



Allowed Tables and Charts: (None)

Answer the following questions

Question (1)

(25 Marks)

(1-a) According to energy band theory, what is the difference between conducting, semiconducting and insulating materials?

(1-b) Give a brief comparison between metals, ceramics, and organic materials.

(1-c) Two distinct metals are connected in series. Prove that:

$$\alpha_{12} = \frac{R_1 \alpha_1 + R_2 \alpha_2}{R_1 + R_2}$$

where,  $R_1$  and  $R_2$  are the resistances of the two metals, and  $\alpha_1$  and  $\alpha_2$  are their temperature coefficient of resistances, respectively.

(1-d) A resistor of  $80 \Omega$  resistance having a temperature coefficient of  $0.0021/C^\circ$  at  $0 C^\circ$  is to be constructed. Wires of two materials (A and B) of suitable cross-sectional area are available. For material A the resistance is  $80 \Omega$  per 100 m and temperature coefficient is  $0.003/C^\circ$  at  $0 C^\circ$ . For material B the resistance is  $60 \Omega$  per 100 m and temperature coefficient is  $0.0015/C^\circ$  at  $0 C^\circ$ . Calculate suitable lengths of the wires of materials A and B to be connected in series to get required resistor.

Question (2)

(25 Marks)

(2-a) Explain briefly, with the aid of suitable sketches, the conduction mechanism in an intrinsic semiconductor.

(2-b) Describe, with the aid of suitable sketches, the construction of photovoltaic cells, its theory of operation, and its characteristics.

(2-c) What is the usefulness of the conductive grid attached at the surface of photovoltaic cells?

(2-d) Thermistor is one of the important applications of semiconducting materials. Explain briefly what is mean by the term "thermistor", and its characteristics.

Question (3)

(25 Marks)

(3-a) What is meant by "Nanofiller". Give at least four examples of its possible shapes.

(3-b) Define the terms: "Nanotechnology", and "Nanocomposites".

(3-c) Define the following terms: "hydrophilic", "hydrophobic", and "superhydrophobic" surfaces.

(3-d) Calculate (a) the saturation magnetization and (b) the saturation flux density for nickel, which has a density of  $8.90 \text{ g/cm}^3$ . Take: the atomic weight of nickel =  $58.71 \text{ g/mole}$ , Bohr magnetons per atom =  $0.6$ , Bohr magneton ( $\mu_B$ ) =  $9.27 \cdot 10^{-24} \text{ A.m}^2$ , and Avogadro's number =  $6.023 \cdot 10^{23} \text{ atoms/mole}$ .

(25 Marks)

Question (4)

- (4-a) What is the effect of semiconductive coating on the electric field distribution over the surfaces of high voltage insulators?. Clarify your answer with suitable sketches.
- (4-b) High voltage insulator is coated with a hydrophobic nanocomposite has a nonlinear IV characteristics. Is the flashover performance of this insulator improved?. If yes, what are the reasons for this improvement?.
- (4-c) Describe the effect of nanosized TiO<sub>2</sub> on the flashover performance at oil/pressboard interface.
- (4-d) Give the reasons for flashover performance improvement at oil/pressboard interface when using nanosized TiO<sub>2</sub>.

Good Luck .....Dr. Hamza M. Diab

Dr. Mohamed E. Ibrahim

This exam measures the following ILOs														
Skills	Knowledge & Understanding Skills					Intellectual Skills				Professional Skills				
	a1-1	a1-2	a1-2	a1.4	a3.2	b5-1	b6-2				c1-1	c1-2	c1.3	c4.2
Question Number	Q1-a,c	Q1-b	Q2-a, b	Q3-a, b	Q3-c,d	Q2-c	Q2-d				Q1-d	Q4-a, b	Q4-c	Q4-d