

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.

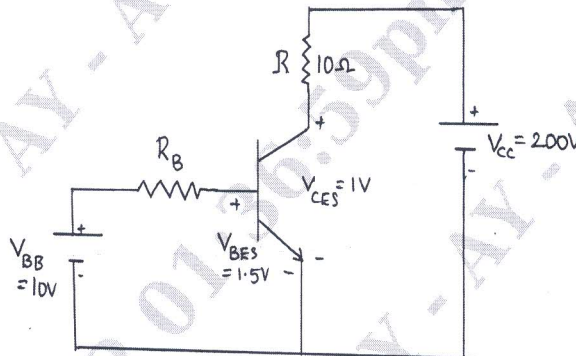


Fig Q2(c)

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 $\frac{dv}{dt}(\max) = 18\text{v}/\mu\text{s}$ and $\frac{di}{dt}(\max) = 45\text{A}/\mu\text{s}$. 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 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 $R = 10\Omega$ 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.

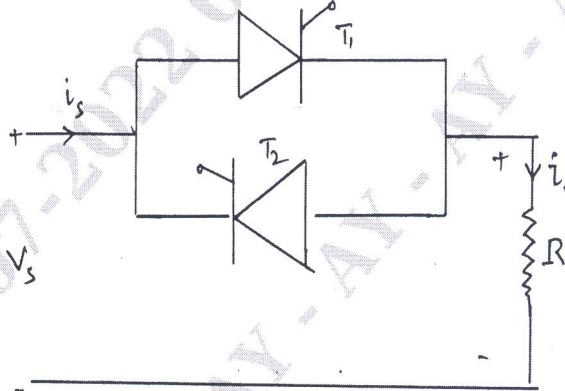
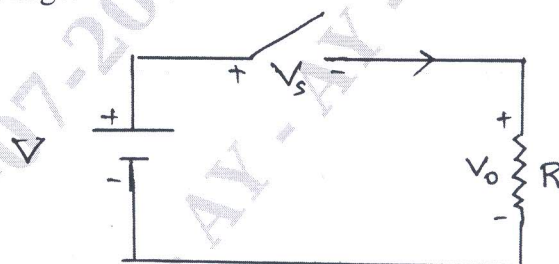


Fig Q5(c)

(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.



$$R = 10\Omega$$

$$f = 1.5KHz$$

$$V_s = 2V$$

$$\delta = 50\%$$

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)
