preform. The preform is later heated or treated and drawn into a filament, which is then coated with the external layer with a different refractive index.

Other systems include co-extrusion, continuous casting, direct co-polymerization, injection, wet drawing and soft extrusion with mercury formers.

These later techniques, and others under research, try to attain a better alignment of polymer chains in order to improve transmission and reduce attenuation. In fact, the fiber stretching and tensioning after drawing to promote molecular alignment is one of the industry secrets.

1. . Are opt ical f ibers fragi le?

Glass fibers are very brittle, in fact in any glass light guide there is a percentage of fibers broken during the manufacturing process, on the other hand, because these light guides are sheathed, once installed are very resistant to external influences.

Bare PMMA fibers are extremely delicate during manufacture and manipulation, requiring great handling care. Once sheathed are practically impervious to external damage.

Other solid core fibers are very tough because of an external Teflon cladding and can be installed without any problem. The only drawback with this type of optics is the hardening with age, which makes these conductors brittle and prone to shatter.

1. . Can f ibers be bent at r ight angles?

No. All fibers must be bent with a radius, which will not alter the internal architecture of the fiber. For every type and size of fiber, there is a minimum radius of curvature, specified and recommended by the manufacturer. Bending fiber optics at right angles will cause the conductor to shatter in the case of glass, and be permanently damaged in all other types

1. . Can l ight ing f iber opt ics be spl iced or joined?

All fibers can be spliced with more or less success and difficulty. The problem is the losses resulting from such a joint.

Fiber splicing is a common practice in the telecommunications industry where is done with sophisticated alignment apparatus and a considerable dose of skill.

Nowadays there are splicing systems for polymer light guides using special fittings and a refraction index equalizing gel capable of low price splices with minimal losses. In glass fibers where one would have to indi- vidually splice hundreds or even thousands of single fibers, splicing is not resolved yet.

Solid core fibers can be joined with greater ease but the losses are massive; up to 25% of the available light.

1. . Wi ll l ight go any length along a f iber?

All conductors have losses, and in the case of fiber optics, these are sizeable.

Light losses in the industry average 2 to 5% per meter or over. If we start with, say 100 units of light at the common end we will lose 25% at the end of five meters and over 40% after ten.

In fact, most systems have losses greater than 50% over a ten-meter length.

1. . How many sizes are there of l ight ing f iber opt ics?

Literally hundreds, from a few microns to over an inch in diameter, solid core and multicore, square shaped, ribbons, tapes and sheet.

1. . Can you put any amount of l ight into a f iber opt ic?

This is one of the standard fallacies of the industry. The system needed to put a sizeable amount of light into a fiber optic is very simple; a lamp, perhaps a lens and something to hold the fiber pointing at the light source. It follows that the bigger and more powerful the lamp the greater amount of light it will issue and the more light that will get into the fiber; at least this is the argument that most people think logical.

The problem is that optics is a subject far from simple. An optical fiber will accept a measure of light and no more, regardless of the power of the lamp: if a light source puts ten units of light through a fiber, another light source, twice as bright will not put double the light into the fiber.

There is one thing called power density acceptance which marks the limit to how much energy can circulate through a system, no matter how much more energy you try to force into it. A copper wire of a given thick- ness will be happy with five amps, get warm with ten, heat up with twenty and melt with forty.

1. . Do f iber opt ics transmit radiat ion?

Light is a radiation; therefore, the answer is yes. Some fibers, depending on the nature of the materials from which they are made, transmit one band of radiation more or less wide or restricted.

Generally, the fibers used for lighting transmit little or no ultraviolet, a very small amount of infrared and varia- ble quantities of the visible light frequencies.

Heat is a radiation on the infrared region and does not transmit well on standard lighting fibers. To put an example; the amount of heat that will build up inside a case with a volume of one cubic meter of air, is only one degree in 24 hours, from a 5mm diameter PMMA light guide powered by a 150W metal halide illumina- tor.

1. . Glass or polymer?

There is not an easy answer because it will always depend on the final use and working conditions of the system.

Generally speaking glass fibers are better suited for those environments where high temperatures are cons- tant and for data transmission. Glass fibers are very thin conductors only a few microns in diameter, therefo- re in order to construct a sizeable light conductor, hundreds or even thousands have to be bunched and she- athed together.

Bending radii are small and the performance is acceptable although glass fibers with comparable spectral characteristics to PMMA are considerably more expensive.

In essence both, glass and polymer systems have advantages and drawbacks, to be individually assessed in view of the actual application and working conditions. In recent times, however, there seems to be a general trend to abandon glass fiber optics in lighting applications in favor of PMMA.

1. . Can f ibers be made any size?

Theoretically, yes. There are, however, physical constraints because of the materials and utility. Very large fibers have proportional bending radii and are not very economical to produce. Under the all encom- passing classification of Remote Source Lighting, tubes made from special polymers and behaving like fiber optics are currently being manufactured, capable of being formed into light conductors over a foot in diame- ter.

1. . How long wi ll f iber opt ics last?

In the case of glass practically indefinitely due to the inert characteristics of the material. This refers to the actual fiber, and not to the polymer cladding. Also the common ends being an encapsulation of epoxy's will behave less predictably and perform erratically, depending of many factors, such as temperature of ope- ration and level of radiation exposure.

As far as polymer systems are concerned 20 years for the conductors is the standard guarantee in the industry. This also refers to the actual fiber, without reference to the common end whose average life depends on the same factors outlined before.

1. . Can several f ibers give the same amount of l ight?

No. If a number of fibers or light guides are coupled to the same illuminator, it is physically impossible that each receives the same amount of light and therefore transmit it. The spot or tack formed by a reflector lamp at the focus point or screen is not completely homogeneous, this is to say that it does not have the same quantity of light in each point of its surface. This problem is sometimes minimized by mixing the fibers at the common end (a process termed “randomizing”) but it can never be made totally even.

1. . What are side- emi tt ing f ibers?

There are no side-emitting fibers. All fiber optics receive the light at one end and transport it to the other. When light enters a fiber and travels through the core it encounters multitude of obstacles: microscopic cracks and fissures, impurities and other elements which obstruct the passage of some light and which, in turn, esca- pes through the outer cladding. All fibers lose some light though the cladding because there are no perfect systems. This unavoidable effect is used to produce elements termed "side emitting fibers" which, in fact are normal fiber optics with a clear protective external cladding which permit to view the escaping light. In fact, some manufacturers induce stres- ses on the fibers, by means of torsion or bending to bruise the fibers and cause more light to escape along the way.

Some glass fibers are made side emitting, by the expedient method of cladding a bunch into a clear tube and breaking them at intervals. Clearly there comes a point along the tube when there are no more unbroken fibers to continue the process.

1. . Are there di fferent types of side emi tt ing f ibers?

Nowadays several types of side emitting fibers are marketed. The most common are: Solid core optics

Multistranded optics

Multistranded roped/coiled and woven/knitted optics.

1. . What are sol id core f ibers?

These optics are cylinders made of diverse polymers and encased on a transparent sheath or tube. As a standard are manufactured in different gauges or calibers from 3 to 25 or more millimeters in diameter.

1. . What are mul t istranded opt ics?

Multistranded optics are narrow walled tubes off transparent material, housing a number of smaller solid core fibers. The inner fibers are, generally 0,75mm in diameter and numbered from ten or less to seve- ral hundred, depending on the final use and diameter of the optic.

1. . What are coi led roped and woven/ kni tted opt ics?

Simply braided or woven ropes manufactured with thin solid core fiber optics, instead of hemp or nylon. Because of the strain produced on the individual fibers by means of the torsion, coiling or knitting, the fibers have greater losses along the length. This means that more light is available for side viewing purposes.

1. . Sol id core or mul t icore?

That will depend on the use to which the optic is put and the actual installation conditions. Solid core optics have generally, a larger bending radius to avoid important losses.

Furthermore, because of the trans- parent quality of the core, unless the contrast with the background is adequate the appearance is that of infe- rior luminance.

Multicore optics, on the other hand, have a more flexible construction, especially in large diameters. Becau- se of the reduced transparency of the optic, the luminance appears greater. Solid core fibers can operate in some types with higher screen temperatures and can be connected (at least in theory) to generators that are more powerful without damage to the core. It must be said, however, that the long-term effects, especially those related to the power density of the systems, are as yet undetermined.

1. . Can side emi tt ing opt ics be as br ight or br ighter than neon?

Fiber optics can be made to be brighter than neon but only for very short distances. We can think of a garden hose as an example: making tiny holes along the hose can cause a sizeable amount of water gus- hing out of the holes nearer the tap, and for a distance that will depend on the size of the holes. If we make the holes larger a greater amount of water will issue, but only for a shorter distance until it only trickles.

There is a limit to the quantity of water that can be made to pass through a hose, a limit given by the mate- rial of the pipe and the viscosity of water. We simply cannot increase pressure infinitely.

The limit on the quantity of light traveling through a fiber optic is also imposed by physics: the actual material of which the optic is made and the intrinsic qualities of light. There is a power density limit to each material. In some systems, especially with late generation purpose made metal halide illuminators, luminance values greater or equal to that of neon may be obtained for lengths up to few meters. The sizeable cost of these sys- tems when compared to neon makes the proposal impractical in most cases.

1. . Wi th all the l imi tat ions, what are the uses of side emi tt ing opt ics?

There is a common misconception about the quantity of light needed for a given task:

more light is not necessarily better, and often is worse than the right amount with the correct characteristics.

In many instances, small quantities of light to demarcate, decorate or accent are much better than a glaring neon-like line.

A good example that comes to mind is the uses in theatres, cinemas and public buildings to line out corridors, aisles and emergency exits: in these instances the brightness of neon would simply not be acceptable. Cou- pled with the beauty of color change capabilities side emitting optics are a valuable tool in the hands of the designer for outlining buildings, both externally and internally, pools, spas, cornices, gardens, and all kinds of architectural details.

Another point not to be forgotten is the total safety of fiber optics. There is no electricity in them. This means that in all those instances where high voltage neon simply cannot be contemplated because of danger, main- tenance or fragility; side-emitting fibers can be the only sensible alternative.

1. . What are the design constraints to side emi tt ing opt ics?

The actual illuminance of side emitting optics is low, although the luminance is quite acceptable in most cases. This means that if the contrast values are correctly applied the visibility of the optics can be excellent. The actual quantity of ambient illuminance, the colors of backgrounds, distance and line of vision are para- meters to be carefully balanced, in order to obtain the best results.

1. . Could the l ight along a side emi tt ing opt ic be total ly homogeneous?

Despite the assurances of some manufacturers, this is a total impossibility because it would clash with the laws of physics, as we know them.

In order for an optic to display the same illuminance along a given length, it would have to be perfect: with no losses.

As soon as light is produced by an emitter starts to decay, in a similar fashion that a bullet starts to lose speed from the moment it issues from the muzzle of a gun.

The light is not the same inch by inch in an optic as it leaves the optical port of the illuminator:

the farthest from the light source, less light, due to the attenuation of the optic.

1. . Wi ll we always see a di fference in br ightness along an opt ic?

Not necessarily so. The human vision system appreciates illuminance grades in a logarithmic fashion and if the transition was smooth would be very difficult to actually notice the difference.

If we observe an optic of, say 30 meters, from one end to the other along the optic it would not matter in which end is situated the illuminator: we would see the optic homogeneously lit, although we know that it is not pos- sible. If we were to look at the same optic sideways, from some distance, then we would notice the differen- ce in luminance, because we could compare both ends.

The judicious use of illuminators, daisy chaining the optics, restricting the length of the fibers to that recom- mended by manufacturers, the control of the contrast and the angle of vision, are the tools needed for a suc- cessful installation.

