EC42

Fourth Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Power Electronics

3 hrs. Max. Marks:100

Note :1. ***Answer any FIVE full questions.***

Explain the peripheral effects caused by power electronic converters. **(06 Marks)**

Give the characteristic features of the following devices:
i) MOSFET ii) Triac iii) GTO iv) RCT **(08 Marks)**

Latching current of a SCR, with a dc voltage source of 200 V, is 100 mA. Compute the minimum width of gate pulse current required to turn-on this SCR, in case the load consists of i) L = 0.2 H ii) R = 20 Ω in series with L = 0.2 H and iii) R = 20 Ω in series with L = 2.0 H. **(06 Marks)**

Give the construction, static characteristics and applications of IGBT. **(06 Marks)**

With circuit diagrams, discuss the methods for providing isolation of gate / base circuits from power circuit. **(08 Marks)**

The collector clamping circuit of figure Q2 (c) has V_{CC} = 100 V, R_C = 1.5 Ω, V_{d1} = 2.1 V, V_{d2} = 0.9 V, V_{BE} = 0.7 V, V_B = 15 V and R_B = 2.5 Ω and β = 16. Calculate i) the collector current without clamping, ii) the collector-emitter clamping voltage, V_{CE} and iii) the collector current with clamping. **(06 Marks)**

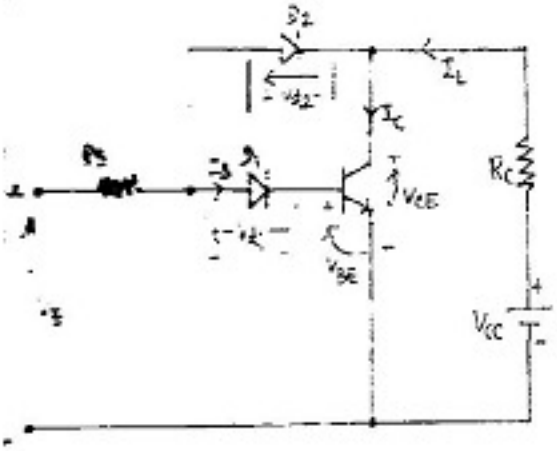

Fig. Q2 (c)

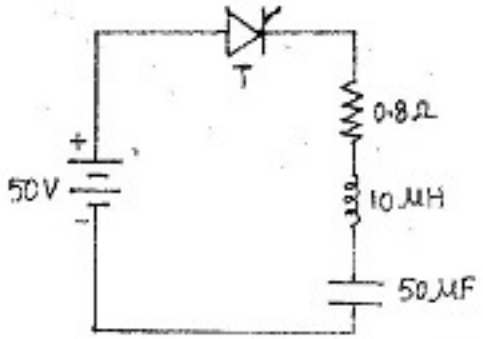

Fig. Q4 (c)

Using two-transistor model, explain the switching action of a thyristor and significance of gate control. Also derive an expression for the anode current. **(08 Marks)**

Distinguish between:
i) Latching current and holding current.
ii) Converter grade thyristor and inverter grade thyristor.
iii) Thyristor turn-off time and circuit turn-off time. **(06 Marks)**

Twelve thyristors are used in a string to withstand a DC voltage of 16 KV. The maximum leakage current and recovery charge differences of the thyristors are 10 mA and 175 μC respectively. Each thyristor has equalizing components of R = 56 KΩ and C = 0.5 μF. Determine the derating factors for i) steady state and ii) transient state. **(06 Marks)**

Distinguish between:
i) Voltage commutation and current commutation.
ii) Load-side commutation and Line-side commutation. **(06 Marks)**

Explain with the help of a circuit diagram and relevant waveforms, the operation of an impulse commutated circuit with accelerated recharging. **(08 Marks)**

4 c. Commutation circuit for a SCR by resonating load is as shown in figure Q4 (c). Ch whether the SCR is self-commutated. Calculate the time of conduction of SCR and voltage of the capacitor at the time of commutation. (06 Ma

5 a. Derive an expression for the rms value of the output voltage of a bi-directional AC volt controller, employing on-off control.

b. Explain the operation of a single-phase phase-control type of voltage controller with load. Give an illustration to show that for firing angle α less than load angle θ, out voltage of the AC voltage controller cannot be regulated. (06 Ma (08 Mar

c. A single phase full-wave voltage controller has an input voltage of 230 V and a lo having $R = 4\ \Omega$ and $L = 22$ mH. The frequency is 50 Hz. The firing angles are 60° for bo thyristors. Find i) Conduction angle of thyristors and ii) rms output voltage. (06 Mark

6 a. Give the equations to show that the power factor of semiconverter is better than that of fu converter.

b. With neat circuit and wave diagrams, explain the working of a line-commutated converte which can function as a rectifier and also as an inverter. Derive an expression for i average output voltage. (04 Mark

c. A single phase dual converter is operated from a 230 V, 50 Hz supply and the loa resistance is $R = 10\ \Omega$. The circulating inductance is $L_r = 40$ mH. Delay angles are $\alpha_1 = 60$ and $\alpha_2 = 120°$. Calculate the peak circulating current and the peak current of converter L (10 Mark

7 a. With the help of circuit and quadrantal diagrams, explain the working of a class-E chopper. Mention the devices that provide path for the current in each quadrant. (06 Marks)

b. A chopper is feeding an RL load as shown in figure Q7 (b). The chopper frequency is 1 kHz and duty cycle $K = 0.5$. Calculate (10 Marks)

i) The minimum instantaneous load current. ii) The peak instantaneous load current.
iii) The average value of load current. iv) The rms load current.
v) The rms chopper input current.

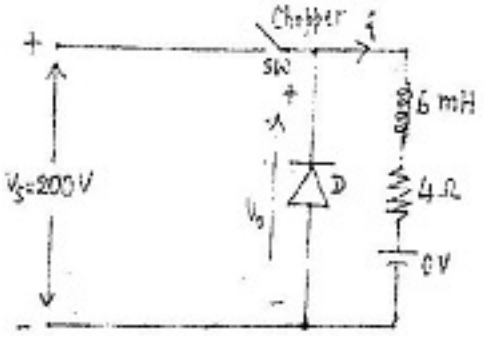

Fig. Q7 (b)

8 a. Explain the operation of a three-phase transistorized inverter in 180° conduction mode, with resistive star connected load. (08 Marks)

b. Write a note on voltage control of single phase inverters by sinusoidal pulse width modulation technique. (05 Marks)

c. A full-bridge inverter circuit has an input voltage of 200 V. The load is a series RLC circuit with $R = 10\ \Omega$, $L = 20$ mH and $C = 100\ \mu$F. The inverter frequency is 50 Hz.

i) Express the instantaneous load current as fourier series. Consider upto 9th harmonic only.
ii) Find the rms value of fundamental component of load current and
iii) Total harmonic distortion of the load current. (07 Marks)

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