Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech. End Semester - Nov. 2019

Branch	: Electrical & Electronics Engg.	Semester	: V
Title of the Course	: Electrical Machines-II	Course Code	: EEB 301

Time: 3 Hours | Maximum Marks: 50

SECTION-A (10 Marks)

Note: All parts of this question are compulsory and carry equal marks. Answer should be precise and to the point. All questions must be attempted together at one place.

Q1.

i. Explain the effect of armature reaction in synchronous machines.

ii. What are V curves and inverted V curves? Also explain their significance in synchronous machine operation.

iii. Explain the various modes of operation of three phase induction motor using neatly drawn torque-slip characteristics.

iv. Compare the DOL starter, star-delta starter and auto-transformer starter in terms of starting current and starting torque.

v. Explain the process of separating out core losses from friction and windage losses in induction machines and synchronous machines.

SECTION-B (20 Marks)

Note: Attempt any four questions, each question carries 5 marks.

Q2. Draw and explain the open-circuit and short-circuit characteristics of synchronous generator. Also derive the expressions for unsaturated and saturated synchronous reactance.

Q3. Derive the power flow transfer equations for a synchronous generator operation. Also derive the condition for power factor with armature resistance taken into account.

Q4. A 600 V, 6-pole, 3-phase, 50 Hz, star connected synchronous motor has a resistance and synchronous reactance of 0.4 ohm and 7 ohms, respectively. It takes a current of 15 amps at unity power factor when operating with certain field current. With the field current remaining constant, the load is increased until the motor draws a current of 50 amps. Find the gross torque and the new power factor.

Q5. A squirrel cage induction motor has a slip of 4% at full load. Its starting current is five times the full load current. The stator impedance and magnetizing current may be neglected and rotor resistance is assumed constant: (a) calculate the maximum torque and the slip at which it occurs, (b) starting torque. Express torque in per unit of full load torque.

Q6. A 25 kVA, 400 V, 3-phase synchronous generator delivers rated kVA at rated voltage at 0.8 pf lagging. The per phase (star basis) armature resistance and synchronous reactance respectively are 0.66 ohms and 7.1 ohms. The field winding is supplied 10.6 A at 110 V. The friction and winding loss is estimated to be 480 W and iron loss as 580 W. Calculate:
(a) The full-load efficiency and
(b) the terminal voltage when the load is thrown off.

SECTION-C (20 Marks)

Note: Attempt any two questions, each question carries 10 marks.

Q7. A 3-phase, 6-pole, 2.3 kV, 200 kVA, star connected synchronous motor has synchronous reactance of 12 ohms per phase and negligible resistance. Motor is initially operating at a load of 120 kW with the field current adjusted such that the armature current is minimum. The field current is now increased such that the armature current increased by 50%. With this field current, the load is reduced to 60 kW. Calculate the new values of armature current and power factor. Draw necessary phasor diagrams to solve.

Q8. Explain the operation of synchronous generator and motor at constant load and variable excitation with neatly drawn phasor diagrams. What conclusions are drawn out and what is the significance of these conclusions in the study of synchronous machines?

Q9. Write Short Note on any two (5 Marks each)
(i) Parallel operation of synchronous generators.
(ii) Synchronization of synchronous generators with grid.
(iii) Speed control of three-phase induction motor by V/f control.

*************Best of Luck for Exam*************