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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**FLD30103**
SUBJECT TITLE	:	**POWER ELECTRONIC AND DRIVES**
LEVEL	:	**DIPLOMA**
TIME / DURATION	:	**2.00 PM – 4.30 PM (2.5 HOURS)**
DATE	:	**5 JANUARY 2015**

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 5 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) **Draw** the symbols **IGBT** and **GTO**.

(4 marks)

(b) **List** four types of Power Electronic Conversion.

(6 marks)

(c) **Give** the definition of power electronics and **describe** the system using block diagram.

(10 mark)

Question 2

(a) **Explain** the different types of uncontrolled and controlled switches in terms of switching method and give an example of the switches for each type.

(8 marks)

(b) **Draw** the positive single-phase uncontrolled half-wave rectifier and full-wave center-tapped rectifier with resistive load and **explain** the operation of each rectifier.

(12 marks)

Question 3

(a) **Draw** a circuit diagram for Boost Converter and **explain** the operation of the circuit when switch in the circuit is on and off.

(5 marks)

(b) **Explain** the principles of phase control for AC voltage controller in **Figure 1**.

(5 marks)

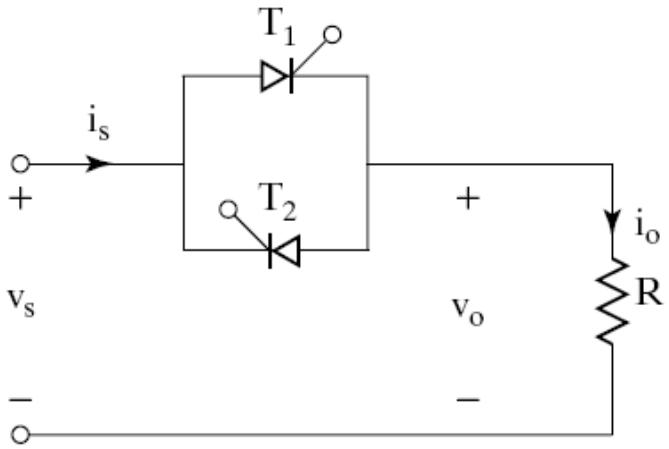

Figure 1

(c) **Give** the definition and **list** two applications of dc to ac converter (inverter).

(4 marks)

(d) **Draw** a circuit diagram for single-phase inverter and **explain** the operation.

(6 Marks)

SECTION B (Total: 40 marks)

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

Question 4

(a) A single-phase half-wave controlled rectifier is connected to 120 V_{ac}, 50 Hz source. The output of the rectifier is connected to a 100 ohm resistive load. If the average output voltage (V_{DC}) is 30 V_{DC}, determine:

i. the delay angle α
ii. the rms and average output current
iii. the power absorbed by the load
iv. the apparent power supplied by the source
v. the input power factor

(15 marks)

(b) Prove that the average value of output voltage (V_{dc}) of single phase full-wave rectifier with resistive load is $V_{dc} = \frac{2V_m}{\pi}$.

Where $V_{dc} = \left[\frac{1}{T} \int_o^{T/2} \left(V_m \sin \omega t \right) \, dt \right]$

(5 marks)

Question 5

The DC converter in the Figure 2 has a resistive load, R_L = 20 Ω and input voltage, V_s = 120 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 80%, determine

(a) the average output voltage
(b) the rms output voltage V_0
(c) the converter efficiency
(d) the effective input resistance R_i

(20 marks)

