



TECHNICAL UNIVERSITY OF MOMBASA
FACULTY OF ENGINEERING AND TECHNOLOGY
DEPARTMENT OF MEDICAL ENGINEERING
UNIVERSITY EXAMINATION FOR:
BACHELOR OF SCIENCE IN MEDICAL ENGINEERING
ECL4402: MEDICAL OPTICS I
SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: SEPTEMBER 2018
TIME: 2HOURS
DATE: Pick Date Sep 2018

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FIVE** questions.

Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

Question ONE

- a) What are the basic attenuation mechanisms in the optical fiber communication? Explain in brief on what factors this mechanism depends? **(9 Marks)**
- b) Derive the expression of Numerical Aperture of Step- index fiber. What will happen to Numerical Aperture if cladding is removed? **(10 Marks)**
- c) Compare the phototransistor to photodarlington transistor in terms of:
 - i) sensitivity to incident radiant energy
 - ii) switching time **(5 marks)**
- d) Explain the following:
 - i) How a photo diode differs from a rectifier diode
 - ii) Why is LED not made of silicon or germanium **(6 marks)**

Question TWO

- a) With schematic representation explain the working principle of pin photo diode. **(8 Marks)**
- b) Describe important specifications of semiconductor photo diode to be suitable for fiber optic communications. **(6 Marks)**
- c) A pin photodiode on average generates one electron hole pair per three incident photons at a wavelength of $0.8 \mu\text{m}$. Assuming all the electrons are collected, calculate;
 - i) The quantum efficiency of the device
 - ii) Its maximum possible band gap energy
 - iii) The mean output photocurrent when the received optical power is 10^{-7} W . **(6 Marks)**

Question THREE

- a) With the aid of illustrations, explain the applications of LEDs as:
 - i). A power indicator **(8 marks)**
 - ii). Seven-segment display **(6 Marks)**
- b) Using a flow chart explain the optical receiver design. **(6 Marks)**
- c) Figure Q3 (c) shows the construction of optical fiber cable. Name the parts A, B and C explaining the function of each. **(6 marks)**

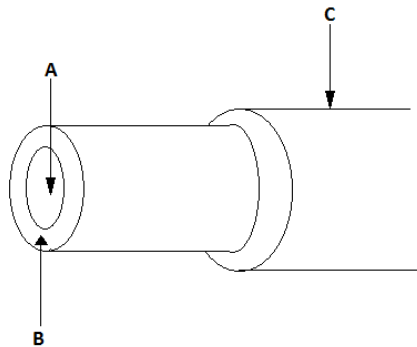


Figure Q3 (c)

Question FOUR

- a) The refractive indices of core and cladding materials of a step index fiber are 1.48 and 1.45, respectively. Calculate:
 - i). numerical aperture,
 - ii). acceptance angle, and
 - iii). the critical angle at the core-cladding interface and
 - iv). Fractional refractive indices change. **(12 marks)**
- b) Draw the diagram of an Opto-isolator and briefly explain its working **(8 marks)**

Question FIVE

- a) With the aid of suitable diagrams explain the following basic types of optical fiber:
 - i). Multimode Step Index
 - ii). Multimode Graded Index
 - iii). Singlemode **(15 marks)**
- b) Enumerate any FIVE factors to be considered when choosing an LED for a particular application. **(5 marks)**