



## 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**.

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#### **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  $\beta$  and  $\alpha$ .

**[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]**

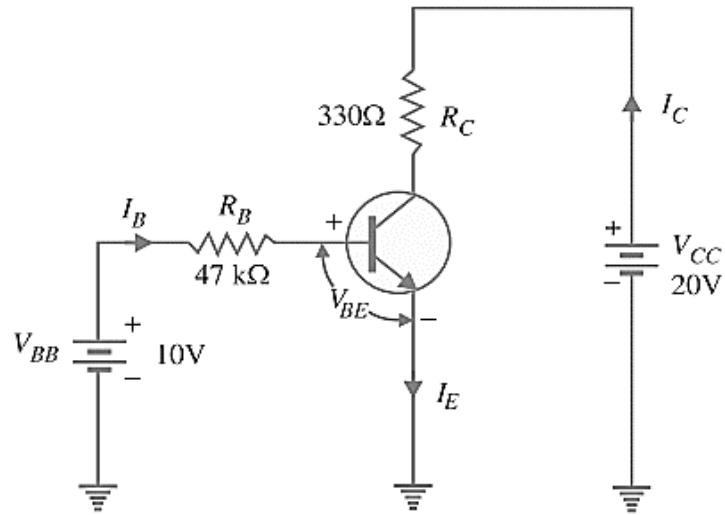


Fig. Q1

## **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  $\beta$  increase to 100 whilst  $V_{BE}$  decreases to 0.6V. **[10 Marks]**

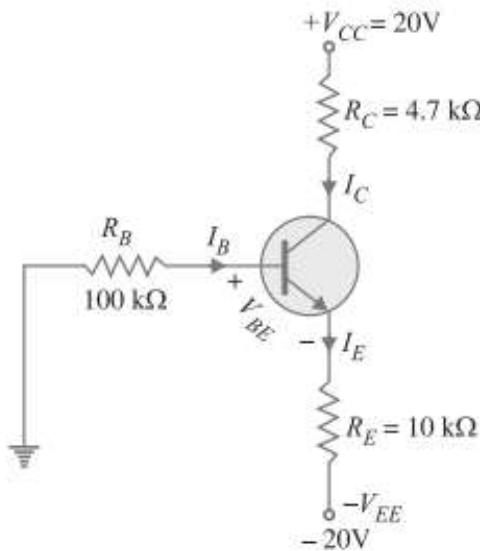


Fig. Q2

**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  $50\mu\text{A}$  and collector current of  $3.65 \text{ mA}$ .
- Calculate the parameter  $\beta_{dc}$  **[3 Marks]**
  - 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  $I_{DSS} = 8 \text{ mA}$ ,  $V_{GS(\text{off})} = -10 \text{ V}$  and  $I_D = 1.9 \text{ mA}$ . **[6 Marks]**

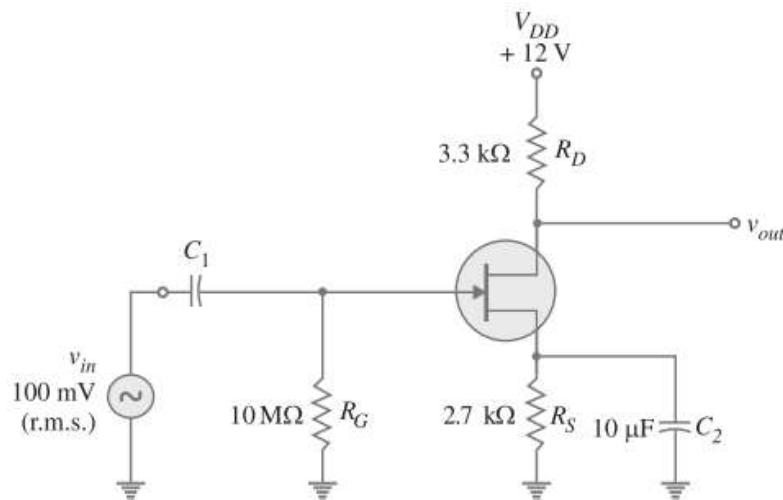


Fig. Q3

**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  $10^{22} \text{ m}^{-3}$  in **n** material, the temperature of the charger changes from  $27^\circ\text{C}$  to  $42^\circ\text{C}$ , 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]**
- Ohmic conductors
  - 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,  $V_{cc} = 20V$ ,  $R_C = 10k\Omega$ ,  $R_{B1} = 1M\Omega$ ,  $R_{B2} = \infty$ ,  $R_L = 1M\Omega$ ,  $V_s = 2\text{mV}$ , and  $\beta = 50$ , find;  $i_b$ ,  $i_c$ ,  $r_{in}$ ,  $r_L$ ,  $A_v$ , and  $G_p$ . **[10 Marks]**

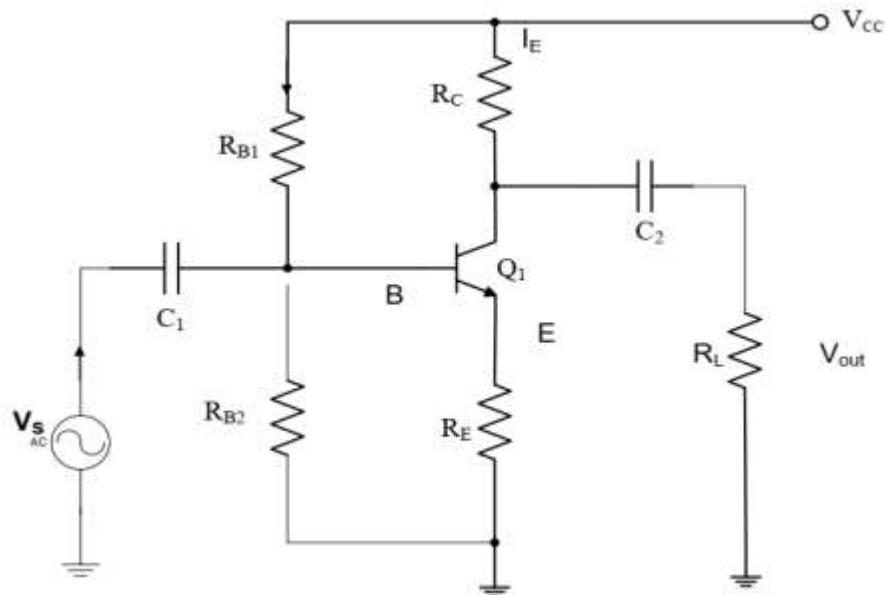


Fig. Q5