University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

Spring Trimester Exams, 22/23 TRIMESTER EXAMINATIONS

EEEN20090

Electrical Energy Systems [Midterm Exam]

Module Coordinator: Professor Federico Milano

Student Number

Seat Number

Time Allowed: 50 minutes

Material Permitted in the Exam Venue:
Non-programmable calculators are permitted.

Material to be Supplied to Students:
8-page answer booklets

Instructions to Students:
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 section.

Section A

Figure 1 shows an RLC circuit. Suppose $v_g(t) = 10\sin(2t - 30°)$ V, $R = 2\ \Omega$, $L = 4$ H, and $C = \frac{1}{6}$ F.

Determine:

1. The current $i(t)$. 40%
2. The active and reactive powers delivered to each passive element of the circuit. 40%
3. Determine the complex power delivered by the source in the circuit. 20%

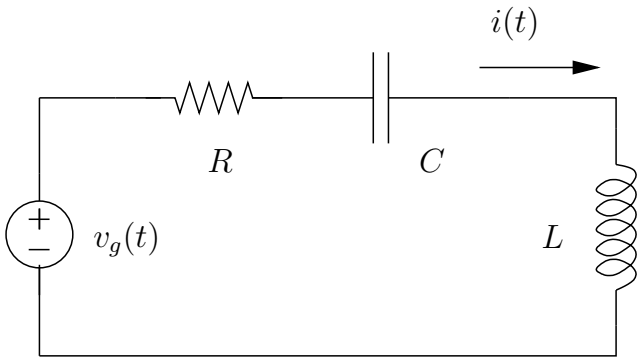

Figure 1

Section B

An idealized picture of a magnetic circuit is shown in Figure 2. In this picture the core leg width w is 2 cm, the depth d is 2.5 cm and the gap g is 0.5 mm. The coil (actually two coils) has a total of $N = 100$ turns (50 each side). Assume the permeability of the core material is very high so that its reluctance can be ignored.

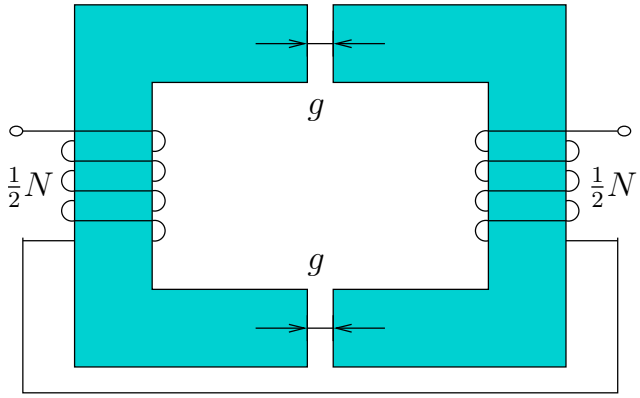

Figure 2

4. What is the inductance L of this device? 40%

5. How much current i in the coil is required to make flux density in the gap equal to 1.8 T? 30%

6. What gap g would be required to make the inductance 10 mH? 30%

Section C

A 160 kVA single-phase transformer with a voltage ratio $2000/200$ V has the following parameters:

$$R_1 = 0.22\ \Omega, \quad R_2 = 0.0018\ \Omega, \quad R_{\mathrm{FE}} = 4500\ \Omega,$$
$$X_1 = 0.41\ \Omega, \quad X_2 = 0.005\ \Omega, \quad X_\mu = 2200\ \Omega,$$

where R_1, X_1, R_{FE} and X_μ are referred to the primary winding, whereas R_2 and X_2 are referred to the secondary winding.

Calculate:

7. The magnitude of the voltage $V_{1\mathrm{sc}}$ on the primary winding, the active power $P_{1\mathrm{sc}}$ dissipated by the transformer, and the power factor $\cos(\phi_{1sc})$, if the transformer is shortcircuited and the current that circulates in the secondary winding is the nominal one. 40%

8. Assuming no load conditions, the current I_{10} that circulates in the primary winding, the losses P_{10} in the transformer, and the power factor $\cos(\phi_{10})$, if the primary winding is connected to a source at the nominal voltage. 40%

9. The voltage regulation $\epsilon_{\%}$ at power factor 0.9 leading. 20%

Hint: To solve questions 7 and 8, use the approximations of the transformer equivalent circuit that are usually adopted for short-circuit and no-load tests.

Result Sheet

Student Number

Question 1	$i(t) =$		
Question 2	$P_R =$	$Q_R =$	
	$P_L =$	$Q_L =$	
	$P_C =$	$Q_C =$	
Question 3	$\bar{S}_g =$		
Question 4	$L =$		
Question 5	$i =$		
Question 6	$g =$		
Question 7	$V_{1\text{sc}} =$	$P_{1\text{sc}} =$	$\cos(\phi_{1sc}) =$
Question 8	$I_{10} =$	$P_{10} =$	$\cos(\phi_{10}) =$
Question 9	$\epsilon_{\%} =$		

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