UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: COMPUTER SYSTEMS* *ENGINEERING: ELECTRICAL*
SUBJECT	:	**ELECTRICAL ENGINEERING 1** **ELECTROTECHNOLOGY 1**
CODE	:	**AEI 1221 / ELT 1111**
DATE	:	WINTER SUPPLEMENTARY EXAMINATION 26 JULY 2016
DURATION	:	(SESSION 1) 08:00 - 11:00
WEIGHT	:	40 : 60
FULL MARKS	:	100
TOTAL MARKS	:	108

EXAMINER	:	MR A.F. COTTRELL	2009
MODERATOR	:	MR E. MALATJI	
NUMBER OF PAGES	:	8 PAGES (including this page)	

INSTRUCTIONS TO STUDENTS (TO BE READ):

1. WORK IN PENCIL WILL NOT BE MARKED;
2. ALL WORK WITH THE EXCEPTION OF THE DIAGRAMS MUST BE IN INK.
3. ALL CALCULATIONS MUST BE SHOWN, NO MARKS FOR ANSWERS ONLY.
4. 1 MARK = 1%
5. QUESTIONS MAY BE ANSWERED IN ANY ORDER.
6. ANY HAND-HELD CALCULATORS ARE PERMITTED
7. **ANSWERS ARE TO BE FILLED IN ON THE ATTACHED SHEET, AND HANDED IN, INSIDE THE ANSWER BOOK.**
8. DO NOT WAIT UNTIL THE END OF THE EXAM BEFORE YOU START FILLING IN YOUR ANSWER SHEET! FILL IT IN AS YOU GO!

QUESTION1

Figure 1 shows an electrical circuit with the known parameters given. Use your knowledge of electric circuits, and calculate the unknown currents, voltages and powers that are indicated on the answer sheet and fill these in correctly on this sheet.

[20]

QUESTION 2

Figure 2 shows two batteries connected in parallel, both supplying a load of 10Ω. Use Kirchhoff's laws to find the current in each leg of this circuit. A multiple choice item is provided with regard to the correct equations, and a table for you to fill in the required answers.

Which equations are you going to use? Use the answer sheet to indicate your choice.

A	$68 = 5I_1 - 3I_2$ $62 = 10I_1 + 13I_2$	❶ ❷	C	$68 = 15I_1 + 10I_2$ $62 = 10I_1 + 13I_2$	❶ ❷
B	$68 = 15I_1 + 10I_2$ $6 = 8I_1 + 3I_2$	❶ ❷	D	$6 = 5I_1 - 3I_2$ $62 = 10I_1 + 3I_2$	❶ ❷

[11]

QUESTION 3

A magnetic circuit is shown below (Figure 3(a)), together with the B/H curves of the steel core materials used (Figure 3(b)). The table shows the dimensions of each section of the magnetic circuit. (Note that the Magnetic field strength on the B/H curve is x100).
Determine the current needed to produce a total flux of 240μWb. Fill this answer (and the others indicated), on the table provided. ($\mu_o = 4\pi \times 10^{-7}$ H/m).

	Part A1 & A2 (each)	Part B	Air gap
Mean length (m)	60 mm	40mm	0.5 mm
Cross sectional area (m^2)	400 mm^2	600 mm^2	400 mm^2

[10]

QUESTION 4

The coil of an electrical machine has an initial temperature of $17^{o}C$. It is supplied with a constant 380 volt. The initial current is 0.75 ampere. After three hours of operation, this current has dropped to 0.643 ampere, the temperature of the coil, being $65^{o}C$. Determine:

4.1 The temperature coefficient of resistance of the conductor material, at $20^{o}C$. (8)

4.2 The initial current that would flow, if the starting temperature was $25^{o}C$. (3)

[11]

QUESTION 5

Fill in the missing words of the following laws of electricity and magnetism. Also state who's law each on is:

5.1 "The ❶ flowing in an electric circuit is ❷ proportional to the voltage and inversely ❸ to the ❹, the ❺ being held constant". This is ❻'s Law. (3)

