



DEDAN KIMATHI UNIVERSITY OF TECHNOLOGY
UNIVERSITY EXAMINATION 2021/2022 ACADEMIC YEAR

THIRD YEAR SPECIAL/SUPPLEMENTARY EXAMINATION FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING
&
BACHELOR OF SCIENCE IN TELECOMMUNICATION AND INFORMATION
ENGINEERING
&
BACHELOR OF EDUCATION IN TECHNOLOGY (ELECTRICAL AND
ELECTRONIC ENGINEERING)

EEE/ETI 3101: ANALOGUE ELECTRONICS I

DATE: 13TH APRIL 2022

TIME: 8:30 - 10:30 AM

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 $\beta_{dc} = 200$. **[6 Marks]**

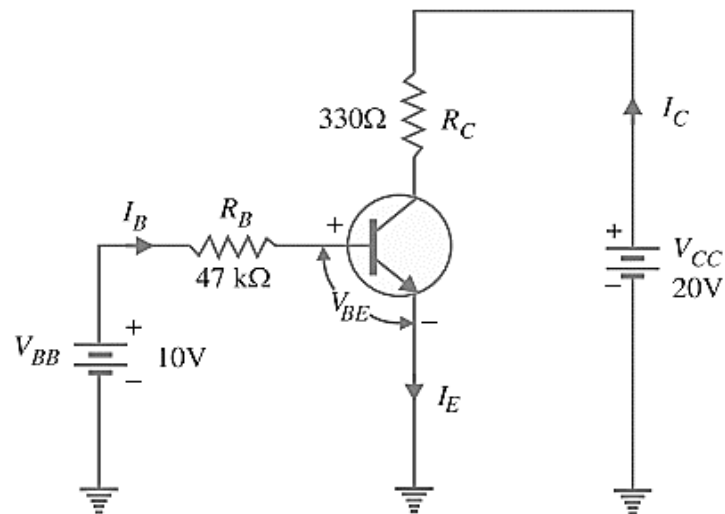


Fig. Q1

QUESTION TWO.

20 MARKS

- (a) Define the following terms in relation to FETs. **[4 Marks]**
- Source
 - Drain
 - Gate
 - 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 $\beta = 85$. 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]**

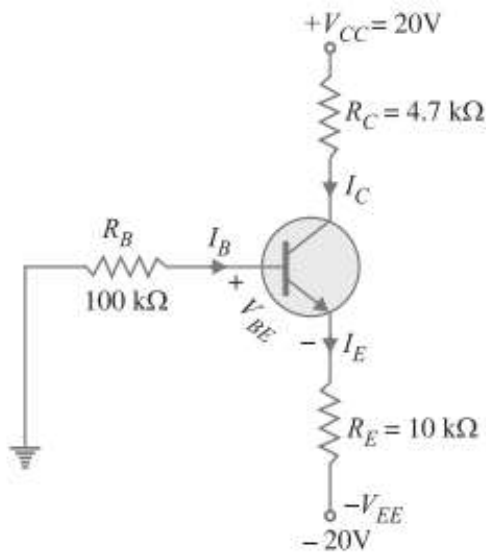


Fig. Q2

QUESTION THREE.

20 MARKS

- With aid of a circuit diagram, explain why a common emitter configuration for transistors is the most used. **[4 Marks]**
- A transistor has a base current of $50\mu\text{A}$ and collector current of 3.65 mA .
 - Calculate the parameter β_{dc} **[3 Marks]**
 - Calculate the parameter I_E **[3 Marks]**
- Draw the construction and schematic diagrams for a *p*-channel and an *n*-channel JFET. Label the terminals. **[4 Marks]**
- 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 $I_{DSS} = 8\text{ mA}$, $V_{GS(off)} = -10\text{ V}$ and $I_D = 1.9\text{ mA}$. **[6 Marks]**

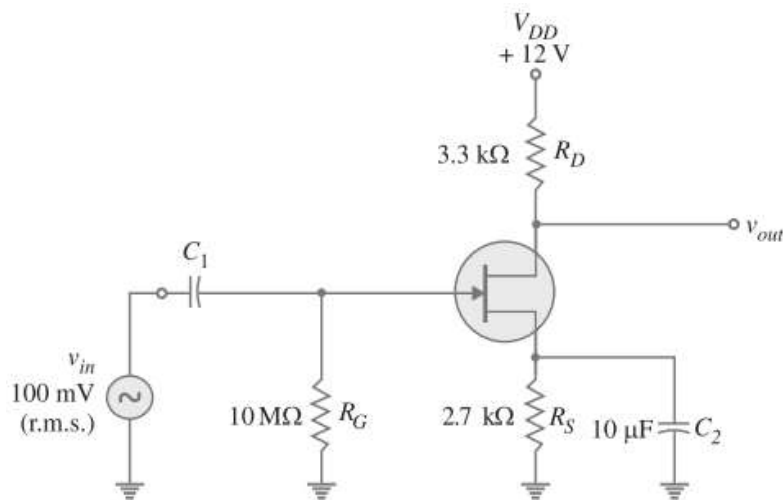


Fig. Q3

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, $V_{cc} = 20\text{V}$, $R_C = 10\text{k}\Omega$, $R_{B1} = 1\text{M}\Omega$, $R_{B2} = \infty$, $R_L = 1\text{M}\Omega$, $V_s = 2\text{mV}$, and $\beta = 50$, find; i_b , i_c , r_{in} , r_L , A_v , and G_p . **[10 Marks]**

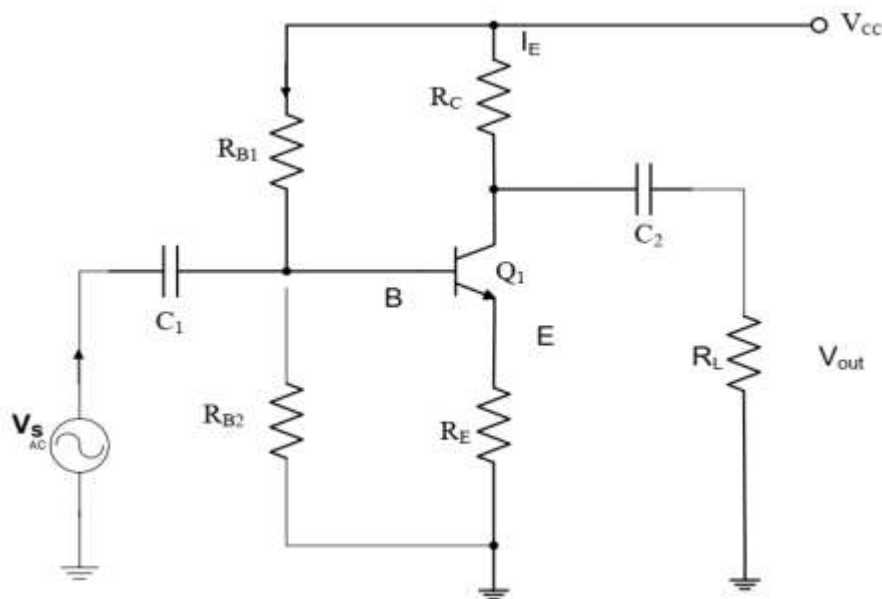


Fig. Q5