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
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
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
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
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.
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
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
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
9. Multimode graded index fibers use incoherent source only.  
   a) True  
   b) False
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
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
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
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
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
15. Fiber mostly suited in single-wavelength transmission in O-band is?  
    a) Low-water-peak non dispersion-shifted fibers  
    b) Standard single mode fibers  
    c) Low minimized fibers  
    d) Non-zero-dispersion-shifted fibers
16. When optical fibers are to be installed in a working environment, the most important parameter to be considered is?  
    a) Transmission property of the fiber  
    b) Mechanical property of the fiber  
    c) Core cladding ratio of the fiber  
    d) Numerical aperture of the fiber
17. Optical fibers for communication use are mostly fabricated from \_\_\_\_\_\_\_\_\_\_\_  
    a) Plastic  
    b) Silica or multicomponent glass  
    c) Ceramics  
    d) Copper
18. \_\_\_\_\_\_\_\_\_\_\_\_ results from small lateral forces exerted on the fiber during the cabling process.  
    a) Attenuation  
    b) Micro-bending  
    c) Dispersion  
    d) Stimulated Emission
19. Microscopic meandering of the fiber core axis that is micro-bending is caused due to \_\_\_\_\_\_\_\_\_\_\_  
    a) Environmental effects  
    b) Rough edges of the fiber  
    c) Large diameter of core  
    d) Polarization
20. What does micro-bending losses depend on \_\_\_\_\_\_\_\_\_\_\_\_\_  
    a) Core material  
    b) Refractive index  
    c) Diameter  
    d) Mode and wavelength
21. 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  
    b) Coupled with plastic  
    c) Large in diameter  
    d) Smooth and in a steady state
22. The diffusion of hydrogen into optical fiber affects the \_\_\_\_\_\_\_\_\_\_\_\_\_\_  
    a) Transmission of optical light in the fiber  
    b) Spectral attenuation characteristics of the fiber  
    c) Core of the fiber  
    d) Cladding of the fiber
23. \_\_\_\_\_\_\_\_\_\_ can induce a considerable amount of attenuation in optical fibers.  
    a) Micro-bending  
    b) Dispersion  
    c) Diffusion of hydrogen  
    d) Radiation Exposure
24. The ratio r = (n1 – n)/(n1 – n) indicates \_\_\_\_\_\_\_\_\_\_\_\_  
    a) Fresnel reflection  
    b) Reflection coefficient  
    c) Refraction coefficient  
    d) Angular power distribution coefficient
25. Losses caused by factors such as core-cladding diameter, numerical aperture, relative refractive index differences, different refractive index profiles, fiber faults are known as \_\_\_\_\_\_\_\_\_\_\_\_  
    a) Intrinsic joint losses  
    b) Extrinsic losses  
    c) Insertion losses  
    d) Coupling losses
26. 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  
    b) 0.40 dB  
    c) 0.42 dB  
    d) 0.62 Db

Loss10t = -10log10t η10t  
Where, Loss10t = insertion loss due to lateral misalignment  
η10t = Coupling efficiency.

1. 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  
   b) 0.106  
   c) 0.280  
   d) 0.080

Lt = 0.85(y/a)  
Where y = lateral misalignment  
a = core radius.

1. 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.  
   a) 0.66 dB  
   b) 0.26 dB  
   c) 0.38 dB  
   d) 0.40 dB

TT = TL + Ta  
Where, TT = total insertion loss  
TL = lateral offset loss  
Ta = Angular misalignment loss.

