Code: 15A02401 **R15**

B.Tech II Year II Semester (R15) Supplementary Examinations December 2018

ELECTRICAL MACHINES – II

(Electrical & Electronics Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

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1 Answer the following: (10 X 02 = 20 Marks)

(a) Why the efficiency of a transformer is very high?

(b) Draw the phasor diagram of a single-phase transformer supplying a leading power factor load.

(c) Discuss the relative merits and demerits of an auto-transformer.

(d) Discuss the essential and desirable conditions to be fulfilled for the operation of two 3-phase transformers in parallel.

(e) The stator of a 3-phase, 4-pole wound rotor induction motor is connected to 50 Hz source, but its rotor is energized from 30 Hz source. Determine the two possible no-load speeds of the motor. Neglect al losses.

(f) Why the rotor of three-phase induction motor can never attain synchronous speed?

(g) Sketch the torque-speed curve of a conventional induction motor and indicate how this will change when the rotor resistance is doubled, keeping stator voltage and frequency unchanged.

(h) What does crawling of induction motor mean?

(i) Define asynchronous torque.

(j) List out the methods of speed control of cage type 3-phase induction motor.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) Derive an expression for computing the per unit voltage regulation of a transformer both for lagging and leading power factors.

(b) A single–speed transformer has a regulation of 10% when delivering full load at unity pf and 15% when delivering the same load at 0.8 pf lagging. What would be the regulation if the transformer is delivering half-load at 0.8 pf leading?

OR

3 (a) Discuss the effect of frequency and voltage on the equivalent circuit parameters of a transformer.

(b) In a test for the determination of losses of 440 V, 50 Hz transformer, the total iron losses were found to be 2500 watts at normal voltage and frequency. When the applied voltage and frequency were 220 V and 25 Hz, the iron losses were found to be 850 watts. Calculate the eddy current and hysteresis losses at normal voltage and frequency.

UNIT – II

4 (a) Give the merits and demerits of a delta/star connected three-phase transformer.

(b) Two transformers connected in open delta supply a 400 kVA balanced load operating at 0.866 pf (lag). The load voltage is 440 V. What is the: (i) kVA supplied by each transformer. (ii) kW supplied by each transformer.

OR

5 (a) Explain the effect of third harmonics in phase voltages of three phase transformers.

(b) A 400/100 V, 5 kVA, 1-phase two winding transformer is to be used as an auto-transformer to supply 400 V from a 500 V voltage source. When tested as a two-winding transformer at rated load and 0.8 pf lagging, its efficiency was found to be 0.95. Determine its kVA rating as an auto-transformer. Also calculate the transformed kVA and conducted kVA.

Contd. in page 2

UNIT – III

6 (a) Explain how a rotating magnetic field is produced in a three-phase induction motor.

(b) A 3-phase, 400 V, 50 Hz induction motor takes a power input of 35 kW at its full-load speed of 890 rpm. The total stator losses are 1 kW and the friction and windage losses are 1.5 kW. Calculate: (i) Slip. (ii) Rotor ohmic losses. (iii) Shat power. (iv) Efficiency.

OR

7 (a) Draw and explain stator and rotor equivalent circuits of 3-phase induction motor.

(b) A 3-phae, star connected, 400 V, 50 Hz, 4-pole induction motor has the following per phase constants in ohms referred to stator.

$r_1 = 0.15\ \Omega$, $x_1 = 0.45\ \Omega$, $r_2 = 0.13\ \Omega$, $x_2 = 0.46\ \Omega$, $x_\phi = 28\ \Omega$, fixed losses = 400 watts.

Compute the stator current, rotor speed, output torque and efficiency when the motor is operated at rated voltage and frequency at a slip of 4%.

UNIT – IV

8 (a) A 3-phase required cage induction motor is designed to have rotor copper bars. If, instead of using copper, aluminium is used for rotor bars, explain what happens to its speed, efficiency etc under normal running conditions.

(b) A 400 V, 50 Hz, 3-phase star connected squirrel cage induction motor gone the following test results:

No-load test (line values): 400 V, 9 A, 560 W

Blocked rotor test (line values): 210 V, 36 A, 4820 W

The effective stator resistance is 0.72 Ω per phase. Calculate the equivalent circuit parameters.

OR

9 (a) Explain how the circle diagram for a poly-phase induction motor can be drawn from its test data.

(b) A 3-phase, 4-pole, 50 Hz induction motor, during the short circuit test, took 100 A and 30 kW. Incase stator resistance is equal to equivalent stands till rotor resistance, compute the starting torque.

