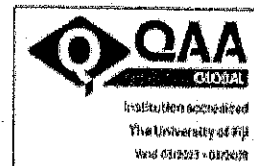


The University of Fiji
(An Entity of Arya Pratinidhi Sabha of Fiji)



SCHOOL OF SCIENCE AND TECHNOLOGY

Semester 2, 2025

FINAL EXAMINATION PAPER

PHY314: ELECTRICITY AND ELECTRONICS

Important Instructions to Students:

1. There are 6 pages. Read the questions and instructions carefully and answer the questions.
2. You are allowed an **extra 10 minutes of reading time** (during this time, you are not allowed to write with a pen) and **180 minutes (3 Hours) to complete this paper**.
3. Silent, non-programmable calculators are allowed, but not supplied.
4. Write all your answers in the answer booklet provided. If you need extra sheets, please ask the supervisor. Write your name, course code and student identification number in the answer booklet and in the attendance sheet.
5. This paper contains two (2) sections A and B. All questions are compulsory to answer **except** section B has choices.
6. Write all your answers legibly. The marker has the right to award zero for answers that are not legible.
7. This is a **Closed Book Examination**. The University views plagiarism, cheating and dishonest practice as serious offences and if found, offenders are penalized.

Examination Paper Content (Format):

<u>Section</u>	<u>Question</u>	<u>Content</u>	<u>Marks</u>	<u>Suggested Time</u>
A	1-10	Short Answer Questions	30	50 minutes
B	1-8	Long Answer Questions	70	130 minutes
		TOTAL	100	180 Minutes

*Registered with the Fiji Higher Education Commission as a University under the Higher Education Act 2008.
Registration Certificate Number (RGN0020/11)*

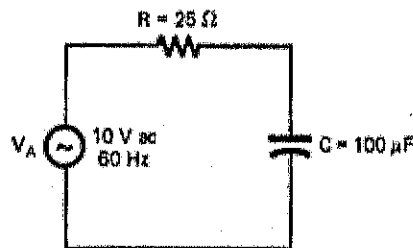
SECTION A

SHORT ANSWER QUESTIONS

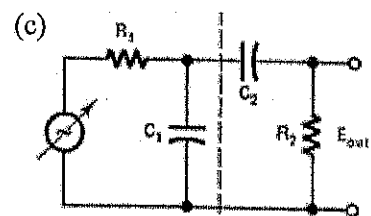
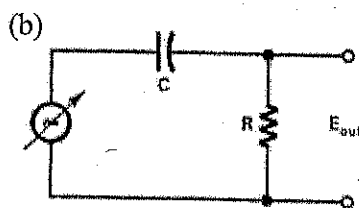
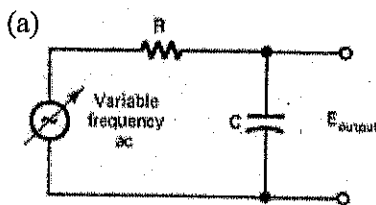
[30 MARKS]

Answer **ALL** questions in the answer booklet. You are advised not to spend more than 50 minutes in this section. **Each question is worth 3 marks.**

- Using suitable diagrams, describe how alternating current (AC) differs from direct current (DC).
- For the series RC circuit below, find the **capacitive reactance** (X_c) and the **impedance** (Z).



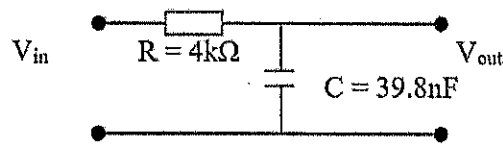
- Define the terms insulator, conductor, and semiconductor and give examples for each.
- Draw phasor diagrams showing the relationship between voltage and current for a pure resistor, pure inductor, and pure capacitor in an AC circuit. Explain the phase difference for each component.
- Three different filter circuits are shown below. State the type of filter each circuit represents and draw the corresponding frequency response curves, clearly indicating the cut-off frequency and the general shape of the response.



- Describe the behaviour of a diode under forward and reverse bias conditions.
- List 3 differences between a Bipolar Junction Transistor and a Junction Field Effect Transistor.
- Convert 4780_{10} into its hexadecimal equivalent.
- Draw the logic circuit corresponding to the Boolean expression: $ABC + \bar{A}\bar{B}C = X$
- Explain why a counter circuit is often referred to as a divider?