1. A permanent joint formed between two different optical fibers in the field is known as a \_\_\_\_\_\_\_\_\_\_\_\_  
   a) Fiber splice  
   b) Fiber connector  
   c) Fiber attenuator  
   d) Fiber dispersion
2. The insertion losses of the fiber splices are much less than the Fresnel reflection loss at a butted fiber joint.  
   a) True  
   b) False
3. 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  
   b) Fusion splicing  
   c) Melting  
   d) Diffusion
4. Average insertion losses as low as \_\_\_\_\_\_\_\_\_ have been obtained with multimode graded index and single-mode fibers using ceramic capillaries.  
   a) 0.1 dB  
   b) 0.5 dB  
   c) 0.02 dB  
   d) 0.3 dB
5. \_\_\_\_\_\_\_\_\_\_\_\_\_ are formed by sandwiching the butted fiber ends between a V-groove glass substrate and a flat glass retainer plate.  
   a) Springroove splices  
   b) V-groove splices  
   c) Elastic splices  
   d) Fusion splices
6. When considering source-to-fiber coupling efficiencies, the \_\_\_\_\_\_\_\_ is an important parameter than total output power.  
   a) Numerical aperture  
   b) Radiance of an optical source  
   c) Coupling efficiency  
   d) Angular power distribution
7. It is a device that distributes light from a main fiber into one or more branch fibers.  
   a) Optical fiber coupler  
   b) Optical fiber splice  
   c) Optical fiber connector  
   d) Optical isolator
8. Optical fiber couplers are also called as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
   a) Isolators  
   b) Circulators  
   c) Directional couplers  
   d) Attenuators
9. The optical power coupled from one fiber to another is limited by \_\_\_\_\_\_\_\_\_\_\_\_  
   a) Numerical apertures of fibers  
   b) Varying refractive index of fibers  
   c) Angular power distribution at source  
   d) Number of modes propagating in each fiber
10. \_\_\_\_\_\_\_\_ couplers combine the different wavelength optical signal onto the fiber or separate the different wavelength optical signal output from the fiber.  
    a) 3-port  
    b) 2\*2-star  
    c) WDM  
    d) Directional
11. Which is the most common method for manufacturing couplers?  
    a) Wavelength division multiplexing  
    b) Lateral offset method  
    c) Semitransparent mirror method  
    d) Fused bi-conical taper (FBT) technique
12. 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  
    b) 0.33 dB  
    c) 0.45 dB  
    d) 0.12 dB

Excess loss = 10log10 P1/(P3+P4)  
WhereP1, P3, P4 = output power at ports 1,3 and 4 resp.

1. 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%  
   b) 46%  
   c) 52%  
   d) 45%

Split ratio = [P3/(P3+P4)]\*100%  
Where P3 and P4 are output powers at ports 3 and 4 respectively.

1. 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  
   b) 15 dB  
   c) 14.77 dB  
   d) 16.02 dB

Splitting loss (Star coupler) = 10log10N (dB).

1. 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  
   b) 1.4 dB  
   c) 0.9 dB  
   d) 1.1 dB

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).

1. A device which is made of isolators and follows a closed loop path is called as a \_\_\_\_\_\_\_\_\_\_\_\_  
   a) Circulator  
   b) Gyrator  
   c) Attenuator  
   d) Connector
2. The commercially available circulators exhibit insertion losses around \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
   a) 2 dB  
   b) 0.7 dB  
   c) 0.2 dB  
   d) 1 dB
3. A device which converts electrical energy in the form of a current into optical energy is called as \_\_\_\_\_\_\_\_\_\_\_  
   a) Optical source  
   b) Optical coupler  
   c) Optical isolator  
   d) Circulator
4. How many types of sources of optical light are available?  
   a) One  
   b) Two  
   c) Three  
   d) Four
5. 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

a)Gravitation constant  
b) Planck’s constant  
c) Permittivity  
d) Attenuation constant

1. The radiation emission process (emission of a proton at frequency) can occur in \_\_\_\_\_\_\_\_\_\_ ways.  
   a) Two  
   b) Three  
   c) Four  
   d) One
2. An incandescent lamp is operating at a temperature of 1000K at an operating frequency of 5.2×1014Hz. Calculate the ratio of stimulated emission rate to spontaneous emission rate.  
   a) 3×10-13  
   b) 1.47×10-11  
   c) 2×10-12  
   d) 1.5×10-13

Stimulated emission rate/ Spontaneous emission rate = 1/exp (hf/KT)-1.