1. . Can l ight be made to move or chase along a side emi tt ing opt ic?

With roped or braided multicore fiber and a special process at the common end optics can be made to chase in both directions and display multiple colors at the same time.

1. . Are the side- emi tt ing f ibers wi th ref lect ing core more luminous?

To answer this question honestly is very much like trying to determine the sex of the angels. If a side emitting light guide has a center reflecting core it would appear that it would issue more light omni directionally, this is to say: if the light guide was suspended in mid-air and viewed from any angle.

The problem with that argument is that those optics are, normally attached to a support and viewed from fixed angles. The opaque centerpiece, in this case, would impede the passage of light from behind the core and hence the optic would have less light available to the viewer. Side-emitting light guides are sheathed in a transparent cover and the viewer, by transparency, has the bene- fit of the light escaping not only from the individual fibers placed directly in front of his line of vision but also from the ones behind.

If we take a glass tube filled with a colored liquid and light it up from one end, we could view the whole of the mass as a lit-up cylinder. If we then place a concentric opaque core, from a given direction we would have less vision of the cylinder mass. The same would hold true with any transparent cylinder.

To prove this argument is a practical impossibility since it would require two optics, with and without core of the same size and optical properties, placed exactly on the same spot in an illuminator. In my opinion, no mat- ter the patents, the so-called center reflecting cores do not add more light to a guide and probably rests light to the viewer and the system as a whole.

47. . Is there any way to improve side- emi tt ing viewing?

A side emitting light guide is viewed optimally when the contrast between the optic and background is maximized. If the light guide is placed on a white track or against a tight opaque white back the light is more apparent.

This does not mean that the optic issues more light, only that the illuminance falling on the background impro- ves the overall luminance of the optic.

### I L L U M I N A T O R S

1. . What is an i l luminator?

An illuminator, light source or generator is a box with a lamp inside, pointing towards an opening where fiber optics are secured. Naturally, this is an over-simplification, although in reality a large number of the illuminators available in the industry are little more than this.

1. . What makes a good i l luminator?

Illuminators must perform three separate tasks with a degree of efficiency. Firstly must

house a lamp and its power source, transformer, ballast, igniter and wiring in a correct and safe manner.

Secondly, it must focus the light of the lamp in the most efficient way to ensure an adequate performance. Thirdly, it must create a suitable environment to guarantee the long life of the common end, this being the union with the fiber optics. With this last task in mind, an illuminator must be designed to minimize the ther- mal load on the screen by all possible means, filters, forced ventilation, air ducting and deflectors.

1. . Is bigger better?

It is somehow surprising that manufacturers place great emphasis in the power consumption, stating that a machine is 50, 100 or 400 Watts, when in reality this has little bearing on the overall performance of the illuminator.

In the lighting industry, the performance of a lamp is measured in a number of ways, depending on the com- parison standards. The accepted data regarding a lamp's virtues are, usually, efficiency and light output, although the single must important element is the burner size.

Efficiency, determined in Lm/W, states the amount of light that a lamp produces for each unit of energy used. Is very low on incandescent lamps, where most of the energy is transformed in heat and very high in fluo- rescent and some types of discharge lamps, such as low-pressure sodium. Unfortunately, neither of these last lamps can be used sensibly with fiber optics.

The amount of light that a lamp makes is a useful piece of information when we try to light up a warehouse or an office table but useless when used to project and concentrate light on a given point. In this case the screen of the illuminator or the fiber common end.

The actual quantity and directionality of light reaching the screen, having little to do with the power con- sumption of the machine, is the only measure of performance in an illuminator. Many lamps, specially the latest arrivals, have much improved light outputs, better beam control and preci- sion. Paradoxically a last generation 50W-halogen lamp with a dychroic reflector puts more light into a fiber than a 75W lamp with a similar construction and outdated technology.

1. . How many types of i l luminators are there?

Since there are no standards in the industry, the term "type" is slightly confusing. With regards to power usage, the lamp illuminators vary from as little as 5W to as much as a

1.000W and more.

As far as the type of lamp, illuminators are divided into two families: those using incandescent lamps, gene- rally halogen, and the ones equipped with gas discharge lamps.

Illuminators can also be typed by use. Some are mainly used for lighting and others to produce effects such as animations, color change or twinkles and sparkles.

1. . Halogen or gas discharge?

Again, it will depend on the use of the system. Gas discharge lamps, especially those with a very small plasma area are ideally suited for use with optical systems such as lenses or reflectors. Consequently, the quantity of light aimed in the right direction can be far superior to that of a halogen lamp. Lumen output of these lamps is, usually greater than their incandescent counterparts. Conventional means cannot be used to regulate the output of gas discharge lamps. This means that if regulation is required mechanical irises or com- plex high frequency oscillators have to be used.

Halogen lamps are smaller, less costly, and need simpler power supplies but give less overall light. For lighting and side light applications, gas discharge is used universally, reserving the less powerful halogen light sources for effects and decoration.

It must be said, however, that if the correct halogen lamp, with the right projection angle is used, excellent results can be obtained with small diameter harnesses.

1. . Must all i l luminators have forced vent i lat ion?

Generally yes, the exception being those with a massive construction, which dissipate heat by radia- tion or transfer.

1. . How noisy is an i l luminator?

Very noisy, slightly so or totally silent, depending on the power source and the construction. Heat dissipation is something that has to be done by one of two means: radiation or ventilation. If radiation is the method chosen then the housing must have the mass and surface to ensure dissipation of the heat. In ventilated systems, the air is the agent for cooling and must be evacuated and renewed. The pro- blem is that some light sources are so hot that would need an oversized housing to dissipate all the heat build up, clearly not a very practical solution. Silent illuminators use normally small halogen or gas discharge lamps, devoid of mechanical ventilation and relying on radiation to cool the housing and dissipate the heat. Generally, works well only if placed outdoors or in a volume where the ambiance temperature is considerable lower than that of the housing.

Forced air drought is used in most power illuminators and the noise can range from 20 or so dB to 70 or 80dB. Taking into account that noise in a forced air system is relative to duct size and air speed, in addition to ven- tilator speed, mounting, vibration and other related aspects is easy to suspect that design can vary the amount of noise that a illuminator produces. This can be brought down to a minimum that can only be further reduced by damping with noise suppression material.

1. . Are cert i f icat ions important?

That will depend on the type of certificate, what is certified and by who is granted. Many certifications refer to the inherent safety of a product, with regards to accidental electrical shock. In fact some certifications attest to the fact that the contraption will not kill you, but say nothing, or very little, as far as the performance of the product. The certificate on a washing machine says nothing to the effect that the thing will wash clothes; only that is unlikely that you will get an electrical shock.

Some other certifications refer to the performance, but unfortunately, these are not compulsory. In the fiber optics industry even these certificates are, very often meaningless because there is little or no control on the interface between illuminator and fiber. A laboratory report will say that a illuminator delivers so many screen lumens but cannot say how many will get into the fiber, because that will depend on a number of factors totally outside their scope.

1. . Are machines wi th the CE mark cert i f ied?

The CE mark was a good idea in its inception but it has been so much abused that has become prac- tically meaningless for the end user.

CE is not a certification or a quality mark, moreover is not granted by any official body or controlled in any way, distributors or end users have no right whatsoever to demand a CE certificate from the manufacturer, even if his products bear the stamp.

CE is a declaration from the manufacturer stating that the object complies with CE directives and regulations. Really is the equivalent to taking the words of a used car salesman as Gospel truth.

The market is awash with shoddy products of uncertain origin and parentage bearing the CE mark, products that, obviously, do not conform to any regulation whatsoever.

In a resume: the CE mark does not attest or imply any quality or fitness for use of the object bearing the stamp. It only says that the manufacturer declares that his product is built in accordance with the community directives, under his own responsibility and without effective control by an official body.

1. . How then do I recognize a product ' s qual i ty?

There are a number of ways. The name and status of the company making the product is important and its geographical location. Some countries are famous for making good quality products and others just the opposite.

The stamp of approval of an internationally recognized testing organization is a sure way of knowing that the product has been tested and found built to very high standards. Generally, such institutes or laboratories have follow-up programs that control the manufacturing and quality processes of the manufacturer.

It can be said, with a level of certainty, that a machine bearing one or several such stamps has a traceable pedigree and is well made.

1. . What about ISO 9000 ?

Again there seems to be confusion about the ISO 9000 series of certifications. The ISO in essence is not a guarantee of good quality and is not given to an object but to a company.

ISO 9000 is, in lays terms, a system that removes anarchy from management or production, making sure that things are made always the same and with the same quality, which is not a mean feat.

It does not guarantee that the products are good but with a constant in quality. If a manufacturer makes a good gizmo or widget, the ISO 9000 certificate guarantee that it will always be good. For the same token if someone makes a bad product the ISO will ensure that is always bad. A combination of ISO 9000 and labo- ratory certificates on a product is the surest way to ascertain that an object, an illuminator in this case, is good and will remain so.

1. . How does a color change works?

It consists generally of a small, geared motor with a disc. This can be made of glass, glass segments or a polymer material in a number of colors.

The motor causes the disc to revolve in from of the common end, altering the color of the issuing light. Lower priced systems use colored films or glass whilst most others make use of dychroic filters.

In animation illuminators instead of a disc, there is a turning drum of glass or polycarbonate with color films or varnishes applied in special patterns to create movement and rapid color changes.

1. . What is a dychroic f i l ter?

A thin flat piece of glass with a metal deposition in one of the surfaces applied in a high

vacuum envi- ronment. The metal layer, only a few atoms thick causes interference in the incoming light, letting some fre- quencies pass whilst stopping others.

This frequency separation has the effect of producing very saturated and vibrant colors.

Depending on the deposition type, all visible light can be allowed to pass through, whilst stopping infrared or ultraviolet radiation. In fact, there is a dychroic or interference filter to separate practically all frequencies in the spectrum.

1. . Are heat fuses necessary?

The working temperature range of the fiber optics common end is critical if the performance of the sys- tem is to be maintained and the life guaranteed. A heat fuse of thermostat must be installed in such a way as to disconnect the illuminator should there be a heat build up.

Heat can accumulate rapidly for a number of reasons: a failed fan, obstructions on the air passages or poor ventilation. A 50ºC thermostat should be the most adequate.

It must be borne in mind that the ambiance temperature in which illuminators must operate seldom allow more than 25ºC, a very low temperature to maintain in most instances.

1. . Can mul t iple i l luminators change colors simul taneously?

Yes. Generally the standard disc rotating motors are of the synchronous type, very reliable, and gea- red to the most adequate speed. The problem is that, although individually these motors work fine, is difficult to make two or more act in perfect synchronization with each other without additional mechanical or electro- nic gear.

A simple micro switch and an adequate wiring can make any number of synchronous motors operate at the same time in perfect step.

Some manufacturers offer a variable speed synchronizer to control their illuminators with special motors, zero settings and electronic control gear.

1. . Can i l luminators be computer control led?

Practically everything can be computer controlled and illuminators are not an exception. Color discs, lamp voltage and mechanical shutters, in the case of gas discharge lamps, can be programmed and contro- lled with a computer.

This is normally offered as an option on most illuminators, using step motors and DMX control.

1. . What is DMX?

A communications protocol between an electronic circuit and step motors and actuators. A kind of lan- guage between elements so that different manufacturers can use compatible components which will work happily understanding the same data.

**E N D S , F I T T I N G S A N D T E R M I N A L S**

65. . What are end terminat ions?

Again, we find ourselves in an area where a lot of confusion and controversy are the order of the day. Some American institutions have tried to set standards as to the correct terminology to be applied in fiber optics specification. The problems is that not every manufacturer is American and was not asked their opinion in the matter, hence many people use different names referring to the same part or component.

