Mark Scored:

KATHMANDU UNIVERSITY
End Semester Examination
February/March, 2019

Level : B. Sc. | Course : PHYS 404
Year : IV | Semester: I
Exam Roll No. : | Time: 30 mins. | F. M. : 20
Registration No.: | Date 05 MAR 2019

SECTION "A"
[20Q. × 1= 20 marks]

Choose and tick (√) the most appropriate answer.

1. If the calcite cladding is formed such that its optical axis is parallel to the
[a] TM mode [b] TE mode
[c] both TE and TM modes [d] $LiNbO_3$ substrate

2. The radiative recombination life time in GaAs having injection level of $p_o \approx n_o = 10^{18}$ cm^{-3} and $B_r = 7\times10^{-10}$ cm^3s^{-1} is equal to
[a] 7.14×10^{-5} Sec [b] 7.14×10^{-10} Sec [c] 7.14×10^{-15} Sec [d] 7.14×10^{-20} Sec

3. Work function of Cesium is 1.9 eV. Then the cut off wavelength of radiation for photoelectric emission from this material is equal to
[a] 640 nm [b] 551 nm [c] 651 nm [d] 751 nm

4. The wavelength of light emitted form GaP LED is
[a] 550 nm [b] 450 nm [c] 650 nm [d] 750 nm

5. The gain of a PMT if there are nine dynodes in it and the secondary electron generation factor is 5 is equal to
[a] 3×10^6 [b] 4×10^6 [c] 6×10^6 [d] 1.95×10^6

6. The responsivity of a PMT having a quantum efficiency of 80% at 600 nm becomes
[a] 0.386 A/W [b] 0.936 A/W [c] 0.886 A/W [d] 0.786 A/W

7. In an InGaAs PIN photodiode the width of the depletion region in 5 μm and the drift velocity of the electron is $10^5 ms^{-1}$. Then the transit time becomes
[a] 50 ps [b] 100 ps [c] 80 ps [d] 30 ps

8. An argon ion laser beam with a power 1 watt and having a wavelength 514.5 nm is falling on a photodetector. Then the number of photons hitting the surface of the detector in every second is equal to
[a] 2.59×10^{10} photons/sec [b] 2.59×10^{18} photons/sec
[c] 3.59×10^{20} photons/sec [d] 4.59×10^{30} photons/sec

9. For a silicon solar cell with fill factor 0.7 and the short circuit current 25 mA and the open circuit voltage 0.5 V. Then the maximum output power of the cell is
[a] 8.75×10^{-6} W [b] 8.75×10^{-10} W [c] 8.75×10^{-3} W [d] 8.75×10^{-5} W

10. The relative refractive index change of a silicon fiber is 0.007, and the core refractive index is 1.46. Then the numerical aperture becomes
[a] 2 [b] 6 [c] 1.17 [d] 0.17

Fill in the blanks with most appropriate answer.

11. A reflecting surface which obeys the cosine law for all directions of the incident light is called a uniformly_____

12. In extended sources, it is assumed that the radiance is independent of angle. Such sources are known as_____

13. The irradiance is inversely proportional to the square of the distance of the area from the source of radiation. This is known as the _____

14. A thick layer of freshly prepared _____ on a plane surface forms an almost perfect diffuser.

15. If the luminescence exists for a longer time even after the excitation source is removed, the phenomena is called_____

16. To improve the radiation tolerance certain elements such as _____ has been incorporated into the solar cells which reduces the degradation of lifetime.

17. 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 becomes _____ nm.

18. A waveguide is a dielectric region placed in between dielectrics of smaller refractive index, the light is propagated through the guiding region on the principle of _____

19. A directional coupler allows the light to pass through _____

20. _____ recombination is responsible for heating during light matter interaction.

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Time : 2 hrs. 30 mins.

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F. M. : 55

SECTION "B"
[5Q. × 4 = 20 marks]

Attempt *ALL* questions.

1. Write short note on phase modulator.

OR

Write short notes on: (a) schottky- barrier and thin film solar cells (b) homojunction and heterojunction solar cells

2. Explain the electron-hole (e-h) pair creation and recombination in semiconductor.

OR

Write short note on direct and indirect band gap semiconductors with examples.

3. Explain the types of optical fibers. Describe the Stepped index and Graded index optical fibers.

4. Derive the inverse square law of illumination for point source and also deduce the total radiant power from a diffusing surface.

5. Explain the construction and working principle of PMT with a well labeled diagram.

SECTION "C"
[5Q. × 7 = 35 marks]

Attempt *ALL* questions.

6. Explain the electroluminescence in p-n junction with necessary diagram. What is LED drive circuit? Describe the performance of LED which specifies its different characteristics with a well labeled diagram.

7. Explain in details about active waveguide devices based on (a) acousto optic effect (b) magneto optic effect and (c) thermo optic effect with necessary well labeled diagrams.

OR

Write a short note on different types of passive wave guide devices.

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

9. What do you mean by recombination, absorption and emission mechanisms semiconductors? Explain the radiative-recombination efficiency and some of the important types of absorption transition and emission process in semiconductors.

OR

Explain the design and equivalent circuit of photodiodes. What is PIN photodiode? Write an expression for photocurrent in PIN photodiode. What is phototransistor? Establish an expression for the external current flowing in phototransistor.

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