30

(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS

UNIVERSITY EXAMINATIONS
2022/2023 ACADEMIC YEAR

SECOND YEAR FIRST SEMESTER EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN ELECTRICAL
AND
COMMUNICATION ENGINEERING

COURSE CODE: ECE 211

COURSE TITLE: PHYSICAL ELECTRONICS

DATE: 6TH DECEMBER, 2022 **TIME:** 12: 00 PM – 2:00 PM

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS.
QUESTION ONE CARRIES 30 MARKS AND ALL OTHERS 20 MARKS EACH.

TIME: 2 Hours

MMUST observes ZERO tolerance to examination cheating

QUESTION ONE

1a) State any four postulates that were made by Bohr. (4mks)

b) Define the following terms as they are applied to an atom of hydrogen. (3mks)

i. Normal
ii. Excited
iii. Ionized

c) Using energy band diagrams, show the differences of the following materials (6mks)

i. Insulators
ii. Conductors
iii. Semi-conductors

d) Explain the following using relevant diagrams

i. Fermi level in an intrinsic semi-conductor. (2mks)
ii. Fermi level in extrinsic semi-conductor. (3mks)

e) Describe using a well labeled diagram the Hall Effect phenomenon. (5mks)

f) State any four uses of the Hall Effect phenomenon. (4mks)

g) Molecules of electrons and holes in a sample of intrinsic germanium at room temperature are $0.36m^2$/volt-second and $0.17m^2$/volt-second respectively. If the electron and hole densities are each equal to 2.5×10^{19} per m^3. Calculate the conductivity. ($e=1.6\times10^{-19}C$) (3mks)

QUESTION TWO

2a) Explain the mass action law. (4mks)

b) The mobility of free electrons and holes in pure germanium are 3800 and 1800 cm^2/v-s respectively. The corresponding values of silicon are 1300 and 500 cm^2/v-s respectively. Determine the values of intrinsic conductivity for both germanium and silicon. Assume $ni=2.5\times10^{13}cm^{-3}$ for germanium and $ni=1.5\times10^{10}cm^{-3}$ for silicon at room temperature.(4mks)

c) i. using a diagram explain how light emitting diode (LED) operates to produce light that is green. (5mks)

ii. State any four applications of LED's (4mks)

d) A 24V, 600mW Zener diode is used for providing a 24V stabilized supply to a variable load. If the input voltage is 32V, calculate:

i. The series resistance R required (1½mks)

ii. Diode current when Ri =1200 ohms (1½mks)

QUESTION THREE

3a) Define the term tunneling (2mks)

b) State the three effects of heavy doping in a semiconductor material. (4½mks)

c) i. Draw the equivalent circuit of a tunnel diode and explain the various components. (4mks)

ii. Explain using a diagram the biasing of a Tunnel diode for use as an amplifier, mixer and relaxation oscillator. (5mks)

iii. State any three applications of a Tunnel diode. (4½mks)

QUESTION FOUR

4a) Differentiate between drift and diffusion current. (4mks)

b) Explain the following phenomenon/terms

i. Electroluminescence (2½mks)

ii. Fermi-level (2mks)

c) State any four disadvantages of solar panels (4mks)

d) Explain the differences between the Zener breakdown and avalanche breakdown. (6mks)

e) The hall coefficient of a specimen of doped semi-conductor is $3.66\times10^{-4}m^3c^{-1}$ and resistivity of the specimen is 8.93×10^{-3}ohm-meter. Determine the carrier mobility in $m^2v^{-1}s^{-1}$. (1½mks)

QUESTION FIVE

5a) Explain what Schrodinger wave equation is all about. (7mks)

b) i. Explain the diode current equation. (3mks)

c) A potential difference of 10V is applied longitudinally to a rectangular specimen of intrinsic germanium of length 2.5cm, width 0.4cm and thickness 0.15cm. Calculate at room temperature

i) Electron and hole drift velocities. (3mks)

ii) The conductivity of intrinsic Ge if intrinsic carrier density is $2.5\times10^{19}/m^3$. (1½mks)

iii. The total current (1½mks)

d) Outline any four applications of semi –conductor diodes in modern electronic circuits (4mks)