Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Power Electronics

3 hrs. Max. Marks:100

Note :1. ***Answer any FIVE full questions.***
2. ***Missing data may be suitably assumed.***

a. **Explain** briefly the different types of power electronic circuits. **(05 Marks)**
b. **Discuss** peripheral effects of power electronics equipments. **(05 Marks)**
c. **Explain** turn-on and turn-off characteristics of SCR. **(10 Marks)**

a. **Compare** power MOSFETs and bipolar junction transistors. **(05 Marks)**
b. **Draw** and explain the dynamic characteristic of IGBT. **(05 Marks)**
c. **For** the BJT circuit shown in figure Q2 (c), if $V_{BE(sat)} = 1.5V$, $V_{CE(sat)} = 1.2V$, $\beta = 25$, $V_{CC} = 10V$, $R_C = 10\Omega$ and $R_B = 20\Omega$. Find i) Minimum voltage off V_{BB} required to **ensure** transistor saturation ii) On-state power loss in the transistor. **(05 Marks)**

d. **Discuss** methods of providing isolation of gate/base drive circuits from power circuits. **(05 Marks)**

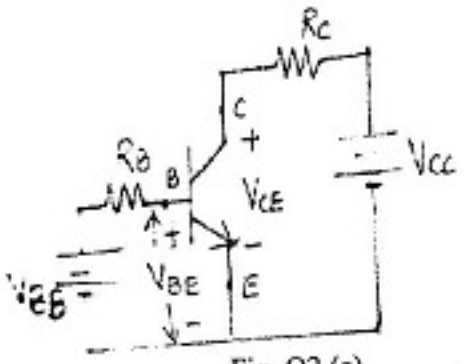

Fig. Q2 (c)

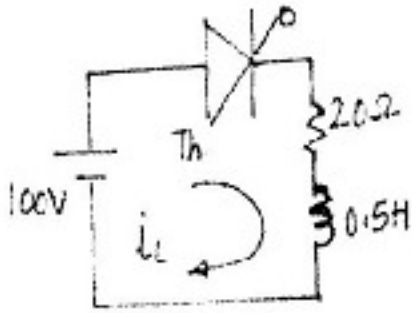

Fig. Q3 (b)

a. **With** two transistor model explain switching action of thyristor. Derive an expression for **anode** current. **(10 Marks)**
The thyristor in figure Q3 (b) has a latching current level of 50 mA and width of triggering **pulse** is 50 μsec. Find out whether the thyristor can be turned on successfully or not. **(04 Marks)**
c. **Design** UJT firing circuit shown in figure Q3 (c). The parameters of UJT are : $V_S = 20V$, $\eta = 0.66$, $I_p = 10\ \mu A$, $V_v = 2.5V$, $I_v = 10mA$. The frequency of oscillations is $f = 1$ kHz. **The pulse** width is $t_g = 40\ \mu sec$. **(06 Marks)**

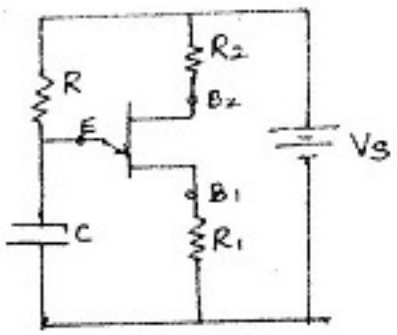

Fig. Q3 (c)

4 a. Distinguish between natural commutation and forced commutation. (04 Marks)

b. Commutation circuit for an SCR by resonating load is shown in figure Q4 (b). Check whether the SCR will be self commutated or not. If SCR is self commutated, calculate the voltage of the capacitor at the time of commutation. (06 Marks)

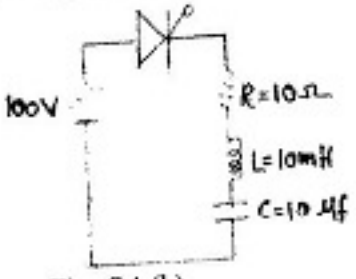

Fig. Q4 (b)

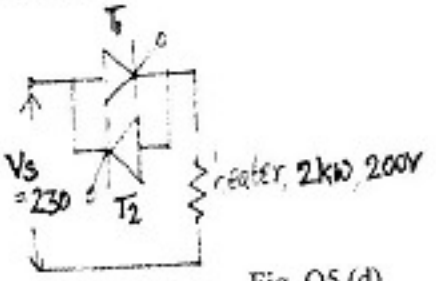

Fig. Q5 (d)

c. With neat circuit diagram and waveforms explain the working of complementary commutation. (10 Marks)

5 a. Draw the circuit of a single phase full wave AC voltage controller with "RL" load and sketch the output voltage and current and thyristor current waveforms. Derive expression for RMS output voltage. Also explain its operation. (08 Marks)

b. Distinguish between on-off control and phase control of AC voltage controllers. (04 Marks)

c. An on-off type of AC voltage controller is operating with a resistive load of R = 10Ω and the RMS supply voltage is 230 V. The controller remains on for 40 cycles and off 60 cycles. Determine i) RMS load voltage. ii) Input power factor. (04 Marks)

d. In the circuit of figure Q5 (d), if the load is 2 KW, 230 V, heater and $V_s = 230V$, 50 Hz. Calculate i) $V_{Load-rms}$ ii) Power dissipated in the heater for $\alpha = 45°$. (04 Marks)

6 a. Explain with the help of waveforms, fully controlled single phase converter with "RL" load. (08 Marks)

b. A single phase half controlled rectifier is used to supply power to a load of 10Ω, from 230V, 50 Hz AC supply at firing angle 30°. Calculate: i) Average output voltage ii) effective output voltage iii) average load current. (05 Marks)

c. What is a freewheeling diode? What are the advantages of freewheeling diode in rectifier circuits feeding inductive load. (03 Marks)

d. Draw the circuit diagram of a single-phase dual converter. What are the advantages and disadvantages of circulating current mode dual converter? (04 Marks)

7 a. Explain how DC choppers are classified with reference to load voltage and load current. (10 Marks)

b. Write a short note on: step-up chopper. (04 Marks)

c. A DC chopper, of type A has a resistive load R = 20Ω and input voltage of 220 V. When chopper remains on, its voltage drop is $V_{Ch} = 1.5V$ and chopping frequency is 10 kHz? If duty cycle is 80%, determine i) Average output voltage ii) rms output voltage iii) chopper efficiency iv) effective input resistance Ri. (06 Marks)

8 a. With the necessary circuit diagram and waveforms. Explain the operation of single-phase half bridge inverter. (06 Marks)

b. Define the performance parameter of the inverters. (04 Marks)

c. With a circuit diagram explain the working of single-phase current source inverter. What are the advantages and disadvantages of current source inverter? (Note: CSI using transistor) (08 Marks)

d. RMS value of fundamental component of output voltage in a single phase full bridge inverter employing displacement angle control is 80% of dc input. If there is one pulse in each half cycle calculate displacement angle 'β'. (02 Marks)