University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

MIDTERM EXAMINATIONS - 2017/2018

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

The input to the circuit shown in Figure 1 is the voltage

$$v_s(t) = 25\cos(40t + 45^\circ) \text{ V}$$

and $L_1 = 8$ H, $L_2 = 6$ H, $L_3 = 3$ H, $R_1 = 50\ \Omega$, and $R_2 = 400\ \Omega$.

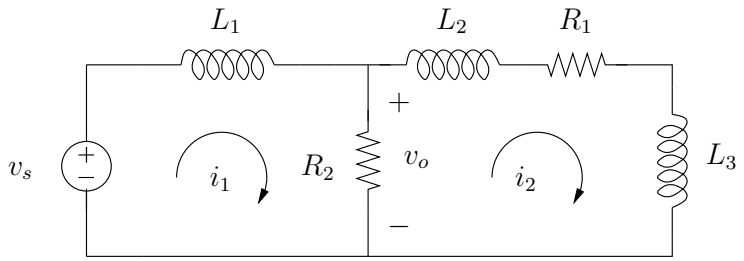

Figure 1

Determine:

1. The mesh current $i_1(t)$ and $i_2(t)$. 25%
2. The voltage $v_o(t)$. 25%

Consider the circuit shown in Figure 2.

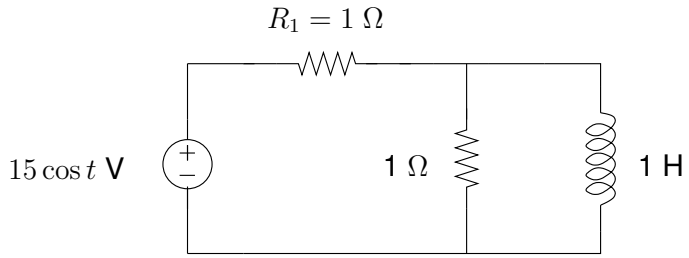

Figure 2

Find:

3. The average power delivered by the source to the circuit. 25%
4. The average power absorbed by the resistor R_1. 25%

Section B

In the magnetic system shown in Figure 3, $\ell_1 = \ell_3 = 300$ mm, $\ell_2 = 100$ mm, $A_1 = A_3 = 200$ mm^2, $A_2 = 400$ mm^2, $\mu_{r1} = \mu_{r3} = 2250$, $\mu_{r2} = 1350$, and $N = 25$.

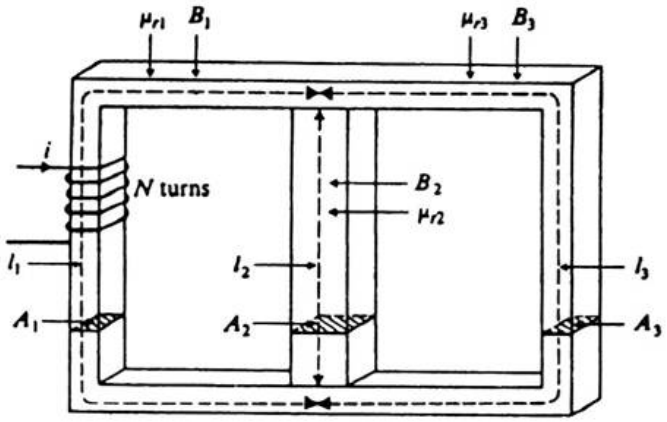

Figure 3

Determine:

5. the fluxes ϕ_1, ϕ_2, and ϕ_3 in the three branches of the circuit when the coil current is 0.5 A. 40%
6. the flux densities B_1, B_2, and B_3 in the three branches of the circuit when the coil current is 0.5 A. 10%
7. The self-inductance of the magntic circuit. 25%
8. The self-inductance of the magntic circuit if the coil is moved to the central part of the magnetic circuit. 25%

Section C

An open-circuit test of a single-phase transformer yielded the following data: $2,200$ V, 3.1 A and $1,550$ W. The following data were obtained in a short-circuit test of the transformer, with its high-voltage winding short-circuited: 210 V, 90.9 A, $2,500$ W. The nominal parameter of the transformer are: $S_N = 200$ kVA, $V_{1N} = 13,200$ V, $V_{2N} = 2,200$ V. The transformer is feeding a load consuming $S_2 = 180$ kVA with power factor $\cos\phi_2 = 0.9$ leading with $V_2 = V_{2N}$.

Calculate:

9. The exciting conductance G''_{Fe}, and susceptance B''_{μ}. 25%

10. The equivalent short-circuit impedance of the transformer (R''_{sc}, X''_{sc}). 25%

11. The voltage regulation at the given operating condition. 25%

12. The efficiency at the given operating condition. 25%

Note: G''_{Fe}, B''_{μ}, R''_{sc}, and X''_{sc} indicate quantitities referred to the secondary (low voltage) winding of the transformer.

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