INTERNATIONAL UNIVERSITY OF EAST AFRICA

'Learning to Succeed'

FACULTY OF ENGINEERING

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: BACHELOR OF ELECTRICAL AND CONTROL ENGINEERING

YEAR/SEM: YEAR 3/SEMESTER 2

COURSE CODE: ELE3232

NAME: NETWORK ANALYSIS

DATE: 2025-04-16

TIME: 2:00-5:00PM

INSTRUCTIONS TO CANDIDATES:

1. Read the instructions very carefully
2. The time allowed for this examination is STRICTLY three hours
3. Read each question carefully before you attempt and allocate your time equally between all the Sections
4. Write clearly and legibly. Illegible handwriting cannot be marked
5. Number the questions you have attempted
6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks
7. Any examination malpractice detected will lead to automatic disqualification.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER

Section A Choose any two questions from this section. All questions carry equal marks (20MKS)

Question 1:

Choose the correct answer. @2mks

1. The transfer function is the ratio of:

15. A. Input to output
    B. Output to input in the s-domain
    C. Impedance to admittance
    D. Voltage to charge

2.The impedance of a capacitor in the s-domain is given by:

A. sC

B. 1/sC

C. C/sC

D. s/Cs

3.The voltage and current in a single port component are considered as _____.

A. Input

B. Output

C. Impedance

D. Both a and b

4. **A transfer function of network analysis can be represented as _____**

A. Attenuation

B. Gain

C. Frequency

D. Both A and B

5.Components in a circuit if connected one after the other is called _____connection.

A. Serial

B. Parallel

C. Concurrent

D. Both b and c

6.The real part of the complex frequency represents:

A. Oscillation frequency

B. Phase shift

C. Damping factor
D. Gain of the system

7. The Laplace transform is used in circuit analysis because it:
A. Converts differential equations into algebraic equations
B. Eliminates frequency components
C. Directly provides time-domain solutions
D. Reduces circuit complexity

8. A transfer function of network analysis can be represented as _____

A. Attenuation

B. Gain

C. Frequency

D. Both a and b

9. Which of the following is NOT an advantage of the Laplace transform?
A. Simplifies solving linear differential equations
B. Provides a direct solution in the time domain
C. Allows easy handling of initial conditions
D. Facilitates frequency domain analysis

10.Resistance of a wire is expressed in _____ units.

A. Ohms

B. Farads

C. Henry

D. Columbâ??s

Question 2:

Choose the correct answer. @2mks
1.An electric network in which current and voltage values are identified is called _____ process.
A. Network analysis
B. Network bisection
C. Networking
D. None of the above
2. The inverse of an impedance matrix (Z-parameters) gives:
A. Admittance matrix (Y-parameters)
B. Hybrid matrix (H-parameters)
C. Transmission matrix (ABCD-parameters)
D. Scattering matrix (S-parameters)
3. A terminated two-port network means that:
A. The circuit has load impedance connected at the output port
B. The circuit has zero impedance
C. The circuit is disconnected

D. The circuit has no power

4.The flow of current through 2 or more input/output terminals of an electrical or electronic device is called _____.

A. Component

B. Node

C. Circuit

D. Mesh

5. A two-port network is characterized by:

A. One input and one output
B. Two inputs and two outputs
C. One input and multiple outputs
D. Multiple inputs and one output

6.In an ideal transformer, the primary and secondary currents are related by:

A. Ip/Is=Np/Ns
B. Ip/Is=Ns/Np
C. Ip/Is=$(Np/Ns)^2$
D. Ip/Is=1

7. If the coefficient of coupling between two coils is 1, the system is said to be:

A. Loosely coupled
B. Partially coupled
C. Completely coupled
D. Uncoupled

8.In a network load is generally connected on _____ port.

A. Input

B. Output

C. Both a and b

D. Not connected

9. The Laplace transform of the voltage across an inductor L is:

A. LsI(s)
B. I(s)/LsI(s)
C. LsV(s)
D. I(s)/LI(s)

10. If an input function is a unit step function, its Laplace transform is:

A. 1/s
B. s
C. $1/s^2$
D. s/(s+1)

Question 3:

Choose the correct answer. @2mks

1.A procedure to simplify a network can be done by _____ the number of components.

A. Reducing

B. Multiplying

C. Adding

D. None of the above

2.The Laplace transform of a sinusoidal voltage source V(t)=5sin(2t)u(t) is:
A. 5/(S+2)

B. $5s/(S^2+4)$

C. $5/(S^2+4)$

D. 10/(s+2)

3.The voltage and current in a single port component are considered as output and input then its transfer function is expressed in terms of _____.

A. Admittance

B. Impedance

C. Resistance

D. Both a and b

4. A terminated two-port network refers to a:
A. Network with loads at both ports
B. Network with an open circuit
C. Network with only resistors
D. Network with only capacitors

5. The coefficient of coupling between two coils varies between:
A. 0 to 0.5
B. 0 to 1
C. 1 to 10
D. -1 to 1

6. What is the Laplace transform of the impedance of a resistor R?
A. R
B. sR
C. R/s
D. 1/R

7._____ in a network are replaced with other network components which provide same effect same effect.

