CONFIDENTIAL

UNIVERSITI KUALA LUMPUR
Malaysian Institute of Marine Engineering Technology

FINAL EXAMINATION (SPECIAL EXAM)
JULY 2025 SEMESTER SESSION

SUBJECT CODE	:	**LED31503**
SUBJECT TITLE	:	**POWER ELECTRONICS AND DRIVES**
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	:	**24 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 9 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) Explain the definition of power electronics and draw the block diagram of power electronics system

(6 marks)

(b) Explain FOUR (4) basic types of power converter and provide names in common usage and explain the function at each circuit in terms of electric power conversion.

(8 marks)

(c) Explain THREE (3) characteristic of ideal switch. Hence, state three (3) types of diodes switch.

(6 marks)

Question 2

With reference to AC to DC converter

(a) Explain the operation of single phase half-wave uncontrolled rectifier with R load using suitable circuit.

(4 marks)

(b) Sketch the waveform of the output voltage, V_o , input current i_s and voltage across the diode, V_D for the circuit in part (a). Use APPENDIX I.

(6 marks)

(c) The controlled single-phase half-wave rectifier circuit of Figure 2 has a resistive load and **has** an ac source of 240Vrms at 60Hz. The load is a 30Ω resistor:

i. Determine the delay angle such that the average load current is 2.5A

(4 marks)

ii. Determine the power absorbed by the load.

(4 marks)

iii. Determine the power factor

(2 marks)

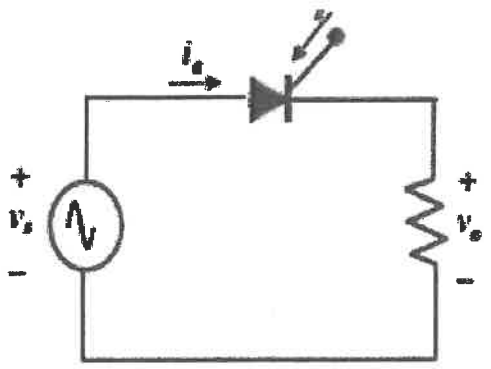


Figure 2

Question 3

With reference to DC-to-DC converter

(a) Explain the function of buck boost converter for DC-DC converter.

(2 marks)

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

(6 marks)

(c) A buck converter of figure 3 has an input of 50V and output of 25V. The switching frequency is 100 kHz and the output power to a load resistor is 125W. Determine:

i. Duty ratio

(4 marks)

ii. The value of inductance to limit the peak inductor current to 6.25A

(4 marks)

iii. The value of capacitance to limit the output voltage ripple to 0.5%

(4 marks)

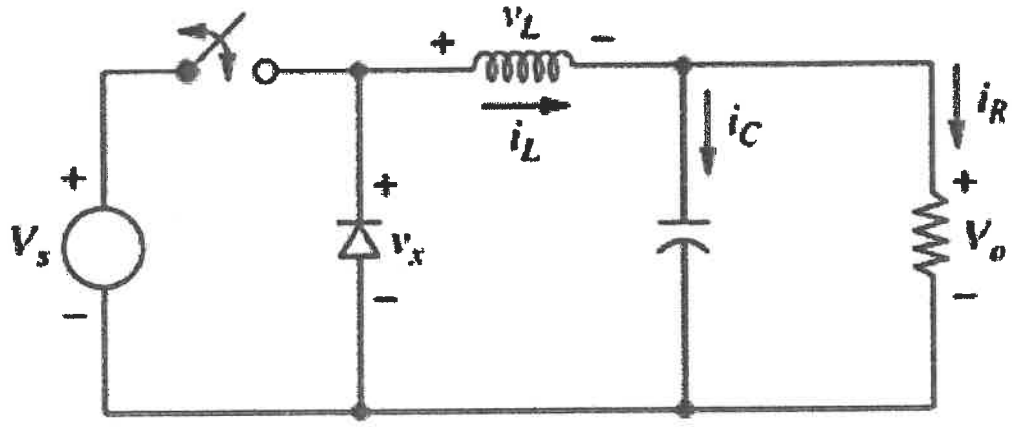


Figure 3

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) Explain briefly the operation of a single phase AC voltage controller with resistive load using suitable circuit

(4 marks)

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

(6 marks)

