B.E. Fourth Semester (Electrical Engineering (Electronics & Power) / Power Engineering)
(C.B.S.)

Electrical Machines - I

P. Pages : 3 **NKT/KS/17/7281/7310**

Time : Three Hours * 0 5 0 5 * Max. Marks : 80

Notes :
1. All questions carry marks as indicated.
2. Solve Question 1 OR Questions No. 2.
3. Solve Question 3 OR Questions No. 4.
4. Solve Question 5 OR Questions No. 6.
5. Solve Question 7 OR Questions No. 8.
6. Solve Question 9 OR Questions No. 10.
7. Solve Question 11 OR Questions No. 12.
8. Due credit will be given to neatness and adequate dimensions.
9. Assume suitable data whenever necessary.
10. Illustrate your answers whenever necessary with the help of neat sketches.
11. Use of non programmable calculator is permitted.

1. a) Draw and explain phasor diagram of single phase transformer for unity power factor. **6**

b) A 20-KVA transformer has a maximum efficiency of 98 percent when delivering three-forth full load at U.P.F. If during the day, the transformer is loaded as follows : **7**
12 hours No load
6 hours 12 kW, 0.8 p.f.
6 hours 20 kW, U.P.F.
Calculate the all day efficiency of the transformer.

OR

2. a) Draw the phasor diagram and connection diagram of following : **5**
i) D_{y11} ii) Y_{y6}

b) A 3-ϕ, 50 KVA, 2000V/500V, 50 Hz, Δ-Y transformer has following test results **8**
O.C. test (LV side) : 500V ; 3A ; 500 W
S.C. test (HV side) : 250V ; I_{FL} ; 900 W
Calculate :
i) Parameter of shunt branch of equivalent circuit.
ii) Regulation & efficiency of transformer at full load 0.8 p.f. lagging.
iii) Maximum efficiency & load at which it occurs at unity power factor.

3. a) Derive expression for saving of copper in case of auto transformer. **6**

b) A Scott connection transformer set supplies two single phase furnaces A & B each at 120V from a 3-phase 6600V system. If the furnace connected to teaser transformer takes 300 kW at U.P.F. & other connected to main transformer takes 495 kW at 0.8 p.f. lagging. Determine the line current taken from 3-ϕ mains. Neglect losses. **7**

OR

4. a) Draw circuit and explain Back to back test for determining regulation & efficiency of pair of similar transformers. **6**

b) Two transformers A & B are connected in parallel to a load of $(2 + j1.5)\ \Omega$. There impedance with reference to secondary are $Z_A = (0.15 + j0.5)\ \Omega$ & $Z_B = (0.1 + j0.6)\ \Omega$. There no load terminal voltages are $E_A = 207 \angle 0°V$ & $E_B = 205 \angle 0°V$. Find the power output & power factor of each transformer. **7**

5. a) Explain commutation in D.C. Machines. **5**

b) Draw and explain following characteristics : **4**
i) Magnetization curve (OCC) for dc generator (shunt) at 2 different speed.
ii) External characteristic (V_t vs I_a) for dc separately excited, dc shunt, dc compound generator.

c) Write a short note on "Methods of Cooling of transformer". **5**

OR

6. a) What are the speed control methods for d.c. shunt motor. Give details about any one method of speed control. **7**

b) A 25 kW, 250 volts. D.C. machine has armature and field resistance of 0.06 Ω and 100 Ω respectively. Determine the total armature power developed when the machine works : **7**
i) As a generator delivering 25 kW output.
ii) As a motor taking 25 kW I/P from the supply.

7. a) Explain the effect of variation of rotor resistance and reactance on torque speed characteristic of 3-phase I.M. **4**

b) A 4-pole, 50 Hz, 3-Ph, 400V, Δ-connected wound rotor induction motor has rotor resistance of 0.3 Ω/ph, runs at 1425 rpm of full load. Calculate the additional resistance to be inserted in rotor circuit to reduce the speed to 1250 rpm at constant load torque. **5**

c) For a 3-Ph, Induction motor, show that per phase input power to rotor can be divided in the ratio of : **4**
$1 : S : (1-S) = P_g$: rotor ohmic loss : P_m.

OR

8. a) Explain the No-load & blocked rotor test on 3-ϕ IM to find the Parameters of equivalent circuit with necessary equations. **6**

b) An 18.65 kW, 4 pole, 50 Hz, 3 ph I.M. has friction & windage losses of 2.5 percent of the output. The full load slip is 4% compute for full load. **7**
i) the rotor Cu loss
ii) the rotor output
iii) the shaft torque
iv) the gross electromagnetic torque.

9. a) Why starters are necessary for starting the 3-Ph, I.M.? Explain Auto-transformer starter with neat diagram. **5**

b) Explain the working of double cage induction motor with the help of torque slip characteristics. **5**

c) The short circuit current of a squirrel cage I.M. on normal voltage is 3.5 times the full load current & full load slip is 4%. Determine the percentage tapping required on an auto-transformer started to start the motor against $1/3^{rd}$ full load torque. Nelglect magnetising current. **4**

OR

10. Write a short note on :

a) Speed control of 3-phase Induction motor. **5**

b) Crawling and Cogging in 3ph . I.M. **4**

c) Braking methods of 3-ph. I.M. **5**

11. a) Why 1-phase IM is not self-starting ? How double field revolving theory helpful in starting of 1-ϕ I.M. **7**

b) Explain working of capacitor start induction Run IM with torque speed characteristics. **6**

OR

12. a) Explain working of shaded pole induction motor. Draw its torque speed characteristics. **7**

b) Explain split phase I.M. What are its advantages and disadvantages ? **6**

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