**II B.Tech. II Semester Regular Examinations, April/May -2005**
**ELECTRO MECHANICS-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) Prove that the EMF induced in the windings of the transformer will lag behind the flux by $90^0$.
   (b) Explain how equivalent circuit of transformer can be obtained?

2. (a) What are the sources of heat in a transformer. Describe briefly various methods used for cooling of transformers.
   (b) A 40 KVA single phase transformer has got maximum efficiency of 97 % at 80 % of full load at UPF. During the day, the load on the transformer is as follows.

| No. of hours | Load | Power factor |
|---|---|---|
| 9 | 6 KW | 0.6 lag |
| 8 | 25 KW | 0.8 lag |
| 7 | 30 KW | 0.9 lag |

   Determine the All day efficiency of the transformer.

3. (a) Derive the equation for saving in copper in using Auto transformer when compared to two winding transformer.
   (b) Obtain the equivalent circuit of an auto transformer.

4. (a) What are the conditions required for the parallel operation of two transformers.
   (b) Derive the equations for the currents supplied by each transformer when two transformers are operating in parallel with equal voltage ratios.

5. (a) Explain why the rotor of polyphase induction motor can never attain synchronous speed
   (b) The rotor of a slip ring induction motor is connected to an AC source, where as its stator winding is short circuited. If rotating magnetic field produced by rotor winding' rotates clock wise, Explain the direction in which rotor must revolve.

6. (a) In an induction motor deduce the condition $P_2$:$P_m$:$P_c$::l:1-s:s
   (b) A 4-pole wound rotor induction motor is used as a frequency changer. The starter is connected to a 50 Hz 3-phase supply. The load is connected to the rotor slip rings. What are the possible speeds at which the rotor can supply power to this load at 25Hz? What would be the ratio of voltages at load terminals at these speeds? Assume the rotor impedance to be negligible.

7. (a) Draw and explain the phasor diagram of 3-phase induction motor.
   (b) Discuss the phenomenon of crawling and cogging in an induction motor.

8. The rotor of 3-phase slip ring induction motor has an induced voltage of 100V and impedance of 0.2 + j1 ohm at stand still. The induction motor has full load slip of 0.04 driving constant torque load and running at 1440 rpm. Calculate the voltage to be injected if the motor is to be driven at
   (a) 800 rpm
   (b) 1000 rpm

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Code No: RR220205 **Set No.2**

**II B.Tech. II Semester Regular Examinations, April/May -2005**
**ELECTRO MECHANICS-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) Prove that the EMF induced in the windings of the transformer will lag behind the flux by $90^0$.
   (b) Explain how equivalent circuit of transformer can be obtained?

2. (a) Derive the condition for zero voltage regulation. Also show that the magnitude of maximum voltage regulation equals to per unit value of leakage impedance.
   (b) A 20 KVA 2000/200 V single phase transformer has the following parameters. H. V. Winding: $R_1 = 3\ \Omega$, $X_1 = 5.3\Omega$, L. V. Winding: $R_2 = 0.05\ \Omega$, $X_2 = 0.1\ \Omega$ Find the voltage regulation at
      i. At a power factor of 0.8 lagging
      ii. UPF
      iii. 0.707 power factor leading

3. (a) Derive the equation for saving in copper in using Auto transformer when compared to two winding transformer.
   (b) Obtain the equivalent circuit of an auto transformer.

4. A 3-phase 50KVA, 6.6/0.4 Kv, 50Hz transformer is $\Delta$/Y connected. It yielded the following test results:

| OC test | SC test |
|---|---|
| $P_o = 520$ W | $P_sc = 610$ W |
| $I_o = 4.21$A | $I_sc = 4.35$ A |
| $V_o = 400$V | $V_sc = 340$ V |

   Calculate the pu circuit parameters of the transformer. Determine its efficiency and voltage regulation at full load 0.8 p.f. lagging. Calculate also the maximum efficiency and the load (0.8 p.f) at which it will occur.

