



TECHNICAL UNIVERSITY OF MOMBASA

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.

Question ONE (Compulsory)

- (a)
- (i) Define quantum yield or quantum efficiency. **(1 mark)**
 - (ii) State any **TWO** photoconductive materials. **(2 marks)**
 - (iii) State the **THREE** main factors that limit the speed of response of photodiodes. **(3 marks)**
- (b)
- (i) With the aid of a typical variation of current gain against reverse bias voltage for an avalanche photodiode, sketch the response characteristic curve. **(3 marks)**
 - (ii) Define responsivity. **(1 mark)**
- (c)
- (i) State **TWO** applications of LEDs. **(2 marks)**

- (ii) Describe the fundamental differences between an LED and a Laser Diode. **(4 marks)**
 - (iii) State the **THREE** methods of Q-Switching. **(3 marks)**
 - (iv) Explain Q-Switching. **(5 marks)**
- (d) Explain the following terms as used in Luminescent coatings and film devices:
- (i) Cathodo luminescence
 - (ii) Photo luminescence
 - (iii) Electro luminescence
- (6 marks)**

Question TWO

- (a) With the aid of a schematic diagram, outline the main components of a fibre optical communication systems. **(4 marks)**
- (b)
 - (i) With the aid of a characteristic curve diagram, explain the typical spectral response of a silicon photo diode. **(6 marks)**
 - (ii) Describe the operation of a photodiode using diagrams where the operating point is determined by the loadline. **(6 marks)**
- (c) With the aid of circuit symbol and the forward characteristic curve of a light activated switch, explain the operation. **(4 marks)**

Question THREE

- (a)
 - (i) Define energy ratio. **(1 mark)**
 - (ii) Describe the photovoltaic cell with its junction operating in the fourth quadrant of the characteristic curve. **(6 marks)**
 - (iii) State the inverse law of photoconductive cell. **(1 mark)**
 - (iv) Describe the photoconductive cell using the typical resistance-illumination characteristic curve. **(6 marks)**
- (b) With the aid of a diagram, explain how a half-wafer cell is produced. **(6 marks)**

Question FOUR

- (a) (i) State the expression which proposes that the energy of a quantum of radiation is directly related to the frequency of radiation. **(1 mark)**
- (ii) With the aid of a diagram, describe the conditions of the energy absorption and emission by a semiconductor. **(6 marks)**
- (iii) Describe the photofet. **(6 marks)**
- (b) With the aid of the circuit symbol and the forward characteristics curve describe the operation of the photo-thyristor as a light activated switch. **(7 marks)**

Question FIVE

- (a) (i) Explain the meaning of laser as used in fibre-optic.
- (ii) With the aid of energy level diagrams, illustrate absorption, spontaneous, emission and stimulated emission of radiation when excited electron fall to lower energy states. **(6 marks)**
- (ii) Explain the typical laser diode characteristic using the characteristic curve. **(6 marks)**
- (b) (i) Define mode dispersion. **(1 mark)**
- (ii) Explain the following terms:
- (I) Luminous flux ϕ
- (II) Luminous intensity I **(4 marks)**
- (iii) State the **TWO** applications of the Luminescent coating film devices. **(2 marks)**