Roll No.												

PRESIDENCY UNIVERSITY
BENGALURU

School of Engineering

Mid - Term Examinations - November 2024

Semester: First | **Date**: 6th November 2024

Course Code: PHY1002 | **Time**: 02:00pm – 03:30pm

Course Name: Optoelectronics and Device Physics | **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	How intrinsic concentration of a semiconductor depends on its band gap.	2 Marks	M	CO1
2	GaAs, Si and Ge have band gap 1.4 eV, 1.1 eV and 0.7 eV respectively. Identify among them which has more conductivity.	2 Marks	H	CO1
3	Define Fermi energy and Fermi level.	2 Marks	L	CO1
4	Mention four applications of Hall Effect.	2 Marks	M	CO1
5	Niobium-tin is a Type II superconductor with a critical temperature of 18 K and a critical magnetic field of 24.5 Tesla. Estimate the critical magnetic field at 18 K.	2 Marks	H	CO1

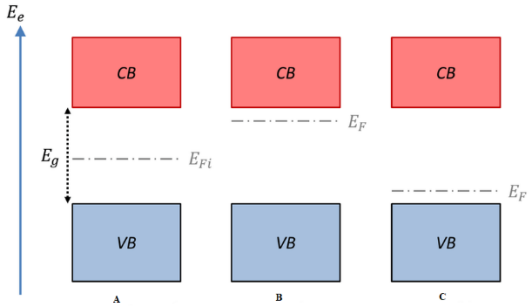
Part B

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

6	6a	Mention the importance of doping a semiconductor and hence list the differences between the intrinsic semiconductor and extrinsic semiconductor.	5 Marks	M	CO1
	6b	Considering the doping concentration being same for n-type and p-type semiconductor, identify which semiconductor has more conductivity and give reason. List any two differences between n-type and p-type semiconductors.	5 Marks	M	CO1

or

7		Calculate the concentration of intrinsic charge carriers in a silicon crystal at 300 K. Given that Eg = 1.1 eV and assume that $m_e=m_h$, Boltzmann constant $k_B=1.38\times10^{-23}$ J/K, mass of electron $m_e=9.1\times10^{-31}$ Kg and Planck's constant $h=6.626\times10^{-34}$ Js.	10 Marks	H	CO1
8	8a	Discuss the Hall effect with the help of neat diagram. Mention the formula for Hall voltage and Hall Coefficient explaining the terms.	6 Marks	M	CO1
	8b	The energy band diagrams of semiconductor samples of Si are shown in Fig. Identify X, Y and Z. Justify your answer with suitable explanation E_F.	4 Marks	M	CO1



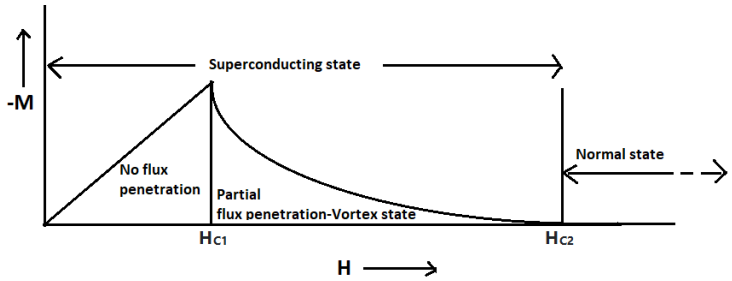
or

9	9a	Estimate the fraction of electrons in the conduction band at 300K for Germanium having energy gap Eg= 0.7 eV.	5 Marks	H	CO1
	9b	Calculate the Hall voltage when a conductor carrying a current of 0.5 A is placed in a magnetic field of 1.5 T. The conductor has a thickness of 1 cm and the number density of charges inside the conductor is 5.9×10^{28} /m^3. Given charge of electron e= 1.6×10^{-19} C.	5 Marks	H	CO1
10	10a	Discuss BCS theory with the help of a suitable diagram.	6 Marks	M	CO1
	10b	Discuss any four properties of diamagnetic materials.	4 Marks	M	CO1

or

11	11a	Explain Meissner effect with the help of a suitable diagram.	6 Marks	M	CO1
	11b	Discuss any four properties of ferromagnetic materials.	4 Marks	M	CO1

12	12a	The behavior of magnetization (M) of a superconductor with the external magnetic force (H) is shown in below. Identify the type of superconductor and discuss its properties. List any two examples (material composition) for this type superconductor.	6 Marks	H	CO1



	12b	Discuss the temperature dependence of critical magnetic field for a given semiconductor with help of a neat diagram.	4 Marks	H	CO1

or

13	13a	The critical field for niobium superconductor is $1X10^5$ amp/m at 8K and $2X\ 10^5$ amp/m at absolute zero temperature. Find the critical temperature of the niobium.	5 Marks	H	CO1
	13b	A superconducting tin has a critical temperature of 3.7 K has a critical magnetic field of $2X10^5$ amp/m at 2 K. Find the critical field at 0 K.	5 Marks	H	CO1