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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023**

COURSE NAME : PHOTONIC DEVICES

COURSE CODE : BEJ 33002

PROGRAMME CODE : BEE

EXAMINATION DATE : FEBRUARY 2023

DURATION : 2 HOURS

INSTRUCTION

1. ANSWER ALL QUESTIONS
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

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- Q1** (a) A photovoltaic (PV) cell is a basic unit in a solar system that converts sunlight into electricity.
- (i) Illustrate and label clearly the structure of a single junction solar cell using metal oxide. (4 marks)
 - (ii) Recommend **ONE (1)** suitable material for each layer in the structure given from the answer in **Q1(a)(i)**. (4 marks)
- (b) Full sunlight is falling on a 20% efficiency solar cell of area 2 m^2 at an angle of incidence of 60 degrees to the normal to the cell. Determine the output power of the cell. Shows all the calculation steps. (4 marks)
- Q2** (a) A phototransistor is a semiconductor photodetector that is less frequently used compared to a photodiode.
- (i) Elaborate on the working principle of phototransistor by referring to photodiode? (5 marks)
 - (ii) Identify **TWO (2)** applications that used phototransistors in their system. (2 marks)
- (b) Discuss **THREE (3)** important parameters of photodetector. (6 marks)
- Q3** (a) As a material engineer, you are given Gallium Arsenide (GaAs) with a bandgap of 1.42eV to fabricate Light Emitting Diodes (LEDs).
- (i) Calculate the wavelength of GaAs using the Plank equation. Show all the parameters and calculations involved. (5 marks)
 - (ii) From the answer obtained in **Q3(a)(i)**, what is the output color of the fabricating LEDs? (2 marks)
 - (iii) Suggest **ONE (1)** fabrication method to change the LEDs colour from the original material. (2 marks)
- (b) List **THREE (3)** advantages of LEDs compared to other lighting systems. (3 marks)

- Q4** (a) Analyze the working principle of laser for spontaneous emission with the aid of a diagram. (8 marks)
- (b) List **THREE (3)** types of lasers. (3 marks)
- (c) Erbium-doped yttrium-aluminum-garnet (Er:YAG) lasers with a wavelength of 2940 nm are widely used in medical applications. It produces laser irradiation in the near-infrared portion of the electromagnetic spectrum. Propose **TWO (2)** the medical system used this Er:YAG laser. (2 marks)

-END OF QUESTIONS -