(c) The single phase AC voltage controller in part (a) has a $480 V_{rms}$ at 60 Hz source. The load resistance is 50Ω. The delay angle α is 60^o Determine:

i. The rms load voltage

(2marks)

ii. The power absorbed by the load

(2 marks)

iii. The power factor

(2 marks)

iv. The average and rms current in the SCRs

(4 marks)

Question 5

With reference to the DC to DC converter

(a) Explain the function of buck-boost converter

(2 marks)

(b) The output voltage equation of buck-boost converter is given below. Referring to the given equation, state the condition where the value of duty ratio affects the value of output voltage is :

$$V_O = -V_S\left(\frac{D}{1-D}\right)$$

(4 marks)

(c) A common buck-boost converter circuit diagram is shown in figure 5. With the aid of suitable equivalent circuit diagrams, explain the operation of buck-boost converter during the switch is closed and opened.

(6 marks)

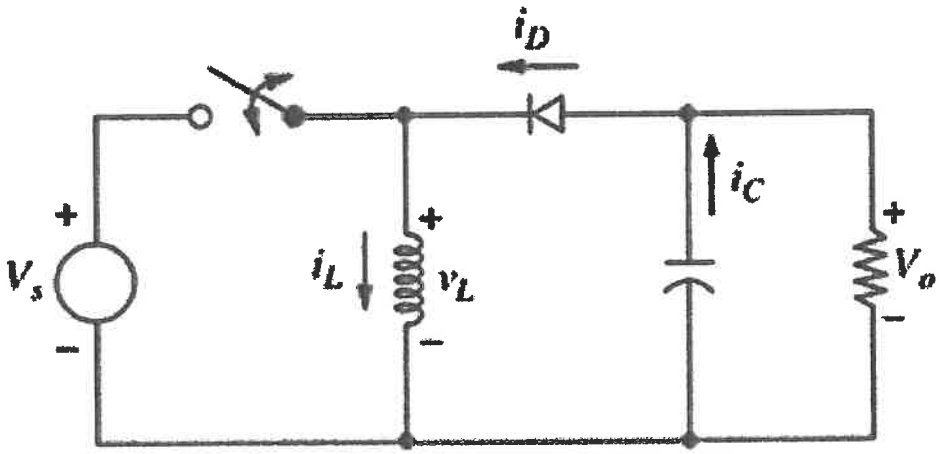


Figure 5

(d) A buck-boost converter in figure 5 is supplied with 60V input and produces an output power of 200W. Its maximum inductor current is 10.3 A. Calculate the duty ratio (assume the value of output voltage is negative) and the minimum inductor current

(8 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 and draw its block diagram. Hence, two (2) of their examples.

(5 marks)

(b) Sketch voltage source inverter circuit and explain the function of capacitor in the circuit.

(5 marks)

(c) Sketch the circuit of current source inverter and explain the use of inductor in the circuit.

(5 marks)

(d) Cycloconverter is one type of AC to AC converter. Draw the single phase circuit cycloconverter and sketch the input and output voltage across load.

(5 marks)

END OF QUESTION

FORMULA'S

HALF-WAVE RECTIFIER

$$V_O = \frac{V_m}{\pi}$$

$$I_0 = \frac{V_0}{R} = \frac{V_m}{\pi R}$$

$$V_{RMS} = \frac{V_m}{2}$$

$$I_{RMS} = \frac{V_m}{2R}$$

BUCK AND BOOST CONVERTER

$$V_O = \frac{V_m}{\sqrt{2}}\sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin(2\alpha)}{2\pi}}$$

$$I_{O,RMS} = \frac{V_{0,RMS}}{R}$$

$$pf = \sqrt{1 - \frac{\alpha}{\pi} + \frac{\sin(2\alpha)}{2\pi}}$$

$$I_{SCR,avg} = \frac{V_m}{2\pi R}(1 + \cos\alpha)$$

$$I_{rms,scr} = \frac{I_{O,RMS}}{\sqrt{2}}$$

FULL-WAVE RECTIFIER

$$V_O = \frac{2V_m}{\pi}$$

$$I_O = \frac{V_O}{R} = \frac{2V_M}{\pi R}$$

$$V_O = \frac{Vm}{\pi}(1 + \cos\alpha)$$

$$I_O = \frac{V_O}{R} = \frac{V_m}{\pi R}(1 + \cos\alpha)$$

$$I_{RMS} = \frac{V_m}{R}\sqrt{\frac{1}{2} - \frac{\alpha}{2\pi} + \frac{\sin(2\alpha)}{4\pi}}$$