A. Physical components

B. Resistor

C. Impedance

D. All the above

8.If two identical inductors are magnetically coupled, the mutual inductance is 10 mH and the coefficient of coupling is 0.4. Find the self â?? inductance of the identical inductors.
A. 4 mH
B. 25 mH
C. 16 mH
D. 20 Mh

9.Which of the following are passive components used in network analysis?

A. Resistor

B. Capacitor

C. Inductor

D. All the above

10. The unit impulse function can be considered as the derivative of:
A. The unit ramp function
B. The unit step function
C. The unit sine function
D. The unit parabolic function

Question 4:

Choose the correct answer. @2mks

1.Mutual inductance between two coils depends on:
A. The number of turns in each coil
B. The distance between the coils
C. The core material
D. All of the above

2.In an ideal transformer, the voltage transformation ratio is given by:
A. Vp/Vs=Np/Ns
B. Vp/Vs=Ns/Np
C. Vp/Vs=Ip/Is
D. $Vp/Vs=(Np/Ns)^2$

3.A two-port network is characterized by:
A. One input and one output
B. Two inputs and two outputs
C. One input and multiple outputs
D. Multiple inputs and one output

4._____ is defined as relations between voltage or/and current between input-output ports.

A. Transfer function

B. Transfer junction

C. Impedance

D. Fall time

5.A network has _____ number of standard ports.

A. 2

B. 3

C. 4

D. 5

6.A voltage source with Laplace transform representation V(s)=10/(s+5)
A. Step input of 10V
B. Exponential input $10e^{-5t}$
C. Impulse function
D. Sinusoidal input

7.In complex frequency analysis, what does the real part of s represent?
A. Oscillation frequency
B. Damping factor
C. Initial condition
D. Steady-state response

8.Generally, the convolution process associated with the Laplace Transform in time domain results into_____
A. Simple multiplication in complex frequency domain
B. Simple division in complex frequency domain
C. Simple multiplication in complex time domain
D. Simple division in complex time domain

9.The Laplace transform of the impedance of an inductor L is:
A. sL
B. L/sL
C. s/Ls
D. 1/sL

10. Two 300H coils in series without mutual coupling have a total inductance of.
A. 150H
B. 200 H
C. 600H
D. 75H

Section B Choose any three questions from this section. All questions carry equal marks(20MKS) each.

Question 1:

a. What is;

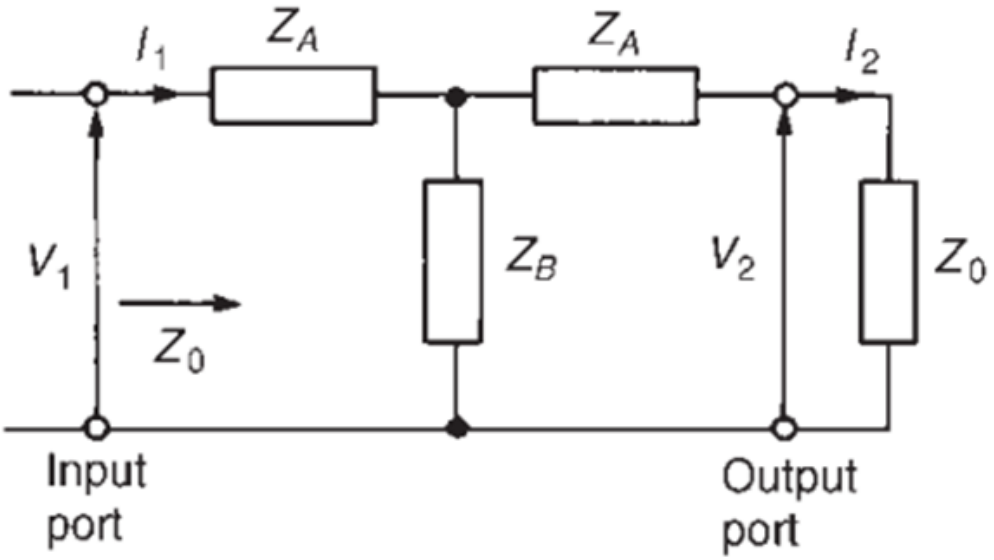
i. An **attenuator**

ii. **Two port** network

b. With aid of circuit diagrams, distinguish between **a balanced, unbalanced, symmetrical and asymmetrical** two port networks.

c. Design a ï? **section symmetrical attenuator pad** to provide a voltage **attenuation of 10dB** and having a **characteristic impedance of 300** ohms

d. Consider the circuit below.



Determine **the expressions for;**

i. **the open circuit impedance (Z_{0c})** and **short circuit Impedance (Zsc)** of the symmetrical network above

ii. and hence deduce the **characteristic impedance Zo** of the pad if **ZA**=6 **ohms** and $\mathbf{Z_B}$=12 ohms

Question 2:

a. a. **i.** With aid of mathematical models, discuss the **final and initial** value theorem

ii. For the function given below,

$$f(t) = v = Ve^{\frac{-t}{CR}} \text{ and if, say,}$$

$$V = 10 \text{ and } CR = 0.5,$$

Determine the initial and final value for the function.

