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

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B.E. (Electronics) Sem I

ADVANCED POWER ELECTRONICS

(2003 Course)

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

Instructions to the candidates :

1) *Answer Q. No. 1 or Q. No. 2, Q. No. 3 or Q. No. 4, Q. No. 5 or Q. No. 6 from Section - I and Q. No. 7 or Q. No. 8, Q. No. 9 or Q. No. 10, Q. No. 11 or Q. No. 12 from Section - II.*
2) *Answers to the two sections should be written in separate books.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.*
5) *Assume suitable data, if necessary.*

SECTION - I

Q1) a) Draw the diagram of 3-phase fully controlled converter operating with a highly inductive load and explain operation with following waveforms for $\alpha = 60°$. **[10]**

i) Load voltage.

ii) Load current.

iii) Current through SCR. (any one)

b) Discuss the effect of source inductance on the performance of a single phase full converter indicating clearly the conduction of various thyristors during one cycle derive expressions for output voltage interms of **[8]**

i) Maximum Voltage (V_m).

ii) Firing angle (α). &

iii) Overlap angle (μ).

OR

Q2) a) Explain how two 3-ϕ full converter can be connected back to back to form a circulating current type of dual converter. **[10]**

i) Discuss its operation with the help of voltage waveforms across (1) each converter (2) load (3) reactor.

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ii) If one of the two converter is loaded, sketch the waveforms of their load currents.

b) Explain the necessity of series and parallel connection of power devices. [4]

c) Define 'String efficiency' and state its significance in connection with series and parallel operation of power devices. [4]

Q3) a) With an appropriate power diagram, discuss the principle of working of 3-phase inverter. Draw phase and line voltage waveforms on the assumption that each thyristor conducts for 120° and the resistive load is star connected. [8]

b) A 3 phase bridge inverter is operating with d.c. supply of V volts. The load is star connected and it is purely resistive. The load resistance per phase is R ohms. Calculate the device utilization factor (DUF) for 180° and 120° mode and comment on result. [8]

OR

Q4) a) With the help of circuit diagram explain the circuit of Boost inverter circuit with analysis. [8]

b) Explain the necessity of voltage control and harmonic reduction in inverters. [4]

c) Write note on Space Vector Modulation. [4]

Q5) Explain the concept of power factor on which parameters does the power factor depend? Enlist various power factor improvement techniques for line commutated converters. Explain any one method of power factor improvement in details. Compare it with other techniques. [16]

OR

Q6) a) With the help of neat circuit diagram and associated waveforms, explain the operation of class E resonant inverters. [8]

b) How will you measure? [8]

i) Sinusoidal voltage and current.

ii) Non-sinusoidal voltage and current.

SECTION - II

Q7) a) Draw and explain the power circuit of 1-ϕ semiconverter feeding a separately excited d.c. motor. Explain with typical voltage and current waveforms, the operation in both continuous armature current and discontinuous armature current mode. **[10]**

b) What are the effect of discontinuous armature current for d.c. motor drive? **[6]**

OR

Q8) a) The speed of a separately excited motor is controlled by a single-phase semiconverter. The field current, which is also controlled by semiconverter, is set to the maximum possible value. The ac supply voltage to the armature and field converters is one phase 208V, 60Hz. The armature resistance $R_a = 0.25\Omega$, the field resistance is $R_f = 147\Omega$ and the motor voltage constant is $K_v = 0.7032$V/A rad/sec. The load torque is $T_L = 45$ Nm at 1000 rpm. The viscous friction and no-load losses are negligible. The inductances of the armature and field circuits are sufficient enough to make the armature and field currents continuous and ripple free. **[10]**

Determine :

i) The field currents.

ii) The delay angle of converter in armature circuit α_a and

iii) The input power factor (PF) of the armature circuit converter.

b) Draw the circuit diagram and explain the working of Chopper drive (unipolar) for stepper motor. **[6]**

Q9) a) Draw and explain the operation of three-phase brushless d.c. motor drive. Also explain the related waveforms. **[8]**

b) Draw the torque-speed characteristics of the polyphase induction motor. Also explain the following operating regions. **[6]**

i) Motoring region.

ii) Generating region.

iii) Braking region.

c) Justify "The speed range of an induction motor is restricted to about 30% of full range while operating with slip power regulation system. **[4]**

OR

Q10) a) Explain field failure and under voltage protections for d.c. motors. [4]

b) Explain operation of V/f control for induction motor. [8]

c) Explain briefly the following methods of braking d.c. motor. [6]

i) Regenerative braking.

ii) Dynamic braking.

iii) Plugging.

Q11) a) What is energy audit? Explain types of energy audit. [8]

b) Define the term voltage sag. Explain different sources of sags and interruptions. [8]

OR

Q12) a) What is power quality? Why it is required? Explain different types of power line disturbance. [8]

b) Explain probable preventive solutions to control the factors contributing the power quality distortions. [8]

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