



TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATIONS FOR:

BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONIC ENGINEERING

TEE: 4342 ELECTRICAL MACHINES

END-OF-SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

DATE: April 2025

Instructions to Candidates

It would be best if you had the following for this examination

-Answer Booklet, examination pass, and student ID

This paper consists of FIVE questions. Attempt **QUESTIONS ONE plus any other TWO.**

Do not write on the question paper.

Question ONE 30 -MARKS (COMPULSORY)

- a) Describe the construction of the DC machines (6 marks)
- b) Derive the e.m.f. equation for D.C generators (5 marks)
- c) A D.C. generator running at 30rev/s generates an e.m.f. of 200V. Determine the percentage increase in the flux per pole required to generate 250V at 20rev/s (4 marks)
- d) A separately excited generator develops a no-load e.m.f. of 180V at an armature speed of 15 rev/s and a flux per pole of 0.20Wb. Calculate the generated e.m.f. When:
 - i. The speed increases to 20 rev/s, and the flux per pole remains unchanged
 - ii. The speed remains at 15 rev/s, and the pole flux is decreased to 0.125 Wb
 - iii. The speed increases to 25 rev/s, and the pole flux is reduced to 0.18 Wb (9 marks)
- e) Explain any THREE losses in D.C generators (6 marks)

Question TWO

- a) Derive the torque equation for DC motors (6 marks)
- b) A 500V shunt motor takes a total current of 100A and runs at 1200 rev/min. If the shunt field resistance is 50Ω , the armature resistance is 0.25Ω , and the iron, friction, and windage losses amount to 2 kW, determine the overall efficiency of the motor. (6 marks)
- c) A 500V shunt motor runs at its normal speed of 10 rev/s when the armature current is 120A. The armature resistance is 0.2Ω .
- Determine the speed when the current is 60A and a resistance of 0.5Ω is connected in series with the armature, the shunt field remaining constant.
 - Determine the speed when the current is 60A and the shunt field is reduced to 80 percent of its normal value by increasing resistance in the field circuit.
- (8 marks)

Question THREE

- a) Using diagrams, describe the construction of the following types of rotors of the induction machine.
- Squirrel cage rotor
 - Phase wound rotor (8 marks)
- b) A 4-pole, 3-phase induction motor operates from a supply whose frequency is 50 Hz. Calculate:
- The speed at which the magnetic field of the stator is rotating.
 - The speed of the rotor when the slip is 0.04.
 - The frequency of the rotor currents when the slip is 0.03.
 - The frequency of the rotor currents at a standstill. (12 marks)

Question FOUR

- a) State any THREE losses in a single phase transformer (3 marks)
- a) A 100 kVA, 1800 V/200 V, 50 Hz, single-phase transformer has 30 secondary windings. Calculate
- The primary and secondary current
 - The number of primary turns
 - The maximum value of the flux (9 marks)
- b) A three-phase transformer has 500 primary turns and 50 secondary turns. If the supply voltage is 2.4 kV, find the secondary line voltage on no-load when the windings are connected.

- i. Star–delta,
- ii. Delta–star

(8 marks)

Question FIVE

- a) Describe any FOUR methods of starting single-phase motors (8 marks)
- b) With the aid of diagrams, describe the construction, operation, and any two areas of the applications of the following types of single-phase motors
 - i. Split phase motors
 - ii. Shaded pole motors
 - iii. Capacitor start-capacitor run

(12 marks)