

B.E. ELECTRICAL ENGINEERING SECOND YEAR FIRST SEMESTER – 2024

ELECTRICAL ENGINEERING MATERIALS

Time : 3 Hours

Full Marks : 100 (50 for this part)

Part – I

Use Separate Answer scripts for each Part

All questions carry eight (08) marks. Two (02) marks reserved for well organized answers and answer script.

Answer all questions of this part in the same answer script.

Group A : Answer any three (03) questions

1. With suitable derivation relate susceptibility to permeability. What is the order of susceptibility for different classes of magnetic materials?
2. What is the source of permanent magnetic dipole moments in materials?
3. Discuss how magnetic anisotropy dictates the design of electrical machines.
4. Why do ferromagnetic materials contain magnetic domains? Discuss Weiss hypothesis in this context.
5. Write short note on the paramagnetic materials.

Group B : Answer any two (02) questions

6. Explain Drude's Model of electrical conductivity.
7. The temperature coefficient of a material at $t_1^\circ\text{C}$ is α_1 . Relate temperature coefficient α_2 at an arbitrary temperature $t_2^\circ\text{C}$ with α_1 .
8. Write short note on high resistance conducting materials.
9. Discuss how contact force, working voltage and current dictate the contact resistance of an electrical contact.

Group C : Answer any one (01) question

10. State and explain Silsbee's rule of Superconducting materials.
11. Discuss BCS theory of Superconducting materials.

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Ex/EE/ES/B/T/213/2024

B.E.ELECTRICAL ENGINEERING EXAMINATION, 2024

(2nd Year, 1st Semester)

ELECTRICAL ENGINEERING MATERIALS

Time: Three Hours

Full Marks: 100

(50 marks for each part)

Use a separate Answer-script for each Part

PART-II

Answer *any three* questions

Two Marks are reserved for neat and well-organized answer script

1. a) Explain Bohr's theory of Hydrogen Atom. Hence, derive the expression for the total energy of the electron in Bohr's Hydrogen atom. 5+6
b) "Sigma bonding of atoms is stable, whereas pi bonding of atoms is always unstable"-justify or rectify the statement with proper explanation. 5
2. a) Discuss how energy plays an important role in the stable formation of molecules. Can the bonding molecular orbital have higher energy than the total energy of the individual atoms for a stable molecule? 5+3
b) Can un-impregnated Kraft paper be used as insulation for equipment where the temperature rise is more than 150°C? Justify your answer. Based on your comment, briefly discuss the temperature limit for the usage of different insulating materials in high-voltage equipment. 2+6
3. a) Derive expressions for the dielectric dissipation factor (DDF) of a typical dielectric, including proper schematic and phasor representations. Hence, draw a typical frequency versus DDF curve and justify its nature. 6+4
b) What is the difference between the breakdown strength and breakdown voltage of an insulating material? 3
c) Why does the dielectric constant of polar materials become higher than that of non-polar materials? 3
4. a) Potassium chloride crystal is subjected to a field of 1.5V/mm. The polarization of the crystal is found to be 4.3×10^{-8} C/m². Is it possible to find the relative permittivity of potassium chloride from the above data? Justify your answer by deriving suitable formula. 8

- b) A package containing 100 meters of high-voltage single-core cables is acquired from the market. The supplier provides a sample length of 5 meters for quality testing. In the case of the sample, the overall insulation resistance is $7 \text{ G}\Omega$ at 25°C . The dielectric of the cables exhibits a characteristic such that a temperature increase of 10°C is needed to halve its insulation resistance from the value at 25°C . On the other hand, the overall insulation resistance of the packaged cable is found to be $67.5 \text{ M}\Omega$ at 45°C . Should the customer make the purchase? Justify. 8
5. a) Provide a flow diagram to illustrate the typical processes in the manufacturing of porcelain insulators. What is the primary challenge faced in the manufacturing process? 7+2
- b) Justify or rectify the statement "The breakdown voltage of gas insulation decreases with an increment of pressure" with a proper explanation. 4
- c) Discuss the 'flash point' and 'pour point' of transformer oil. 3