



MACHAKOS UNIVERSITY

University Examinations 2016/2017

SCHOOL OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

SECOND YEAR EXAMINATION FOR BACHELOR OF SCIENCE IN ELECTRICAL
AND ELECTRONICS ENGINEERING

SUPPLEMENTARY EXAMINATION

EEE 205: PHYSICAL ELECTRONICS

DATE: 30/8/2017

TIME: 2:00 - 4:00 PM

INSTRUCTIONS.

Answer Question One and Any Other Two Questions

Planks constant= 6.626×10^{-34} J-sec.

Electronic charge = 1.6×10^{-19} C

1eV= 1.6×10^{-19} Joules

Mass of electron, $m_e = 9.1 \times 10^{-31}$ kg

Permittivity of free space, $\epsilon_0 = 8.854 \times 10^{-12}$ F-m

QUESTION ONE (COMPULSORY) (30 MARKS)

- a) State any FOUR Bohr's postulates. (6 marks)
- b) Obtain the expression of electron drift velocity of metals. (4 marks)
- c) Find the intrinsic carrier concentration and conductivity of germanium at 290°K for which constant $N = 3 \times 10^{25}/m^3$, energy gap $E_g = 1.2$ eV, electron mobility= $0.14 m^2/v-s$, hole mobility= $0.05 m^2/v-s$. (8 marks)
- d) Draw and explain the VI-characteristic of a pn junction diode. (6 marks)
- e) Describe the variation of the following semiconductor parameters with variation in temperature:
 - i. Mobility
 - ii. Energy gap.
 - iii. Conductivity (6 marks)

QUESTION TWO (20 MARKS)

- a) With aid of a diagram explain how N-type extrinsic semi conductor is formed. (8 marks)
- b) Obtain the expression of conductivity of intrinsic semiconductor. (4 marks)
- c) Describe the three electric discharge regimes namely dark discharge, glow discharge and arc discharge. (8 marks)

QUESTION THREE (20 MARKS)

- a) Proof that for an intrinsic semi conductor, the fermi-level lies between the conduction and the valence bands. (7 marks)
- b) With aid of a diagram describe covalent bonding. (4 marks)
- c) State any THREE common uses of tunnel diode. (3 marks)
- d) Determine the PN junction diode current for the forward bias of 0.22V at 25°C with reverse saturation current of 1mA. Take $\eta=1$. (6 marks)

QUESTION FOUR (20 MARKS)

- a) With aid of a diagram describe the formation of a depletion layer in Pn-junction. (4 marks)
- b) The resistance of copper wire of diameter 1.033mm is 6.51Ω per 333 meters. The concentration of copper is 8.4×10^{23} electrons per m^3 . If the current is 2A, find:
- i. Drift velocity
 - ii. Conductivity
 - iii. Mobility. (8 marks)
- c) The first four orbits of an atom are K, L, M and N. Fill a table showing the maximum total number of electrons in each orbit, number of sub-orbits, and name of the sub-orbits and distribution of electrons in the sub-orbits. (8 marks)

QUESTION FIVE (20 MARKS)

- a) Differentiate between good, semi and bad conductors using the energy band diagrams. (8 marks)
- b) Sketch a well labeled tunnel diode characteristic. (4 marks)
- c) Mention any FOUR applications of light emitting diodes. (4 marks)
- d) In a germanium sample, a donor type impurity is added to the extent of 1 atom per 10^8 germanium atoms. Show the resistivity of the sample drops to 3.7 ohm-cm. Given electron mobility= $3800 \text{ cm}^2/\text{v-s}$, hole mobility= $1800 \text{ cm}^2/\text{v-s}$, intrinsic carrier density is $2.5 \times 10^{13}/\text{cm}^3$, germanium atoms per m^3 $N_{\text{ge}}=4.41 \times 10^{22}/\text{cm}^3$. (4 marks)