

CBCS SCHEME

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1BPHEE102/202

First/Second Semester B.E./B.Tech. Degree Examination, June/July 2026 Physics of Electrical Engineering Materials (EEE stream- only for EEE students)

Time: 3 hrs.

Max. Marks: 100

- Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.
3. VTU Formula Hand Book is permitted.*

Module – 1			M	L	C
Q.1	a.	Describe the different polarization mechanisms.	08	L2	CO1
	b.	Derive Clausius - Mossotti relation.	08	L2	CO1
	c.	The atomic weight and density of Sulphur are 32 and $2.08 \times 10^3 \text{ kg m}^{-3}$. The electronic polarizability of the atom is $3.28 \times 10^{-40} \text{ Fm}^{-2}$. If Sulphur solid has a cubic structure, calculate its dielectric constant.	04	L3	CO1
OR					
Q.2	a.	Explain Ferromagnetic Hysteresis using Domain theory,	08	L2	CO1
	b.	Explain the classification of magnetic materials.	08	L2	CO1
	c.	Given the Curie temperatures for Cobalt 1600 K and Iron 1200K, find the ratio of their magnetic susceptibilities at a temperature of 1800K.	04	L3	CO1
Module – 2					
Q.3	a.	Derive the expression for thermo emf in terms of T_1 and T_2 .	06	L2	CO2
	b.	Explain the construction and working thermoelectric coolers (TEC)	06	L2	CO2
	c.	Explain the application of thermoelectric materials in the exhaust of automobile.	04	L2	CO2
	d.	The thermo emf and the temperature of hot junction T satisfies the relation $e = aT + bT^2$ where $a = 4.1 \times 10^{-5} \text{ V/}^\circ\text{C}$ and $b = -4.1 \times 10^{-8} \text{ V/}^\circ\text{C}^2$. If the cold junction temperature is 0°C , find the neutral temperature.	04	L3	CO2
OR					
Q.4	a.	State the laws of thermoelectricity with necessary diagrams.	06	L2	CO2
	b.	Explain the construction and working of thermoelectric generators (TEG),	06	L2	CO2
	c.	Explain the application of thermoelectric materials in refrigerator.	04	L2	CO2
	d.	The junctions of a Ni – Cu thermocouple are at 0°C and 100°C . Calculate the Seeback emf if $a = 16.3 \times 10^{-6} \text{ V/}^\circ\text{C}$ and $b = -0.042 \times 10^{-6} \text{ V/}^\circ\text{C}^2$.	04	L3	CO2
1 of 2					

Module – 3

Q.5	a.	Derive an expression for electron concentration in intrinsic semiconductors.	08	L2	CO3
	b.	What is Fermi energy? Explain the variation of Fermi factor with temperature and energy.	08	L2	CO3
	c.	Calculate the probability of an electron occupying an energy level 0.02eV above Fermi level at 300K.	04	L3	CO3

OR

Q.6	a.	Explain Matheissen's rule. Derive the expression for Fermi level in intrinsic semiconductor.	08	L2	CO3
	b.	What is Hall effect? Derive the expression for the Hall voltage.	08	L2	CO3
	c.	The Fermi level for silver is 5.5eV. What is the energy for which probability of occupancy at 300K is 0.01.	04	L3	CO3

Module – 4

Q.7	a.	Derive the expression for critical current for a cylindrical wire using Ampere's law.	08	L2	CO4
	b.	What is Meissner effect? Explain the Type-I and Type-II superconductors.	08	L2	CO4
	c.	Superconducting tin has a critical temperature of 3.7 K at zero magnetic field and a critical field of 0.0306 T at 0K. Find the critical field at 2K.	04	L3	CO4

OR

Q.8	a.	Explain BCS Theory and mention its limitations.	08	L2	CO4
	b.	Explain with neat diagram i) DC Squid ii) MAGLEV vehicle	08	L2	CO4
	c.	Calculate the critical current which can flow through a long thin superconducting wire of aluminum of diameter 1 mm. the critical magnetic field for aluminum is 7.9×10^3 A/m.	04	L3	CO4

Module – 5

Q.9	a.	Explain the principle and applications of Magnetorheological (MR) materials.	07	L2	CO5
	b.	Elaborate on three types of electrical ceramics with neat diagrams and mention any two of their applications.	08	L2	CO5
	c.	Discuss the general characteristics and importance of rare earth elements in modern technology.	05	L2	CO5

OR

Q.10	a.	Write a note on electrostriction and piezoelectric effect and mention their applications.	07	L2	CO5
	b.	Discuss about Electrorheological (ER) materials, its principle and applications in detail.	08	L2	CO5
	c.	Explain the application of Electrorheological materials in ER Clutches.	05	L2	CO5

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