FEDERAL UNIVERSITY OF TECHNOLOGY, OWERRI
DEPARTMENT OF ELECTRICAL AND ELECTRONIC ENGINEERING
2017/2018 RAIN SEMESTER TEST

EEE 202: BASIC ELECTRONIC — UNITS: 2
INSTRUCTION: ATTEMPT ALL QUESTIONS. — TIME: 1hrs

1a Using the concept of Energy bands in solids, with the aid of detailed diagram and explanation, illustrate the difference between Conductors, Insulators and Semiconductors.

1b What is the difference between a valence electron and a free electron

1c Outline the differences between intrinsic and extrinsic semiconductors.

2a. Consider the GaAs Crystal at 300k. Calculate the intrinsic conductivity and resistivity. Assuming $n_i = 1.8 \times 10^6 cm^{-3}$, $\mu_e \approx 6500 cm^2V^{-1}s^{-1}$ and $\mu_h \approx 350 cm^2V^{-1}s^{-1}$ and $e = 1.602 \times 10^{-19}$ C.

2b. State the typical values of the barrier potential for Silicon and germanium diodes.

3 Explain Fermi-Dirac Function. Give equations for Fermi Function and state the two possible conditions that exist in Fermi Function.

4. With the aid of diagram, briefly discuss the mode of operation of the following

i. Vacuum Diode
ii. Vacuum Triode

$cm^{-3} \times (C \times CV^{-1}s^{-1})$.

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2017/2018 RAIN SEMESTER EXAMINATION

EEE 202: BASIC ELECTRONICS

INSTRUCTION: Attempt all questions in Section A and any three questions from Section B. Time: 2 hrs

SECTION A:

i. Explain the term 'Electronics'
ii. Electronics discipline by nature, comprises four Cs, name them
iii. State the two major eras identified in Electronics industry development
iv. Define: Mobility and Conductivity
v. Why does an intrinsic semiconductor behave as an insulator at 0^0K
vi. State the mass-action Law
vii. What is meant by the term 'Extrinsic Semiconductor'?
viii. State the difference between a valence electron and a free electron
ix. What is the majority carrier in a P-type semiconductor?
x. Give three examples of trivalent atoms and three of pentavalent atoms relevant for electronic devices fabrications.
xi. Outline 3 figures of merit (characteristics) of a vacuum triode
xii. What are the central objectives of static and/or dynamic characteristics of a vacuum tube.
xiii. Compare a vacuum diode with a vacuum triode
xiv. Explain with diagrams how holes are produced.
xv. Discuss in few sentences, Donor-Acceptor mechanism
xvi. Sketch the IV-characteristics of (a) ideal S/C diode and (b) practical S/C diode. Comment on their structures

SECTION B

1(a) State Bohr's three fundamental postulations of planetary/stationary bodies (5 marks)

(b) From Classical Mechanics, show that the energy level of each stationary state of an atom is

$$W_n = -\frac{me^4}{8h^2\varepsilon_0^2 n^2}$$

(9 marks)

(c) Outline three reasons that supports Wave-particle duality (4 marks)

(d) What is ionization potential (2 marks)

2(a) Explain Fermi-Dirac Function, hence state the basic equation and the three possible conditions that justified the relationship (7 marks)

(b) State Pauli's Exclusion Principle? Explain its contribution to atomic structure and physical properties of materials. (6 marks)

(c) With the aid of a circuit diagram, describe the mode of operation of a Vacuum Triode. Mention three applications of Vacuum Triode (7 marks)

3(a) Explain with examples, how a Silicon semiconductor is converted to an N-Type material/component (4 marks)

(b) Consider the GaAs crystal at 300k. calculate the intrinsic conductivity and resistivity when $n_i = 2.4x10^6 cm^{-3}$, $\mu_n = 4500cm^2v^{-1}s^{-1}$, $\mu_h = 6500cm^2v^{-1}s^{-1}$ and $e = 1.602x10^{-19}c$ (6 marks)

(c) Briefly describe the mode of conduction in both p-type and n-type semiconductor materials (4 marks)

(d) Using the concept of Energy bands in a solid, as the case study, differentiate among conductors, insulators and semiconductors. Detailed diagrams explanations essential (6 marks)

4(a) Consider the circuit diagram in Figure 1, with R=3K and Vi=9V. State (i) the connection mode of the diode made from germanium materials (ii) Determine the forward diode current and total current flowing in the circuit and (iii) calculate the power dissipated at the diode (8 marks)

(b) By the use of appropriate diagrams, differentiate between reverse and forward biasing in semiconductor diodes. (5 marks)

(c) State 4 applications of diodes and 5 different types of diodes with their symbols (7 marks).

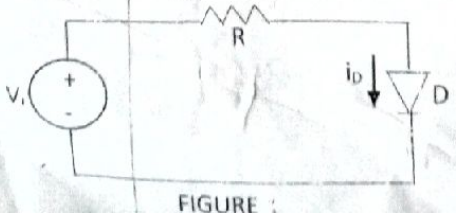

FIGURE 1