With Illuminators happens the same as with ends, one can see reflected in manufacturer's literature names such as: light engine, light source, generator, etc. All refers to the same box with lamp inside.

End terminations suffer the same fate: single end, fiber end, single termination, emitting end, tip, end, final, common end, bundle head, head, end ferrule, etc.

In order to set a common ground we will use the term single end and common end.

Terminations therefore are the extremes of a single fiber or a group of fibers.

1. . What are single ends?

The extreme of the fiber optics conductor farthest from the illuminator. The bit that emits light or the end that lights up.

1. . Are there many types of single ends?

Single ends can be anything from a simple cut with snips or a cutter to a sophisticated polished encap- sulation. The actual technique used depends not only on the type of fiber but also on the application of the system.

1. . Is the f iber end important?

As far as the actual light output the fiber termination has little influence on the overall light output. It is however, very important, when at the single end will be fixed some lens system. Imperfections, scratches, dig and fractures at the single end termination will show as darker patches on the resulting beam.

The mechanical connection between the single end and the finishing piece, being a board or housing is also dependent on the actual finish and precision of the single end. Ferrules, machined pieces and connectors have to be scrupulously free of adhesives and with even diameters, to ensure a precise fitting.

1. . How are glass f ibers ended?

Glass fibers are, generally potted or encapsulated at the single end with the help of an epoxy adhesi- ve or compound. This results on a very hard element of fibers and adhesive that, when hardened, is suitable for cutting flush and polishing or buffing.

This encapsulation is generally enclosed on a hollow brass tube, rivet or machined piece, which then serves as a fixing, or positioning aid.

Glass fibers permit some sophisticated single end termination to support extreme temperatures or working conditions. Special potting adhesives can be used and ends processed to an operating temperature of 400ºC, indicated for oven and burner sensors and controls. In these instances, special thermal bridges have to be built into the fiber to protect the conductor.

Other terminations can be in the shape of wafers, rings, blocks or lines for machine vision, instrument ligh- ting, microscopy and other highly specialized lighting applications.

1. . How are polymer f ibers terminated?

PMMA fiber single ends can be of several types always depending on the nature of the conductor and the final application. A Simply cut fiber with cutters or snips is a standard for decorative, display and sign uses. The same type of encapsulation as for glass fibers can be used with multiple single conductors and for the same applications with the exception of high temperature work.

For most decorative and lighting uses PMMA fibers are considerably more user friendly than glass fibers. Very simple tools and little skill are, in most instances, sufficient to produce stunning results on site, without having to result to factory custom made and cut components which results in dramatic cost reductions.

PMMA fibers can also be polished to a mirror finish with buffing compounds and machines without encapsu- lation for single fibers. Common ends must always be fused together, without using adhesives. Some fiber manufacturers specifically render their guarantee void if adhesives of any kind are used at the common end. Fusion produces a solid block , which can the be polished to a very high optical finish.

1. . How are sol id core f ibers terminated?

The very architecture of solid core fibers makes the precise termination a difficult operation, although it must be said that in most applications a precise end is academic. Solid core fibers are considerably softer than PMMA or glass and hardness is a pre-condition for precise polis- hing. Additionally if an attempt is made to polishing, the compounds,

(whether Cerium based or otherwise) are always in a wax or grease medium and seep in between the Teflon coating and the core, ruining the optic. Standard finishing techniques for the single ends dispense with polishing and resolve to cutting with special tools where the quality and sharpness of the blade determines the accuracy of the cut. Further polishing can be accomplished with thermal treatment but only in factory installations.

Research is under way to polish solid core fibers using very low temperatures or else with water jets and laser cutters with uncertain degree of success.

1. . How are coi led, twisted or roped f ibers terminated?

In general terms the same techniques as with PMMA apply, since these optics are no more that 0,75mm diameter PMMA fibers bunched together.

In the case of coiled optics the sheath and the internal core (if existing) has to be removed because of the different nature, melting point and physic characteristics with respect to the fibers.

Wherever possible both extremes of a sidelight light guide should be fused and glass polished.

1. . What is a common end?

The fiber or fibers have to be connected to the illuminator. Especially in the case of a number of fibers, these have to be bunched together and held securely. The common end is the grouping, fusion or encapsu- lation where all of the fibers from a bundle come together and are cut flush and even, polished or prepared to connect to the illuminator port.

1. . Is the common end important?

Although manufacturers place more attention on fibers and illuminators the common end is a vital piece for the correct operation of an optical fiber system.

A properly engineered common end must pack the fibers tightey without adhesives and be suitable for fine polishing.

Most failures on fiber optics are due to a bad common end design and construction.

The use of potting adhesives is the single cause most commonly found in harness failure, both in glass and PMMA systems and should be avoided at all costs since it only reduces the overall life expectancy of the sys- tem.

1. . What makes a good common end?

The capacity to hold the fibers ever and flush, lack of adhesives, optical polish and absence of packing losses.

1. . How many types of common end are there?

Basically two: adhesive encapsulated and state of the art fused, although some manufactures dispen- se with both and simply fasten the fibers to the illuminator by means of a pressure gland.

1. . What is a randomized common end?

When several light guides are bundled together into a single common end it becomes a physical impos- sibility to attain the same level of light in each light guide because the lamp emission is not totally even on the screen plane. In order to minimize the differences individual fibers are mixed or "randomized" so that each light guide gathers its light from different geometrical points within the screen. Light issuing from individual ends in a randomized system is considerably more even but not perfectly so.

In polymer fiber systems state of the art optical randomizers can achieve greater evenness with little loss.

1. . What are end f i tt ings?

Practically the only part of a fiber optic system that the public ever sees. End fittings are the elements for fixing, aiming, supporting and finishing the fiber ends.

1. . How many types of end f i tt ings are there?

Literally thousands for every thought or dreamed up application. From small bullet lenses to very large pavers, floor and pool lights. From simple rings and bezels to complex optical trains with several lenses, besi- des hundreds of custom designed elements for specific applications and uses.

1. . Fi tt ings or f ixtures?

In the industry, these terms are used indistinctly and often together. Some manufacturers describe fittings as the fixing elements, such as connectors, ferrules, machined ends, tubular rivets and bezel rings, reserving the term fixtures for large elements, swivel rings, pool luminaries and the like.

Other manufacturers use the term fitting to describe anything at the end of the fibers.

1. . Who manufactures end f i tt ings?

Every system manufacturer produces a range of end fittings designed to be used with their own fiber system.

1. . Are end f i tt ings standard?

As a whole no. Each system manufacturer favors a kind of termination for his fibers with pressure glands, threads, rivets or machined pieces as connectors for his own fittings. Due to the absolute lack of stan- dards in the industry, it becomes impossible to use one manufacturer's fittings with the fibers of other.

1. . What is an opt ical port?

In the fiber optics industry, optical port is the element that physically makes the connection or interfa- ce between the illuminator and the harness. In its simplest form, an optical port is made of male and female tubes fitting one inside the other with a retaining screw or other fastener. More sophisticated optical ports include filter holders and various devices to adjust, conform and cool the common end.

1. . Are there di fferent types of opt ical ports?

Optical ports can be divided in two types: potting and pressure. Potting optical ports are little more than a hollow tube into which the fibers are introduced and encapsulated with some adhesive, making a block to be later polished.

Pressure optical ports are more sophisticated and include seals to grip tightly, by means of a tool, the har- ness of fibers.

Glass fibers are always prepared in potting optical ports whilst solid core fibers use pressure optical ports. PMMA fibers can have the common end in either.

1. . Who manufactures opt ical ports?

All system integrator produce a particular type of optical port to connect to their choice of illuminator.

1. . Are opt ical ports compat ible?

In general no. Illuminator manufacturers use a particular type of optical port to effect the connection with the common end. As a whole, the harness made by a given manufacturer will not fit into the illuminator made by another without retooling.

1. . What is a f iber opt ics system?

The term comprises all the necessary elements to install a working unit.

### S Y S T E M S

1. . What is a f iber opt ics systems integrator?

A fiber optics system integrator purchases the bulk fibers from a fiber optics manufacturer, and ende- avor to manipulate, cut, polish, assemble, pack, produce and market a final product.

1. . What is the di fference between a f iber opt ics manufacturer and a f iber opt ics system manufacturer?

This is a question that would sound silly in other industries but not in this one. Many firms hint, or even affirm in their brochures and catalogues to be fiber optics manufacturers when this is simply not true. A Com- pany that manufactures fiber optics is the one that transforms polymers, monomers or glass raw materials into rods and filaments, cladding those with other elements to, finally create bulk fiber optics.

One can readily see the difference between a glass manufacturer, a glass merchant and a window manufac- turer. The first takes sand and melts it into glass the second stores and trades with glass and the third incor- porates glass into his final product: a window.

If one looks at the giant chemical and glass corporations it's a fair bet that they are fiber optics manufactu- rers.

On the other hand, most fiber optics companies are System Integrators. This is to say that they do not make fibers, just like the window producer does not make glass.

1. . Who are the best f iber opt ics manufacturers?

To single out a company would be grossly unfair because in this business the players are, generally, respected industrial corporations with impeccable quality reputations. State of the art fiber optics cannot be made in a garage shed and huge investments have to be made in plant, equipment and human resources to produce optics of any kind.

The overall quality of fibers in the market is exceptionally high and it must be said that the failures and disas- ters that may have happened have had nothing to do with the quality of the fibers but with the handling and application of systems.

1. . Who are the best systems integrators?

Being quite the opposite to fiber optics manufacturers, system producers are usually small companies. In this case size has the opposite effect on the final product because fiber optics system design require an inordinate amount of ingenuity, talent and technical expertise even for tiny projects. The fast responses, ins- tant drawings, quotations and studies normally demanded are very hard to produce in a corporate environ- ment.

Naturally, this means that some system integrators are little more than a oneman band and some operations are run on a shoestring with more enthusiasm than resources.

On the other hand many system integrators have very little know-how and soon get into trouble with the laws of physics.

Product certification, documentation, information and references are the easiest way to ascertain the profes- sional reputation of a manufactures In this industry when detailed and precise technical information is not forthcoming and things are shrouded in a veil of secrecy, it usually means that for the manufacturer the thing is also a mystery.

1. . How many parts does a f iber opt ics system have?

Depending on the final use the most common parts to account for in a basic system are: illuminator, fiber bundle, bushing and end fittings. Additional fittings, fixtures, controlling units and power sources may be used harness, optical port.

1. . Are f iber opt ics systems expensive?

To determine whether a system is expensive one would have to establish a comparison with an alter- native, which in most cases does not exist.

To compare fiber optics with a standard off the shelf light fitting, lamp or system is an unfair rule of thumb because fiber optics are unique.

Fiber optics systems can carry minute or large amounts of light to, practically any place with precision, wit- hout heat or electricity and with the light source far away.

If the fiber optics system is to be used in applications where the above values were of no consequence then one would have to say that there is no need for it.

Fiber optics are not the universal solution to all lighting problems but a tool or a technique to be used in cir- cumstances where other systems would be at a disadvantage or even totally inadequate.

If one compares a one point of conventional light fixture with a one-point fiber optics system then the price difference would weigh heavily in favor of the standard fixture. If we compare several fixtures and one fiber optics system with several light guides and one illuminator, taking into account the maintenance advantages and power savings, then one would have to concede that fiber optics are cheap.

94. . Wi ll f iber opt ics systems be cheaper in the future?

Lighting fiber optics is not a mass-market product and perhaps will never be. Even today most systems are, at least in part, hand crafted or produced in small batches of a few hundred units at most. Very few items are made in the thousands, with the exception of injected parts, which have a very low unit cost.

