UNIVERSITY OF JOHANNESBURG

PROGRAM	:	NATIONAL DIPLOMA *ENGINEERING: ELECTRICAL* *ENGINEERING: COMPUTER SYSTEMS* *ENGINEERING: MECHANICAL*
SUBJECT	:	**ELECTROTECHNOLOGY II** **ELECTRICAL ENGINEERING II**
CODE	:	**ELT2211**
		SUPPLEMENTARY EXAMINATION
DATE	:	
DURATION	:	(3HRS)
WEIGHT	:	40 : 60
TOTAL MARKS	:	105

EXAMINER	:	DR. NE MABUNDA	2025
MODERATOR	:	MR. TF MAZIBUKO	
NUMBER OF PAGES	:	9 PAGES AND 1 ANSWER SHEET	

INSTRUCTIONS

1. THE ANSWER SHEET MUST BE HANDED IN TOGETHER WITH THE SCRIPT
2. POCKET CALCULATORS PERMITTED.
3. ATTEMPT ALL THE QUESTIONS.

INSTRUCTIONS TO CANDIDATES:

1. TEAR OFF ANSWER SHEET AND SUBMIT IT WITH YOUR SCRIPT.
2. POCKET CALCULATORS PERMITTED.
3. ONLY DRAWINGS MAY BE IN PENCIL.
4. ANSWERS WITH NO UNITS ARE ASSUMED TO BE INCORRECT THEREFORE NO UNITS, NO MARKS.
5. GIVE FINAL COMPLEX NUMBER ANSWER IN POLAR FORM.
6. QUESTIONS THAT ARE NOT CLEARLY NUMBERED WILL NOT BE MARKED.
7. ALL STUDENTS MUST DO ALL QUESTIONS
8. KEEP PARTS OF THE QUESTION TOGETHER AND WORK FROM TOP TO BOTTOM AND NOT ALL OVER THE PAGE.
9. START EACH STEP ON A NEW LINE
10. ANY ROUGH WORK NOT TO BE MARKED MUST BE CANCELLED WITH A SINGLE DIAGONAL LINE.
11. ONE MARK EQUALS ONE PERCENT

SECTION A

This section is to be answered on the sheet provided.

QUESTION 1 - TRUE OR FALSE STATEMENTS

Negative marking applies for this question.
Answer true for a statement which you agree with and false to statements that you disagree with. A correct answer results in one mark allocated to you while an incorrect answer will result in half a mark being deducted.

1.1. A variac is used to obtain variable DC voltage in an AC circuit. T/F

1.2. If the inductance is changed from 0,3H to 0,7H, the inductive reactance will increase in a DC circuit. T/F

1.3. If an ammeter with a broken fuse is connected in a circuit to measure its AC current, the ammeter will display 0A and current will not flow through this section where the ammeter is connected. T/F

1.4. In a short transmission line network, the efficiency is taken as the received power divided by the sending power. T/F

1.5. A circuit has a capacitor in series with an inductor. A complex wave is applied to this series circuit. The complex wave contains a DC voltage component. The expression for the resultant current wave would however not contain a DC component due to the capacitor. T/F

1.6. Series and parallel resonance are similar in that both exhibit a peak total power dissipation when the power factor is at unity. T/F

QUESTION 1 (Continued)

1.7. Two wattmeters are connected to a delta load. The reading on the one wattmeter is 10kW. The total power consumed by the load is 26kW. Thus the reading on the other cannot be 16kW. T/F

1.8. Power factor correction should be accomplished in many factories to reduce the current requirement so as to assist with Eskom's recent power shortages. T/F

1.9. A high value of apparent power does not affect the recent electricity shortages that Eskom is dealing with. Eskom is only interested in the real power which is measured in Watts. T/F

