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Fourth Semester B.E. Degree Examination, Dec.08 / Jan.09
Transformers and Induction Machines

Time: 3 hrs. Max. Marks:100

Note : ***Answer FIVE full questions choosing at least two full questions from each part.***

Part A

1 a. What are coupled circuits? What is the importance of dot convention used in coupled circuits? **(03 Marks)**

b. Distinguish between core type and shell type transformers. **(07 Marks)**

c. An ideal 25 kVA transformer has 500 turns on primary winding and 40 turns on secondary winding. Primary is connected to 3000 V, 50 Hz supply. Calculate
   i) Full load primary and secondary current.
   ii) Secondary induced emf.
   iii) Maximum flux in the core. **(05 Marks)**

d. What is an auto transformer? Discuss merits and demerits of auto transformer. **(05 Marks)**

2 a. Explain how the flux in the core of transformer remains constant, from no load to full load. Develop the phasor diagram of an actual transformer when it is inductively loaded. **(08 Marks)**

b. A 30 kVA, 2400/120 V, 50 Hz transformer has $R_1 = 0.1\Omega$, $X_1 = 0.22\Omega$, $R_2 = 0.035\Omega$, $X_2 = 0.012\Omega$. Obtain the equivalent circuit as referred to secondary side and find full load copper loss. **(06 Marks)**

c. Find the all day efficiency of a transformer having maximum efficiency of 98% at 15 kVA at upf and loaded as follows:
   2 KW at 0.5 pf lag for 12 Hrs.
   12 KW at 0.8 pf lag for 6 Hrs.
   No load for 6 Hrs. **(06 Marks)**

3 a. The results obtained from open circuit and short circuit tests on 10 kVA, 450/120 V, 50 Hz transformer are

O.C. test	120 V	4.2 A	80 W	Instruments placed on lv side
S.C. test	9.65 V	22.2 A	120 W	With lv winding short circuited

Compute:
   i) Equivalent circuit constants.
   ii) Efficiency and voltage regulation at full load 0.8 pf lag.
   iii) Efficiency at half full load and 0.8 lagging pf. **(10 Marks)**

b. Obtain expressions for load sharing of two transformers having equal voltage ratio. **(04 Marks)**

c. Two transformers A & B are joined in parallel to the same load. Determine the current delivered by each transformer given open circuit emf is 6600 V for A and 6400 V for B. Equivalent impedance on secondary are $(0.3+j3)\Omega$ for A and $(0.2+j1)\ \Omega$ for B and load impedance is $(8+j6)\ \Omega$. Also find the circulating current at no load. **(06 Marks)**

4 a. Show that open delta connection of 3 phase transformers has kVA rating of 58% of that of delta-delta connection. **(05 Marks)**

b. Explain with circuit diagram and phasor diagram the method of conversion of 3 phase to 2-phase supply. Show that load is balanced on both sides. **(10 Marks)**

c. Two 100V, 1 phase furnaces take loads of 600 kW and 900 kW respectively at a power factor of 0.707 lagging and are supplied from 6600 V, 3 phase supply through a scott connected transformer. Calculate the line currents in the 3 phase side. **(05 Marks)**

Part B

5 a. With neat sketches explain constructional features of slipring and squirrel cage induction motor. Give their applications. **(10 Marks)**

b. Explain the principle of operation of 3 phase induction motor. **(05 Marks)**

c. The power input to the rotor of 440 V, 50 Hz, 6 pole, 3 phase induction motor is 80 kW. The rotor emf is observed to make 100 complete alternations per minute. Calculate the slip, rotor speed, rotor copper loss, rotor resistance per phase if the rotor current is 65 A. **(05 Marks)**

6 a. Obtain the equivalent circuit of 3 phase induction motor. **(05 Marks)**

b. Show that ratio of mechanical power developed to the rotor copper loss is $\left(\frac{1-s}{s}\right)$ where s is the slip. **(05 Marks)**

c. Explain crawling and cogging of induction motors. **(05 Marks)**

d. A 6 pole, 3 phase 50 Hz induction motor develops a maximum torque of 30 Nm at 960 rpm. Determine the torque exerted by the motor at 5% slip. The rotor resistance per phase is 0.6 Ω. **(05 Marks)**

7 a. Derive the torque equation of 3 phase induction motor. What is the condition for maximum torque? **(06 Marks)**

b. Explain torque slip characteristics of 3 phase induction motor indicating all the regions of operation. **(05 Marks)**

c. Draw the circle diagram from no load and blocked rotor test of 3 phase 14.92 KW, 400 V, 6 pole IM motor from the following test results:
No load test : 400 V, 11 A, pf = 0.2
Blocked rotor test : 100 V, 25 A, pf = 0.4
Rotor cu loss at stand still is half the total cu loss from the diagram. Find
Line current, slip, efficiency, max torque, pf. **(09 Marks)**

8 a. Why single phase induction motor is not self starting? Explain capacitor start method of starting. **(05 Marks)**

b. State the different methods of speed control of 3 phase induction motor. Discuss in detail any two methods. **(10 Marks)**

c. The main and auxiliary winding impedances of a 50 Hz, capacitor start single phase induction motor are (3+j2.7)Ω and (7+j3)Ω respectively. Determine the values of capacitor to be connected in series with auxiliary winding to achieve phase difference of 90° between the currents of 2 windings at starting. **(05 Marks)**