



TECHNICAL UNIVERSITY OF MOMBASA

School of Applied and Health Sciences

DEPARTMENT OF MATHEMATICS AND PHYSICS

UNIVERSITY SUPPLEMENTARY EXAMINATIONS 2024/2025

FOR THE DEGREE OF BACHELOR OF TECHNOLOGY IN APPLIED PHYSICS IN ELECTRONIC & INSTRUMENTATION

EEE 4253: ANALOGUE ELECTRONICS

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: JULY, 2025

TIME: 2 HOURS

INSTRUCTIONS:

1. You should have the following for this examination:
 - Answer booklet
 - Non-Programmable Scientific calculator
2. This paper consists of **FIVE** questions
3. Answer **QUESTION ONE** and other TWO Questions.
4. Do not write on the question paper.

Question ONE

- (a)
- (i) Explain the difference in conductors, insulators and semi-conductors using the number of electrons on the outer energy shell.
 - (ii) Discuss the effect of temperature on semiconductors.
 - (iii) Describe the transistor action and its operation as an amplifier.
 - (iv) Derive the expression

$$I_c = \alpha \cdot I_B / (1 - \alpha) + I_{CBO} / (1 - \alpha)$$

(10 marks)

- (b) Consider a triac and uni-junction transistor
- (i) Draw the basic structure diagram
 - (ii) Draw the circuit symbol
 - (iii) Sketch the I-V characteristics
 - (iv) Briefly describe the principle of operation
- (c) Find the h-parameters for the circuit of Fig.Q1

(10 marks)

(10 marks)

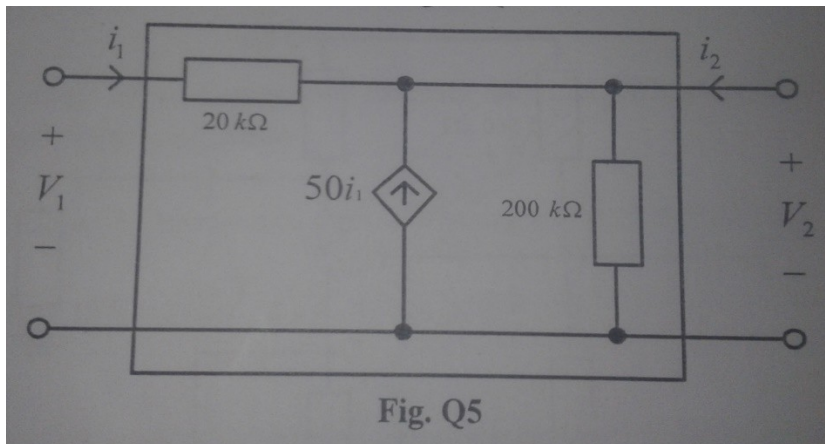


Fig.Q1

Question TWO

- (a)
 - (i) Sketch the circuit of full wave rectifier .
 - (ii) Discuss the terminologies thermal runaway and heat sink as used in transistors. **(5 marks)**
- (b) A half wave rectifier with ideal diode has an applied a.c. voltage of 250 V rms at 50 Hz; the load is $R = 575\Omega$. Calculate I_{dc} , V_{dc} and I_{rms} in the load. **(10 marks)**
- (c) State and explain at least TWO main technologies of fabricating integrated circuits. **(5 marks)**

Question THREE

- (a) Consider an enhancement type MOSFET.
 - (i) Draw the circuit symbol
 - (ii) Discuss its construction and operation
 - (iii) Draw its output and transfer characteristics. **(10 marks)**
- (b)
 - (i) Describe single stage transistor amplifier
 - (ii) Draw the circuit of single transistor amplifier. Explain the function of each component. **(10 marks)**

Question FOUR

- (a)
 - (i) Draw a sketch to show the various current components in a transistor and briefly explain the origin of each.
 - (ii) Derive an expression for the collector current I_C in terms of base currents I_B and reverse saturation current I_{CBO} .
 - (iv) The collector and base currents of a transistor are measured as $I_C = 5.202\text{mA}$, $I_B = 50\mu\text{A}$, $I_{CBO} = 2\mu\text{A}$.
 - (I) Calculate α_{dc} , β_{dc} and I_E
 - (II) Determine the new level of I_B required to make $I_C = 10\text{mA}$. **(10 marks)**
- (c) Consider photodiode
 - (i) Draw the basic structure diagram
 - (ii) Draw the circuit symbol
 - (iii) Sketch the I-V characteristics
 - (iv) Briefly describe the principle of operation
 - (v) State one application. **(10 marks)**

Question FIVE

- (a) State in what respects the diffusion technique transistor manufacture superior to either alloy or grown methods. **(2 marks)**
- (b) (i) Using suitable diagrams differentiate between common-base, common emitter and common-collector transistor circuit configuration.
- (ii) A transistor connected in CE configuration in which collector supply is 10V and the voltage drop across load resistance R_L connected in the collector circuit is 0.5V. The value of $R = 1k\Omega$ and $\alpha = 0.95$.
- (I) Draw the circuit diagram
- (II) Collector emitter voltage
- (III) Base current. **(10 marks)**
- (c). Define and state the names of four h-parameters for a transistor in CE configuration **(8 marks)**