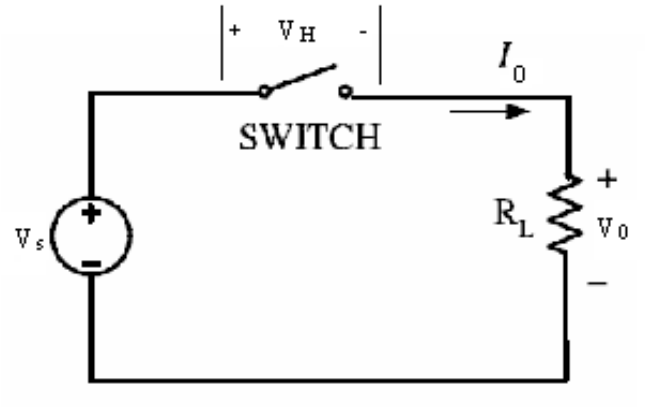

Figure 2

Question 6

The AC voltage controller in **Figure 3** is connected to a resistive load R = 20 Ω and the input supply voltage Vs = 110 V (rms), 50 Hz. The thyristor is on for n = 100 cycles and is off for m = 50 cycles.

(i) Explain the operation of on-off control of the circuit.

(ii) Calculate the rms output voltage ($V_{O(rms)}$)

(iii) Determine the input power factor (PF).

(iv) Calculate the average and rms thyristor current ($I_A = \frac{kI_m}{\pi}$, $I_R = \frac{I_m\sqrt{k}}{2}$)

(20 marks)

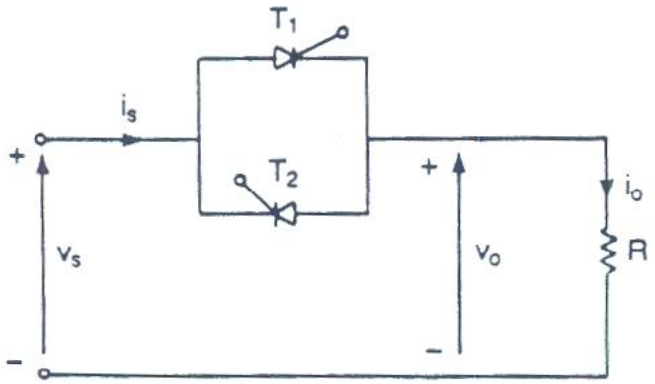

Figure 3

END OF QUESTION PAPER

APPENDIX

AC to DC Formulas

1. $V_{L(ave)} = \frac{V_m}{\pi}$
2. $I_{L(ave)} = \frac{V_m}{\pi R_L}$
3. $V_{L(rms)} = \frac{V_m}{2}$
4. $I_{L(rms)} = \frac{V_m}{2R_L}$
5. $I_{L(rms)} = \frac{V_m}{2R_L}$
6. $V_{L(ave)} = \frac{V_m}{2\pi}\left[1+\cos\alpha\right]$
7. $V_{L(rms)} = \frac{V_m}{2}\sqrt{1-\frac{\alpha}{\pi}+\frac{\sin 2\alpha}{2\pi}}$
8. $V_{L(ave)} = \frac{V_m}{\pi}\left[1+\cos\alpha\right]$
9. $V_{L(rms)} = V_m\sqrt{\frac{1}{2}-\frac{\alpha}{\pi}+\frac{\sin 2\alpha}{2\pi}}$
10. $S = I_{rms} \times V_{irms}$
11. $P = I_{rms} \times V_{orms}$
12. $p.f = \frac{P}{S}$

Trigonometro Function

1. $\int \sin^2 x dx = \int \frac{1-\cos 2x}{2} dx$
2. $\int \sin x dx = -\cos x$
3. $\int \cos nx dx = \frac{\sin nx}{2}$

DC to DC Converter

1. $V_a = k(V_S - V_{ch})$
2. $V_a = \sqrt{k}(V_S - V_{ch})$
3. $P_o = \frac{k(V_S - V_{ch})^2}{R}$
4. $P_i = \frac{k\left(V_S(V_S - V_{ch})\right)}{R}$
5. $R_i = \frac{R}{k}$

AC Voltage Controller

1. $k = \frac{n}{n+m}$

2. $V_0 = V_S\sqrt{k}$

3. $Pf = \frac{V_0}{V_s I_s}$

4. $I_A = \frac{kI_m}{\pi}$

5. $I_R = \frac{I_m\sqrt{k}}{2}$