53 (IE 401) ELMC

2017

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 transformer ? Give the concept of ideal transformer. 5

   (b) Derive an expression for the e.m.f. induced in a transformer winding. 5

   (c) A 40*kVA* transformer with a ratio of 2000/250*V* has a primary resistance of 1·15Ω and a secondary resistance of 0·0155Ω. Calculate *(a)* the total resistance in terms of the secondary winding *(b)* the total resistance drop on full load *(c)* the total copper loss on full load. 10

2. *(a)* Draw neat diagram of a 4-pole dc machine. Label all its parts and mention the material used for each part. 10

(b) A shunt generator delivers $50kW$ at $250V$ and $400rpm$. The armature and field resistances are $0{\cdot}02\Omega$ and 50Ω respectively. Calculate the speed of the machine running as a shunt motor and taking $50kW$ input at $250V$. Allow IV per brush for contact drop. 10

3. *(a)* Calculate the efficiency at half, full and $1\frac{1}{4}$ load of a $100kVA$ transformer for power factor of *(a)* unity *(b)* 0·8. The copper loss is $1000W$ at full load and the iron loss is $1000W$. 10

(b) A $10kW$, $250V$, 8-pole, $600rpm$ lap-connected dc generator has 400 armature conductors. At rated voltage and current, armature ohmic losses are 150 *watts*. Compute the useful flux per pole. 10

4. *(a)* Define distribution factor and find its expression for the fundamental frequency. 10

(b) Draw and explain the no-load phasor diagram of a 1-phase transformer. Discuss how primary leakage flux is accounted in the phasor diagram. 5+5=10

5. (a) Explain why a 3-phase induction motor, at no load, operates at a very low power factor. 5

(b) Derive the expression of frequency of rotor winding in case of an induction motor. 5

(c) The power input to a 500*V*, 50*Hz*, 6-pole, 3-phase induction motor at 975*rmp* is 40*kW*. The stator losses are 1*kW*. The friction and windage losses total are 2*kW*. Calculate *(a)* slip *(b)* rotor copper loss *(c)* efficiency. 10

6. (a) Describe one of the various schemes used for exciting synchronous machine. 5

(b) Develop and draw space and time phasor diagrams for a cylindrical-rotor machine in case the alternator operates at an internal power factor of $\cos\psi$ lagging. 5

(c) 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 $(0{\cdot}2 + j2)\Omega$ per phase. Find the load angle at which it is operating. 10

7. (a) Draw the connection diagram, phasor diagram and torque-slip curve of a single phase induction motor. 10

(b) Describe the basic operating principle of the stepper motor. 10
