SLOT: C2+TC2

SCHOOL OF ELECTRICAL ENGINEERING

CONTINUOUS ASSESSMENT TEST – II

WINTER SEMESTER 2022-2023 (Freshers)

Programme Name & Branch: B. Tech (BEE and BEI)
Course Code & Course Name: BEEE201L & Electronic Materials
Faculty Name: Chaman Lal Dewangan, Mallikarjuna Golla, and Mrutunjay Panda
Class Number(s): VL2022230505445, VL2022230505776, and VL2022230506506
Date of the Examination: 09-May-2023, 10:00 AM - 11:30 AM

Exam Duration: 90 minutes **Maximum Marks: 50**

General instruction(s): CAT-2 is open notebook for the subject BEE201L. **No printed materials will be allowed in exam.**

Q.No	Question	Marks
1.	a) Compare ferromagnetic and anti-ferromagnetic material with examples. Also explain the effect of temperature on these materials.	5 marks
	b) Explain magnetostriction and how it is responsible for humming noise in transformers.	5 marks
2	a) i) Proof $\mu_r = 1 + \chi_m$ in magnetic materials (2 marks). A magnetic field of 3×10^5 A/m is applied to magnetic material with a relative permeability of 1.05. ii) Identify the type of magnetic material (1 marks). iii) Calculate magnetic flux density (2 marks).	5 marks
	b) A superconducting solenoid that is 15 cm in diameter and 0.75 m in length and has 750 turns of Nb3Sn wire, whose critical field B_c at 3.5 K (liquid He temperature) is about 15 T and critical current density J_c is $3 \times 10^6\ A\,cm^{-2}$, the diameter of wire is 3mm. Superconductor current density is five times the current density in the wire given due to use of copper matrix in solenoid. What is the current necessary to set up a field of 3 T at the centre of a solenoid? What is the approximate energy stored in the solenoid? Assume that the critical current density decreases linearly with the applied field. Further, assume also that the field across the diameter of the solenoid is approximately uniform (field at the windings is the same as that at the centre). Comment on the operating condition of solenoid.	10 marks
3.	In a *pnp* Si BJT, the emitter region mean acceptor doping is 1×10^{17} per cm^3, the base region mean donor doping is 2×10^{15} per cm^3, and the collector region mean acceptor doping is 2×10^{15} per cm^3. The effective cross-sectional area of the device is 0.03 mm^2. The hole drift mobility in the base is 200 cm^2/V.s, and the electron drift mobility in the emitter is 400 cm^2/V.s. The hole lifetime in the base is approximately 300 ns. The transistor emitter and base neutral region widths are about 1.5 μm each when the transistor is under normal operating conditions. Assume that the emitter has 100 percent injection efficiency. Calculate the collector to base current gain and the emitter–base voltage if the emitter current is 2 mA. (Intrinsic concentration for Si is 1.0×10^{10} per cm^3 at 300K normal room temperature.)	10 marks

4. Discuss the Interfacial polarization with neat diagrams. 5 marks

5. a) A Germanium crystal is inserted in a parallel plate condenser of plate dimensions 90 cm$\times$200 cm. A capacitance of 4×10^{-9} F is noticed when the plates are separated by 64 mm. Determine the dielectric constant of the crystal (3 marks). Also determine the ratio of local electric field to applied electric field (2marks). 5 marks

b) Consider the NaCl crystal which has four Na+ –Cl− pair per unit cell and a lattice parameter a of 0.563 nm. The electronic polarizability of Na+ and Cl− ions is 1.9×10^{-40} Fm^2 and 2.3×10^{-40} F m^2, respectively, and the mean ionic polarizability per ion pair is 3.6×10^{-40} Fm^2. What is the dielectric constant at low frequency. 5 marks