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S.E. (Electrical) (Second Sem.) EXAMINATION, 2010

ELECTRICAL MACHINES—I

(2008 COURSE)

Time : Three Hours **Maximum Marks : 100**

N.B. :— (*i*) Answer *three* questions from Section I and *three* questions from Section II.

(*ii*) Answers to the two sections should be written in separate answer-books.

(*iii*) Neat diagrams must be drawn wherever necessary.

(*iv*) Figures to the right indicate full marks.

(*v*) Use of logarithmic tables, slide rule, Mollier charts, electronic pocket calculator and steam tables is allowed.

(*vi*) Assume suitable data, if necessary.

SECTION I

1. (*a*) What are the losses present in the transformer and their locations ? How will you separate hysteresis and eddy current losses from the knowledge of iron losses of a transformer ? [8]

(*b*) A 250 kVA, 1-ϕ transformer has 98.135% efficiency at full-load and 0.8 lagging p.f. The efficiency at half-load and 0.8 lagging p.f. is 97.751%. Calculate the iron loss and full-load copper loss. [8]

Or

2. (*a*) What is an Auto-transformer ? Obtain the expression for saving of copper used in Auto-transformer as compared to simillar two winding transformer. [8]

P.T.O.

(*b*) The open circuit and short circuit tests on a 5 KVA, 250/125 V, 50 Hz, 1-ϕ transformer gave the following results :

O.C. Test : 250 V, 0.7 Amp, 90 Watt (HV side)

S.C. test : 12 V, 30 Amp, 90 Watt (LV side)

Calculate :

(*i*) Full-load efficiency and

(*ii*) The voltage on LV side when supplying full-load current both at 0.8 leading p.f. [8]

3. (*a*) What are the conditions to be satisfied for parallel operation ? Explain the load sharing for equal voltage ratio. [8]

(*b*) Two 1-ϕ transformers A and B rated at 250 KVA each are operated on both sides percentage impedances for A and B are $(1 + j\,6)$ and $(1.2 + j\,4.8)$ respectively. Compute the load shared by each when the total load is 500 kVA at 0.8 p.f. lagging. [8]

Or

4. (*a*) Explain the V-V connection for a 3-ϕ transformer for supplying a 3-ϕ balanced load at u.p.f. List advantages and disadvantages of such connection. [8]

(*b*) Explain Scott connection to convert 3-ph supply to 2-ph supply. [8]

5. (*a*) Explain the construction of DC machine. [10]

(*b*) A DC shunt motor runs at a speed of 1,000 rpm on no load taking a current of 6 Amp from supply, when connected to 220 V dc supply. Its full-load current is 50 Amp. Calculate its speed on full-load. Assume R_a = 0.3 Ω and R_{sh} = 110 Ω. [8]

Or

6. (*a*) Show the power flow diagram of DC motor. [5]

(*b*) Obtain the torque equation of DC motor. [5]

(*c*) What is back e.m.f. ? Explain the significance of back e.m.f. [4]

(*d*) A 4-pole series motor has Z = 944, wave wound, flux/pole = 34.6 mWb. Gross torque 209 N-m, supply voltage = 500 V and R = 3 Ω. Calculate line current and speed. [4]

SECTION II

7. (*a*) Explain the following terms : [8]

(*i*) Commutation

(*ii*) Time of commutation

(*iii*) Reactance voltage

(*iv*) Straight line commutation.

(*b*) Explain any *two* methods of speed control of a D.C. series motor. [8]

Or

8. (*a*) Write short notes on : [8]

(*i*) Interpole

(*ii*) Compensating winding.

(*b*) Draw and explain the Torque-Armature Current, Speed-Current and Torque-Speed characteristics of DC series motor. [8]

9. (*a*) A 4-pole, 3-phase induction motor operates from a supply whose frequency is 50 Hz. Calculate :

(*i*) The speed at which the magnetic field of the stator is rotating.

(*ii*) The speed of the rotor when the slip is 0.04.

(*iii*) The frequency of the rotor currents when the slip is 0.03.

(*iv*) The frequency of the rotor currents at standstill. [8]

(*b*) Distinguish between squirrel cage and phase wound induction motor. [8]

Or

10. (*a*) Derive the expression regarding 3-phase induction motor for the following : [8]

(*i*) $\frac{\text{Full load torque}}{\text{Maximum torque}}$

(*ii*) $\frac{\text{Starting torque}}{\text{Maximum torque}}$.

(*b*) A 746 kW, 3-phase, 50 Hz, 16 pole induction motor has a rotor impedance of $(0.02 + j\,0.15)\ \Omega$ at standstill. Full torque is obtained at 360 r.p.m. Calculate :

(*i*) The ratio of maximum to full-load torque

(*ii*) The speed of maximum torque and

(*iii*) The rotor resistance to be added to get maximum starting torque. [8]

11. (*a*) Draw and explain the exact and approximate equivalent circuit diagram of Induction motor. [9]

(*b*) Why are starters necessary for starting 3-phase induction motor ? Also write a short note on auto-transformer starter. [9]

Or

12. (*a*) Explain any *two* methods of speed control of a 3-phase Induction Motor. [9]

(*b*) A 3-phase, 6-pole, 50 Hz induction motor takes 60 A at full-load speed of 940 r.p.m. and develops a torque of 150 N-m. The starting current at rated voltage is 300 A. What is the starting torque ? If a star/delta starter is used, determine the starting torque and starting current. [9]