

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

**PAPER ID : 2028**

Roll No.

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### B.Tech.

SIXTH SEMESTER EXAMINATION, 2005-2006

## FUNDAMENTALS OF POWER ELECTRONICS

Time : 3 Hours

Total Marks : 100

- Note :**
- Attempt **ALL** questions.
  - All questions carry equal marks.
  - In case of numerical problems assume data wherever not provided.
  - Be precise in your answer.

1. Attempt *any four* parts of the following : (5x4=20)

- State and explain desirable characteristics of power electronic controllable devices.
- Explain  $dv/dt$  and  $\frac{di}{dt}$  ratings of thyristor and discuss their significance.
- 20 thyristors, each of 500V, 500A ratings are used in a power circuit to supply a load at 1.6 kV and 2.25 kA. Four thyristors are connected in series in a string and 5 parallel strings are used. Calculate the percent voltage and current derating factors.

- aktuonline.com (d) Draw and explain turn off characteristics of thyristor and hence define and explain turn off time of thyristors. aktuonline.com
- (e) Draw symbol, control characteristics and static V-I characteristics of Triac. Compare it with SCR.
- (f) A power transistor is supplying a resistive load.  $V_o$  and  $I_o$  are the off-state voltage and on-state current respectively and  $T$  is the switching time. Assuming negligible on-state voltage drop and on-state leakage current, show that the switching energy loss during transistor switch on is given

$$\text{by } \left[ \frac{V_o I_o}{6} \right] \cdot T$$

2. Attempt *any two* parts of the following : (10x2=20)

- (a) With the help of circuit connection, load voltage and current waveforms and source current waveform, explain the operation of single phase half wave thyristor converter with resistive load.
- (b) What will be the average and rms values of current, load voltage average power across the load for the circuit shown in Fig. 1 when the thyristor is fired at an angle  $\frac{\pi}{4}$  in every positive half cycle of ac voltage.

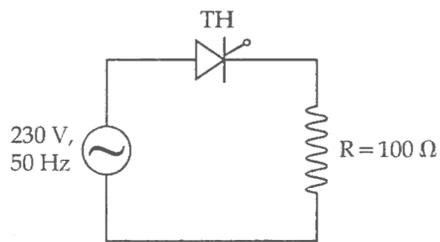


Fig. 1

Draw and explain the simple series thyristor inverter circuit employing class A type commutation. Draw and discuss important waveforms. Also state the limitations of this series inverter.

- (d) Load voltage in a single phase,  $10 \Omega$  resistive circuit is controlled by a symmetrical phase angle triggering of inverse parallel connected thyristors. The supply voltage is  $v = 170 \sin(314 t)$  and firing delay angle is  $90^\circ$ . Calculate the rms value of load voltage and current and input power factor.

3. Attempt *any two* parts of the following : (10x2=20)

- (a) Give performance comparison of pulse with modulated inverters (PWMI), Adjustable voltage source inverters (VSI) and current source inverters (CSI).
- (b) Explain principle of operation of a three phase bridge inverter. Draw phase and line voltage wave forms for  $120^\circ$  mode of operation.
- (c) A single phase full bridge inverter is used to control power in a resistance load and is supplied from a 220V dc source. A uniform pulse width modulation with 5 pulses per half cycle is used and width of each pulse is  $30^\circ$ . Determine : (i) the rms voltage of the load and (ii) the pulse width to maintain the same load power if the input dc voltage source increases by 10%.

4. Attempt *any two* parts of the following : (10x2=20)

- (a) Explain and compare step - up and step - down chopper circuits and also mention their applications. Also obtain expression for average load voltage for both the chopper circuits.
- (b) A step - down chopper is supplying a back emf load and is operating in continuous current conduction mode with rectangular load voltage waveform. Explain the chopper operation and obtain expressions for minimum and maximum instantaneous values of load current. State assumptions made, if any.
- (c) Explain and compare forced commutation methods used with thyristorised choppers.

5. Attempt *any two* parts of the following : (10x2=20)

- (a) Compare and distinguish between phase controlled and chopper controlled dc drives.
- (b) A small separately excited dc motor is supplied via a half controlled single phase bridge rectifier. The input supply is  $1\phi$ , 240 V, 50 Hz and the thyristors are triggered at  $110^\circ$ . Armature current continues for  $50^\circ$  beyond the voltage zero. Determine the motor speed at a torque of 1.8 Nm. The motor torque constant is 1.0 Nm/A and its armature resistance is  $6\Omega$ . Neglect converter losses.
- (c) Briefly describe VSI and CSI fed induction motor drives and compare them.

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