Benha University
Faculty of Engineering- Shoubra
Electrical Engineering Department
First Year (Power)

Final Term Exam
Date: 22 / 1 / 2015
Electrical and magnetic Properties of Materials
Total Duration : 3 hours

First Page

- Answer all the following question
- Illustrate your answers with sketches when necessary.
- The exam. Consists of two pages
- Mark of the 1st Page: **50** Mark
- Total Mark: **100** Marks
- 1st Page time: **1.5** hours

1.a) Write notes on each of the following items: (10 Marks)

1. Electrostrictive materials
2. Isotropic materials
3. The electric dipole moment
4. The total energy of the electron in different circular orbits
5. The internal electric field

1. b) Discuss the types of interaction between the particles of the microscopic domain. For polyatomic gas, find the relation between ε_r and temperature T. (7 Marks)

1. c) A gas has a number of molecules/cm^3= 2.5*10^{19}, its dielectric constant ε_r=1.0044 at a temperature 27 ^{o}c, the dipole moment of the molecules μ_p= 3.1*10^{-28} Coulombs.cm. Find the total polarizabilty of the molecules ($\alpha_e+\alpha_i$) and the orientational polarization for applied field E=1 Kvolt/cm. If the temperature is decreased to 7 ^{o}c, find the corresponding value of ε_r. (8 Marks)

2.a) Derive an expression for the electronic polarizability $\bar{\alpha}_e$ in terms of ω. Illustrate a schematic representation of the frequency dependence of the real and imaginary parts of the electronic polarizability (α_e', α_e'') for an atom contains one electron and then for n electrons. (12 Marks)

2.b) Find the rate of change of the orientational polarization of a liquid for the two cases:- (5 Marks)

1- Upon switching-on the field at t = 0
2- Upon switching-off the field at t = 0

2.c) Consider a parallel plate condenser filled with a dielectric between them characterized by a complex dielectric constant $\bar{\varepsilon}_r = \varepsilon_r' - j\,\varepsilon_r''$. The applied field $E_o \cos \omega t$, Find: - An expression for the current density J(t)
- The dielectric losses per m^3 W(t).

Sketch the vector relationship between the field and the current. (8 Marks)

Good Luck &

Prof. Dr M. Moenes
Dr Tamer Elian

Please turn over the page