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10EE45

Fourth Semester B.E. Degree Examination, June/July 2019
Power Electronics

Time: 3 hrs.

Max. Marks:100

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

PART - A

1.
 - a. Define power Electronics. Give the list of power semiconductor conductor devices and also explain the control characteristics of i) SCR ii) GTO iii) MOSFET. (07 Marks)
 - b. With the help of circuit and wave forms, explain the various types of power electronic Converter circuits. (08 Marks)
 - c. Give the list of industrial applications of power electronics. Explain electric heating and welding applications. (05 Marks)

2.
 - a. What is IGBT? Draw static and switching characteristics of IGBT. Write its merit and demerits and applications. (10 Marks)
 - b. Compare BJT, MOSFET and IGBT as switching devices. (04 Marks)
 - c. For the transistor switch circuit shown in Fig Q2(c). Calculate :
 - i) The value of R_B that will in saturation with an ODF of 20
 - ii) The forced beta (β_f)
 - iii) Power loss in the transistor

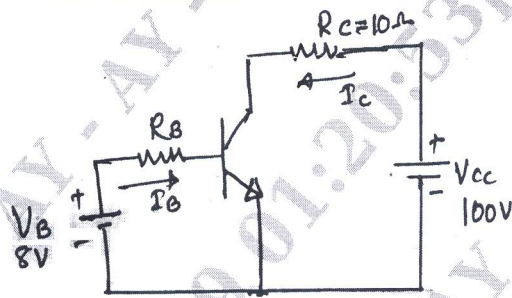


Fig Q2(c)

(06 Marks)

3.
 - a. Derive an expression for the anode current of a thyristor with the help of a two transistor analogy. (08 Marks)
 - b. What are the different types of firing circuits? Explain UJT firing circuit to turn on the SCR. (07 Marks)
 - c. Explain the need for $\frac{dv}{dt}$ and $\frac{di}{dt}$ protection for SCR. A SCR circuit has the following data: Supply voltage $V_s = 200V$, $\frac{dv}{dt}$ rating = $100 \frac{V}{\mu sec}$, $\frac{di}{dt}$ rating = $50 \frac{A}{\mu Sec}$. Calculate the snubber circuit elements using approximate expressions. (05 Marks)

4.
 - a. What do you understand by commutation? Distinguish between natural and forced commutation. (06 Marks)
 - b. With the help of circuit diagram and relevant waveforms, explain the working complementary commutation technique. (10 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.

- c. For an impulse commutated thyristor circuit shown in Fig Q4(c) capacitor is initially charged to V_s with polarity shown. Find the circuit turns - off time for main thyristor. In case $C = 20\mu\text{F}$, $R = 10\Omega$ and $V_s = 220\text{V}$.

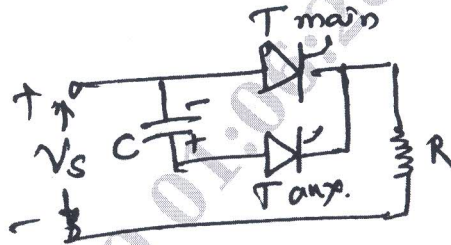


Fig Q4(c)

(04 Marks)

PART - B

- 5 a. With the necessary circuit and waveforms, explain the principle operation of single phase full converter with resistive load, write the necessary equations. (06 Marks)
- b. Explain three phase halfwave converter circuit for R load. Derive an equation for average output voltage. (08 Marks)
- c. A 1ϕ half wave converter is operated from a 120V 50Hz supply and the load resistance $R = 10\Omega$. If the average output voltage is 25% of the maximum possible average output voltage. Calculate ;
- i) Delay angle ii) The rms and average output currents. (06 Marks)
- 6 a. With the help of circuit diagram, explain the working principle of step-up chopper, write the equation of average output voltage. (06 Marks)
- b. How choppers are classified? With help of circuit and quadrant diagram, explain the working of class E chopper. (08 Marks)
- c. A DC chopper has a resistive load of 20Ω and input voltage $V_s = 220\text{V}$. When the chopper is on, its voltage drop is 1.5V and chopping frequency is 10KHz . If duty cycle is 80%. Determine the average output voltage, rms output voltage and chopper on time. (06 Marks)
- 7 a. What do you mean by inverter? Explain the working principle of a 1ϕ half bridge inverter with inductive load; write the rms value of output voltage equation. (08 Marks)
- b. Write and explain the performance parameters of an inverter. (06 Marks)
- c. Write a short note on current source inverters. (06 Marks)
- 8 a. Explain the principle of ON-OFF control and obtain an expression for rms voltage, rms current and power factor of 1ϕ full wave A.C voltage controller. (08 Marks)
- b. Find the power consumed in the heater element as shown in Fig Q8(b). If both SCR's are triggered with delay angle of 45° . If load is 2kW , 230V heater and $V_s = 230\text{V}$, 50Hz .

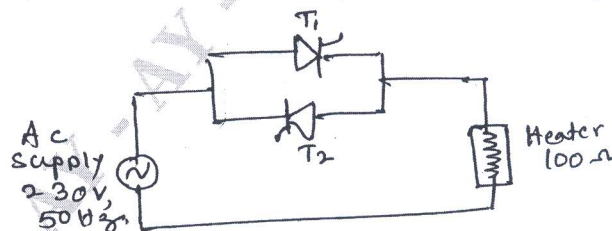


Fig Q8(b)

- Calculate: i) $V_{o(\text{rms})}$ ii) Power dissipated in heater for $\alpha = 45^\circ$. (06 Marks)
- c. Write a short note on effect of power electronic converters and its remedial measures. (06 Marks)