From a manufacturing point of view short series are very expensive to produce, since the cost advantages of bulk purchase and manufacturing are missing.

Fiber optics groups or harnesses could easily be mass-produced with very important savings, which would reduce unit costs drastically. The problem is that very seldom, harnesses are of the same size or have the same fiber composition. Consequently, they have to be hand tailored, practically one by one, which results on very high production costs.

Another reason for the high unit costs of systems is the technical backup that system manufacturers have to provide. Nearly all of the installations have to be individually assessed, studied and estimated in house, because of the lack of widespread technical expertise elsewhere. This means that expensive technical departments have to be kept in order to provide know-how on a daily basis.

1. . Are f iber opt ics systems di ff icult to instal l?

Again, it becomes important to establish a fair comparison with other elements, in this case ordinary light fixtures.

Fiber optics systems, as a whole, are easier to install than electrical fittings. Sometimes displays, panels, ceilings, effects or projects are made involving thousands or even hundreds of thousands of single optical fiber ends which, to be fair, are a challenge to install.

The problem in these cases is of sheer numbers, size and complexity. In any case to install a point of fiber optics is considerably easier than to install an electrical point.

1. . What is a starry sky?

Probably one of the most beautiful lighting effects that can be created, which can be very simple or quite sophisticated.

In its simplest form, a starry sky effect is made with a number of small diameter fibers coupled to a large solid core, which delivers the light from the illuminator. This creates a number of static points of the same diame- ter, which can be quite effective if a little flat.

More elaborate systems use several fiber caliber's, from 0,25mm to 3mm diameter and run directly to the illu- minator. The several sizes of fiber make for different intensities on the point light, giving the effect of distan- ce and perspective creating great depth. Coupled with a twinkle effect wheel the effect can be quite stunning.

1. . What is an effect wheel?

* 1. disc of metal or polycarbonate revolving between the lamp and the common end with holes, slits, colors or patterns.

1. . What is an animat ion harness?

* 1. group of fiber optics arranged in a sequential fashion and numbered. The fibers are then installed in the same order and, with the help of special illuminators, movement can be added to lines or patterns.

1. . What are spat ial effects?

Representations of comets, nebulas, shooting stars and others, made with often thousands of indivi- dual fibers and animation illuminator.

1. . How would you descr ibe in one word f iber opt ics l ight ing systems?

Magic



**Multiple Choice Questions**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**BE (2015)Pattern**

**404190 Broadband Communication Systems )**

**Topic : Satellite Communication**

**UNIT IV: Orbital Mechanics and Launchers**

This set of Avionics Multiple Choice Questions & Answers (MCQs) focuses on “Satellite Orbits”.

1. What happens if a satellite is launched vertically and released at its design altitude? a) Continue to orbit the earth

1. Fall back
2. Overshoots the altitude and moves at a constant speed
3. Stays where it was released

View Answer

Answer: b

Explanation: If a satellite were launched vertically from the earth and then released, it would fall back to earth because of gravity. For the satellite to go into orbit around the earth, it must have some forward motion. For that reason, when the satellite is launched, it is given both vertical and forward motion.

2. The satellite is accelerating as it orbits the earth.

1. True
2. False View Answer

Answer: a

Explanation: Although the speed of the satellite is constant its direction keeps on changing as the orbit is circular or elliptical. The rate of change of velocity vector is acceleration and hence its direction changes, the satellite is under acceleration.

3. Why does the orbit take the shape of an ellipse or circle?

1. Position can be easily determined
2. Consume less fuel
3. Most efficient geometry
4. Better coverage on earth View Answer

Answer: a

Explanation: A satellite rotates about the earth in either a circular or an elliptical path. Circles and ellipses are geometric figures that can be accurately described mathematically. Because the orbit is either circular or elliptical, it is possible to calculate the position of a satellite at any given time.

4. The direction of orbit in the same direction of earth rotation is called \_\_\_\_\_\_ a) Retrograde

1. Posigrade
2. Perigee
3. Apogee

View Answer

Answer: b

Explanation: The direction of satellite rotation may be either in the same direction as the earth’s rotation or against the direction of earth’s rotation. In the former case, the orbit is said to be posigrade, and in the latter case, retrograde. Most orbits are posigrade.

5. When is the speed of the satellite maximum in an elliptical orbit?

1. Retrograde
2. Posigrade
3. Perigee
4. Apogee View Answer

Answer: c

Explanation: In an elliptical orbit, the speed changes depending upon the height of the satellite above the earth. Naturally, the speed of the satellite is greater when it is close to the earth than when it is far away. The closest point is called the perigee.

6. Satellites closer to the earth travel at lower speeds than satellites that are far away from earth. a) True

b) False View Answer

Answer: b

Explanation: Satellites that are near earth have to move at higher speeds to sustain their orbit since the gravitational pull is much higher. Since the effect of gravity is less at higher altitudes, satellites that far away require less speeds.

7. The time period taken by the satellite to complete one orbit is called \_\_\_\_\_\_\_\_ a) Lapsed time

1. Time period
2. Sidereal period
3. Unit frequency View Answer

Answer: c

Explanation: The period is the time it takes for a satellite to complete one orbit. It is also called the sidereal period. A sidereal orbit uses some external fixed or apparently motionless object such as the sun or star for reference in determining a sidereal period.

8. The period of time that elapses between the successive passes of the satellite over a given meridian of earth longitude is called as \_\_\_\_\_\_\_\_\_\_\_\_\_ a) synodic period

1. Lapsed time
2. Time period
3. Sidereal period View Answer

Answer: a

Explanation: Another method of expressing the time for one orbit is the revolution or synodic period. One revolution (1 r) is the period of time that elapses between the successive passes of the satellite over a given meridian of earth longitude. Naturally, the synodic and sidereal periods differ from each other because of the earth’s rotation.

9. What is the angle of inclination for a satellite following an equatorial orbit? a) 0°

1. 180°
2. 45°
3. 90°

View Answer

Answer: a

Explanation: Another definition of inclination is the angle between the equatorial plane and the satellite orbital plane as the satellite enters the northern hemisphere. When the angle of inclination is 0°, the satellite is directly above the equator. Orbits with 0° inclination are generally called equatorial orbits.

10. The angle between the line from the earth station’s antenna to the satellite and the line between the earth station’s antenna and the earth’s horizon is called as \_\_\_\_\_\_\_\_\_\_\_ a) Angle of inclination

1. Angle of elevation
2. Apogee angle
3. LOS angle View Answer

Answer: b

Explanation: The angle of elevation of a satellite is the angle that appears between the line from the earth station’s antenna to the satellite and the line between the earth station’s antenna and the earth’s horizon. If the angle of elevation is too small, the signals between the earth station and the satellite have to pass through much more of the earth’s atmosphere. Because of the very low powers used and the high absorption of the earth’s atmosphere.

11. To use a satellite for communication relay or repeater purposes what type of orbit will be the best?

1. Circular orbit
2. Elliptical orbit
3. Geosynchronous orbit
4. Triangular orbit View Answer

Answer: c

Explanation: The best solution is to launch a synchronous or geostationary satellite. In a geosynchronous earth orbit. Since the satellite remains apparently fixed, no special earth station tracking antennas are required. The antenna is simply pointed at the satellite and remains in a fixed position. With this arrangement, continuous communication is possible.

12. What percentage of the earth can communication satellites see? a) 20

1. 50
2. 70
3. 40

View Answer

Answer: d

Explanation: Most communication satellites in use today are of the geosynchronous variety.

Approximately 40 percent of the earth’s surface can be “seen” or accessed from such a satellite. Users inside that area can use the satellite for communication.

13. What is the point on the surface of the earth that is directly below the satellite called? a) Satellite point

1. Subsatellite point
2. Supersatellite point
3. Overhead point

View Answer

Answer:b

Explanation: The satellite location is specified by a point on the surface of the earth directly below the satellite. This point is known as the subsatellite point (SSP). The subsatellite point is then located by using conventional latitude and longitude designations.



Communication Systems”.

1. The satellite that is used as a relay to extend communication distance is called as \_\_\_\_\_\_\_\_\_\_ a) Relay satellites

1. Communication satellites
2. Repeater satellites
3. Geosynchronous satellites

View Answer

Answer: b

Explanation: Communication satellites are not originators of information to be transmitted. If a transmitting station cannot communicate directly with one or more receiving stations because of line-of-sight restrictions, a satellite can be used. The transmitting station sends the information to the satellite, which in turn re-transmits it to the receiving stations.

2. The transmitter-receiver combination in the satellite is known as a \_\_\_\_\_\_\_ a) Relay

1. Repeater
2. Transponder
3. Duplexer View Answer

Answer: c

Explanation: The transmitter-receiver combination in the satellite is known as a transponder. The basic functions of a transponder are amplification and frequency translation. The reason for frequency translation is that the transponder cannot transmit and receive on the same frequency.

3. The downlink frequency is lower than the uplink frequency. a) True

b) False View Answer

Answer: a

Explanation: The original signal being transmitted from the earth station to the satellite is called the uplink, and the re-transmitted signal from the satellite to the receiving stations is called the downlink. Usually, the downlink frequency is lower than the uplink frequency. A typical uplink frequency is 6 GHz, and a common downlink frequency is 4 GHz.

4. What is the reason for carrying multiple transponders in a satellite?

1. More number of operating channel
2. Better reception
3. More gain
4. Redundancy View Answer

Answer: a

Explanation: To be economically feasible, a satellite must be capable of handling several channels. As a result, most satellites contain multiple transponders, each operating at a different frequency. Each transponder represents an individual communication channel.

5. Why are VHF, UHF, and microwave signals used in satellite communication? a) More bandwidth

1. More spectrum space
2. Are not diffracted by the ionosphere
3. Economically viable View Answer

Answer: c

Explanation: VHF, UHF, and microwave signals penetrate the ionosphere with little or no attenuation and are not refracted to earth. Lower frequencies undergo total internal refraction and get reflected back to earth.

6. What is the reason for shifting from c band to ku band in satellite communication? a) Lesser attenuation

1. Less power requirements
2. More bandwidth
3. Overcrowding View Answer

Answer: d

Explanation: Most new communication satellites will operate in the Ku band. This upward shift in frequency is happening because the C band is overcrowded. Many communication satellites are in orbit now, most of them operating in the C band. However, there is some difficulty with interference because of the heavy usage. The only way this interference will be minimized is to shift all future satellite communication to higher frequencies.

7. Which of the following bands cannot be used for satellite communication? a) MF

1. Ku
2. X
3. C

View Answer

Answer: a

Explanation: MF is a lower frequency band than Ku, C and X bands and does not lie in the microwave spectrum. Microwaves are used for satellite communication since the lower bands get reflected by the ionosphere.

8. What is the maximum theoretical data rate if a transponder is used for binary transmission and has a bandwidth of 36MHz? a) 32Mpbs

1. 72Mpbs
2. 36Mpbs
3. 12Mpbs View Answer

Answer: b

Explanation: For binary transmission, the maximum theoretical data rate or channel capacity C for a given bandwidth B is C = 2B = 2(36) =72Mpbs.

9. Why are techniques like frequency reuse and spatial isolation carried out? a) Reduce traffic load

1. More gain
2. High speed
3. Error detection View Answer

Answer: a

Explanation: at times there is more traffic than there are transponders to handle it. For that reason, numerous techniques have been developed to effectively increase the bandwidth and signal-carrying capacity of the satellite. Two of these techniques are known as frequency reuse and spatial isolation.

