B.E. ELECTRICAL ENGINEERING SECOND YEAR SECOND SEMESTER - 2024

ELECTRICAL MACHINES-II

Time: Three hours Full Marks: 100

(50 marks for each part)
(Use separate Answer Script for each part)

PART – I

1. Answer any four from the following: 4x2.5
   (a) Why an induction machine is called a generalized transformer?
   (b) What will be the direction of rotation of the rotor, if the primary winding is placed on the rotor of a poly-phase induction motor?
   (c) What is the relative speed between the magnetic field produced by stator winding and the magnetic field produced by the rotor winding? Give reasons for your answer.
   (d) Find an expression for peach factor for a short peached winding.
   (e) What is deep bar rotor induction motor? How it produces high starting torque?

2. Answer any one from (a) and (b): 10
   (a) Explain how a rotating magnetic field with constant amplitude is generated in an three phase induction machine.
   (a) Derive an expression for developed torque of an induction motor. Also derive the value of slip for which torque is maximum and draw the torque-speed characteristics.

3. Answer any one from (a) and (b): 10
   (a) From the basic principle develop the equivalent circuit of a poly phase induction motor.
   (b) How can you determine the equivalent circuit parameters in the laboratory?

4. Answer any one from (a) and (b): 10
   (a) i) If the stator impedance of an induction motor is neglected show that :

   $$T_e / T_{em} = 2/ (s_{mT}/s + s/ s_{mT})$$

   ii) From the equivalent circuit of a poly phase induction motor, obtain the following relations:
      1) $I_{2st} / I_2 = \sqrt{[(s^2+s_{mT}^2)/(s^2(1 + s_{mT}^2))]}$
      2) $I_{2mT} / I_2 = \sqrt{[0.5 (1 + (s_{mT}/ s)^2)]}$

(b) Describe a double cage induction motor. Draw and explain the equivalent circuit of double cage rotor induction motor. 10

5. Answer any one from (a) and (b): 10

(a) The rotor resistance and standstill reactance of a 3-phase induction motor are 0.012 ohm and 0.08 ohm per phase respectively. The full load slip is 4% at normal voltage. Calculate the percentage reduction in stator voltage to develop the full-load torque at 75% of full-load speed.

(b) The standstill impedances of the two cages of a double-cage induction motor are (3.2 + j 1.2) ohm and (0.5 + j 6.5) ohm respectively. If the full-load slip is 5%, then find the ratio of starting torque to full-load torque. Neglect magnetizing current and stator impedance.

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Bachelor of Electrical Engineering, 2nd Year 2nd Semester Examination, 2024

SUBJECT: ELECTRICAL MACHINES-II

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PART - II

Answer any three questions. Question no. 3 carries 18 marks.

1. Correct and/or justify following. **4x4=16**

(i) Delta-star is more preferable than star-star without neutral three phase transformer.

(ii) The cross section of the central limb of a shell type transformer is usually designed to have larger cross section to avoid flux saturation.

(iii) The $9n^{th}$ harmonics of magnetic flux are always in phase though its $7n^{th}$ harmonics have a reversed phase sequence compared to fundamental.

(iv) Vector group formation is unavoidable with 30 phase shift in case of Delta-star or Star-delta transformer.

2. (i) How core construction helps in reducing harmonics in a three phase transformer? **4+9+3=16**

(ii) Draw the connection diagram and phasor diagram of the following connections.

a) Dy1, b) Yz1 and c) Yd1

(iii) Yy0 and Dd6 connected transformers cannot be connected in parallel- explain

3. (i) Show that by using two single phase transformers with proper taps, three phase power supply is possible from a two phase supply. **7+11=18**

PART - II

(ii) In Scott-connected transformers, teaser transformer supplies 0.75 leading power factor load of 25 kW at 220 V and main transformer supplies 0.75 power factor lagging load of 45 kW at 220 V, from a three phase input line voltage of 3300V. Determine the input 3-phase line currents. Neglect magnetizing currents and the leakage impedance drops. Draw input current phasors computed for above along with a Scott-connection diagram.

4. i) Draw and explain two resistor type on-load tap changer schemes. **7+5+4=16**

ii) Write the advantages and disadvantages of using off-load and on-load type tap-changers.

iii) Why high voltage winding of a transformer is preferred for tappings of tap-changer?

5. Write Short notes on: **8 x 2 =16**

(i) Development of voltage stress along the winding of a three phase transformer for input impulse and RMS voltage. And also write the measure to be taken to withstand it.

(ii) Tertiary windings and its applications.