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No. of Printed Pages—4

EE-607

B. TECH.

SIXTH SEMESTER EXAMINATION, 2002-2003

FUNDAMENTALS OF POWER ELECTRONICS

Time : 3 Hours

Total Marks : 100

- Note :** (1) Attempt **ALL** the five questions.
(2) All questions carry equal marks.

1. Attempt any **FOUR** parts of the following :— (5×4=20)

- (a) Draw the static $v-i$ characteristic of a thyristor. Also define and explain the significance of the following :—
(i) Forward breakover voltage,
(ii) Holding current, and
(iii) Reverse breakdown voltage.
- (b) What are the differences between a Thyristor and a Triac ? Draw the symbol of two thyristor equivalent circuit and its static $v-i$ characteristic.
- (c) Write short notes on overcurrent and overvoltage protection of power semiconductor devices.
- (d) 20 thyristors, each of 500 V, 500 A rating, are used in a power circuit to supply a load at 1.6 KV and 2.25 KA. 4 thyristors are connected in series in a string and 5 parallel strings are used. Calculate the per cent voltage and current derating factors.

- (e) Discuss comparative properties of MOSFET and IGBT.
- (f) Draw and explain gate characteristics of a thyristor. Also mention its significance.
2. Attempt any FOUR parts of the following :— (5×4=20)
- (a) State and explain normal specifications of power supplies. Draw the half-bridge configuration of the resonant d.c. power supply.
- (b) Explain the effect of source inductance on the operation and current and voltage waveforms of a 2-pulse converter.
- (c) Explain the working of single phase dual converter with the help of circuit.
- (d) Draw and explain the working of different configurations of single phase a.c. voltage controllers. Also compare them.
- (e) A single phase half controlled bridge converter feeds a load comprising of a resistance of 10Ω and a large inductance to provide a constant and ripple-free load current. Calculate the following, if the firing delay angle is $\frac{\pi}{4}$ and input a.c. source voltage is 120 V, 50 Hz :
- (i) Rectification ratio,
- (ii) form factor, and
- (iii) power factor.
- (f) Describe input performance parameters of controlled rectifiers. Also obtain expression for power factor.

3. Attempt any TWO parts of the following :— (10×2=20)

- (a) What is an Inverter ? Discuss important performance parameters which dictate quality of a m-inverter.
- (b) Describe modified Mc Murray-Bedford half-bridge inverter circuit with related voltage and current waveforms.
- (c) What is pulse width modulation ? List the various PWM Techniques. How do these differ from each other ?

4. Attempt any TWO parts of the following :— (10×2=20)

- (a) A step down chopper is supplying a resistive load of 10Ω from an ideal d.c. source of 220 V. When chopper switch remains on, its voltage drop is 2 V. Chopper frequency is 1000 Hz. If the chopper duty ratio is maintained at 0.5, calculate :
 - (i) the average and rms values of load voltage, and
 - (ii) the chopper efficiency and effective input resistance.
- (b) Explain the working of thyristorised chopper with parallel commutation. Also draw load voltage, load current and input current waveforms.
- (c) Explain the working of multi-quadrant choppers. Mention their advantages, limitations and areas of application.

5. Attempt any TWO parts of the following :— (10×2=20)
- (a) A separately excited d.c. motor rated at 10 KW, 220 V, 1000 rpm is supplied via a fully controlled 2 pulse bridge converter from a 230 V, 50 Hz supply. Armature resistance of 0.5Ω and motor efficiency of 89% are at rated condition and load is a constant torque load. If the value of field resistance is 220Ω and motor current is continuous and ripple-free, determine the speed and efficiency of motor at firing delay angle of zero.
- (b) A separately excited d.c. motor is fed via a first quadrant chopper from a d.c. source. The chopper output voltage waveform is rectangular. The motor is operating under steady state and current conduction is continuous.
- (i) Give the schematic circuit diagram and explain its working with the help of voltage and current waveforms.
- (ii) Obtain the expression for average load voltage. Mention assumptions made, if any.
- (c) State and explain various schemes for three-phase induction motor speed control using voltage source inverters.