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Printed Pages : 4 **TEE – 405**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 2049 Roll No.

B. Tech.

(SEM. IV) EXAMINATION, 2006-07

ELECTRICAL MACHINES

Time : 3 Hours] *[Total Marks : **100***

Note : *Attempt all questions. All questions carry **equal** marks. In case of numerical problems assume data wherever not provided.*

1 Attempt any **four** parts of the followings : **5×4=20**

(a) Explain Sumpner's test with suitable diagram for finding efficiency of a transformer.

(b) Derive an expression for the saving of copper in auto-transformer as compared with an equivalent two winding transformer.

(c) Draw the Scott connection of transformers and mark the terminals and turn-ratio.

(d) A transformer has its maximum efficiency of 0.98 at 20 kVA at unity power factor. During the day it is loaded as follows :
12 hours; 2 kW at power factor 0.6
6 hours; 10 kW at power factor 0.8
6 hours; 20 kW at power factor 0.9
Find the 'all-day' efficiency of the transformer.

(e) Two transformers each rated 250 kVA, 11/2 kV and 50 Hz are connected in open-delta on both the primary and secondary. Find the load kVA that can be supplied from this transformer connection.

(f) The HV terminals of a 3-phase bank of three single phase transformers are connected to a 3-wire, 3-phase, 11 kV (LL) system. The LV terminals are connected to a 3-wire, 3-phase load rated of 1000 kVA and 2200 V line-to-line (LL). Specify the voltage, current and kVA ratings of each transformer (both HV and LV windings) for the following connections
(i) $Y - Y$ (ii) $\Delta - \Delta$ (iii) $Y - \Delta$ (iv) $\Delta - Y$.

2 Attempt any **two** parts of the following : **10×2=20**

(a) (i) Explain the "armature reaction" in a dc machine, indicating remedies to overcome its adverse effects.

(ii) Hopkinson's test on two dc machines gave the following results for the full load; line voltage 250V, line current excluding field current 50A; motor armature current 380A; field currents 5 and 4.2A. Calculate the efficiency of each machine. The armature resistance of each machine is 0.01 ohm. State the assumptions made.

(b) (i) Why is starter necessary for starting a dc motor? Explain briefly working principle of a 3-point starter with the help of neat diagram.

(ii) A 200V shunt motor with a constant main field drives a load, the torque of which varies as the square of the speed. When running at 600 rpm, it takes 30A. Find the speed at which it will run and the current it will draw, if a 10 ohm resistor is connected in series with armature. Neglect motor losses.

(c) (i) Explain the speed control of dc series motor by (i) Field divertors (ii) Variable resistance in series with motor

(ii) List the different losses in a dc machine. Which of these losses are constant? Derive a condition for maximum efficiency?

3 Attempt any **two** parts of the following : **10×2=20**

(a) (i) Is it possible to vary the speed of synchronous motor by varying the field excitation or by any other method? Explain what happens when the field current is increased or decreased.

(ii) Explain how a synchronous motor can be operated as a synchronous condenser. Give the application of synchronous motor.

(b) A 400 V, 50 Hz, 3-phase, 37.3 kW star-connected synchronous motor has a fall-load efficiency of 80%. The synchronous impedance of the motor is (0.2 + j 1.6) ohm per phase. If the motor is adjusted to give a leading power factor of 0.9, calculate the induced emf for full load.

(c) A 1 MVA, 11 KV, 3-phase star-connected synchronous machine has the following open circuit characteristic test data :

If (A)	50	110	140	180
V_{oc} (line) (V)	7000	12500	13750	15000

The short circuit test yielded full load current at a field current of 40A. The zero power factor (ZPF) test yielded full load current at rated terminal voltage for a field current of 150A. The armature resistance is negligible.

Calculate the field current needed for the machine to draw full load 0.8 power factor leading current when operated as the motor connected to a 11 kV supply.

4 Attempt any **two** parts of the following : **10×2=20**

(a) A 400 V, 3-phase, 6-pole, 50Hz induction motor gave the following test results :
No load 400 V, 8A, 0.2 power factor
Blocked-rotar 200V, 40A, 0.4 power factor
Determine the mechanical output, torque and slip when the motor draws a current of 30A from the mains. Assume the starter and rotar copper losses to be equal.

(b) Explain various starting methods for 3-phase induction motor with suitable diagrams.

(c) The rotar of a 6 pole 50Hz slip ring induction motor has a resistance of 0.2 ohm per phase and runs at 960 rpm on the full load. Calculate the approximate resistance per phase of a rotar rheastat such that speed is reduced to 750 rpm for the full load torque.

5 Attempt any **two** parts of the following : **10×2=20**

(a) Explain the following :
(i) What is meant by split phase method of motor starting?
(ii) Why regenerative braking cannot be applied to a squirrel cage induction motor?

(b) Explain the construction, working and applications of a stepper motor with neat diagram.

(c) Discuss double revolving field theory of a single phase induction motor. Explain the starting methods of single phase induction motor.