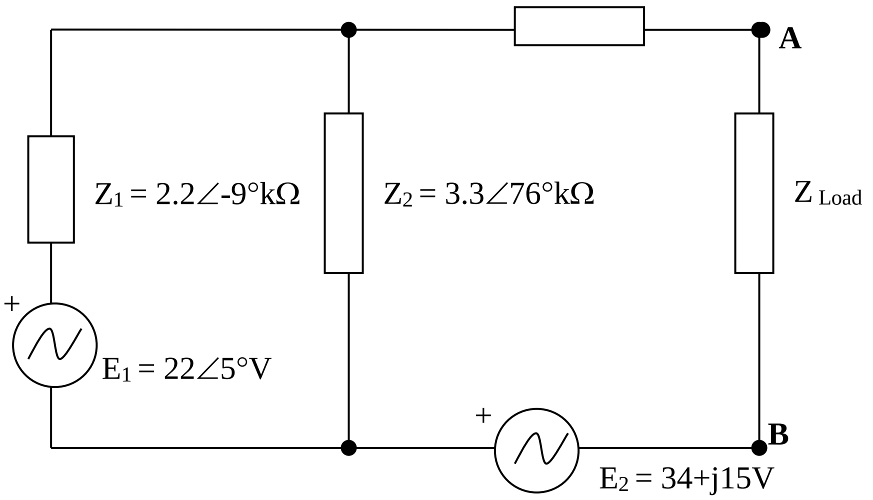
1.10. A complex wave consists of many sine waves that often have differing amplitude and frequency. T/F

[10]

QUESTION 2 - MULTIPLE CHOICE

Choose the most correct answer and mark an x over the corresponding letter on your answer sheet (rough work can be done at the back of the answer script).

Figure 2.1



2.1 Using Figure 1, choose the most correct answer and mark an x over the corresponding letter on your answer sheet (rough work can be done at the back of your answer script).

2.1.1 Which of the following ranges would you find the Thevenin's impedance?

A) $x\angle\phi\ \Omega$ $1 \le x \le 300$; $-120° \le \phi \le 120°$
B) $x\angle\phi\ \Omega$ $301 \le x \le 900$; $-120° \le \phi \le 120°$
C) $x\angle\phi\ \Omega$ $901 \le x \le 2500$; $-120° \le \phi \le 120°$
D) $x\angle\phi\ \Omega$ $2501 \le x \le 3000$; $-120° \le \phi \le 120°$

E) $x\angle\phi\ \Omega$ $\quad 3001 \le x \le 4000 \quad ; \quad -120° \le \phi \le 120°$ (3)

2.1.2 Which of the following ranges would you find the Thevenin's equivalent EMF?

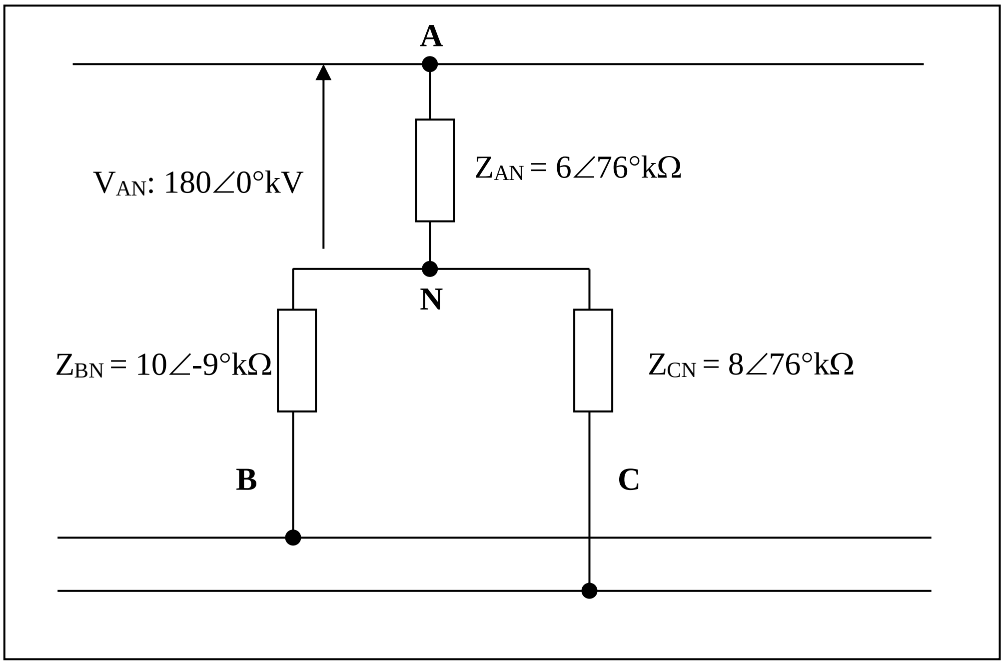
A) $x\angle\phi$ V $\quad 0 \le x \le 10 \quad ; \quad -120° \le \phi \le 120°$
B) $x\angle\phi$ V $\quad 10{,}1 \le x \le 25 \quad ; \quad -120° \le \phi \le 120°$
C) $x\angle\phi$ V $\quad 25{,}1 \le x \le 40 \quad ; \quad -120° \le \phi \le 120°$
D) $x\angle\phi$ V $\quad 40{,}1 \le x \le 60 \quad ; \quad -120° \le \phi \le 120°$
E) $x\angle\phi$ V $\quad 60{,}1 \le x \le 130 \quad ; \quad -120° \le \phi \le 120°$ (3)

