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Total Number of Pages: 02

B.Tech  
PE15J003

210 210 210 **5<sup>th</sup> Semester Regular / Back Examination: 2019-20** 210 210  
**OPTOELECTRONICS DEVICE & INSTRUMENTATION**

BRANCH: AEIE, EIE, IEE

Max Marks: 100

Time: 3 Hours

Q.Code: HRB399

Answer Question No.1 (Part-1) which is compulsory, any eight from Part-II and any two from Part-III.

The figures in the right hand margin indicate marks.

Part- I

Q1 Only Short Answer Type Questions (Answer All-10)

(02x10)

Suggested Words: How, Why, Determine, Derive, State, Write, Create, etc

- a) Define the critical angle, acceptance angle and numerical aperture in optical fiber.
- b) What is meridional ray in fiber optics?  
If the relative refractive index difference is 1.3% and core refractive index is 1.48, and operating wavelength is  $0.85\mu\text{m}$  then calculate the maximum core diameter for single mode operation.
- c) An optical signal at a specific wavelength has lost 55% of its power after traversing 15 km of fiber. Calculate the attenuation of this fiber in dB/km.
- d) Illustrate the Huygens principle of light wave propagation.
- e) What is a polarizer? Where it is used?
- f) What is meant by Mode in LASER?
- g) A p-n photodiode has quantum efficiency of 55% at  $\lambda=0.8\mu\text{m}$ . Find the responsivity at this wavelength.
- h) Draw the schematic of planar and dome type LEDs showing their ohmic contacts and light emission.
- i) Illustrate the working principle of optical frequency domain reflectometer (OFDR).
- j)

Part- II

Q2 Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)

(06x08)

Analyze, Justify, Design, Formulate, Calculate, Develop, Illustrate, Explain, Distinguish, Differences & Similarities

- a) Describe the main constituents of an optical fiber communication link with suitable block diagram.
- b) Illustrate the Goos-Haenchen shift and mode coupling in optical fibers.
- c) What do you understand from normalized frequency (V) in optical fiber? How the normalized frequency (V) is related to the radius of the core in optical fiber? What is the value for a single mode to exist?
- d) What are the factors responsible for optical power loss on fiber optic communication?
- e) Define the mode-field diameter (MFD) in a single-mode fiber and indicate how this parameter relates to the spot size.  
A photodiode has a quantum efficiency of 65% when photons of energy  $1.5 \times 10^{-19}$  J are incident upon it.
- f) (a) At what wavelength is the photodiode operating?  
(b) Calculate the incident optical power required to obtain a photocurrent of  $2.5 \mu\text{A}$  when the photodiode is operating as described above.
- g) Comparing and contrasting the intrinsic and extrinsic absorption mechanism in optical fibers.
- h) What do you mean by indirect band gap materials in optical sources?
- i) Explain construction and working of APD using suitable schematics.
- j) Illustrate the Einstein coefficient of spontaneous emission and stimulated emission. Derive the relation between these coefficients.
- k) Briefly describe the sensing techniques for displacement measurement with neat diagram.
- l) How carrier recombination take place in direct and indirect band gap semiconductors? Explain it using suitable energy momentum diagram.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Discuss, Describe, Examine, Classify, Prove, Evaluate, Compare, Contrast, etc

210 Q3 (a) Define the relative refractive index difference for an optical fiber and show how it is related with numerical aperture. (8)210

Determine the cut off wavelength for a step index fiber to exhibit single mode operation when the core refractive index and radius are 1.47 and 3.6  $\mu\text{m}$ , respectively with  $\Delta$  of 0.25 %

(b) Describe with suitable diagram various types of optical splices and couplers for optical fiber communication. (8)

210 Q4 (a) Discuss the working principle of PIN photo detector with physical structure, equivalent circuit, field distribution and energy diagram. (8)

(b) What is modal birefringence phenomenon? Illustrate the beat length in single mode fiber using neat sketch. (8)

210 Q5 (a) Explain the structure of Fabry-Perot resonator cavity using a suitable schematic diagram. (6)210

(c) Describe the principle of operation of Fiber optic gyroscope using sagnac effect using suitable sketches. Discuss their advantages and disadvantages and briefly outline their applications. (10)

Q6 Write short notes of following: (8x2)

(a) RAPD

(b) OTDR