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**University Examinations 2014/2015**

FIRST YEAR, FIRST SEMESTER EXAMINATION FOR DIPLOMA IN ELECTRICAL ENGINEERING

**EMC 0203: MATERIALS AND METALLURGY I**

**DATE: DECEMBER 2014 TIME: 1**$^{1}/\_{2}$ **HOURS**

**INSTRUCTIONS:** *Answer question* ***one*** *and any other* ***two*** *questions*

**QUESTION ONE (30 MARKS)**

1. Define each of the following terms as applied in materials science and engineering (5 marks)
2. Unit cell
3. Phase diagram
4. Alloy
5. Homologous temperature
6. Hardness
7. Give at least two specific engineering applications for each of the following materials

(5 marks)

1. Dielectric
2. Intrinsic semi-conductor
3. Ferromagnet
4. Elastomer
5. Solder
6. Sketch a well-labelled graph of electrical resistivity against absolute temperature for each of the following electrical materials (5 marks)
7. Normal conductor
8. Super conductor
9. Write equation for ohm’s law. Define the symbols and give thri SI units (3 marks)
10. A wire whose diameter is 0.20 cm must carry a 20A current. The maximum power dissipation along the wire is 4W/m (watts per meter). Calculate the minimum allowable conductivity of the wire in (ohm meters)-1 for this application (12 marks)

**QUESTION TWO (15 MARKS)**

1. Distinguish the following materials (7$\frac{1}{2}$ marks)
2. Hypo-entectoid steel and Hyper-entectoid steel
3. Insulator and dielectric
4. Alloy and compound
5. Substitutional solution and interstitial solution
6. Hard magnet and soft magnet
7. A steel wire of diameter 5mm and length 10m carries a load of 3.40N at its end. If the modulus of elasticity of steel is 200GPa and coefficient of thermal expansion for steel is 12x10-6/0c, Calculate: (7$\frac{1}{2}$ marks)
8. The increase in length of the wire caused by the load
9. The temperature rise that would cause the same increase in length as in b (i) above.

**QUESTION THREE (15 MARKS**)

1. Define each of the following properties of materials (6 marks)
2. Resistivity
3. Magnetostricion
4. Hardenability
5. Allotropism
6. Grain boundary
7. Invar effect
8. With aid of neat sketches of ‘hard sphere models’ illustrate each of the following crystalline structure of metals (9 marks)
9. Body centred cubic
10. Face centred cubic
11. Hexagonal close packed

**QUESTION FOUR (15 MARKS)**

1. Plot a well-labelled cooling curve for pure iron at a pressure of 1 atmospher

(6 marks)

1. What are conditions for formation of each of the following types of alloys (6 marks)
2. Substitutional solid solution
3. Interstitical solid solution
4. Outline the three stages of annealing process (3 marks)