

Final Exam for the Subject: Fundamentals of Electrotechnics 02

Department: EE
Subject: ELT F 02
Session: Normal
Date: 22/05/2025

L2: ELT
Semester 2 Exam
Time: 01H30

Exercise 01

Tests on a single-phase transformer gave the following results:

- No-load test at rated primary voltage: $V_{10} = V_{1n} = 220 \text{ V}$, $I_{10} = 0.51 \text{ A}$, $f = 50 \text{ Hz}$, $V_{20} = 82.4 \text{ V}$, $P_{10} = 17.5 \text{ W}$
 - Short-circuit test at reduced primary voltage: $V_{1cc} = 50 \text{ V}$, $I_{2cc} = I_{2n} = 10 \text{ A}$, $P_{1cc} = 63 \text{ W}$
1. Propose a wiring diagram for the transformer so that, during the no-load test, all devices to measure V_{10} , I_{10} , V_{20} and P_{10} are connected, indicating the type of device chosen.
 2. Calculate the transformation ratio m .
 3. Why is the short-circuit test performed at reduced primary voltage?
 4. What does the active power P_{1cc} represent during this test?
 5. Calculate r_s (secondary winding resistance).
 6. Calculate the modulus of the secondary impedance z_s . Deduce x_s .
 7. The secondary now supplies a resistive load. $V_{1n} = 220 \text{ V}$, $I_{2n} = 10 \text{ A}$. Calculate the load voltage V_2 .
 8. Calculate transformer efficiency and maximum efficiency.

Exercise 02

A 220/380 V three-phase tetra-polar (4 poles) asynchronous motor is supplied by a 127/220 V, 50 Hz network. A no-load test at a rotation speed equal to the synchronous speed gave:

- Power consumption measured by the two-wattmeter method: $P_1 = 1160 \text{ W}$ and $P_2 = -660 \text{ W}$
- No-load current consumption: $I_0 = 6.8 \text{ A}$

A load test gave: $I = 22.2 \text{ A}$, $g = 6\% = 0.06$, $P = 6700 \text{ W}$
 The resistance of a stator winding is $R_s = 1 \Omega$

1. Give the stator coupling.
2. For no-load operation, calculate rotational speed, iron losses and mechanical losses, assuming they are equal.
3. For on-load operation, calculate speed, useful torque and efficiency.

Exercise 03

The nominal characteristics of a DC motor with independent (separate) excitation are:

- Armature: $U_a = 100 \text{ V}$, $I_a = 8 \text{ A}$, $R_a = 1.25 \Omega$, $N = 1500 \text{ rpm}$
- Field (excitation): $U_{ex} = 200 \text{ V}$, $R_{ex} = 400 \Omega$

The field flux is assumed constant.

1. From the nominal data, calculate the nominal electromotive force E .
2. The armature current is $I_a = 8 \text{ A}$, and the motor is running at $N' = 1000 \text{ rpm}$. Determine the new voltage U'_a to be applied across the armature.
3. Calculate the Joule losses in the armature and in the field.
4. Calculate the electromagnetic torque for $N = 1500 \text{ rpm}$.