University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

MIDTERM EXAMINATIONS - 2020/2021

School of Electrical and Electronic Engineering

EEEN20090 – Electrical Energy Systems

Module Coordinator: Prof. Federico Milano *

Time Allowed: 50 minutes

Instructions for Candidates

Answer all questions from any two of the three sections.
All question papers **must** be handed up with the answer booklets at the end of the exam.
The distribution of marks in the right margin gives an approximate indication of the relative importance of each part of the question.

Instructions for Invigilators

Non-programmable calculators are permitted.

Section A

For the circuit shown in Figure 1 and assuming $\omega = 314.16$ rad/s, determine:

1. The Thévenin equivalent circuit ($\bar{V}_{\text{th}}$, $\bar{Z}_{\text{th}}$) at the terminals a-b. 50%

2. The current $\bar{I}_{\text{load}}$ and the active power P_{load} in an inductive load connected to the terminals a-b, if the reactance of the load is $2\ \Omega$. 50%

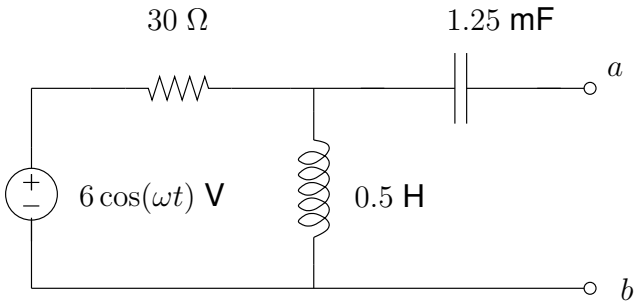

Figure 1

Section B

The coil of the magnetic circuit shown in Figure 2 has the following parameters: $i = 0.5$ A, $N = 1000$ turns. The air gaps measure $g_1 = 1$ mm and $g_2 = 2$ mm. The cross-sectional area of both left and right legs of the iron core is 5 cm^2.

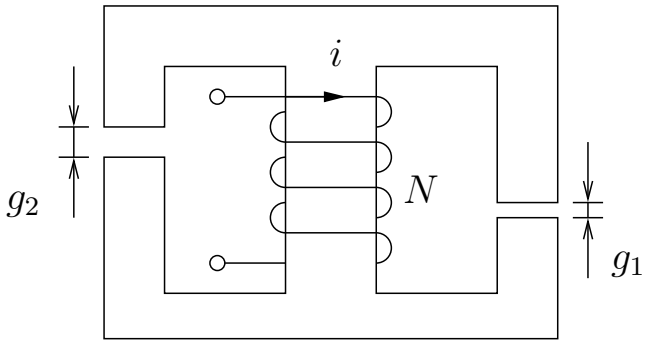

Figure 2

Assuming that the iron core has infinite permeability, determine:

3. The fluxes in the air gaps ϕ_1 and ϕ_2. 50%
4. The magnetic field (H_1) and the magnetic flux density (B_1) in the air gap g_1. 25%
5. The self-inductance L of the magnetic circuit. 25%

Section C

A single-phase transformer has the following nominal parameters: $S_N = 500$ kVA, $V_{1N} = 15,000$ V, $V_{2N} = 3,300$ V.

The open-circuit test of a single-phase transformer was carried out leaving in open circuit the high-voltage winding. The test yielded the following data: $3,300$ V, 5 A and $3,200$ W.

The following data were obtained in a short-circuit test of the transformer, with its low-voltage winding short-circuited: 350 V, nominal current, $2,950$ W.

The transformer is feeding a load consuming $S_2 = 480$ kVA with power factor $\cos\phi_2 = 0.85$ lagging with $V_2 = V_{2N}$.

Calculate:

6. The iron equivalent resistance R_{Fe}, and magnetising reactance X_μ of the transformer referred to the high-voltage winding. 25%

7. The equivalent short-circuit resistance R'_{sc} and rectance X'_{sc} of the transformer. 25%

8. The voltage regulation $\epsilon_{\%}$ at the given loading condition. 25%

9. The magnitude of the secondary current I'_{2M} for which the efficiency of the transformer is maximum and the value of such an efficiency (η_M) for a load with power factor 0.85 lagging. 25%

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