INDIAN MARITIME UNIVERSITY

(A Central University, Government of India)

End Semester Examinations- June-July 2019

Semester – III

B.Tech (Marine Engineering)

Electrical Mechanics – I (UG11T1306 / UG11T2306)

Date: 20-07-2019 Maximum Marks: 100

Time: 3 Hrs Pass Marks: 50

Part A (10 × 3 = 30 Marks)
All Questions are compulsory

1. (a) What is the advantage of using fractional – pitch windings in dc machines?
   (b) Name the three basic principles for the electromechanical energy conversion.
   (c) Explain why the emf generated in the armature of a DC motor is called "back emf".
   (d) What features of dc series generators distinguish it from other dc generators? Explain.
   (e) What are the purpose of interpoles and compensating windings in dc machines?
   (f) Define arc quenching in circuit breakers.
   (g) What are the functions of transformers?
   (h) What are the two components of exciting current in a transformer? What is the function of each of these components?
   (i) How can core – loss be measured in a transformer?
   (j) How is the voltage regulation of transformer affected by a change in its operating frequency?

Part B (5 × 14 = 70 Marks)
Answer any five of the following

2. (a) Describe briefly the energy conversion process in a dc generator under load. (7)
   (b) Determine the number of turns on each commutating pole of a 6 – pole machine, if the flux density in the air – gap of the commutating pole = 0.5 wb/m^2 at the full – load and the effective length of the air – gap is 4 mm. the full – load current is 500 A and the armature is lap wound with 540 conductors. Assume the ampere turns required for the remainder of the magnetic circuit to be one tenth of that air gap. (7)

3. (a) What is a compound generator? How does its terminal voltage vary with loads? (7)
   (b) A dc shunt – generator driven by a belt from an engine runs at 750 rpm while feeding 100 kw of electric power into 230 V mains. When the belt

breaks it continuous to runs as a motor drawing 9 kw from the mains. At what speed it would run? Given r_a = 0.08 Ω and r_f = 115 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 0.2 Ω and 240 Ω 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) Discuss the operating principle of air circuit breaker with neat sketch. (7)

   (b) What are the different types dc distributors? Explain in detail. (7)

6. (a) Derive the emf equation of an ideal single – phase transformer. (7)

   (b) A transformer has a primary winding of 800 turns and secondary winding of 200 turns. When the load current of the secondary is 80 A at 0.8 power factor lagging, the primary current is 25 A at 0.707 power factor lagging. Determine the no –load current of the transformer and its phase with respect to the primary voltage. (7)

7. (a) Derive the condition for the maximum efficiency of a single – phase transformer. (7)

   (b) A 150 kVA transformer has an iron loss of 1400 watts and full – load copper loss of 1600 watts. Find the efficiency of the transformer at 50% full –load (i) unity power factor and (ii) 0.8 power factor lagging. (7)

8. (a) Explain the working principle of auto – transformer. (7)

   (b) A three – phase transformer consisting of three single – phase transformers used to step down the voltage of a three – phase, 6600 V transmission line. If the primary line current is 10 A, calculate the secondary line voltage, line current and output kVA for the following connections (i) star/delta and (ii) delta/star. The turns ratio is 12 and neglect the losses.