



# ISHIK UNIVERSITY

Faculty of Education  
Department of Physics Education  
Course: **Semiconductors** Code: **PHYS. 426**  
2016-2017 Ac. Year, Fall Term

Date : .01.2017  
Duration : 120 min  
Type of Exam:  Final Exam  
 Make Up Exam

## Group ()

**Note: There are 40 points for the following questions. Students are allowed to use calculators.**

- 1- Why is the mobility higher (the scattering weaker) at a higher T? (3points)
- 2- The electron concentration in a piece of Si at 300 K is  $10^5 \text{ cm}^{-3}$ . What is the hole concentration?  $n_i = 10^{10} \text{ cm}^{-3}$ . (3points)
- 3- What are the approximate thermal velocities of electrons and holes in silicon at room temperature?  $T = 300 \text{ K}$  and recall  $m_n = 0.26 m_0$ ,  $m_p = 0.39 m_0$ ,  $k = 1.38 \times 10^{-23} \text{ JK}^{-1}$ ,  $m_0 = 9.1 \times 10^{-31} \text{ kg}$ . (7points)
- 4- Derive the equation for hole mobility ( $\mu_p$ ). (7points)
- 5- Draw the energy band diagram of a semiconductor that showing the donor and acceptor energy level. (2points)
- 6- Fill the blanks with correct word. (8points)  
[lattice constant, X-ray diffraction, drift, hole, electron, crystalline solid, shallow levels, imperfections , hot-point probe test, electric field]
  - a) As, P, Sb, and B are the most commonly used dopants for silicon. Acceptor and donor levels with small ionization energies, such as these four, are called .....
  - b) Electrons may gain energy by getting accelerated in a/an ..... and may lose energy through collisions with ..... in the crystal.
  - c) ..... is a practical and simple technique of testing the doping type of a semiconductor sample.
- 7- Show in the bracket that the below statements are true (T) or false (F). (10points)
  - a) A lower location in the energy diagram represents a lower hole energy ( )
  - b) Crystal vibration distorts the periodic crystal structure and thus scatters the electron waves. ( )
  - c) An electron can be scattered by either a donor (positive) ion or an acceptor (negative) ion. The same is true for a hole. ( )
  - d) Electrons and holes move at the thermal velocity but not in a simple straight-line fashion. ( )
  - e) A very important fact to remember about  $E_F$  is that there is only two Fermi level in a system at thermal equilibrium. ( )

Instructor's Name :

Signature :