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

## Optical Fiber Communication

Time: 3 hrs.

Max. Marks: 100

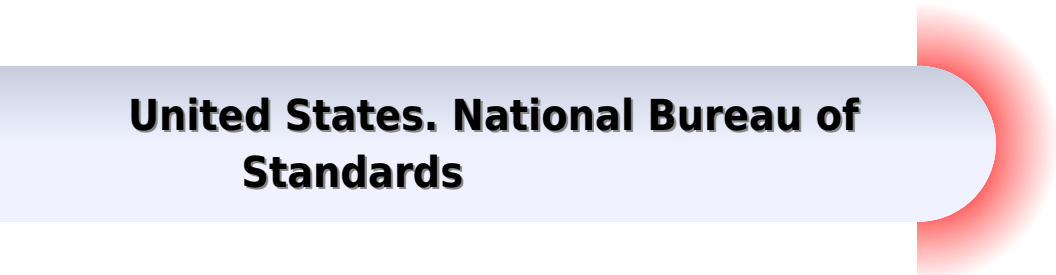
Note: Answer FIVE full questions, selecting at least TWO questions from each part.

### 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  $78.5^\circ$ . 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 ( $\theta$ ) of  $1^\circ$ . (06 Marks)

# Optical Fiber Communication Question Paper

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