1. The lower energy level contains more atoms than upper level under the conditions of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
   a) Isothermal packaging  
   b) Population inversion  
   c) Thermal equilibrium  
   d) Pumping
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in the laser occurs when photon colliding with an excited atom causes the stimulated emission of a second photon.  
   a) Light amplification  
   b) Attenuation  
   c) Dispersion  
   d) Population inversion
3. 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  
   b) 3×106  
   c) 2.9×105  
   d) 2.2×105

q = 2nL/λ  
Where  
q = Number of longitudinal modes  
n = Refractive index  
L = Length of the crystal  
λ = Peak emission wavelength.

1. 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  
   b) 1.2 GHz  
   c) 1.6 GHz  
   d) 2 GHz

δf = c/2nL  
Where  
c = velocity of light  
n = Refractive index  
L = Length of the crystal.

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
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
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
4. The majority of the carriers in a p-type semiconductor are \_\_\_\_\_\_\_\_\_\_  
   a) Holes  
   b) Electrons  
   c) Photons  
   d) Neutrons
5. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is used when the optical emission results from the application of electric field.  
   a) Radiation  
   b) Efficiency  
   c) Electro-luminescence  
   d) Magnetron oscillator
6. How many types of hetero-junctions are available?  
   a) Two  
   b) One  
   c) Three  
   d) Four
7. 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
8. P-n photodiode is forward biased.  
   a) True  
   b) False
9. The depletion region must be \_\_\_\_\_\_\_\_\_\_\_\_ to allow a large fraction of the incident light to be absorbed in the device(photodiode).  
   a) Thick  
   b) Thin  
   c) Long  
   d) Inactive
10. 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  
    b) Absorption  
    c) Degeneration of an electron-hole pair  
    d) Regeneration of an electron-hole pair
11. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ always leads to the generation of a hole and an electron.  
    a) Repulsion  
    b) Dispersion  
    c) Absorption  
    d) Attenuation
12. The electron hole pairs generated in a photodiode are separated by the \_\_\_\_\_\_\_\_\_\_\_\_  
    a) Magnetic field  
    b) Electric field  
    c) Static field  
    d) Depletion region
13. The photocurrent of an optical detector should be \_\_\_\_\_\_\_\_\_\_  
    a) Less  
    b) More  
    c) Linear  
    d) Non-linear
14. How many types of optical detectors are available?  
    a) One  
    b) Four  
    c) Two  
    d) Three
15. The absorption of photons in a photodiode is dependent on \_\_\_\_\_\_\_\_\_\_  
    a) Absorption Coefficient α0  
    b) Properties of material  
    c) Charge carrier at junction  
    d) Amount of light
16. The photocurrent in a photodiode is directly proportional to absorption coefficient.  
    a) True  
    b) False
17. The absorption coefficient of semiconductor materials is strongly dependent on \_\_\_\_\_\_\_\_\_\_  
    a) Properties of material  
    b) Wavelength  
    c) Amount of light  
    d) Amplitude
18. In optical fiber communication, the only weakly absorbing material over wavelength band required is?  
    a) GaAs  
    b) Silicon  
    c) GaSb  
    d) Germanium
19. The threshold for indirect absorption occurs at wavelength \_\_\_\_\_\_\_\_\_\_  
    a) 3.01 μm  
    b) 2.09 μm  
    c) 0.92 μm  
    d) 1.09 μm
20. The semiconductor material for which the lowest energy absorption takes place is?  
    a) GaAs  
    b) Silicon  
    c) GaSb  
    d) Germanium
21. The wavelength range of interest for Germanium is \_\_\_\_\_\_\_\_\_\_  
    a) 0.8 to 1.6 μm  
    b) 0.3 to 0.9 μm  
    c) 0.4 to 0.8 μm  
    d) 0.9 to 1.8 μm
22. A photodiode should be chosen with a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ less than photon energy.  
    a) Direct absorption  
    b) Band gap energy  
    c) Wavelength range  
    d) Absorption coefficient
23. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ photodiodes have large dark currents.  
    a) GaAs  
    b) Silicon  
    c) GaSb  
    d) Germanium
24. For fabrication of semiconductor photodiodes, there is a drawback while considering \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
    a) GaAs  
    b) Silicon  
    c) GaSb  
    d) Germanium
25. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ materials are potentially superior to germanium.  
    a) GaAs  
    b) Silicon  
    c) GaSb  
    d) III – V alloys
26. \_\_\_\_\_\_\_\_\_\_\_\_ alloys such as InGaAsP and GaAsSb deposited on InP and GaSb substrate.  
    a) Ternary  
    b) Quaternary  
    c) Gain-guided  
    d) III – V alloys
27. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ alloys can be fabricated in hetero-junction structures.  
    a) InGaSb  
    b) III – V alloys  
    c) InGaAsP  
    d) GaAsSb
28. The alloys lattice matched to InP responds to wavelengths up to 1.7μm is?  
    a) InAsSb  
    b) III – V alloys  
    c) InGaSb  
    d) InGaAs
29. The fraction of incident photons generated by photodiode of electrons generated collected at detector is known as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
    a) Quantum efficiency  
    b) Absorption coefficient  
    c) Responsivity  
    d) Anger recombination
30. In photo detectors, energy of incident photons must be \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ band gap energy.  
    a) Lesser than  
    b) Greater than  
    c) Same as  
    d) Negligible
31. 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  
    b) 6.424\*10-7  
    c) 6.023\*103  
    d) 7.234\*10-7

