

M.Sc. DEGREE (CSS) EXAMINATION, JUNE 2015**Fourth Semester**

Faculty 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 $0.8 \mu\text{m}$, 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 $20 \mu\text{m}$.
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 $30 \mu\text{m}$, a carrier velocity of $5 \times 10^4 \text{ m/s}$ and a junction capacitance of 6 pF .
- Transit time limited bandwidth.
 - Calculate the bandwidth if the load resistance is $10 \text{ k}\Omega$.
15. The quantum efficiency of a particular avalanche photo-diode is 80% for detection of radiation at a wavelength of $0.9 \mu\text{m}$. When the incident optical power is $0.5 \mu\text{W}$ the output current, after avalanche multiplication, is $11 \mu\text{A}$. 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 $150 \mu\text{W}$. Find the loss in dB/km . Express the loss in dBm .

(4 × 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

- Explain the working of a semiconductor laser.
 - 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

- Define the quantum efficiency and the responsivity of a photodetector.
 - 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

- Discuss second and third order nonlinear processes.
- Explain the term optical mixing in nonlinear optics.

(4 × 4 = 16)