QUESTION 3

The circuit below shows a low pass filter. Use the circuit to answer the questions that follows.



- I. Obtain an expression for the response gain A_v of the filter.
- II. Derive an expression for the response A_v in dB of the filter in terms of frequency f and cut-off frequency f_c .
- III. Determine the corner frequency.
- IV. Determine the slope per decade in dB/decade.

[3+3+2+2 marks]

QUESTION 4

- A. With the help of diagrams show how the structure of the n-type and p-type semiconductor materials are made and the process through which conduction occurs.

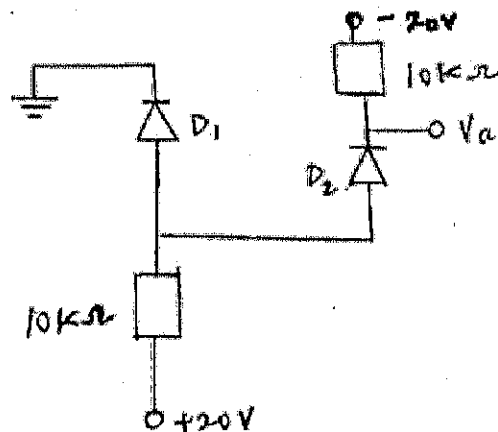
[4 marks]

- B. Explain the operation of a half-wave rectifier and a full-wave rectifier, supporting your explanation with clearly labelled circuit diagrams and waveform sketches. In your response, describe how each circuit converts AC to DC.

[6 marks]

QUESTION 5

Refer to the circuit below and assuming the diodes to be ideal, determine the value of V_a and current, I through the resistors and diodes.



[10 marks]

QUESTION 6

A. A bipolar transistor having $\beta = 300$, $V_A = 120 \text{ V}$ and $I_{SE} = 2 \times 10^{-13} \text{ A}$ at $V_{CE} = 10 \text{ V}$ connected in common-emitter configuration.

- I. If $V_{CE} = 5 \text{ V}$ and $V_{BE} = 0.65 \text{ V}$, calculate the value of I_C , I_E and I_B assuming that $K = 40 \text{ V}^{-1}$
- II. What is the output resistance of the transistor at the operating point?

[2+2 marks]

B. The following readings were obtained experimentally from a JFET:

V_{GS}	V_{DS}	I_D
0.0 V	6 V	9.20 mA
0.0 V	16 V	9.60 mA
-0.30 V	16 V	8.70 mA

Determine:

- I. a.c. drain resistance
- II. Transconductance
- III. Amplification factor.

[2+2+2 marks]

QUESTION 7

A. Convert the octal number 7401 to binary.

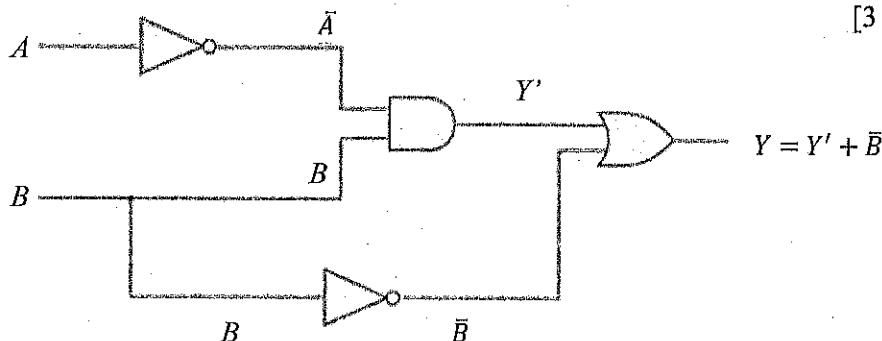
[2 marks]

B. Convert $(101110)_2$ into a decimal number.

[2 marks]

C. Obtain the truth table for the circuit shown below.

[3 marks]



D. Determine the complement of the expression: $Y = \bar{A} + (B\bar{C} + \bar{B}C)$

[3 marks]

QUESTION 8

A. Differentiate between synchronous and asynchronous flip-flop.

[2 marks]

B. I. Draw the circuit diagram of a Master-slave J-K flip-flop using NAND gates.

II. What is race around condition?

III. How is it eliminated in a Master-slave J-K flip-flop?

[4+2+2 marks]

THE END