Marks Scored:

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2018

Level: B. Sc.
Year : IV

Course : PHYS 404
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 20

Registration No.:

Date : MAR 15 2018

SECTION "A"
[20 Q. × 1=20 marks]

Choose and tick (√) the most appropriate answer.

1. The wavelength of the light emitted if the band gap is 2.24 eV is equal to
   [a] 560 nm [b] 600 nm [c] 400 nm [d] 552 nm

2. 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] thermo optic effect [d] electro optic effect

3. For AlGaAs, FWHM is about 40 nm, with maximum relative intensity at about
   [a] 1000 nm [b] 700 nm [c] 830 nm [d] 530 nm

4. For silica fibre the attenuation is minimum at
   [a] 1030 nm [b] 1550 nm [c] 1250 nm [d] 1450 nm

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

6. A single mode fibre 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

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

8. 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] power [b] momentum [c] velocity [d] energy

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

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

Fill in the blanks with most appropriate answer.

11. A junction formed between two or more semiconductors with different band gap is called a _____ .

12. For the most solar cells, the fill factor is about _____

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

14. The response time of the PMT is generally of the order of _____

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

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

17. Two basic quantities that is required for high speed photodiode detectors are a large quantum efficiency and a large _____

18. For AlGaAs LED, the loss in light power is about a few percent after operation of about _____ hours.

19. At the peak sensitivity of the relative luminosity curve 1 watt of radiant power correspond to _____ lumens.

20. The radiant intensity I of a point source with radiant flux φ is given by _____

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Time : 2 hrs. 30 mins.

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SECTION "B"
[5Q.× 4 = 20 marks]

Attempt *ALL* questions.

1. Obtain the inverse square law of illumination for a point source.

OR

Derive the total radiant power from a diffusing surface.

2. What is band structure? Distinguish between direct and indirect band gap semiconductors with suitable examples.

OR

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

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

4. Write short notes on:
(a) Homojunction and Heterojunction solar cells.
(b) Thin film and Schottky- barrier solar cells

5. Describe the types of optical fibres. Distinguish between Stepped index and Graded index optical fibres.

SECTION "C"
[5Q. × 7 = 35 marks]

Attempt *ALL* questions.

6. Describe different types of passive waveguide devices with well labeled diagrams.

OR

Describe active waveguide devices based on (i) acousto optic effect (ii) Magneto-optic effect and (iii) thermo optic effect with necessary diagrams.

7. Describe the principle and operation of a solar cell. Derive the expressions for open circuit voltage, output electrical power, condition for maximum power, maximum voltage and current, ideal conversion efficiency and fill factor in solar cell.

8. Describe the design and equivalent circuit of photodiode. What is PIN photodiode? Write an expression for photocurrent in PIN photodiode. What is phototransistor? Derive an expression for the external current flowing in phototransistor.

OR

Derive and expression for numerical aperture in optical fibres. What is the attenuation in optical fibres? Explain the mechanisms responsible for the attenuation in optical fiber.

9. What do you mean by recombination process? Explain radiative-recombination and its efficiency.

OR

What are absorption and emission processes in semiconductors? Explain some of the important types of absorption and emission process in semiconductors.

10. Explain the electroluminescence in p-n junction with necessary diagram. What is LED drive circuit? Describe the different characteristics which specify the performance of LED.