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

**May/June 2016 End Semester Examinations**
**B.Tech. (Marine Engineering)**

**Fourth Semester – Electrical Machines - II - (UG11 T2404/T1404)**

**Date : 15.06.2016** **Max. Marks: 100**
**Time: 3 Hrs** **Pass Marks: 50**

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**PART-A** **(3 x 10 = 30 Marks)**
**Compulsory Question**

1) a) Enlist the advantages of using rotating field system.
b) Define pitch factor of an alternator.
c) What is damper winding? How does it help to minimize damping?
d) Why is the no-load current drawn by 3-phase induction motor so high?
e) What are the ill effects of high starting current?
f) Under what conditions is the direct-on-line starting of poly-phase case induction motors preferred?
g) Explain "synchronous" for synchronous machine.
h) Define the voltage regulation of an alternator. Is it possible to have the full-load terminal voltage greater than the no-load terminal voltage? Explain.
i) In an alternator, explain why short-circuit characteristic is a straight line whereas open-circuit characteristic is a curve.
j) Explain hunting of alternators

**Part-B** **(14 x 5 =70 Marks)**
**Answer any Five Questions**

2) (a) Derive an expression for the torque of an induction motor by use of Thevenin's theorem and also obtain the condition for maximum torque. (8)

(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 291rpm at full load. Calculate slip at maximum torque and ratio of maximum torque to full load torque. (6)

3) (a) Why the induction motor is called the generalized transformer, explain? (4)

(b) A 10 kW, 400 V, 3-phase, 50 Hz, 4 pole delta connected induction motor is running at no-load with a line current of 8A and an input power of 660 watts. At full load, the line current is 18A and the input pow · is 1.2 ohm and friction, windage loss is 420 watts. For negligible rotor ohmic losses at no-load, calculate, (i) stator core loss (ii) total rotor losses at full load (iii) total rotor ohmic losses at full load (iv) full load speed (v) internal torque, shaft torque and motor efficiency. (10)

4) (a) Write down the advantages of squirrel cage motor over a phase wound induction motor. Define "slip" of a 3-phase induction motor. Derive the relationship between the rotor copper losses and rotor input in a 3-phase induction motor. (2+2+3)

(b) An induction motor has an efficiency of 85% when the load is 60HP. At this load, the stator copper loss and rotor copper loss are equal to the core-loss. The mechanical losses are one-fourth of the no-load loss. Calculate the slip. (7)

4) (a) Give the constructional details of a cylindrical-pole synchronous machine. (6)

(b) A 2300-V, 1000-kVA, 0.8 PF-lagging, 50-Hz two-pole, Y(star)-connected synchronous generator has a synchronous reactance of 1.1 Ω and an armature resistance of 0.15 Ω. At 50 Hz, its friction and windage losses are 24 kW and its core losses are 18 kW. (8)

Find:
(i) the internal generated voltage of this machine at rated conditions?
(ii) the terminal voltage of this generator at open circuit?
(iii) the efficiency of the generator at these conditions?
(iv) Draw phasor diagram of voltage and current.

6) (a) A 3-phase, 16-pole alternator has the following data: number of slots = 192; conductors per slot = 8 (conductors of each phase are connected in series); coil span = 160 electrical degrees; speed of the alternator = 375 rpm; flux per pole = 55mWb. Calculate the phase and line voltages. (7)

(b) Design the sections of a rotor starter for a 75kW, 3-phase induction motor, using 7 notches. Rotor resistance per phase is 0.018 ohm. The upper current limit is to be full-load current for which slip is 2%. (7)

7) a) Discuss about the conditions necessary for paralleling of two three phase alternators. (6)

b) A 208V, 45KVA, delta-connected, 50Hz, 3-phase synchronous motor has a synchronous reactance of 2.5-ohms and negligible armature resistance per phase. Its friction and windage losses are 1.5KW and core losses of 1.0KW. Initially the shaft is supplying a 15HP mechanical load taking 0.8 leading power factor current. Compute with the help of phasor diagrams:

i) Phase current and induced emf at 15HP load.
ii) Phase current and power factor when shaft load is increased to 30HP. (4 + 4 = 8)

8) a) Derive from fundamental relation the equation for induced emf in an alternator. (6)

b) A three-phase Y-connected 50Hz,2-pole,synchronous generator has stator with total 18 slots.
Its coils form a double layer chorded winding and each coil has 60 turns. The pitch of the stator coils is 8/9.

Calculate the following:
i) Pitch factor and Distribution factor for fundamental and Rotor magnetic flux to produce a terminal voltage (line to line) of 6KV,
ii) Pitch factor for 5-th and 7-th harmonics emfs. How effective are coils for reducing these harmonics. (5+3=8)

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