Roll No.:.....

National Institute of Technology, Delhi

Name of the Examination: B. Tech.

Branch	: Electrical & Electronics Engg.	Semester	: V
Title of the Course	: Electrical Machines-II	Course Code	: EEB301

Time: 3 Hours | Maximum Marks: 50

SECTION-A (10 Marks)

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

Q1.

i. Define and explain voltage regulation of an alternator.

ii. Describe the advantages and limitations of rotating field system over stationary field system?

iii. Draw comparison between salient pole rotor and cylindrical pole rotor?

iv. State the condition to be satisfied before connecting two alternators in parallel?

v. A three phase synchronous motor when connected to 3-phase supply fails to start. Explain the possible reasons for the same.

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

vii. Discuss the various possibilities by which the starting torque of slip ring induction motor can be increased?

viii. Explain deep bar and double cage rotor used for induction motors with suitable characteristics.

ix. Explain cogging and crawling in a three-phase induction motor?

x. In a synchronous motor running with fixed excitation, when the load is increased three times, its torque angle becomes approximately:
(a) one-third (b) twice (c) thrice (d) six times (e) nine times

SECTION-B (20 Marks)

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

Q2. A 1000 kVA, 6.6 kV, 3-phase star-connected synchronous generator has a synchronous reactance of 25 Ω per phase. It supplies full-load current at 0.8 lagging pf and a rated terminal voltage. Compute the terminal voltage for the same excitation when the generator supplies full-load current at 0.8 p. f. leading.

Q3. 600 V, 6-pole, 3-phase, 50 Hz, star-connected synchronous motor has a resistance and synchronous reactance of 0.4 Ω and 7 Ω respectively. It takes a current of 15 A at unity power factor when operating with a certain field current. With the field current remaining

constant, the load torque is increased until the motor draws a current of 50 A. Find the torque (gross) developed and the new power factor.

Q4. A 20 kW, 400 V, 3-phase, 50 Hz, Y-connected, 4-pole squirrel-cage induction motor has the following parameters in ohms referred to stator: $r_1=0.2$, $X_1=X_2=0.45$, $X_m=18$
When this motor is energized at rated voltage and frequency, it develops full-load internal torque at a slip of 0.04. Rotational and core losses are neglected. Calculate: (a) maximum internal torque and internal starting toque at rated voltage and frequency and (b) slip at maximum torque.

Q5. Explain with neat circuit diagram how No-Load and Blocked-Rotor test is done on three-phase induction motors. Also derive the generalized expressions to find the parameters of the equivalent circuit of the motor.

Q6. Explain the operation of synchronous 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?

SECTION-C (20 Marks)

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

Q7. Derive the power flow transfer equations for a synchronous machine for (a) Generator operation and (b) Motor operation. Also derive the condition for power factor with armature resistance taken into account.

Q8. (a) A 3-phase, 400 V, 100 kVA, star-connected synchronous machine is used as motor. The stray loss of the machine, assumed to be constant, is 4000 W. The synchronous impedance per phase of the machine is 0.13+j1.3 ohms. Calculate the power factor and efficiency when the excitation is so adjusted as to take the line current equal to its rated value keeping the power delivered constant at 75 kW. Determine the excitation e.m.f. both at under and over excitation and the respective load angles. Give the phasor diagrams. What will be the input current at normal excitation?
(b) For the motor in part (a), calculate the load angle for obtaining the maximum power output and the value of the possible maximum output when under excited.

Q9. 75 kW, 440 V, 3-phase, 6-pole, 50 Hz, wound-rotor induction motor has a full-load slip of 0.04 and a slip at maximum torque of 0.2 when operating at rated voltage and frequency with rotor winding short-circuited at the slip-rings. Assume the stator resistance and rotational losses to be negligible. Find: (a) Maximum torque, (b) Starting torque, and (c) Full-load rotor copper loss. The rotor resistance is now doubled by adding an external series resistance determine: (d) Slip at full-load, (e) Full-load torque, and (f) Slip at maximum torque.

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