TOPIC 2.1 OSCILLATORY MOTION

1. The motion of the earth about its axis is periodic and simple harmonic.
a) True
b) False

Answer: b
Explanation: The earth takes 24 hours to complete its rotation about its axis, but the concept of to and fro motion is absent, and hence the rotation of the earth is periodic and not simple harmonic.

2. An object of mass 0.2kg executes simple harmonic motion along the x-axis with a frequency of (25/π)Hz. At the position x = 0.04, the object has kinetic energy of 0.5J and potential energy 0.4J. The amplitude of oscillation is?
a) 6cm
b) 4cm
c) 8cm
d) 2cm

Answer: a
Explanation: Total energy,
$E=2\pi^2 mv^2 A^2$
$0.5+0.4=2\pi^2\times0.2\times(25/\pi)^2 A^2$
$A^2=0.9/(0.4\times25^2)$
A=3/(2×25)=3/50 m=6cm.

3. A spring of force constant 800N/m has an extension of 5cm. The work done in extending it from 5cm to 15cm is?
a) 8J
b) 16J
c) 24J
d) 32J

Answer: a
Explanation: At x_1 = 5 cm,
$U_1=1/2\times k(x_1)^2=1/2\times800\times0.05^2=1J$
At x_2=15cm,
$U_2=1/2\times k(x_2)^2=1/2\times800\times0.15^2=9J$
$W=U_2-U_1=9-1=8J$.

4. A simple pendulum is attached to the roof of a lift. If the time period of oscillation, when the lift is stationary is T, then the frequency of oscillation when the lift falls freely, will be ___________
a) Zero
b) T
c) 1/T
d) ∞

Answer: a
Explanation: In a freely falling lift,
g=0
$v=1/2\pi\times\sqrt{(g/l)}=1/2\pi\times\sqrt{(0/l)}=0$.

5. There is a simple pendulum hanging from the ceiling of a lift. When the lift is standstill, the time period of the pendulum is T. If the resultant acceleration becomes g/4, then the new time period of the pendulum is?
a) 0.8T
b) 0.25T
c) 2T
d) 4T

Answer: c
Explanation: $T=2\times\sqrt{(l/g)}$
$T`=2\pi\times\sqrt{((l/g)/4)}$
T`=2T.

6. A lightly damped oscillator with a frequency v is set in motion by a harmonic driving force of frequency v'. When v' is lesser than v, then the response of the oscillator is controlled by ___________
a) Spring constant
b) Inertia of the mass
c) Oscillator frequency
d) Damping coefficient

Answer: a
Explanation: Frequency of driving force is lesser than frequency v of a damped oscillator. The vibrations are nearly in phase

Answer: a
Explanation: $v \propto \sqrt{T}$
$t \propto 1/v$
$t \propto 1/\sqrt{T}$
$t_2/t_1 = \sqrt{(T_1/T_2)} = \sqrt{((273+10)/(273+30))} = \sqrt{(283/303)}$
$t_2 = \sqrt{(283/303)} \times 2s = 1.9s.$

3. The disc of a siren containing 60holes rotates at a constant speed of 360rpm. The emitted sound is in unison with a tuning fork of frequency.
a) 10Hz
b) 360Hz
c) 216Hz
d) 60Hz

Answer: b
Explanation: Frequency of revolution of disc=360rpm=360/60rps=60rps
Frequency of emitted sound=6×No.of holes =6×60=360Hz.

4. The quantity which does not change, when sound enters from one medium to another __________
a) Wavelength
b) Speed
c) Frequency
d) Velocity

Answer: c
Explanation: Frequency remains unchanged when sound travels from one medium to another.

5. The equation of a simple harmonic wave is given by
$y=5\sin(\pi/2)(100t-x)$
Where x and y are in metre and time is in second. The period of the wave in second will be __________
a) 0.04
b) 0.01
c) 1
d) 5

Answer: a
Explanation: $y=5\sin(\pi/2)(100t-x)$
$y=A\sin(\omega t-kx)$
$\omega=2\pi/T=\pi/2\times100$
$T=2/50=0.04s.$

6. If wave $y=A\cos(\omega t+kx)$ Is moving along x-axis, the shapes of a pulse at t=0 and t=2s.
a) Are different
b) Are same
c) May not be the same
d) Unpredictable

Answer: b
Explanation: The shapes of y-x graph remains the same at t=0 and t=2s.

