BIRLA INSTITUE OF TECHNOLOGY AND SCIENCE, PILANI

FIRST SEMESTER 2017-2018

EEE F426 FIBER OPTICS AND OPTOELECTRONICS

DURATION: 90 min **MID-SEMESTER TEST** **October 9, 2017**

Note: *All questions equal marks. State valid assumptions and consider typical values wherever necessary. Mark Table or Figure Number from TB/RB in your answer, if referred.*

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1. For a planar waveguide operating at $\lambda = 1.55$ μm, with core index, 1.48 of thickness, 8 μm and $\Delta = 0.2$ %; Find propagation constant, β where $\beta_1 \leq \beta \leq \beta_2$. Thus, find effective index, n. Repeat the exercise for a cylindrical waveguide with core diameter = 16 μm.
2. Find the ratio of diameter of GI to SI multimode fiber, when number of propagating modes through both of them is same. How will the ratio vary, if SMF is assumed? By what factor multipath dispersion will be less in GI fiber. Estimate difference in MFD for both fibers.
3. Light is fed to a fiber of length 75 km using a GaAs LED with spectral width of 36 nm at $\lambda = 810$ nm. Find pulse broadening due to multipath and material dispersion, if core index is 1.452 and $\Delta = 0.3$ %. Calculate diameter of core to make total dispersion zero.
4. A step-index silica fiber with core index, 1.478 and $\Delta = 0.3$ % has a diameter of 25 μm. Calculate the wavelength, λ_c at which only single mode propagates through the fiber. Calculate wavelength λ_{12} so that 75% of power within LP_{12} mode propagates through core. Find the number of modes propagating at $\lambda_c/10$.
5. A single mode fiber has the following parameters: $V = 2.4$; $n_1 = 1.46$; $2a = 8$ μm and $NA = 0.1$. Estimate the total insertion loss of a fiber joint with a lateral and longitudinal misalignment of 0.76 μm and an angular misalignment of 0.9°. Assume both fibers have a difference of 1% in NA. Which feature dominates total insertion loss?
6. A planar LED is fabricated from GaAs (n = 3.59). Calculate the optical power emitted in air as a percentage of internal optical power for the device when the transmission factor at the substrate-air interface is 0.7. When internal efficiency is 50%, determine the external power efficiency. The light is further couple to a SI fiber with NA = 0.2 and $n_1 = 1.4$. Estimate the coupling efficiency and optical loss in dB when there is a small air gap between LED and coupling fiber.
