M.E. DEGREE EXAMINATION, MAY/JUNE 2006.

First Semester

Power Electronics and Drives

PE 1603 — ANALYSIS OF POWER CONVERTERS

(Regulations 2005)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What are the Dominant Harmonics in the output of a Single phase and three phase full converter?

2. Write down the values of the performance parameters of an Ideal rectifier.

3. Why is a circulating current inductor required in dual converters?

4. What are the effects of source impedance on the output of a three phase converter?

5. What are the advantages and disadvantages of a Buck regulator?

6. What are the various types of resonant converters?

7. Compare constant frequency and variable frequency operation of a step down chopper.

8. What is a tie control arrangement in a.c. voltage controller?

9. What is a Cycloconverter?

10. What are the advantages of Sinusoidal harmonic reduction techniques for Cycloconverters?

11. (i) Draw the circuit diagram of a single phase full converter with R-L-E load and describe the operation with associated load current and voltage waveforms. Also derive the formula for the average output voltage. (8)

(ii) A single phase full converter is connected to a 230 V, 50 Hz supply. The load current is assumed to be continuous and its ripple current is negligible. Express the instantaneous input current in Fourier series and for a delay angle $\alpha = 60°$, determine the Harmonic Factor of input current and input power factor. (8)

12. (a) (i) A three phase full converter delivers power to RLE load with $R = 1.5\,\Omega$, $L = 1.5$ mH and $E = 0$ V. The a.c. input voltage is 400 V, 50 Hz. For continuous conduction, determine the r.m.s. output current and average output current for a delay angle $\alpha = 30°$. (8)

(ii) Sketch the output voltage waveforms of a Three phase dual converter with Delay angles $\alpha_1 = 60°$ and $\alpha_2 = 120°$ and also show the phase voltages and firing pulses. (8)

Or

(b) (i) Draw the circuit diagram of a Three Phase Full Converter and describe its operation with associated load current and voltage waveforms. (8)

(ii) Derive an expression to show the effects of source inductance on the output voltage of a Three Phase Converter. (8)

13. (a) (i) Draw the circuit diagram of Boost Converter with continuous load current and describe the operation with necessary equivalent circuits, current and voltage waveforms. (8)

(ii) A Buck converter circuit is operating from a 12 V source. The required average output voltage is 5 V and the peak-to-peak output ripple voltage is 20 mV. The Switching frequency is 25 kHz. If the peak to peak ripple current of inductor is limited to 0.8 A, determine the duty cycle and the filter inductance. (8)

Or

(b) (i) Draw the circuit diagram of a Step down chopper and describe the principle of operation with associated output voltage and current waveform. Also derive the formula for the average and r.m.s output voltages. (8)

(ii) Draw the circuit diagram of Zero Voltage Switching Resonant Converter and describe its various modes of operation with necessary equivalent circuits, current and voltage waveforms. (8)

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(a) (i) Draw the circuit diagram with associated input and output waveforms and describe the principle of Phase control of a single phase a.c voltage controller. (8)

(ii) Sketch the input and output voltage waveforms of Three Phase bidirectional a.c. voltage controller for a delay angle $\alpha = 60°$. And also show the firing pulses. (8)

Or

(b) A three phase star connected bidirectional a.c. voltage controller has a resistive load of $R = 10\,\Omega$. The controller is supplied from a line-to-line voltage 400 V, 50 Hz supply. For a delay $\alpha = 60°$, determine,

(i) r.m.s. output voltage

(ii) Output power

(iii) Input power factor

(iv) Expressions for instantaneous output voltage. (4 × 4 = 16)

(a) (i) Draw and explain the circuit diagrams for a single phase to single phase cycloconverter with associated waveforms for resistive load. (10)

(ii) What are the gating signal requirements of thyristors in ac-dc converters? (6)

Or

(b) (i) Draw and explain the circuit diagrams for a three phase to single phase cycloconverter with associated waveforms for resistive load. (10)

(ii) What are the effects of load inductance on the performance of a cycloconverters? (6)

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