University College Dublin
An Coláiste Ollscoile, Baile Átha Cliath

SEMESTER I EXAMINATIONS - 2017/2018

School of Electrical and Electronic Engineering

EEEN20090 – Electrical Energy Systems

External Examiner: Prof. Andrew Gibson

Head of School: Prof. Andrew Keane

Module Coordinator: Prof. Federico Milano *

Time Allowed: 2 hours

Instructions for Candidates

Answer all questions from any three of the five 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.

Instructions for Invigilators

Non-programmable calculators are permitted.
No rough-work paper is to be provided for candidates.

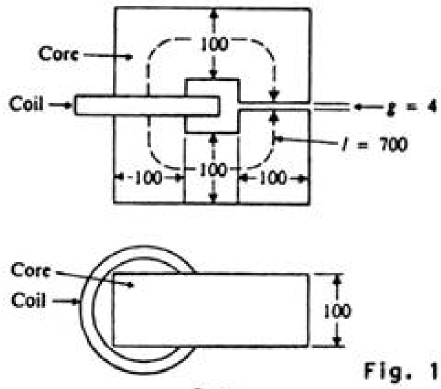
Student No: ____________________ **Seat No:** ____________________

Section A

A three-phase, Y-connected system with 220 V per phase is connected to three loads: 10 Ω, 20∠20° Ω, and 12∠ – 350° Ω to phases 1, 2 and 3, respectively. Find the current in each line and in the neutral line.

Section B

A 1000–turn coil is located on a ferromagnetic core that has an air gap, as illustrated in Fig. 1. If the coil current is 1.5 amperes and the relative permeability of the core is 1450.



System

Fig. 1

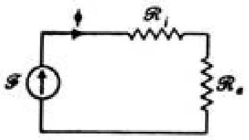


Fig. 2

Equivalent magnetic circuit of the system of Fig. 1.

a) Determine the proportion of the total mmf required to overcome the reluctance of the air gap. 25%

b) Determine the flux density produced in the air gap. 25%

c) Determine the ratio of the flux density in the air gap to the flux density produced at the center of the coil in the absence of the core. 25%

d) Determine the magnetic field intensity in the core and in the air gap. 25%

In Figure 1, all dimensions are in millimeters. Leakage flux and fringing at the air gap may be neglected.

Section C

For the 11.2 kW, 4–pole induction motor described below

220 V	Three–phase	11.2 kW	1725 rpm
$R_1 = 0.15\ \Omega$	$R'_2 = 0.18\ \Omega$	$X_1 = 0.31\ \Omega$	$X'_2 = 0.31\ \Omega$

Volts per phase = 127, friction = 240 W

Find:

a) slip at which maximum torque occurs, 20%

b) maximum torque, 20%

c) slip at which maximum power occurs, 20%

d) maximum power, 20%

e) starting torque and 10%

f) starting current. 10%

Section D

An ac synchronous generator has six poles and operates at 1,200 rpm.

a) What frequency does it generate? 40%

b) At what speed must the generator operate to develop 25 cycles? 50 cycles? 30%

c) How many poles are there in a generator that operates at a speed of 240 rpm and develops a frequency of 60 cycles? 30%

Section E

A power station supplies 60 kW to a load over 750 m of 2-conductor copper feeder the resistance of which is 0.26 Ω/km. The reactance of the feeder is negligible. The voltage at the point of connection with the power station is maintained constant at 600 V. Determine:

a) current; 40%

b) voltage at load; 20%

c) efficiency of transmission; 20%

d) maximum power that can be transmitted; 10%

e) maximum current that can be supplied. 10%

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