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.

1. The long cutoff wavelength of GaAs is 0.923 μm. Determine bandgap energy.  
   a) 1.478\*10-7  
   b) 4.265\*10-14  
   c) 2.784\*10-9  
   d) 2.152\*10-19

λc = hc/Eg  
Eg = hc/λc = 6.6268\*10-34\*2.998\*108/0.923\*10-6  
= 2.152\*10-19eV.

1. Quantum efficiency is a function of photon wavelength.  
   a) True  
   b) False
2. Determine quantum efficiency if incident photons on photodiodes is 4\*1011 and electrons collected at terminals is 1.5\*1011?  
   a) 50%  
   b) 37.5%  
   c) 25%  
   d) 30%

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%.

1. A photodiode has quantum efficiency of 45% and incident photons are 3\*1011. Determine electrons collected at terminals of device.  
   a) 2.456\*109  
   b) 1.35\*1011  
   c) 5.245\*10-7  
   d) 4.21\*10-3

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.

1. The quantum efficiency of photodiode is 40% with wavelength of 0.90\*10-6. Determine the responsivity of photodiodes.  
   a) 0.20  
   b) 0.52  
   c) 0.29  
   d) 0.55

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.

1. The Responsivity of photodiode is 0.294 AW-1at wavelength of 0.90 μm. Determine quantum efficiency.  
   a) 0.405  
   b) 0.914  
   c) 0.654  
   d) 0.249

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.

1. Determine wavelength of photodiode having quantum efficiency of 40% and Responsivity of 0.304 AW-1.  
   a) 0.87 μm  
   b) 0.91 μm  
   c) 0.88 μm  
   d) 0.94 μm

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.

1. Determine wavelength at which photodiode is operating if energy of photons is 1.9\*10-19J?  
   a) 2.33  
   b) 1.48  
   c) 1.04  
   d) 3.91

Explanation: To determine wavelength,  
λ = hc/t  
= 6.626\*10-34\*3\*108/1.9\*10-19  
= 1.04 μm

1. Determine the energy of photons incident on a photodiode if it operates at a wavelength of 1.36 μm.  
   a) 1.22\*10-34J  
   b) 1.46\*10-19J  
   c) 6.45\*10-34J  
   d) 3.12\*109J

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.

1. Determine Responsivity of photodiode having o/p power of 3.55 μm and photo current of 2.9 μm.  
   a) 0.451  
   b) 0.367  
   c) 0.982  
   d) 0.816

Explanation: The Responsivity of photodiode is  
R = Ip/Po  
= 2.9\*10-6/3.55\*10-6  
= 0.816 A/W.

