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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2013 SESSION

SUBJECT CODE	:	**FLD 30103**
SUBJECT TITLE	:	**POWER ELECTRONIC AND DRIVES**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**2.5 HOURS**
DATE	:	

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 question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer two (2) question only.**
6. **Answer all questions in English.**
7. **Fomula is appended.**

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

SECTION A (Total: 60 marks)

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

Question 1

(a) **List four** types of power electronics conversion in energy power converter.

(4 marks)

(b) **Draw** single-phase bridge rectifier with resistive load circuits and explain the operation.

(6 marks)

(c) **Explain** briefly the difference conversion of static applications and drive applications in power electronic system and **state two** examples each of them.

(10 marks)

Question 2

(a) **Draw** a single-phase inverter with resistive load, **sketch** the output voltage and **explain** the operation.

(10 marks)

(b) Prove that the DC output voltage (V_{DC}) of a single phase half-wave uncontrolled rectifier with resistive load is $V_{DC} = \frac{V_m}{\pi}$.

$$V_{DC} = \frac{1}{T}\int_0^{T/2} V_m \sin(\omega t)dt$$

(10 marks)

Question 3

(a) Name and draw three types of DC to DC power converter.

(6 marks)

(b) Name the type of converter in **Figure 1** and explain the operation when S is on and off.

(6 marks)

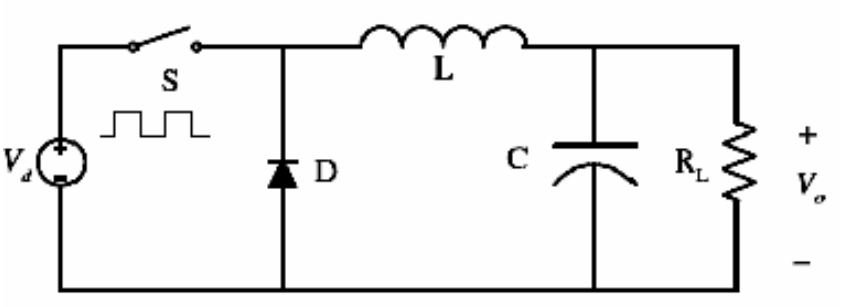

Figure 1

(c) (i) Explain the concepts of unidirectional and bidirectional controllers for AC voltage controllers.

(4 marks)

(ii) Explain the principles of On-Off Control for AC voltage controller in **Figure 2** and sketch the output voltage.

(4 marks)

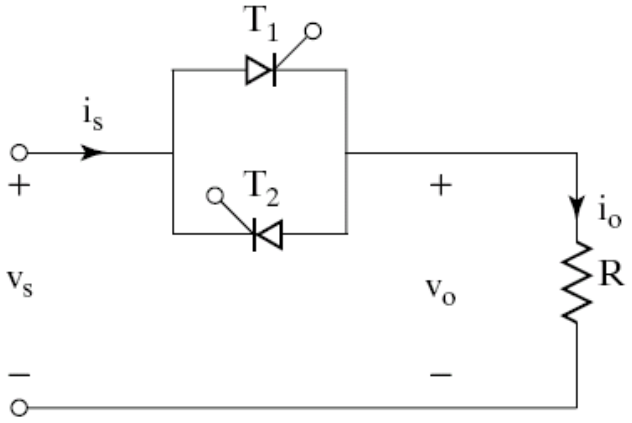

Figure 2

SECTION B (Total: 40 marks)

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

Question 4

(a) **Figure 3** is the boost converter which has parameter supply voltage (Vs) = 24 V, duty cycle (D) = 0.7, load resistance (R_L) = 10 Ω, inductor (L) = 14 μH, capacitor (C) = 60μF and the switching frequency is 200KHz. Determine,

i. The output voltage Vo

ii. the average, maximum and minimum inductor current (I_L, I_{max} and I_{min})

iii. the output voltage rippled ($\frac{\Delta Vo}{Vo}$)