7. $y_1=4\sin(\omega t+kx)$, $y_2=-4\cos(\omega t+kx)$, the phase difference is __________
a) $\pi/2$
b) $3\pi/2$
c) π
d) Zero

Answer: b
Explanation: $y_1=4\sin(\omega t+kx)$
$y_2=-4\cos(\omega t+kx)$
$=-4\sin(\omega t+kx+3\pi/2)$
$\Delta\varphi=3\pi/2.$

8. A wave equation is $y=0.1\sin[100\pi t-kx]$ and wave velocity is 100m/s, its number is equal to __________
a) 1/m
b) 2/m
c) π/m
d) 2π/m

Answer: c
Explanation: $y=0.1\sin[100\pi t-kx]$
$y=A\sin(\omega t-kx)$
$\omega=100\pi$
Wave number=$\omega/v=100\pi/100=\pi$/m.

9. A particle on the trough of a wave at any instant will come to the mean position after a time (T=time period).
a) T/2

b) T/4
c) T
d) 2T

Answer: b
Explanation: Time taken by a particle to move from trough to the mean position=T/4.

10. A string is tied on a sonometer, second end is hanging downward through a pulley with tension T. The velocity of the transverse wave produced is proportional to __________
a) 1/√T
b) √T
c) T
d) 1/T

Answer: b
Explanation: v=√(T/m)
v∝√T.

11. The fundamental frequency of a sonometer wire is n. If the tension is made 3 times and length and diameter are also increased 3 times, the new frequency will be __________
a) 3n
b) n/3√3
c) n/3
d) √3 n

Answer: b
Explanation: n=1/LD×√(T/πρ)
n‘=1/(3L×3D)×√(3T/πρ)=√3/9×n=1/(3√3) n.

TOPIC 2.4 WAVE EQUATION. LASERS : POPULATION OF ENERGY LEVELS, EINSTEIN'S A AND B COEFFICIENTS DERIVATION

1. Which of the following is the correct expression for the relation between Einstein's coefficients A and B?
a) $\frac{8\pi v^3 h}{c^3}$
b) $\frac{8\pi v^2 h}{c^3}$
c) $\frac{8\pi v^2 h}{c^2}$
d) $\frac{8\pi h v}{c^3}$

Answer: a
Explanation: The expression $\frac{8\pi v^3 h}{c^3}$ is the correct expression for the relation between the two Einstein's coefficients. This expression is known as the Einstein's relation.

2. What is the relationship between B_{21} and B_{12}?
a) $B_{12} > B_{21}$
b) $B_{12} < B_{21}$
c) $B_{12} = B_{21}$
d) No specific relation

Answer: c
Explanation: B_{21} is the coefficient for the stimulated emission while B_{12} is the coefficient for stimulated absorption. Both the processes are mutually reverse processes and their probabilities are equal. Therefore, $B_{12} = B_{21}$.

3. Which of the following Einstein's coefficient represents spontaneous emission?
a) A_{12}
b) A_{21}
c) B_{12}
d) B_{21}

Answer: b
Explanation: A_{21} represents the spontaneous emission of photons. A_{12} signifies spontaneous absorption.B_{12} is for stimulated absorption while B_{21} is for stimulated emission.

4. The correct expression for the rate of stimulated emission is ______________
a) $R_{se} = A_{21}N_2$
b) $R_{se} = A_{21}uN_2$

c) $R_{se} = B_{21}N_2$
d) $R_{se} = B_{21}uN_2$

Answer: d
Explanation: The stimulates emission is directly proportional to the energy density u, of the external radiation field. Also, stimulated emission rate increases with the increase in number N_2 of exited atoms.

5. Which law is used for achieving the relation between the Einstein's coefficients?
a) Heisenberg's Uncertainty Principle
b) Planck's radiation law
c) Einstein's equation
d) Quantum law

Answer: b
Explanation: Planck's radiation law, which gives the energy density u = $\frac{8\pi h v^3}{c^3}\frac{1}{e^{\alpha}-1}$, is used as the formula resembles the one for the energy density of the external radiation field in stimulated emission, u = $\frac{A_{21}}{B_{21}(\frac{B_{12}}{B_{21}}e^{\alpha}-1)}$.

