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**UNIVERSITI TUN HUSSEIN ONN
MALAYSIA**

**FINAL
EXAMINATION
SEMESTER I
SESSION 2019/2020**

COURSE NAME	:	PHOTONIC DEVICES
COURSE CODE	:	BED 40902
PROGRAMMECODE	:	BEJ EXAMINATION
DATE	:	DECEMBER 2019/JANUARY 2020
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWERS ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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- Q1** (a) Figure Q1(a) shows a waterfall.
- (i) Using the analogical analysis, correlate the valence band, conduction band, defect state and bandgap. (8 marks)
 - (ii) Using your imagination, explain the phenomenon of exciton separation and recombination. Please also correlate the type of recombination theoretically. (12 marks)
- Q2** (a) Referring to Figure Q2(a-c) explain the following;
- (i) Assume the sunlight was incident on a P-N junction solar cell. With the aid of diagram, explain the mechanism of electricity generation as depicted in Figure Q2(a). (12 marks)
 - (ii) Discuss the power generation and consumption as indicated in Figure Q2(b). (4 marks)
 - (iii) Without the presence of sunlight, explain the reason why the light is still ON in Figure Q2(c). (4 marks)
- Q3** Mr. Ajinomoto is the CEO of LED fabrication company, Greedy Sdn Bhd. You are the process engineer of the company. He wish to produce a new blue LED with wavelength of (350-450 nm). Given that the Plank constant, P is (4.14×10^{-15}) and the velocity of light is (3×10^8 m/s), answer the following questions.
- (a) Referring to Figure Q3(a), select the suitable materials to form a p-n junction by showing the mathematical calculation. Illustrate the band diagram showing the fermi level, valence band and conduction band for the selected materials. (10 marks)
 - (b) Analyze the electron excitation, transport and recombination in the band diagram for the LED. (10 marks)

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- Q4** (a) Explain the working principles of a photodiode and a photodetector with the aid of diagrams. (14 marks)
- (b) Figure Q4(b) shows the configuration of photosensor to sense the turbidity level of water. Discuss the operation of this device by assuming the turbidity absorb light at wavelength of 630 nm. (6 marks)
- Q5** (a) The heart of every photonic device such as solar cell and photodetector lies on the p-n junction semiconductor. Figure Q5(a) shows a complete schematic of a p-n junction photodetector.
- (i) Draw the electronic band alignment on every segment of the device. (2 marks)
- (ii) Illustrate the electron and hole movement when external photon is present. (3 marks)
- (iii) Analyze in detail on how electrical current/signal is present from the p-n junction and complete the external circuit through anode and cathode. (15 marks)

-END OF QUESTIONS -

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Figure Q1 (a)

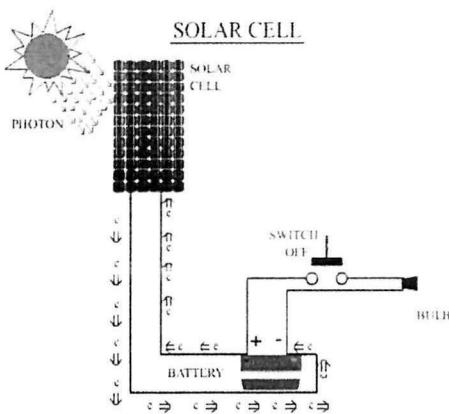


Figure Q2 (a)

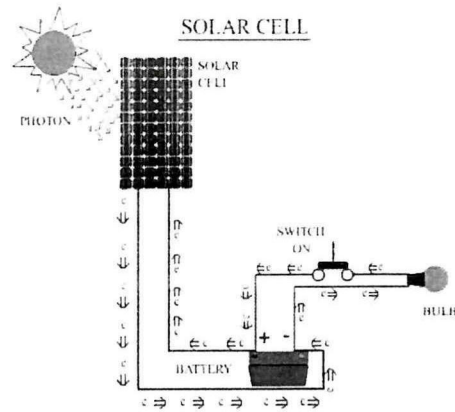


Figure Q2 (b)

