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10EE46

**Fourth Semester B.E. Degree Examination, June/July 2018**

**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. Explain with a neat sketch the construction of a three phase core type transformer. (04 Marks)
- b. With schematic representation and relevant phasor diagram, explain the operation of a practical single phase transformer, when it is supplying an inductive load. (06 Marks)
- c. A single phase 200/100 V transformer is connected to a load of  $5\sqrt{30}\angle\Omega$ . The no load current drawn by the transformer is  $0.6\sqrt{75}\angle A$ . Calculate:
  - i) Load current
  - ii) Load power
  - iii) Primary current
  - iv) Primary power factor
  - v) Primary input power
 (10 Marks)
- 2 a. Derive an approximate expression for the voltage regulation of a transformer. (05 Marks)
- b. The equivalent series leakage impedance referred to HV side of a 50 KVA, 2400/240 V, 50 Hz one phase transformer is  $(1.5 + j2)\Omega$ . The transformer is supplying full load at 0.8 power factor lagging. Determine the voltage regulation. (05 Marks)
- c. A 5 KVA, single phase transformer has a core loss of 40 Watts and full load ohmic loss of 100 Watts. The daily variation of load on the transformer is as follows:
 

7 AM to 1 PM : 3 KW at pf 0.6  
 1 PM to 6 PM : 2 KW at pf 0.8  
 6 PM to 1 AM : 6 KW at pf 0.9  
 1 AM to 7 AM : No load

 Determine the all day efficiency of the transformer. (10 Marks)
- 3 a. Derive an expression for saving of copper when an autotransformer is used. Mention its applications. (10 Marks)
- b. A 1000 KVA single phase transformer with 0.01 per unit resistance and 0.04 per unit leakage reactance operates in parallel with 500 KVA transformer having resistance of 0.012 per unit and leakage reactance of 0.036 per unit. How will they share a load of 1500 KVA at 0.8 lagging power factor. Assume that the secondary voltages are equal. (10 Marks)
- 4 a. Explain the need for parallel operation of transformers and give the necessary conditions for the parallel operation of three phase transformers. (10 Marks)
- b. A three phase transformer bank consisting of three-single phase transformers is used to step down the voltage of a 3-phase, 6600 V transmission line. If the primary line current is 10 A, calculate the secondary line voltage, line current and output KVA for the following connections (i)  $\lambda/\Delta$  and (ii)  $\Delta/\lambda$ . The turns ratio is 12. Neglect losses. (10 Marks)

**PART – B**

- 5 a. Explain with neat sketches, the construction of squirrel cage and slip ring induction motor. (06 Marks)
- b. Explain torque-slip characteristics of a 3-phase induction motor. (04 Marks)

- c. A 3-phase, 4-pole, 1440 rpm, 50 Hz, induction motor has star connected rotor winding having a resistance of  $0.2 \Omega$  per phase and a stand still leakage reactance of  $1 \Omega$  per phase. When the stator is energized at rated voltage and frequency the rotor induced emf at stand still is 120 V per phase. Calculate:
- Rotor current
  - Rotor power factor
  - Starting torque
  - Full load torque
- (10 Marks)
- 6 a. Explain how to arrive at the approximate equivalent circuit of a 3-phase induction motor. (10 Marks)
- b. A 10 HP, 4-pole, 50 Hz, 3-phase induction motor runs at 1450 rpm on full load. The stator copper loss is 231 Watts and the rotational loss is 343 Watts. Determine:
- The shaft torque
  - The mechanical power developed
  - The air gap power
  - The rotor copper loss
  - The input power
  - The efficiency
- (10 Marks)
- 7 a. Explain high torque double cage rotor induction motor. Draw its equivalent circuit and torque slip characteristics for its 2 cages. (10 Marks)
- b. The impedances at standstill of the inner and outer cages of a double-cage rotor are  $(0.01 + j0.5)\Omega$  and  $(0.05 + j0.1)\Omega$  respectively. The stator impedance may be assumed to be negligible. Calculate the ratio of the torques due to the two cages: (i) at starting and (ii) when running with a slip of 5%. (10 Marks)
- 8 a. Explain star-delta method of starting of 3-phase induction motor with necessary diagram. (06 Marks)
- b. A squirrel cage induction motor has a full load slip of 0.05. The motor starting current at rated voltage is 6 times its full load current. Find the tapping on the autotransformer starter which should give full load torque at start. Also find the line current at starting in terms of full load. (06 Marks)
- c. Explain with neat diagrams any 2-types of making 1-phase induction motor self starting. (08 Marks)

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