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**Fourth Semester B.E. Degree Examination, December 2010**  
**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. Write the equilibrium equations in a coupled circuit. Derive the expressions for effective inductance when two inductors are connected in : i) Series opposing ii) Parallel aiding. (10 Marks)
- b. Write a brief note on :  
i) Power transformer ii) Constant voltage transformer. (10 Marks)
- 2 a. Develop the exact equivalent circuit of a single phase transformer. From this, derive the approximate and simplified equivalent circuits of a transformer. State the various assumptions made. (10 Marks)
- b. Develop the phasor diagram of a single phase transformer under load condition. Assume lagging power factor load. (05 Marks)
- c. 3300 /300 V single - phase 300 KVA transformer has 1100 primary turns. Find  
i) Transformation ratio ii) Secondary turns iii) Voltage /turn iv) Secondary current when it supplies a load of 200 kW at 0.8 pf. lagging. (05 Marks)
- 3 a. Explain the Sumpner's test for testing two single – phase transformers. Also explain why this is beneficial for finding efficiency of transformers. (08 Marks)
- b. Two single-phase transformers are operating in parallel. Derive an expression for the current drawn by each, sharing a common load, when no<sub>c</sub>– load voltages of these are equal. (06 Marks)
- c. A 5 KVA distribution transformer has a full load efficiency of 95% at which Cu-loss is equal to the iron loss. The transformer is loaded for 24 hours as under :  
No load for 10 hours, one – fourth full load for 7 hours, half full load for 5 hours and full load for 2 hours. Calculate the all-day efficiency of the transformer. (06 Marks)
- 4 a. Explain with the help of connection and phasor diagrams, how Soctt connections are used to obtain two phase supply from three phase supply mains. (08 Marks)
- b. Discuss the essential and desirable conditions to be fulfilled for operating two three phase transformers in parallel. (06 Marks)
- c. A balanced three phase load of 30 KVA, at a power factor of 0.866 lagging, is connected to two transformers connected in open-delta, to a five 230 V three phase system. Find the power delivered by each transformer. (06 Marks)

**PART – B**

- 5 a. Give the equivalent circuit and applications of a 3 – winding transformer. (08 Marks)
- b. Show that a rotating magnetic field can be produced by the use of 3 – phase currents of equal magnitude. (08 Marks)
- c. What are the advantages of skewed slots in the rotor of a squirrel cage motor? (04 Marks)

- 6 a. Develop the equivalent circuit for a 3-phase induction motor. Explain how the mechanical power developed is taken care of in the equivalent circuit. (10 Marks)
- b. A 4-pole, 50Hz, 3-phase induction motor develops a maximum torque of 110 Nm at 1360 rpm. The resistance of the star connected rotor is  $0.25 \Omega$  /phase. Calculate the value of resistance that must be inserted in series, with each rotor phase, to produce a starting torque equal to half of the maximum torque. (10 Marks)
- 7 a. Explain the phenomenon of cogging and crawling in a 3-phase induction motor. (08 Marks)
- b. A 400 V, 11 kW, 3-phase, 50Hz, 4-pole delta-connected induction motor gave the following test data :
- No load test : 400 V, 8 A, 1000 W  
Locked rotor test : 100 V, 25A, 1750 W  
Construct the circle diagram and determine :
- Fuel load current and the power factor
  - Maximum possible power output
  - The best possible operating power factor. (12 Marks)
- 8 a. Using double revolving field theory, explain the principle of operation of an I – phase induction motor. (10 Marks)
- b. A three-phase delta-connected cage type induction, motor when connected directly to a 400 V, 50Hz supply, takes a starting current of 100 A, in each stator phase. Calculate
- The line current for 'direct-on-line' starting.
  - Line and phase starting currents for star-delta starting
  - Line and phase starting currents for a 70% tapping on auto-transformer starting. (10 Marks)

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