CENTRAL INSTITUTE OF TECHNOLOGY KOKRAJHAR
(Deemed to be University)
KOKRAJHAR :: BTR :: ASSAM :: 783370

END – SEMESTER EXAMINATION
UG

Session: January-July 2025 Semester: 8th Time: 3Hrs. Full Marks: 100

Course Code: UECE811A Course Title: Optical Communication

Answers any five questions 5 X 20=100

1. (a)What are the major advantages of optical fiber communication?
   (b)What are the main components of an optical communication system?
   (c)With the suitable ray diagram explain the transmission of a light ray in a perfect optical fiber.
   (d) What does acceptance angle mean? Explain it with the suitable ray diagram in an optical fiber.
   6+3+5+ (2+4)
2. (a) With the neat sketch describe the ray transmission in Step Index Fiber (SIF) for multimode and single mode.
   (b) With the neat sketch describe the ray transmission in Graded Index Fiber for multimode and skew ray.
   (c) What is "V" number? Derive the relation with relative refractive index.
   (d) Prove that the number of modes propagating through the step index fiber is two times the number of modes propagating through the graded index fiber with $\alpha = 2$. 5+5+5+5

3. (a)What are injection efficiency, radiative recombination efficiency and extraction efficiency in connection with LED? Derive the expression of injection efficiency.
   (b) Discuss with suitable diagram why is dome shaped LED very popular?
   (c) With suitable band diagram and structure discuss the operating principle of double hetero structure surface emitting LED.
   (d) With suitable structure discuss the operating principle of burrus type surface emitting LED. 5+5+5+5

4. (a) What is the main advantage of Avalanche Photo Diode? Discuss qualitatively the avalanche multiplication process in APD?

(b) Deducing the necessary equations prove that at breakdown in APD

(i) $\int_0^W \alpha_e dx = 1 \quad when\ \alpha_e = \alpha_h$ and

(ii) $\int_0^W \alpha_h \exp[\int_0^x (\alpha_h - \alpha_e) dx'] dx = 1 \quad when\ \alpha_e \neq \alpha_h$ and the avalanche process is initiated by electrons. Where the symbols are their usual meanings. (2+3) +15

5. (a) With the suitable energy level diagram describe the process of population inversion of a two level system. How do the drawbacks of the two level systems can be overcome by using a three level system and the drawbacks of three level systems by four level systems?

(b) With the suitable schematic diagram derive the threshold condition for laser oscillation in a Fabry-Perot cavity $g_{th} = \gamma + \frac{1}{2l} ln\left(\frac{1}{R_1 R_2}\right)$. Where $g_{th}, \gamma, l, R_1, R_2$ are the threshold gain, loss co-efficient, length of the cavity and reflection coefficients at the two ends. (6+2+2)+10

6. (a) Derive the expressions for the coupling efficiency of SIF and GIF for light source with lambertian beam profile $B(\theta, \Phi) = B_0 Cos\theta$ for $a > r_s\ and\ a < r_s$ where $a\ and\ r_s$ are the radius of optical fiber and the light source.

(b) Deriving the necessary expressions discuss how the coupling efficiency can be increased by using non lambertian source with beam profile $B(\theta, \Phi) = B_0 Cos^n\theta, (n > 1)$. 12+8

7. (a) What does coupling efficiency in an optical fiber mean? How this efficiency is varies with α for a graded index fiber?

(b) What is equivalent numerical aperture? Discuss how the numerical aperture changes with fiber length.

(c) What are the possible lensing schemes used to improve the optical source-to-fiber coupling efficiency? (3 +3)+ (4+3) +7