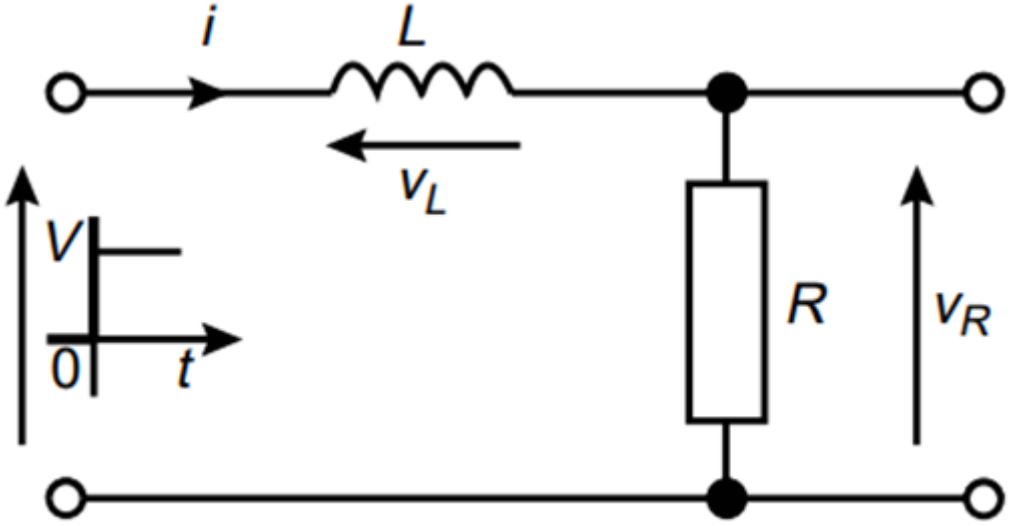
b. c. **i. Explain the procedure** in solving differential equations by using Laplace transform

ii. Use Laplace transform to solve the function below.

$$2\frac{d^2y}{dx^2} + 5\frac{dy}{dx} - 3y = 0, \text{ given that when } x = 0,\ y = 4 \text{ and } \frac{dy}{dx} = 9$$

a. c. Using circuit diagrams, give the **representations of R, L and C** circuit components in both the **time domain and frequency domain**.

b. d. A **step Voltage V** volt is applied to the circuit below.



i. Draw the equivalent circuit in the s-domain

ii. Determine the expression for the **current i** through the circuit

iii. The **voltage V_L** across the Inductor

iv. If **R=2**ohms **, L= 4mH and t=2s**, calculate the **numerical values of i and V_L**

Question 3:

a. a. Define the **following terms** as applied to magnetically coupled circuits

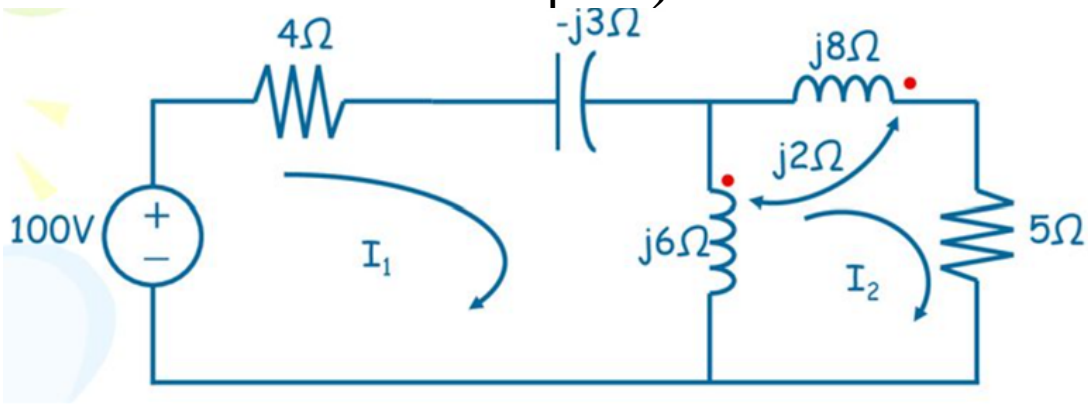
- **i.** Self-inductance
- **ii.** Mutual Inductance

b. b. **i.** Define the term **coupling co-efficient K** for magnetically coupled circuits

ii. State the **value ranges of K** and hence **explain** the meaning of each value.

c. c. State the dot convention as applied to the resolution of magnetically coupled circuits.

d. d. Calculate **the mesh currents I_1 and I_2** in the circuit below



Question 4:

a. i. What is **complex frequency**

b. Write short notes on the **different types of waves** used in circuit analysis.

c. A **complex exponential signal** is a signal of type;

$$X(t) = X_m e^{st}$$

where **Xm** and **s** are time independent complex parameters. And

$$S = \sigma + jw$$

Starting from the above expressions;

- **i.** **Perform a mathematical analysis** for the different cases that may exist as a result of the different variations of the parameters.
- **ii.** For each case, sketch the **graphical representations** where necessary.

d. Give **atleast four applications** of the concept of complex frequency analysis