Fourth Semester B.E. Degree Examination, June/July 2017
Transformers and Induction Machines

Time: 3 hrs.   Max. Marks:100

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

PART – A

1   a.   With phasor diagram, explain the operation of :
        i) Ideal transformer on no load
        ii) Practical transformer supplying a lagging load.   **(10 Marks)**
   b.   Write a note on current inrush phenomena in transformers.   **(05 Marks)**
   c.   A single phase transformer with a ratio of 440V/110V takes a no load current of 5 Amps at 0.2pf lagging. If the secondary supplies a current of 120 Amps at a pf of 0.8 lagging, estimate the current taken by the primary.   **(05 Marks)**

2   a.   For a two winding transformer, derive an expression for the total ohmic loss in terms of the equivalent resistance refereed to either side.   **(05 Marks)**
   b.   Derive the condition for : i) maximum voltage regulation and ii) zero voltage regulation of a transformer.   **(05 Marks)**
   c.   Two 100 KW transformers, each has a maximum efficiency of 98%. but in one of the transformer the maximum efficiency occurs at full load while in the other, it occurs at half load. Each transformer is on full load for 4 hours, on half load for 6 hours and on one–tenth load for 14 hours per day. Determine the all-day efficiency of each transformer.   **(10 Marks)**

3   a.   Derive an expression for saving of copper when an auto transformer is used to supply a load instead of a two winding transformer and hence mention the advantages and limitations of an auto transformer.   **(10 Marks)**
   b.   Two single phase transformers A and B of equal voltage ratio are operating in parallel to supply a load of 1000 Amps at 0.8pf lag. The equivalent impedance of the two transformers are (2 + j3) Ω and (2.5 + j5) Ω respectively. Calculate the current supplied by each transformer and the ratio of the KW output of the two transformers.   **(10 Marks)**

4   a.   What do you mean by open delta connection? When it is used?   **(05 Marks)**
   b.   A 3-phase transformer bank is used to step-down the voltage of a 3-phase, 6600V transmission line. if the primary line current is 10A, calculate the secondary line voltage, line current and output KVA for : i) star/delta and ii) delta/star connections the turns ratio is 12. Neglect losses.   **(05 Marks)**
   c.   Two single phase furnaces A and B are supplied at 100 volts by means of a Scott-connected transformer from a 3-phase 6600volts system. The voltage of furnace A is leading. Calculate the line currents on the 3-phase side, when the furnace A takes 400 KW at 0.707 pf lagging and B takes 800 KW at unity pf.   **(10 Marks)**

PART – B

5   a.   Explain principle of operation of a 3-phase induction motor.   **(05 Marks)**

     b.   Draw and explain the Torque-slip characteristic of 3-phase induction motor covering motoring, generating and braking regions of operation.   **(05 Marks)**

     c.   A 4pole, 50Hz, 10h-p motor has, at rated voltage and frequency, a starting torque of 160% and a maximum torque of 200% of full-load torque. Determine : i) full-load speed ii) speed at maximum torque.   **(10 Marks)**

6   a.   Develop the equivalent circuit of a 3-phase induction motor and draw its phasor diagram and explain.   **(10 Marks)**

     b.   A 220V, 3-phase, 4-pole, 50Hz star-connected induction motor is rated 5hp the equivalent circuit parameters are : $R_1 = 0.45\Omega$, $x_1 = 0.8\Omega$; $R_2{}^1 = 0.4\Omega$, $x_2{}^1 = 0.8\Omega$. $B_0 = -1/30$ mho.
The stator core loss is 50W and rotational loss is 150W. For a slip of 0.04, find :
i) input current   ii) pf   iii) air gap power   iv) mechanical power   v) efficiency.   **(10 Marks)**

7   Write brief notes on :

     a.   Double cage induction motor

     b.   Deep bar rotor

     c.   Induction generator and its applications

     d.   Cogging and crawling in 3-phase induction motors.   **(20 Marks)**

8   a.   What are the different methods of starting an induction motor? Explain star Delta starting of induction motor.   **(05 Marks)**

     b.   A 3-phse squirrel cage induction motor has a short circuit $I_{sc} = 5I_f$ (I_f = full load current). Find the starting torque as a percentage of full load torque if the motor is started by :
i) direct switching to the supply   ii) a star-delta starter is used   iii) an auto transformer is used   iv) A resistance in the stator circuit. the starting current in iii) and iv) is 2.5 times the full load current and full load slip = 4%.   **(10 Marks)**

     c.   Why single phase induction motors are not self starting?   **(05 Marks)**

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