10. Which technique uses two different antennas to reduce traffic on the same frequency? a) Spatial isolation

1. Frequency reuse
2. Multiplexing
3. Modulation View Answer

Answer: b

Explanation: In the frequency reuse technique two systems use the same frequency, although operating on exactly the same frequencies, they are isolated from each other by the use of special antenna techniques. For example, a vertically polarized antenna will not respond to a horizontally polarized signal and vice versa. Or a left-hand circularly polarized (LHCP) antenna will not respond to a right-hand circularly polarized (RHCP) signal and vice versa.

11. Which technique uses spot beam antennas to divide the area covered by the satellite into smaller segments?

1. Spatial isolation
2. Frequency reuse
3. Multiplexing
4. Modulation View Answer

Answer: a

Explanation: By using narrow beam or spot beam antennas, the area on the earth covered by the satellite can be divided up into smaller segments. Earth stations in each segment may actually use the same frequency, but because of the very narrow beam widths of the antennas, there is no interference between adjacent segments.

12. Spatial-division multiple access (SDMA) depends on satellite location and not frequency. a) True

b) False View Answer

Answer: a

Explanation: Spatial-division multiple access uses spatial isolation technique. Earth stations in each segment may actually use the same frequency, but because of the very narrow beam widths of the antennas, there is no interference between adjacent segments. This technique is referred to a spatial-division multiple access (SDMA) in that access to the satellite depends on location and not frequency.





This set of Avionics Multiple Choice Questions & Answers (MCQs) focuses on “Satellite

This set of Avionics Multiple Choice Questions & Answers (MCQs) focuses on “Satellite Subsystems”.

1. Which of the following is not a satellite subsystem?

1. Ground station
2. Power system
3. Telemetry tracking
4. Communication subsystem View Answer

Answer: a

Explanation: The communication subsystem is the most important part of the satellite. It requires varies additional systems like the power system, propulsion system, telemetry system for its proper functioning. The ground system however is not one of the satellite subsystem and is independent of the satellite. It is just a transponder to monitor and command the satellite.

2. Which of the following is not a part of the propulsion subsystem of a satellite? a) Gyroscope

1. Jet thruster
2. AKM
3. Fuel control system View Answer

Answer: a

Explanation: The propulsion subsystem consists of the AKM(Apogee kick motor), jet thruster and the fuel control system. Gyroscopes and other attitude systems fall under the attitude control subsystem.

3. Which of the following are common baseband signals transmitted from the earth ground station?

1. Navigational data, computer data, video
2. Computer data, navigational data, voice
3. Voice, video, computer data
4. Computer data View Answer

Answer: c

Explanation: An earth station takes the signals to be transmitted, known as baseband signals, and modulates a microwave carrier. The three most common baseband signals are voice, video, and computer data.

4. Which of the following components receives, translates the signal frequency and re-transmits the signal in a satellite? a) Repeater

1. Relay
2. Transponder
3. Transducer View Answer

Answer: c

Explanation: The uplink signals from earth are amplified, translated in frequency, and retransmitted on the downlink to one or more earth stations. The component that performs this function is known as a transponder.

5. Why is there a huge spectrum space between the transmitted and received signal in satellite communication?

1. Reduce interference
2. Maximum efficiency
3. Less attenuation
4. To reduce space occupied by filters View Answer

Answer: a

Explanation: Because of the close proximity of the transmitter and the receiver in the satellite, the high transmitter output power for the downlink is picked up by that satellite receiver. Naturally, the uplink signal is totally obliterated. Furthermore, the transmitter output fed back into the receiver input causes oscillation. To avoid this problem, the receiver and transmitter in the satellite transponder are designed to operate at separate frequencies. In this way, they will not interfere with each other.

6. Which of the following transponders convert the uplink signal to downlink signal using two mixers

1. Single conversion transponders
2. Dual conversion transponders
3. Regenerative transponders
4. Dual mixer transponder View Answer

Answer: b

Explanation: A dual-conversion transponder makes the frequency translation in two steps with two mixers. No demodulation occurs.

7. In a regenerative transponder, the signal is demodulated and modulated again before transmission. a) True

b) False View Answer

Answer: a

Explanation: A regenerative repeater demodulates the uplink signal after the frequency is translated to some lower intermediate frequency. The recovered baseband signal is then used to modulate the downlink signal.

8. What is the number of transponders if the satellite uses 12 channels of frequency and frequency reuse is implemented? a) 12

1. 6
2. 24
3. 3

View Answer

Answer: c

Explanation: Since in frequency reuse each channel can be used twice the numbers of transponders are also doubled. 12 x 2 = 24 transponders, two for each frequency.

9. Why is it not possible to provide transmit function by wideband amplifier and mixer circuits? a) Heavy attenuation

1. High power output over wideband is not possible
2. Economically not profitable
3. Weight of the system increases five fold View Answer

Answer: b

Explanation: it is generally not possible to generate very high output power over such wide bandwidth. The fact is that no components and circuits can do this well. The high-power amplifiers in most transponders are traveling-wave tubes that inherently have limited bandwidth. They operate well over a small range but cannot deal with the entire 500-MHz bandwidth allocated to a satellite.

10. Which of the following is not true?

1. Battery is only used as a back up
2. When in orbit, solar power is always available
3. Battery is used for initial satellite orientation and stabilization
4. The batteries are charged using solar power View Answer

Answer: b

Explanation: When a satellite goes into an eclipse or when the solar panels are not properly positioned, there is a temporary cut in solar power supply. In situations like this the batteries take over temporarily and keep the satellite operating. The batteries are not large enough to power the satellite for a long time; they are used as a backup system for eclipses, initial satellite orientation and stabilization, or emergency conditions.

11. Telemetry, command, and control (TC&C) subsystem allow a ground station to monitor and control conditions in the satellite. a) True

b) False View Answer

Answer: a

Explanation: The telemetry system is used to report the status of the onboard subsystems to the ground station. The telemetry system typically consists of various electronic sensors whose data are selected by a multiplexer and then converted to a digital signal, which then modulates an internal transmitter. This transmitter sends the telemetry information back to the earth station, where it is recorded and monitored.



**Q1. Satellite engine uses …………**

1. Jet propulsion
2. Ion propulsion system
3. Liquid fuel
4. Solar jet

**Answer : b**

**Q2. The earth area covered by a satellite radio beam is known as ……..**

1. Beam width
2. Band width
3. Footprint
4. Zone

**Answer : c**

**Q3. What kind of battery used by older satellites ?**

1. Lithium
2. Leclanche
3. Hydrogen
4. Magnesium

**Answer : c**

**Q4. The location of AsiaSat I.**

1. 105.5˚ East
2. 151.5˚ East
3. 115.5˚ East
4. 170.5˚ East

**Answer : a**

**Q5. To make antenna more directional, either its size must be increased or**

**a.** the number of its feed horns must be increased

**b.**the frequency of its transmission must be increased

1. its effective isotropic radiated power (EIRP) must be increased
2. its footprint must be increased

**Answer : b**

**Q6. India’s first domestic geostationary satellite 1NSAT-IA was launched on 10th April 1982 from**

**a.** USSR

**b.**USA

1. UK
2. UP

**Answer : b**

**Q7. Satellite launch sites are invariably located on Eastern seaboards to ensure that** **a.** launch takes place eastward

1. expenditure of propulsion fuel is reduced during plane changing
2. the satellite achieves circular orbit quickly
3. spent rocket motor and other launcher debris falls into the sea

**Answer : d**

**Q8. The owner of a communication satellite is usually required to keep the spacecraft on station at its assigned place in the geosynchronous orbit with an accuracy of \_\_\_\_\_\_\_\_\_\_ degree.**

1. 0.1
2. 1.0
3. 2.0
4. 0.5

**Answer : a**

**Q9. The number of days when Earth’s shadow falls on a geosynchronous satellite is** **a.** 88

1. 277
2. 5
3. 10

**Answer : a**

**Q10. A satellite signal transmitted from a satellite transponder to earth’s station is ……….** **a.** Uplink

1. Downlink
2. Terrestrial
3. Earthbound

**Answer : b**

**Q11. A helical antenna is used for satellite tracking because of …………..** **a.** Circular polarization

1. Maneuverability
2. Beamwidth
3. Gain

**Answer : a**

**Q12. What band does VSAT first operate?**

1. L-band
2. X-band
3. C-band
4. Ku-band **Answer : c**

**Q13. VSAT was made available in ……..**

1. 1979
2. 1981
3. 1983
4. 1977

**Answer : a**

**Q14. ……………. collects very weak signals from a broadcast satellite**  **a.** Helical antenna

1. Satellite dish
2. LNA
3. TWT

**Answer : b**

**Q15. ………….is a loss of power of a satellite downlink signal due to earth’s atmosphere.** **a.** Atmospheric loss

1. Path loss
2. Radiation loss
3. RFI

**Answer : b**

**Q16. …………… is considered as the unsolved problem in satellite system.**  **a.** Coverage

1. Cost
2. Access
3. Privacy

**Answer : d**

**Q17. As the height of a satellite orbit gets lower, the speed of the satellite ……………** **a.** Increases

1. Decreases
2. Remains the same
3. None of the above

**Answer : a**

**Q18. A satellite beam that covers almost 42.4% of the earth’s surface is called ……………** **a.** Zone beam

1. Hemispheric beam
2. Spot beam
3. Global beam

**Answer : d**

**Q19. A geosynchronous satellite**

1. has the same period a that of the Earth
2. has a circular orbit
3. rotates in the equatorial plane
4. has all of the above

**Answer : d**

**Q20. A transponder is a satellite equipment which**

1. receives a signal from Earth station and amplifies
2. changes the frequency of the received signal
3. retransmits the received signal
4. does all of the above-mentioned functions

**Answer : d**

**Q21. The INTELSAT-IV satellite launched in 1974 had two earth coverage antenna and two narrower-angle antennas subtending 4.5°. The signal from narrow-angle antenna was stronger than that from earth- coverage antenna by a factor of ……………** **a.** 17.34/4.5

1. 17.34/4.5
2. (17.34/4.5)**2**
3. (17.34/4.5)4

**Answer : c**

**Q22. The angle subtended by earth at geostationary communication satellite is ………..** **a.** 17.34°

1. 51.4°
2. 120°
3. 60°

**Answer : a**

**Q23. The discussing sharing of a communication satellite by many geographically dispersed Earth station, DAMA means**

1. Demand-Assigned Multiple Access
2. Decibel Attenuated Microwave Access
3. Digital Analog Master Antenna
4. Dynamically-Assigned Multiple Access

**Answer : a**

**Q24. A 20 m antenna gives a certain uplink gain at frequencies of 4/6 GHz. For getting same gain in the 20/30 GHz band, antenna size required is ……… metre.** **a.** 100

1. 4
2. 1
3. 10

**Answer : b**

**Q25. Of the four INSAT-I satellites planned by India so for, only …………… has proved to be successful.**

1. INSAT-IA
2. INSAT-IB
3. INSAT-IC
4. INSAT-ID

**Answer : b**

**Q26. Radio broadcasting is a familiar example of …………….**

1. space multiplexing
2. time multiplexing
3. frequency multiplexing
4. none of the above

**Answer : c**

**Q27. As compared to 17.34° antenna, the total increase in the signal relayed by 4.5° antenna of INTELSAT-IV is ……….**

1. 14.85
2. 220
3. 78
4. 3.85

**Answer : b**

**Q28. Which one of the following statements regarding DSI is false?**

1. It is a digital form of TASI
2. Though it is more efficient than TASI, it is much slower
3. A speaker has to wait (it at all) for only a few milliseconds for reallocation of channel
4. It has increased the capacity of satellite channels by a factor of 2.2 or more with out degrading speech quality

