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)

MAIN

SPECIAL RESITS EXAMINATIONS   FEB 2022

COURSE CODE: SPH 307

COURSE TITLE: INTRODUCTION TO DIGITAL ELECTRONICS

EXAM VENUE: **STREAM: EDUCATION**

DATE: **EXAM SESSION:**

TIME: 2:00 HRS

<u>**Instructions:**</u>

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. Define the term doping as used in semiconductor theory **[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 solids **[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 parameters for a transistor **[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]**