UNIT – V

10 (a) What are the advantages of inserting external resistance in the rotor circuit of a wound-rotor induction motor at the time of starting?

(b) Calculate the relative values of starting currents and starting torques of a 3-phase squirrel cage induction motor, when it is started by: (i) Direct on line starter. (ii) Star-delta starter. (iii) Auto-transformer starter with 60% tapping.

OR

11 (a) Explain about the speed control of slip ring induction motor with different methods.

(b) Explain any two methods for performing the polarity test on a 3-phase induction motor.

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PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

(a) How are the transformer losses affected if power factor of a given load is varied?

(b) Distinguish between power and distribution transformers.

(c) In a single phase transformer, OC-test is conducted on LV-side and SC-test is conducted on HV-side usually. Why?

(d) A 2/1 ratio two winding transformer is connected as an auto transformer to a given voltage ratio 2/3. Calculate its kVA rating as an auto transformer compared to a two winding transformer.

(e) Give the expressions of rotor frequency at the time of starting and at running condition.

(f) Why is it not possible to run an induction motor on synchronous speed?

(g) The starting torque of a given SCIM can't be altered, when the applied voltage is constant? Why?

(h) What is the effect of variation of supply voltage in an induction motor?

(i) How can frequencies greater than the supply frequency are obtained with the use of 3-phase SRIM?

(j) Name four types of starters used for 3-phase induction motor.

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) Define efficiency and regulation of a transformer. Show how the power factor affects both of them.

(b) A 230 V/115 V single phase transformer takes a no load current of 2 A at a power factor of 0.2 lagging with low voltage winding kept open. If the low voltage winding is now loaded to take a current of 15 A at 0.8 pf lagging. Find the current taken by high voltage winding.

OR

3 (a) Draw and explain the phasor diagram of single phase transformer on load considering with winding resistance.

(b) The emf per turn for a single phase transformer is 1.1 V. When the primary winding us connected to a 220 V 50 Hz A.C. supply, the secondary voltage is found to be 550 V. Calculate: (i) The number of primary and secondary turns. (ii) The net cross-sectional area of the core, for a maximum flux density of 1.1 T.

UNIT – II

4 Derive the equations for the currents supplied by each transformer when two transformers are operating in parallel with equal and unequal voltage ratios.

OR

5 (a) Explain the effect of third harmonics in phase voltages of three phase transformers.

(b) The efficiency of a 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) The transformer core loss and ohmic losses. (ii) The p.u value of the equivalent resistance of the transformer.

Contd. in page 2

UNIT – III

6 (a) What are the various losses occurred in 3-phase induction motor and also represent power flow diagram.

(b) A 3-phase, 50 Hz induction motor is wound for 8-poles. Calculate: (i) The synchronous speed. (ii) The rotor speed when slip is 3%. (iii) Rotor frequency when rotor runs at 800 rpm.

OR

7 Describe in detail the constructional features of both slip ring and squirrel cage induction motor. Discuss the merits of one over the other.

UNIT – IV

8 (a) Explain in detail about Crawling and Cogging.

(b) A 3-phase, 50 Hz, 500 V, 6-pole IM gives an output of 37.3 kW at 955 r.p.m the p.f is 0.86. Frictional and windage losses total 1492 kW, stator losses amount to 1.5 kW. Determine line current, efficiency and rotor copper losses for this load.

OR

9 A 415 V, 29.84 kW, 50 Hz, delta-connected motor gave the following test data:

No-load test: 415 V, 21 A, 1250 W

Locked rotor test: 100 V, 45 A, 2730 W

Construct the circle diagram and determine: (i) The line current and p.f for rated output. (ii) The maximum torque. Assume stator and rotor copper losses equal at standstill.

UNIT – V

10 Why at all starters are necessary for starting the induction motor? Explain the different starters used for squirrel cage motors.

OR

11 Explain the operation of star-delta starter used for squirrel cage induction motor. Which method is preferred for starting wound rotor induction motor?

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B.Tech II Year II Semester (R15) Supplementary Examinations December 2017

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R15

B.Tech II Year II Semester (R15) Regular Examinations May/June 2017

ELECTRICAL MACHINES – II

(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 70

PART – A

(Compulsory Question)

*****

1 Answer the following: (10 X 02 = 20 Marks)

(a) Mention the functions of the two components of exciting current in a transformer.

