CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION

JULY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LED31403**
SUBJECT TITLE	:	**POWER ELECTRONICS AND DEVICES**
PROGRAMME NAME (FOR MPU: PROGRAMME LEVEL)	:	**DIPLOMA OF ENGINEERING TECHNOLOGY IN ELECTRICAL AND ELECTRONICS (MARINE)**
TIME / DURATION	:	**09.00 AM - 12.00 PM (3 HOURS)**
DATE	:	**23 DECEMBER 2025**

INSTRUCTIONS TO CANDIDATES

1. Please read **CAREFULLY** the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of **TWO (2)** sections; Section A and Section B.
4. Answer **ALL** questions in Section A. For Section A, answer **TWO (2)** questions **ONLY**.
5. Please write your answers on this answer booklet provided.
6. Answer **ALL** questions in English language **ONLY**.
7. Answer should be written in blue or black ink except for sketching, graphic and illustrations.

THERE ARE 6 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total:60 marks)

INSTRUCTION: Answer ALL questions

Please use the answer booklet provided

Question 1

With reference to introduction of power electronics

(a) State the definition of power electronics and give 2 examples of its application. The 2 examples of power devices are DIODE and TRIAC. Draw their symbol and characteristic.

(6 marks)

(b) 4 types of power electronics circuit are listed below. Explain each circuit function in terms of electric power conversion.

i. Rectifier
ii. AC voltage controller.
iii. DC chopper.
iv. Inverter.

(4 marks)

(c) Thyristor is one of the most important types of semiconductor devices. Draw the symbol and the construction of 3 p-n junctions.

Draw the thyristor characteristics graph and show the followings:

i. Forward Breakover Voltage, V_{BO}.
ii. Reverse Breakdown Voltage, V_{RB}.
iii. Latching Current, I_L.
iv. Holding current, I_H.
v. Gate Triggered Curve.

(10 marks)

Question 2

With reference to AC to DC converter

(a) With the aid of suitable circuit, explain briefly the operation of the uncontrolled half-wave rectifier with R load

(4 marks)

(b) Sketch the waveform of the input voltage, V_S output voltage, V_O and input current i_s and voltage across the diode, V_D for the circuit in part (a).

(6 marks)

(c) A uncontrolled half wave rectifier has an AC source of 100 V_{rms} at 50 Hz. The load is 100 Ω resistors. Determine:

i. the dc output voltage

(4 marks)

ii. the dc load current

(2 marks)

iii. the ac load current

(2 marks)

iv. the input power to the rectifier

(2 marks)

Question 3

With reference to DC-to-DC converter

(a) State the function of buck converter and boost converter.

(2 marks)

(b) Sketch circuit diagrams for buck converter and boost converter. Label important parameters in the circuits.

(4 marks)

(c) A buck converter with parameters L = 10mH, C = 50μF and R = 5Ω is supplies with 24V input and operated with 0.6 duty ratio. Its switching frequency is 150 kHz. Calculate:

i. the output voltage,

(2 marks)

ii. the maximum and minimum inductor current.

(2 marks)

(d) A boost converter with a 5 mH inductor has an input of 50V and an output of 125 V. the switching frequency is 4 kHz and the output power to the resistor load is 125W. calculate :

i. the duty cycle,

(3 marks)

ii. the minimum and maximum inductor current

(4 marks)

iii. sketch the inductor current waveform over one (1) period. Mark the minimum and maximum values of inductor current based calculation made in Part (d) (i).

(3 marks)

SECTION B (Total:40 marks)

INSTRUCTION: Answer only TWO (2) questions.

Please use the answer booklet provided.

Question 4

With reference to the AC to AC converter

(a) With the aid of suitable circuit explain briefly the operation of a single phase AC voltage controller with resistive load

(4 marks)

(b) Sketch the waveform of the input voltage, V_S output voltage, V_O and output current i_o and voltage across the switch, Vsw for the circuit in part (a).

(6 marks)

(c) The single phase AC voltage controller in Figure part (a) has a $120 V_{rms}$ at 50 Hz source. The load resistance is 15Ω. The delay angle α is 90^o Determine:

i. the rms source current to deliver 500W to the load

(4marks)

ii. the rms and average currents in the SCRs,

(4 marks)

iii. the power factor

(2 marks)

Question 5

With reference to the AC to DC converter

Controlled rectifier, which is also known as ac-dc converters are used especially in variable speed drives. Three phase controlled rectifiers are simple and less expensive and the efficiency is in general above 95%.

(a) Draw the circuits for the following single-phase controlled rectifiers below:

i. Half-wave converter

ii. Full-wave converter.

(b) A single phase full-wave converter is operated from 120V 50Hz supply. The circuit has a highly inductive load and following formulas are given:

$V_{dc} = (2V_m \cos\alpha)/\pi$

$V_{rms} = V_s$

The thyristors are fired at three different firing angles $\alpha : 0, \pi/2 \text{ and } \pi$.

i. Draw the input waveform to the circuit and draw the output waveforms for all firing angles.

ii. Evaluate the following quantities and fill in the table below.

Quantity	$\alpha_1 = 0$	$\alpha_2 = \pi/2$	$\alpha_3 = \pi$
Average Output Voltage, V_{dc}			
RMS Output Voltage, V_{rms}			

(c) Conclude about the DC voltage of the full-wave converter.

(d) Give the application of this circuit.

(20 marks)

Question 6

With reference to the DC to AC converter

a. DC to AC converter or inverter is one of the elements in power electronics. Explain the definition of inverter. Draw the block diagram and state 2 of their application.
b. Draw the circuit of voltage source inverter and state the use of capacitor in the circuit.
c. Draw the circuit of current source inverter and state the use of inductor in the circuit.
d. Cycloconverter is one of type AC to AC converter. Draw the single phase circuit cycloconverter and sketch the input and output voltage across load.

(20 marks)

END OF QUESTION