

International Islamic University Chittagong
Department of Electrical and Electronic Engineering

Final Examination **Spring-2019**

Course Code: **EEE- 3607**

Time: **2 hours 30 minutes**

Program: **B.Sc. Engg. (EEE)**

Course Title: **Solid State Devices**

Full Marks: **50**

Figures in the right margin indicate full marks.

Part A

[Answer any two questions from the followings]

- | | |
|--|---|
| 1(a). Evaluate the terminal current by using proper boundary conditions in the diffusion equation (only emitter current evaluation is sufficient). | 5 |
| 1(b). Why must there be some base current in BJT? Mention the three dominant physical mechanisms to account for the base current. | 3 |
| 1(c). What is current transfer ration in BJT? Show its relationship with base transport factor. | 2 |
| 2(a). Derive the relationship between the pinch-off voltage and the metallurgical half width of a JFET. | 4 |
| 2(b). Explain how JFET is normally in 'ON' state. What is saturation current in JFET? | 3 |
| 2(c). How MESFET is different from MOSFET? Also, how it is different from JFET? | 3 |
| 3(a). Derive the equation of charge storage capacitance C_s for a pn junction diode. On what biasing condition will the effect of C_s be dominated? | 4 |
| 3(b). Write the equation of junction capacitance C_j for a pn junction diode and modify it for a p^+n junction. On what biasing condition will the effect of C_j be dominated? | 3 |
| 3(c). For a JFET given that; $I_{DSS} = 12 \text{ mA}$ and $V_P = -6 \text{ V}$. Sketch the transfer characteristics on a graph paper. Mention the type of the JFET. | 3 |

Part B

[Answer any three questions from the followings.]

- | | |
|--|---|
| 4(a). 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. | 4 |
| 4(b). What is threshold voltage in MOSFET? Draw the transfer and output characteristics of MOSFET. | 3 |
| 4(c). What is <i>hot electron</i> effect? What is <i>short channel</i> effect in MOSFET? | 3 |
| 5(a). Explain the principle of a photovoltaic solar cell. | 4 |
| 5(b). What is a heterojunction? What are the advantages of a heterojunction solar cell? | 2 |

- 5(c). Consider the following I-V curve in the **Fig.01** below of a solar cell driving a load of $3\ \Omega$. The cell has an area of $3\text{ cm} \times 3\text{ cm}$ 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 fill factor of the solar cell.

4

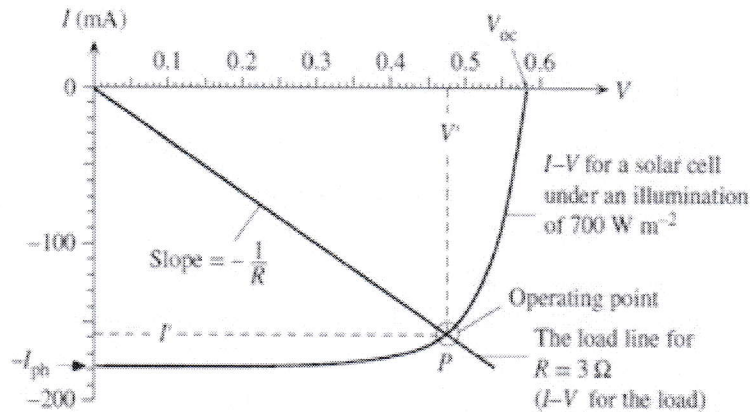


Fig. 01: for Question 5(c)

- 6(a). Why direct band gap semiconductor is used in LASER? What is the purpose of “gain medium” in LASER? 2
- 6(b). Briefly explain the working principle of LASER. 4
- 6(c). What is external quantum efficiency η_{ext} of LED? Describe the fabrication process of a simple junction LASER. 4
- 7(a). For a BJT prove that; $\beta = \alpha/(1 - \alpha)$ 3
- 7(b). Find the expression for I_E , I_C and I_B for a p^+np transistor, if $\gamma = 1$ and $V_{CB} = 0\text{ V}$. 4
- 7(c). Find I_D for $V_{GS} = 5\text{ V}$ for an enhancement type MOSFET. Given; $V_T = 3\text{ V}$, $V_{GS}(\text{on}) = 10\text{ V}$ and $I_D(\text{on}) = 3\text{ mA}$. 3