# PRESIDENCY UNIVERSITY

## BENGALURU

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### Mid - Term Examinations – October 2025

**Date:** 09-10-2025      **Time:** 02.00pm to 03.30pm

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| **School:** SOE | **Program:** B. Tech | |
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| **Course Code :** ECE3122 | **Course Name:** Microelectronics | |
| **Semester**: V | **Max Marks**: 50 | **Weightage**: 25% |

| CO - Levels | CO1 | CO2 | CO3 | CO4 | CO5 |
|---|---|---|---|---|---|
| Marks | 29 | 14 | 7 | | |

**Instructions:**

    *(i) Read all questions carefully and answer accordingly.*

    *(ii) Do not write anything on the question paper other than roll number.*

## Part A

**Answer ALL the Questions. Each question carries 2marks.**      **5Q x 2M=10M**

| | | | | |
|---|---|---|---|---|
| 1 | What is an energy band diagram and what does it show in a semiconductor? | 2 Marks | L1 | CO1 |
| 2 | Sketch the graph showing how mobility varies with dopant concentration. | 2 Marks | L1 | CO1 |
| 3 | Given that a silicon wafer is doped with acceptors with $N_a = 10^{14}$ cm-3 along with a donor with concentration of $N_d = 7.5 \times 10^{13}$ cm-3 to a particular region.<br>(a) What type is the region (n or p)?<br>(b) What is the electron concentration $n_0$ (cm-3) in the region? | 2 Marks | L1 | CO2 |
| 4 | The current in a PN junction diode is measured to be 0.3 $\mu A$ for a forward bias voltage of VD = 720 mV. Find the saturation current $I_0$. | 2 Marks | L1 | CO2 |
| 5 | Why is a Schottky diode faster than a regular p-n junction diode? | 2 Marks | L1 | CO3 |

# Part B

**Answer the Questions.**               **Total Marks 40M**

| | | | | | |
|---|---|---|---|---|---|
| **6.** | **a.** | Derive an expression for drift current density in p-region as function of concentration gradient. | **10 Marks** | **L2** | **CO1** |
| | | *Or* | | | |
| **7.** | **a.** | Derive an expression for diffusion current density in n-region with necessary analysis. | **10 Marks** | **L2** | **CO1** |

| | | | | | |
|---|---|---|---|---|---|
| **8.** | **a.** | Explain the difference between n-type and p-type doping in semiconductors with bond model and acceptor and donor concentration equation. | **10 Marks** | **L2** | **CO1** |
| | **b.** | Assuming the fundamentals constants and physical parameter for silicon at room temperature. Compute the concentration of electrons n0 and concentration of hole p0 for Nd =10^17 cm-3 and Na = 10^16 cm-3 at thermal equilibrium. | **5 Marks** | **L2** | **CO1** |
| | | *Or* | | | |
| **9.** | **a.** | Describe the various processes such as generation, recombination, and thermal equilibrium that occur in an intrinsic semiconductor. | **10 Marks** | **L2** | **CO1** |
| | **b.** | In a silicon region with donor concentration Nd = 10^16 cm-3 when an electric field is applied in the +x direction with a magnitude of 10^3 V/cm.<br>(a) What is the electron drift velocity (magnitude and sign)?<br>(b) What is the electron drift current density (magnitude and sign)? | **5 Marks** | **L2** | **CO1** |

| | | | | | |
|---|---|---|---|---|---|
| **10.** | **a.** | Obtain an expression for the current flowing through a PN junction diode when it is reverse biased. | **10 Marks** | **L3** | **CO2** |
| | **b.** | Describe the working principle of solar cell which helps to convert sunlight into electrical energy. | **5 Marks** | **L2** | **CO3** |
| | | *Or* | | | |
| **11.** | **a.** | Explain briefly about Qualitative Carrier Transport under Applied Bias in PN junction diode. | **10 Marks** | **L3** | **CO2** |
| | **b.** | With neat sketch, explain the working of opto-couplers works. | **5 Marks** | **L2** | **CO3** |