Code No: R22024 **R10** SET - 1

II B. Tech II Semester Regular Examinations, August – 2014
ELECTRICAL MACHINES - II
(Electronics and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Explain the principle of operation of transformer and develop the phasor diagram under load condition assuming lagging power factor load?
   b) The primary winding of step down transformer takes a current of 22 A at 3300 V when working at full load. If the transformation ratio is 15:1, calculate the secondary voltage and current? (10M+5M)

2. a) With the help of relevant expressions explain how the iron loss is varied by the variation of supply voltage and frequency?
   b) A 100 kVA, 2000/200 V, 50 Hz distribution transformer has core loss of 750 W at rated voltage and copper loss of 1500 W at full load. It has the following load cycle: (8M+7M)

% load	0%	50%	75%	100%	110%
Power factor	-	0.95 lag	0.8 lag	0.85 lag	0.95 lag
Hours	3	6	8	5	2

   Determine the all-day efficiency of the transformer?

3. a) Derive the expressions for load shared by two transformers in parallel when no-load voltages of these transformers are not equal. What will be the load distribution if the voltage ratio is exactly equal?
   b) Draw the equivalent circuit of 3000/400V single phase transformer on which the following test results were obtained. Input to high voltage winding when low voltage winding is open circuited: 3000V, 0.5A, 500W. Input to low voltage winding when high voltage winding is short circuited: 11V, 100A, 5000W. Insert the appropriate values of resistance and reactance. And find regulation of transformer at full load and 0.8 p.f. lagging? (7M+8M)

4. a) Explain open delta connection to carry out 3-phase operation with the help of two transformers. State the disadvantages in this operation?
   b) Two single phase transformers are supplied at 250V from a 6600 V, 3-phase system through a pair of Scott-connected transformers. If the load on the main transformer is 85 kW at 0.9 p.f. lagging and that on teaser transformer is 69 kW at 0.8 p.f. lagging, find the values of line currents on the 3-phase side. Neglect the magnetizing and core loss currents in the transformers? (5M+10M)
~~~~~~~~~~~~~~~~~~~~~~~~

5. a) Compare the cage and wound 3-phase induction motors with respect to their construction and performance?
   b) A 3-phase, 4 Pole, 1440 rpm, 50 Hz induction motor has star connected rotor winding, having a resistance of 0.2 Ω per phase and standstill leakage reactance of 1 Ω per phase. When the stator is energized at rated voltage and frequency, the rotor induced e.m.f. at standstill is 110 V per phase.
   Calculate the rotor current, rotor power factor and torque both at starting and at full load
   If an external resistance of 1 Ω per phase is inserted in rotor circuit, calculate rotor current, rotor power factor and torque at the time of starting? (7M+8M)

6. a) Prove that in 3-phase induction motor the ratio of maximum torque to starting torque is $\frac{(1+k^2)}{2k}$, where k is ratio of rotor resistance to rotor reactance. Neglect stator impedance?

   b) Explain the phenomenon of cogging and crawling in 3-phase induction motor in brief? (7M+8M)

7. a) Why the starters are necessary for starting induction motors? List the different starting methods?
   b) A three phase, 400 V, 50 Hz, 4-Pole, delta connected, squirrel cage induction motor has the following data:
   No-load: 400 V, 3.0 A, 300 W
   Blocked rotor: 120 V, 7.0 A 500 W
   Draw the circle diagram and determine starting torque, maximum torque and efficiency when the motor works with a slip of 5%. The stator effective resistance per phase is equal to 4 Ω?
   (5M+10M)

8. a) Discuss the pole-changing methods of speed control of 3-phase induction motor?
   b) Explain stator voltage control of 3-phase induction motors? (7M+8M)

Code No: R22024 **R10** SET - 2

II B. Tech II Semester Regular Examinations, August – 2014
ELECTRICAL MACHINES - II
(Electronics and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Derive the expressions for the r.m.s. values of the induced voltages in the two windings of a single phase transformer connected to sinusoidal supply?
   b) A 1-phase 3300/400V transformer has the primary resistance, R1=0.7Ω, secondary resistance, R2=0.011Ω primary leakage reactance, X1=3.6Ω and secondary leakage reactance, X2=0.045Ω. The secondary is connected to a coil having the resistance of 2.5Ω and inductance of 0.01H. Calculate the secondary terminal voltage and power consumed by the coil? (8M+7M)

2. a) Develop the exact equivalent circuit of a 1-phase transformer. From this derive the approximate and simplified equivalent circuits. State the various assumptions made?
   b) A single phase transformer working at unity power factor has an efficiency of 0.9 p.u. both at half load and at the full load of 500 W. Determine the efficiency at full load at 0.8 pf lagging? (5M+10M)

3. a) Explain Sumpner's test on single phase transformer and also list its advantages?
   b) Derive an expression for approximate relative weights of conductor material in an autotransformer and 2-winding transformer, the primary voltage being V1, and secondary voltage V2. Compare the weights of conductor material when the transformation ratio is 3. Ignore the magnetizing current? (8M+7M)

4. a) What are distinguishing features of Y-Y, Y-Δ, Δ-Y and Δ- Δ three phase connections? Compare their advantages and disadvantages?
   b) Describe the configuration and working principle of on load tap changer with neat sketches? (8M+7M)

5. a) Briefly describe the constructional details of squirrel cage 3-phase induction motor?
   b) A 10 kW, 400 V, 3-phase, 4 pole, 50 Hz delta connected induction motor is running at no load with a line current of 8 A and an input power of 660 W. At full load, the line current is 18 A and the input power is 11.20 kW. Stator effective resistance per phase is 1.2 Ω and friction, windage loss is 420 W. For negligible rotor ohmic losses at no load, Calculate: i) Stator core loss ii) Total rotor losses at full load iii) Total rotor ohmic losses at full load iv) Full load speed. (7M+8M)
~~~~~~~~~~~~~~~~~~~~~~~~