**Answer : b**

**Q29. Which one of the following statements regarding compandor is FALSE?**

1. It compresses the higher-amplitude parts of a signal before modulation and expands them back to normal again after demodulation.
2. It gives preferential treatment to the weaker parts of the signal
3. For weaker signals it gives a poor ratio of signal strength to quantizing error
4. Weaker signals, traverse more quantum steps than they would do otherwise and so quantizing error is reduced. **Answer : c**

**Q30. The quality of a space-link is measured in terms of the ………. ratio.** **a.** C/N

1. S/N
2. G/T
3. EIRP

**Answer :a**

**Q31. The useful operational life of INSAT-IB (launched in 1983) is expected to end by** **a.** 1992-93

1. 1991-92
2. 1989-90
3. 1993-94

**Answer : c**

**Q32. At present, the radio-frequency band mainly used by most satellites is ……….** **a.** EHF

1. UHF
2. VHF
3. SHF

**Answer : d**

**Q33. Orbital disturbances of a geosynchronous satellite are caused by the** **a.** moon

1. sun
2. earth
3. all of the above

**Answer : d**

**Q34. Which one of the following statement is correct?**

1. Satellite spacing is not affected by the bandwidth of the transmitting earth station
2. Beamwidth is independent of antenna size and frequency band used
3. The width of a beam in space is inversely proportional to the width of the transmitting antenna
4. Use of high-frequency bands permits less number of satellites to share the orbit

**Answer : c**

**Q35. In a stop-and-wait ARQ system, the transmitting terminal**

1. waits for positive or negative acknowled-gement from the receiving terminal after sending a block
2. sends another block if positive acknowledge is received through ACK character
3. resends the previous block if negative acknowledgement is received through a NAK character
4. does not wait for acknowledgement after sending a block

**Answer : d**

**Q36. A geostationary satellite is one which**

1. hangs motionless in space about 36000 km about Earth
2. travels around the Earth in 24 hours
3. remains stationary above the Earth
4. appears stationary to everybody on Earth

**Answer : d**

**Q37. The geostationary communication satellite APPLE is parked in the equatorial orbit at** **a.** 102° E longitude over Sumatra

1. 90° E longitude over Bangladesh
2. 74° E longitude over India
3. 67° E longitude over Pakistan

**Answer : a**

**Q38. Power received from Sun per m2 surface area of a geosynchronous satellite in nearly…………. watt.**

1. 100
2. 500
3. 2000
4. 1000

**Answer : d**

**Q39. A certain sound has 10000 times more energy than another sound. The number of times it would sound stronger to a listener is**

1. 40
2. 10000
3. 100
4. 10

**Answer : a**

**Q40. The bandwidth of C- band satellite frequency band in U.C is ………** **a.** 500 GHz

1. 1000 GHz
2. 1000 MHz
3. 500 MHz

**Answer : d**

**Q41. Repeaters inside communication satellites are known as ………** **a.** Trancievers

1. Transponders
2. Transducers
3. TWT

**Answer : b**

**Q42. What kind of battery panels are used in some advance satellites?**

1. Germanium based panels
2. Silicon based panel
3. Galium Phosphate solar panel array
4. Galium Arsenide solar panel array

**Answer : d**

**Q43. What is the local oscillator (mixer) frequency of the satellite with an uplink frequency in GHz band?**

1. 3500 MHz
2. 4500 MHz
3. 2225 MHz
4. 2555 MHz

**Answer : c**

**Q44. How many satellite orbital slots are requested by the Philippine Government from ITU ?**

1. 2
2. 4
3. 6
4. 8

**Answer : c**

**Q45. The switching from one element to the other element in a typical mobile satellite array.**

1. Series
2. Radial
3. Matrix
4. Shunt

**Answer : d**

**Q46. What circuit is responsible in activating and deactivating adjacent antenna elements in a mobile satellite array ?**

1. Radial divider
2. Divider/combiner
3. Radial combiner
4. Radial multiplexer

**Answer : a**

**Q47. INTELSAT stands for ………….**

1. Intel Satellite
2. International Telephone Satellite
3. International Telecommunications Satellite
4. International Satellite

**Answer : c**

**Q48. …………. is an artificial body that is projected from earth to orbit either earth (or) another body of solar systems.**

1. Satellite
2. moon
3. sun
4. none of the above

**Answer : a**

**Q49. ………… is defined as the use of orbiting satellites to receive, amplify and retransmit data to earth stations.**

1. Optical communication
2. Digital communication
3. Analog communication
4. Satellite communication

**Answer : d**

**Q50. ………… law states that the path followed by the satellite around the primary will be an ellipse.**

1. Newton’s 1st law
2. kepler’s first law
3. kepler’s second law
4. kepler’s third law

**Answer : b**

**Q51. Which law states that for equal time intervals, the satellite will sweep out equal areas in its orbital plane, focused at the barycenter.**

1. Newton’s 1st law
2. kepler’s first law
3. kepler’s second law
4. kepler’s third law

**Answer : c**

**Q52. Which law states that the square of the periodic time of orbit is perpendicular to the cube of the mean distance between the two bodies. A3 = 3/n2**

1. Newton’s 1st law
2. kepler’s first law
3. kepler’s second law
4. kepler’s third law

**Answer : d**

**Q53. What is meant by GPRS ?**

1. General packet receiver service
2. General packet radio service
3. Global packet radio service
4. none of these

**Answer : b**

**Q54. Television transmission is an example of which type of transmission?**

1. Simplex
2. Half Duplex
3. Full Duplex
4. None of the above

**Answer : a**

**Q55. What are the limitations of FDMA-satellite access?**

1. If the traffic in the downlink is much heavier than that in the uplink, then FDMA is relatively inefficient.
2. Compared with TDMA, FDMA has less flexibility in reassigning channels.
3. Carrier frequency assignments are hardware controlled
4. all of the above

**Answer : d**

**Q56. What is meant by EIRP?**

1. Equivalent Isotropic Radiated Power
2. Energy Isotropic Radiated Power
3. Equivalent Isotropic Resonance Power
4. none of these

**Answer : a**

**Q57. A satellite downlink at 12 GHz operates with a transmit power of 6 W and an antenna gain of 48.2 dB. Calculate the EIRP in dBW.**

1. 45 dBW
2. 50 dBW
3. 75 dBW
4. 56 dBW

**Answer : d**

**Q58. The range between a ground station and a satellite is 42000 km. Calculate the free space loss a frequency of 6 GHz.**

1. 100 dB
2. 150 dB
3. 175dB
4. 200.4dB

**Answer : d**

**Q59. The flux density required at the receiving antenna to produce saturation of TWTA is known as ……….**

1. Electric flux density
2. Magnetic flux density
3. Saturation flux density
4. Photon flux density

**Answer : c**

**Q60. ………….. is necessary to prevent the bursts from overlapping.** **a.** Preamble

1. Guard time
2. Frame efficiency
3. Decoding quenching

**Answer : b**

**Q61. In some phase detection systems, the phase detector must be allowed for some time to recover from one burst before the next burst is receiving by it. This waiting time is known**

**as …………**

1. Preamble
2. Guard time
3. Frame efficiency
4. Decoding quenching

**Answer : d**

**Q62. …………. is a measure of the fraction of frame time which is used for the transmission of traffic.**

1. **.** Preamble
2. Guard time
3. Frame efficiency
4. Decoding quenching

**Answer : c**

**Q63. What is meant by OMT ?**

1. Orthogonal mode tube
2. Orthogonal modulation tube
3. Orthogonal mode transducer
4. none of these

**Answer : c**

**Q64. Which of the following comes under methods of multiple access techniques?**

1. FDMA & TDMA
2. SCPC & CDMA
3. CDMA & GSM
4. none of these

**Answer : a**

**Q65. What is meant by SCPC?**

1. Single channel per carrier
2. Single carrier per channel
3. Single code per channel
4. none of these

**Answer : a**

**Q66. For satellite communication, standard Earth stations have antenna diameters in the range of ………….. metre.**

1. 27.5 to 30
2. 10 to 15

# **30 to 50**

**d.** 5 to 10

**Answer : a**

**Q67. The most effective anti jamming technique is ………..**

1. frequency hopping
2. spread-spectrum modulation
3. key leverage
4. once-only key

**Answer : b**

**Q68. The ending part of the popular teleserial Mahabharat will be beamed to the viewers**  **a.** WESTAT

1. INSAT-IC
2. ARABSAT
3. INSAT-ID

**Answer : c**

**Q69. A communication satellite is a repeater between …………… and …………..**

1. a transmitting station and a receiving station
2. a transmitting station and many receiving station
3. many transmitting station and many receiving station
4. none

**Answer : c**

**Q70. While keeping the down-link frequency constant, the diameter of a satellite antenna is reduced by half. To offer the same EIRP over the increased coverage area, the *RF* output power has to be increases by a factor of ………..** **a.** 2

1. 4
2. 8
3. 16

# Answer : b

**Q71. The Sun blots out the transmission of a geosynchronous satellite twice a year when satellite passes directly in front of it. This outage lasts for about**

1. 10 minutes on 5 consecutive days
2. 5 minutes on 10 consecutive days
3. 30 minutes for 5 consecutive days
4. one hour for 5 consecutive days

# Answer : a

**Q72. In satellite communication, frequency modulation is used because satellite channel has**

1. small bandwidth and negligible noise
2. large bandwidth and severe noise
3. maximum bandwidth and minimum noise
4. high modulation index

# Answer : b

**Q73. Which of the following factor does NOT contribute to the drift of a geostationary satellite from its stationary position in space?**

1. Pressure of solar radiations
2. Gravitational changes due to Sun and Moon
3. Oblateness of the Earth
4. Weight of the satellite

# Answer : d

**Q74. In communication satellites, the up-link normally operates at a higher frequency than the down-link because it**

1. gives a narrow beam shining into space
2. results in lesser signal attenuation
3. gives better beam-shaping
4. is easier to polarize a high frequency beam

**Answer : a**

**Q75. For global communication, the number of satellites needed is** **a.** 1

1. 3
2. 10
3. 5

**Answer : b**

**Q76. The noise temperature of sky is about \_\_\_\_\_\_\_\_\_\_ °K.** **a.** 100

1. 273
2. 0
3. 30

**Answer : d**

**Q77. Assuming earth to be a sphere of radius 6400 km and height of a geosynchronous satellite above Earth as 36000 km, the velocity of a geosynchronous satellite is \_\_\_\_\_\_\_\_\_\_ km/hr.**

1. 28000
2. 15000
3. 36000
4. 11100

**Answer : d**

**Q78. In the context of error detection in satellite transmission, ARQ stands for ……………** **a.** Automatic Repeat Request

1. Automatic Relay Request
2. Accelerated Recovery Request
3. Automatic Radiation Quenching

**Answer : a**

**Q79. To cover all inhabited regions of the Earth, the number of geosynchronous communication satellites required**

1. 5
2. 3
3. 10
4. 2

**Answer : b**

**Q80. Depending on the technique used, digitized television requires a bit rate between \_\_\_\_\_\_\_\_\_\_ millions.**

1. 40 and 92.5
2. 25 and 60
3. 30 and 82.5
4. 2

**Answer : a**

**Q81. In selecting a satellite system, the First determining factor is its** **a.** EIRP

1. antenna size
2. coverage a sea
3. antenna gain

**Answer : c**

**Q82. Phase modulation is commonly-used for data transmission mainly because**

1. phase can be varied from + 180° to 180°
2. it is resistant to the effects of noise
3. demodulation is very easy
4. it gives highest data rates that can be transmitted over a given channel

**Answer : b**

**Q83. India’s Polar Satellite Launch vehicle (PSLV) to be ready in 1991 is designed to launch 1000 kg spacecraft into \_\_\_\_\_\_\_\_\_\_ orbit.**

