Code No: RR220205 **Set No. 1**

II B.Tech II Semester Regular Examinations, Apr/May 2006
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? [6+10]

2. (a) Define efficiency and regulation of a transformer. Show how the power factor affects both of them. [2+2+2]
   (b) The maximum efficiency of 50 KVA transformer is 97.4 % and occurs at 90 % of the full load. Calculate the efficiency of transformer at
      i. Full load 0.8 power factor lagging
      ii. Half full load 0.9 power factor [5+5]

3. A 4KVA, 200/400V, 50Hz, single phase transformer gave the following test results: No-load : low voltage data, 200V, 0.7A, 60W., Short-circuit : High voltage data, 9V, 6A, 21.6W. Calculate
   (a) The magnetizing current and the component corresponding to iron loss at normal voltage and frequency,
   (b) The efficiency on full load at unity power factor,
   (c) The secondary terminal voltage on full-load at power factors of unity, 0.8 lagging and 0.8 leading. [5+5+6]

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. [6+10]

5. (a) With the help of neat sketch, explain the constructional features of a three-phase induction motors.
   (b) A 3-phase, 4-pole, 415 V, 50 Hz, delta connected induction motor running at a slip of 4%. The stator winding is delta connected with 240 conductors per phase, and the rotor winding is star connected with 48 conductors per phase. The per phase rotor winding resistance is 0.013 ohms and a leakage reactance of 0.048 ohms at standstill. Calculate the following: [8+8]
      i. The per phase rotor emf at standstill with the rotor open circuit,
      ii. The rotor emf and current at 4% slip,
      iii. The phase difference between the rotor emf and rotor current at 4% slip.

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.[8+8]

7. (a) A 10KW, 420V.3-phase,4-pole, 50HZ delta connected squirrel cage induction motor gave the following data on blocked rotor test.
   210V, 20A, 5KW Stator core loss at rated voltage and frequency is 300 watts. The dc resistance measured between any two terminals of stator is 0.6 ohm. Determine the starting torque.
   (b) A 10KW, 400V, 4-pole delta connected squirrel cage induction motor gave the following test results.
   No load test : 400V, 8A, 250W
   Blocked rotor test : 90V, 35A, 1350 watts.
   DC resistance per phase of stator is 0.6 calculate equivalent circuit parameters. [8+8]

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. [8+8]

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1. (a) What are the various methods to reduce the leakage flux in transformer. [6]
   (b) Draw the phasor diagram of a single phase transformer with load having a leading power factor and explain. [4+6]

2. (a) Define efficiency and regulation of a transformer. Show how the power factor affects both of them. [2+2+2]
   (b) The maximum efficiency of 50 KVA transformer is 97.4 % and occurs at 90 % of the full load. Calculate the efficiency of transformer at
      i. Full load 0.8 power factor lagging
      ii. Half full load 0.9 power factor [5+5]

3. (a) Two similar 250KVA similar transformers gave the following results when tested by back-to-back method: Mains wattmeter, W_1 = 5.0 KW, Primary series circuit wattmeter, W_2 = 7.5KW (at full load current). Find out the individual transformer efficiencies at 75% full load and 0.8 power factor lead. [8]
   (b) A 10KVA, 440/3300V, 1-phase transformer, when tested on open circuit, gave the following figures on the primary side : 440V, 1.3A, 115W. When tested on short circuit with full load current flowing, the power input was 140W. calculate the efficiency of the transformer at
      i. full load unity power factor
      ii. one quarter full load 0.8p.f. [4+4]

4. A Δ/Y connected bank of 3 identical 60 KVA, 2000/100V, 50Hz transformers is fed with power through a feeder whose impedance is 0.75 + j0.25Ω per phase. The voltage at the sending end of the feeder is held fixed at 2 KV line-to-line. The short circuit test when conducted on one of the transformers with its L.V. terminals short circuited gave the following results:

$$V_{hv} = 40 \text{ V} \qquad \text{f} = 50\text{Hz}$$
$$I_{hv} = 35 \text{ A} \qquad \text{P} = 800 \text{ W}$$

   (a) Find the secondary line-to-line voltage when the bank delivers rated current 2A balanced 3-phase u.p.f. load.
   (b) Calculate the currents in the transformer in the primary and secondary windings and in the feeder wires on the occurrence of a solid 3-phase short circuit at the secondary line terminals. [8+8]

