

INDIAN MARITIME UNIVERSITY
(A Central University, Government of India)

May/ June 2017 End Semester Examinations
B.Tech. (Marine Engineering) Second Semester
(AY 2009-2014 batches)

Electrical Machines - II (UG11T1404/ UG11T2404)

Date : 17.06.2017

Maximum Marks: 100

Time: 3 Hrs

Pass Marks : 50

Part – A (10 x 3=30 marks)
(All questions are compulsory)

1. (a) What is the difference between a squirrel-cage-type rotor and phase-wound rotor?
- (b) Why is it not possible to run an induction motor on synchronous speed?
- (c) What do you mean by breakdown torque of an induction motor?
- (d) What is the effect of variation of supply frequency in an induction motor?
- (e) What do you mean by the Crawling of induction motor?
- (f) What is synchronous reactance for synchronous machine?
- (g) Mention in brief starting methods of synchronous motor?
- (h) Why damper windings are used in a synchronous machine?
- (i) What is V-curve for 3-phase Alternator?
- (j) How can you protect the motor against single phasing?

Part – B (5 x 14=70 Marks)

(Answer any 5 of the following)

2. (a) Show that in an induction motor, "Rotor input : power developed : rotor copper losses :: 1 : (1-S) : S", where S is the fractional slip. (7 marks)
- (b) A 40 kW, 6-pole, 3-phase star-connected induction motor delivers full-load output at 950 rpm and with 0.85 pf when connected to a supply of 500 V (line value), 50-Hz. Friction and windage losses equal 1.5 kW and stator losses are 1.8 kW. Determine for this load (i) rotor copper loss (ii) efficiency and (iii) line current. (7 marks)

3. (a) If stator impedance of an induction motor is neglected, then show that

$$\frac{T_e}{T_{\max}} = \frac{2}{\frac{s_{m1}}{s} + \frac{s}{s_{m1}}}$$

Where, T_{\max} is maximum torque and s_{m1} is the slip at maximum torque.

(7 marks)

(b) A 3-phase star-connected 6.6-kV, 20-pole, 50-Hz induction motor has rotor resistance of 0.12 ohm and stand still reactance of 1.12 ohm. The motor has speed of 291 rpm at full load. Calculate slip at maximum torque and ratio of maximum torque to full load torque. Assume that stator resistance is neglected. (7 marks)

4. (a) Show that an induction motor with star-delta starter behaves as if it is started by an auto-transformer starter with 58% tapping. (7 marks)

(b) Design the 6-sections of a 7-stud rotor starter for a 3-phase wound induction motor. The slip at full load current is 2% and the maximum starting currents is 1.5 times full-load current. The resistance of rotor is 0.02 ohm per phase. (7 marks)

5.(a) Describe the production of Rotating Magnetic Field for 50-Hz two-pole 3-phase Y-connected synchronous generator using 3-phase currents diagram into a cross-section of the machine. (7 marks)

(b) A 3-phase, 4-pole winding of the double-layer type is to be installed on a 48-slot stator. The pitch of the stator windings is $5/6$, and there are 10 turns per coil in the windings. All coils in each phase are connected in series, and the three phases are connected in Δ -delta. The flux per pole in the machine is 0.054 Wb, and the speed of rotation of the magnetic field is 1800 r/min.

(i) What is the pitch factor of this winding? (ii) What is the distribution factor of this winding? (iii) What are the frequency and terminal voltages produced in this winding? (7 marks)

6. (a) Derive the formula for distribution factor or winding factor or breadth factor or spread factor in windings used in a synchronous machine? (7 marks)

(b) A 480V, 200-kVA 0.8 pf lagging 50-Hz two-pole, Y-connected synchronous generator has a synchronous reactance of 0.25Ω and an armature resistance of 0.03Ω . At 50 Hz, its friction and windage losses

are 6 kW, and its core losses are 4 kW. The field circuit has a DC voltage of 200V, and the maximum field current is 10-A. Assume that the field current of the generator is adjusted to achieve rated voltage (480 V) at full load conditions in each of the questions below:

- (i) What is the efficiency of the generator at rated load?
- (ii) What is the voltage regulation of the generator if it is loaded to rated kilo-voltamperes (kVA) with 0.8-pf lagging loads? Draw the Phasor. (7 marks)

7.(a) Explain armature reaction of an alternator and its effect on main flux at zero power-factor-leading load. (7 marks)

- (b) A 208V Star-connected synchronous motor is drawing 50-A at unity power factor from a 208-V power system. The field current flowing under these conditions is 2.7-A. Its synchronous reactance is 0.8Ω . Assume a linear open-circuit characteristic. (i) Find the torque angle. (ii) How much field current would be required to make the motor operate at 0.78 PF (power factor) leading? Also draw the phasors. (7 marks)

8.(a) Classify the single-phase induction motors. Write down the working principle of a single phase motor. (3+4 = 7 marks)

- (b) Explain the double revolving field theory. (7 marks)
