



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: May 2023

Module Number: MN 5305

Module Name: Marine Power and Shipboard Electrical Systems

[Three Hours]

[Answer All Questions, each question carries 20 marks]

Instructions:

1. Start your answers to each question on a fresh page.

- Q1 (a) A shunt generator delivers 450A at 230V and the resistance of the shunt field and armature are 50Ω and 0.03Ω respectively. Calculate the generated E.M.F. [3 Marks]
- (b) Explain the types of DC Motors with principle of operation. [2 Marks]
- (c) A long-shunt compound generator delivers a load current of 50 A at 500 V and has armature, series field and shunt field resistances of 0.05Ω , 0.03Ω and 250Ω respectively. Calculate the generated voltage and the armature current. Allow 1V per brush for contact drop. [5 Marks]
- (d) Explain the back electromotive force with its significance in DC motors. [3 Marks]
- (e) A 220-V DC machine has an armature resistance of 0.5Ω . If the full-load armature current is 20 A, find the induced E.M.F. when the machine acts as a,
(i) generator
(ii) motor. [3 Marks]
- (f) 230 V DC shunt motor takes a current of 40 A and runs at 1100 r.p.m. If armature and shunt field resistances are 0.25Ω and 230Ω respectively, then find the torque developed by the armature. [4 Marks]

- Q2 (a) i. Explain the double revolving theory with mathematical analysis.
 ii. Explain why the single phase motor is not self-started.
 [3 Marks]
- (b) If a 4-pole 50Hz single phase induction motor is running with a slip of 3.4%, calculate the speed of the motor.
 [2 Marks]
- (c) Draw a single-phase motor's equivalent circuit with and without core loss.
 [5 Marks]
- (d) A 4-pole 250W, 115V, 60Hz Capacitor start induction motor takes a full-load line current of 5.3A while running at 1760 r.p.m. If the full load efficiency of the motor is 64% find,
 i. Motor slip
 ii. Power factor (State whether lagging or leading)
 iii. Full-load torque
 [5 Marks]
- (e) Describe 4 different types of single phase motor starting methods.
 [5 Marks]
- Q3 (a) State the main two types of rotors used in induction motors and distinguish the difference between these two.
 [3 Marks]
- (b) Explain the event motor slip with its importance.
 [2 Marks]
- (c) A 6-pole 3-Phase induction motor is connected to a 50Hz supply. Calculate the slip, if it is running at 970 r.p.m.
 [4 Marks]
- (d) A 4-pole, 3-phase induction motor operates from a supply whose frequency is 50 Hz. Calculate,
 i. The speed at which the magnetic field of the stator is rotating
 ii. Speed of the rotor when the slip is 0.04
 iii. The frequency of the rotor current when the slip is 0.03
 iv. The frequency of the rotor with current at stand still
 [5 Marks]
- (e) A 10-Pole 3-Phase alternator is connected to an engine running at 600 r.p.m. It

supplies a 3 phase induction motor which has a full-load speed of 1440 r.p.m. Calculate the number of poles and slip of the motor (State any assumptions clearly).

[6 Marks]

- Q4 (a) Distinguish the difference between the Cylindrical rotor and the Salient pole rotor. [2 Marks]
- (b) Explain the brushless excitation system (proper circuit diagram) of a synchronous motor. [3 Marks]
- (c) Draw per phase equivalent circuit for a synchronous generator. [2 Marks]
- (d) i. What is the voltage equation for a synchronous generator? [2 Marks]
- ii. Explain the following conditions using phase diagrams,
I. Unity power factor
II. Lagging power factor
III. Leading power factor [3 Marks]
- (e) Briefly explain the open circuit characteristic (OCC) and short circuit characteristic (SCC) tests of a synchronous generator. [3 Marks]
- (f) Draw the Torque - Speed characteristic curve of a synchronous motor. [2 Marks]
- (g) State and explain the synchronous motor starting methods. [3 Marks]
- Q5 (a) Explain the function of a Cu cable. [3 Marks]
- (b) Describe the purpose of insulation in power cables stating the different types of insulation material used. [3 Marks]
- (c) Define the Temperature coefficient of the cable with it's importance.

[3 Marks]

(d) Distinguish the common types of cable testing methods.

[5 Marks]

(e) Briefly explain the following types of testing

- i. Continuity testing
- ii. Insulation resistance testing
- iii. High-voltage testing
- iv. Load testing

[6 Marks]