$$I_{S,RMS} = I_{0,RMS}$$

$$i_O(\omega t) = \frac{V_m}{Z}\left[\sin(\omega t - \theta) - \sin(\alpha - \theta)e^{-(\omega t - \alpha)/\omega\tau}\right]$$

$$Z = \sqrt{R^2 + (\omega L)^2}$$

$$\theta = \tan^{-1}\left(\frac{\omega L}{R}\right)$$

$$\tau = \frac{L}{R}$$

$$V_O = \frac{V_S}{1 - D}$$

$$I_L = \frac{V_S}{(1 - D)^2 R}$$

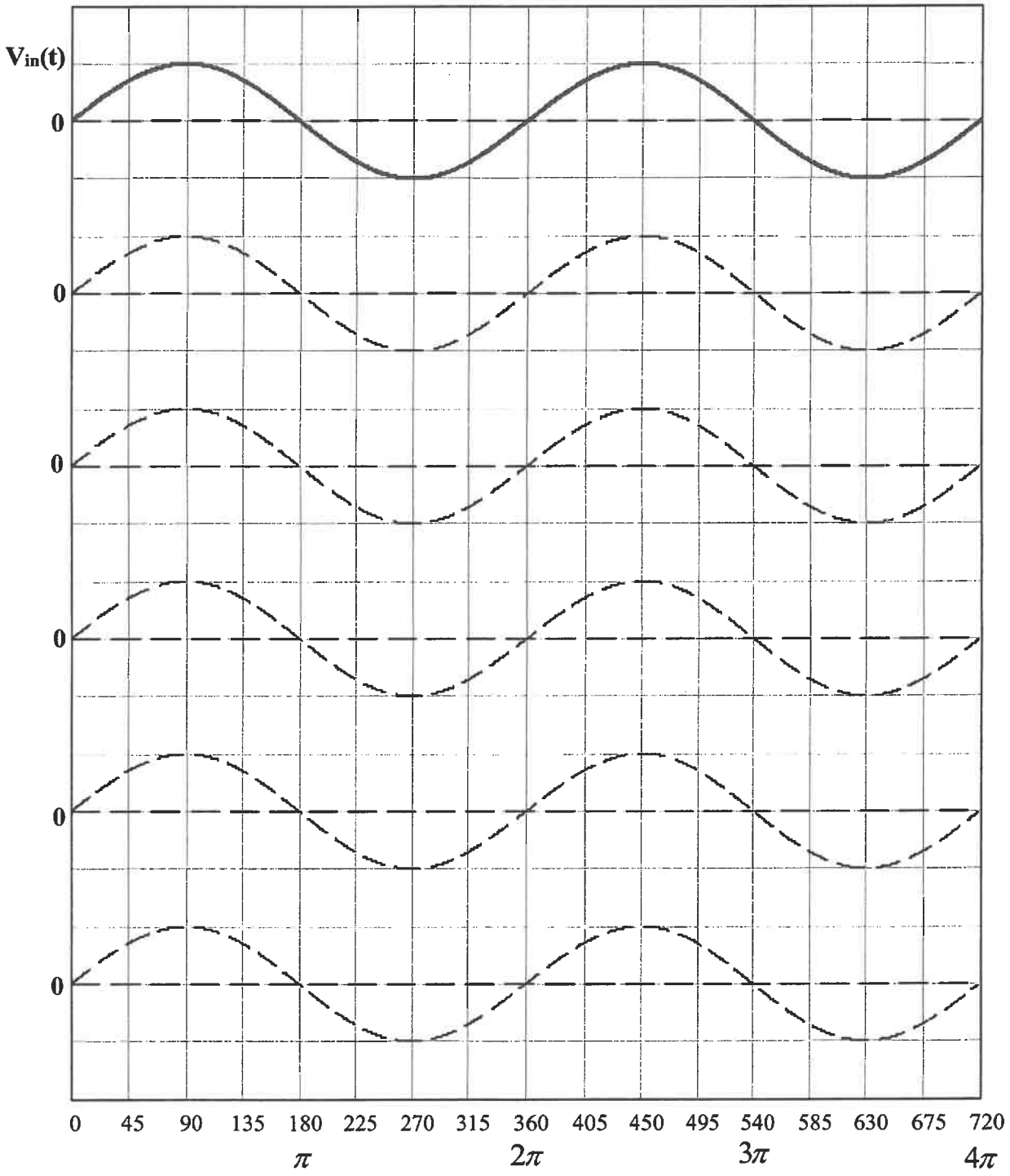
$$I_{\max} = \frac{V_S}{(1 - D)^2 R} + \frac{V_S DT}{2L}$$

