University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

MIDTERM EXAMINATIONS - 2016/2017

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.
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

Consider the circuit shown in Figure 1.

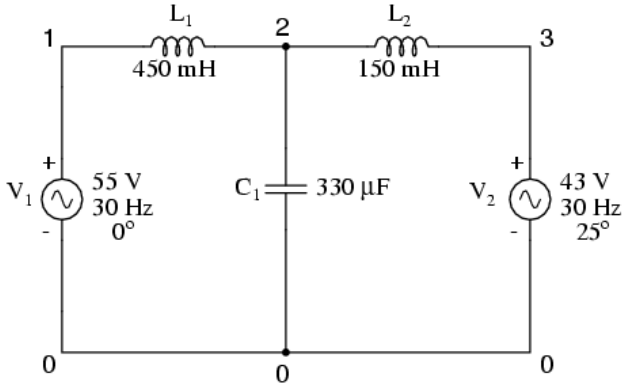

Figure 1

1. Determine the impedances of all branches of the circuit, namely ($\bar{Z}_{L1}$, $\bar{Z}_{L2}$, $\bar{Z}_{C1}$). 10%
2. Determine the currents in the inductances and the voltage at bus 2 ($\bar{I}_{L1}$, $\bar{I}_{L2}$, $\bar{V}_{C1}$). 10%

Section B

Consider the magnetic circuit shown in Figure 2. The permeability of the iron core is $\mu \to \infty$. There are three air gaps, whose lengths are 1 mm, 2 mm, and 3 mm, respectively. The section of the magnetic circuit is 10 cm^2. The windings have $N_1 = 200$ and $N_2 = 100$ turns.

3. If $i_1 = 10$ A and $i_2 = 0$, determine the magnetic fluxes in every air gap (ϕ_1, ϕ_2, ϕ_3). 10%
4. If $i_1 = 10$ A and $i_2 = 0$, determine the self-induction coefficient L_{11} and the mutual indication M_{12}. 10%
5. If $i_1 = 0$ and $i_2 = 20$ A, determine the magnetic fluxes in every air gap. 10%
6. If $i_1 = 0$ and $i_2 = 20$ A, determine the self-induction coefficient L_{22} and the mutual indication M_{21}. 10%

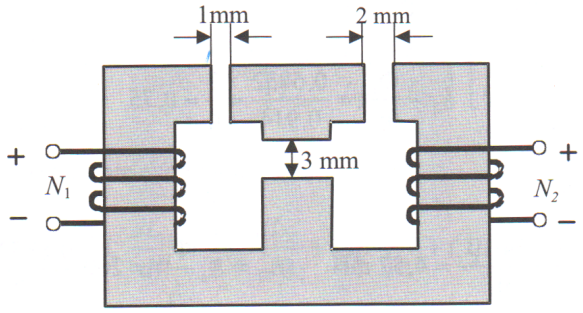

Figure 2

Section C

A single-phase transformer has the following nominal quantities: $S_n = 75$ kVA, $V_{1n} = 3000$ V, $V_{2n} = 220$ V, $f_n = 50$ Hz. The nominal current circulates in the primary winding if it is fed by a voltage of 200 V and the secondary windings is shortcircuited. In these conditions, the consumed power is 2 kW. The power consumed in open-circuit is 1.5 kW.

7. Determine the short-circuit impedance of the transformer (R'_{sc}, X'_{sc}). 10%

8. Determine the voltage drop $\Delta V_{sc\%}$ and the secondary voltage if the transformer works under full load conditions and power factor 0.8 lagging. 10%

9. Repeat the calculation above, but with power factor 0.8 leading. 10%

10. Determine the efficiency η of the transformer at full load with power factor 0.8. 10%

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