iv. the average output current I_0

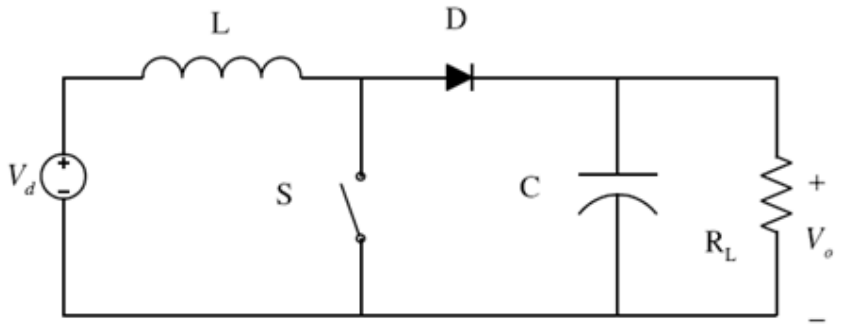

Figure 3

(20 marks)

Question 5

A single-phase half-wave controlled rectifier is connected to 120Vrms, 50 Hz source. The output of the rectifier is connected to a 10 ohm resistive load. If the average output voltage is 80% of the maximum possible output voltage, determine:

(a) the delay angle α

(b) the rms and average output voltage

(c) the average and rms thyristor current

(d) the input power factor

(20 marks)

Question 6

The AC voltage controller in **Figure 4** is connected to a resistive load R = 30 Ω and the input supply voltage Vs = 240 V (rms), 50 Hz. The delay angles of thyristorT1 and T2 are equal: $\alpha 1 = \alpha 2$ =90^0. Calculate

(i) the rms output voltage

(ii) the input power factor (PF)

(iii) the average and rms thyristor current (I_A and I_R)

(20 marks)

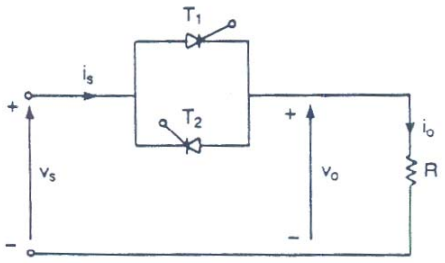

Figure 4

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. $PF = \frac{P_{REAL}}{P_{RMS}} = \frac{P_0}{VI} = COS\varphi$

Trigonometro Function

$$\int \sin nx dx = -\frac{\cos nx}{n}$$

Single phase half-wave controlled rectifier:

$$V_n = \frac{V_{dc}}{V_{dm}} = 0.5(1+\cos\alpha)\ , \qquad V_m = \sqrt{2} \times Vs\ , \qquad V_{dc} = \frac{V_m}{2\pi}(1+\cos\alpha)$$

$$V_{rms} = \frac{V_m}{2}\left[\frac{1}{\pi}\left(\pi - \alpha + \frac{\sin 2\alpha}{2}\right)\right]^{1/2}, \qquad P_f = P_o/VA$$

Single phase full-wave controlled rectifier:

$$V_n = \frac{V_{dc}}{V_{dm}}, \qquad V_m = \sqrt{2} * Vs, \qquad V_{dc} = \frac{V_m}{\pi}(1+\cos\alpha)$$

$$V_{rms} = V_m\sqrt{\frac{1}{2} - \frac{\alpha}{2\pi} + \frac{\sin(2\alpha)}{4\pi}}, \qquad P_f = P_o/S \quad \text{where, } S = Vsrms \times Irms$$

Boost converter

$Vo = Vs / (1- D)$, $\qquad I_L = \frac{V_S}{(1-D)^2 R}, \quad I_{\max} = \frac{V_S}{(1-D)^2 R} + \frac{V_S DT}{2L}, \; I_{\min} = \frac{V_S}{(1-D)^2 R} - \frac{V_S DT}{2L}$

$I_0 = V_0 / R$, $\qquad \frac{\Delta V_o}{V_o} = \frac{1-D}{8LCf^2}$

AC voltage controller

$$V_o = V_s\left[\frac{1}{\pi}\left(\pi - \alpha + \frac{\sin 2\alpha}{2}\right)\right]^{\frac{1}{2}}, \quad P_o = V_s I_0, \quad I_A = \frac{\sqrt{2}V_s}{2\pi R}(\cos\alpha + 1)$$

$$I_R = \frac{V_s}{\sqrt{2}R}\left[\frac{1}{\pi}(\pi - \alpha + \frac{\sin 2\alpha}{2}\right]^{1/2}$$