5. (a) Explain why the rotor of polyphase induction motor can never attain synchronous speed
   (b) The rotor of a slip ring induction motor is connected to an AC source, where as its stator winding is short circuited. If rotating magnetic field produced by rotor winding' rotates clock wise, Explain the direction in which rotor must revolve.

6. A 4-pole, 3-phase slip ring induction motor is coupled mechanically with a synchronous motor having 2 poles. The synchronous motor and stator of the induction motor are fed from 50Hz voltage source. What will be the frequency of the emfs at the rotor terminals if the synchronous motor is driven?

(a) In a direction opposite to the induction motor stator rotating field.

(b) In a direction of the induction motor stator rotating field. If the frequency of the rotor voltage is required to be 300Hz, then calculate

(c) The number of poles that the induction motor must have.

7. (a) Draw the approximate equivalent circuit of an induction motor. Also explain the significance of each component.

   (b) A 7.5Kw, 440V, 3-phase star connected, 50Hz, 4 pole squirrel cage induction motor develops full load torque at a slip of 5% when operated at rated voltage and frequency. Rotational 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 motor torque at rated voltage and the slip at which it will occur. Also calculate the starting torque.

8. The rotor of 3-phase slip ring induction motor has an induced voltage of 100V and impedance of 0.2 + j1 ohm at stand still. The induction motor has full load slip of 0.04 driving constant torque load and running at 1440 rpm. Calculate the voltage to be injected if the motor is to be driven at

   (a) 800 rpm

   (b) 1000 rpm

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**II B.Tech. II Semester Regular Examinations, April/May -2005**
**ELECTRO MECHANICS-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 why hysteris and eddy current losses occur in a transformer.
   (b) A transformer on load takes 1.5 amps at a power factor of 0.2 lagging when connected across 50 Hz 230 V supply. The ratio between primary and secondary number of turns is 3. Calculate the value of primary current when secondary is supplying a current of 40 amps at a power factor of 0.8 lagging. Neglect the voltage drop in the windings. Draw the relevant phasor diagram.

2. (a) Explain how the iron losses and copper losses are affected with change in load on the transformer.
   (b) Find the All Day efficiency of 1500 KVA transformer whose copper and iron losses at full load are 4.5 KW and 3.2 KW respectively. During a day of 24 hours it is loaded as follows:

| No. of hours | Load | Power factor |
|---|---|---|
| 6 | 1200 KW | 0.8 lag |
| 10 | 900 KW | 0.75 lag |
| 4 | 300 KW | 0.8 lag |
| 4 | 0 | 0 |

3. A 20KVA, 2300/230V, two winding transformer is to be used as an auto transformer, with constant source voltage of 2300V. At full load of unity power factor, calculate the power output, power transformed and conducted. If the efficiency of the two winding transformer at 0.6p.f.is 96%, find the auto transformer efficiency at the same power factor.

4. (a) List out the advantages and disadvantages of a bank of 3, 1-phase transformers to single 3-phase transformers.
   (b) A $\Delta$/Y connected 3-phase transformer has a voltage ratio of 22Kv ($\Delta$)/345 Kv (Y) (line-to-line). The transformer is feeding 500 MWAR to the grid (345 Kv). Determine the VA and voltage rating of each unit (I-Phase). Compute all currents and voltages to both magnitude and phase angle in all the windings.

5. (a) Explain why the rotor of polyphase induction motor can never attain synchronous speed
   (b) The rotor of a slip ring induction motor is connected to an AC source, where as its stator winding is short circuited. If rotating magnetic field produced by rotor winding' rotates clock wise, Explain the direction in which rotor must revolve.

6. A 4-pole, 3-phase slip ring induction motor is coupled mechanically with a synchronous motor having 2 poles. The synchronous motor and stator of the induction motor are fed from 50Hz voltage source. What will be the frequency of the emfs at the rotor terminals if the synchronous motor is driven?
   (a) In a direction opposite to the induction motor stator rotating field.
   (b) In a direction of the induction motor stator rotating field. If the frequency of the rotor voltage is required to be 300Hz, then calculate
   (c) The number of poles that the induction motor must have.