6. The probability of spontaneous emission increases rapidly with the energy difference between the two states.
a) True
b) False

Answer: a
Explanation: From Einstein's relation we know that the ratio of Einstein's coefficients is $\frac{8\pi v^3 h}{c^3}$. Thus, the ration of Einstein's coefficients is proportional to the cube of the frequency. Hence, the probability of spontaneous emission increases rapidly with the energy difference between the two states.

7. If the frequency of emitted photon is 10 Hz, the ratio of Einstein's coefficient is ________________
a) 2.177×10^{-51}
b) 3.177×10^{-51}
c) 5.177×10^{-51}
d) 6.177×10^{-51}

Answer: d
Explanation: We know Einstein's relation = $\frac{8\pi v^3 h}{c^3}$
v = 10 Hz, h = 6.63×10^{-34} Js, c = 3×10^{8}m/s
Therefore, the ratio of Einstein's coefficients is: 6.177×10^{-51}.

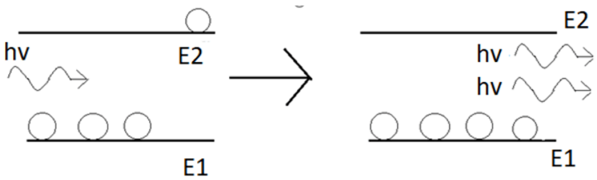
8. What is the unit of the coefficient of spontaneous emission?
a) s^{-1}
b) s
c) J^{-1}
d) J

Answer: a
Explanation: For spontaneous emission, the expression for the rate is = $A_{21}N_2$, where N_2 is the number of particles in exited state. As the unit of rate is Number of particles per second, the unit of A_{21} is s^{-1}.

9. What is the unit for the coefficient of stimulated emission?
a) s^{-2}
b) $m^3\ s^{-2}$
c) $J^{-1}\ m^3$
d) $J^{-1}\ m^3\ s^{-2}$

Answer: d
Explanation: For stimulated emission, the expression for the rate is $B_{21}uN_2$ where u stands for the energy density and N is the number of exited atoms. Therefore, the unit of B turns out to be $J^{-1}\ m^3\ s^{-2}$.

10. Which Einstein's coefficient should be used in this case?



a) A_{12}
b) A_{21}
c) B_{12}
d) B_{21}

Answer: d
Explanation: The given figure shows stimulated emission. Hence, the Einstein coefficient for stimulated emission is B_{21}. If it had been spontaneous emission, then A_{21} would have been used.

TOPIC 2.5 RESONANT CAVITY, OPTICAL AMPLIFICATION (QUALITATIVE)

1. A cylindrical cavity resonator can be constructed using a circular waveguide.
a) shorted at both the ends
b) open at both the ends
c) matched at both the ends
d) none of the mentioned

Answer: a
Explanation: A cylindrical cavity resonator is formed by shorting both the ends of the cylindrical cavity because open ends may result in radiation losses in the cavity.

2. The dominant mode in the cylindrical cavity resonator is TE_{101} mode.
a) true
b) false

Answer: b
Explanation: The dominant mode of propagation in a circular waveguide is TE_{111} mode. Hence, the dominant mode of resonance in a cylindrical cavity made of a circular waveguide is TE_{111} mode. In a cylindrical resonator, the mode of propagation depends on the length of the cavity.

3. Circular cavities are used for microwave frequency meters.
a) true
b) false

Answer: a
Explanation: Circular cavities are used for microwave frequency meters. The cavity is constructed with a movable top wall to allow the mechanical tuning of the resonant frequency.

4. The mode of the circular cavity resonator used in frequency meters is:
a) TE_{011} mode
b) TE_{101} mode
c) TE_{111} mode
d) TM_{111} mode

Answer: a
Explanation: Frequency resolution of a frequency meter is determined from its quality factor. Q factor of TE_{011} mode is much greater than the quality factor of the dominant mode of propagation.

