Total No. of Questions : 12] [Total No. of Pages : 4

P1352

[3764] - 243

B.E. (Electronics)

ADVANCED POWER ELECTRONICS

(2003)

Time : 3 Hours] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6 from Section - I and Q7 or Q8, Q9 or Q10, Q11 or Q12 from Section - II.***
2) ***Answers to the two sections should be written in separate books.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right indicate full marks.***
5) ***Use of logarithmic tables slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.***
6) ***Assume suitable data, if necessary.***

SECTION - I

Q1) a) Draw the circuit diagram of a three-phase fully-controlled converter feeding a highly inductive (level) active load and the following waveforms for firing angle $\alpha = 120°$.

i) Supply phase voltages.
ii) Supply line voltages.
iii) Output voltage.
iv) Phase B line current. **[8]**

b) A three-phase fully-controlled converter operates from the 415V, 50Hz mains and feeds a highly inductive (level) active load having E = –400V and R = 20Ω. If the firing angle is 120°, calculate :

i) Average (DC) load voltage.
ii) Average (DC) load current.
iii) RMS line current.
iv) Power supplied by the battery of the active load. **[10]**
v) Power fed back to the mains assuming the converter to be lossless.

P.T.O.

OR

Q2) a) Why are dual converters important? With the help of a neat circuit diagram and relevant waveforms, explain the operation of a three-phase dual mode dual converter. **[10]**

b) With the help of a neat circuit diagram, explain the technique for achieving equal voltage sharing of two series connected diodes. Derive the relationship between the current sharing resistors in terms of the diode parameters. **[8]**

Q3) a) With the help of a neat circuit diagram, relevant waveforms and mode equivalent circuits, explain the operation of a three-phase, 180° mode, voltage source inverter feeding a balanced, star-connected resistive load. Also derive an expressions for the following :

i) RMS line-to-neutral output voltage.

ii) RMS SCR current. **[10]**

b) Explain the MMSR technique of selective harmonic elimination for inverters. **[6]**

OR

Q4) a) With the help of a neat circuit diagram, relevant waveforms and mode equivalent circuits, explain the operation of a three-phase, ASCSI feeding an induction motor load. **[10]**

b) Briefly explain any one technique for output voltage control and harmonic reduction in inverters. **[6]**

Q5) a) With the help of a neat circuit diagram and relevant waveforms, explain the Symmetrical Angle Control (SAC) technique for power factor improvement in AC-DC converters. **[8]**

b) Enumerate the different methods of sensing DC current in power electronic circuits and explain any one in detail. How would you modify this method to sense DC voltage? **[8]**

OR

Q6) a) With the help of a neat circuit diagram, waveforms of capacitor voltage & inductor current and mode equivalent circuits, explain the operation of a ZVS resonant DC-DC converter. **[10]**

b) What are the advantages of resonant converters over switched-mode converters? **[6]**

SECTION - II

Q7) a) Compare the inherent properties of a typical DC stepper motor and DC servo motor with respect to any four of the following :

i) Speed control.

ii) Torque-speed behaviour.

iii) Shaft-torque and input power.

iv) Angular position control.

v) Rotor inertia.

vi) Start-stop operation at high speed. **[10]**

b) Explain half-stepping & micro-stepping modes of operation for stepper motors. **[8]**

OR

Q8) a) With the help of a neat circuit diagram and relevant waveforms, explain the operation of a single-phase semiconverter-based separately excited DC motor drive. Derive expressions for the motor armature current and torque in terms of the firing angle, motor speed, field current and motor parameters. **[12]**

b) A 230V, 1000rpm, 10A separately excited DC motor is fed from a single-phase semiconverter operating from the 230V, 50Hz mains. If $R_a = 0.75\Omega$, calculate the firing angle to obtain rated torque for a motor speed of 500rpm. **[6]**

Q9) Explain any two of the following methods for speed control of induction motors : **[16]**

a) Variable frequency PWM-VSI drive.

b) Stator voltage control.

c) Slip power.

OR

*Q10)*a) With the help of the appropriate torque-speed characteristics, explain how electromagnetic braking is achieved for three-phase induction motors fed from a constant V/f variable voltage variable frequency drive. **[8]**

b) A 4 pole, 415V, 50Hz, three-phase induction motor has a rated speed of 1460rpm. Calculate its speed, slip and slip frequency under constant V/f control for a stator frequency of 40Hz, the load torque being equal to 60% of rated motor torque. **[8]**

*Q11)*a) What are the different types of transients present in the power system? What are the sources of these transients? **[8]**

b) What are the different types of industrial and residential/ commercial loads which contribute to harmonics in the power supply? Explain the effect of these harmonics on the working of power systems and connected equipment. **[8]**

OR

*Q12)*a) Write a short note on Energy Audit. **[8]**

b) Enumerate the different types of short-duration power-line voltage disturbances and explain any two in detail. **[8]**

❖ ❖ ❖ ❖