PP2

TECHNICAL UNIVERSITY OF MOMBASA

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School of Engineering and Technology

DEPARTMENT OF ELECTRICAL & ELECTRONIC ENGINEERING

UNIVERSITY EXAMINATION FOR:

THE DEGREE OF BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONIC ENGINEERING.

EEE 4312: CIRCUIT AND NETWORK THEORY II

SPECIAL/SUPPLEMENTARY EXAMINATION

SERIES: JULY 2025

TIME: 2 HOURS

DATE: JULY 2025

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of FIVE questions. Answer any THREE questions.

Refer to the last page for selected Laplace transform pairs and specific gain decibel values.

Do not write on the question paper

QUESTION ONE

(a) Describe the procedures in nodal analysis (4 marks)

(b) For Fig. Q.5, given that $E = 50 \angle 0^{o} V$

i. Find the total impedance Z_T

ii. Determine the branch currents I_1, I_2 and I_3

iii. Determine the power dissipated by each of branch of the circuit.

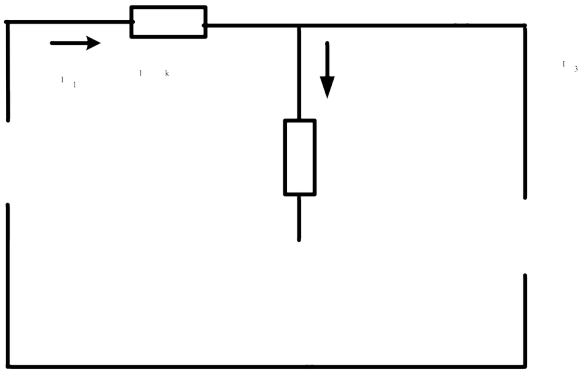

Fig. Q1.

(11 marks)

(c) Describe the term super-mesh and state its THREE major properties with regard to circuit analysis. (5marks)

QUESTION TWO (20 marks)

(a) Describe the major steps in analyzing a circuit using Laplace transform (5 marks)

(b) In the RC circuit in Fig. Q2, the switch is in position 1 long enough to establish steady state conditions, and at t=0. By applying Lapalce Transform, find the resulting circuit current i. (15 marks)

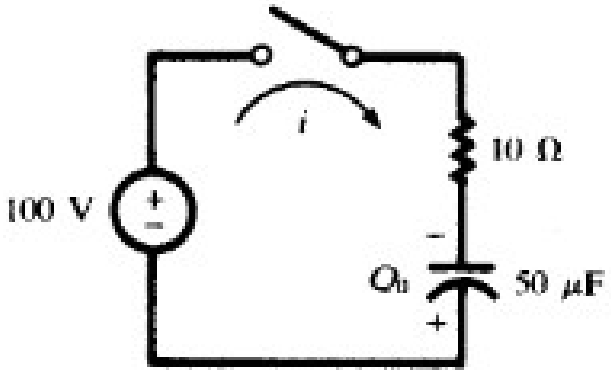

Fig. Q2

QUESTION THREE (20 marks)

(a) Draw the asymptotic Bode Magnitude Plot for the transfer function.

$$H_{(s)}=\frac{4(s+2)}{(s+1)(s+4)}$$ (8 marks)

(b) The asymptotic Bode plot of a minimum phase linear system is shown in **Fig.Q3**

Determine its transfer function. (8 marks)

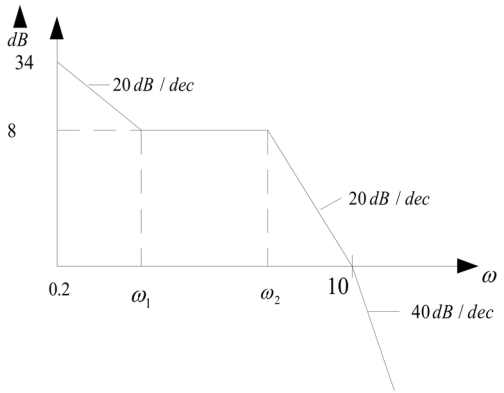

Fig.Q3

QUESTION FOUR (20marks)

(a) Define the following terms in reference to analogue filters

i. Magnitude scaling
ii. Frequency scaling
iii. Robustness
iv. Bode sensitivity (6marks)

(b) A filter has a transfer function

$$H(s)=\frac{5}{s^2+ks+5}$$

Given that the nominal value of k is 2, obtain the poles sensitivity and hence their location after a 10% increase in k (9marks)

(c) Determine the frequency ω_{max} that gives maximum $|T(j\omega)|$ for the function. (5marks)

QUESTION FIVE (20 marks)

(a) Describe the term transfer function (4 marks)

(b) Fot the circuit of Fig Q.5, assuming $v_s = V_m \cos\omega t$:

(i). Determine the transfer function hence draw the amplitude response curve

(ii). Determine the Phase of the transfer function hence draw the phase response curve

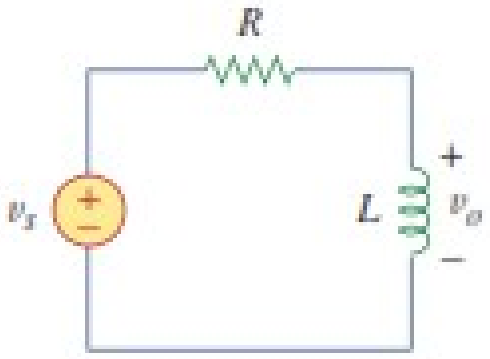

Fig. Q5.

	Laplace transform pairs	
1	*f(t)*	*F(s)*
2	1	$\frac{1}{s}$
3	t	$\frac{1}{s^2}$
4	e^{-at}	$\frac{1}{s+a}$
5	te^{-at}	$\frac{1}{(s+a)^2}$
6	$\frac{df}{dt}$	$sF(s) - f(0)$
7	$\int f(t)$	$\frac{F(s)}{s}$
8	$\sin \omega t$	$\frac{\omega}{s^2+\omega^2}$
9	$\cos \omega t$	$\frac{s}{s^2+\omega^2}$
10	$\sin(\omega t+\theta)$	$\frac{s\sin\theta+\omega\cos\theta}{s^2+\omega^2}$
11	$\cos(\omega t+\theta)$	$\frac{s\cos\theta-\omega\sin\theta}{s^2+\omega^2}$

Specific gain and their decibel values.*

Magnitude *H*	**20 $\log_{10} H$ (dB)**
0.001	−60
0.01	−40
0.1	−20
0.5	−6
$1/\sqrt{2}$	−3
1	0
$\sqrt{2}$	3
2	6
10	20
20	26
100	40
1000	60