JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF BIOLOGICAL, PHYSICAL, MATHEMATICS AND ACTUARIAL SCIENCES

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR OF EDUCATION (SCIENCE) WITH IT

2022/2023 ACADEMIC YEAR   3RD YEAR   1ST SEMESTER

MAIN

REGULAR

COURSE CODE: SPB 9311

COURSE TITLE: INTRODUCTION TO DIGITAL ELECTRONICS

EXAM VENUE: STREAM: EDUCATION

DATE: EXAM SESSION:

TIME: 2:00 HRS

Instructions:

1. **Answer question 1 (Compulsory) and ANY other 2 questions.**
2. **Candidates are advised not to write on the question paper.**

3. **Candidates must hand in their answer booklets to the invigilator while in the examination room.**

QUESTION ONE (30 MARKS)

a. Briefly explain the Bohr theory of structure of an atoms **[2 mark]**
b. Distinguish between extrinsic and intrinsic semiconductors **[2 marks]**
c. Explain the basic working principle of a transistor **[4 marks]**
d. With the aid of a well labelled diagram, explain the working mechanism of an operational amplifier **[4 marks]**
e. An NPN Transistor has a DC current gain, β, value of 200. Calculate the base current I_b required to switch a resistive load of 4mA. **[3 marks]**
f. An NPN Transistor has a DC base bias voltage, V_b of 10v and an input base resistor, R_b of 100kΩ. What will be the value of the base current into the transistor. **[3 marks]**
g. Draw a fully well labeled Output Characteristics Curves for a Typical Bipolar Transistor **[4 marks]**
h. Define the term oscillator and give any three of its applications **[4 marks]**
i. Write down the steps involved in analyzing an OP-Amp circuit **[4 marks]**

QUESTION TWO (20 MARKS)

a. With focus to band theory of solids, distinguish between conductors, semiconductors and soilids **[8 marks]**
b. Using well illustrated bonding diagrams, explain the formation of N-type and P-type semiconductors **[6 marks]**
c. Draw the Voltage-Current characteristics curve of PN junction diode both in reverse and forward biasing modes. With focus to charge transport, explain the shape of the curve **[6 marks]**

QUESTION THREE (20 MARKS)

a. Define a transistor **[2 marks]**
b. Draw the circuit diagram of NPN transistor in a common base configuration and explain its working principle **[4 marks]**
c. Obtain the relation between α and β **[4 marks]**
d. Explain the working of a transistor as an amplifier **[6 marks]**
e. Biasing of a transistor can make it operate in active region, saturation region and cut-off regions. With the aid of well labelled diagrams, explain the conditions of operation and application of each case. **[4 marks]**

QUESTION FOUR (20 MARKS)

a. Define an operational amplifier and draw its standard circuit **[2 marks]**
b. Design an operational amplifier with negative feedback and fully explain its working principle. **[3 marks]**

c. With the aid of well labelled circuit diagrams and with supportive voltage equations, explain the operation of the following types of op amps
   i)   Voltage follower   **[5 marks]**
   ii)   Inverting amplifier   **[5 marks]**
   iii) Differential amplifier   **[5 marks]**

QUESTION FIVE (20 MARKS)

a. There are two major types of oscillators, the feedback oscillator and the relaxation oscillator. Distinguish between the two.   **[4 marks]**

b. Using well labelled circuit diagrams, explain the operation of the following feedback RC oscillators
   i)   Wien-bridge oscillator   **[5 marks]**
   ii)   Phase-Shift oscillator   **[5 marks]**

c. One of the relaxation oscillators is the triangular- wave oscillator. Explain its working mechanism   [**6 marks**]