Code No: R05220204 **Set No. 1**

II B.Tech II Semester Regular Examinations, Apr/May 2007
ELECTRICAL MACHINES-II
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Derive the EMF equation of transformer? Hence derive the voltage ratio.
   (b) A 15kVA 2400-240-V, 60 Hz transformer has a magnetic core of 50-cm^2 cross section and a mean length of 66.7 cm. The application of 2400 V causes magnetic field intensity of 450 AT/m (RMS) and a maximum flux density of 1.5 T . Determine
      i. The turn's ratio
      ii. The numbers of turns in each winding
      iii. The magnetizing current [8+8]

2. (a) Draw the neat diagram of approximate equivalent circuit of transformer.
   (b) A 30 kVA, 6000/230 V, 50 Hz, single-phase transformer has the following winding resistances and leakage reactances:
   R_1=10 Ω, R_2 (ref to primary) = 10.8 Ω,
   X_1= 16 Ω, X_1(ref to primary) = 18 Ω.
   Calculate the primary current with secondary SC. [8+8]

3. A 200 VA, 120/12 V two winding transformer is to be used as an auto transformer. The input voltage is 120 V. The resistances of primary & secondary windings are 1.5 Ω & 0.015 Ω respectively. Find the efficiency at full load UPF when it is used as:
   (a) as a two winding 120/12 V step down transformer.
   (b) as 120/132 V auto-transformer. Iron losses are 5 W. [16]

4. (a) With neat phasor diagram, explain the voltage regulation of three-phase transformer.
   (b) An ideal 3-Φ step down transformer connected in delta/star delivers power to a balanced 3-Φ load of 120 kVA at 0.8 pf. The input line voltage is 11 kV and the turn's ratio of transformer (phase to phase) is 10. Determine the line voltage line currents, phase voltages, phase currents on both primary & secondary sides. [8+8]

5. (a) A 3-Φ, 400 V IM has transformation ratio of 6 (stator to rotor). The rotor has per phase resistance & reactance of 0.5 Ω & 1.5 Ω respectively. Calculate rotor current and power factor: when slip rings are short circuited and slip is 5 % and when external resistance of 1 Ω/ph is connected in rotor circuit and motor is rotating with 8 % slip.

(b) Explain the differences between sq. cage IM & Slip ring IM. [8+8]

6. (a) Obtain the ratio of Maximum torque to Full load torque & Maximum torque to staring torque.

   (b) A 4-pole, 50 Hz, 3-Φ IM has rotor impedance of 0.04 + j 0.16 Ω. Calculate the value of external rotor resistance to be inserted in rotor circuit to obtain 70 % of maximum torque at starting. [8+8]

7. (a) The short circuit current of a squirrel cage IM on normal voltage is 3.5 times the full load current & the full load slip is 4 %. Determine the percentage tapping required to an auto transformer starter to start the motor against $1/3^{rd}$ full load torque. Neglect magnetising current.

   (b) With neat diagram explain the construction & operation of auto transformer starter. [12+4]

8. (a) Compare the speed control of 3-Φ IM by rotor resistance control & variable frequency control.

   (b) Two slip ring IMs having 10 & 6 poles respectively are mechanically coupled.

      i. Calculate the possible speed when first motor is supplied from a 50 Hz supply line.

      ii. Calculate the ratio of power shared by the two motors.

      iii. If the smallest possible speed is to be attained independently by each machine,
      calculate the frequency of the voltage to be injected in the rotor circuit.
      [8+8]

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Code No: R05220204 **Set No. 2**

II B.Tech II Semester Regular Examinations, Apr/May 2007
ELECTRICAL MACHINES-II
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) With neat phasor diagram explain the operation of transformer at No-load
   (b) A 2000 kVA 4800/600 V, 50 Hz core type transformer has a no load current equal to 2% of full load current. The core has mean length of 3.15 m & is operated at a flux density of 1.55 Tesla. The magnetic flux intensity is 360 AT/m. Determine the magnetising current,the number of turns in two coils, the core flux & the cross sectional area of core. [8+8]

2. (a) Derive the condition for maximum efficiency of a transformer.
   (b) A single phase 150 kVA transformer has efficiency of 96 % at full load, 0.8 pf and at half load, 0.8 pf lagging. Find maximum efficiency of transformer and corresponding load. [8+8]

