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06EE46

Fourth Semester B.E. Degree Examination, December 2011
Transformers and Induction Machines

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. What are the essential parts of a transformer? Briefly explain their functions and mention the material used for them. **(08 Marks)**

b. Mention the features that make transformer a versatile electric device. **(05 Marks)**

c. A 50 kVA, single phase transformer has 500 turns on the primary and 100 turns on the secondary. The primary is connected to 2500V, 50Hz supply. Calculate the following, neglecting losses:
i) The secondary voltage on open circuit
ii) Currents flowing through the windings.
iii) Maximum value of flux
iv) If the transformer delivers 50A to a load, what is its impedance? **(07 Marks)**

2 a. With the connection diagrams and equivalent circuits, explain the theory behind the OC and SC tests conducted to find the constants of a transformer. **(10 Marks)**

b. Draw and explain the phasor diagram of a practical transformer when supplying a load, with logging power factor. **(04 Marks)**

c. The equivalent of a 200/400V, step-up transformer has the following parameters referred to LV side:
Equivalent resistance = 0.15Ω, Equivalent reactance = 0.37 ohm,
core loss component of resistance = 600 ohm Magnetizing reactance = 300 ohm.
When the transformer is supplying load of 10A at a p.f. of 0.8 lag, calculate
i) Primary current ii) Secondary terminal voltage. **(06 Marks)**

3 a. Derive an expression for the currents shared by two transformers connected in parallel supplying a common load when no-load voltages of these transformers are unequal. **(08 Marks)**

b. Develop an expression for efficiency of a transformer and obtain the condition for maximum efficiency. **(05 Marks)**

c. A single phase 1100/220V transformer has primary and secondary resistances 0.30 ohm and 0.020 ohm respectively. If the iron loss of the transformer is 250W, calculate the secondary current at which maximum efficiency occurs. Also calculate the maximum efficiency at 0.8 power factor lagging. **(07 Marks)**

4 a. With the help of connection diagram and phasor diagram of the Scott connection, show that 3-phasor supply can be converted to 2-phase supplies of equal voltages. **(10 Marks)**

b. A 3-phase, 1200 kVA, 6.6/1.1 kV transformer has delta connected primary and star connected secondary. The per phase value of primary resistance and secondary resistances are 2 ohm and 0.03 ohm respectively. Calculate the efficiency on full load at 0.9 p.f. lagging if iron loss is 20 kW. **(06 Marks)**

c. Discuss the conditions that must be satisfied to operate two 3-phase transformers in parallel. **(04 Marks)**

PART – B

5 a. Explain how the rotating magnetic field is produced in 3-phase induction motor with the help of flux diagram and vector diagram. **(10 Marks)**

b. A 6 pole, 3-phase induction motor develops 30 HP including mechanical losses, total 2 HP at a speed of 950 rpm on 550V, 50Hz mains. The power factor is 0.88. Calculate for this load i) slip ii) the rotor copper loss iii) the total input if the stator losses are 2000W iv) the efficiency v) the line current vi) the number of complete cycles of the rotor emf per minute. **(10 Marks)**

6 a. In a 3-phase induction motor, show that
Rotor input : Rotor copper loss : Mechanical power developed equal to 1 : S : 1–S **(10 Marks)**

b. A 25 HP, 6 pole, 50 Hz, slip ring induction motor runs at 960 rpm on full load, with a rotor current of 35A. Allowing 250W for the copper loss in the short circuiting glar and 1000W for mechanical losses, find the resistance per phase of the 3-phase rotor winding. **(10 Marks)**

7 a. Draw and explain the complete torque-slip characteristics of a 3-phase induction motor, indicating motoring, generating and braking regions. **(08 Marks)**

b. Draw the circle diagram from no load and short circuit test of a 3-phase, 20HP (14.92 kW), 400V, 6 pole induction motor from the following test results (line values).
No load test : 400V, 9A, $\cos \phi = 0.2$
Short circuit test : 200V, 50A, $\cos \phi = 0.4$
From the diagram find i) line current and power factor at full load ii) the maximum HP and iii) maximum torque. Assume stator and rotor copper losses equal at standstill. **(12 Marks)**

8 a. Explain the following speed control methods of 3-phase induction motor.
i) Stator voltage control ii) Rotor resistance control **(06 Marks)**

b. Why single phase induction motor is not self starting? Explain the double revolving field theory. **(08 Marks)**

c. What is the necessity of starter for a 3-phase induction motor? Explain the star-delta starter. **(06 Marks)**

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