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Printed Pages : 4 **EE – 607**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2028 Roll No.

B. Tech.

(SEM. VI) EXAMINATION, 2006-07

FUNDAMENTALS OF POWER ELECTRONICS

Time : 3 Hours] *[Total Marks : 100*

Note : *Attempt **all five** questions. All questions carry **equal** marks.*

1 Attempt any **four** parts of the following : **5×4=20**

(a) Discuss the difference between :
   (i) Traic and Thyristor
   (ii) MOSFET and IGBT.

(b) Explain the differences in the gating requirements of thyristor and transistor.

(c) Draw the thyristor voltage and current waveforms during turn-on and turn-off processes.

(d) What are different possible configurations of a single-phase voltage controller ? Also, list some of industrial applications of the ac voltage controllers.

(e) Discuss the merits of controlling the heater power by a Triac using integral cycle control over the phase-angle control.

(f) Discuss the functions of diodes in antiparallel with thyristors in the inverter circuits.

2 Attempt any **four** parts of the following : **5×4=20**

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(a) Explain the control of a chopper output voltage using variable frequency system.

(b) Discuss the effect of source inductance in a fully controlled single phase bridge rectifier.

(c) Explain the difference between line-commulated inverters.

(d) Explain Pulse Width Modulation? List the different PWM techniques.

(e) For a three phase induction motor, explain why V/f ratio is maintained constant for operation below the base speed.

(f) Explain the static V-I characteristics of a Triac.

3 Attempt any **two** parts of the following : **10×2=20**

(a) A single-phase fully controlled rectifier bridge delivers power to a resistive load R. Sketch the time variation of source voltage Vs, output voltage, output current and voltage across one pair of SCRs. Show that average output Voltage Vo is

$$V_0 = \frac{\sqrt{2}\, V_s}{\pi} (1 + \cos \alpha)$$

(b) Describe modes of operation of modified Mc-Murray Bedford half-bridge single-phase inverter. Also draw its relevant voltage and current waveforms.

(c) Describe the principle of burst firing control for a single-phase ac voltage controller, for a resistive load. Show that its power factor is given by,

$$\left[\frac{1}{\pi}\left\{(\pi - \alpha) + \frac{1}{2}\sin 2\alpha\right\}\right]^{1/2}$$

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4 Attempt any **two** parts of the following : **10×2=20**

(a) Show that the fundamental rms value of per-phase output voltage of low-frequency for an m-pulse cycloconverter is given by,

$$V_{0r} = V_{ph}\left(\frac{m}{\pi}\right)\sin\left(\frac{\pi}{m}\right)$$

Also express Vor in terms of voltage reduction factor.

(b) A three-phase fully controlled bridge converter is connected to a pure resistive load. Show that the average output voltage is given by,

$$V_{0r} = \frac{6V_L}{\sqrt{2}\,\pi}\cos\alpha \quad for < \alpha < \frac{\pi}{3} \quad \text{and}$$

$$V_0 = \frac{6V_L}{\sqrt{2}\,\pi}\left[1+\cos\left(\alpha+\frac{\pi}{3}\right)\right] \quad for \ \frac{\pi}{3} < \alpha < \frac{2\pi}{3}$$

where VL is rms value of line Voltage.

(c) A single-phase fully controlled bridge converter is connected to ac supply of 320 Sin 314 t Volt and 50 Hz. It operates at a firing angle of $\frac{\pi}{4}$ rad. The total load current is maintained constant at 6A and the load voltage is 140V. Calculate the source inductrance, angle of overlap and the load resistance.

5 Attempt any **two** parts of the following : **10×2=20**

(a) Describe the following :

(i) Static chopper based resistance control method for the speed control of a three-phase induction motor.

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(ii) Explain operation of multi quadrant chopper.

(b) A single-phase voltage controller has resource voltage 230V at 50Hz and a pure inductive load of $5\ \Omega$

Calculate :

(i) the control range of firing angle

(ii) the maximum value of rms load current,

(iii) the maximum value of $\frac{di}{dt}$ that may occur in the thyrister.

(c) Explain operation of single phase half controlled bridge converter fed separately excited dc motor. Draw waveforms of load voltage, load current and source current.

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