1. geostationary
2. equatorial
3. polar
4. sun-synchronous polar

**Answer : d**

**Q84. Most of the communication satellites are stationed to the West of their service areas in order to reduce their ………..**

1. eclipse period
2. loss of power
3. battery power provision
4. mass of station-keeping fuel

**Answer : c**

**Q85. The degradation of satellite solar cells with time is mainly due to**

1. their bombardment by electrons
2. collection of meteoric dust
3. increase in resistivity of silicon
4. gradual leakage of charge carriers from the semiconductor material

**Answer : a**

**Q86. The echo heard by a telephone user on a satellite channel can be removed by using** **a.** a vocoder

1. a multiplexer
2. echo suppressor
3. digital techniques

**Answer : c**

**Q87. The 1150 kg geosynchronous satellite INSAT-IA parked 36000 km above India had greatly improved India’s**

1. intelligence gathering capacity
2. domestic communications
3. meteorological capability
4. both (b) and (c)

**Answer : d**

**Q88. Presently, the worlds’s largest and most advanced multi-purpose communication satellite is ……………**

1. INSAT-2
2. Intelsat-V
3. INSAT-ID
4. Olympus-I

**Answer : d**

**Q89. A satellite link uses different frequencies for receiving and transmitting in order to**

**……..**

1. avoid interference from terrestrial microwave links
2. avoid interference between its powerful transmitted signal and weak in coming signal **c.** minimise free-space losses

**d.** maximise antenna gain

**Answer : b**

**Q90. Regarding TASI which one of the following statements is wrong?**

1. It snatches the channel in his speech and may allocate it to another speaker needing it.
2. The same speaker is reassigned a channel almost instantly when he speaks again even when the circuit is heavily loaded.
3. It increases the overall utilization of the transmission channel.
4. Intercontinental callers sometimes confuse the effects of TASI with the effects of satellite delay

**Answer : b**

**Q91. Master control facility (MCF) for INSAT-2 series satellites is located at …………..** **a.** Madras

1. New Delhi
2. Leh
3. Hassan

**Answer : d**

**Q92. The communication satellite INSAT-IB had to take up the job of INSAT-IA because the latter collapsed within …………… months of its launch.** **a.** 12

1. 20
2. 5
3. 36

**Answer : c**

**Q93. The distance of a synchronous satellite from Earth’s surface is ………….. km.** **a.** 300

**b.** 10000

**c.**35900

**d.** 5

**Answer : c**

**Q94. The traffic-handling capacity of an Earth station on the uplink depends on …………** **a.** its EIRP

1. satellite antenna gain
2. noise associated with the satellite
3. all of the above

**Answer : d**

**Q95. System satellites orbit the Earth once in …………. hrs.** **a.** 24

1. 12
2. 1
3. 6

**Answer : a**

**Q96. The lowest frequency used in satellite communications is ……….. GHz.** **a.** 0.8

1. 3
2. 18
3. 30

**Answer : a**

**Q97. Geosynchronous satellites are always launched in the equatorial plane because it is the only plane which provides**

1. 24-hour orbit
2. stationary satellite
3. global communication
4. zero-gravity environs

**Answer : c**

**Q98. A few minutes disturbance in space communications occurs twice a year during Sunblinding when \_\_\_\_\_\_\_\_\_\_ are in line.**

1. Sun and satellite
2. Sun and Earth station
3. Satellite and Earth station
4. Sun, satellite and Earth station

**Answer : d**

**Q99. After the death of INSAT-IB, the mainstay of the entire Indian satellite network for some time to come would be**

1. INSTELSAT-V
2. INSAT-ID
3. INSAT-2
4. ARABSAT

**Answer : d**

**Q100. For satellite transmission, analog signals may be converted into digital form with the help of ……………..**

1. modem
2. transponder
3. codec
4. compandor

**Answer : c**

**Q101. The maximum signal propagation time of a geosynchronous satellite transmission is about ……….. millisecond**

1. 540
2. 270
3. 135
4. 1080

**Answer : b**

**Q102. The life time of a geosynchronous communication ……..** **a.** 5

1. 10
2. 20
3. 50

**Answer : b**

**Q103. A typical error rate on satellite circuits is one bit error in** **a.** 107

1. 103
2. 102
3. 1010

**Answer : a**

**Q104. In satellite communication, highly directional antennas are used to**

1. direct the spot beam to a particular region of space on Earth
2. strengthen the beam to overcome the cosmic noise
3. make corrections in change of polarisation of the beam
4. select a particular channel in transmission and reception

**Answer : a**

**Q105. The average noise temperature of Earth, as viewed from space, is ………. °K** **a.** 254

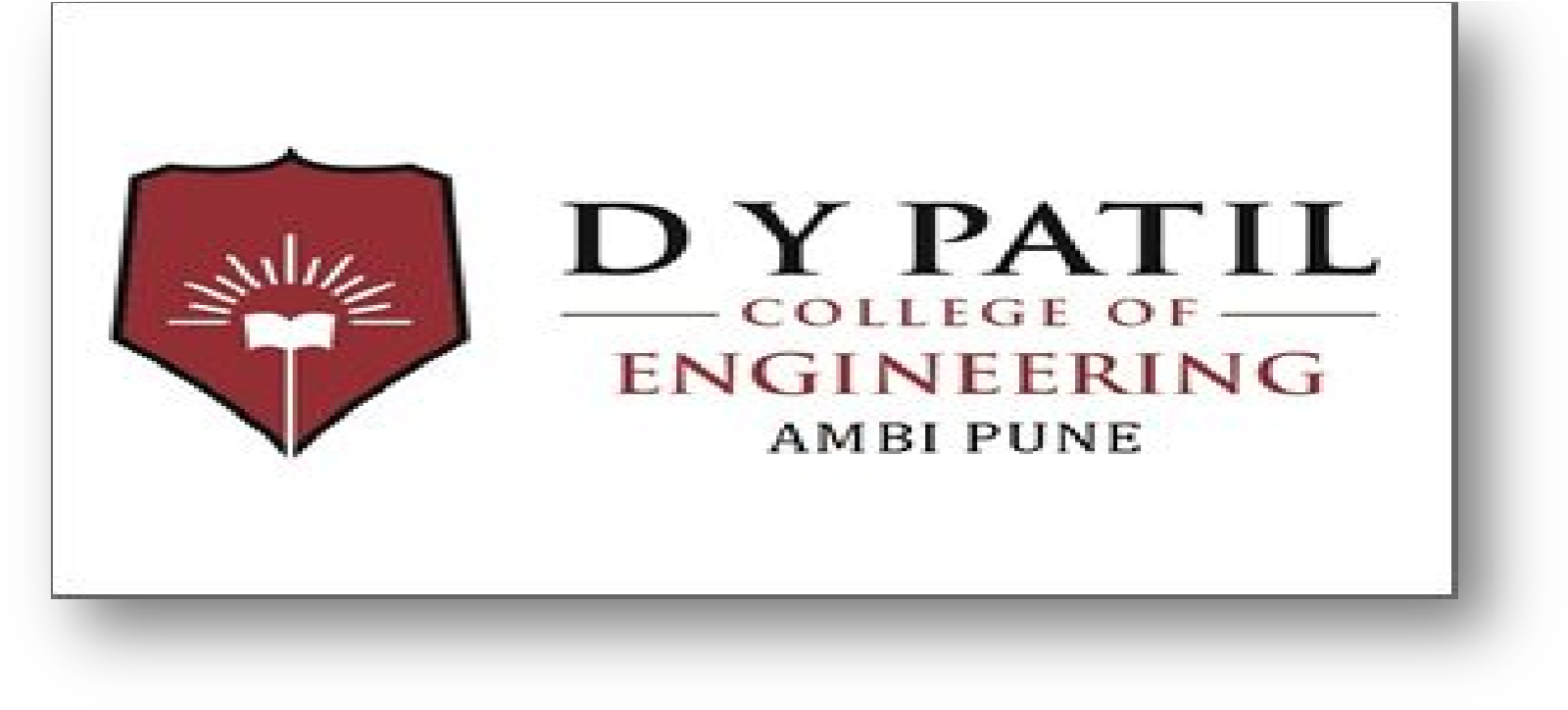
1. 303
2. 100
3. 500

**Answer : a**

**Q106. Low-orbit satellites are not used for communications because they**

1. produce sonic booms
2. do not provide 24 hour/ day contact to the users on Earth
3. heat up and melt
4. none

**Answer : c**



**Short Answers Questions**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**BE (2015)Pattern**

**404190 Broadband Communication Systems )**

**Satellite Communication**

ORBIT DYNAMICS

1. What is Satellite?

An artificial body that is projected from earth to orbit either earth (or) another body of solar systems.

Types: Information satellites and Communication Satellites

1. Define Satellite Communication. It is defined as the use of orbiting satellites to receive, amplify and retransmit data to earth stations.
2. State Kepler’s first law.

It states that the path followed by the satellite around the primary will be an ellipse. An ellipse has two focal points F1 and F2. The center o f mass of the two body system, termed the barycenter is always centered on one of the foci. e = [square root of (a2– b2) ] / a

1. State Kepler’s second law.

It states that for equal time intervals, the satellite will sweep out equal areas in its orbital plane, focused at the barycenter.

1. State Kepler’s third law.

It states that the square of the periodic time of orbit is perpendicular to the cube of the mean distance between the two bodies.

a3= 3 / n22

Where, n = Mean motion of the satellite in rad/sec. 3 = Earth’s geocentric gravitational constant. With the n in radians per sec. the orbital period in second is given by,

P = 2 / n

1. Define apogee. The point farthest from the earth.
2. Define Perigee. The point closest from the earth.
3. What is line of apsides? The line joining the perigee and apogee through the center of the earth.
4. Define ascending node. The point where the orbit crosses the equatorial plane going from south to north.
5. Define descending node. The point where the orbit crosses the equatorial plane going from north to south.

very small with the result that a region that is only a few hundred km in diameter is illuminated on earth.

1. What is meant by momentum wheel stabilization?

During the spin stabilization, flywheels may be used rather than spinning the satellite. These flywheels are termed as momentum wheels.

1. What is polarization interleaving?

Overlap occurs between channels, but these are alternatively polarized left hand circular and right hand circular to reduce interference to acceptable levels.

This is referred to as polarization interleaving.

1. Define S/N ratio.

The S/N introduced in the preceding section is used to refer to the ratio of signal power to noise power at the receiver output. This is known as S/N ratio.

1. What is noise weighting?

The method used to improve the post detection signal to noise ratio is referred to as noise weighting.

1. What is noise power spectral density?

Noise power per unit Bandwidth is termed as the noise p ower spectral density.

1. What is an intermodulation noise?

Intermodulation distortion in high power amplifier can result in signal product which appear as noise and it is referred to as intermodulation noise.

1. What is an antenna loss?

It is added to noise received as radiation and the total antenna noise temperature is the sum of the equivalent noise temperature of all these sources.

1. Define sky noise.

It is a term used to describe the microwave radiation w

hich is present throughout universe and which appears to originate from matter in any form, at finite temperature.

1. Define noise factor.

An alternative way of representing amplifier noise is

by means of its noise factor. Indefining the noise factor of an amplifiers, usually taken as 290 k.

1. What is TWTA?

TWTA means Traveling Wave Tube Amplifier. The TWTA i

s widely used in transponder to provide the final output power required to the transtube and its power supplies.

24. What is an OMT?

The polarization separation takes place in a device kno wn as an orthocoupler or Orthogonal Mode Transducer.

SATELLITE ACCESS

1. What is a single mode of operation?

A transponder channel abroad a satellite may be fully loaded by a single transmission from an earth station. This is referred to as a single access mode of operation.

