



# TECHNICAL UNIVERSITY OF MOMBASA

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FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MEDICAL ENGINEERING (DME 224)

**UNIVERSITY EXAMINATION FOR:**

**DIPLOMA IN MEDICAL ENGINEERING**

**EHL 2303: OPTO-ELECTRONICS**

**END OF SEMESTER EXAMINATION**

**SERIES: APRIL 2016**

**TIME: 2HOURS**

**DATE:** Pick Date Select Month Pick Year

## Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of **FOUR** questions. Attempt question ONE (Compulsory) and any other TWO questions.

**Do not write on the question paper.**

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## Question ONE (Compulsory)

- (a) (i) Define Quanta. **(1 mark)**
- (ii) State the parameters of the equation which proposed that the energy of a quantum of radiation is directly related to the frequency of the radiation. **(3 marks)**
- (b) (i) With the aid of the EM spectrum diagram explain the optical range in use by optical devices. **(9 marks)**
- (ii) Explain the **THREE** types of optical transducers in the classification of Electro-optical transducers. **(6 marks)**

- (iii) With the aid of a basic structure diagram, briefly describe the LED as a PN Junction. **(5 marks)**
- (c) Distinguish between an LED and a Laser diode. **(6 marks)**

### Question TWO

- (a) (i) Describe the photodiode as essentially a PN junction diode. **(6 marks)**
- (ii) With the use of relevant diagrams, briefly explain the operation of the photodiode as a photo detector in the (3<sup>rd</sup> quadrant). **(6 marks)**
- (b) (i) With the aid of an output characteristic curve diagram. Describe the phototransistor as an optical device. **(6 marks)**
- (ii) State any **TWO** applications of a photo transistor. **(2 marks)**

### Question THREE

- (a) (i) Describe the principles of operation of the Opto-coupler using the practical arrangement diagram. **(6 marks)**
- (ii) State **TWO** applications of the Opto-coupler. **(2 marks)**
- (b) Explain the following terms as used in Lasers:
- (i) Population Inversion
- (ii) Spontaneous emission
- (iii) Stimulated emission **(6 marks)**
- (c) State any **THREE** types of gas Lasers. **(3 marks)**
- (d) Explain the following terms as applied to Lasers:
- (i) Monochromatism
- (ii) Coherence
- (iii) Collimation **(3 marks)**

#### Question FOUR

- (a) (i) Define mode locking technique as applied in lasers.  
(ii) State the formula for the total electric field as a function of time and define the constants. **(4 marks)**
- (b) (i) Define Q-Switching.  
(ii) With the aid of graph representation explain the time variation of some of the laser parameters during Q-Switching. **(9 marks)**
- (c) (i) Explain the **TWO** important requirements for effective Q-Switching. **(4 marks)**  
(ii) State the **THREE** methods of Q-Switching. **(3 marks)**

#### Question FIVE

- (a) (i) Name the **FOUR** classes of Lasers.  
(ii) With the aid of a diagram, describe the Atomic Laser-the He-Ne Laser. **(10 marks)**
- (b) (i) Describe Attainment of a population inversion.  
(ii) Calculate the ratio for a tungsten filament lamp operating at a temperature of 2000K. Taking the average frequency to be  $5 \times 10^{14}$  Hz.  
(Use  $R = \text{Exp}(hv/kT) - 1$ ). **(6 marks)**
- (c) (i) The total laser losses of a system is due to a number of different processes. List the **THREE** most important processes. **(3 marks)**  
(ii) Define Holography. **(1 mark)**