MACHAKOS UNIVERSITY

University Examinations for 2024/2025 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR DEGREE IN BACHELOR OF SCIENCE IN TELECOMMUNICATION AND INFORMATION TECHNOLOGY

SPH437: OPTIC FIBER COMMUNICATION

DATE: 14TH JANUARY 2025 **TIME: 11.00 AM - 1.00 PM**

INSTRUCTIONS:
Answer question ***ONE (Compulsory)*** *and* ***any other TWO*** *questions*

QUESTION ONE *(COMPULSORY)* (30 MARKS)

a) Discuss briefly the evolution of optic fiber. (4 Marks)

b) A light ray is incident from medium-1 to medium-2. If the refractive indices of medium-1 and medium-2 are 1.5 and 1.36 respectively then determine the angle of refraction for an angle of incidence of 30^0. (2 Marks)

c) Define the term attenuation hence Compute the length over which Power is decreases by 50 for a low loss fiber which has an average loss of 3 dB/km at 900 nm. (4 Marks)

d) Distinguish between micro bending and macro bending in reference to optical fiber (2 Marks)

e) Highlight the features of Edge Light Emitting Diode(ELED) (3 Marks)

f) Outline the advantages and disadvantages of Laser diode (4 Marks)

g) Explain the two types fiber splices used (4 Marks)

h) Differentiate between intrinsic and extrinsic absorption (4 Marks)

i) State and explain in brief the principle of light propagation (3 Marks)

QUESTION TWO (20 MARKS)

a) Discuss the advantages, disadvantages and application of optic fiber communication (8 Marks)

b) A step index multimode fiber with a numerical aperture of a 0.20 supports approximately 1000 modes at an 850 nm wavelength.

   i) Determine the diameter of its core

   ii) How many modes does the fiber support at 1320 nm?

   iii) How many modes does the fiber support at 1550 nm? (6Marks)

c) A continuous 12 km long optical fiber link has a loss of 1.5 dB/km.

   i) Determine the minimum optical power level that must be launched into the fiber to maintain as optical power level of 0.3 μW at the receiving end?

   ii) Find the required input power if the fiber has a loss of 2.5 dB/km? (6 Marks)

QUESTION THREE (20 MARKS)

a) Discuss briefly the characteristic of light used for communication (4 Marks)

b) Using illustration, explain how Light Emitting Diode (LED)is used as a detector (6 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 1.50 and a cladding refractive index of 1.47. *Determine:*

   (i) The critical angle at the core–cladding interface;

   (ii) The *NA* for the fiber;

   (iii) The acceptance angle in air for the fiber. (6 Marks)

d) Compare the features of Laser diode and LED (4 Marks)

QUESTION FOUR (20 MARKS)

a) Explain various types of misalignment that occur in fiber cables (6 Marks)

b) With suitable diagrams, explain the following

   i) Step index fiber

   ii) Graded index fiber (8 Marks)

c) A multimode step index fiber with a core diameter of 80 μm and a relative index difference of 1.5 % is operating at a wavelength of 0.85 μm. If the core refractive index is 1.48, estimate the normalized frequency for the fiber and number of guided modes. (6 Marks)

QUESTION FIVE (20 MARKS)

a) For Tatal Internal Reflection (TIR) in fiber to occur, several conditions have to be fulfilled. Describe this conditions in details. (4Marks)

b) With Suitable Diagrams Differentiate the operation of surface emitting and edge emitting LEDs (6Marks)

c) With suitable Diagrams, Describe material dispersion and modal Dispersion. (10Marks)