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BTECH
(SEM-IV) THEORY EXAMINATION 2017-18
ELECTRICAL MACHINES-I

Time: 3 Hours *Total Marks: 70*

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.
2. Any special paper specific instruction.

SECTION A

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

a) Explain with the help of an example why in an electrical machine the number of stator poles should be equal to the number of rotor poles.

b) Explain Faraday's laws of electromagnetic induction and Lenz's law.

c) Explain why equalizer connections are used in lap-winding and dummy coils are sometimes used in wave-windings.

d) Explain why a DC motor should not be started direct-on-line.

e) Describe how a DC machine is to be maintained for a long satisfactory performance.

f) Explain the function of a commutator in a DC machine for motoring and generating action.

g) State why the core of a transformer should be made of magnetic material.

SECTION B

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

a) The magnetic flux density on the surface of an iron face is 1.6 T which is a typical saturation level value for ferromagnetic material. Find the force density on the iron face.

b) Derive the EMF equation and torque equation for DC machines.

c) A 250 kW, 400 V, 6-pole DC generator has 720 lap wound conductors. It is given a brush lead of 2.5 angular degrees (mech.) from the geometric neutral. Calculate the cross and demagnetizing turns per pole. Neglect the shunt field current.

d) A transformer on no-load has a core loss of 50 W, draws a current of 2 A (rms) and has an induced emf of 230 V (rms). Determine the no-load power factor, core-loss current and magnetizing current. Also calculate the no-load circuit parameters of the transformer. Neglect winding resistance and leakage flux.

e) A 20 kVA, 50 Hz, 2000/200 V distribution transformer has a leakage impedance of 0.42+j0.52 Ω in the HV winding and 0.004+j0.05 Ω in the LV winding. When seen from the LV side, the shunt branch admittance Y_0 is (0.002-j0.015) ℧ (at rated voltage and frequency). Draw the equivalent circuit referred to (i) HV side (ii) LV side, indicating all impedances on the circuit.

SECTION C

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

a) Find an expression for the force per unit area between the plates of a parallel plate condenser in terms of the electric field intensity. Use both the energy and coenergy

methods. Find the value of the force per unit area when E = 3 x 10^6 V/m, the breakdown strength of air.

b) Derive an expression for dynamical equations of electromechanical systems.

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

a) The following test results were obtained while Hopkinson's test was performed on two similar DC shunt machines: supply voltage=250V, field current of motor=2A, field current of generator=2.5A, armature current of generator=60A, current taken by the two armatures from supply=15A, resistance of each armature circuit=0.2Ω, Calculate the efficiency of the motor and generator under these conditions of load.

b) Explain the efficiency and testing of DC machines in detail.

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

a) Explain the plugging, dynamic braking and regenerative braking of DC machines in detail.

b) A 400 V series motor has a total armature resistance of 0.25 Ω. When running at 1200 rpm it draws a current of 25 A. When a regulating resistance of 2.75 Ω is included in the armature circuit, it draws a current of 15 A. Find the speed and ratio of the two mechanical outputs. Assume that the flux with 15 A is 70% of that with 25A.

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

a) Explain the potential transformer, current transformer, audio-frequency transformer and grounding transformer.

b) Two 1-phase furnaces A and B are supplied at 100V by means of a scott-connected transformer combination from a 3-phase 6600 V system. The voltage of furnace A is leading. Calculate the line currents on the 3-phase side, when the furnace A takes 400 kW at 0.707 pf lagging and B takes 800 kW at unity pf.

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

a) Explain the parallel operation of transformers in detail.

b) A 500 kVA transformer has an efficiency of 95% at full load and also at 60% of full load; both at upf (i) separate out the losses of the transformer (ii) determine the efficiency of the transformer at ¾ th full load.