

INDIAN MARITIME UNIVERSITY
(A Central University, Govt. of India)

B.Tech. (Marine Engineering) - Semester III
December 2015 End Semester Examinations

Electrical Machines - I
Subject Code: UG11T2306/UG11T1306

Time: 3 hrs
Date: 28.12.2015

Max Marks: 100
Pass Marks: 50

Part - A

(3×10 = 30 Marks)

Compulsory Questions

- 1) (a) What is the function of a commutator?
(b) What do you mean by back emf of a DC motor?
(c) What are the important characteristics of a DC generator?
(d) A eight pole lap-wound DC motor having 760 conductors and a useful flux of 35 mWb/pole is driven at 500 rpm. Calculate the back emf of motor.
(e) What are advantages of three-phase transformer?
(f) In transformer open-circuit test, why are the ohmic losses negligible?
(g) Explain why transformer rating is expressed in kVA or VA.
(h) Why is low voltage windings placed near the core of a transformer?
(i) Define voltage regulation of a transformer.
(j) What are the functions of a starter for DC motor?

Part - B

(5×14 = 70 Marks)

Answer Any Five of the following

- 2) (a) Draw a neat sketch of a DC Machine. State the functions of major parts. (3+ 5 = 8)
(b) Derive the emf equation of a DC machine by using Blv concept. (6)
- 3) (a) A 6-pole wave connected DC shunt generator has 350 conductors and flux 0.02 Wb/pole is driven at 1000 rpm. The resistances of armature, shunt field and load are 0.8 Ω , 120 Ω and 12 Ω respectively. Calculate the power absorbed by the load. (7)
(b) A separately excited DC generator having constant excitation supplies power to a constant resistance load. It delivers 150 A at 400 V at a speed of 1000 rpm . If current is reduced to 100 A, determine the speed. Total contact drop of brush is 2 V. Neglect the armature reaction. Armature resistance of the generator is 0.12 Ω . (7)

- 4) (a) Explain the working principle of a three-point starter for a DC shunt motor. (7)
- (b) A 240 V DC shunt motor takes a current of 4 A from 240 V supply mains while running at no-load. The resistances of armature and shunt field are 0.2Ω and 240Ω respectively. Determine (i) the efficiency of the motor when it draws 20 A from the supply mains and (ii) the armature current during maximum efficiency. (7)
- 5) (a) Describe briefly different types of DC distributors. (7)
- (b) A 4-pole, 220 V, lap-connected DC series motor has 200 slots with six conductors per slot. The armature current is 40 A and flux/pole is 16 mWb. The armature and field resistances are 0.46Ω and 0.26Ω respectively. The iron and friction losses are 700 W. Calculate the useful torque. (7)
- 6) (a) Give the concept of single-phase ideal transformer. Draw the phasor diagram of a single-phase transformer under lagging power-factor load. (4+6=10)
- (b) In a transformer if the load current is kept constant, find the power factor at which the maximum efficiency occurs. (4)
- 7) (a) Derive an expression for the per unit voltage regulation of a transformer for lagging power factors. (7)
- (b) Consider a 20kVA, 2200/220V, 50 Hz transformer. The open-circuit and short-circuit test results are as follows:
- Open-circuit (on low voltage side) - 220V, 4.2A, 148 watts.
- Short-circuit (on high voltage side) - 86V, 10.5A, 360 watts.
- Calculate: (i) The voltage regulation at 0.8 p.f. lagging at full load. (ii) What is the p.f. on short-circuit test? (7)
- 8) (a) State the essential conditions which should be satisfied before two single-phase transformers operating parallel. (4)
- (b) A 15 kVA, 2000/200V transformer has an iron loss of 250W and full-load copper loss 350W. During the day it is loaded as follows:
- | No. of hours | Load | Power factor |
|--------------|--------------------|--------------|
| 9 | $\frac{1}{4}$ load | 0.6 |
| 7 | full-load | 0.8 |
| 6 | $\frac{3}{4}$ load | 1.0 |
| 2 | no-load | --- |
- Calculate the all-day efficiency. (10)
- 9) (a) Define an Auto-transformer. Discuss the relative merits and demerits of an Auto-transformer. Write down the applications of Auto-transformer. (2 + 4 + 2 = 8)
- (b) Proof that copper saving in Auto-transformer is dependent on the turns ratio. (6)
