G 2422 (Pages : 2) Reg. No.....

Name.....

M.Sc. DEGREE (CSS) EXAMINATION, JUNE 2015

Fourth Semester

Factulty of Science

Branch II—Physics-A—Pure Physics—Open Elective Bunch

PH4 OE1—OPTO ELECTRONICS

(2012 Admission onwards—Regular/Supplementary)

Time : Three Hours Maximum Weight : 30

Part A

Answer any **six** *questions.*
Each question carries a weight of 1.

1. Explain optical code division multiplexing.
2. Write a note on electro optic modulator.
3. Explain bending losses in optic fibre.
4. Enumerate the causes of attenuation in an optical fibre. How can they be reduced ?
5. Explain direct and indirect band gap semiconductors with energy band diagrams and with examples.
6. Define optical absorption coefficient.
7. Describe the structure and functioning of a photodiode.
8. Explain population inversion in laser.
9. Explain the term phase matching in non-linear optics.
10. Write a short note on two photon absorption.

(6 × 1 = 6)

Part B

Answer any **four** *questions.*
Each question carries a weight of 2.

11. A double heterojunction InGaAsP LED emitting at a peak wavelength of 1310 nm has radiative and non-radiative recombination times of 25 and 90 ns respectively. The drive current is 35 mA. If the refractive index of the light source material is $n = 35$, find the power emitted from the source.
12. For light of wavelength 0.8 μm, the absorption coefficient of silicon is 10^5 m.$^{-1}$ Refractive index of Si is 3.5. Calculate quantum efficiency and responsivity. The width of depletion layer is 20 μm.
13. The optical power launched at the input of a multimode fibre is 10 mW. If the power received 10 km away at the output is 1 mW. Calculate the attenuation at the fibre in dB/km.

Turn over

14. Compute the following if a PIN Photo-diode has a depletion width of 30 μm, a carrier velocity of 5×10^4 m/s and a junction capacitance of 6 pF.

    (i) Transit time limited bandwidth.

    (ii) Calculate the bandwidth if the load resistance is 10 kΩ.

15. The quantum efficiency of a particular avalanche photo-diode is 80 % for detection of radiation at a wavelength of 0.9 μm. When the incident optical power is 0.5 μW the output current, after avalanche multiplication, is 11 μA. Calculate the multiplication factor of the avalanche photodiode.

16. A 2 km. length of optical fibre has input power of 20 mW and an output power 150 μW. Find the loss in dB/km. Express the loss in dBm.

$(4 \times 2 = 8)$

Part C

Answer **all** *questions.*
Each question carries a weight of 4.

17. (a) Explain the working of an optical fibre on a wave guide.

    (b) What is the difference between the performance of a step-index fiber and a graded index fiber ?

Or

(a) Explain the working of a semiconductor laser.

(b) Derive an expression for the power output of a semiconductor Laser.

18. Explain what is the signal loss or attenuation mechanisms in an optical fiber.

Or

(a) Define the quantum efficiency and the responsitivity of a photodetector.

(b) Derive an expression for the responsivity of an intrinsic photodetector.

19. Explain the difference between photo-transistor and ordinary transistor. Describe the working of a phototransistor and derive an expression for its optical gain.

Or

Discuss the different dispersion mechanisms in a single mode optical fibre.

20. Explain pockets and Kerr effect with necessary details.

Or

(a) Discuss second and third order nonlinear processes.

(b) Explain the term optical mixing in nonlinear optics.

$(4 \times 4 = 16)$