3. (a) What is auto transformer? How auto transformer is different from ordinary two winding transformer? What are the advantages & disadvantages of auto transformer? Explain the working principle of auto transformer.
   (b) Obtain the derivation for the copper saving in auto transformer compare to two winding transformer for identical rating. [8+8]

4. (a) With neat phasor diagram, explain the voltage regulation of three-phase transformer.
   (b) An ideal 3-Φ step down transformer connected in delta/star delivers power to a balanced 3-Φ load of 120 kVA at 0.8 pf. The input line voltage is 11 kV and the turn's ratio of transformer (phase to phase) is 10. Determine the line voltage line currents, phase voltages, phase currents on both primary & secondary sides. [8+8]

5. (a) A 3 ?Φ, IM operates from a supply whose frequency is 50 Hz and rotates at a speed of 1485 RPM at no load & 1350 RPM at full load. Calculate:
      i. the speed at which the magnetic field of stator is rotating
      ii. the slip at no load & at full load.
      iii. the frequency of the rotor current at no load & at full load.
      iv. the frequency of rotor current at stand still.
   (b) Explain the slip? How the slip affects the rotor frequency, emf, current & pf. [8+8]

6. (a) Explain term Maximum torque, Full load torque, Starting torque & No-load torque.

(b) An 8-pole, 50 Hz, 3-Φ slip ring IM has effective resistance of 0.08 Ω/phase. The speed correspond to maximum torque is 650 rpm. What is the value of resistance to be inserted in rotor circuit to obtain maximum torque at starting? [8+8]

7. A 3-Φ, star connected, 5.6 kW, 400 V, 4-pole, 50 Hz slip ring IM gave the following test results:

   No load Test: 400 V, 6 A, 0.187 PF

   Blocked rotor test: 100 V, 12a, 720 ω
   All above are the line values. The ratio of primary to secondary turns = 2.62, stator resistance/ph is 0.67 Ω and that of the rotor is 0.185 Ω/ph. Plot the circle diagram and for full load find:

   (a) The line current
   (b) The power factor
   (c) Slip
   (d) Maximum Torque / Full load torque.
   (e) Maximum Power [16]

8. (a) Two slip ring IMs having 6 & 10 poles respectively are mechanically coupled.
      i. Calculate the possible speed when first motor is supplied from a 50 Hz supply line.
      ii. Calculate the ratio of power shared by the two motors.
      iii. If the smallest possible speed is to be attained independently by each machine,
      calculate the frequency of the voltage to be injected in the rotor circuit.

   (b) Explain the speed control of IM by rotor resistance control method. How this method of speed control is different from stator side speed control methods. [8+8]

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Code No: R05220204 **Set No. 3**

II B.Tech II Semester Regular Examinations, Apr/May 2007
ELECTRICAL MACHINES-II
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain what are various losses taking place in transformer. Explain the variation of these losses with load.
   (b) A 22 kV/ 2.2 kV, 500 kVA, 60 Hz transformer is charged with rated voltage on 22 kV side. If the resultant core flux is 0.0683 Wb (max), determine the number of turns on primary & secondary. Find the new value of flux if the voltage is increased by 20% and frequency is decreased by 5%. [8+8]

2. (a) Derive the condition for maximum efficiency of a transformer.
   (b) A single phase 150 kVA transformer has efficiency of 96 % at full load, 0.8 pf and at half load, 0.8 pf lagging. Find maximum efficiency of transformer and corresponding load. [8+8]

3. (a) Explain the procedure for OC test of transformer.
   (b) A single phase transformer has the following data: Turns ratio 10:1, Z_1= 1.6 +j 4.3 Ω, Z_2 = 0.019 + j0.048 Ω. The input voltage of the transformer is 5000 V and the load current at the secondary is 250 A at 0.8 pf lagging. Neglecting no load current, calculate secondary terminal voltage and output power. [6+10]

4. (a) With neat diagram explain, a how three phase transformer can be used for supply of two single phase furnaces.
   (b) A 3- Φ, 1200 kVA, 6.6/1.1 kV transformer has Delta/Star connection. The per phase resistance is 2 Ω & 0.03 Ω on primary & secondary respectively. Calculate the efficiency on full load at 0.9 pf lagging, if iron losses are 20 kW. [8+8]

