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Reg. No.....

Name.....

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, MAY 2024

Fourth Semester

Core Course—OPTO ELECTRONICS

(For the Programme B.Sc. Electronics)

[2013—2016 Admissions]

Time : Three Hours Maximum Marks : 80

Part A

Answer **all** *questions.*
Each question carries 1 *mark.*

Choose the most appropriate answer :

1. A source of light for optical fibre is :
   (a) P/N diode. (b) Photodiode.
   (c) Photo transistor. (d) LED.
2. Response time of the photodetector in a fibre optic system set-up limits which parameter of the optical fibre :
   (a) Bandwidth. (b) Numerical aperture.
   (c) Attenuation. (d) Pulse spread.
3. In comparison to LEDs, laser has :
   (a) Narrow spectral width. (b) Provision for confinement.
   (c) No tuning arrangement. (d) High emission efficiency.
4. In a photodetection process which of the following phenomenon occurs ?
   (a) Generation of carriers.
   (b) Generation of photocurrent.
   (c) Transportation of carriers across transition region.
   (d) All of above.
5. Laser light is produced by :
   (a) Electricity. (b) Spontaneous emission.
   (c) Stimulated emission. (d) All the above.

Turn over

6. Interference patterns maty be divided into two main classes, those based on :
   (a) Wavefront and wavelength. (b) Wavefront and amplitude.
   (c) Wavefront and phase. (d) Wavefront and frequency.
7. Laser diodes present more problems to the circuit designer than LED because of :
   (a) The threshold current's age dependence.
   (b) The threshold current temperature dependence.
   (c) The emission wavelength's temperature dependence.
   (d) All of the above.
8. Out of multimode step index fibres and multimode graded index fibres which one will support more number of modes for a given set of fibre parameters ?
   (a) Multimode step index fibre.
   (b) Multimode graded index fibre.
   (c) Both will support equal number of modes.
   (d) None of the above.
9. Population inversion can be achieved in a material by an action called :
   (a) Stimulated emission. (b) Spontaneous emission.
   (c) Spherical abberation. (d) None of the above.
10. Which of the following requirements a photodetector should possess for its good performance ?
   (a) Wide bandwidth. (b) Low dark current.
   (c) High conversion efficiency. (d) All of above.

$(10 \times 1 = 10)$

Part B

Answer any **eight** *questions.*
Each question carries 2 *marks.*

11. Explain how elliptical polarisation is produced.
12. Explain Acousto-optic effect.
13. What is spatial coherence of laser ?
14. What are the common methods to produce polarised light ?
15. Differentiate step index and graded index fibres.
16. Draw the refractive index profile of an optic fibre.

17. With ray diagrams, describe single mode step index optical fibre.
18. What are the requisites for laser action ?
19. Explain quantum well structure working.
20. What are the different types of distortion in optical fibre ?
21. Explain the principle of CL displays.
22. Explain the operation of LED analog modulation. What is intermodulation distortion ?

(8 × 2 = 16)

Part C

Answer any **six** *questions.*
Each question carries 4 *marks.*

23. Explain the principle and applications of Kerr modulator.
24. Compute the responsivity of an InGaAs APD operating at 1.55 μm and having a quantum efficiency of 0.7 if its gain is 10. How much optical power is needed by this detector to produce 20 nA ?
25. Explain the LED emission pattern for surface emitting LED and edge emitting LED.
26. With suitable diagrams, explain the principle of operation of injection LASER.
27. A silicon APD has a quantum efficiency of 65 % at a wavelength of 900 nm. If incident optical power of 0.5 μW produces a multiplied photocurrent of 20 μA, find the vlaue of the multiplication factor.
28. A double heterostructure surface emitter LED emitting at a peak wavelength of 1310 nm has value of internal quantum efficiency as 70 % and drive current as 50 mA. Calculate the value of the optical power generated internally to the LED.
29. A multimode step index fibre having core refractive index of 1.5 and a relative refractive index difference of 1 %. If the number of modes propagating at a wavelength of 1.3 μm is 1100, estimate the diameter of the fibre core.
30. Describe the mechanism of intermodal dispersion in a multimode step index fibre
31. For a LED, compute the fraction of injected charges which produce photons if 2 mW of optical power are radiated with a drive current of 50 mA at 1.3 μm.

(6 × 4 = 24)

Turn over

Part D

Answer any **two** *questions.*
Each question carries 15 *marks.*

32. Describe, with the aid of suitable diagrams, the major strategies and structures utilised in the fabrication of single frequency injection lasers.

33. Explain with necessary diagrams the working of Plasma panel display.

34. Describe the structure and principle of an optical fibre. Derive the expression for critical angle from Snell's law and differentiate between single mode and multimode optical fibres.

35. Explain the constructional details and properties of materials used in solar cell. Explain the I-V characteristics and spectral response.

$(2 \times 15 = 30)$