KATHMANDU UNIVERSITY
End Semester Examination [C]
June, 2018

Marks Scored:

Level: B. Sc.
Year : IV

Course : PHYS 404
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date JUN 19 2018

SECTION "A"

[20Q. × 1 =20 marks]

*Choose and tick (√) the most appropriate answer.*

1. The wavelength of gap LED material is equal to
   [a] 550 nm [b] 650 nm [c] 860 nm [d] 450 nm

2. Absorption is a process in which an electron in the lower state excited to a higher energy state by absorbing a suitable amount of
   [a] momentum [b] power [c] velocity [d] energy

3. An electron rising from the top of the valence band to the bottom of the conduction band by the absorption of a
   [a] wave vector [b] phonon [c] photon [d] momentum

4. Semiconductor with a carrier density $n \sim p \sim 10^{17}$ $cm^{-3}$, under low level injector the e-h radiative life time is $2.5\times10^{-7}$ sec. Then the recombination rate becomes
   [a] $3\times10^{-9} cm^3 s^{-1}$ [b] $5\times10^{-15} cm^3 s^{-1}$ [c] $2\times10^{-11} cm^3 s^{-1}$ [d] $7\times10^{-20} cm^3 s^{-1}$

5. AlGaAs, of FWHM is about 40 nm, with maximum relative intensity at about
   [a] 600 nm [b] 900 nm [c] 830 nm [d] 550 nm

6. The eye has maximum sensitivity at the wavelength of
   [a] 400 nm [b] 700 nm [c] 450 nm [d] 555 nm

7. A single mode fiber of radius 2 μm has a core refractive index 1.46 and fractional refractive index 0.015. Then the cut -off wavelength is equal to
   [a] 1500 nm [b] 1321 nm [c] 700 nm [d] 1100 nm

8. The light coupled can be varied from 0 to 100 percent by suitably choosing the
   [a] coupling volume [b] coupling length [c] coupling area [d] coupling power

9. The attenuation is minimum for silica fiber at
   [a] 1000 nm [b] 1550 nm [c] 1150 nm [d] 850 nm

10. The change in refractive index of a medium due to mechanical strain produced by an acoustic wave is called the
    [a] acousto optic effect
    [b] magneto optic effect
    [c] electro optic effect
    [d] thermo optic effect

*Fill in the blanks with most appropriate answer.*

11. Reflection and transmission type grating elements can be incorporated in the waveguide structure as _____

12. The responsivity of an LED emitting at 600 nm, if its efficiency is 3% is equal to _____

13. The wavelength of the light emitted if the band gap is 2.24 eV is equal to _____

14. To avoid thermal noise most of the photoconductive detectors working in the far infrared region has to be cooled to liquid nitrogen at temperature _____

15. An electric field applied to an electro optic material will change the refractive index of the the medium by virtue of _____

16. PbS is a near infrared photodetector material with a wavelength response from 1 to 3.4 μm and have a response time about _____ μs.

17. The efficiency of a light emitting diode operating at 50 mA is 2%. The bandgap of the material is 1.4 eV. The optical power that can be extracted from it is equal to _____

18. The working of all optoelectronic devices are based on the creation and annihilitation of _____

19. The zero energy level is chosen to lie at the top of the _____

20. A light source of luminous power 100 lm in suspended 6 m vertically above a horizontal surface. The illuminance at a point 8 m from the foot of the lamp is equal to _____ lm $m^{-2}$.

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SECTION "B"
[5Q.×4 = 20 marks]

1. What do you mean by recombination mechanisms? Explain the radiative-recombination efficiency.

2. Write short notes on:
   (i) Thin film and Schottky- barrier solar cells.
   (ii) Homojunction and Heterojunction solar cells.

3. Describe the construction and working principle of photomultiplier tube with suitable diagrams.

   OR

   Explain the design and equivalent circuit of photodiodes. What is PIN photodiode?

4. Describe the e-h pair creation and recombination in semiconductor.

   OR

   What do you understand about band structure? Write short notes on direct and indirect band gap semiconductors with suitable examples.

5. Deduce the expressions for the inverse square law of illumination for point source and total radiant power from a diffusing surface.

SECTION "C"
[5Q.×7 = 35 marks]

6. Describe the electroluminescence in p-n junction with necessary diagrams. What is LED drive circuit? Explain the performance of different LED characteristics in details with suitable diagrams.

7. What are absorption mechanisms and emission in semiconductors? Describe the some of the important types of absorption transition and emission process in semiconductors.

8. Obtain an expression for numerical aperture in optical fibers. What is the attenuation in optical fibers? Describe the attenuation in optical fibers due to several mechanisms.

   OR

   Obtain an expression for photocurrent in PIN photodiode. What is phototransistor? Deduce an expression for the external current flowing in phototransistor.

9. Describe the principle and operation of solar cell with necessary diagrams. Obtain the expressions for open circuit voltage, output electrical power, and condition for maximum power, maximum voltage, maximum and magnitude of current, maximum power, ideal conversion efficiency and fill factor in solar cell.

10. Explain in details about active waveguide devices based on
    (i) acousto optic effect
    (ii) Magneto optic effect
    (iii) thermos optic effect with necessary diagrams.

    OR

    Explain in details about different types of passive waveguide devices with necessary diagrams.