5. (a) Discuss the points of similarities between a transformer and an induction machine. Hence, explain why an induction machine is called a generalized transformer.
   (b) Explain why an induction motor, at noload, operates at a very low power factor. [8+8]

6. (a) Explain the principle of 3-phase induction motor with the help of rotating magnetic field.
   (b) A 6-pole, 50Hz, 3-phase induction motor running on full load develops a useful torque of 160 N-m and the rotor emf is absorbed to make 120 cycles/min. Calculate the net mechanical power developed. If the torque loss in windage and friction is l2N- m, find the copper loss in the rotor windings, the input to the motor and efficiency. [6+10]
   Given stator losses=200W (inclusive of core loss)

7. A 4KW, 400V, 3-phase, delta connected slip ring induction motor gave the following test results.
   No load test : 210V, 16A, power factor = 0.45
   Blocked rotor test :400V, 3.3A, power factor =0.174
   Draw circle diagram and final maximum torque and corresponding efficiency and line current. At stand still rotor and stator resistances are equal. [8+8]

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. [8+8]

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Code No: RR220205 **Set No. 3**

II B.Tech II Semester Regular Examinations, Apr/May 2006
ELECTRO MECHANICS-II
(Electrical & Electronic Engineering)

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

Answer any FIVE Questions
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1. (a) Explain the working principle of transformer and derive the emf equation. [3]
   (b) A single phase 50 Hz transformer has 100 turns on the primary and 400 turns on the secondary winding. The net cross-sectional area of core is 250 cm^2. If the primary winding is connected to a 230 V 50 Hz supply, determine [5]
      i. The EMF induced in the secondary winding
      ii. The maximum value of flux density in the core. [4+4]

2. (a) Write a short note on All day efficiency of the transformer. [4]
   (b) Find the All day efficiency of single phase transformer having maximum efficiency of 98 % at 15 KVA at UPF and loaded as follows.
   12 hours — 2 KW at 0.5 power factor lagging
   6 hours — 12 KW at 0.8 power factor lagging
   6 hours — no load [12]

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. [10+6]

4. Two transformers each rated 250 KVA, 11/2 Kv and 50 Hz are connected in open delta on both primary and secondary.
   (a) Find the load KV A that can be supplied from this transformer connection.
   (b) A delta connected 3-phase load of 250 KVA, 0.8 p.f., 2 Kv is connected to the low voltage terminal of this open voltage transformers. Determine the transformer currents on the 11 Kv side of this connection. [8+8]

5. (a) With the help of neat sketch, explain the constructional features of a three-phase induction motors.
   (b) A 3-phase, 4-pole, 415 V, 50 Hz, delta connected induction motor running at a slip of 4%. The stator winding is delta connected with 240 conductors per phase, and the rotor winding is star connected with 48 conductors per phase. The per phase rotor winding resistance is 0.013 ohms and a leakage reactance of 0.048 ohms at standstill. Calculate the following: [8+8]
      i. The per phase rotor emf at standstill with the rotor open circuit,
      ii. The rotor emf and current at 4% slip,

iii. The phase difference between the rotor emf and rotor current at 4% slip.

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.[8+8]

7. A 4KW, 400V, 3-phase, delta connected slip ring induction motor gave the following test results.
   No load test : 210V, 16A, power factor = 0.45
   Blocked rotor test :400V, 3.3A, power factor =0.174
   Draw circle diagram and final maximum torque and corresponding efficiency and line current. At stand still rotor and stator resistances are equal. [8+8]

8. Explain the following methods of speed control with slip-torque characteristics.

   (a) Frequency control

   (b) stator voltage control. [8+8]

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

II B.Tech II Semester Regular Examinations, Apr/May 2006
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) Explain why hysteris and eddy current losses occur in a transformer. [6]
   (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. [8+2]

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. [6+10]

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) Explain the following characteristics of an auto transformer with two winding transformer:
      i. Rating
      ii. Losses
      iii. Impedance drop
      iv. Voltage regulation [2+2+2+2]
   (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. [8]

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

OC test	SC test
P_o = 520 W	Psc = 610 W
I_o = 4.21A	Isc = 4.35 A
V_o = 400V	Vsc = 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. [16]

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. [8+8]

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. [6+6+4]

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+8]

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. [8+8]

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