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10EC73

**Seventh Semester B.E. Degree Examination, July/August 2022**  
**Power Electronics**

Time: 3 hrs.

Max. Marks: 100

**Note: Answer any FIVE full questions, selecting atleast TWO questions from each part.**

**PART – A**

1.
  - a. Mention any four properties of a super power device should posses. (02 Marks)
  - b. Explain any four different types of power converter circuit with the help of circuit diagram, input and output waveforms. Also mention one application of each type. (10 Marks)
  - c. With the circuit diagram, input and output waveforms, explain the control characteristics of SCR and IGBT. (08 Marks)
  
2.
  - a. What is the necessity of Base Drive Control in a power transistor? Explain proportional base control. (06 Marks)
  - b. Draw the equivalent model of BJT and explain the switching characteristics of power transistor. (08 Marks)
  - c. A transistor switch of Fig Q2(c) has  $\beta$  in the rang of 8 to 40. Calculate :
    - i) the value of  $R_B$  that results in saturation, with an overdrive factor of 5
    - ii) the forced  $\beta_f$  and
    - iii) the power loss in the transistor.

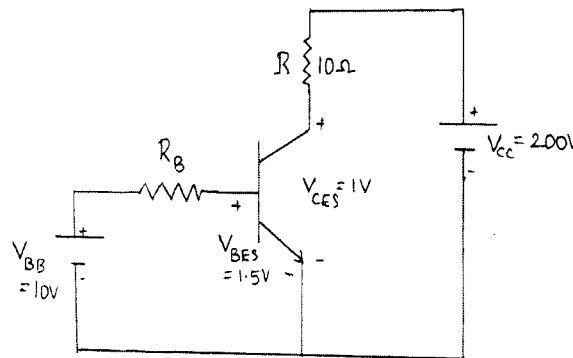


Fig Q2(c) (06 Marks)

3.
  - a. Explain the two transistor model of SCR and derive the formula. (10 Marks)
  - b. Explain the dynamic characteristics of SCR during turn off with suitable waveforms. (06 Marks)
  - c. Design the snubber circuit elements  $R_s$  and  $C_s$  connected across the SCR, given that  $\frac{dv}{dt}(\text{max}) = 18\text{v}/\mu\text{s}$  and  $\frac{di}{dt}(\text{max}) = 45\text{A}/\mu\text{s}$ . An inductor  $L = 0.1\text{H}$  and a resistance  $R \ll R_s$  are in series with the SCR with a 300V, DC applied to the circuit. (04 Marks)
  
4.
  - a. With a circuit diagram and waveform, explain the working of a single phase semiconrolled Rectifier. Derive an expression for the average voltage across the R-L load. (10 Marks)
  - b. A single phase full converter is operated from a 120V, 60Hz supply. The load current with an average of  $I_a$  is continuous with negligible ripple current. If the delay angle is  $\alpha = \frac{\pi}{3}$ , calculate : i) Harmonic factor ii) Displacement factor iii) Power factor. (06 Marks)
  - c. What are the advantages of I- $\phi$  dual converter operation with circulating current? (04 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42.8 50, will be treated as malpractice.

## PART – B

- 5 a. Explain or compare natural and forced commutation. (04 Marks)
- b. With the help of circuit diagram and waveforms explain the operation of self commutation. (10 Marks)
- c. An AC voltage controller in Fig Q5(c), has a resistive load of  $R = 10\Omega$  and the root mean-square input voltage is  $V_s = 120V$ , 60Hz. The thyristor switch is ON for  $n = 25$  cycles and is OFF for  $m = 75$  cycles. Determine: i) The rms output voltage  $V_o$  ii) input power factor (PF) and iii) The average and rms current of thyristors.

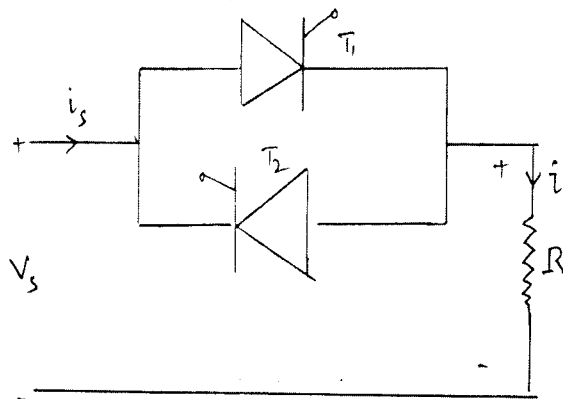


Fig Q5(c)

(06 Marks)

- 6 a. With the help of circuit diagram, explain the operation of single phase AC regulator using ON-OFF control. Derive the expression for rms value of load voltage. (08 Marks)
- b. Explain the operation of single phase bi-directional AC voltage controller for inductive load with the help of circuit diagram and waveforms. (08 Marks)
- c. Distinguish between ON-OFF control and phase control of AC voltage controller. (04 Marks)
- 7 a. With neat circuit diagram, explain the principle of operation of step up chopper. (06 Marks)
- b. Give the classification of choppers. Explain class E-chopper with circuit and quadrant diagram. (08 Marks)
- c. In the chopper circuit shown in Fig Q7(c), the average output voltage is 109V. The voltage drop across chopper switch when it is ON is  $V_s = 2V$ . The load resistor  $R = 10\Omega$ ,  $f = 1.5KHz$  and duty cycle ratio  $\delta = 50\%$ . Calculate the i) DC input voltage to the chopper ii) RMS output voltage.

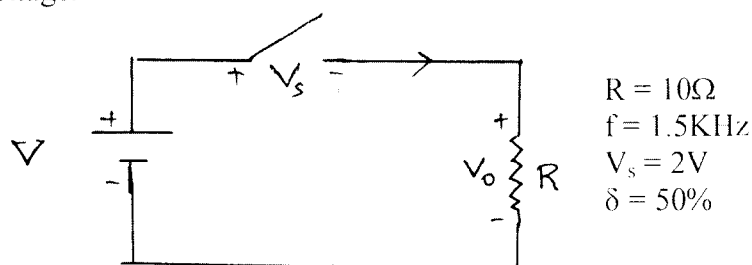


Fig Q7(c)

(06 Marks)

- 8 a. With necessary sketches, explain the single phase transistorized current source inverter. (10 Marks)
- b. Explain the performance parameters of inverters. (06 Marks)
- c. Compare voltage source inverters and current source inverters. (04 Marks)

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