2.1.3 Which of the following load impedances will allow 25mA to flow through the load at an angle of 15°?

A) $1{,}57\angle -115{,}5°$ kΩ
B) $2{,}18\angle 13{,}1°$ kΩ
C) $5{,}48\angle 26{,}1°$ kΩ
D) $1{,}57\angle 115{,}5°$ kΩ
E) $5{,}48\angle 26{,}1°$ kΩ (3)

2.2 Convert the following star network (Figure 2.2) to an equivalent delta and answer the questions

Figure 2.2



2.2.1 What is the value of Z_{AB} and Z_{BC}?

A)	$Z_A : x\angle\phi\ \Omega$	$0 \le x \le 1500$	;	$-120° \le \phi \le 120°$
	$Z_B : x\angle\phi\ \Omega$	$0 \le x \le 1500$	;	$-120° \le \phi \le 120°$
B)	$Z_A : x\angle\phi\ k\Omega$	$1{,}51 \le x \le 8$	;	$-120° \le \phi \le 120°$
	$Z_B : x\angle\phi\ k\Omega$	$1{,}51 \le x \le 8$	;	$-120° \le \phi \le 120°$
C)	$Z_A : x\angle\phi\ k\Omega$	$8{,}1 \le x \le 15$	;	$-120° \le \phi \le 120°$
	$Z_B : x\angle\phi\ k\Omega$	$8{,}1 \le x \le 15$	;	$-120° \le \phi \le 120°$
D)	$Z_A : x\angle\phi\ k\Omega$	$15{,}1 \le x \le 27$	;	$-120° \le \phi \le 120°$
	$Z_B : x\angle\phi\ k\Omega$	$15{,}1 \le x \le 27$	;	$-120° \le \phi \le 120°$
E)	$Z_A : x\angle\phi\ k\Omega$	$27{,}1 \le x \le 54$	;	$-120° \le \phi \le 120°$
	$Z_B : x\angle\phi\ k\Omega$	$27{,}1 \le x \le 54$	;	$-120° \le \phi \le 120°$ = (3)

2.2.2 What is the power dissipated in Z_{AB}?

A) 0,1W ≤ real power ≤ 500W
B) 5kW ≤ real power ≤ 1MW
C) 1,1MW ≤ real power ≤ 2,8MW
D) 2,81MW ≤ real power ≤ 4,9MW
E) More than 4,91MW (3)

2.3 A 120kVA, 4,4kV/660V, 50Hz single-phase transformer has 180 secondary turns. Neglect losses and calculate the following:

