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B.Sc. Engg. (EEE), 6th Sem. March 5, 2024 (Morning)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid Semester Examination
Course No.: EEE 4671
Course Title: Optoelectronics

Summer Semester, A. Y. 2022-2023
Time: 90 Minutes
Full Marks: 75

There are **3 (three)** questions. Answer all of them. All questions carry equal marks. Marks of each question and corresponding COs and POs have been written in the brackets on the right margin. Programmable calculators are not allowed. Do not write on this question paper. All symbols bear their usual meaning. Assume reasonable values for missing data.

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1. a) Explain why conventional InGaAsP lasers could not be used for third generation lightwave systems. Mention the salient features of the fifth generation lightwave system. (7) (CO1) (PO1)

   b) Explain 'numerical aperture' and express it in terms of fractional index change, Δ. Using suitable diagram, derive a measure of pulse broadening in step-index fiber. (10) (CO1) (PO1)

   c) Explain fiber birefringence covering degree of modal birefringence, beat length, fast and slow axis. (8) (CO1) (PO1)

2. a) Define mie scattering. Compare macro and microbending losses in optical fiber. (10) (CO1) (PO1)

   b) Discuss how dry fiber assists in reducing extrinsic absorption loss. (4) (CO1) (PO1)

   c) Clarify the concept of mode in optical fiber. Explain when a mode ceases to be guided and reaches cutoff using p and q parameters from Helmholtz equation in cylindrical coordinates. Define zero dispersion wavelength. (11) (CO1) (PO1)

3. a) Find out effective core area, normalized propagation constant and confinement factor for a fiber with core radius 3.15 μm and normalized frequency, V = 2.3. Also calculate the value of numerical aperture and effective index taking wavelength, λ = 1.2 μm and fractional index, $\Delta = 3.25 \times 10^{-3}$. (12) (CO2) (PO2)

   b) A typical fiber has n_1=1.45, λ=1.2 μm, $\Delta=5\times10^{-3}$. Find the maximum value of core radius for the fiber to behave as a single mode fiber. What is required to be done to continue with the single mode operation if the core radius is changed to 4 μm? (6) (CO2) (PO2)

   c) Calculate the bit-rate distance product for a cladded graded-index fiber with n_1 = 1.5, n_2 = 1.497. Find out the index profile α for minimum dispersion in this case. Compare this α value with that of parabolic index profile. (7) (CO2) (PO2)