5. (a) A 200 HP, 2300 V, 3-Φ 60 Hz, wound rotor IM has a blocked rotor voltage of 104 V. The shaft speed and slip speed when operating at rated load are 1775 RPM and 25 RPM respectively. Determine:
      i. Number of poles
      ii. Slip
      iii. Rotor frequency
      iv. rotor voltage at slip speed.
   (b) Explain how the rotor rotates in IM? Explain how the RMF and rotor rotates in same direction. [8+8]

6. (a) Obtain the ratio of Maximum torque to Full load torque & Maximum torque to staring torque.
   (b) A 4-pole, 50 Hz, 3-Φ IM has rotor impedance of 0.04 + j 0.16 Ω. Calculate the value of external rotor resistance to be inserted in rotor circuit to obtain 70 % of maximum torque at starting. [8+8]

7. A 3-Φ, Δ connected, 20 HP, 440 V, 6-pole, 50 Hz IM gave the following test results:

   No load Test: 440 V, 10 A, PF = 0.2

   Blocked rotor test: 200 V, 50 A, PF = 0.4

   All above are the line values. Plot the circle diagram and for full load find:

   (a) The line current
   (b) The power factor
   (c) Slip
   (d) Torque
   (e) Efficiency
   (f) Maximum Power factor

   Given that rotor copper losses are equal to stator copper losses at stand still. [16]

8. (a) Explain the speed control of 3-Φ IM using 'rotor emf injection method'.
   (b) A 2-pole, 3-ϕ, 50 Hz, slip ring IM has its rotor resistance of 0.2Ω/ph and full load speed of 2900 rpm. Calculate the external resistance per phase required to be added in rotor circuit to decrease the speed to 2500 rpm. The torque remains the same as before. [8+8]

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Code No: R05220204 **Set No. 4**

II B.Tech II Semester Regular Examinations, Apr/May 2007
ELECTRICAL MACHINES-II
(Electrical & Electronic Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the construction & working principle of transformer.
   (b) In detail explain the classification of transformer? [8+8]

2. (a) Obtain the conditions for maximum efficiency of transformer, power factor for zero voltage regulation & maximum voltage regulation.
   (b) A 300 kVA, single phase transformer is designed to have a resistance of 1.5 % and maximum efficiency occurs at a load of 173.2 kVA. Find its efficiency when supplying full load at 0.8 pf lagging. [8+8]

3. (a) Explain the various constant losses taking place in transformer. How these losses can be separated. Explain the test procedure.
   (b) With neat diagram explain the experimental set up required for the conduct of Sumpner?s test on two similar transformers. [8+8]

4. (a) What is tap changer? What are the various types of tap changers? Explain the need of tap changers.
   (b) The primary & secondary windings of two transformers, each rated 250 kVA, 11/22kV and 50 Hz are connected in open delta. Find
      i. The kVA load that can be supplied from this connection
      ii. Currents on the HV side if a delta connected 3-Φload of 250 kVA, 0.8 pf lagging, 2 kV is connected on the LV side of connection [6+10]

5. (a) Explain the classification of induction motors based on construction of rotor. Explain the advantages & disadvantages of each.
   (b) The frequency of stator EMF is 50 Hz for an 8-pole induction motor. If the rotor frequency is 2.5 Hz, calculate the slip and the actual speed of rotor. [8+8]

6. A 7.5 kW, 440 V, 3-Φ, star connected, 50 Hz, 4 pole Sq. cage IM develops full load torque at the slip of 5 % when fed from a feeder having impedance of 1.8 +j 1.2 Ω/ph. Rotational, core & windage losses are to be neglected. Motor impedance data is as follows: R_1= 1.32 Ω, $X_1 = X_2$= 1.46 Ω, X_m = 22.7 Ω. Determine the Maximum torque and the slip at which it will occur. Also calculate the corresponding current. [16]

7. With neat diagram explain the various tests to be conducted on 3-Φ IM to plot the circle diagram. [16]

8. (a) Explain the principle of consequent poles method of speed control of 3-Φ IM. Explain the advantages of this method above other methods.

   (b) A 4-pole, 3-Φ, 50 Hz, slip ring IM has its rotor resistance of 0.25 Ω/ph and full load speed of 1425 rpm. Calculate the external resistance per phase required to be added in rotor circuit to decrease the speed to 1275 rpm. The torque remains the same as before. [8+8]

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