DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

University Examinations – 2019/2020

THIRD YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

EEE3101: ANALOGUE ELECTRONICS I

DATE: AUGUST 2019 **TIME: 2 Hours**

INSTRUCTIONS

This paper consists of **FIVE** questions. Answer questions **ONE** and **ANY OTHER TWO**.

The following constants maybe of importance

- Silicon $n_i = 1.4 \times 10^{16}\ m^{-3}$
- $k = 1.38 \times 10^{-23}$
- $e = 1.6 \times 10^{-19}$

QUESTION ONE. **30 MARKS**

(a) Define the following terms as applied to semi-conductor sector.

i). Doping **[1 mark]**

ii). Quiescent point **[1 mark]**

iii). Knee voltage **[1 mark]**

iv). Extrinsic semiconductor **[1 mark]**

(b) Derive the relationship between β and α. **[5 marks]**

(c) Outline the conditions that enables faithful amplification **[3 marks]**

(d) Differentiate bipolar transistors (BJT) from field effect transistors (FET). **[6 marks]**

(e) With the aid of well labeled diagram, describe how an n-p-n transistor can be used as a switch. **[6 marks]**

(f) Determine the Q point of the silicon transistor circuit shown in Fig Q1. Also draw the D.C. load line, given $\beta_{dc} = 200$ **[6 marks]**

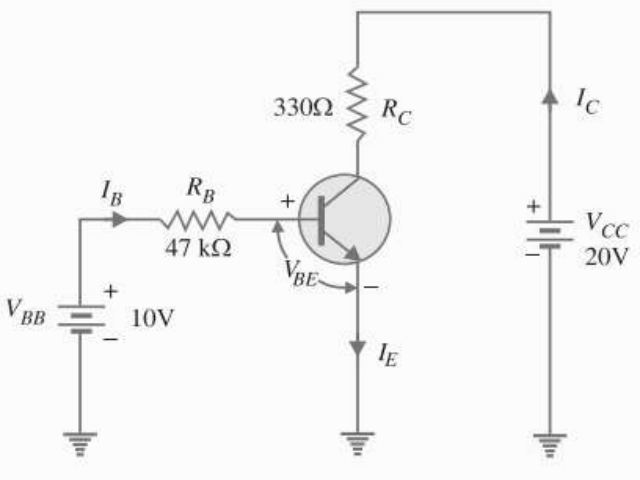

Fig. Q1

QUESTION TWO. **20 MARKS**

(a) Define the following terms in relation to FETs.

i. Source

ii. Drain

iii. Gate

iv. Channel **[4 marks]**

(b) In order for a transistor to operate in a circuit, it must be properly biased. State and explain the main reasons why transistors are biased. **[3 marks]**

(c) Describe the principle of thermal runaway. **[3 marks]**

(d) For the emitter bias silicon transistor circuit shown in Fig Q2, calculate I_E, I_C, V_C, V_{CE} for $\beta = 85$. Also determine how much the Q-point will change over a temperature range when β increase to 100 whilst V_{BE} decreases to 0.6V. **[10 marks]**

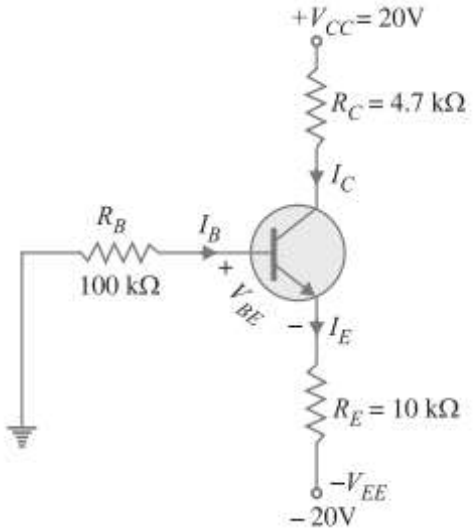

Fig. Q2

QUESTION THREE. **20 MARKS**

(a) With aid of a circuit diagram, explain why a common emitter configuration for transistors is the most used. **[4 marks]**

(b) A transistor has a base current of 50 mA and collector current of 3.65 mA.

i). Calculate the parameter β_{dc} **[3 marks]**

ii). Calculate the parameter I_E **[3 marks]**

(c) Draw the schematic diagrams for a *p*-channel and an *n*-channel JFET. Label the terminals. **[4 marks]**

(d) One application of transistors is acting as an amplifier. Using Fig. Q3, determine the r.m.s output voltage of the unloaded amplifier given that I_{DSS} = 8 mA, $V_{GS\,(off)}$ = -10 V and I_D = 1.9 mA. **[6 marks]**

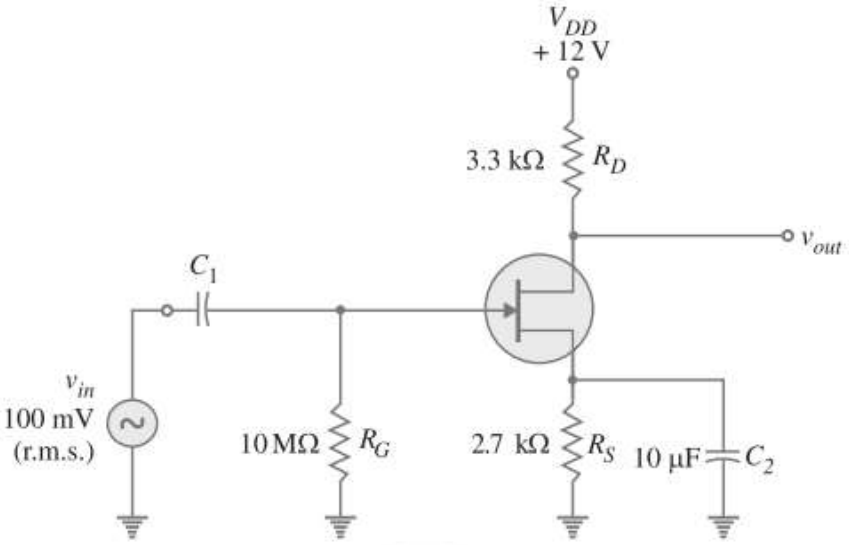

Fig. Q3

QUESTION FOUR. **20 MARKS**

(a) Outline four methods of bipolar transistor biasing. **[4 marks]**

(b) With aid of diagram explain hole formation so as to establish hole current in semiconductor circuits. **[6 marks]**

(c) Name three (3) discharge methods by which gases can conduct electricity **[3 marks]**

(d) A silicon diode in an adapter rectifying circuit has a carrier density of 10^{-21}in ***p*** material and $10^{22}m^{-3}$ in ***n*** material, the temperature of the charger changes from 27°C to 42°C, find the change in barrier potential of the diode. **[7 marks]**

QUESTION FIVE. **20 MARKS**

a) Define the following giving an example in each case.

i). Ohmic conductors

ii). Negative temperature coefficient **[4 marks]**

b) With the aid of well labelled diagrams, explain how a silicon crystal can be doped to form extrinsic semiconductors. Give examples of appropriate doping elements for each case. **[8 marks]**

c) In a self-bias n-channel JFET, the operating point is to be set at I_D = 1.5 mA and V_{DS} = 10 V. Provided that the JFET parameters are I_{DSS} = 5 mA and $V_{GS\ (off)}$ = -2 V. Given that V_{DD} = 20 V. Draw the circuit diagram and calculate the values of R_S and R_D. **[8 marks]**