Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

School of Engineering

Mid - Term Examinations - November 2024

Semester: III
Date: 07-11-2024
Course Code: ECE2012
Time: 09:30am – 11:00 am
Course Name: SOLID STATE ELECTRONICS
Max Marks: 50
Program: B Tech
Weightage: 25%

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. **2Mx5Q=10M**

1	Solids are held together by strong attractive forces between atoms, ions, or molecules. These forces are so strong that the particles in a solid are held in fixed positions and have very little freedom of movement. List any two types of bonding in solids.	**2 Marks**	**L1**	**CO1**
2	The band gap of a semiconductor is the energy difference between the top of the valence band and the bottom of the conduction band. It's a key factor in determining a material's electrical conductivity. Two materials have a bandgap of 0.7eV and 1.1eV. Classify them as metal/semiconductor/insulator.	**2 Marks**	**L2**	**CO1**
3	The charge carrier movement in semiconductor can happen either due to the concentration gradient or due to the effect of an electric field. Identify the former and latter type of transport phenomena.	**2 Marks**	**L1**	**CO2**
4	In a laboratory experiment, it is found that we can control the junction capacitance of a pn junction diode by varying the reverse bias voltage. Identify the diode. Write the mathematical relationship between the junction capacitance and reverse bias voltage applied across the diode.	**2 Marks**	**L1**	**CO3**
5	For several researches, the magnetic field is measured by placing a current carrying conductor in the magnetic field. Define the phenomenon which is used to measure the magnetic field.	**2 Marks**	**L1**	**CO2**

Part B

Answer ALL Questions. Each question carries 10 marks. **4QX10M=40M**

6	**a**	Doping is a process of intentionally adding impurities to a pure semiconductor to improve its electrical properties. A pure germanium bar is doped with donor impurity to the extent of one impurity atom every 10^7 Ge atoms. Given Concentration of Ge atoms is $4.421x10^{22}$ atoms/cm^3, intrinsic carrier concentration is $2.5x10^{13}$/cm^3, mobility of electron is 3800 cm^2/Vs and mobility of hole is 1800 cm^2/Vs. Find donor concentration, majority carrier concentration, minority carrier concentration, conductivity and resistivity.	**10 Marks**	**L12**	**CO1**
		or			
7	**a**	The energy gap in a semiconductor is important because it determines the semiconductor's electrical conductivity and optical properties, and makes it possible for semiconductors to conduct electricity under certain conditions. Explain the band gap formation in a semiconductor with necessary diagrams.	**10 Marks**	**L2**	**CO1**
8	**a**	Drift and diffusion are two important transport phenomena in semiconductor diode. The ease with which the electron moves under the influence of an electric field is known as electron mobility(μ) and the ease with which the electron moves due to the concentration gradient is known as diffusion Coefficient (D). Derive a relationship between them.	**10 Marks**	**L2**	**CO2**
		or			
9	**a**	The Continuity Equation in Semiconductor states a condition of dynamic equilibrium for the concentration of mobile carriers in any elementary volume of the semiconductor. Derive the continuity equation in semiconductors.	**10 Marks**	**L2**	**CO2**
10	**10a**	The PN junction capacitance is divided into two components, the barrier capacitance and the diffusion capacitance. Explain them with necessary equations.	**5 Marks**	**L2**	**CO3**
	10b	The biasing voltage applied at the pn junction affects the transition width, barrier potential and energy band diagram. Depict the above statement with necessary diagrams.	**5 Marks**	**L2**	**CO3**

or

11	11a	Minority carrier injection is important for the performance of semiconductor devices. Explain minority carrier injection in pn junction diode.	**5 Marks**	**L2**	**CO3**
	11b	Barrier potential is the potential difference that opposes the flow of charge carriers across the depletion layer of a semiconductor diode. An abrupt Si pn junction has $N_a=10^{18}$ /cm^3 on one side and $N_d=5x\ 10^{15}$ / cm^3 on the other. The intrinsic carrier concentration $n_i=1.5x10^{10}$/cm^3. Find the value of the barrier potential at 300K.	**5 Marks**	**L1**	**CO3**
12		Doping is the process of intentionally adding impurities to a semiconductor to change its electrical, optical, and structural properties. The doped material is called an extrinsic semiconductor. For a heavily doped pn junction the contact potential is almost equal to the bandgap voltage. Is the above statement true? Justify your answer with necessary equations, explanations and diagrams.	**10 Marks**	**L2**	**CO3**

or

13		A heavily doped Silicon pn junction diode current doesn't follows the normal diode current equation whereas a heavily doped Germanium pn junction diode follows diode current equation. Is the above statement true? Justify your answer with necessary equations, explanations and diagrams.	**10 Marks**	**L2**	**CO3**