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10EE45

Fourth Semester B.E. Degree Examination, June/July 2017
Power Electronics

Time: 3 hrs. Max. Marks:100

Note: ***Answer FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. List and explain the different types of power electronic converters. Show their I/O characteristics. **(08 Marks)**

b. What are the peripheral effects of power converters? **(04 Marks)**

c. What is the necessity of base drive control high power transistor? Explain proportional base and anti-saturation control. **(08 Marks)**

2 a. With necessary waveforms. Explain the switching performance of power BJT. **(07 Marks)**

b. With relevant diagrams, discuss the methods of providing isolation of Gate/base drive control in power circuits and what are its limitation? **(07 Marks)**

c. In the power BJT circuit has β in the range of 10 to 25. If V_{CC} = 230V, R_c = 12Ω, V_{BB} = 15V, V_{CES} = 1.2V and V_{BES} = 1.8V. Calculate :

i) The value of R_B required to move the transistor into saturation with an ODF of 6.

ii) Forced beta β_f

iii) Total power dissipation. **(06 Marks)**

3 a. With a neat sketch, explain the static VI characteristics of an SCR. What are the significances? Define the latching current, holding current and break over voltage. **(08 Marks)**

b. With the help of two transistor model of an SCR, Derive the expression of anode current. Explain the switching action and significance of the Gate control. **(08 Marks)**

c. The SCR in the circuit of Fig Q3(c) has a latching current of 50mA and is triggered by a gate pulse width 50 μ.sec. Show that without resistance R^1 thyristor will fail to remain ON when the gating pulse ends. Also find the maximum value of R^1 to ensure firing. The ON state voltage drop of an SCR can be neglected. **(04 Marks)**

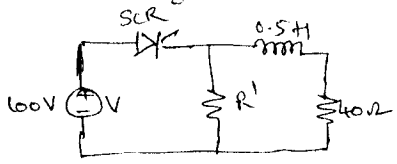

Fig Q3 (c)

4 a. Define commutation? What are the necessary conditions of commutation? Mention the different types of commutation circuits. **(08 Marks)**

b. With necessary circuit and waveforms, explain complementary commutation scheme. Derive an expression for t_c. **(08 Marks)**

c. The circuit of Fig Q4(c) employing class –C commutation has V_s = 200V, R_1 = 10Ω, R_2 = 100Ω. Determine :

i) Peak value of the current through T_1

ii) Value of capacitor C, if each thyristor has turn off time of 40 μ.sec. Take factor of safety as 2. **(04 Marks)**

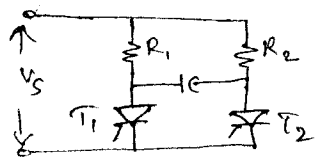

Fig Q4(c)

PART – B

5 a. What is the use of freewheeling diode in the converters? Explain the principle of operation of single phase FWR feeding with R-L loads. Draw the relevant sketch and waveforms. (07 Marks)

b. With neat circuit and waveforms, explain the working of three phase half wave converter. Derive the expression for $V_o(av)$ for resistive load. (07 Marks)

c. In the three phase half wave converter has a line – line voltage of 415V, 50Hz, the load is purely resistive load with R = 15Ω. If the average load voltage is 50% of maximum possible average output voltage. Determine :
   i) The delay angle α
   ii) Average values of output current
   iii) The average and rms values of thyristor current. (06 Marks)

6 a. What is chopper? Classify the different types of choppers with circuit diagrams. (06 Marks)

b. With the help of circuit and quadrilateral diagrams, explain the working of a class E chopper. Mention the devices that give path for the current in each quadrant. (08 Marks)

c. In the chopper circuit of Fig Q6(c). The average output voltage is 109V. The voltage drop across the chopper switch when it is ON ie V_s = 2V. If the load resistance R = 10Ω, f = 1.5 KHz and duty ratio δ = 50%. Calculate :
   i) The rms output voltage
   ii) The dc input to the chopper
   iii) Chopper efficiency
   iv) Input resistance of chopper. (06 Marks)

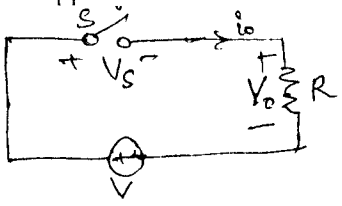

Fig Q6(c)

7 a. What do you mean by inverters? Explain the operation of single phase full bridge inverter. Draw the load current waveforms for R, R-L load and RLC loads. (08 Marks)

b. Explain the operation of a three phase transistorized inverter in 180° conduction angle mode with star connected Resistive load. (08 Marks)

c. Explain voltage control of single phase inverter by sinusoidal pulse width modulation technique. Draw relevant forms. (04 Marks)

8 a. What is AC voltage regulator (controller)? With the help of waveforms explain ON-OFF control and phase control. (07 Marks)

b. Explain the operation of a single phase bidirectional controller with resistive load. Obtain the expression for rms value of output voltage. Show their waveforms. (08 Marks)

c. Write a note on electromagnetic compatibility effect on power electronic converters. (05 Marks)

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