

B.SC. DEGREE END SEMESTER EXAMINATION - MARCH 2018**SEMESTER – 6: PHYSICS (CORE ELECTIVE)****COURSE: 15U6CRPHY13EL / U6ORPHY13– OPTOELECTRONICS***Common for Regular (2015 Admission) & Supplementary (2014 Admission)*

Time: Three Hours

Max. Marks: 75

PART AAnswer **all** questions. Each question carries **1** Mark.

1. Luminous flux per unit solid angle due to a point source of one international candle power is
2. Define cut-off frequency of a photodetector.
3. A phototransistor has slower response time in comparison to a photodiode; True or False?
4. Define terminal capacitance of a photodetector.
5. How do you normally connect an avalanche photodiode in a circuit – Forwards bias or Reverse bias?
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. A quarter wave plate will introduce a phase difference of..... between two emerging beams.
9. Electrons and holes produced by the absorption of a photon of near-bandgap energy pair to form
10. A semiconductor device structure that has a junction between same semiconducting materials is called adevice. (1 × 10 = 10)

PART BAnswer **any eight** questions. Each question carries **2** Marks.

11. Define responsivity and quantum efficiency of a photodetector. How are they related?
12. Differentiate between a p-n junction photodiode and a PIN photodiode.
13. What is meant by Fill Factor of a solar cell?
14. State two main features of a halide fibre.
15. Why is GaAs preferred over silicon in making p-n photodiodes?
16. What do you mean by “plastic clad silica” fibres? Give two characteristics.
17. Define photoluminescence and cathodluminescence.
18. Define acousto-optic effect.
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 $0.126 \mu\text{W}$ incident on a Si PIN photodiode produces a photocurrent of $56.6 \times 10^{-9} \text{ A}$. What is the responsivity and quantum efficiency of the photodiode at 700 nm? (Planks constant and charge of electron is).
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 for wavelength 5890 Å, when refractive index of ordinary ray is 1.55 and that for e-ray is 1.54.
24. Draw and explain the current voltage characteristics of a solar cell. Why do you think that the device can deliver power?
25. Describe Auger recombination in semiconductors and define carrier life time. How does the rate of Auger process depend on temperature?
26. In an optical fibre, the core material has refractive index 1.6 and refractive index of cladding is 1.3. What is the value of the critical angle? Also calculate the value of the acceptance cone.
27. The numerical aperture of an optical fibre is 0.22 and the fractional refractive index change is 0.012. Calculate the refractive indices of the core and the cladding materials of the fibre.

(5 × 5 = 25)

PART D

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

28. What do you mean by radiative and non-radiative recombination in semiconductors? Obtain expression for internal quantum efficiency of radiative recombination in semiconductors in terms of radiative and non-radiative life times.
29. Explain the structure of a step index mono-mode fibre with appropriate diagrams. Derive expressions for acceptance angle and numerical aperture. Compare the properties of step index and graded index fibres.
30. What do you mean by half-wave voltage in an electro-optic modulator? Obtain an expression for the phase shift introduced in a longitudinal electro-optic modulator.
31. What do you mean by a photodetector? Define dark current, Noise equivalent power, and frequency bandwidth of a photodetector. Explain the working of a Phototransistor and an avalanche photodiode.

(12 × 2 = 24)
