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B.E. (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2013

Electrical and Electronics Engineering

Fifth Semester

EE 9301 – POWER ELECTRONICS

(Regulation 2008)

Time: 3 Hours

Answer ALL Questions

Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. What is meant by secondary break down?
2. What are holding and latching currents in SCR?
3. For a half wave rectifier draw the load voltage and current waveforms for an RL load?
4. Draw the circuit diagram of boost chopper.
5. What is inductor current freewheeling?
6. Give the voltage gain of buck, boost and buck-boost dc-dc converters.
7. Define : Amplitude Modulation index and frequency modulation index.
8. What are the advantages of PWM techniques used in voltage source converters?
9. Draw any one configuration of a single phase current source inverter.
10. Draw the circuit diagram of a single phase to single phase cyclo converter. Sketch the load voltage waveforms and indicate the sequence of conducting devices for 50 Hz to 25 Hz and 50 Hz to 100Hz frequency conversion..

PART – B
(5X16=80)

11.(a)(i) Explain the the construction and working of a Power BJT and discuss the static characteristics. (8)

(ii) Explain the gate characteristics and forward characteristics of SCR. (8)

- 12.(a) A single phase full converter feeding RL load has the following data: source voltage 230 V(RMS) ,50 Hz,R= 2.5Ω ,L= very large, Firing angle = 30° . If the load inductance is large enough to make the load current virtually constant then
- (a) Sketch the time variations of source voltage, source current, load voltage, and load current, current through one SCR and voltage across it. (4)
 - (b) Compute the average value of load voltage and load current. Derive the formula used. (8)
 - (c) Compute the input power factor. (4)

(OR)

12(b) A three phase fully controlled converter operates from a 3 phase 230 V, 50 Hz supply through a Y/Δ transformer to supply a 220 V, 600 rpm, 500 A separately excited dc

motor. The motor has an armature resistance of 0.02Ω . What should be the transformer turns ratio such that the converter produces rated motor terminal voltage at 0° firing angle. Assume continuous conduction. The same converter is now used to brake the motor regeneratively in the reverse direction. If the thyristors are to be provided with a minimum turn off time of $100 \mu\text{s}$, what is the maximum reverse speed at which rated braking torque can be produced. Derive the formula used.

- 13(a) (i) Explain the working of a Type-A chopper supplying RLE load. Obtain expressions for maximum and minimum currents taken by the load. (8)
- (ii) An RLE load is operating in a chopper circuit from a 500V dc source. For the load $L = 0.06\text{H}$ and $R = 0$ and with duty cycle = 0.2 find the chopping frequency to limit the amplitude of the load current excursion to 10A . (8)

(OR)

- 13(b) (i) A buck dc-dc converter is supplied with an input voltage that varies between 25V and 40V . The output is required to be regulated at 15V . Find the duty cycle range. (6)
- (ii) Explain the operation of a buck-boost dc-dc converter and illustrate the operation with inductor current and switch waveforms. (10)

- 14(a) (i) Explain the 120° mode of operation of a three phase voltage source inverter. (8)
- (ii) What is the need for controlling voltage at the output terminals of the inverter? Describe briefly the various methods employed for the control of output voltage of inverters. (8)

(OR)

- 14 (b) (i) Explain about the sinusoidal pulse width modulation technique used in three phase voltage source inverters. Sketch phase voltage, line voltage and harmonic spectrum of both line voltage and phase voltage. (10)
- (ii) Explain the working principle of a series resonant inverter and derive an expression for load current. (6)

15. (a) (i) A Single phase to single phase mid point cycloconverter is delivering power to a resistive load. The supply transformer has turns ratio of $1:1:1$. The frequency ratio is $f_0/f_s = 1/5$. The firing angle delay α for all the four SCRs are the same. Sketch the time variations of the following waveforms for $\alpha = 0^\circ$ and $\alpha = 30^\circ$. (a) Supply voltage (b) output current and (c) supply current. Indicate the conduction of various thyristors also.

(OR)

- 15.(b)(i) A 3 phase to single phase cycloconverters employs a 6 pulse bridge circuit. This device is fed from 400V , 50Hz supply through a delta/star transformer whose per phase turns ratio is $3:1$. For an output frequency of 2Hz , the load reactance is $\omega_0 L = 3\Omega$. The load resistance is 4Ω . The commutation overlap and thyristor turn off time limit the firing angle in the inversion mode to 165° . Compute (a) peak value of rms output voltage (b) rms output current and (c) output power. (8)