

International Islamic University Chittagong
Department of Electrical and Electronic Engineering

Final Examination Autumn-2018

Program: B.Sc. Engg. (EEE)

Course Code: EEE- 3607

Course Title: Solid State Devices

Time: 2 hours 30 minutes

Full Marks: 50

Figures in the right margin indicate full marks.

Part A

[Answer any two questions from the followings]

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|-------|--|----|
| 1(a). | Derive the Ebers-Moll equations. What is the significance of it? | 05 |
| 1(b). | Mathematically explain how current is amplified in BJT. | 03 |
| 1(c). | Sketch the summary of charge carrier flow in a p-n-p transistor with proper biasing. | 02 |
| 2(a). | Determine the pinch-off voltage of a JFET in terms of its doping concentrations and metallurgical half width. | 04 |
| 2(b). | Determine the mathematical expression for drain current in a JFET. | 04 |
| 2(c). | Draw the current-voltage curves for the channel for varying gate voltage. | 02 |
| 3(a). | Explain the operation of JFET with proper diagram. | 04 |
| 3(b). | Find the expression for the current I , for the transistor connection shown in Fig 1 if $\gamma = 1$. Also, how does the current I divide between the base lead and the collector lead? | 03 |

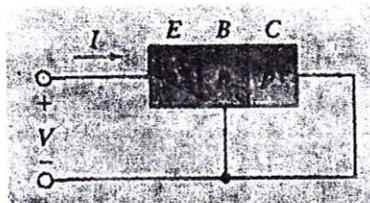


Fig. 1: For Question 3(b).

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|-------|---|----|
| 3(c). | What do you understand by MODFET? What purpose does it serve? | 03 |
|-------|---|----|

Part B

[Answer any three questions from the followings.]

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|-------|--|----|
| 4(a). | Explain the operation on enhancement type NMOS with neat diagram. | 04 |
| 4(b). | What do you understand by work function? Draw the energy band diagram for ideal MOS structure when we apply i) negative voltage, ii) positive voltage between metal and semiconductor. | 04 |
| 4(c). | What is the difference between MESFET and MOSFET? What is threshold voltage? | 02 |
| 5(a). | Explain how photocurrent is generated in a simple photovoltaic solar cell. | 04 |
| 5(b). | What are the limiting factors that affect the efficiency of a solar cell? | 02 |
| 7(c). | | 4 |

- 5(c). Consider the following I-V curve in the Fig.2 below of a solar cell driving a load of 3Ω . The cell has an area $3 \text{ cm} \times 3 \text{ cm}$ and is illuminated with light of intensity 700 W m^{-2} . Find the current and voltage in the circuit. Find the power delivered to the load, the efficiency of the solar cell in this circuit, and the efficiency of the solar cell.

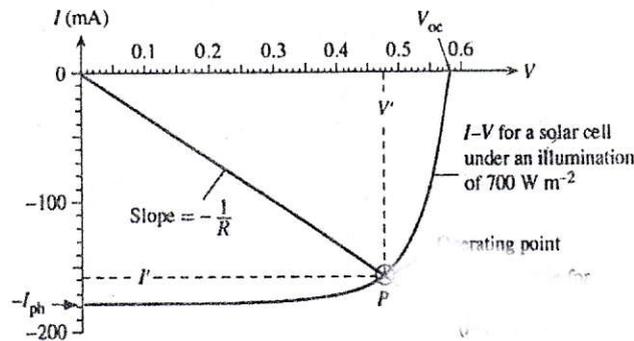


Fig.2: For Question 5(c).

- 6(a). What is "population inversion"? Briefly explain the working principle of LASER. 04
- 6(b). What do you mean by "injection electron"? Describe the fabrication process for a simple junction LASER. diagram. 04
- 6(c). What is a heterojunction? What are the advantages of heterojunction LASER over homojunction LASER? 02
- 7(a). Neatly draw the equivalent circuit of MOSFET naming the associated capacitive components properly. 02
- 7(b). What is hot electron effect in MOSFET? 02
- 7(c). Write the expression for external quantum efficiency η_{ext} of LED. 04
 Explain why direct band-gap semiconductors are good choice for LASER.
 Also, mention two advantages of amorphous solar cell.