

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 $R_C = 1.5 \Omega$. The dc supply voltage $V_{CC} = 40 \text{ V}$ and the input voltage to the base circuit $V_B = 6\text{V}$, if $V_{CB(\text{sat})} = 1.6\text{V}$, $V_{CE(\text{sat})} = 1.2 \text{ V}$, $R_B = 0.7 \Omega$. Determine:

i) Over drive factor	ii) Forced β	iii) Power loss in transistor.
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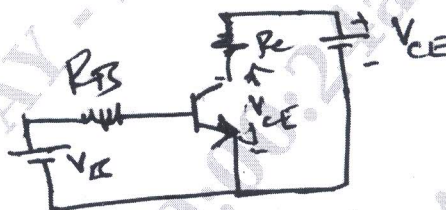


Fig.Q2(b)

- 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.

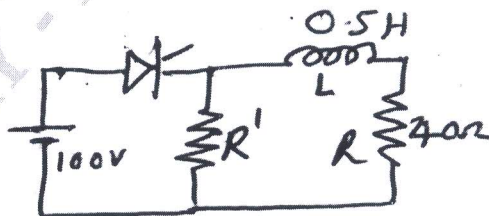


Fig.Q3(c)

(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 $R = 10 \Omega$. The circulating inductance is $L_r = 40 \text{ mH}$; delay angle $\alpha_1 = 60^\circ$ and $\alpha_2 = 120^\circ$. 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 $V_c(0) = -500 \text{ V}$. If $L = 15 \mu\text{H}$ and $C = 50 \mu\text{F}$ and the SCR is turned on at $t = 0$. Calculate Peak value of resonant current and the conduction time of thyristor.

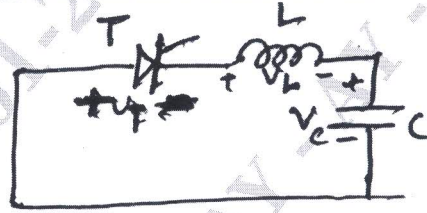


Fig.Q5(b)

- (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 $R = 10 \Omega$ and the input voltage is $V_s = 120 \text{ V}$, 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 10Ω . 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 $R = 5 \Omega$. 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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