M.Tech. – I Semester Supplementary Examinations, September, 2008

ANALYSIS OF POWER ELECTRONIC CONVERTERS
(Common to Power Electronics & Electric Drives/
Power & Industrial Drives/ Power Electronics/
Power Engineering & Energy Systems)

Time: 3hours   **Max. Marks:60**

Answer any FIVE questions
All questions carry equal marks
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1.a)   What is Synchronous tap changer? Discuss the application of ac voltage controller as tap changer.

   b)   An ac voltage controller feeding a resistance of 5Ω is fed from a 220V, 50Hz supply. Determine the form factor of the current as a function of firing angle 'α'. Determine the power factor, displacement factor and distortion factor as function of α.

2.a)   A three phase star connected balanced resistances are supplied from a three phase ac voltage controller. Derive the expression for rms value of load current in the complete range of firing angles. Draw the waveforms of load current.

   b)   A three phase ac voltage controller feeds a balanced star connected R-L load. The value of resistance is 5Ω and inductance is 7.5mH. The controller is fed from a 3-phase supply of 400V, 50Hz. Determine for a firing angle of 90⁰, the values of
   i) rms load current   ii) rms load voltage   iii) Power factor.

3.a)   Explain and compare the circulating and non-circulating current modes of operation of cycloconverters.

   b)   A six pulse cycloconverter is fed from 380V, 3-phase supply. Source has a reactance of 0.4Ω/phase. If the load current is 50A, determine the output load voltage for firing angles of 30⁰ and 60⁰.

4.a)   Explain the following terms:
   i) Input power factor   ii) Displacement factor
   iii) Harmonic factor   iv) Total harmonic distortion and derive the relation between input p.f. and displacement factor.

b)   What are the various power factor improvement methods in converters? Discuss any two of them with relative merits and demerits.

5.a)   Describe the operation of a six pulse bridge converter with a resistive load and draw the input and output current & voltage waveforms for a firing angle of $30^0.$

   b)   Show that the average value of dc voltage is

$$V_d = \frac{3\sqrt{2}}{\pi} V \cos\alpha, \ for \ 0 < \alpha < \pi/3$$

$$V_d = \frac{3\sqrt{2}}{\pi} V \left[1 + \cos(\alpha + \pi/3)\right], \ for \ \pi/3 < \alpha < 2\pi/3$$

Determine also expressions for displacement factor and power factor as a function of α.

6.a)   Explain the principle and operation of Buck and Boost regulator with neat waveforms. What are advantages and applications of this regulator?

   b)   A dc chopper operating from a 220V dc supply feeds a load of resistance of 5Ω in series with an inductance of 30MH. The chopper frequency is 200Hz and ON time of the chopper is 1.2ms. Determine the limits of variation of load current.

7.   Explain briefly the following modulation techniques with relative advantages and disadvantages.
    a) Multiple PWM   b) Sinusoidal PWM   c) Delta modulation.

8.a)   Compare the 180^0 and 120^0 conduction modes of operation of a three-phase inverter.

   b)   Explain the space vector PWM technique as applicable to 3-phase inverter control with neat schematic diagrams.

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