Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/M.Tech (EE)/SEM-1/MEE-103/2009-10

2009

ADVANCED INDUSTRIAL ELECTRONICS

Time Allotted : 3 Hours Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions. 5 × 14 = 70

1. a) Explain with necessary waveform the principle of operation of a cosine triggering circuit.

   b) Explain the complementary commutation & prove that Toff = 0·693 CR_L where the symbol has usual significance. 7 + 7

2. a) A 1ϕ half-wave converter with resistive (R = 10 ohm) and inductive (L = 1 mh) load, the firing angle (α) is $\frac{\pi}{4}$, find the

   i) extinction angle β

   ii) form factor

   iii) ripple factor

   when supply voltage is E_s = 230 V, f = 50 Hz

b) Show that the performance of a single-phase full converter as effected by source inductance is given by the relation $\cos(\alpha + \mu) = \cos\alpha - \omega L_S I_0/V_m$, where the symbols used have their usual meanings. 7 + 7

3. a) What is cycloconverter ? What are the advantages it offers compared to inverters ?

b) Explain with schematic diagram and necessary waveforms, the principle of operation of a three-phase to single-phase step-down cycloconverter.

c) Draw the circuit diagram of a four quadrant chopper and explain its operation. 2 + 5 + 7

4. a) For a type *A* chopper, *dc* source voltage = 230 V, load resistance 10 Ω, take a drop of 2 V across chopper when it is ON. For a duty cycle of 0·5, calculate

i) average and rms value of output voltage

ii) chopper efficiency.

b) Describe how the speed of a separately excited *dc* motor is controlled through the use of two single-phase converters. 7 + 7

5. Discuss the principle of working of a 3-phase bridge inverter with an appropriate circuit. Draw phase and line voltage waveforms on the assumption that each SCR conducts for 180° and the resistive load is star connected. The sequence of firing of various SCRs should also be indicated in the diagram. 14

6. a) Describe different types of modes of operation employed in the practical dual converters with associated waveforms.

   b) For a 1 ϕ *ac* voltage controller with resistive load, show that power factor is given by

$$\cos\phi = \left[\frac{1}{\pi}\left\{(\pi-\alpha) + \frac{\sin 2\alpha}{2}\right\}\right]^{\frac{1}{2}}.$$ 7 + 7

7. a) What is Snubber circuit ? Explain with a neat circuit and give the procedural steps for design. What happens if d*i*/d*t* rating of the SCR is exceeded and how can you protect it ?

   b) Design the UJT firing circuit and explain it with suitable waveforms. 7 + 7