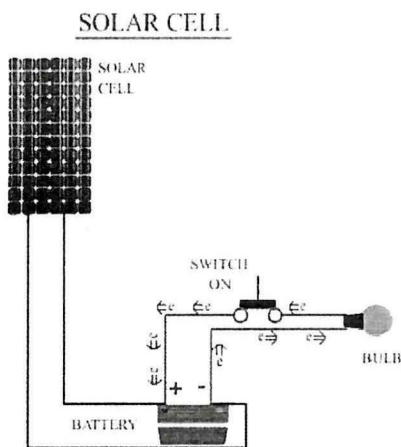


Figure Q2 (c)

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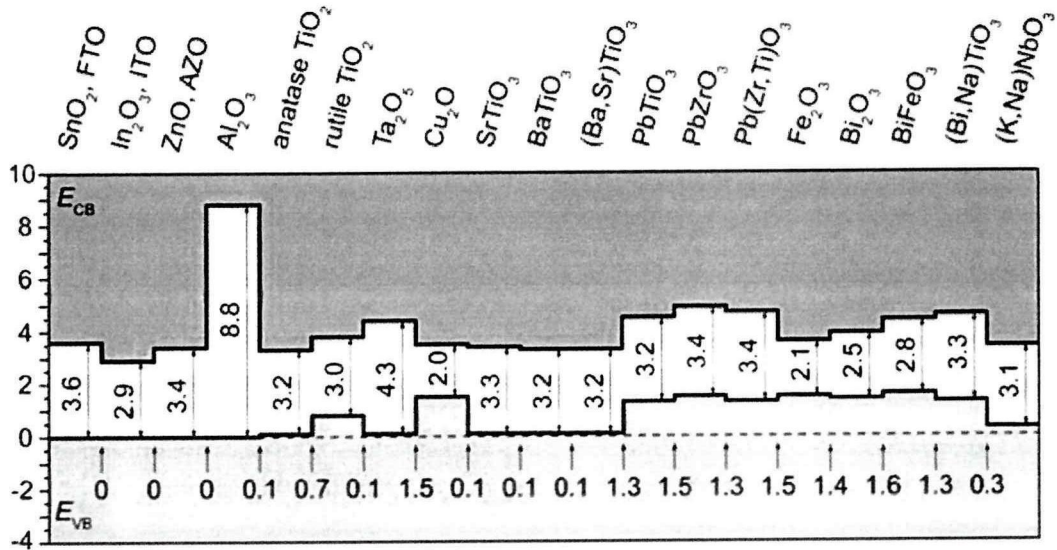


Figure Q3 (a)

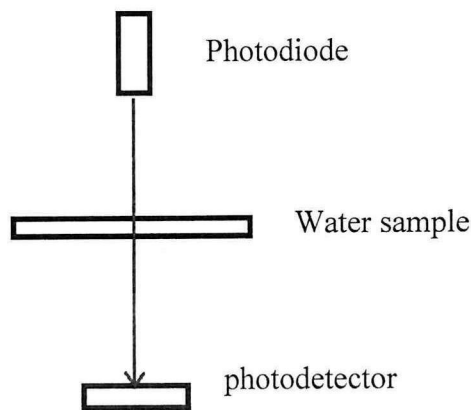


Figure Q4 (b)

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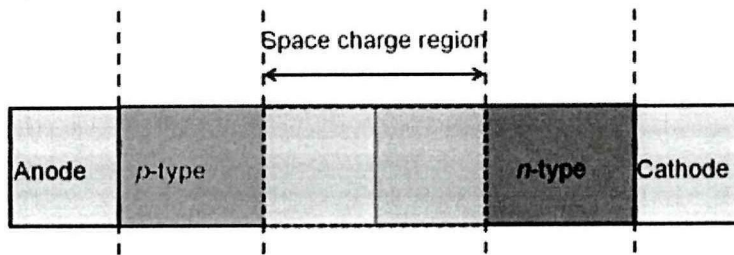


Figure Q5 (a)

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