5.2 "The direction of the ❶ ❷ is always such as to produce a current which ❸ the motion (or change of ❹) producing it". This is ❺'s Law. (3)

5.3 "The ❶ sum of the ❷ flowing toward a ❸ Is equal to ❹ ". This is ❺'s ❻ Law. (3)

5.4 "The magnitude of the ❶ induced in a circuit is ❷ to the rate of change of the ❸". This is ❹'s Law of ❺ ❻. (3)

[12]

QUESTION 6

Consider figure 4. Convert the STAR circuit, ABD (The star-point is at C) to a DELTA circuit, and thus, find the power dissipated in R_4. Let the DELTA resistances be R_{AB}, R_{BD} and R_{DA}. Now find the value of the power dissipated in the 120 Ω resistor.

[20]

QUESTION 7

Figure 5 shows a composite capacitor having two plates having an effective area of 0.42 m^2. The thicknesses & relative permittivities of the respective dielectrics are given. The permittivity of free space is 8.85×10^{-12} (F/m). Determine:

7.1 The capacitance of the capacitor. (5)

7.2 If 12 volts is applied to the capacitor, the final charge. (2)

7.3 The voltage gradient across each dielectric. (6)

[13]

QUESTION 8

A coil used in a moving coil meter is wound on a rectangular former shown in Figure 5. If this coil has 110 turns and carries a maximum current of 85 mA, calculate:

8.1 The torque exerted on the movement under these conditions, the flux density being 0.4 tesla. (5)

8.2 The voltage across the coil terminals, if the diameter and resistivity of the wire is 0.2 mm and 0.018 μΩ.m, respectively. (6)

[11]

TOTAL MARKS: 108

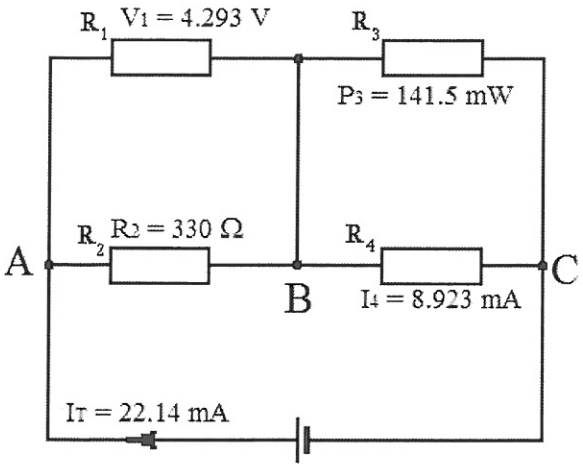


Figure 1

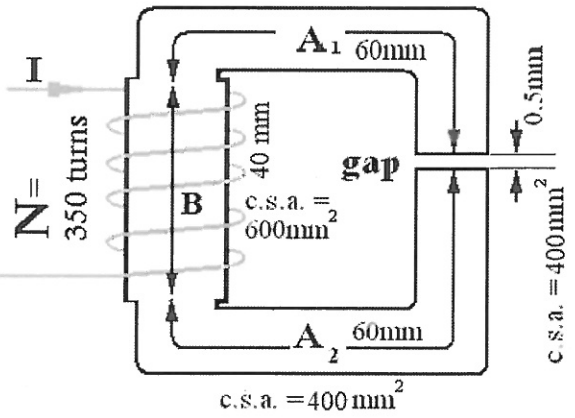


Figure 3 (a)

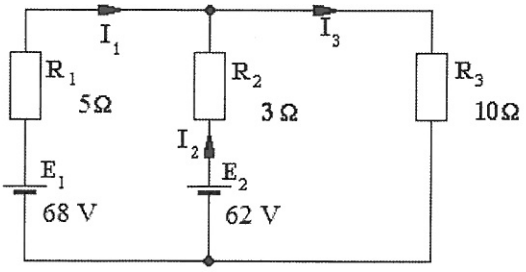


Figure 2

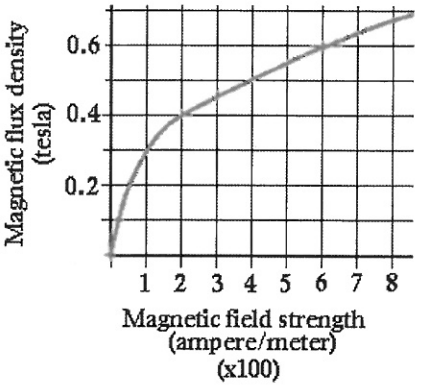
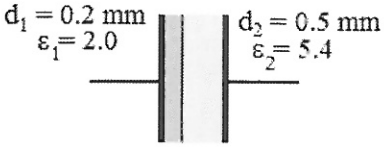


