USN | | | | | | | | | | | 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 β 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 β_f and
   iii) the power loss in the transistor.

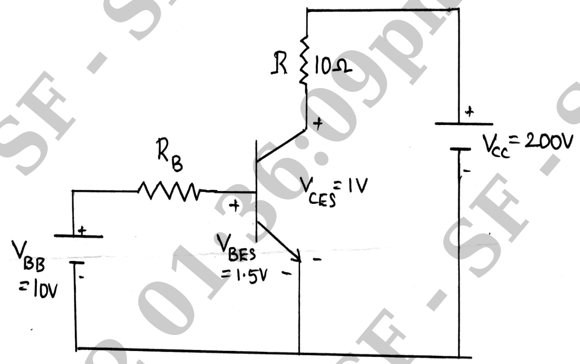


Fig Q2(c) **(06 Marks)**

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 $\frac{dv}{dt}(\max) = 18v/\mu s$ and $\frac{di}{dt}(\max) = 45A/\mu s$. An inductor L = 0.1H and a resistance R<<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 semicontrolled 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-ϕ dual converter operation with circulating current? **(04 Marks)**

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 = 10Ω 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_0 ii) input power factor (PF) and iii) The average and rms current of thyristors.

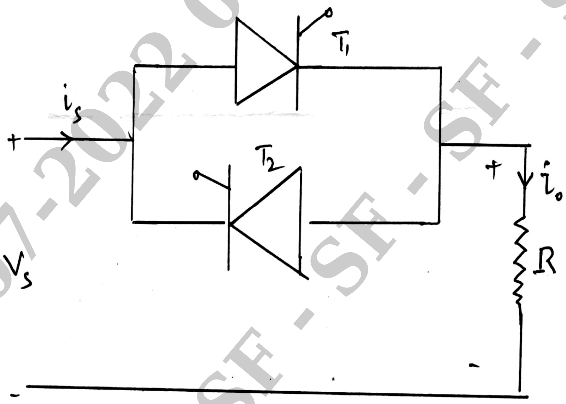


Fig Q5(c) **(06 Marks)**

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)**

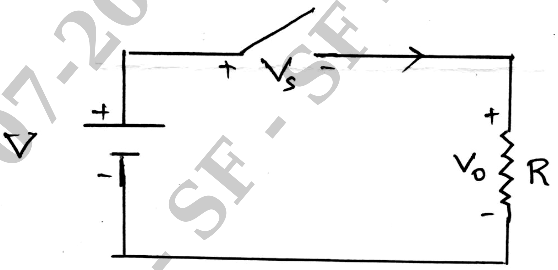
b. Explain the operation of single phase bi-directional AC voltage controller for inductive load with the help of circuit diagram and waveforms. **(08 Marks)**

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 = 10Ω, f = 1.5KHz and duty cycle ratio δ = 50%. Calculate the i) DC input voltage to the chopper ii) RMS output voltage.



R = 10Ω
f = 1.5KHz
V_s = 2V
δ = 50%

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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