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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JANUARY 2010 SESSION

SUBJECT CODE	:	FLD 30102
SUBJECT TITLE	:	POWER ELECTRONICS
LEVEL	:	DIPLOMA
TIME / DURATION	:	9.00am – 11.30am (2.5 HOURS)
DATE	:	05 MAY 2010

INSTRUCTIONS TO CANDIDATES

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

THERE ARE 4 PAGES OF QUESTIONS AND 1 PAGE OF APPENDIX, EXCLUDING THIS PAGE.

SECTION A (Total: 60 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

(a) Referring to the block diagram in Figure 1, define the power electronics

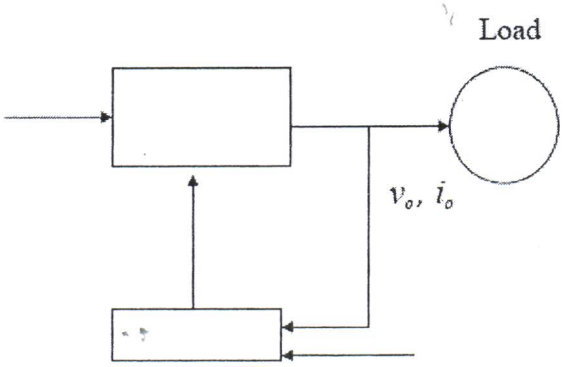

Figure 1

(8 marks)

(b) List six types classifications of power electronics switching devices

(6 marks)

(c) Draw a full-wave bridge rectifier circuit and explain the operation of the circuit

(6 marks)

Question 2

(a) List four performance parameters of a rectifier and explain the significance of efficiency of rectification

(7 marks)

(b) List three advantages of a three-phase rectifier over a single-phase rectifier

(3 marks)

(c) Prove that the average output voltage (V_{dc}) of a single phase half-wave controlled rectifier with resistive load $Vdc = \frac{V_m}{2\pi}(1+\cos\alpha)$.

$$V_{dc} = \frac{1}{2\pi}\int_{\alpha}^{\pi} V_m \sin\omega t d(\omega t)$$

(10 marks)

Question 3

(a) Draw a circuit diagram of single-phase full-bridge inverter and sketch output of the inverters

(6 marks)

(b) Referring to Figure 2,

(i) Name the circuit diagram

(1 mark)

(ii) Explain the operation of Phase Control of the circuit

(5 marks)

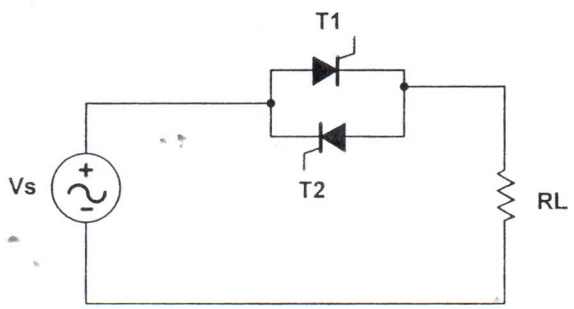

Figure 2

(c) List three applications of dc to dc converter, name the converter in Figure 3 and explain the operation of the circuit if S is switched on and off.

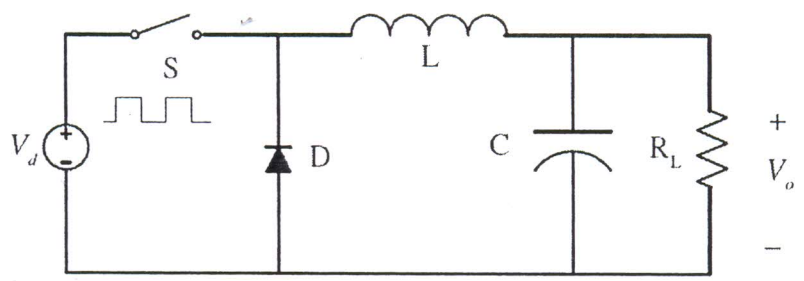

Figure 3

(8 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer TWO (2) questions only
Please use the answer booklet provided.

