Vellore – 632014, Tamil Nadu, India

SCHOOL OF ELECTRICAL ENGINEERING

WINTER SEMESTER 2023-2024

CAT-II

SLOT: E1+TE1

Program Name & Branch : B.Tech. EEE/EIE Course Code: BEEE201L

Course Name : Electronic Materials

Faculty Members : Profs. (Devesh Shukla, P. Uma Sathyakam)

Class Number(s): VL2022230505443

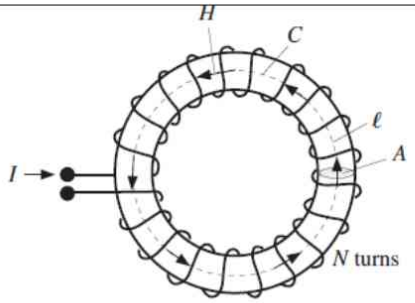
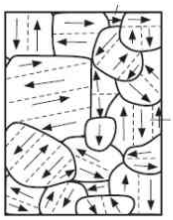
Date of the Examination : 30-03-2023

Duration : 90 minutes **Max. Marks : 50**

General instruction(s): Open notebook examination.

Assume values wherever needed. Draw diagrams wherever necessary

Q. No	Question	Marks	CO	BL
1.	(a) Using the relation between the drift mobility and the mean free time τ (between scattering events), and the expression for the diffusion coefficient $D = \ell^2/\tau$, establish the Einstein relation for electrons. [5] (b) Investigate the reason behind the particles' drift and diffusion in a semiconductor. Starting from the particle flux density Γ, derive the Fick's first law. [5]	10	CO2	BL3
2.	(a) Derive the expression for orbital magnetic moment and Bohr magneton. [5] (b) Hence evaluate the following, given that radius is 0.01Å and frequency is 1×10^{12}Hz considering spin down i. Gyromagnetic ratio ii. Angular momentum iii. Orbital magnetic moment iv. Spin magnetic moment [1+1+1+2]	10	CO3	BL5
3.	(a) With the help of Ampere's law, derive the magnetic field **B** and inductance **L** of a toroid depicted in figure below. [4] (b) Calculate the inductance of the toroid wire if the core diameter is 2cm, length of the core is 30cm and number of turns is 300. How can the inductance be increased? Consider the relative permeability to be 5000. [2] (c) Calculate the magnetic field if the current in the coil is 0.8A. [2] (d) What will happen if the core is replaced with mercury and the ambient temperature is 4.2K? [2]	10	CO3	BL3

				
4.	(a) An industrial visit is organized to your class to an electrical substation. You happen to hear a humming noise from the substation when you are nearby. (i) From where is the humming noise emitted exactly? (ii)What is the reason for this noise? (iii) Explain the phenomenon associated with this effects (iv) What are the other possible applications of the phenomenon involved [5] (b) What does the figure below depict? What will happen when magnetic field is applied and later removed? Explain the process with a B-H curve. [5] 	10	CO3	BL3
5.	(a) Establish the relations between magnetic permeability $\boldsymbol{\mu_r}$, magnetic susceptibility $\boldsymbol{\chi_m}$, magnetization vector **M**, magnetic field applied **B** and magnetic field intensity **H**. [3] (b) Consider a long solenoid with a core that is an iron alloy. Suppose that the diameter of the solenoid is 2 cm and the length of the solenoid is 20 cm. The number of turns on the solenoid is 200. The current is increased until the core is magnetized to saturation at about $I = 2$ A and the saturated magnetic field is 1.5 T. Consider the absolute permeability of free space is $4\pi \times 10^{-7}$. Calculate the following: (i) Magnetic field intensity **H** at the centre of the solenoid (ii) Applied magnetic flux density, $\boldsymbol{\mu_0 H}$, for saturation (iii) μ_r and χ_m (iv) Saturation magnetization $\mathbf{M_{sat}}$ of iron alloy (v) What is the total magnetization current on the surface of the magnetized iron alloy specimen? (vi) If we were to remove the iron-alloy core and attempt to obtain the same magnetic field of 1.5 T inside the solenoid, how much current would we need? Is there a practical way of doing this, if yes cite a practical example? [7]	10	CO3	BL5