2.3.1 The primary current I_1 and the maximum value of flux present.

A) Less than 5A
Less than 10mWb
B) Between 5,1A and 10A
Between 0 and 30mWb
C) Between 10,1A and 25A
Between 0 and 100mWb
D) Between 25,1A and 50A
Between 10mWb and 30mWb
E) More than 25A
More than 30mWb (3)

2.4 A circuit that consists of a parallel tank circuit and a series connected resistor was given. The parallel section contains an inductor of 0,5H with an internal resistance and load resistance totaling 10Ω. The other branch consists of a capacitor of unknown value. The supply voltage is 150V at a frequency of 60Hz. The series connected resistor has an unknown value. Calculate the following:

2.4.1 The value of capacitance required in order for resonance to occur. (Q-factor needs to be calculated)

A) 3 ≤ Q-factor ≤ 9,9 ; 1 ≤ Capacitance (μF)≤ 20
B) 10 ≤ Q-factor ≤ 17 ; 0,1 ≤ Capacitance (μF) ≤ 13

6/…

C) $17,1 \leq$ Q-factor ≤ 20 ; $15,1 \leq$ Capacitance (μF) ≤ 25
D) $17,1 \leq$ Q-factor ≤ 20 ; $10 \leq$ Capacitance (μF) ≤ 15
E) $10 \leq$ Q-factor ≤ 17 ; $14 \leq$ Capacitance (μF) ≤ 76 (3)

2.4.2 The dynamic impedance of the resonant section of the circuit as well as the total current if the voltage across the capacitor is 90V

A) Less than 700Ω
Less than 100mA
B) Between 701Ω and 1,4kΩ
Less than 2A
C) Between 1,41kΩ and 3,4kΩ
Less than 2A
D) Between 3,41Ω and 8kΩ
Less than 0,2A
E) More than 8kΩ
More than 2mA (3)

2.4.3 The power dissipated in the series resistor:

A) 2.1W $\leq$ real power $\leq$ 20W
C) 21W $\leq$ real power $\leq$ 90W
C) 91W $\leq$ real power $\leq$ 200W
D) less than 2W
E) More than 200W (3)

2.5 A series circuit consists of a non-inductive resistor of 10Ω, two series inductors of 0,2H and 0,3H and two series capacitors of 10μF and 14μF. What is the resonant frequency for this series circuit?

A) Less than 40Hz
D) Between 40,1Hz and 60Hz
C) Between 61Hz and 91Hz
D) More than 91Hz
E) Cannot be calculated (3)

[30]

SUB TOTAL SECTION A: 40

SECTION B

This section is to be answered on your answer script.

QUESTION 3

3.1 Two coils are connected in series across a 240V 50Hz supply as shown in Figure 3.1. The resistance of coil A is 5Ω and the inductance of coil B is 0,015H. If the input from the supply is 3kW and 2kVAR, calculate:

3.1.1 The inductance of coil A and the resistance of coil B (9)

3.1.2 The voltage across each coil. (4)

Figure 3.1

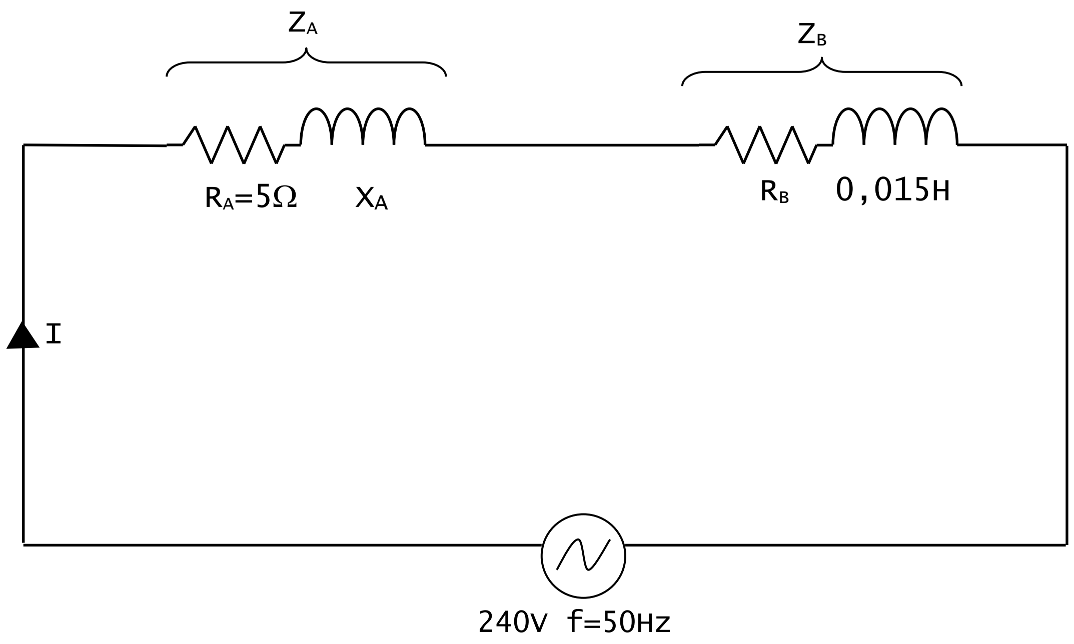
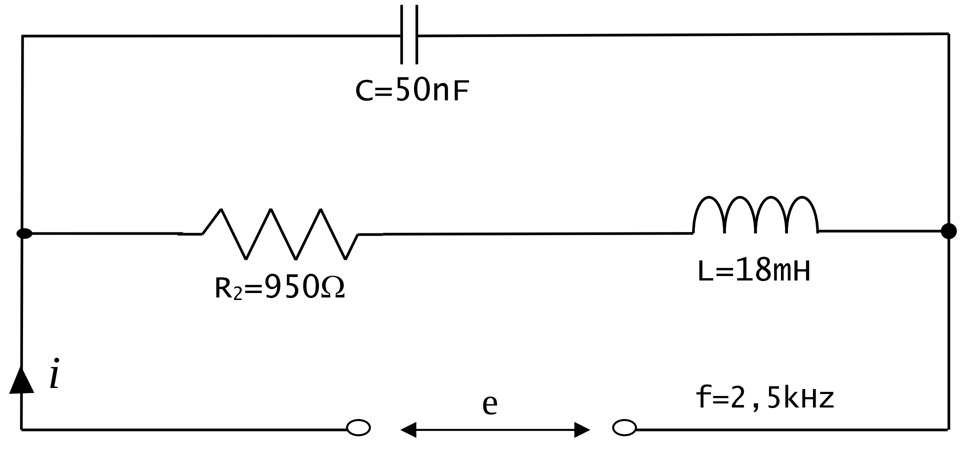


Figure 3.2



$$i = 20 + 100Sin\omega t + 75Sin(3\omega t - 45)\ mA$$

3.2 Use Figure 3.2 to calculate the following:

3.2.1 The expression for the voltage wave that is present. (6)
3.2.2 The circuits power factor. (7)

[26]

QUESTION 4

4.1 A three-phase supply feeds the following two loads:
(i) A three-phase balanced star connected motor with an impedances of $5\angle 78°\Omega$ per phase.
(ii) A balanced delta-connected machine of unknown impedance.

4.1.1 If an engineer wanted to measure the power of only the delta section, where would he place the TWO wattmeters? Sketch a circuit diagram of this layout including both loads. Show your two wattmeters and their connections clearly. Remember to label the impedances, currents and lines. Use at least 10 lines for your diagram. (6)

4.1.2 If the engineer now wanted to measure the complete power with his TWO wattmeters, where would he connect them now? Redraw the circuit. (3)
4.1.3 If the two wattmeters read 5kW and 8kW respectively, what is the value of the total real and reactive power for this combined load?. (4)
4.1.4 State Kirchhoff's current law. (2)

[15]