Question 1

A Three phase bridge rectifier is connected to a resistive load is operated. The rectifier delivers 90A at V_{dc} = 561.4 V, Determine

i. the efficiency
ii. the form factor
iii. the ripple factor
iv. the transformer utilization factor
v. the peak inverse voltage
vi. the peak current through a diode (given $I_d = 0.318 \times I_M$)

Given, $V_{dc} = \frac{3\sqrt{3}}{\pi} V_m$ and $V_{rms} = \left(\frac{3}{2} + \frac{9\sqrt{3}}{4\pi}\right)^{1/2} V_m$

(20 marks)

Question 2

The ac voltage controller in Figure 4 is used for heating a resistive load of R = 10 Ω and the input voltage is V_s = 240 V (rms), 60 Hz. The thyristor switch is on for n = 20 cycles and is off for m = 80 cycles. Determine

i. the rms output voltage V_0
ii. the input power factor (PF)
iii. the average and rms thyristor currents

(20 marks)

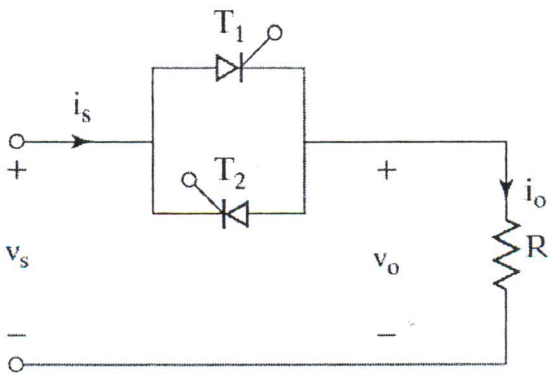

Figure 4

Question 3

The DC converter in the Figure 5 has a resistive load, R = 20 Ω and input voltage, V_s = 240 V. When the converter switch remains on, its voltage drop is V_{ch} = 1.5 V and the chopping frequency is 5 kHz. If the duty cycle is 70%, determine

i. the average output voltage
ii. the rms output voltage V_0
iii. the converter efficiency
iv. the effective input resistance R_i

(20 marks)

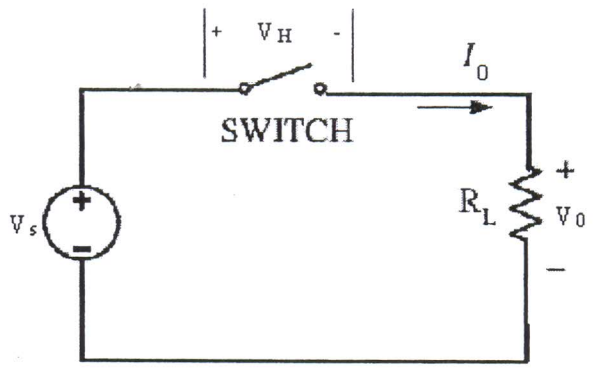

Figure 5

END OF QUESTION PAPER

APPENDIX

Performance Parameters of Rectifiers Formula

1. $P_{DC} = I_{DC} V_{DC}$
2. $P_{AC} = I_{RMS} V_{RMS}$
3. $\eta = \frac{P_{DC}}{P_{AC}}$
4. $V_{AC} = \sqrt{\{V^2_{RMS} - V^2_{DC}\}}$
5. $FF = \frac{V_{RMS}}{V_{DC}}$
6. $RF = \frac{V_{AC}}{V_{DC}}$
7. $TUF = \frac{P_{DC}}{I_S V_S}$
8. $DF = Cos\varphi$
9. $HF = \left(\frac{I_S^2 - I_{S1}^2}{I_{S1}^2} \right)^{\frac{1}{2}}$
10. $CF = \frac{I_{S(PEAK)}}{I_S}$
11. $PF = \frac{P_{REAL}}{P_{RMS}} = COS\varphi$
12. $PF = COS\varphi_2 COS\varphi_3 COS\varphi_1$