Figure 3 (b)



A composite dielectric capacitor

Figure 5

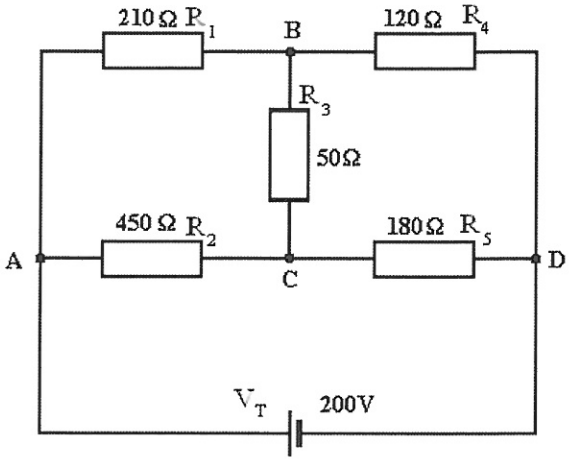


Figure 4

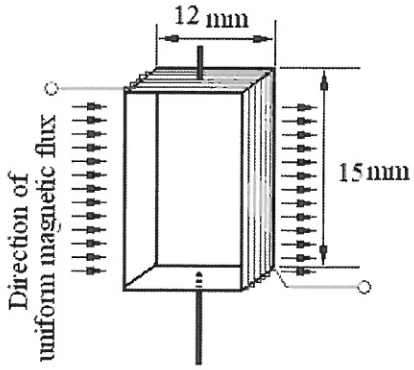


Figure 6

STUDENT NAME & INITIALS _____

STUDENT NUMBER _____

QUESTION 1 (NOTE: YOU **MUST** FILL IN UNITS!)

R_1		I_1	=	V_{Supply}		P_2	=
R_2	= 330Ω	I_2	=	V_1	= 4.293 V	P_3	=141.5 mW
R_3	=	I_3	=	V_3	=	P_4	=
R_4	=	I_4	= 8.923 mA	P_T	=		
I_T	22.14 mA	I_x	=	P_1	=		

Note: I_x is the current through the "bridge", joining the top resistors to the bottoms

Answers to QUESTION 2
Place a cross on the letter representing the correct equations.

Equations	A	B	C	D
I_1 =				
I_2 =				
I_3 =				

Answers to QUESTION 3

B_{A1}	=	H_{A1}	=	m.m.f.	=
B_{A2}	=	H_{A2}	=		
B_B	=	H_B	=		
B_{gap}	=	H_{gap}	=	I	=

QUESTION 4

θ_1	17°C	R_1		I_1	0.75 A
θ_2	65°C	R_2		I_2	0.643A
Vsupply	380 V				
α_{20}		$R_{@\ 25^0}$		$I_{3@\ 25^0}$	

QUESTION 5

5.1	❶		❷	
	❸		❹	
	❺		❻	

5.2	❶		❷	
	❸		❹	
	❺			

5.3	❶		❷	
	❸		❹	
	❺		❻	

5.4	❶		❷	
	❸		❹	
	❺		❻	

QUESTION 6

R_{AB}		$R_{BD(//)}$		V_{R4}	
R_{BD}		R_{ABD} (series)		I_{R4}	
R_{DA}		R_T		P_{R4}	
$R_{AB(//)}$		I_T			

QUESTION 7

C_1		C_T		V_1	
C_2		Q		V_2	
E_1 (V/mm)		E_2(V/mm)		V_{Supply}	

QUESTION 8

F		R meter		R other	
T		V meter		V other	