5. The propagation constant of TEmn mode of propagation for a cylindrical cavity resonator is:
a) $\sqrt{(k^2-(p_{nm}/a)^2)}$
b) $\sqrt{p_{nm}/a}$
c) $\sqrt{(k^2+(p_{nm}/a)^2)}$
d) none of the mentioned

Answer: a
Explanation: The propagation constant for a circular cavity depends on the radius of the cavity, and the wave number. If the mode of propagation is known and the dimension of the cavity is known then the propagation constant can be found out.

6. A circular cavity resonator is filled with a dielectric of 2.08 and is operating at 5GHz of frequency. Then the wave number is:
a) 181
b) 151
c) 161
d) 216

Answer: b
Explanation: Wave number for a circular cavity resonator is given by the expression $2\pi f_{011}\sqrt{\epsilon_r}/C$. substituting the given values in the above expression; the wave number of the cavity resonator is 151.

7. Given that the wave number of a circular cavity resonator is 151 (TE_{011} mode), and the length of the cavity is twice the radius of the cavity, the radius of the circular cavity operating at 5GHz frequency is:
a) 2.1 cm
b) 1.7 cm
c) 2.84 cm
d) insufficient data

Answer: d
Explanation: For a circular cavity resonator, wave number is given by $\sqrt{((p_{01}/a)^2 +(\pi/d)^2)}$. P_{01} for the given mode of resonance is 3.832. Substituting the given values the radius of the cavity is 2.74 cm.

8. The loss tangent for a circular cavity resonator is 0.0004.Then the unloaded Q due to dielectric loss is:
a) 1350
b) 1560
c) 560
d) 2500

Answer: d
Answer: Unloaded Q due to the dielectric loss in a circular cavity resonator is the reciprocal of the loss tangent. Hence, taking the reciprocal of the loss tangent, unloaded Q due to dielectric loss is 2500.

9. A circular cavity resonator has a wave number of 151, radius of 2.74 cm, and surface resistance of 0.0184Ω. If the cavity is filled with a dielectric of 2.01, then unloaded Q due to conductor loss is:
a) 25490
b) 21460
c) 29390
d) none of the mentioned

Answer: c
Explanation: Unloaded Q of a circular resonator due to conductor loss is given by $ka/2R_s$. is the intrinsic impedance of the medium. Substituting the given values in the equation for loaded Q, value is 29390.

10. If unloaded Q due to conductor loss and unloaded Q due to dielectric loss is 29390 and 2500 respectively, then the total unloaded Q of the circular cavity is:
a) 2500
b) 29390
c) 2300
d) 31890

Answer: c
Explanation: The total unloaded Q of a circular cavity resonator is given by the expression $(Q_c^{-1}+ Q_d^{-1})^{-1}$. Substituting the given values in the above expression, the total unloaded Q for the resonator is 2300.

TOPIC 2.6 SEMICONDUCTOR LASERS: HOMOJUNCTION AND HETEROJUNCTION

1. A perfect semiconductor crystal containing no impurities or lattice defects is called as __________
a) Intrinsic semiconductor
b) Extrinsic semiconductor
c) Excitation
d) Valence electron

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 __________
a) Boltzmann distribution function
b) Probability distribution function
c) Fermi-Dirac distribution function
d) Cumulative distribution function

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-
$P(E) = 1/(1+\exp(E-E_F/KT))$
Where K = Boltzmann constant, T = absolute temperature, E_F = Fermi energy level.

3. What is done to create an extrinsic semiconductor?
a) Refractive index is decreased
b) Doping the material with impurities
c) Increase the band-gap of the material
d) Stimulated emission

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
b) Electrons
c) Photons
d) Neutrons

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.
a) Radiation
b) Efficiency
c) Electro-luminescence
d) Magnetron oscillator

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?

$p = 2\pi hk$

a) Permittivity
b) Probability
c) Holes
d) Crystal momentum

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

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 $10^{18}cm^{-3}$. The recombination coefficient for gallium arsenide is $7.21*10^{-10}cm^3s^{-1}$.
a) 2ns
b) 1.39ns
c) 1.56ns
d) 2.12ms

Answer: b
Explanation: The radioactive minority carrier lifetime ςrconsidering the p-type region is given by-
$ς_r = [B_rN]^{-1}$ where Br = Recombination coefficient in cm^3s^{-1} and N = carrier concentration in n-region.

