B.E. ELECTRICAL ENGINEERING EXAMINATION - 2022

(2nd Year, 2nd Semester)

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) Discuss the similarities between a transformer and an induction machine. Hence, explain 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) Explain why the rotor of an induction motor can never attain synchronous speed while the rotor field with respect to the stator rotates with the synchronous speed.

   (d) What do you mean by distributed winding? Find an expression for distribution factor.

   (e) The maximum torque of a three phase induction motor does not depend on the rotor resistance – Explain.

   (f) What is deep bar rotor induction motor? How it produces high starting torque?

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

   (a) Prove that, a three phase balanced supply on a balanced three phase winding can produce a rotating magnetic field with constant magnitude and with synchronous speed.

   (b) Derive an expression for torque developed in an induction motor. Draw the torque-speed characteristics.

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

   (a) Draw and explain the phasor diagram of a three phase induction motor and develop the equivalent circuit.

   (b) Describe different tests to determine the equivalent circuit parameters of a three phase induction motor. How can you calculate the equivalent circuit parameters from these test results?

[Turn over

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 the construction of a double cage induction motor and explain how high starting torque is developed in double cage induction motor. Draw the equivalent circuit of double cage rotor induction motor.

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

    (a) A 440 V, 3-phase, 4-pole, 50 Hz, 37.3 kW, Y-connected induction motor has the   10 following parameters:

    $R_1 = 0.1\ \Omega$, $X_1 = 0.4\ \Omega$, $R'_2 = 0.15\ \Omega$, $X'_2 = 0.44\ \Omega$

    Motor has stator core loss of 1250 W and rotational loss of 1000 W. It draws a no-load line current of 20 A at a power factor of 0.09 (lag). When motor operates at a slip of 3%, calculate (i) input line current and power factor, (ii) electromagnetic torque developed in N-m, (iii) output and (iv) efficiency of the motor.

    (c) A 25 kW, 6-pole, 50 Hz, 400 V, 960 rpm, efficiency 90%, power factor 0.86 SCIM takes 200 amperes on direct on-line starting. Determine the ratio of starting to full-load torque and starting to full-load current in case of (a) DOL starting, (b) star-delta starting, (c) auto-transformer starting with 80% tappings and (d) series resistance starting limiting the starting current to 120 amperes.

Ref No. : Ex/EE/PC/B/T/222/2022

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Time: Three Hours   Full Marks: 100 (50 each part)

Use a separate Answer-Script for each part

PART - II

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

1. (i)   Why a core type three phase transformer is better than other for   **4+6+6=16**
harmonics related problems.

(ii)   How Delta winding is used to overcome the problems of harmonics in a
three phase transformers?

(iii)   What is the harmonics related problem with Yy connected transformer
without neutral? – Explain with proper diagram.

2. (i)   Draw the connection diagram and phasor diagram of the following   **9+7=16**
connections.

a) Yy6,   b) Dz6   and   c) Dy1

(ii)   What will happen if a Dy1 connected transformer is paralleled with a
Yd11 connected transformer? Show how they can be connected
properly with connection modification.

3. (i)   If two identical single-phase transformers have tapings at 50% and   **7+11=18**
86.7% then show that they can be connected in Scott connection to
convert a three to a two phase system.

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PART - II

(ii)   In Scott-connected transformers, teaser transformer supplies 0.75 leading power factor load of 30 kW at 220 V and main transformer supplies 0.85 power factor lagging load of 50 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.

4. i)   Taps should be provided at the middle of the high voltage winding- explain   **6+5+5=16**

   ii)   Why either resistor or reactor is used in an On-load tap changer(OLTC)?

   iii)   Describe the operation of a resistor type tap changers.

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

(i)   Full wave and chopped wave impulse voltage tests on a transformer for detection of faults in the winding.

(ii)   Development of voltage stress along the winding of a three phase transformer for input impulse and RMS voltage. And also write the