6. a) With the help of relevant expressions develop speed-torque characteristics of 3-phase induction motor and discuss the effect rotor resistance in the variation of these characteristic?
   b) A 3-phase induction motor has a synchronous speed of 250 rpm and 5% slip at full load. The rotor has a resistance of 0.02 Ω per phase and a standstill leakage reactance of 0.25 Ω per phase. Calculate:
   a) The speed at which the maximum torque developed
   b) The ratio of maximum to full load torque
   c) The ratio of maximum to starting torque
   d) What should be the rotor resistance per phase to produce starting torque equal to three forth of maximum torque? (7M+8M)

7. a) Briefly describe why the starting current is high in the direct on line starting of 3-phase induction motor?
   b) A three phase, 15 kW, 400 V, 50 Hz, 4-pole, star connected squirrel cage induction motor has the following data:
   No-load: 400 V, 5.0 A, p.f= 0.2
   Blocked rotor: 120 V, 20.0 A p.f= 0.6
   The ratio of stator to rotor copper losses on short circuit was unity. Draw the circle diagram and determine: i) the full load current and power factor ii) the maximum power developed iii) starting torque. (5M+10M)

8. a) Describe how the stator voltage control method of speed control of 3-phase induction motor?
   b) Explain the principle of working of induction generator? Briefly discriminate motoring and generating operations of 3-phase induction motor? (7M+8M)

Code No: R22024 **R10** SET - 3

II B. Tech II Semester Regular Examinations, August – 2014
ELECTRICAL MACHINES - II
(Electronics and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Develop the phasor diagram of 1-phase transformer under loaded condition for all power factor loads?
   b) A 1-phase, 50 Hz core type transformer has square core of 20 cm side. The permissible maximum flux density is 1 T. Calculate the number of turns per limb on the high voltage and low voltage sides of 3000/220 V ratio? (10M+5M)

2. a) In a transformer if the load current is kept constant, find the power factor at which the maximum efficiency occurs?
   b) The efficiency of 20 kVA, 2500/250 V, single phase transformer at unity power factor is 98 % at rated load and also at half rated load. Determine: i) transformer core loss, ii) full load copper loss iii) per unit value of the equivalent resistance of the transformer (7M+8M)

3. a) Derive the expressions for load shared by two transformers in parallel when no-load voltages of these transformers are not equal. What will be the load distribution if the voltage ratio is exactly equal?
   b) Two similar 200 kVA, 1-phase transformers gave the following results when tested by back-to-back method: W_1 in the supply line, 4 kW, W_2 in the primary series circuit, when full-load current circulated through the secondary, 6 kW. Calculate the efficiency of each transformer (7M+8M)

