DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY

University Examinations – 2021/2022

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR THE DEGREE OF

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

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BACHELOR OF SCIENCE IN TELECOMMUNICATION AND INFORMATION ENGINEERING

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BACHELOR OF EDUCATION IN TECHNOLOGY (ELECTRICAL AND ELECTRONIC ENGINEERING)

EEE/ETI 3101: ANALOGUE ELECTRONICS I

DATE: APRIL 2022 **TIME: 2 Hours**

INSTRUCTIONS

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

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) Show that the transconductance of a JFET varies as the square root of the drain current. **[4 Marks]**

(d) Differentiate bipolar transistors (BJT) from field effect transistors (FET). **[5 Marks]**

(e) Draw and explain the operation of Enhancement only PMOS. **[6 Marks]**

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

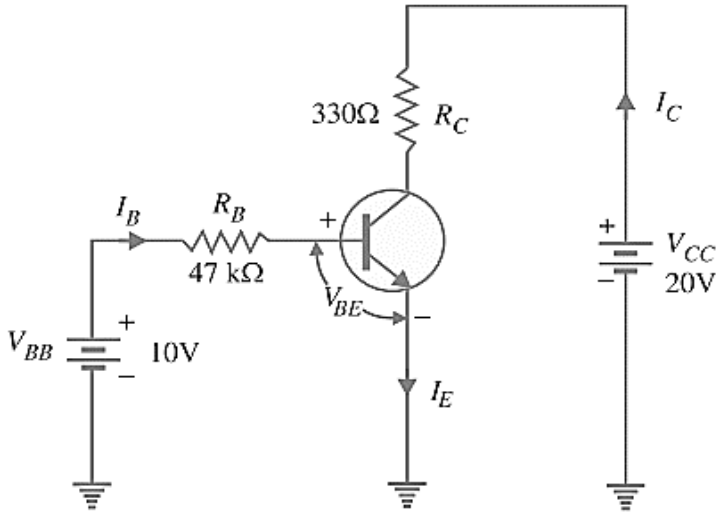

Fig. Q1

QUESTION TWO. **20 MARKS**

(a) Define the following terms in relation to FETs. **[4 Marks]**

i. Source

ii. Drain

iii. Gate

iv. Channel

(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 in transistors. **[3 Marks]**

(d) For the emitter bias silicon transistor circuit shown in Fig Q2, calculate I_E, I_C, V_C, V_{CE} for β = 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]**

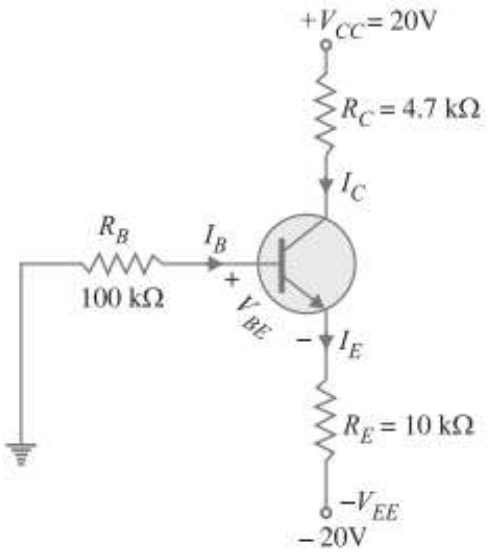

Fig. Q2

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 50μA 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 construction and 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]**

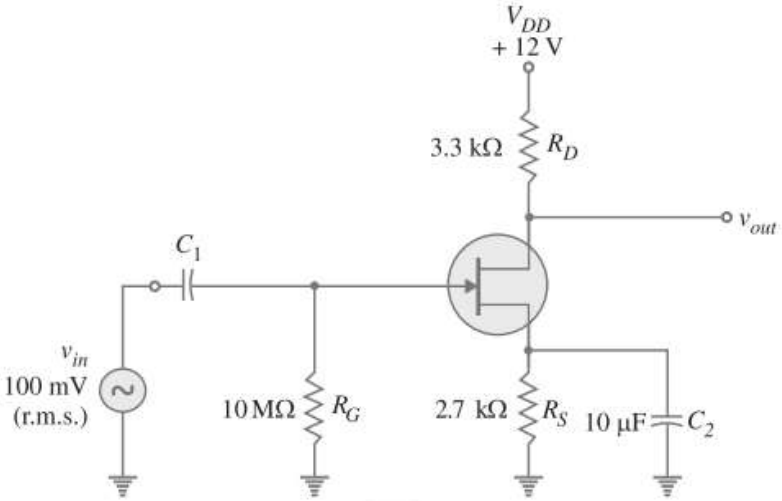

Fig. Q3

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. **[4 Marks]**

i). Ohmic conductors

ii). Negative temperature coefficient

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

c) If in the CE circuit given in Fig Q5, V_{cc} = 20V, R_C = 10$k\Omega$, R_{B1} = 1MΩ, R_{B2} = ∞, R_L = 1MΩ, V_S = 2mV, and β = 50, find; i_b, i_c, r_{in}, r_L, A_v, and G_p. **[10 Marks]**

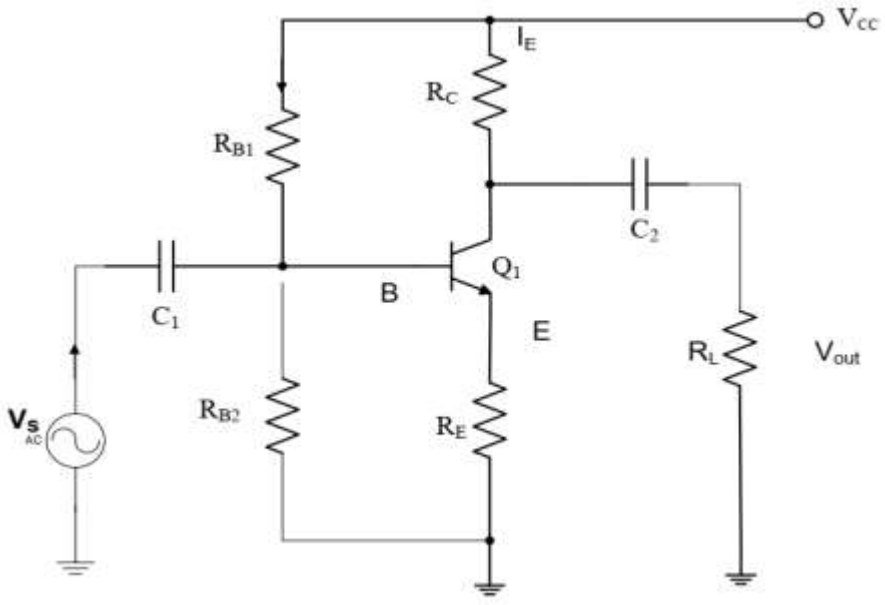

Fig. Q5