Reg. No..... Name.....

BSC DEGREE END SEMESTER EXAMINATION MARCH 2017

SEMESTER **– 6: PHYSICS (OPEN CORE)**

COURSE: **U6ORPHY13 – OPTOELECTRONICS**

(For Regular - 2014 admission)

Time: Three Hours Max. Marks: 75

PART A

(Answer **all** questions. Each question carries 1 Mark.)

1. The number of electron-hole pairs generated per photon in a photodetector is called _____
2. Amount of visible light which flows from a source or illuminated surface in one second is called _____
3. Define noise equivalent power of a photo detector.
4. How can you use a p-n junction photodiode as a switch?
5. Write down the equation that governs the attenuation in optical fibres.
6. Give two examples of doubly refracting crystals.
7. Change in refractive index of a material subjected to a steady magnetic field is known as____
8. Calculate the maximum wavelength of electromagnetic radiation that can be absorbed by germanium, given the band gap of germanium is 0.67 eV.
9. State the condition on the diameter of a single mode optical fibre, in terms of wavelength and numerical aperture.
10. A semiconductor device structure that has a junction between different band gap materials is called a _____ device.

(1 × 10 = 10)

PART B

(Answer **any eight** questions. Each question carries 2 Marks.)

11. Describe briefly the structure and working of a PIN photodiode.
12. What is an avalanche photodiode (APD)? Explain the working of an APD.
13. What is a quantum well laser? What is its prime difference from a usual heterojunction laser diode?
14. What is meant by Fill Factor of a solar cell?
15. Why is GaAs preferred over silicon in making PN photodiodes?
16. State any two advantages of glass fibres over plastic fibres.
17. Explain plane polarization of light.
18. What are the characteristics of impurity-band transitions in semiconductors?

19. State major differences between Kerr effect and Pockels effect.
20. What are the advantages of optical fibres over the metallic wires and cables?

(2 × 8 = 16)

PART C

Answer **any five** questions. Each question carries 5 Marks.

21. Radiation of wavelength 700 nm and optical power 0.126 μW incident on a Si PIN photodiode produces a photocurrent of 56.6 × 10^{-9} A. What is the responsivity and quantum efficiency of the Photodiode at 700 nm? (Planks constant $h = 6.62 \times 10^{-34} Js$ and charge of electron is $1.602 \times 10^{-19} C$).
22. A Ge solar cell when exposed to solar radiation on earth's surface produce 4 × 10^{17} electron-hole pairs per second. Area of the cell in 5 cm^{-2}, dark current 2 nA and the electron-hole diffusion length 5 μm. Calculate the short circuit current and open circuit voltage of the cell.
23. Calculate the thickness of a quarter wave plate made of quartz to be used with sodium light, λ = 589.3 nm. It is given that the principal refractive indices n_e and n_o for quartz are 1.553 and 1.544, respectively.
24. Draw and explain the current voltage characteristics of a solar cell. Why do you think that the device can deliver power?
25. State and prove the inverse square law on intensity of a point source of light.
26. Justify the statement "Franz-Keldysh effect is, in essence, photon assisted tunneling"
27. The linear electro-optic coefficient for KDP is 10.6 pm/V. The refractive index for ordinary ray is 1.51. Calculate the half wave voltage for KDP for a wavelength 1.06 μm.

(5 × 5 = 25)

PART D

(Answer **any two** questions. Each question carries 12 Marks.)

28. Explain absorption mechanisms in semiconducting materials.
29. Explain the structure of a step index mono-mode fibre with the help of appropriate diagrams. Derive expressions for acceptance angle and numerical aperture. Compare the properties of step index and graded index fibres.
30. Explain the relation between absorption and emission spectra in a semiconductor. Derive expression for total spontaneous emission rate per unit volume at thermodynamic equilibrium.
31. What are accousto-optic modulators? Explain the required conditions for Raman-Nath and Bragg regimes of operation of an accousto-optic modulator. (Use diagrams wherever necessary).

(12 × 2 = 24)

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