

M.E. DEGREE EXAMINATIONS: JANUARY 2009

First Semester

POWER ELECTRONICS AND DRIVES

P07PE103: Analysis of Power Converters

Time: Three Hours**Maximum Marks: 100****Answer All Questions:-****PART A (20 X 1 = 20 Marks)**

1. In a thyristor, ratio of latching current to holding current is
(a) 0.4 (b) 1.0
(c) 2.5 (d) 6.0
2. A single phase one pulse controlled circuit has resistance and counter emf load and 400 sin 314 t as the source voltage. For a load counter emf of 200 V, the range of firing angle control is
(a) 30 to 150 (b) 30 to 180
(c) 60 to 120 (d) 60 to 180
3. In a single phase full converter if load current is I and ripple free, then average thyristor current is
(a) I/2 (b) I/3 (c) I/4 (d) I
4. A single phase two pulse bridge converter has an average output voltage and power output of 500 V and 10 KW respectively. The SCRs used in the two pulse bridge converter are now re employed to form a single phase two pulse mid point converter. This new controlled converter would give, respectively, an average output voltage and power output of
(a) 500 V, 10 KW (b) 250 V, 5 KW
(c) 250 V, 10 KW (d) 500 V, 5 KW
5. The total number of SCRs conducting simultaneously in 3 phase full converter with overlap considered has the sequence of
(a) 3,3,2,2 (b) 3,3,3,2
(c) 3,2,3,2 (d) 2,2,2,3
6. In circulating current type of dual converter, the nature of voltage across reactor is
(a) alternating (b) pulsating
(c) direct (d) triangular
7. The PIV in ac to dc converter systems is highest in
(a) single phase full wave mid point converter
(b) single phase full converter
(c) 3 phase bridge converter
(d) 3 phase half wave converter

8. A 3 phase full converter has an average output voltage of 200 V for zero degree firing angle and for resistive load. For a firing angle of 90 degree, the output voltage would be
 (a) zero (b) 50 V (c) 100 V (d) 26.8 V
9. In dc choppers the waveforms for input and output voltages are respectively
 (a) discontinuous, continues (b) both continuous
 (c) both discontinuous (d) continuous, discontinuous
10. In dc choppers, per unit ripple is maximum when duty cycle α is
 (a) 0.2 (b) 0.5 (c) 0.7 (d) 0.9
11. In dc choppers, if T is the chopping period, then output voltage can be controlled by PWM by varying
 (a) T keeping T_{on} constant (b) T_{on} keeping T constant
 (c) T_{off} keeping T constant (d) T keeping T_{off} constant
12. A dc chopper is fed from 100 V dc. Its load voltage consists of rectangular pulses of duration 1 msec in an overall cycle time of 3 msec. The average output voltage and ripple factor for this chopper are respectively
 (a) 25 V, 1 (b) 50 V, 1 (c) 33.33 V, $\sqrt{2}$ (d) 33.33 V, 1
13. A load resistance of 10 ohm is fed through a 1 phase voltage controller from a voltage source of $200 \sin 314t$. For a firing angle delay of 90 deg, the power delivered to load in KW, is
 (a) 0.5 (b) 0.75 (c) 1 (d) 2
14. A single phase voltage controller feeds power to a resistance of 10 ohm. The source voltage is 200 V rms. For a firing angle of 90 deg., the rms value of thyristor current in amperes is
 (a) 20 (b) 15 (c) 10 (d) 5
15. A single phase voltage controller using two SCRs in ant parallel, is found to be operating as a controlled rectifier. This is because
 (a) Load is R and pulse gating is used
 (b) Load is R and high frequency carrier gating is used
 (c) Load is RL and pulse gating is used
 (d) load is RL and continuous gating is used
16. In a single phase voltage controller with RL load, α is the firing angle, ϕ is the load phase angle and β is the extinction angle. For this voltage controller, output power can be controlled if $\alpha > \phi$ and
 (a) $(\beta - \alpha) = \pi$ (b) $(\beta - \alpha) < \pi$
 (c) $\beta > \pi$ (d) $\beta < \pi$
17. The cycloconverters require natural or forced commutation as under
 (a) Natural commutation in both step up and step down cycloconverters
 (b) forced commutation in both step up and step down cycloconverters
 (c) forced commutation in step up cycloconverters
 (d) forced commutation in step down cycloconverters

