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B. TECH.
(SEM. IV) THEORY EXAMINATION 2018-19
ELECTRICAL MACHINES - I

Time: 3 Hours ***Total Marks: 70***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. Write the energy balance equation for the generator and motor.
b. Why is the wave winding useful for high voltage low current DC machines?
c. Write voltage equation of dc motor.
d. How the direction of rotation of the DC shunt motor can be changed.
e. Draw phasor diagram of transformer at no load condition.
f. How are the transformer losses affected by the power factor of the connected load?
g. An auto transformer has primary voltage V_1 and secondary voltage V_2, where $V_1 > V_2$. Calculate the fraction of power transferred inductively.

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. Derive an expression for Reluctance torque in rotating electrical machines.
b. Explain Commutator action in dc machines. Also describe two ways of achieving good commutation and compare them.
c. Describe a 3-point starter using a neat diagram. Compare and distinguish it with a four point starter.
d. Show that the VA rating of the auto transformer is more than the corresponding two winding transformer. Derive an expression for copper saving in case of auto-transformer.
e. Two transformers having equal voltage ratio are operated in parallel. Obtain expressions for the maximum possible KVA loading of the two transformers in parallel. State assumptions made if any. Also write the condition required for parallel operation of two transformers.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a) Define energy and co-energy. What is the significance of co-energy? Show that the field energy in a linear magnetic system is given by $W_f = \frac{1}{2}L_i^2 = \frac{1}{2}\psi_i = \frac{1}{2L}\psi^2$

(b) Derive an expression for the torque in a doubly excited system having salient pole type of stator as well as rotor.

4. Attempt any *one* part of the following: 7 x 1 = 7

(a) Discuss the internal and external characteristics of the DC shunt generator. Also explain why the load characteristics of DC shunt generator have drooping more than that of separately excited generator.

(b) Calculate the number of conductor on each pole piece required in a compensating winding for a 4-pole, lap wound DC armature containing 136 conductors. The pole arc to pole pitch ratio is 0.9. The compensating winding carries full armature current.

5. Attempt any *one* part of the following: 7 x 1 = 7

(a) A 240 V, 25 KW shunt motor has a maximum efficiency of 90 % and a speed of 800 rpm, when delivering 80 % of its rated output. The resistance of its shunt field is 200 Ω. Determine the efficiency and speed when the motor draws a current of 68 A from mains.

(b) Describe Swinburne's test in detail with its advantages and disadvantages.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a) Define voltage regulation in transformer. A 20 kVA, 2500/500V, single phase transformer has the following parameters:

HV side: $r_1 = 8\Omega,\ x_1 = 17\Omega$

LV side: $r_1 = 0.3\Omega,\ x_1 = 0.7\Omega$

Find the voltage regulation at full load for a power factor of 0.8 lagging.

(b) Explain the procedure of O.C. and S.C. tests for a transformer. How different parameters of the transformer can be determined from these tests?

7. Attempt any *one* part of the following: 7 x 1 = 7

(a) With a neat diagram, explain how a balanced three-phase supply can be converted to balance two-phase supply using transformer.

(b) A 500 KVA, 11/0.43 KV, 3 phase delta/star connected transformer has on rated load. The HV copper loss of 2.5 KW and the LV loss of 2 KW and the total leakage reactance of 0.08 per unit. Find the ohmic values of the equivalent resistance and leakage reactance on the delta side.