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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION

JULY 2010 SESSION

SUBJECT CODE	:	FLD 30102
SUBJECT TITLE	:	POWER ELECTRONICS
LEVEL	:	DIPLOMA
TIME / DURATION	:	12.30pm – 2.30pm (2 HOURS)
DATE	:	11 NOVEMBER 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. Answers 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) questions only.
6. Answer all questions in English.
7. Fomula 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) Power electronics system consists of input power, output power, power processor, controller and load. Draw the block diagram and explain the function of each block

(8 marks)

(b) List two applications of power electronics in utility, domestic and industrial.

(6 marks)

(c) Draw the symbol of power electronic components listed in Table 1.

(6 marks)

Table 1

Diode
Thyristor
GTO
MCT
Triac
IGBT

Question 2

(a) Give five importance factors that must be considered when converting energy from one to another form of energy using power electronic devices.

(5 marks)

(b) Explain the concept of natural commutation and the concept of force commutation

(5 marks)

(c) Prove that the rms output voltage (V_{rms}) of a full-wave single phase rectifier with resistive load $Vrms = \frac{V_m}{\sqrt{2}}$.

$$V_{rms} = \left[\frac{2}{T}\int_{o}^{T/2}\left(V_m \sin \omega t\right)^2 dt\right]^{1/2}$$

(10 marks)

Question 3

(a) Draw a circuit diagram of Buck converter and explain the operation

(6 marks)

(b) Draw the circuit diagram of single-phase uncontrolled bridge rectifier, explain the operation and sketch the output of the rectifier.

(8 marks)

(c) List 3 performance parameters of rectifier and explain the significant of each parameter.

(6 marks)

SECTION B (Total: 40 marks)

INSTRUCTION: Answer TWO (2) questions only

Please use the answer booklet provided.

Question 4

The DC converter in the Figure 5 has a resistive load, R_L = 40 Ω and input voltage, V_s = 110 V. When the converter switch remains on, its voltage drop is V_{ch} = 1.5 V and the chopping frequency is 4 kHz. If the duty cycle is 60%, determine

(a) the average output voltage

(b) the rms output voltage V_o

(c) the converter efficiency

(d) the effective input resistance R_i

(20 marks)

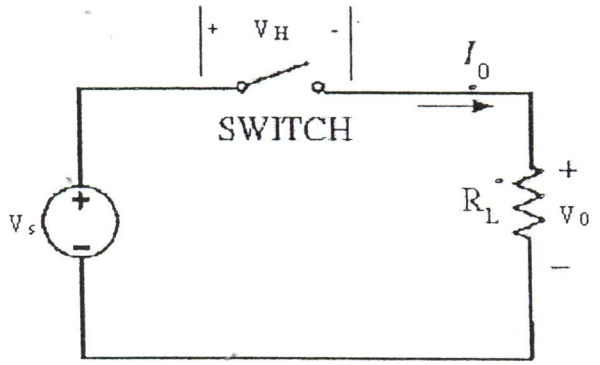

Figure 5

Question 5

A single-phase half-wave controlled rectifier is connected to 240 Vac, 60 Hz source. The output of the rectifier is connected to a 20 ohm resistive load. If the average output voltage is 40% of the maximum possible output voltage, determine:

(a) the delay angle α

(b) the rms and average output current

(c) the average and rms thyristor current

(d) the input power factor

(20 marks)

Question 6

A Three-phase full wave controlled rectifier is operated from a three-phase Y-connected 240-V, 60 Hz supply and the load resistance is 20 ohm. If it is required to obtain an average output voltage of 60 % of the maximum possible output voltage, calculate:

(a) the delay angle α

(b) the rms and average output currents

(c) the average and rms thyristor currents (rms current of thyristor $I_R = I_{rms}\sqrt{2/6}$)

(d) the rectification efficiency

(e) the transformer utilization factor (rms input line current $I_s = I_{rms}\sqrt{4/6}$)

(f) the power factor

Given, $V_{dm} = \frac{3\sqrt{3}}{\pi}V_m$, $V_{rms} = \sqrt{3}Vm\left(\frac{1}{2} + \frac{3\sqrt{3}}{4\pi}\cos 2\alpha\right)^{1/2}$

and $V_n = \frac{V_{dc}}{V_{dm}} = \cos\alpha$

(20 marks)

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