1. 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  
   b) 1.75  
   c) 3.81  
   d) 8.47

Explanation: The Responsivity of photodiode is  
R = Ip/Po  
Po = Ip/R  
= 2.1\*10-6/0.55  
= 3.81 μm.

1. If a photodiode requires incident optical power of 0.70 A/W. Determine photocurrent.  
   a) 1.482  
   b) 2.457  
   c) 4.124  
   d) 3.199

Explanation: The Responsivity of photodiode is given by  
R = Ip/Po  
Ip = R\*Po  
= 0.70\*3.51\*10-6  
= 2.457μm.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_ refers to any spurious or undesired disturbances that mask the received signal in a communication system.  
   a) Attenuation  
   b) Noise  
   c) Dispersion  
   d) Bandwidth
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_ is caused due to thermal interaction between the free electrons and the vibrating ions in the conduction medium.  
   a) Thermal noise  
   b) Dark noise  
   c) Quantum noise  
   d) Gaussian noise
3. 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  
   b) 21.2  
   c) 20.7  
   d) 26.2

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.

1. 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  
   b) 4.2×10-18  
   c) 6.2×10-14  
   d) 7.2×10-14

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.

1. 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).  
   a) 46  
   b) 40  
   c) 50  
   d) 52

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.

1. 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  
   b) -37 dBm  
   c) – 34 dBm  
   d) -38.2 dBm

Explanation: Incident power in denoted by P0. It is given by –  
P0 = 10log10(P0(watts))  
Where P0(watts) = incident power in Watts/milliWatt.

1. Which are the two main sources of noise in photodiodes without internal gain?  
   a) Gaussian noise and dark current noise  
   b) Internal noise and external noise  
   c) Dark current noise & Quantum noise  
   d) Gaussian noise and 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  
   b) 0.8 to 0.9 μm  
   c) 0.3 to 0.4 μm  
   d) 0.7 to 0.79 μm
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.

Compute the photocurrent in the device.  
a) 67.7nA  
b) 81.2nA  
c) 68.35nA  
d) 46.1nA

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.

1. 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  
   b) 1.23 × 10-17A2  
   c) 1.65 × 10-16A2  
   d) 1.61 × 10-17A2

Explanation: The thermal noise in the load resistor is given by –  
it2 = 4KTB/RL  
Where T = Temperature  
B = Bandwidth  
RL = Load resistance.

1. A photodiode has a capacitance of 6 pF. Calculate the maximum load resistance which allows an 8MHz post detection bandwidth.  
   a) 3.9 kΩ  
   b) 3.46 kΩ  
   c) 3.12 kΩ  
   d) 3.32 kΩ

Explanation: The load resistance is given by-  
RL = 1/2πCdB  
Where  
B = Post detection bandwidth  
Cd = Input capacitance  
RL = Load resistance.

