Total No. of printed pages = 4

CAI-402/EM&C/4th Sem/2016/N

ELECTRICAL MACHINES AND CONTROL

Full Marks – 70

Pass Marks – 28

Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer any *five* questions.

1. (a) Give the concept of single-phase ideal transformer. 4

   (b) Draw the phasor diagram of an ideal transformer for inductive load. 5

   (c) A 5 kVA, 1000/200V, 50 Hz single-phase transformer gave the following test results :

   Short-circuit test (high voltage side) : 50V, 5A, 110W

   Open-circuit test (low voltage side) : 200V, 1.2A, 90W

   Compute the parameters of the equivalent circuit referred to low voltage side. 5

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2. (a) Derive the relationship between phase voltage and line voltage in case of star-connected 3-phase power supply. Also draw the phasor diagram. 7

(b) A balanced star connected load of $(8+6j)\Omega$ per phase is connected to a 3-phase, 230V supply. Find the line current, power factor, power reactive volt-amperes and total volt-amperes. 7

3. (a) Derive the emf expression of D.C machine. 4

(b) Write the constructional details of D.C machine with a suitable diagram. 5

(c) A shunt generator has an induced voltage on open circuit of 127V. When the machine is on load, the terminal voltage is 120V. Find the load current if the field-circuit resistance be 15Ω and the armature resistance 0.02Ω. Ignore armature reaction. 5

4. (a) A 1-phase transformer has 180 and 90 turns respectively in its secondary and primary windings. The respective resistances are 0.233Ω and 0.067Ω. Calculate the equivalent resistance of :

(i) the primary in terms of the secondary winding

(ii) the secondary in terms of the primary winding

(iii) the total resistance of the transformer in terms of the primary. 7

(b) A 10 kW, 250V, 6-pole lap-connected d.c generator runs at 1200 rpm. Armature has 500 conductors. For full-load armature ohmic loss of 200W, find the useful flux per pole. Take 2V as the brush drop at full load. 7

5. (a) What is the difference between squirrel-cage induction motor and slip-ring induction motor ? 3

(b) Discuss the points of similarities between a transformer and an induction machine. 4

(c) A 400V, 3-phase, 6-pole, 50 Hz induction motor draws a power of 2 kW at no load and at rated voltage and frequency. At full load slip of 3% the power input to motor is 50 kW and the stator ohmic loss is 1.5 kW. Neglect I^2R loss at no load. If the stator core loss and mechanical losses are assumed equal, then at a slip of 3% calculate :

(i) rotor ohmic loss

(ii) shaft power or output power. 7

6. (a) Describe one scheme used for exciting large synchronous machine. 7

(b) A 3-phase star-connected alternator is delivering 20 MW and 8 MVAR to an infinite bus at 11 KV. The alternator has synchronous impedance of $(0 + 3j)\Omega$. Determine the load angle and the excitation emf of the alternator. 7

7. (a) Explain why a single-phase induction motor should be provided with an auxiliary winding on the stator. 7

(b) Explain the constructional details and principle of working of Reluctance motor. 7