

071306T4ELC

ELECTRONICS ENGINEERING LEVEL 6

ENG/CU/ET/CC/05/6/A

Demonstrate Understanding of Electronics

July/August 2023

Time: 3 Hours



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

**WRITTEN ASSESSMENT
3 HOURS**

INSTRUCTIONS TO CANDIDATE:

- i. *This paper consists of **TWO** sections: **A** and **B**.*
- ii. *Answer **ALL** questions in sections **A** and **B** in the answer booklet provided.*
- iii. *Marks for each question are indicated in brackets.*
- iv. *Do not write on this question paper.*
- v. *You are allowed to use non programmable scientific calculator.*
- vi. *Answer the questions in **English**.*

This paper consists of FOUR printed pages.

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

SECTION A (40 MARKS)

Answer ALL the questions in this section.

1. With aid of a diagram, explain what is a conductor using energy band theory is.(4 marks)
2. Outline THREE properties of semiconductors. (3 marks)
3. Distinguish between intrinsic and extrinsic semiconductors. (4 marks)
4. Explain the following terms as used in semiconductors:
 - i. Forward biasing; (2 marks)
 - ii. Reverse biasing. (2 marks)
5. Use standard symbols to differentiate between PNP and NPN transistors. (4 marks)
6. List FOUR advantages of Field Effect Transistor (FET) over Bipolar Junction Transistor (BJT). (4 marks)
7. State FOUR applications of a zener diode. (4 marks)
8. State THREE types of rectifiers. (3 marks)
9. Complete the following Boolean identities. (3 marks)
 - i. $A + 0 = \underline{\hspace{2cm}}$
 - ii. $A + 1 = \underline{\hspace{2cm}}$
 - iii. $A + A = \underline{\hspace{2cm}}$
10. State THREE types of flip-flops. (3 marks)
11. A bipolar transistor has a common-emitter current gain of 125. If the transistor operates with a collector current of $50mA$, determine the value of base current. (3 marks)
12. Define doping as used in semiconductors. (1 mark)

SECTION B (60 MARKS)

Answer any *THREE* questions in this section.

13. (a) Figure 1 shows a circuit diagram of an amplifier using the collector-base feed bias. Taking $\beta = 100$ and $V_{BE} = 0.7V$, determine the:

- i. Base current, I_b ;
- ii. Collector current, I_C ;
- iii. Emitter terminal voltage V_e ;
- iv. Collector emitter voltage V_{Ce} . (10 marks)

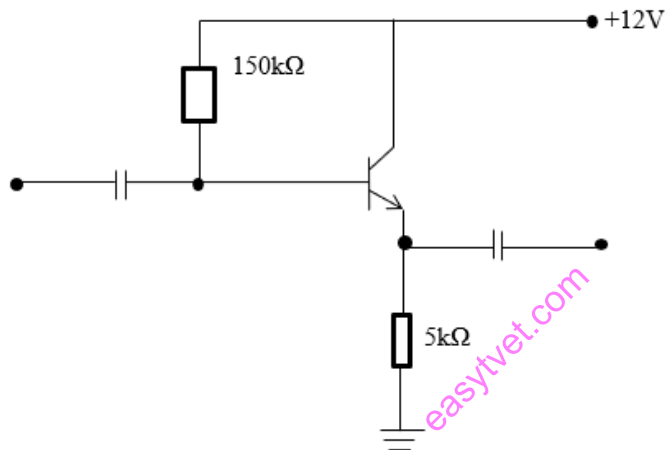


Figure 1

(b) Draw and explain the *voltage – current ($V - I$)* characteristics curves of a P-N junction diode. (10 marks)

14. (a) A center-tapped full-wave rectifier is connected to a transformer whose each secondary coil has a r.m.s. voltage of 12 V. Assume the internal resistances of the diode and load resistance are 50Ω and $1k \Omega$, respectively. Find:

- i. The load current measured by a voltmeter;
- ii. The D.C. load current. (6 marks)

(b) For the JFET circuit shown in the figure 2, $I_{DSS} = 5mA$, $I_D = 1.5mA$, $V_{DS} = 10V$ and $V_{GS} = -2V$. Given that $V_{DD} = 20V$, Determine the working values of:

- i. R_S ;
- ii. R_L . (6 marks)

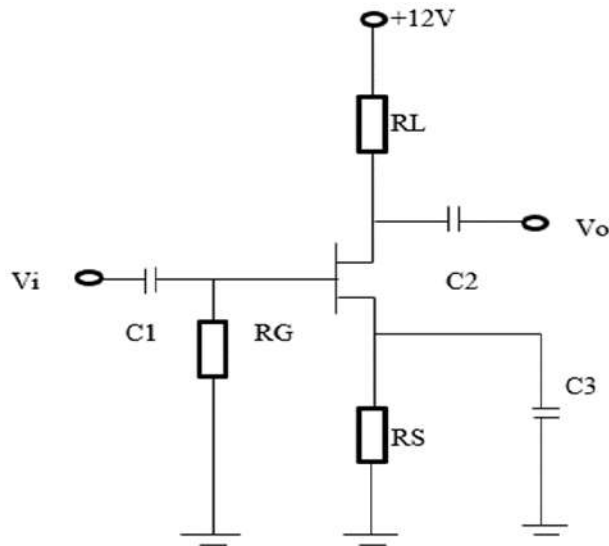


Figure 2

(c) State FOUR method of biasing a transistor. (4 marks)

(d) State TWO types of diodes and give two uses for each. (4 marks)

15. (a) Perform the following number conversions:

i. 7401_8 to decimal;

ii. 10.625_{10} to binary;

iii. $2C9_{16}$ to decimal.

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(9 marks)

b) Perform each of the following binary arithmetic:

i. $(11010)_2 + (1001)_2$;

ii. $(11010)_2 \div (101)_2$.

(6 marks)

c) Using Boolean rules, simplify the following expression.

$$Y = (A + B)(B + C)$$

(5 marks)

16. (a) Derive the expression for the logic circuit shown in figure 3.

(6 marks)

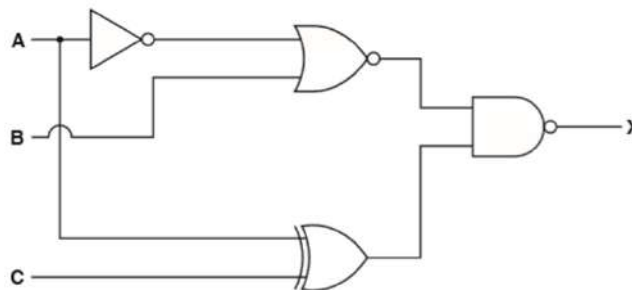


Figure 3

(b) With aid of a truth table, explain the operation of a JK- flipflop. (8 marks)

(c) State THREE differences between synchronous and asynchronous counters. (6 marks)

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