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**University Examinations 2014/2015**

SECOND YEAR, SECOND SEMESTER EXAMINATION FOR DIPLOMA IN ELECTRICAL AND ELECTRONICS ENGINEERING

**EEE 0234: POWER ELECTRONICS**

**DATE: DECEMBER 2014 TIME: 1**$\frac{1}{2}$ **HOURS**

**INSTRUCTIONS:** *Answer questions* ***on****e**and any other* ***two*** *questions*

**QUESTION ONE (30 MARKS)**

1. (i) Briefly describe the concept of power electronics (2 marks)

(ii)Enumerate two applications of power electronics (1 mark)

(iii)Give two differences between triac and thyristor (1 mark)

1. (i) Define using a diagram
2. Latching current (1 mark)
3. Holding current (1 mark)

(ii) Using a sketch explain the effect of gate current on the forward break over voltage of an SCR (1 mark)

(iii)What are the necessary conditions for turning-on of an SCR (2 marks)

(iv) Briefly discuss the methods of turning-on of a thyristor with its gate disconnected (2 marks)

1. (i) A thyristor is conducting forward current. Discuss the basic requirement for commutating this SCR (3 marks)

(ii) (a) What is hard-driving of a thyristor (1 mark)

(b) State hard-driving advantages (1 mark)

(iii) Explain

(a)Delay time (1 mark)

(b) Rise time (1 mark)

(c) Spread time (1 mark)

(d) Gate recovery time (1 mark)

(e) Reverse recovery time (1 mark)

iv) SCRS with a rating of 1000v and 200A are available to be used in a string to control

6kv and 1KA. Calculate the number of series and parallel units required in case

derating factor is:

1. 0.1 (1 mark)
2. 0.2 (1 mark)
3. A single-phase half-wave SCR circuit feeds power to a resistive load as shown in FIG I
4. Draw waveforms for
5. Source voltage ($\frac{1}{2}$ marks)
6. Load voltage ($\frac{1}{2}$ marks)
7. Load current ($\frac{1}{2}$ marks)
8. Voltage across SCR ($\frac{1}{2}$ marks)

for a given firing angle of $∝$

1. Obtain expressions for
2. Average voltage of the load (1 mark)
3. RMS load voltages (1 mark)

in terms of source voltage source voltage/peak voltage and firing angle vs/vm and $∝$ respectively.

1. A resistive load of 10 ohms is connected through a half-wave SCR circuit to 220v, 50Hz, single phase supply. Calculate the power delivered to the load for firing angle of 600 (3 marks)

**QUESTION TWO (15 MARKS)**

1. For the FIG 2, d.c source voltage=230v, load resistacne=10 ohms. Take a voltage drop of 2v across chopper when is on. For a duty cycle of 0.4, calculate
2. Average output voltage (2 marks)
3. RMS output voltage (2 marks)
4. Chopper efficiency (2 marks)
5. A step-up chopper has input voltage of 220v and output voltage of 660v. If the non-conduction time of thyrister-chopper is 100us, compute the pulse width of output voltage (5 marks)
6. (i) Distinguish constant frequency system and variable frequency system as related to a chopper (2 marks)

(ii)The future electric automobiles are likely to use choppers for their speed control and braking. State four advantages of using the chopper (2 marks)

**QUESTION THREE (15 MARKS)**

1. Describe the following types of RC filters
2. Low pass (2 marks)
3. High pass (2 marks)
4. Band pass (2 marks)
5. Band stop (2 marks)
6. In a two transistor analogy of a thyristor, the gain of PNP tranisistor is 0.40, gain of NPN transistor is 0.5 and rated gate triggering current 1g=60mA.
7. Determine the expression of anode current (3 marks)
8. Calculate the value of anode current (2 marks)

**QUESTION FOUR (15 MARKS)**

1. Circuit of Fig 3 illustrates class –D commutation. For this circuit, Vs=230v, L=20$μH$ and C=40$μF$. For a constant load current of 120 A, calculate
2. Peak value of current through the capacitors and also through main and auxiliary thyristors (5 marks)
3. Circuit turn-off times for main and auxiliary thyristors (5 marks)
4. Explain the merits and demerits of self commutation of SCR (5 marks)