$$I_{\min} = \frac{V_S}{(1 - D)^2 R} - \frac{V_S DT}{2L}$$

$$\frac{\Delta_O}{V_O} = \frac{D}{RCF}$$

$$I_D = I_O = \frac{V_O}{R}$$

APPENDIX I



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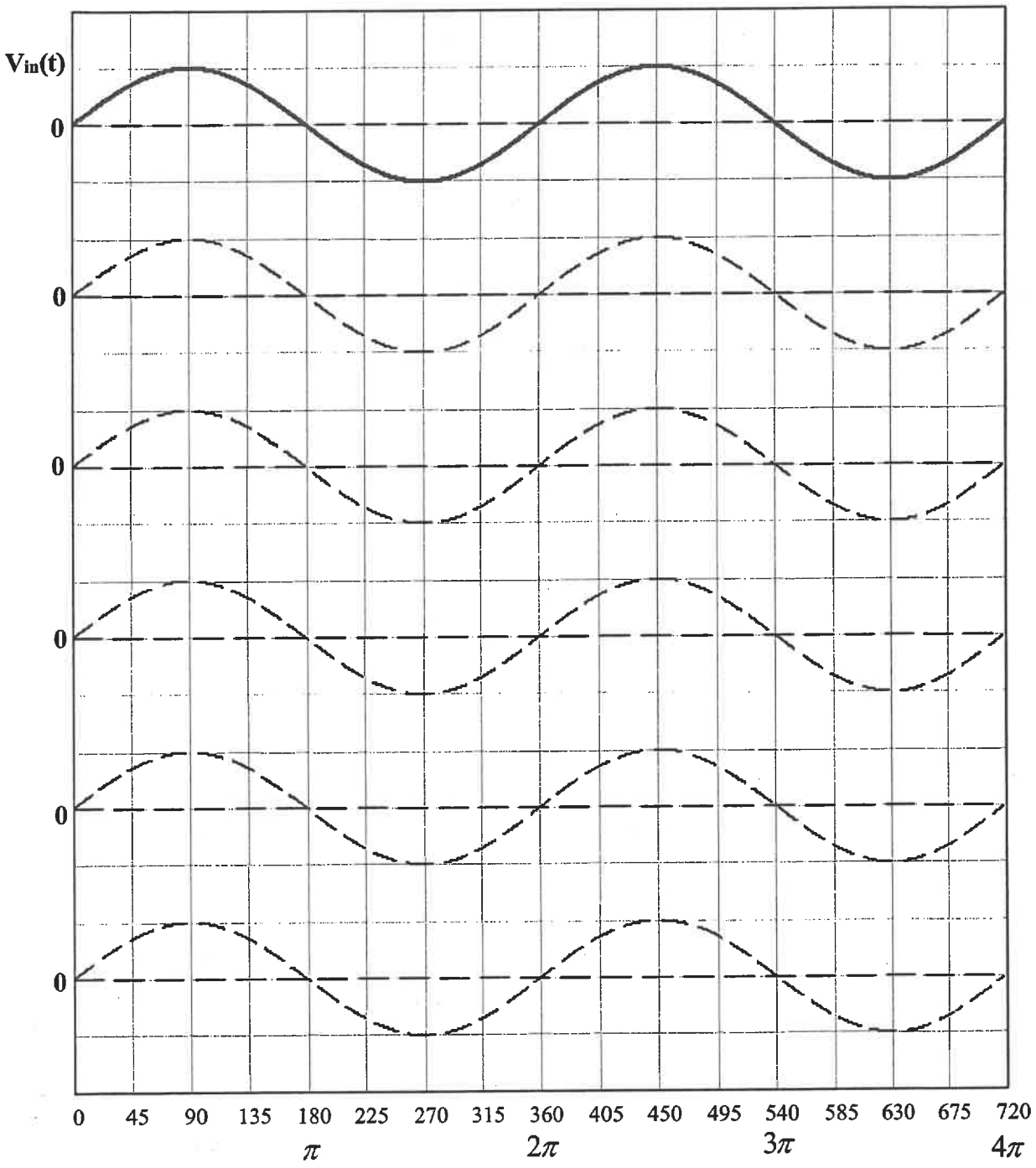
APPENDIX II



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