4. a) For what purpose tertiary windings used on 3-phase transformers? Explain how they can assist in unbalanced loading condition if suitably connected?
   b) A Scott connected transformer supplies two single phase furnaces at 200V, each taking 200 kW. The load on the leading phase is at unity power factor and that on the other phase is 0.8 power factor. The three phase input line voltage is 6600 V. Calculate the values of line currents on the 3-phase side. Neglect the magnetizing and core loss currents in the transformers? (5M+10M)
~~~~~~~~~~~~~~~~~~~~~~~~

5. a) Give the constructional details of wound rotor 3-phase induction motor? What are its advantages over squirrel cage rotor?
   b) A 6 pole, 50 Hz, 3-phase induction motor running on full load develops a useful torque of 160 N-m. When the rotor e.m.f makes 120 complete cycles per minute. Calculate the power input, if the mechanical torque lost in friction and windage loss is 10 N-m. Also calculate: i) the copper loss in the rotor winding ii) the efficiency. The stator loss given to be 800 W. (7M+8M)

6. a) Deduce and discuss the equivalent circuit of 3-phase induction motor?
   b) A 440V, 50Hz squirrel cage induction motor has a ratio of standstill reactance of rotor per phase of 3 to1 and a maximum torque which is 4 times the normal full load torque. Calculate: i) full-load slip ii) ratio of starting torque to full load torque iii) minimum voltage required to develop normal full load torque at starting? (7M+8M)

7. a) Draw and explain the circle diagram of 3-phase induction motor? How the different performance quantities are determined from circle diagram
   b) An induction motor is to be started directly from mains. If the starting torque is equal to full load torque, find the starting current in terms of full load current if the slip of the motor at full load is 5%? (10M+5M)

8. a) Explain the method of speed control of 3-phase induction motor by varying the rotor resistance?
   b) Explain the induction motor operation under injection of an e.m.f. into the rotor circuit? (7M+8M)

Code No: R22024 **R10** SET - 4

II B. Tech II Semester Regular Examinations, August – 2014
ELECTRICAL MACHINES - II
(Electronics and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any **FIVE** Questions
All Questions carry **Equal** Marks
~~~~~~~~~~~~~~~~~~~~~~~~

1. a) Discuss:
   i) Why the primary of transformer draws current form mains when the secondary is not carrying any load?
   ii) How the primary of transformer draws current from mains when the secondary is loaded?
   b) A single phase 230V/15V, 50 Hz transformer has the secondary full load current of 8A. It has 45 turns on the secondary. Calculate: i) the voltage per turn ii) the number of primary turns iii) the full load primary current and iv) kVA output of the transformer? (7M+8M)

2. a) Derive an expression for computing per-unit voltage regulation of a transformer for lagging power factor load?
   b) An 800 kVA transformer at normal voltage and frequency requires an input of 7.5 kW on no load. At reduced voltage and full load current it requires 1.42 kW input when secondary is short circuited. Calculate all day efficiency if the transformer operates on the following load cycle:

6 hours	500 kW	0.8 pf
4 hours	700 kW	0.9 pf
4 hours	300 kW	0.95 pf
10 hours	no load	

(7M+8M)

3. a) How iron losses are separated in single phase transformer, explain with the help of relevant test?
   b) A 110/400V, 1-phase transformer gave the following test results
   Open circuit test 110V, 1A, 80W on l.v. side
   Short circuit test 20V, 15A, 120W on h.v. side
   Calculate the circuit constants and show them on equivalent circuit (7M+8M)

4. a) Explain with the help of connection and phasor diagrams, how Scott connection are used to obtain two-phase supply from 3-phase supply mains?
   b) A Scott connected transformer supplies two single phase furnaces at 100V, each taking 200 kW. The load on the leading phase is at unity power factor and that on the other phase is 0.8 power factor. The three phase input line voltage is 11000 V. Calculate the values of line currents on the 3-phase side. Neglect the magnetizing and core loss currents in the transformers? (8M+7M)
~~~~~~~~~~~~~~~~~~~~~~~~

5. a) Describe the principle of operation of the 3-phase induction motor? What are the different types of induction motors?
   b) A 3-phase slip ring induction motor gives a reading of 60V across slip rings when at rest with normal stator voltage? The rotor is star connected and has impedance of (0.6+j5) Ω per phase. Find the rotor current when the machine is i) at stand still with the slip rings joined to a star connected starter with a phase impedance of (4+j2) Ω and ii) running normally with a 4% slip. (7M+8M)

6. a) Explain how improved starting performance of 3-phase squirrel cage motors may be obtained by means of double cage rotor windings? Compare the speed – torque characteristics of double cage rotor with normal squirrel cage motor?
   b) A 4-pole, 50Hz, 3-phase induction motor has a rotor resistance and standstill rotor reactance of 0.025 Ω and 0.1 Ω per phase respectively. Calculate: i) the speed at which maximum torque occurs ii) the value of rotor resistance per phase to be inserted to obtain 80% of maximum torque at starting? (7M+8M)

7. a) Explain the procedure of drawing circle diagram of an induction motor. What information can be drawn from the circle diagram?
   b) A 15 HP, 3-phase, 6 pole, 50 Hz, 400 V, delta connected IM runs at 960 rpm on full load. If it takes 86.4 A on direct starting, find the ratio of starting torque to full load torque with a star delta starter. Full load efficiency and power factor are 88% and 0.85 respectively? (10M+5M)

8. a) Explain the speed control of induction motor by the cascade connection method?
   b) Explain the principle of operation of induction generator? What are its limitations? (7M+8M)