1. What are the methods of multiple access techniques?

FDMA – Frequency Division Multiple Access Techniques

TDMA – Time Division Multiple Access Techniques

1. What is an CDMA?

CDMA – Code Division Multiple Access Techniques

In this method, each signal is associated with a particular code that is used to spread the signal in frequency and time.

1. Give the types of CDMA.

* Spread spectrum multiple access
* Pulse address multiple access

1. What is SCPC?

SCPC means Single Channel Per Carrier. In a thin route circuit, a transponder channel (36 MHz) may be occupied by a number of single carriers, each associated with its own voice circuit.

1. What is a thin route service?

SCPC systems are widely used on lightly loaded routes, this type of service being referred to as a thin route service.

1. What is an important feature of Intelsat SCPC system? The system is that each channel is voice activated. This me

ans that on a two way telephone conversation only one carriers is operative at any one time.

1. What is an TDMA? What are the advantages?

TDMA – Time Division Multiple Access Techniques Only one carrier uses the transponder at any one time, and therefore Inter modulation products, which results from the nonlinear amplification of multiple carriers are absent.

Advantages : The transponder traveling wave tube can be operated at maximum power output.

1. What is preamble?

Certain time slots at the beginning of each burst are used to carry timing and synchronizing information. These time slots collectively are referred to as preamble.

1. Define guard time.

It is necessary to prevent the bursts from overlapping. The guard time will vary from burst to burst depending on the accuracy with which the various bursts can be positioned within each frame.

1. What is meant by decoding quenching?

In certain phase detection systems, the phase detector must

be allowed for some time to recover from one burst before the next burst is received by it.

This is known as decoding quenching.

1. What is meant by direct closed loop feedback?

The timing positions are reckoned from the last bit of the unique word in the preamble. The loop method is also known as direct closed loop feed back.

1. What is meant by feedback closed loop control?

The synchronization information is transmitted back to an earth station from a distant, that is termed feedback closed loop control.

1. Define frame efficiency.

It is measure of the fraction of frame time used for the transmission of traffic.

1. What is meant by digital speech interpolation?

The point is that for a significant fraction of the time, the channel is available for other transmission and advantages are taken of this in a form of demand assignment known as digital speech interpolation.

1. What is meant by telephone load activity factor? The fraction of time a transmission channel is active is kno wn as the telephone load activity factor.
2. What are the types of digital speech interpolation?

* Digital time assignment speech interpolation
* Speech predictive encoded communications

1. What is meant by freeze out?

It has assumed that a free satellite channel will be found for any incoming speed spurt, but there is a finite probability that all channels will be occupied and the speech spurt lost.

Losing a speech spurt in this manner is referred to as freeze out.

1. What is DSI?

The DSI gain is the ratio of the number of terrestrial space channels to number of satellite channels. It depends on the number of satellite channels provided as well as the design objectives.

1. What are the advantages of SPEC method over DSI method?

Freeze out does not occur during overload conditions.

1. Define satellite switched TDMA?

Space Division Multiplexing can be realized by switching the antenna interconnections in synchronism with the TDMA frame rate, this being known as satellite switched TDMA.

1. What is SS / TDMA?

A repetitive sequence of satellite switch modes, also referred to as SS / TDMA.

1. What is processing gain?

The jamming or interference signal energy is reduced by a factor known as the processing gain.

1. What is burst code word?

It is a binary word, a copy of which is stored at each earth station.

1. What is meant by burst position acquisition?

A station just entering, or reentering after a long delay to acquire its correct slot position is known as burst position acquisition.

26. What is an single access?

A transponder channel aboard a satellite may be fully loaded by a single transmission from earth station.

27. What is an multiple access technique?

A transponder to be loaded by a number of carriers.

These may originate from a number of earth station may transmit one or more of the carriers. This mode of operation known as multiple access technique.

28. What is meant by frequency reuse?

The satellite as a whole to be accessed by earth station

s widely separated geographically but transmitting on the same frequency that is known as frequency reuse.

1. What is meant by space division multiple access?

The satellite as a whole to be accessed by earth stations widely separated geographically but transmitting on the same frequency that is known as frequency reuse. This method of access known as space division multiple access.

1. What is an error detecting code?

A code which allows for the detection of errors is terme d as error detecting code.

31. What are the limitations of FDMA-satellite access?

1. If the traffic in the downlink is much heavier than that in the uplink, then FDMA is relatively inefficient.
2. Compared with TDMA, FDMA has less flexibility in r eassigning channels.
3. Carrier frequency assignments are hardware controlled.
4. Write about pre-assigned TDMA satellite access. Example for pre-assigned TDMA is CSC for the SPADE net

work. CSC can accommodate upto 49 earth stations in the network and 1 reference station. All bursts are of equal length. Each burst contains 128 bits. The bit rate is 128 Kb / s.

1. Write about demand assigned TDMA satellite access.

The burst length may be kept constant and the number f bursts per frame used by the given station is varied when the demand is varied.

EARTH SEGMENT

1. Define earth segment.

Earth segment of a satellite communication system consist s of transmit earth station and receive earth station.

Example : TV Receive Only systems (TVRO systems)

1. Give the difference between KU-band and the C-band receive only systems. Operating frequency of outdoor unit.
2. What is mean by ODU and IDU.

ODU – The Home Receiver Outdoor Unit

IDU – The Home Receiver Indoor Unit

1. Explain about MATV system.

MATV – Master Antenna TV system.

It is used to provide reception of DBS TV channels to the user group.

Example : Apartment users

It consists of one outdoor unit and various indoor units. Each user can independently access all the channels.

1. Write about CATV system.

CATV – Community Antenna TV system.

As in MATV system, it consists of oneoutdoor unit and separ ate feeds for each sense of polarization.

1. Define S/N ratio.

The S/N introduced in the preceding section is used to

refer to the ratio of signal power to noise power at the receiver output. This is known as S/N ratio.

1. What is noise weighting?

The method used to improve the post detection signal to noise ratio is referred to as noise weighting.

1. What is an EIRP?

EIRP means Equivalent Isotropic Radiated Power. It is a measure of radiated or transmitted power of an antenna.

1. What is noise power spectral density?

Noise power per unit Bandwidth is termed as the noise p ower spectral density.

1. What is an inter modulation noise?

Inter modulation distortion in high power amplifier can result in signal product which appear as noise and it is referred to as inter modulation noise.

1. What is an antenna loss?

It is added to noise received as radiation and the total antenna noise temperature is the sum of the equivalent noise temperature of all these sources.

1. Define noise factor.

An alternative way of representing amplifier noise is

by means of its noise factor. In defining the noise factor of an amplifiers, usually taken as 290 k.

1. A satellite downlink at 12 GHz operates with a tra nsmit power of 6 W and an antenna gain of 48.2 dB. Calculate the EIRP in dBW.

EIRP = 10 log 6 + 48.2 = 56 dBW

1. The range between a ground station and a satellite is 42000 km. Calculate the free space loss a frequency of 6 GHz.

[Free space loss] = 32.4 + 20 log 42000 + 20 log 6000

= 200.4 dB

1. An antenna has a noise temperature of 35 K and it is matched into a receiver which has a noise temperature of 100 K. Calculate the noise power density and the noise power for a BW of 36 MHz.

N0 = ( 35 + 100 ) \* 1.38 \* 10-23= 1.86 \* 1 -21

JP N = 1.86 \* 10-21\* 36 \* 106= 0.067 PW

1. Define Saturation flux density.

The flux density required at the receiving antenna to produce saturation of TWTA is termed the saturation flux density.

SATELLITE APPLICATIONS

1. Give the 3 different types of applications with respect to satellite systems.

* The largest international system (Intelsat)
* The domestic satellite system (Dom sat) in U.S.
* U.S. National oceanographic and atmospheric administra tions (NOAA)

2. Mention the 3 regions to allocate the frequency for satellite services.

1. Region1: It covers Europe, Africa and Mangolia
2. Region2: It covers North & South Ameriaca and Greenland.
3. Region3: It covers Asia, Australia and South West Pacif

ic.

3. Give the types of satellite services.

1. Fixed satellite service
2. Broadcasting satellite service
3. Mobile satellite service
4. Navigational satellite services
5. Meteorological satellite services
6. What is mean by Dom sat?

Domestic Satellites. These are used for voice, data and v ideo transmissions within the country.

1. What is mean by INTELSAT?

International Telecommunication Satellite.

1. What is mean by SARSAT?

Search and rescue satellite.

1. What are the applications of Radarsat?
2. Shipping and fisheries.
3. Ocean feature mapping
4. Iceberg detection
5. Crop monitoring
6. What is ECEF?

The geocentric equatorial coordinate system is used with the GPS system.It is called as earth centered, earth fixed coordinate system.

1. What is dilution of precision?

Position calculations involve range differences and where the ranges are nearly equal, any error is greatly magnified in the difference. This effect, brought a result of the satellite geometry is known as dilution of precision.

1. What is PDOP?

With the GPS system, dilution of position is taken into account through a factor known as the position dilution of precision.

1. What is DBS?

Satellites are used to provide the broadcast transmissions. It is used to provide direct transmissions into the home. The service provided is known as Direct Broadcast

Satellite services.

Example : Audio, TV and internet services.

1. Give the frequency range of US DBS systems with hig h power satellites.
2. Uplink frequency range is 17.3 GHz to 17.8 GHz
3. Downlink frequency range is 12.2 GHz to 12.7 GHz 13. Give the frequency range of US DBS systems with med ium power satellites.
4. Uplink frequency range is 14 GHz to 14.5 GHz
5. Downlink frequency range is 11.7 GHz to 12.2 GHz
6. What is DTH?

DBS television is also known as Direct To Home ( DTH ).

1. Write about bit rates for digital television.

It depends format of the picture.

Uncompressed Bit rate = (Number of pixels in a frame) \*

(Number of pixels per second) \* (Number of bits used to encode each pixel)

1. Give the satellite mobile services.
2. DBS – Direct Broadcast satellite
3. VSATS – Very Small Aperture Terminals
4. MSATS – Mobile Satellite Service
5. GPS – Global Positioning Systems
6. Micro Sats
7. Orb Comm – Orbital Communications Corporation
8. Iridium
9. What is GCC and GEC?

GCC - Gateway Control Centers

GEC – Gateway Earth Stations

1. What is INMARSAT?

It is the first global mobile satellite communication system operated at Lband and internationally used by 67 countries for communication between ships and coast so that mergency life saving may be provided. Also it provides modern communication services to maritime, land mobile, aeronautical and other users.

1. List out the regions covered by INMARSAT.

* Atlantic ocean region, east (AOR-E)
* Atlantic ocean region, west (AOR-W)
* Indian ocean region (IOR)\
* Pacific ocean region (POR)

20.What is INSAT?

INSAT – Indian National Satellite System.

INSAT is a Indian National Satellite System for telecommunications, broadcasting, meteorology and search and rescue services. It was commissioned in 1983. INSAT was the largest domestic communication system in the sia-Pacific region.

20. List out the INSAT series.

* INSAT-1
* INSAT-2
* INSAt-2A
* INSAT-2E
* INSAT-3

21.What is GSM?

GSM (Global System for Mobile communications: originally from Groupe Spécial Mobile) is the most popular standard or mobile phones in the world. GSM differs from its predecessors in that both signaling and speech channels are digital, and thus is considered a second generation (2G) mobile phone system. This has also meant that data communication was easy to build into the system.

22.What is GPRS?

General packet radio service (GPRS) is a packet oriented mobile data service available to users of the 2G cellular communication systems global system for mobile communications (GSM), as well as in the 3G systems. In the 2G systems, GPRS provides data rates of 56-114 kbit/s.

23. Define DAB.

DAB - Digital Audio Broadcast