7. (a) Draw the approximate equivalent circuit of an induction motor. Also explain the significance of each component.
   (b) A 7.5Kw, 440V, 3-phase star connected, 50Hz, 4 pole squirrel cage induction motor develops full load torque at a slip of 5% when operated at rated voltage and frequency. Rotational 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 motor torque at rated voltage and the slip at which it will occur. Also calculate the starting torque.

8. The rotor of 3-phase slip ring induction motor has an induced voltage of 100V and impedance of 0.2 + j1 ohm at stand still. The induction motor has full load slip of 0.04 driving constant torque load and running at 1440 rpm. Calculate the voltage to be injected if the motor is to be driven at
   (a) 800 rpm
   (b) 1000 rpm

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Code No: RR220205 **Set No.4**

**II B.Tech. II Semester Regular Examinations, April/May -2005**
**ELECTRO MECHANICS-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) Draw the phasor diagram of a transformer on no load and explain the function of active and reactive components of no load current of transformer.
   (b) Explain why transformer rating will be given in KVA but not in KW.

2. (a) Derive the condition for zero voltage regulation. Also show that the magnitude of maximum voltage regulation equals to per unit value of leakage impedance.
   (b) A 20 KVA 2000/200 V single phase transformer has the following parameters. H. V. Winding: $R_1 = 3\ \Omega$, $X_1 = 5.3\Omega$, L. V. Winding: $R_2 = 0.05\ \Omega$, $X_2 = 0.1\ \Omega$ Find the voltage regulation at
      i. At a power factor of 0.8 lagging
      ii. UPF
      iii. 0.707 power factor leading

3. (a) Explain the following characteristics of an auto transformer with two winding transformer:
      i. Rating
      ii. Losses
      iii. Impedance drop
      iv. Voltage regulation
   (b) The primary and secondary voltages of an auto transformer are 500V and 400V respectively. Show with the aid of a diagram, the current distribution in the winding when the secondary current is 100A and calculate the economy of Cu in this particular case.

4. (a) What precautions should be observed during the operation of on-load tap changer.
   (b) Explain the function of center-tapped reactor in on load tap changer.

5. (a) Explain how the torque is produced in the rotor of an induction motor?
   (b) i. Show that the relative speed between resultant rotor field and resultant stator field of a 3-phase induction motor is zero,
      ii. Derive the expression for the rotor e.m.f and rotor current of an induction motor.

6. A 4-pole, 3-phase slip ring induction motor is coupled mechanically with a synchronous motor having 2 poles. The synchronous motor and stator of the induction

motor are fed from 50Hz voltage source. What will be the frequency of the emfs at the rotor terminals if the synchronous motor is driven?

(a) In a direction opposite to the induction motor stator rotating field.

(b) In a direction of the induction motor stator rotating field. If the frequency of the rotor voltage is required to be 300Hz, then calculate

(c) The number of poles that the induction motor must have.

7. (a) Explain the torque development process in an induction motor and its dependence on rotor slip.

(b) A 12 pole, 3-phase, 50Hz induction motor draws 2.80A and 110Kw under the block rotor test. Find the starting torque when switched on direct to rated voltage and frequency supply. Assume the stator and rotor copper losses to be equal under the blocked rotor test.

8. (a) A 3-phase, 4 pole, 50 Hz, squirrel cage Induction motor has rotor leakage impedance of 1 + j2 Ω/ph, stand still voltage of 100V per phase driving a constant torque load at 0.03 slip. What is speed of the motor, if

i. supply voltage in increased by 25% and frequently in constant.

ii. supply voltage in increased by 25% and frequency is decreased by 25%

(b) A 3-phase, 400V, 6-pole, 50HZ, 960 rpm slip ring induction motor has rotor resistance of 0.1 ohm per phase and leakage reactance of 0.5 ohm per phase. The load torque is independent of the speed.

i. Calculate the speed of motor if 0.05 ohm is inserted in the rotor circuit.

ii. What is the maximum external resistance that can be inserted in the rotor and corresponding speed.

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