QUESTION 5

A short transmission line having a total resistance of 5Ω, and a total inductance of 0,03H supplies a 15MW load at a power factor of 0,84lagging. If the frequency of the system is 50Hz, and the receiving voltage is 33kV, determine:
5.1 The sending end voltage. (5)
5.2 The efficiency of the line. (2)
5.3 The per unit voltage regulation of the line. (2)

[9]

QUESTION 6

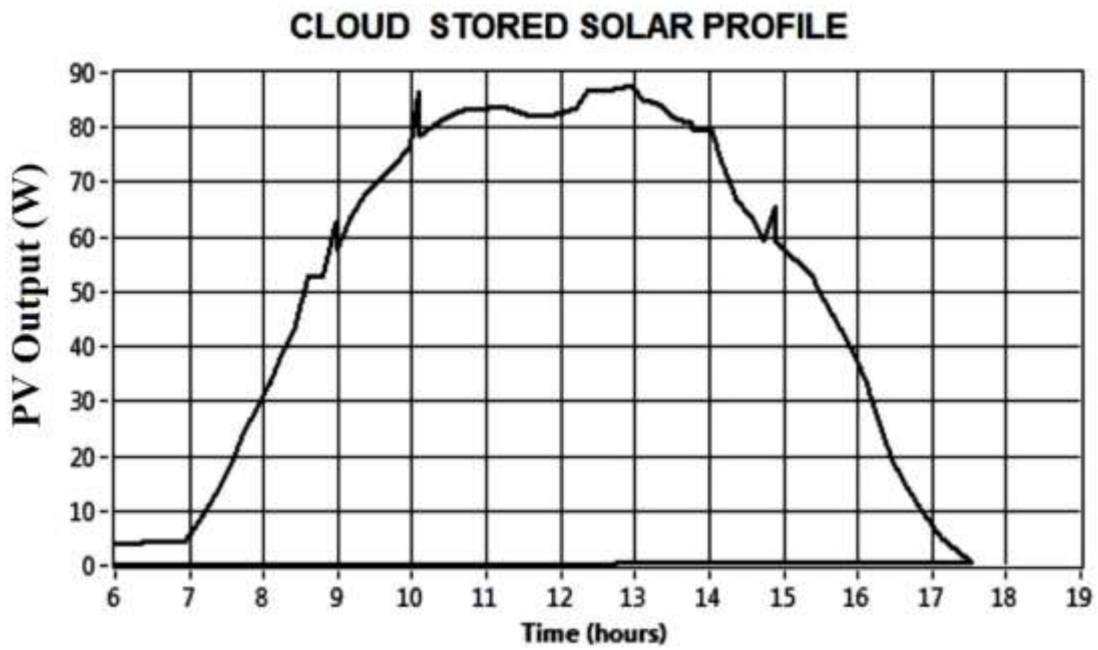


Figure 6.1

Figure 6.1 illustrates a daily output power response curve of a solar panel that connects to a pure resistive load of 25 Ω.

6.1 Determine the 12-hour (Daylight) average voltage. (10)

6.2 Calculate the total average heating power and the peak current that this system produce? (5)

[**10**]

SUB TOTAL SECTION B: 65

TOTAL: 105

STUDENT SURNAME: ______________________________

STUDENT NUMBER: ______________________________

ANSWER SHEET

(This sheet must be handed in with your examination script)

QUESTION 1

1.1	True	False
1.2	True	False
1.3	True	False
1.4	True	False
1.5	True	False

1.6	True	False
1.7	True	False
1.8	True	False
1.9	True	False
1.10	True	False

QUESTION 2

2.1.1	A	B	C	D	E
2.1.2	A	B	C	D	E
2.1.3	A	B	C	D	E
2.2.1	A	B	C	D	E
2.2.2	A	B	C	D	E
2.3.1	A	B	C	D	E
2.4.1	A	B	C	D	E
2.4.2	A	B	C	D	E
2.4.3	A	B	C	D	E
2.5	A	B	C	D	E