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Seventh Semester B.E. Degree Examination, June/July 2017

Optical Fiber Communication

Time: 3 hrs.

Max. Marks: 100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART - A

1.
 - a. Summarize the inherent advantages of optical fiber over conventional copper cables. (06 Marks)
 - b. Describe with neat diagram different types of optical fiber waveguides. Using ray theory, explain the propagation of light inside the fiber. (08 Marks)
 - c. A silica optical fiber with a core diameter large enough to be considered by ray theory analysis has a core refractive index of 1.5. A light ray is incident at the core-cladding interface with a critical angle of 78.5° . Estimate:
 - i) Refractive index of cladding
 - ii) Numerical aperture
 - iii) The acceptance angle in air for the fiber (06 Marks)
2.
 - a. Illustrate the different types of scattering losses in optical fiber with suitable equations. (08 Marks)
 - b. Explain what is meant by the critical bending radius for an optical fiber. Write equation of critical radius of curvature for multimode and single mode fibers. (06 Marks)
 - c. A multimode fiber with a core refractive index of 1.5, a relative refractive index difference of 3% and an operating wavelength of $0.82 \mu\text{m}$. Estimate the critical radius of curvature at which large bending losses occur. (06 Marks)
3.
 - a. Draw and explain the cross-sectional view of a typical AlGaAs double heterojunction LED, along with the energy diagram. (08 Marks)
 - b. Sketch and explain the GaAs homojunction injection laser with a Fabry-Perot cavity. (06 Marks)
 - c. A planar LED is fabricated from Gallium Arsenide which has a refractive index of 3.6,
 - i) Calculate the optical power emitted into air as a percentage of the internal optical power for the device when the transmission factor at the crystal-air interface is 0.68.
 - ii) When the optical power generated internally is 50% of the electric power, determine the external power efficiency. (06 Marks)
4.
 - a. With the aid of simple sketches, outline optical fiber coupler types and their functions. (08 Marks)
 - b. Discuss different types of fiber misalignment and the factors which causes the losses due to those misalignment. (06 Marks)
 - c. A single mode fiber has the following parameters:
 - Normalised frequency (V) = 2.40
 - Core refractive index (n_1) = 1.46
 - Core diameter ($2a$) = $8 \mu\text{m}$
 - Numerical aperture (NA) = 0.1
 - Normalised spot size (w) = $3.12 \mu\text{m}$.
 Estimate the total insertion loss of a fiber joint with a lateral misalignment (Y) of $1 \mu\text{m}$ and an angular misalignment (θ) of 1° . (06 Marks)

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Marcel A. Müller



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