9. Which impurity is added to gallium phosphide to make it an efficient light emitter?
a) Silicon
b) Hydrogen
c) Nitrogen
d) Phosphorus

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 __________
a) Heavy doping of p-type material
b) Heavy doping of n-type material
c) Light doping of p-type material
d) Heavy doping of both p-type and n-type material

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 Fermi-level 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 $2.5*10^3Acm^{-2}$ and length and width of the cavity is 240μm and 110μm respectively. Find the threshold current for the device.
a) 663 mA
b) 660 mA
c) 664 mA
d) 712 mA

Answer: b
Explanation: The threshold current is denoted by I_{th}. It is given by-
$I_{th} = J_{th}$ * area of the optical cavity
Where J_{th} = threshold current density
Area of the cavity = length and width.

12. 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
c) 0.32
d) 0.48

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.

13. A homo-junction is an interface between two adjoining single-crystal semiconductors with different band-gap energies.
a) True
b) False

Answer: b
Explanation: The photo-emissive properties of a single p-n junction fabricated from a single-crystal 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?
a) Two
b) One
c) Three
d) Four

Answer: a
Explanation: Hetero-junctions are classified into an isotype and an-isotype. The isotype hetero-junctions 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
b) GaSb
c) GaAs/GaSb
d) GaAs/Alga AS DH

Answer: d
Explanation: For DH device fabrication, materials such as GaAs, Alga AS are used. The band-gap 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).

TOPIC 2.7 FIBER OPTICS: PRINCIPLE, NUMERICAL APERTURE AND ACCEPTANCE ANGLE

1. What is the principle of fibre optical communication?
a) Frequency modulation
b) Population inversion
c) Total internal reflection
d) Doppler Effect

Answer: c
Explanation: In optical fibres, the light entering the fibre does not encounter any new surfaces, but repeatedly they hit the same surface. The reason for confining the light beam inside the fibres is the total internal reflection.

2. What is the other name for a maximum external incident angle?
a) Optical angle
b) Total internal reflection angle
c) Refraction angle
d) Wave guide acceptance angle

Answer: d
Explanation: Only this rays which pass within the acceptance angle will be totally reflected. Therefore, light incident on the core within the maximum external incident angle

can be coupled into the fibre to propagate. This angle is called a wave guide acceptance angle.

3. A single mode fibre has low intermodal dispersion than multimode.
a) True
b) False

Answer: a
Explanation: In both single and multimode fibres the refractive indices will be in step by step. Since a single mode has less dispersion than multimode, the single mode step index fibre also has low intermodal dispersion compared to multimode step index fibre.

4. How does the refractive index vary in Graded Index fibre?
a) Tangentially
b) Radially
c) Longitudinally
d) Transversely

Answer: b
Explanation: The refractive index of the core is maximum along the fibre axis and it gradually decreases. Here the refractive index varies radially from the axis of the fibre. Hence it is called graded index fibre.

5. Which of the following has more distortion?
a) Single step-index fibre
b) Graded index fibre
c) Multimode step-index fibre
d) Glass fibre

Answer: c
Explanation: When rays travel through longer distances there will be some difference in reflected angles. Hence high angle rays arrive later than low angle rays. Therefore the signal pulses are broadened thereby results in a distorted output.

6. In which of the following there is no distortion?
a) Graded index fibre
b) Multimode step-index fibre
c) Single step-index fibre
d) Glass fibre

Answer: a
Explanation: The light travels with different speeds in different paths because of the variation in their refractive indices. At the outer edge it travels faster than near the centre But almost all the rays reach the exit end at the same time due to the helical path. Thus, there is no dispersion in the pulses and hence the output is not a distorted output.

7. Which of the following loss occurs inside the fibre?
a) Radiative loss
b) Scattering
c) Absorption
d) Attenuation

Answer: b
Explanation: Scattering is a wavelength dependent loss. Since the glass used in the fabrication of fibres, the disordered structure of glass will make some vibrations in the refractive index inside the fibre. This causes Rayleigh scattering.

