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53 (IE 401) ELMC

2016

**ELECTRICAL MACHINES**

Paper : IE 401

Full Marks : 100

Time : Three hours

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

Answer **any five** questions.

1. (a) What is ideal transformer ? 3
- (b) Why is transformer core laminated ? 3
- (c) What are different losses of transformer ? 4

Contd.

- (d) A 20kVa, 2500/250V, 50Hz, single-phase transformer gave the following test results

Open Circuit test (on l.v. side) : 250V, 1.4A, 105Watts

Short Circuit test (on h.v. side) : 104V, 8A, 320Watts

Compute the parameters of the approximate equivalent circuit referred to high voltage and low voltage sides. Also draw the exact equivalent circuit referred to the low voltage side.

10

2. (a) Write the classification of DC machine on the basis of method of excitation.

5

- (b) Derive an expression of generated emf for a DC generator.

5

- (c) A 4-pole, 500V, shunt motor has 720 wave-connected conductors on its armature. The full-load armature current is 60A and the flux per pole is 0.03 weber. The armature resistance is  $0.2\Omega$  and the contact drop is 1V per brush. Calculate the full load speed of the motor.

10

3. (a) In a 25-kVa, 2000/200-V transformer the iron and copper losses are 350 and 400 watt respectively. Calculate the efficiency on unity power factor at (a) full load and (b) half load. Also determine the load for maximum efficiency and the iron and copper loss in this case. 10
- (b) A 4-pole shunt generator with lap-connected armature having field and armature resistances of  $50\Omega$  and  $0.1\Omega$  respectively supplies sixty 100V, 40W lamps. Calculate the total armature current, the current per armature path, and the generated electromotive force. Allow a contact drop of 1V per brush. 10
4. (a) Explain why a 3-phase induction motor in general similar to a transformer, takes more magnetizing current as compared to a transformer. 5
- (b) What are the differences between squirrel induction motor and slip-ring induction motor? 5

- (c) The power input to the rotor of a 440V, 50Hz, 6 pole, 3 phase induction motor is 80kW. The rotor electromotive force is observed to make 100 complete alternations per minute. Calculate (a) slip (b) the rotor speed (c) the mechanical power developed (d) the rotor copper loss per phase (e) the rotor resistance per phase if the rotor current is 65A. 10
5. (a) Derive an expression for pitch factor. What should be the value of chording angle for eliminating third harmonic? 5+5=10
- (b) Compare the working principle of an induction motor with a synchronous motor. 5
- (c) Why shunt branches of the equivalent circuit are neglected in case of transformer short circuit test? 5
6. (a) Discuss one type of excitation system of synchronous machine with a suitable diagram. 10

(b) A 3-phase, 17.32kVA, 400V, star-connected alternator is delivering rated load at 400V, and at 0.8 power factor lag. Its synchronous impedance is  $(0.2 + 2j)\Omega$  per phase. Find the load angle at which it is operating. 10

7. (a) Write the working principle of single-phase induction motor. 10

(b) Derive an expression of torque in case of reluctance motor. 10