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10EE45

Fourth Semester B.E. Degree Examination, Dec.2017/Jan.2018
Power Electronics

Time: 3 hrs. Max. Marks:100

Note: 1. ***Answer FIVE full questions, selecting at least TWO questions from each part.***
2. ***Draw suitable sketches wherever necessary.***

PART – A

1 a. What is power electronics? Mention its industrial applications. **(05 Marks)**

b. With neat diagram and waveforms, explain control characteristics of (i) SCR and (ii) IGBT. **(08 Marks)**

c. Describe thyristorised tap changer with a neat schematic. **(07 Marks)**

2 a. Compare BJT, MOSFET and IGBT (any four points). **(04 Marks)**

b. For the circuit shown in Fig. Q2 (b) the details are given. The bipolar transistor is specified to have β_f in the range of 8 to 40. The load resistance is $R_C = 11\Omega$. The DC supply voltage is V_{CC} = 200 V and the input voltage to the base circuit is V_B = 10 V. If $V_{CE(sat)}$ = 1 V and $V_{BE(sat)}$ = 1.5 V find (i) the value of R_B that results in saturation with an ODF of 5, (ii) the β_{forced} and (iii) the power loss P_T in the transistor. **(10 Marks)**

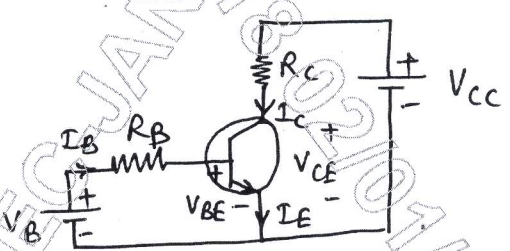

Fig. Q2 (b)

c. With a neat sketch describe the construction of IGBT. **(06 Marks)**

3 a. With the help of a two transistor model derive the expression for anode current for an SCR. **(10 Marks)**

b. Calculate the values of R, R_{B1} and R_{B2} for the following UJT trigger circuit. The parameters of UJT are $V_s = 30V$, $\eta = 0.51$, $I_P = 10\mu A$, $V_V = 3.5$ V and $I_V = 10mA$ and $C = 0.5\mu F$. Assume $V_D = 0.5$ and frequency of oscillations f = 60 Hz, width of the triggering pulse $t_g = 50\ \mu s$. **(10 Marks)**

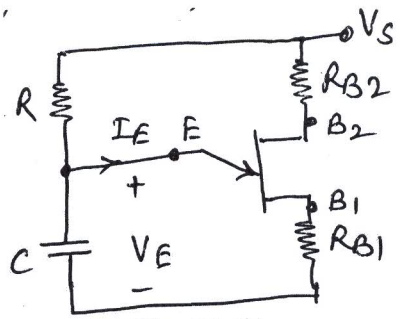

Fig. Q3 (b)

4 a. What do you mean by commutation in thyristors? Differentiate between natural and forced commutation. **(06 Marks)**

b. With the help of a schematic and waveforms explain complementary commutation. **(08 Marks)**

c. For the commutation circuit shown in Fig. Q4 (c) the DC source voltage is 120 V and the current through R_1 and R_2 = 20 A. The turn off time of both the SCRs is 60 µsec. Calculate the value of commutations capacitor C for successful commutation. **(06 Marks)**

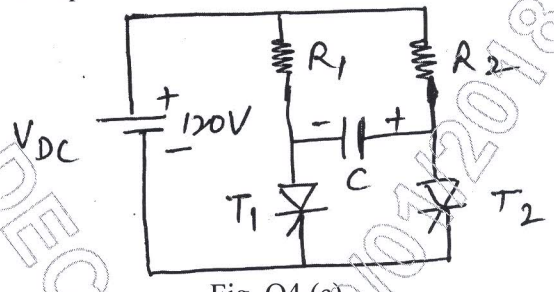

Fig. Q4 (c)

PART – B

5 a. With the help of a neat schematic and waveforms derive an expression for average output voltage of single phase semiconverter with RL load. **(10 Marks)**

b. A single phae half wave controlled rectifier is used to supply power to 10 Ω load from 230 V, 50 Hz supply at a firing angle of 30°. Calculate (i) Average output voltage (ii) Effective output voltage (iii) Average load current (iv) Effective load current. **(10 Marks)**

6 a. What is chopper? What are the various types of chopper? **(06 Marks)**

b. With the help of a schematic and waveform explain step down chopper. **(08 Marks)**

c. A stepdown chopper has a resistive load of 10 Ω and the input voltage is 220 V. When the chopper switch remains on its voltage drop is V_{ch} = 2 V and the chopping frequency is 1 kHz. If the duty cycle is 50% determine (i) The average output voltage (ii) the rms output voltage and (iii) the chopper efficiency. **(06 Marks)**

7 a. Describe various performance parameters of inverter. **(06 Marks)**

b. What are the drawbacks of single phase half bridge inverter? Explain the operation of single phase full bridge inverter for resistive load. **(08 Marks)**

c. With relevant waveforms, explain the sinusoidal pulse width modulation in an inverter. **(06 Marks)**

8 a. Explain the principle of ON-OFF and phase control of AC voltage regulators. **(06 Marks)**

b. With the help of circuit diagram and waveforms explain the operation of single phase AC voltage bidirectional controller with R-L load. Derive an expression for output voltage. **(08 Marks)**

c. A single phase fullwave AC voltage controller has a resistive load of 10 Ω. Input voltage is 120 V (rms), 60 Hz. The delay angle of each thyristor is 90°. Find (i) rms output voltage and (ii) input power factor. **(06 Marks)**

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