28

M.Sc. Engg./ Ph.D (EE) Date: 09 October, 2023 (Afternoon)

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

DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING

Mid Semester Examination
Course No.: EEE 6401
Course Title: Optical Communication

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

There are **4 (four)** questions. Answer **any 3 (three)** questions. All questions carry equal marks. Marks in the margin indicate full marks. Programmable calculators are not allowed. Do not write on this question paper.

---

1. a) Explain modes theory for circular waveguides. 10

   b) A step index fiber has NA of 0.16, core RI of 1.45, sore diameter of 60 μm. Determine the normalized frequency for the fiber when light at a wavelength of 0.82 μm is transmitted. Estimate the number of guided modes. 5

   c) Derive normalized frequency, V of optical fiber and show that for graded index fiber number of modes, $M = V^2/4$. 10

2. a) Discuss the operating principle of a p-i-n and avalanche photodiode. 10

   b) Derive the SNR for shot noise dominated optical receiver. Explain the concept of population inversion. 10

   c) Find the composition of the quaternary alloy InGaAsP for making semiconductor lasers operating at 1.3 μm and 1.55 μm wavelengths. 5

3. a) Draw the energy band diagram for heterostructure p-n junction and state its benefit over homostructure. 10

   b) What are the advantages of p-n photodiode over p-i-n photodiode? Show that the responsivity of a photodiode increases with the wavelength. 10

   c) Draw the loss curve of an optical fiber for various wavelengths and explain the reasons of various peaks occurred. 5

4. Discuss the following: 25
   i) Photonic Crystal Fiber (PCF),
   ii) Single-mode and multi-mode fiber,
   iii) Direct and indirect bandgap material,
   iv) Heterostructure p-n junction..