PP1

TECHNICAL UNIVERSITY OF MOMBASA

FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF MECHANICAL & AUTOMOTIVE ENGINEERING

UNIVERSITY EXAMINATION FOR:

BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

EEE 4321: ELECTRICAL ENGINEERING II

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 Questions.**

Do not write on the question paper.

Question ONE 30 -MARKS (COMPULSORY)

a) Concerning measurements, explain the following terms;
   i. Precision
   ii. Sensitivity (4 marks)

b) Explain TWO possible causes of error in a permanent magnet moving coil instrument (4 marks)

c) Describe the construction and working of the following recording instruments
   i. Strip-chart recorders
   ii. X-Y recorders (12 marks)

d) A voltage has a true value of 1.5 V on an analog indicating meter with a range of 0 to 2.5 V, shows a voltage of 1.46 V. Determine the value of absolute error and correction. Express the error as a fraction of the true value & full scale defection (5 marks)

e) A 0-10 A ammeter has an accuracy of 1.5% of full-scale reading. The current indicated by the ammeter is 2.5 A. Calculate the limiting values of current and the percentage limiting error. (5 marks)

Question TWO

a) A load of 7.5 kW at 230V is supplied by a short-shunt, cumulatively compound DC generator. If the armature, series and shunt field resistances are 0·4, 0·3, and 100 ohms respectively. Calculate the induced emf and the load resistance (5 marks)

b) 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)

c) Explain any THREE losses in D.C generators (6 marks)

Question THREE

a) State any THREE losses in a single-phase transformer (6 marks)

b) A 100 kVA, 1800 V/200 V, 50 Hz, single-phase transformer has 30 secondary windings. Calculate

   i. The primary and secondary current

   ii. The number of primary turns and

   iii. The maximum value of the flux (9 marks)

c) A single-phase 500V/100V, 50Hz transformer has a maximum core flux density of 1.5T and an effective core cross-sectional area of 50 cm^2. Determine the number of primary and secondary turns. (5 marks)

Question FOUR

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.

   i. 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.

ii. 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 FIVE

a) Using diagrams, describe the construction of the following types of rotors of an induction machine
   i. Squirrel cage rotor
   ii. Phase wound rotor (8 marks)

b) 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. The speed of the rotor when the slip is 0.04.
   iii. The frequency of the rotor currents when the slip is 0.03.
   iv. The frequency of the rotor currents at a standstill. (12 marks)