18. Three phase to 3 phase cycloconverter employing 18 SCRs and 36 SCRs have the same voltage and current ratings for their component thyristors. The ratio of VA rating of 36 SCR devices to that of 18 SCR devices is

- (a) 0.5 (b) 1 (c) 2 (d) 4

19. Three phase to 3 phase cycloconverter employing 18 SCRs and 36 SCRs have the same voltage and current ratings for their component thyristors. The ratio of power handled by 36 SCR devices to that handled by of 18 SCR devices is

- (a) 0.5 (b) 1 (c) 2 (d) 4

20. A 3 phase to 1 phase conversion device employs a 6 pulse bridge cycloconverter. For an input voltage of 200 V per phase, the fundamental rms value of output voltage is

- (a) $600/\pi$ V (b) $300\sqrt{3}/\pi$ V
(c) $300/\pi$ V (d) $600\sqrt{3}/\pi$ V

PART B (5 x 12 = 60 Marks)

21.(a). Describe the working of a single phase full converter in the rectifier mode with RLE load. Discuss how one pair of SCRs is commutated by an incoming pair of SCRs. Illustrate your answer with waveforms for source voltage, E , output voltage and current, source current, current through and voltage across one thyristor. Assume continuous conduction.

(OR)

21.(b). A single phase semi converter is operated from a 220 V, 50 Hz supply. If the load is a series connected inductive load with $L=10$ mH, $R= 20$ ohms, $E_b= 20$ Volts, then calculate the root mean square value of the lowest order harmonic current if the firing or delay angle is $\alpha = \pi/8$ radians.

22.(a). A 3 phase fully controlled bridge converter with 415 V supply, 0.04 ohm resistance per phase and 0.25 ohm reactance per phase is operating in the inverting mode at a firing advance angle of 5 deg., Calculate

(i) the mean generator voltage when the current is level at 80 A. the thyristor voltage drop is 1.5 V.

(ii). In case the load consists of RLE, with $R= 0.2$ ohm, inductance large enough to make load current level at 80 A and emf E , Then find the mean value of

- (a) firing angle of 35 deg
(b) firing advance angle of 35 deg

(OR)

22.(b). A 3 phase semi converter is connected to RLE load. For a firing angle delay of 120 Deg., draw output voltage and load current waveforms in case load current is (i) continuous and (ii) discontinuous. Obtain an expression for the average output voltage by using both sine and cosine functions for the supply voltage.

23.(a). What are resonant converters? Give their advantages over PWM controlled converters. Describe M type ZCS resonant converter with relevant circuits and wave forms

(OR)

23.(b). For a type A chopper circuit, source voltage 220 V, chopping period 200 μ s, on period 600 μ s, load circuit parameters $R = 1$ ohm, $L=5$ mH and $E= 24$ V.

- (a) Find whether load current is continuous or not
- (b) Calculate the value of average output current
- (c) compute the maximum and minimum values of steady state output current
- (d) Sketch the time variations of gate signal, load voltage, load current, thyristor current, freewheeling diode current and voltage across thyristor.
- (e) Find rms values of the first, second and third harmonics of the load current
- (f) Compute the average value of supply current
- (g) Compute input power, the power absorbed by the load counter emf and the power loss in the resistor.

24. (a). For a single phase voltage controller feeding a resistive load, draw the waveforms of source voltage, gating signals, output voltage, source and output currents and voltage across one SCR. Describe its working with reference to the waveform drawn. Analyze the output voltage waveform into various harmonics with Fourier series and find expression for the amplitude of n th harmonic and its phase angle.

(OR)

24.(b). A single phase voltage controller, with two thyristor arranged in antiparallel, is connected to RL load. Discuss its working when firing angle is more than the load pf angle. Illustrate your answer with waveforms of source voltage, gating signals, output voltage, source and output currents and voltage across both the thyristors. Derive an expression for the output current in terms of source voltage, load impedance, firing angle etc.

25. (a). Describe the basic principle of working of single phase to single phase step down cycloconverter for both continuous and discontinuous conductions for a bridge type cycloconverter.

(OR)

25. (b). Describe 3 phase to 3 phase cycloconverter with relevant circuit arrangement using 18 SCRs and 36 SCRs, and also What are the advantages of 3 phase bridge circuit cycloconverter over 18 thyristor device
