JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF ENGINEERING AND TECHNOLOGY

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

3RD YEAR 1ST SEMESTER 2019/2020 ACADEMIC YEAR

MAIN CAMPUS

COURSE CODE: SPH 307

COURSE TITLE: Introduction To Electronics

EXAM VENUE: **STREAM: (BED SCI.)**

DATE: **EXAM SESSION:**

TIME: 2 HOURS

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

QUESTION 1 (30 MARKS)

a) Using the band theory of solids distinguish between conductors, semiconductors and insulators. **(6 marks)**

b) By use of schematic diagram, fully explain how an N-type semiconductor is formed **(3 marks)**

c) Derive the relation between β and α (3 marks)

d) For a transistor, $\beta = 45$ and voltage drop across 1kΩ resistor which is connected in the collector circuit is 1 volt. Find the base current for common emitter connection. (3 marks)

e) Using well illustrative diagrams explain the three transistor circuit configurations (6 marks)

f) An NPN Transistor has a DC current gain, β=200. Calculate the base current I_b required to switch a resistive load of 4mA. (3 Marks)
g) An NPN Transistor has a DC base bias voltage, Vb of 10v and an input base resistor, Rb of 100kΩ. What will be the value of the base current into the transistor.
h) Using schematic circuit diagrams, distinguish between inverting and non-inverting op amps giving the relevant voltage properties. (4 marks)
i) An NPN transistor circuit has got the following voltage and current values; Vcc=-4.5V, Vce=3.2V and RL=25ohms, Calculate Ic (3 marks)

QUESTION 2 (20 MARKS)

a) Outline any three properties of Semiconductors (**3 marks)**
b) Using well labelled diagrams, explain the band structures of the P-type and N-type semiconductors hence draw the band structure of a P-N junction diode. **(6 marks)**
c) A p-n junction diode can be connected in a circuit both in a forward bias and reverse bias modes.
   i. Fully explain the voltage-current (V-I) characteristics of a P-N junction diode both in the forward and reverse bias modes. (3 marks)
   ii. Draw a well labelled voltage-current characteristics graph of the diode for both forward and reverse bias modes (3 marks)
   iii. With focus on charge carrier movements, explain the shape of the graph both in the forward and the reverse regions. (3 marks)

QUESTION 3 (20 MARKS)

a. Depending on the biasing of the bipolar junction transistors, a transistor can operate either in saturation, cut off or active modes. Using illustrative circuit diagrams, explain the three modes of the transistor (9 marks)
b. With focus on the charge carriers, explain the operation of a transistor in the active mode. (5 marks)
c. Draw and explain the operation of a transistor as a switch (6 marks)

QUESTION 4 (20 MARKS)

a. Using a well labelled diagram explain how the operation of a Single Stage Common Emitter Amplifier (6 marks)
b. On a common cartesian plane, draw the Output Characteristics Curves for a Typical Bipolar Transistor and in the diagram, indicate the following parameters
   Cut-off region, active region, saturation region, load line, Q-Point (10 marks)
   Explain the following transistor parameters in the diagram above
   Load line. Q point (4 marks)

QUESTION 5 (20 MARKS)

a. Op-amps have been widely applied in various applications. Using the relevant circuit diagrams, explain the operation of the following devices giving relevant voltage equations.

   i. Differential amplifier

   ii. Voltage Summing amplifier

   iii. Integrator amlplifier

   iv. Differentiator amplifier (20 marks)