Roll No. ....

325654(25)

BE (6th Semester)
Examination, April-May, 2018

(New Scheme)

Power Electronics Devices & Circuits

Time Allowed : 3 hours   Maximum Marks : 80
                            Minimum Pass Marks : 28

Note : (i) Answer **all** questions. Part (*a*) of each question is compulsory. Attempt any **two** parts from (*b*), (*c*) and (*d*) of each question.

(ii) The figures in the right-hand margin indicate marks.

Unit–I   csvtuonline.com

1. (*a*) What is reverse recovery time of SCR ?   [2]

   (*b*) Sketch static I-V characteristic of a thyristor. Label the various voltages, currents and the operating modes and explain.   [7]

   (*c*) Define string efficiency for series/parallel connected SCRs. Derive an expression for the series-connected string.   [2+5]

(*d*) For the circuit shown in figure below calculate the maximum values of $\frac{di}{dt}$ and $\frac{dv}{dt}$ for the thyristor :   [7]
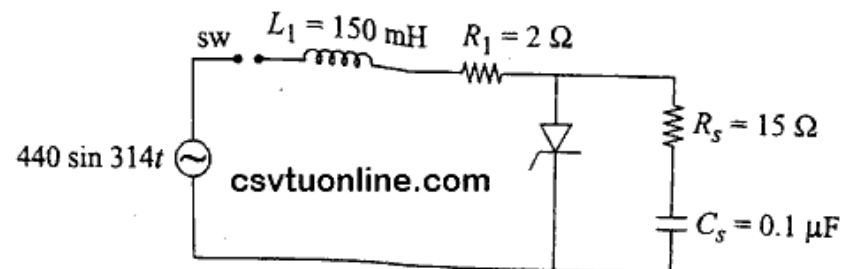
Unit–II

2. (*a*) State the difference between half-wave controlled and half-controlled converter.   [2]

   (*b*) What is the effect of source inductance on the operation of single-phase full-bridge converter ? Derive the expression for output voltage, including the effect of source inductance.   [2+5]

   (*c*) A single-phase full-bridge converter operating from a 230 V, 50 Hz supply feeds a load comprising a d.c. source of voltage 220 V, resistance of 3 Ω and an infinite inductance. The a.c. source inductance is 1 mH. Converter operates in the inverting mode with a firing delay angle $\alpha = 120°$. Calculate the average value of load current, overlap angle and margin angle.   [7]

(d) Explain how two 1-ϕ full converters can be connected back-to-back to form a circulating current type of dual converter. [7]

Unit–III

3. (a) Write any two applications of chopper. [2]

(b) Discuss the technique of obtaining variable d.c. voltage. Hence, derive the expression for step-up chopper using SCR. [4+3]

(c) A d.c. step-down chopper has a resistive load $R = 10\ \Omega$ and input voltage $V_s = 200$ V. When the chopper remains on, its voltage drop is 2 V. The chopper frequency is 1 kHz. If duty cycle is 50%, determine–

(i) average output voltage ;

(ii) r.m.s. output voltage ;

(iii) chopper efficiency ;

(iv) effective input resistance of chopper. [7]

(d) Explain the voltage-commutated chopper along with various waveforms. Also write the merits and demerits of voltage-commutated chopper. [5+2]

Unit–IV

4. (a) What is an inverter ? [2]

(b) Compare the voltage source inverters with current source inverters. [7]

(c) Explain the operation of 180° mode 3-phase bridge inverter feeding a delta-connected resistive load. [7]

(d) Design a series inveter circuit for operation in the frequency range 1 kHz to 5 kHz. The load resistance may vary from 25 Ω to 100 Ω. The peak load current is limited to 3A and the supply voltage is 100 V. [7]

Unit–V

5. (a) Write any two applications of cycloconverter. [2]

(b) Describe the basic working principle of a single-phase to single-phase bridge type cycloconverter. Sketch the output voltage and current waveforms for a resistive load. [7]

(c) A single-phase unidirectional voltage controller is connected to a load of $R = 10\ \Omega$. Input voltage is 230 V, 50 Hz. Firing delay is 30°. Determine (i) r.m.s. value of output voltage, (ii) average and r.m.s. values of thyristor current and (iii) input power factor. [7]

(d) Describe the principle of phase control in single-phase half-wave voltage controller. Derive the expressions for the average and r.m.s. value of output voltage for this voltage controller. [4+3]