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10EC73

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.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. Sketch control characteristics of the following:
i) Thyristor switch ii) GTO switch
iii) BJT switch iv) MOSFET switch **(08 Marks)**

b. Explain briefly the following power electronic circuits:
i) AC-DC controlled rectifier ii) AC voltage controller
iii) DC chopper iv) Inverters **(08 Marks)**

c. Explain peripheral effect with respect to power converters. **(04 Marks)**

2 a. Draw the switching model of MOSFET and explain its switching characteristics. **(08 Marks)**

b. The beta (β) of bipolar transistor shown in Fig.Q2(b) varies from 12 to 75. The load resistance R_C = 1.5 Ω. The dc supply voltage V_{CC} = 40 V and the input voltage to the base circuit V_B = 6V, if $V_{CB(sat)}$ = 1.6V, $V_{CE(sat)}$ = 1.2 V, R_B = 0.7 Ω. Determine:
i) Over drive factor ii) Forced β iii) Power loss in transistor.

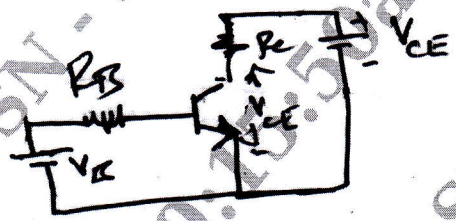

Fig.Q2(b) **(08 Marks)**

c. Sketch the symbol and circuit of IGBT as switch. Mention important features of IGBT. **(04 Marks)**

3 a. Explain two-transistor model of thyristor and hence derive anode current equation in terms of gate current, gain and leakage current. **(08 Marks)**

b. Draw and explain synchronized UJT relaxation oscillator circuit for turning on of SCR. **(08 Marks)**

c. The thyristor in the circuit shown in Fig.Q3(c) has a latching current of 50 mA and is triggered by pulse width of 50 μS. Show without R′, thyristor will fail to remain ON. Calculate R′ to ensure firing of thyristor.

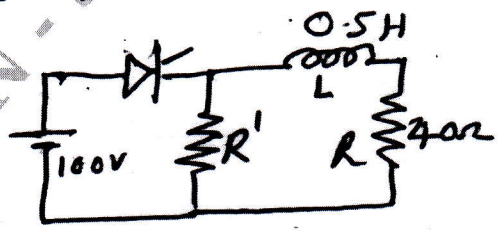

Fig.Q3(c) **(04 Marks)**

4 a. With circuit diagram and waveforms explain the working of 1-ϕ-full converter with RLE load. **(08 Marks)**

b. With neat circuit diagram and waveform explain the working of 1-ϕ dual converter. **(08 Marks)**

c. The single phase dual converter is operated from a 120V, 60 Hz supply and the load resistance is R = 10 Ω. The circulating inductance is L_r = 40 mH; delay angle $\alpha_1 = 60°$ and $\alpha_2 = 120°$. Calculate the peak circulating current and the peak current of converter 1. **(04 Marks)**

PART – B

5 a. Explain the working of impulse commutation with neat circuit and waveforms. **(08 Marks)**

b. In the circuit of Fig.Q5(b) shown the capacitor is initially charged to a voltage of $V_C(0)$ = -500 V. If L = 15 μH and C = 50 μF and the SCR is turned on at t = 0. Calculate Peak value of resonant current and the conduction time of thyristor.

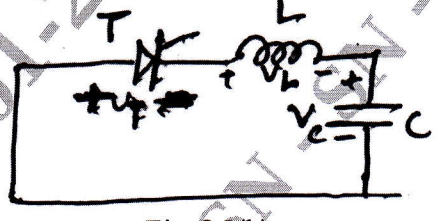

Fig.Q5(b) **(08 Marks)**

c. Explain external pulse commutation with neat circuit diagram. **(04 Marks)**

6 a. Explain the working of ON-OFF type AC voltage controller. Derive expression for RMS output voltage. **(08 Marks)**

b. Explain with neat sketch and waveforms, single phase AC voltage controller with RL load. Derive expression for V_{orms}. **(08 Marks)**

c. A single phase full wave ac voltage controller has a resistive load of R = 10 Ω and the input voltage is V_s = 120 V, 60 Hz. The delay angles of thyristors T_1 and T_2 are equal $\alpha_1 = \alpha_2 = \alpha = \pi/2$. Determine: i) V_{orms} ii) input PF iii) the average current of thyristors, I_A iv) the rms thyristor current, I_A **(04 Marks)**

7 a. Explain the working of class E chopper. Also explain the working principle of step-down chopper and derive expression for:
i) Average output voltage
ii) Output power **(08 Marks)**

b. Explain the working principle of step-up chopper with neat circuit diagram and waveform. Derive expression for average output voltage. **(08 Marks)**

c. A step-down chopper is operation at a frequency of 2 kHz from a 250 V dc source to supply a load resistance of 10 Ω. The time constant of the load circuit is 10 ms. If the average load voltage is 150 V, calculate: i) On-time of the chopper ii) the average and rms values of load current, iii) peak-to-peak ripple current. **(04 Marks)**

8 a. With neat circuit and waveforms, explain the working of 1-ϕ-full bridge inverter. Define the performance parameters related to the inverter. **(08 Marks)**

b. Explain the working of transistorized 1-ϕ-current source inverter with neat circuit diagram and waveforms. **(08 Marks)**

c. The single phase bridge inverter has source voltage of 60 V and R = 5 Ω. Calculate: i) rms output voltage at fundamental frequency ii) rms output power iii) total harmonic distortion iv) distortion factor **(04 Marks)**

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