8. What causes microscopic bend?
a) Uniform pressure
b) Non-uniform volume
c) Uniform volume
d) Non-uniform pressure

Answer: d
Explanation: Micro-bends losses are caused due to non-uniformities inside the fibre. This micro-bends in fibre appears due to non-uniform pressures created during the cabling of fibre.

9. When more than one mode is propagating, how is it dispersed?
a) Dispersion
b) Inter-modal dispersion

c) Material dispersion
d) Waveguide dispersion

Answer: b
Explanation: When more than one mode is propagating through a fibre, then inter modal dispersion will occur. Since many modes are propagating, they will have different wavelengths and will take different time to propagate through the fibre.

10. A fibre optic telephone transmission can handle more than thousands of voice channels.
a) True
b) False

Answer: a
Explanation: Optical fibre has larger bandwidth hence it can handle a large number of channels for communication.

11. Which of the following is known as fibre optic back bone?
a) Telecommunication
b) Cable television
c) Delay lines
d) Bus topology

Answer: d
Explanation: Each computer on the network is connected to the rest of the computers by the optical wiring scheme called bus topology, which is an application known as fibre optic back bone.

12. Calculate the numerical aperture of an optical fibre whose core and cladding are made of materials of refractive index 1.6 and 1.5 respectively.
a) 0.55677
b) 55.77
c) 0.2458
d) 0.647852

Answer: a
Explanation: Numerical aperture = $\sqrt{n1^2 - n2^2}$
Numerical aperture = 0.55677.

13. A step-index fibre has a numerical aperture of 0.26, a core refractive index of 1.5 and a core diameter of 100micrometer. Calculate the acceptance angle.
a) 1.47°
b) 15.07°
c) 2.18°
d) 24.15°

Answer: b
Explanation: sin i = (Numerical aperture)/n
sin i = 15.07°.

TOPIC 2.8 TYPES OF OPTICAL FIBRES (MATERIAL, REFRACTIVE INDEX, MODE)

TOPIC 2.9 LOSSES ASSOCIATED WITH OPTICAL FIBERS

1. Multimode step index fiber has ___________
a) Large core diameter & large numerical aperture
b) Large core diameter and small numerical aperture
c) Small core diameter and large numerical aperture
d) Small core diameter & small numerical aperture

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 ___________

a) 1.2 to 90 dB km^{-1} at wavelength 0.69µm
b) 3.2 to 30 dB km^{-1} at wavelength 0.59µm
c) 2.6 to 50 dB km^{-1} at wavelength 0.85µm
d) 1.6 to 60 dB km^{-1} at wavelength 0.90µm

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
b) 100 to 300 nm
c) 200 to 500 µm
d) 200 to 500 nm

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 ___________
a) 2 to 30 MHz km
b) 6 to 50 MHz km
c) 10 to 40 MHz km
d) 8 to 40 MHz km

Answer: b
Explanation: Multimode step index fibers have a bandwidth of 6 to 50 MHz km. These fibers with this bandwidth are best suited for short -haul, limited bandwidth and relatively low-cost application.

5. Multimode graded index fibers are manufactured from materials with

____
a) Lower purity
b) Higher purity than multimode step index fibers.
c) No impurity
d) Impurity as same as multimode step index fibers.

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

____
a) Better than multimode step index fibers
b) Same as multimode step index fibers
c) Lesser than multimode step index fibers
d) Negligible

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
b) Smaller than multimode step index fibers
c) Same as that of multimode step index fibers
d) Smaller than single mode step index fibers

Answer: b
Explanation: Multimode graded index fibers have smaller core diameter than multimode step index fibers. A small core diameter helps the fiber gain greater rigidity to resist bending.

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

b) 100 µm/140 µm
c) 85 µm/125 µm
d) 50 µm/125µm

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

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
b) Graded index
c) Step and graded index
d) Coaxial cable

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 ___________
a) Single mode fibers
b) Multimode step fibers
c) Coaxial cables
d) Multimode graded index fibers

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 ___________
a) Twice the core diameter
b) Thrice the core diameter
c) Five times the core diameter
d) Ten times the core diameter

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?
a) Coaxial cables
b) Standard single mode fibers
c) Standard multimode fibers
d) Non zero dispersion shifted fibers

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
b) L-band
c) O-band
d) C-band and L-band