Ministry of Higher Education& Scientific Research
University of Technology
Materials Engineering Department

وزارة التعليم العالي والبحث العلمي
الجامعة التكنولوجية
قسم هندسة المواد

Subject: Electronic and Magnetic Materials
Examiner: Assist. lecture Sura S. Ahmed
Allowed time: 3hours

Final Examination (2014-2015)

Class: 3rd/ Ceramic & Building Mat. Eng. Branch
Signature:
Date: 18 / 6 / 2015

Note: answer four questions

Q.1) Sketch the diagram of electron concentration versus temperature for silicon (n-type) that has been doped with $10^{21}m^{-3}$ of a donor impurity, and for intrinsic silicon, and then answer the following questions:

1) Determine the Freeze–out, Extrinsic and Intrinsic temperature regions on figure.
2) Which of these temperate regions are the best for designing most solid–state devices? Why?
3) What occurs to the electron concentration at freeze–out temperature region?
4) Why termed the high end of temperature scale by intrinsic region?
5) On the basis of Figure, as dopant level is increased would you expect the temperature at which a semiconductor becomes intrinsic to increase, to remain essentially the same, or to decrease? Why?

(15marks)

Q.2:- A) If a metallic material is cooled through its melting temperature at an extremely rapid rate, it will form a noncrystalline solid (i.e., a metallic glass). Will the electrical conductivity of the noncrystalline metal be greater or less than its crystalline counterpart? Why? (3marks)

Q.2:- B) For gaseous argon, solid LiF, liquid $H_2O$, and solid Si, what find(s) of polarization is (are) possible? Why? (8marks)

Q.2:-C) A parallel-plate capacitor with dimensions of 38mm by 65mm and a plate separation of 1.3mm must have a minimum capacitance of ($7\times10^{-11}$F) when an (ac) potential of (1000V) is applied at a frequency of 1MHz. Find the relative permittivity of the capacitance material. (4marks)

Q.3:-A) What is the principle of magnetic levitated train? Which kind of material is used in its construction? Why? (5marks)

Q3:-B) (1) Explain the two sources of magnetic moments for electrons. (2) Do all electrons have a net magnetic moment? Why or why not? (3) Do all atoms have a net magnetic moment? Why or why not? (5marks)

Q.3:- C) After finding the electrical conductivity of cobalt at 0°C, we decide to double that conductivity. To what temperature must we cool the metal? Hence the resistivity at room temperature $6.24*10^{-6}$ Ω.cm and $\alpha = 0.006$ Ω.cm/°C. (5marks)

Q.4:-A) Cite the differences between hard and soft magnetic materials in terms of both hysteresis behavior (characterization with sketch) and typical applications. (10marks)

Q.4:-B) $Nb_3Sn$ and $GaV_3$ are candidates for a superconductive application at the same critical magnetic field. Find the lower temperature for $Nb_3Sn$ in order to be superconductive. Hence, $GaV_3$ ($H_o$ = 350,000 oersted, T=12.7K, $T_C$ = 16.8K), $Nb_3Sn$ ($H_o$= 250,000 oersted, $T_C$= 18.05K). (5marks)

Q.5:-A) A light – emitting diode display made using a GaAs–GaP solid solution of composition 0.4 GaP–0.6 GaAs has a band gap of 1.9eV. What will be the color this LED display? Hit: used table (1), Plancks constant (6.63×10-34j.s, 4.14×10-15eV.s), speed of light (2.998×108m/s). (3marks)

Q.5:-B) Briefly explain why the ferroelectric behavior of $BaTiO_3$ ceases above its ferroelectric Curie temperature. (4marks)

Q.5:-C) Figure (1) shows the B-versus-H curve for a nickel–iron alloy.

(a) What is the saturation flux density?

(b) What is the saturation magnetization?

(c) What is the remanence?

(d) What is the coercivity? (8marks)

Figure (1): Complete magnetic hysteresis loop for a nickel–iron alloy.

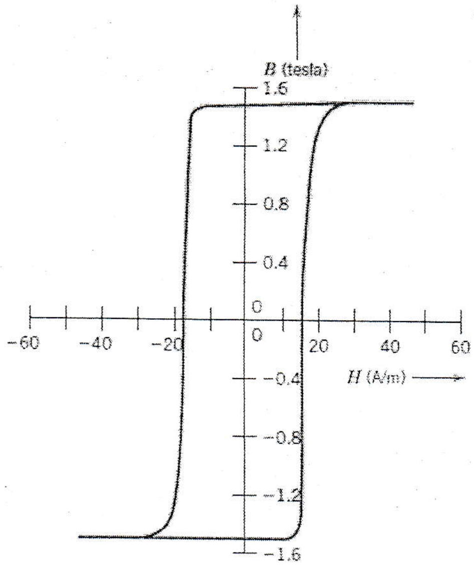


Table (1).
The wave length for some color

| Color | Violet | Blue | Green | Yellow | Orange | Red |
|---|---|---|---|---|---|---|
| λ (nm) | >450 | 450 - 500 | 500 - 570 | 590 - 870 | 590 - 610 | <610 |

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