



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2017/2018**

**COURSE NAME** : **PHOTONIC DEVICES**  
**COURSE CODE** : **BED 40902**  
**PROGRAMME** : **BEJ**  
**EXAMINATION DATE** : **JUNE/ JULY 2018**  
**DURATION** : **2 HOURS AND 30 MINUTES**  
**INSTRUCTION** : **ANSWER ALL QUESTIONS**

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**THIS PAPER CONSISTS OF FOUR (4) PAGES**

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- Q1** The light-emitting diode (LED) is a light source which uses semiconductors and electroluminescence to create light.
- (a) List **TWO (2)** advantages and disadvantages of LEDs. (4 marks)
  - (b) The material engineer team in Pia Matrix Sdn. Bhd are given a task to produce yellow LED using Zinc Telluride (ZnTe) with band gap of 2.25 eV.
    - (i) Discover all parameters to fabricate the new product by band alignment strategy. (7 marks)
    - (ii) Suggest the color of LEDs to be fabricated using ZnTe. (2 marks)
    - (iii) Give **TWO (2)** applications using ZnTe as their material. (4 marks)
  - (c) Draw a single junction of LED and explain its application in electronic devices. (8 marks)
- Q2** A photo detector has a p–n junction that converts light photons into current. The absorbed photons make electron–hole pairs in the depletion region.
- (a) Analyse the absorption operation of photodetector using direct and indirect bandgap. (10 marks)
  - (b) Atomic Force Microscope (AFM) is a characterization tool to observe topological properties of materials. Investigate how an AFM uses photodetector in its operation. (7 marks)
  - (c) Differentiate **THREE (3)** advantages and disadvantages of photodetectors. (6 marks)
  - (d) Find **ONE (1)** domestic electronic application that uses photodetector. (2 marks)
- Q3.** The hetero junction solar cell converts the energy of light directly into electricity by the photovoltaic effect.
- (a) Analyze the mechanism of energy conversion from light to electricity in solar cell. (5 marks)
  - (b) Analyze how the process of electron-hole recombination will degrade the solar cell performance.

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(4 marks)

- (c) Based on **Figure Q2(c)**, using the equation for field factor and energy conversion efficiency, calculate the efficiency and field factor of the information in the figure. Given  $J_{sc} = 6 \text{ mAcm}^{-1}$  and  $P_{mx} = 0.09 \text{ Wcm}^{-1}$ .

(6 marks)

- (d) A process engineer need to manufacture a solar cell using Indium tin oxide (ITO), Titanium Dioxide ( $\text{TiO}_2$ ), Cuprous Oxide ( $\text{Cu}_2\text{O}$ ) and Gold (Au). Construct a single junction solar cell using the materials given with justification. The band gap energy ( $E_g$ ) for  $\text{Cu}_2\text{O} = 2.2 \text{ eV}$  and  $\text{TiO}_2 = 3.32 \text{ eV}$ .

(10 marks)

**Q4** The first laser device has been built by T.H Maiman in 1960. The term "laser" originated as an acronym for *light amplification by stimulated emission of radiation*.

- (a) Demonstrate working mechanism of the laser with the aid of basic laser diode configuration.

(9 marks)

- (b) One of the crucial performance of laser is to make brighter light intensity. Design an experiment implementing laser and quantum dots to enhance the performance of laser.

(10 marks)

- (c) Analyze comprehensively the operation of these electronic applications using laser systems.

- (i) Laser pointer  
(ii) Optical Raman Laser

(6 marks)

**-END OF QUESTIONS -**

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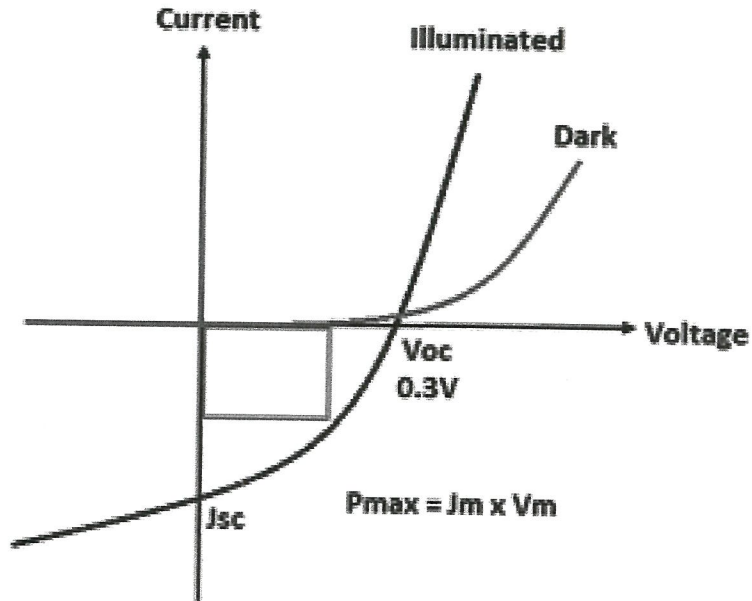


Figure Q2(c)

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