(b) What is the difference between cylindrical-type and sandwich-type winding?

(c) What are the necessary conditions required for parallel operation of single phase transformer?

(d) List the possible ways of connecting a bank of three transformers for three phase service.

(e) Why should the rotor of a 3-phase induction motor rotate in the same direction as that of its rotating magnetic field?

(f) What is the effect of introducing resistance in the rotor circuit of a 3-phase induction motor?

(g) What is meant by crawling?

(h) Mention the effect of variation of supply frequency in an induction motor.

(i) How the speed of induction motor is controlled by variable - frequency?

(j) How is it possible to get frequencies lower than the supply frequency in a 3-phase WRIM?

PART – B

(Answer all five units, 5 X 10 = 50 Marks)

UNIT – I

2 (a) Obtain the equivalent circuit of a single phase transformer referred to LV side and HV side.

(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: (i) The e.m.f induced in the secondary winding. (ii) The maximum value of flux density in the core.

OR

3 (a) Explain why hysteresis and eddy current looses occur in a transformer? What are the methods to reduce these losses?

(b) A 10 kVA, 2500/250 V, single phase transformer has resistances and leakage reactance's as follows: $R_1 = 4.8\ \Omega$, $R_2 = 0.048\ \Omega$, $X_1 = 11.2\ \Omega$ and $X_2 = 0.112\ \Omega$ subscripts 1 and 2 denote high voltage and low voltage windings respectively. With primary supply voltage held constant at 2500 V, calculate the secondary terminal voltage when: (i) The LV winding is connected to a load impedance of $5+j3.5\ \Omega$. (ii) The transformer delivers its rated current at 0.8 p.f lagging on the L.V side.

UNIT – II

4 Mention the different tests that are conducted on transformer. Explain the procedure for conducting Sumpner's test along with all precautions to be taken while conducting the test with neat diagram.

OR

5 (a) How auto transformer is different from ordinary two winding transformer? What are the advantages & disadvantages of auto transformer?

(b) In a Scott-connection, calculate the values of the of the currents on the 3-phase side if the loads on the 2-phase side are 300 kW and 450 kW both at 100 V and 0.707 p.f. lag and the 3-phase line voltage is 3300 V. The 300 kW load is on the leading phase on the 2-phase side. Neglecting transformer losses.

Contd. in page 2

UNIT – III

6 (a) Discuss the points of similarities between a transformer and an induction machine. Hence, explain why induction machine is called a generalized transformer.

(b) A 100 kW (output), 3300 V, 50 Hz, 3-phase, star-connected induction motor has a synchronous speed of 500 r.p.m. The full-load slip is 1.8% and F.L. power factor 0.85. Stator copper loss = 2440 W. Iron loss = 3500 W. Rotational losses = 1200 W. Calculate: (i) The rotor copper loss. (ii) The line current. (iii) The full load efficiency.

OR

7 (a) Show that in an induction motor the rotor input: power developed: rotor copper losses :: 1: (1-s):s, where s is the fractional slip.

(b) In a 6-pole, 3-phase, 50 Hz motor with star connected rotor, the rotor resistance per phase is 0.3 Ω, the reactance at standstill is 1.5 Ω per phase and an e.m.f between the slip rings on open circuit is 175 V. Find: (i) Rotor e.m.f per phase. (ii) Rotor frequency and reactance at a speed of 950 rpm.

UNIT – IV

8 Sketch and explain the slip torque characteristics of an induction motor working at rated voltage and frequency and also explain with respect to the normal one, if the following changes are made: (i) Applied stator voltage is reduced to half at rated frequency. (ii) Both the applied voltage and frequency are reduced to half.

OR

9 (a) Develop an expression for torque of an induction motor and obtain the condition for maximum torque.

(b) The rotor resistance and stand still reactance of a 3-phase induction motor are 0.02 Ω / phase and 0.1 Ω / phase respectively. At normal voltage, the full-load slip is 3%. Estimate the percentage reduction in stator voltage to develop full-load torque at half full-load speed. Also calculate the power factor.

UNIT – V

10 (a) Why a starter is necessary to start an induction motor? Explain Auto-transformer starter in detail.

(b) The rotor of a 4-pole, 50 Hz slip ring induction motor has a resistance of 0.25 Ω per phase and runs at 1440 r.p.m at full load. Calculate the external resistance per phase which must be added to lower the speed at 1200 r.p.m, the torque being the same as before.

OR

11 Explain in detail the different methods for the speed control of induction motors.

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