

EECS176, Spring 2016

Solid State Electronics and Materials

Second Midterm Exam

May 9, Monday, 2:00 – 2:50PM

- 20% 1. This problem is about water. It has a mass density of 1 gram/cm^3 and one mole of water weighs 18 grams. Temperature is 300K.
- From the known relative permittivity of water at frequency lower than 5 GHz, find its susceptibility, i.e., its numeral value.
 - Calculate the number of water molecules per cm^3 and the size of a molecule assuming that it is a cube.
 - Using the result of problem 3.13(b), calculate the permanent dipole of a water molecule.
 - Permanent dipole, $p = 2e\delta$, where e is the magnitude of electron charge. Calculate δ and compare it with the size of a molecule.
- 20% 2. This experiment is conducted in fresh water. You shine a green laser beam with power of 15 milliwatts at normal incidence on a 5-mm thick BK7 glass plate having index of refraction of 1.517. The glass has an absorption coefficient of $\alpha = 1/\text{cm}$ at green light. Calculate:
- The amount of laser beam power that reflects back to you.
 - The amount of laser power that enters the front surface of the glass plate.
 - The amount of laser power that gets out of the rear surface of the glass plate.
 - What happens to the light power consumed in the glass? Where does it go?
- 20% 3. Let us assume that the magnetic dipole produced by an electron revolving at its nucleus with a radius of 0.02nm is the same as the electron spin dipole. Calculate the rate of revolution per minute.
- 10% 4. Explain how a permanent magnet is used in an electrical generator to produce electricity.
- 10% 5. Identify 5 products that use soft magnetic materials.
- 10% 6. Define: yield strength, Young's modulus, and ultimate tensile strength.
- 10% 7. Design an experiment to measure the Young's modulus of a material without using tensile tester.

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Solution Sheet page 1

You must write your answer within the space provided

Problem 1

Problem 2

Problem 3

Problem 4

Problem 5

Problem 6

Problem 7