Register Number.....

M.E. DEGREE EXAMINATIONS: DECEMBER 2009

First Semester

POWER ELECTRONICS AND DRIVES

PED503: Analysis of Power Converters

Time: Three Hours **Maximum Marks: 100**

Answer All the Questions:-

PART A (10 x 2 = 20 Marks)

1. Define rectification and inversion mode of a converter.
2. What is the difference between semi-converter, full converter and dual converter?
3. How three phase converter is advantageous than single phase converters?
4. List out the basic techniques of forced commutation for ac-dc converters.
5. Give the applications of choppers.
6. What is the difference between buck-boost and cuk regulator?
7. Classify ac voltage controllers.
8. Define unidirectional controller.
9. How variable output voltage at variable frequency is obtained?
10. List out the advantages of cycloconverter.

PART B (5 x 16 = 80 Marks)

11. (a) (i) Briefly explain with neat output waveforms the operation of single phase thyristor converter with 'R' load. (10)

(ii) Derive the rms output voltage of single phase full converter. (6)

(OR)

(b) (i) The single phase full converter has a RL load having L=6.5mH, R=0.5 Ω and E=10V. The input voltage is Vs=120V at (rms) 60Hz. Determine (a) the load current I_{Lo} at $\omega t = \alpha = 60^{\circ}$, (b) the average thyristor current I_A, (c) the rms thyristor current I_R, (d) the rms output current Irms, and (e) the average output current I_{dc}. (8)

(ii) Derive the normalized average output of single phase series semi-converter in inversion mode. (8)

12. (a) (i) Illustrate with output waveforms the working principle of three phase full converte and derive its rms value of the output voltage. (12)

(ii) How three phase semi-converter is better than three phase half-wave converter. (4)

(OR)

(b) (i) With neat converter voltage and choke voltage waveforms illustrate the working o three phase dual converter. Derive the relation of circulating current dependent o delay angle α and on inductance Lr. (12)

(ii) The three phase full converter has a load of L=1.5mH, R=2.5Ω and E=10V. The line-to-line voltage is Vab=208V(rms), 60Hz. The delay angle is $\alpha=\Pi/3$. Determine:

(1) the steady state load current I_{L1} at $\omega t'=\Pi/3+\alpha$,

(2) the average thyristor current, I_A , (3) the rms thyristor current, I_R ,

(4) the average output current Idc, (5) the rms output current, Irms. (4)

13. (a) (i) Explain the mode 1 and mode 2 operation of step-down chopper feeding RL load with neat waveforms and derive the relation of peak to peak ripple current. (12)

(ii) The chopper has a load resistance R=0.25Ω, input voltage Vs=550V, and battery voltage E=0V. The average load current Ia=200A, and chopping frequency f=250Hz. Use the average output voltage to calculate the load inductance L, which would limit the maximum load ripple current to 10% of Ia. (4)

(OR)

(b) (i) Derive the ripple voltage across the capacitor C_1 and C_2 of a regulator which provides output voltage of opposite polarity to that of the voltage. (12)

(ii) Classify choppers depending on the direction of current and voltage flows. (4)

14. (a) (i) A single phase ac voltage controller has a resistive load of R=10Ω and the input voltage is Vs=120V, 60Hz. The delay angle of thyristor T_1 is $\alpha=\Pi/2$. Determine:

(1) the rms value of output voltage Va, (2) the input power factor , and

(3) the average input current. (8)

(ii) Explain the working operation of single phase controller with the inductive load. (8)

(OR)

(b) (i) Name the commutation techniques of thyristors. (2)

(ii) Brief out the operation of three phase bi-directional delta connected ac controllers. (14)

15. (a) (i) With the help of neat circuit diagram illustrate the principle of operation of single phase cycloconverter. (8)

(ii) The input voltage to the cycloconverter is 120V(rms), 60Hz. The load resistance is 5Ω and the load inductance is L=40mH. The frequency of the output voltage is 20Hz. If the converters are operated as semi-converters such that $0 \leq \alpha \leq \Pi$ and the delay angle is $\alpha_p = 2\Pi/3$, determine:

(a) the rms value of output voltage Vo,

(b) the rms current of each thyristor I_R, and

(c) the input power factor. (8)

(OR)

(b) (i) Write the expression of peak voltage and rms value of output voltage of three phase cycloconverter. (10)

(ii) Explain the working of three phase cycloconverter with neat output waveforms. (6)

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