USN

Fourth Semester B.E. Degree Examination, June/July 2013 **Power Electronics**

Time: 3 hrs. Max. Marks: 100

> Note: 1. Answer FIVE full questions, selecting atleast TWO questions from each part.

- 2. Draw suitable sketches wherever necessary.
- 3. Missing data, if any, may be suitable assumed.

PART - A

- With suitable sketches, explain the control characteristics of SCR and IGBT. (06 Marks)
 - What are the industrial applications of power electronic circuits? b. (08 Marks)
 - Write a brief note on 'Thyristorised tap changer'.

(06 Marks)

- 2 The bipolar transistor shown in Fig. Q2(a) is specified to have \$\beta\$ in the range 8 to 40. The load resistance is $R_C = 11 \Omega$. The DC supply voltage is $V_{CC} = 200 \text{ V}$ and the input voltage to the base circuit is $V_B = 10 \text{ V}$. If $V_{CE(sat)} = 1 \text{ V}$ and $V_{BE(sat)} = 1.5 \text{ V}$ find:
 - i) The value of R_B that results in saturation with an overdrive factor of 5
 - ii) Forced B_f iii) The power loss in the transistor.

(08 Marks)

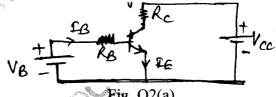


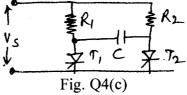
Fig. Q2(a)

- With the help of a circuit schematic describe how the base current peaking is obtained (06 Marks) during turn on of power transistors.
- Describe di/dt and dv/dt protection for transistor.

(06 Marks)

Describe two transistor model of thyristor and obtain the expression for anode current. 3

- Ten thyristors are used in a string to withstand a DC voltage of $V_S = 15$ KV. The maximum leakage current and recovery charge differences of thyristors are 10 mA and 150 µC respectively. Each thyristor has a voltage sharing resistance of R = 56 KΩ and capacitance of $C_1 = 0.5 \mu F$. Determine: i) The maximum steady state voltage sharing $V_{DS(mas)}$ ii) The steady state voltage derating factor iii) the maximum transient voltage sharing $V_{\text{DT}(\text{max})}$ and iv) transient voltage derating factor.
- Describe the need of isolation in thyristor triggering circuit and show typical schematic (06 Marks) showing pulse transformer isolation.
- With the help of a suitable schematic describe self commutation circuit. (08 Marks) a.
 - What is natural commutation? With the help of suitable circuit and waveforms, explain in (08 Marks) brief, natural commutation.
 - The circuit shown in Fig. Q4(c) has load resistances of $R_1 = R_2 = R = 5\Omega$, $C = 10 \mu F$ and supply voltage $V_S = 100 \text{ V}$. Determine the circuit turn off time. (04 Marks)



PART - B

- 5 a. Describe the operation of single phase semi-controlled rectifier feeding resistive load.

 Obtain the expression for the average DC output voltage. (06 Marks)
 - Evaluate the form factor, ripple factor, transformer utilization factor and P/V of thyristor for the circuit shown in Fig. Q5(b). Also find the rectification efficiency. Assume triggering and angle = 90°. V_S = V_m sin wt.

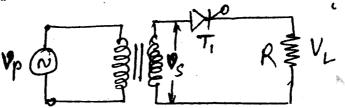


Fig. Q5(b)

- c. Draw the schematic of three phase half wave controlled rectifier feeding resistive load. Also draw the waveforms of input voltages and output voltage for any triggering angle (No explanation required). (06 Marks)
- 6 a. With the help of a circuit schematic describe principle of step up chopper. Obtain the expression for average output voltage in terms of duty ratio. (06 Marks)
 - b. A step down chopper with resistive load has a resistive load of 10 Ω and the input voltage is $V_S = 220$ V. When the converter switch remains on, its voltage drop is 2V and the chopping frequency is F = 1 KHz. If the duty cycle is 50% determine:
 - i) Average output voltage
 - ii) rms output voltage
 - iii) Chopper efficiency
 - iv) The effective input resistance of chopper.

(08 Marks)

c. Mention the various performance parameters of the stepup and stepdown choppers.

(06 Marks)

- 7 a. With the help of circuit schematic and waveforms describe full bridge single phase inverter.

 (06 Marks)
 - b. The single phase full bridge inverter has a resistive load of $R = 2.4 \Omega$ and the DC input voltage is $V_3 = 48 \text{ V}$. Determine:
 - i) The rms output voltage at the fundamental frequency and
 - ii) The output power.

(04 Marks)

- c. With the help of neat sketches of circuit schematic and waveforms explain the operation of three phase inverters in 180 degrees conduction mode. (10 Marks)
- 8 a. With the help of a circuit schematic and waveforms explain the principle of on-off control.

 State the equation of output voltage. (08 Marks)
 - b. A single phase fullwave AC voltage controller has a resistive load of $R = 10 \Omega$ and the input voltage is $V_S = 120 \text{ V (rms)}$, 60 Hz. The delay angles of the thyristors T_1 and T_2 are equal and 90°. Determine:
 - i) The rms output voltage and
 - ii) The input power factor.

(04 Marks)

c. Describe how the power electronic converters produce electromagnetic interference. How is this interference minimized? (08 Marks)

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