071306T4EEN

ELECTRICAL ENGINEERING (POWER OPTION) LEVEL 6

ENG/OS/PO/CR/04/6

Demonstrate Understanding of Electronics

July/August 2025

TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL

TVET CURRICULUM DEVELOPMENT, ASSESSMENT AND CERTIFICATION COUNCIL (TVET CDACC)

WRITTEN ASSESSMENT

Time: 3 HOURS

INSTRUCTIONS TO CANDIDATE

1. This paper consists of **TWO** sections: **A** and **B**
2. Attempt **ALL** questions in section **A** and **ANY THREE (3)** questions in section **B**.
3. Marks for each question are indicated in the brackets.
4. Candidates are provided with a separate answer booklet.
5. **DO NOT** write on the question paper

This paper consists of FIVE (5) printed pages

Candidates should check the question paper to ascertain that all pages are printed as indicated and that no questions are missing.

SECTION A (40 MARKS)

*Attempt **ALL** the questions in this section*

1. In designing power supplies for electronic equipment, one of the earliest steps involves preparing the input voltage for further regulation and use. Define the term rectification with respect to power supplies. (2 marks).
2. In electronic circuits, proper biasing of transistors is crucial for optimal amplifier performance. Explain TWO reasons why transistor biasing is necessary in amplifier circuits. (4 marks)
3. Semiconductor materials form the foundation of modern electronics. Define an intrinsic semiconductor and provide TWO examples of such materials. (4marks)
4. Field-effect transistors (FETs) are essential in modern electronics, with JFETs and MOSFETs being two fundamental types. Identify three key differences between a Junction Field-Effect Transistor (JFET) and a Metal-Oxide-Semiconductor Field-Effect Transistor (MOSFET). (3 marks)
5. Optoelectronic devices play a critical role in modern electronic systems by converting between light and electrical signals. Identify FOUR common types of optoelectronic devices used in electronic circuits. (3 marks)
6. Electronic oscillators are widely used in communication systems, signal generation, and timing applications. Based on their operational principles and output characteristics, name THREE sinusoidal LC oscillators. (3 marks)
7. Special semiconductor devices enable precise control of power in electronic circuits. Identify FOUR types of special semiconductor devices commonly used in power electronics. (4 marks)
8. The choice of semiconductor material significantly impacts the performance, cost, and reliability of electronic devices. In modern applications, silicon has emerged as the dominant choice due to its advantageous properties. Explain TWO reasons why silicon is preferred over germanium in modern electronics. (4 marks)
9. Diodes are fundamental components in electronic circuits. Name THREE types of diodes and ONE application of each of the diodes named. (6marks)
10. Semiconductors are materials with electrical conductivity between conductors and insulators. Their properties can be modified through doping, leading to intrinsic and extrinsic types. Differentiate between intrinsic and extrinsic semiconductors. (4 marks)

11. A transistor amplifier has a collector current of 5mA and a base current of 50μA. Determine the current gain (β). (3 marks)

SECTION B (60 MARKS)

Attempt Any THREE Questions in This Section

12. Most electronics need steady DC power, but get AC electricity from the plug-in point. A bridge rectifier design handles this important conversion.
    a) With the aid of a labelled diagram, explain how a bridge rectifier converts AC to DC. (10 marks)
    b) Sketch the waveform of the input and output signals for the bridge rectifier in (a) above (4 marks).
    c) Illustrate the V-I characteristics of a forward-biased and reverse-biased PN junction diode. (6 marks)
13. In transistor amplifier design, ensuring correct current flow and stable operation depends heavily on how the transistor is biased.
    a) With the aid of a circuit diagram, explain the biasing of a PNP bipolar junction transistor. (8 marks).
    b) Determine the values of I_B, I_E and I_C and V_{CE} in the *fig.1* shown below given that: V_{CC}=6V, R_B=530KΩ, R_C=2KΩ, V_{BE}=0.7V (12 marks)

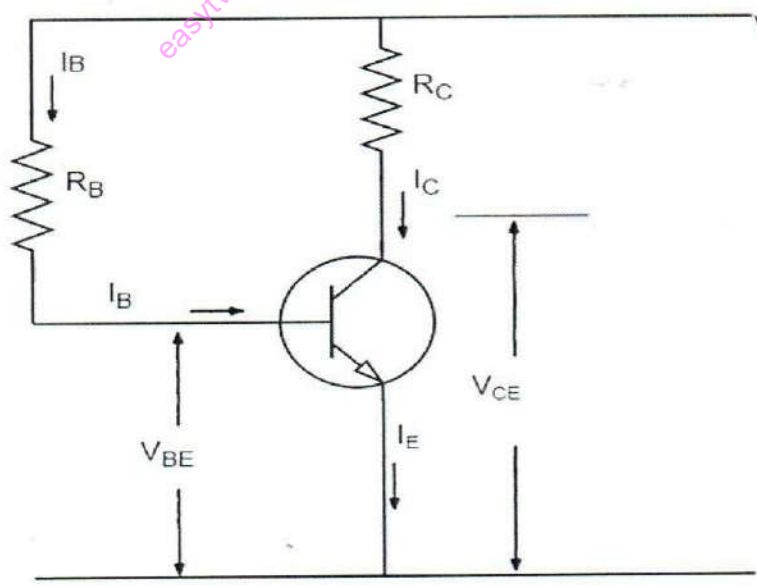

Fig.1

14. Special semiconductor devices play a vital role in electronic switching, triggering, and waveform shaping.
    a) State THREE methods of turning ON a Silicon Controlled Rectifier (SCR). (3 marks).
    b) With the aid of a labelled diagram, describe the operation of an SCR. (7marks).

c) With the aid of a labelled diagram, describe the operation of a TRIAC.(6 marks).

d) Explain TWO applications of the TRIAC (4 marks).

15. Oscillators are essential components in electronic systems for generating continuous waveforms without input signals.

a) Explain THREE merits of sinusoidal oscillators (3 marks).

b) With the aid of a labelled diagram, describe the construction of Colpitt's oscillator. (6 marks).

c) Optoelectronic devices such as LEDs and photodiodes play a vital role in light-based signal transmission and detection in modern electronics systems. With the aid of clearly labelled diagrams, compare the construction and operation principles of a Light Emitting Diode (LED) and a Liquid Crystal Display (LCD), outlining their differences in structure, operation, and application. (11marks)