1. 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
2. \_\_\_\_\_\_\_\_\_\_\_ is dependent upon the detector material, the shape of the electric field profile within the device.  
   a) SNR  
   b) Excess avalanche noise factor  
   c) Noise gradient
3. For silicon APDs, the value of excess noise factor is between \_\_\_\_\_\_\_\_\_  
   a) 0.001 and 0.002  
   b) 0.5 and 0.7  
   c) 0.02 and 0.10  
   d) 1 and 2
4. How many design considerations are considered while determining the receiver performance?  
   a) Three  
   b) Two  
   c) One  
   d) Four
5. FET preamplifiers provide higher sensitivity than the Si-bipolar device.  
   a) True  
   b) False
6. What is the abbreviation of HBT?  
   a) Homo-junction unipolar transistor  
   b) Homo-junction bipolar transistor  
   c) Hetero-junction bipolar transistor  
   d) Hetero-Bandwidth transcendence
7. What type of receivers are used to provide wideband operation, low-noise operation?  
   a) APD optical receivers  
   b) Optoelectronic integrated circuits (OEICs)  
   c) MESFET receivers  
   d) Trans-impedance front-end receivers
8. \_\_\_\_\_\_\_\_\_\_\_ circuits extends the dynamic range of the receiver.  
   a) Monolithic  
   b) Trans-impedance  
   c) Automatic Error Control (AEC)  
   d) Automatic Gain Control (AGC)
9. What is generally used to determine the receiver performance characteristics?  
   a) Noise  
   b) Resistor  
   c) Dynamic range & sensitivity characteristics  
   d) Impedance
10. The \_\_\_\_\_\_\_\_\_\_ technique eliminates the thermal noise associated with the feedback resistor in the trans-impedance front end design.  
    a) Compensation  
    b) Resonating impedance  
    c) Electromagnetic  
    d) Optical feedback
11. The removal of the feedback resistor in the optical feedback technique allows reciever sensitivity of the order of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
    a) -54 dBm at 2Mbit/sec  
    b) -12 dBm at 2Mbit/sec  
    c) -64 dBm at 2Mbit/sec  
    d) -72 dBm at 2Mbit/sec
12. The optimum filter bandwidth is typically in the range \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
    a) 0.1 to 0.3 nm  
    b) 0.5 to 3 nm  
    c) 0.1 to 0.3 μm  
    d) 0.5 to 3 μm
13. For linear as well as in nonlinear mode \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are most important network elements.  
    a) Optical amplifier  
    b) Optical detector  
    c) A/D converter  
    d) D/A converters
14. The more advantages optical amplifier is \_\_\_\_\_\_\_\_\_\_\_\_  
    a) Fiber amplifier  
    b) Semiconductor amplifier  
    c) Repeaters  
    d) Mode hooping amplifier
15. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cannot be used for wideband amplification.  
    a) Semiconductor optical amplifier  
    b) Erbium-doped fiber amplifier  
    c) Raman fiber amplifier  
    d) Brillouin fiber amplifier
16. \_\_\_\_\_\_\_\_\_\_\_\_ is used preferably for channel selection in a WDM system.  
    a) Semiconductor optical amplifier  
    b) Erbium-doped fiber amplifier  
    c) Raman fiber amplifier  
    d) Brillouin fiber amplifier
17. For used in single-mode fiber \_\_\_\_\_\_\_\_\_\_ are used preferably.  
    a) Semiconductor optical amplifier  
    b) Erbium-doped fiber amplifier  
    c) Raman fiber amplifier  
    d) Brillouin fiber amplifier
18. Mostly \_\_\_\_\_\_\_\_\_\_\_\_ are used in nonlinear applications.  
    a) Semiconductor optical amplifier  
    b) Erbium-doped fiber amplifier  
    c) Raman fiber amplifier  
    d) FPAs
19. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ is superior as compared to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
    a) TWA, FPA  
    b) FPA, TWA  
    c) EDFA, FPA  
    d) FPA, EDFA
20. 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  
    b) 3.75×107  
    c) 3.95×107  
    d) 4.25×109

Explanation: n=λ2/2δλL=1.8×10-6/2×0.8×10-9×300×10-6=3.75×107.

1. 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  
   b)4.53×10-8  
   c)1.94×10-6  
   d)4.25×109

Explanation: The peak gain wavelength is given by  
λ2=n2δλL=3.78×2×2×10-9×250×10-6=1.94×10-6m.

1. An SOA has net gain coefficient of 300, at a gain of 30dB. Determine length of SOA.  
   a) 0.32 m  
   b) 0.023 m  
   c) 0.245 m  
   d) 0.563 m

Explanation: The length of SOA is determined by  
L = Gs(dB)/10×g×loge = 30/10×300×0.434`= 0.023 m.

1. An SOA has length of 35.43×10-3m, at 30 dB gain. Determine net gain coefficient.  
   a) 5.124×10-3  
   b) 1.12×10-4  
   c) 5.125×10-3  
   d) 2.15×10-5
2. 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  
   b) 5.13×1012  
   c) 3.29×10-6  
   d) 0.33×10-9

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.

1. 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  
   b) 6.14 × 1012  
   c) 1.78 × 1016  
   d) 4.12 × 10-3

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-